OWEN COUNTY MULTI-HAZARD MITIGATION PLAN

DRAFT - NOVEMBER 2022

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EXECUTIVE SUMMARY

The Federal Emergency Management Agency (FEMA) defines the disaster life cycle as the process through which emergency managers respond to disasters when they occur; help people and institutions recover from them; reduce the risk of future losses; and prepare for emergencies and disasters. The Owen County Multi-Hazard Mitigation Plan (MHMP) focuses on the mitigation phase of the disaster life cycle. According to FEMA, mitigation is most effective when it's based on an inclusive, comprehensive, long-term plan that is developed before a disaster occurs. The MHMP planning process identifies hazards, the extent that they affect the municipality, and formulates mitigation practices to ultimately reduce the social, physical, and economic impact of the hazards.

In order for National Flood Insurance Program (NFIP) communities to be eligible for future mitigation funds, they must adopt either their own MHMP or participate in the development of a multi-jurisdictional MHMP. Further, it is required that local jurisdictions review, revise, and resubmit the MHMP every five years. As representatives from **Owen County, Gosport, and Spencer** have provided information, attended meetings, and participated in the planning process, the planning process used to update the Owen County MHMP satisfies the requirements of a multi-jurisdictional plan.

During Planning Committee meetings, those in attendance revisited existing (in the 2016 MHMP) and identified new critical facilities and local hazards; reviewed the State's mitigation goals and updated the local mitigation goals and updated the local mitigation goals; reviewed the most recent local hazard data, vulnerability assessment, and maps; evaluated the effectiveness of existing mitigation measures and identified new mitigation projects; and reviewed materials for public participation. Meetings were also conducted with key groups such as city planners and various emergency responders and their information will continue to be incorporated into the MHMP update.

Risk Assessment

The risk assessment conducted for the Owen County MHMP is based on the methodology described in the Local Multi-Hazard Mitigation Planning Guidance published by FEMA in 2013 and is incorporated into the following sections:

1. **Hazard Identification** lists the natural, technological, and political hazards selected as having the greatest direct and indirect impact to the county as well as the system used to rank and prioritize the hazards.
2. **Hazard Profile** for each hazard, discusses the 1) historic data relevant to the municipalities where available; 2) vulnerability in terms of number and type of structures, repetitive loss properties (flood only), estimation of potential losses, and impacts based on an analysis of development trends; and 3) the relationship to other hazards identified.
3. **Hazard Summary** provides an overview of the risk assessment process; a table summarizing the relationship of the hazards; and a composite map to illustrate areas impacted by hazards.

When considering the hazards selected for study (drought; earthquake; extreme temperature; fire; flood; hail, thunder, wind; land subsidence; snow and ice storm; tornado; dam failure; and hazardous materials incidents) and the information obtained regarding the hazard profile and the hazard summary, the attached table identifies the hazards studied and ranking outcome. The ranking is completed utilizing the Calculated Risk Priority Index (CPRI), a tool by which individual hazards are evaluated and ranked according to an indexing system considering probability, magnitude, warning time, and duration for any hazard.

1. **Probability** is defined as the likelihood of the hazard occurring over a given period.

2. **Magnitude/Severity** is defined by the extent of the injuries, shutdown of critical infrastructure, the extent of property damage sustained, and the duration of the incident response.
3. **Warning Time** is defined as the length of time before the event occurs.
4. **Duration** is defined as the length of time that the actual event occurs. This does not include response or recovery efforts.

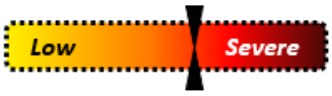
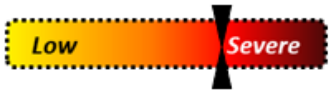
Mitigation Goals and Practices

The overall goal of the Owen County MHMP is to reduce the social, physical, and economic losses associated with hazard incidents through emergency services, natural resource protection, prevention, property protection, public information, and structural control mitigation practices.

As part of the planning process the Planning Committee discussed the strengths and weaknesses of existing mitigation practices and made recommendations for improvements, as well as suggested new practices. To provide further detail, information on the local status, local priority, benefit-cost ratio, project location, responsible entity, and potential funding source will be included with regard to each proposed practice. Those practices ranked by participants as a high priority are anticipated to be implemented within five years from the final Plan adoption and additional steps, or an implementation plan is included for each.

Plan Maintenance

The successful implementation of the MHMP will require the participation and cooperation of the entire Planning Committee to successfully monitor, evaluate, and update the Owen County MHMP. Local jurisdictions are required to update and resubmit the MHMP every five years. Information gathered following individual hazard incidents and annual meetings will be utilized along with updated vulnerability assessments to assess the risks associated with each hazard common in Owen County.

Type of Hazard	List of Hazards	Weighted Average CPRI
Natural	Drought	
	Earthquake	
	Extreme Temperature - Cold	
	Extreme Temperature - Heat	
	Fire	
	Flood - Flash	
	Flood - Riverine	
	Hail/Thunder/Windstorm	
	Landslide/Subsidence	
	Tornado	
	Winter Storm/Ice	
Technological	Dam Failure	
	Hazardous Materials Incident	

CHAPTER 1: INTRODUCTION

1.1 DISASTER LIFE CYCLE

The Federal Emergency Management Agency (FEMA) defines the disaster life cycle as the process through which emergency managers respond to disasters when they occur; help people and institutions recover from them; reduce the risk of future losses; and prepare for emergencies and disasters. The disaster life cycle, **Figure 1** includes four phases:

Figure 1 Disaster Life Cycle

- **Response** – the mobilization of the necessary emergency services and first responders to the disaster area (search and rescue; emergency relief)
- **Recovery** – to restore the affected area to its previous state (rebuilding destroyed property, re-employment, and the repair of other essential infrastructure)
- **Mitigation** – to prevent or to reduce the effects of disasters (building codes and zoning, vulnerability analyses, public education)
- **Preparedness** – planning, organizing, training, equipping, exercising, evaluation and improvement activities to ensure effective coordination and the enhancement of capabilities (preparedness plans, emergency exercises/training, warning systems)

The Owen County Multi-Hazard Mitigation Plan (MHMP) focuses on the mitigation phase of the disaster life cycle. According to FEMA, mitigation is most effective when it's based on an inclusive, comprehensive, long-term plan that is developed before a disaster occurs. Recent reviews of grant programs have determined for every $1 spent on mitigation efforts, between $6 and $10 are saved within the community on efforts following disasters. The MHMP planning process identifies hazards, the extent that they affect the municipality, and formulates mitigation practices to ultimately reduce the social, physical, and economic impact of the hazards.

1.2 PROJECT SCOPE & PURPOSE

REQUIREMENT §201.6(d)(3):
A local jurisdiction must review and revise its plan to reflect changes in development, progress in local mitigation efforts, and changes in priorities, and resubmit it for approval within five (5) years in order to continue to be eligible for mitigation project grant funding.

A MHMP is a requirement of the Federal Disaster Mitigation Act of 2000 (DMA 2000). According to DMA 2000, the purpose of mitigation planning is for State, local, and Indian tribal governments to identify the natural hazards that impact them, to identify actions and activities to reduce any losses from those

hazards, and to establish a coordinated process to implement the plan, taking advantage of a wide range of occurrences.

A FEMA-approved MHMP is required to apply for and/or receive project grants under the Building Resilient Infrastructure and Communities (BRIC), Hazard Mitigation Grant Program (HMGP), and Flood Mitigation Assistance (FMA). Although the Owen County MHMP meets the requirements of DMA 2000 and eligibility requirements of these grant programs, additional detailed studies may need to be completed prior to applying for these grants.

For National Flood Insurance Program (NFIP) communities to be eligible for future mitigation funds, they must adopt either their own MHMP or participate in the development of a multi-jurisdictional MHMP. The Indiana Department of Homeland Security (IDHS) and the United States Department of Homeland Security (US DHS)/FEMA Region V offices administer the MHMP program in Indiana. As noted above, it is required that local jurisdictions review, revise, and resubmit the MHMP every five years. MHMP updates must demonstrate that progress has been made in the last five years to fulfill the commitments outlined in the previously approved MHMP. The updated MHMP may validate the information in the previously approved Plan or may be a major plan rewrite. The updated MHMP is not intended to be an annex to the previously approved Plan; it stands on its own as a complete and current MHMP.

The Owen County MHMP Update is a multi-jurisdictional planning effort led by the Owen County EMA. This Plan was prepared in partnership with Owen County and the towns of Gosport and Spencer. Representatives from these communities attended the Committee meetings, provided valuable information about their community, reviewed and commented on the draft MHMP, and assisted with local adoption of the approved Plan. As each of the communities had an equal opportunity for participation and representation in the planning process, the process used to update the Owen County MHMP satisfies the requirements of DMA 2000 in which multi-jurisdictional plans may be accepted.

Throughout this Plan, activities that could count toward Community Rating System (CRS) points are identified with the NFIP/CRS logo. The CRS is a voluntary incentive program that recognizes and encourages community floodplain activities that exceed the minimum NFIP requirements. As a result, flood insurance premiums are discounted to reflect the reduced flood risk resulting from community actions that meet the three goals of the CRS: (1) reduce flood losses; (2) facilitate accurate insurance rating; and (3) promote education and awareness of flood insurance. Savings in flood insurance premiums are proportional to the points assigned to various activities. A minimum of 500 points is necessary to enter the CRS program and receive a 5% flood insurance premium discount. This MHMP could contribute as many as 382 points toward participation in the CRS. At the time of this planning effort, none of the communities or the county participates in the CRS program.

Funding to update the MHMP was made available through a FEMA/DHS grant awarded to the Owen County EMA and administered by IDHS. Owen County provided the local 25% match required by the grant. Christopher B. Burke Engineering, LLC (Burke) was hired to facilitate the planning process and prepare the Owen County MHMP under the direction of an American Institute of Certified Planners (AICP) certified planner.

1.3 ANALYSIS PROCESS

REQUIREMENT §201.6(c)(1):
The plan shall document the planning process used to prepare the plan, including how it was prepared, who was involved in the process, and how the public was involved.

Preparation for the Owen County MHMP Update began in 2020, the grant request was approved by FEMA and grant funds were awarded in 2021.

Once the grant was awarded, the planning process to update the 2016 MHMP took 18 months. This included a review period by IDHS and FEMA for the draft MHMP Update, and time for Owen County and communities to adopt the final MHMP Update.

1.3.1 Planning Committee

In March of 2021, the EMA compiled a list of Planning Committee members to guide the MHMP update planning process. These individuals were specifically invited to serve on the Committee because they were knowledgeable of local hazards; have been involved in hazard mitigation; have the tools necessary to reduce the impact of future hazard events; and/or served as a representative on the original Planning Committee in 2016. **Table 1** lists the individuals that actively participated on the Committee and the entity they represented.

Table 1: MHMP Update Committee

Name	Office	Representing
Bill Browne	Owen County Sheriff; Spencer/Owen County Schools	Owen County
Andy Cline	Spencer/Owen County Schools	Owen County
Nathan Cross	Owen County Emergency Management Services	Owen County
Bob Curry	Owen County Commissioner	Owen County
Shelley Edwards	Spencer Sewer Department	Town of Spencer
Richard Foutch	Spencer Police Department	Town of Spencer
Lee Freeman	Owen Valley Fire Territory	Owen County
Aaron LaGrange	Owen County Sheriff; Spencer/Owen County Schools	Owen County
Kathleen Lamb	Owen County Communications/911	Owen County
Cris Lunsford	Owen County Emergency Management Services	Owen County
Allan McBride	Owen County Health Department	Owen County
Greg Melton	Owen County Highway Department	Owen County
Matt Miller	Owen County Sheriff	Town of Gosport (Resident)
Jamie Neibel	IU Health Emergency Management	Owen County
Larry Norman	Gosport Town Council	Town of Gosport
Daniel Rhienhart	Owen County Sheriff Department	Owen County
Matt Riddle	Owen Valley Fire Territory	Owen County
Jerry Sears	Indiana Department of Homeland Security	Indiana
Suzanne Simmerman	Owen County Building and Mapping	Owen County
Mike Spinks	Spencer Town Council	Town of Spencer
Jack White	Owen County Emergency Management Agency	Owen County
Andy Wood	Owen County Council	Owen County

Members of the Committee participated in the MHMP Update as a Planning Committee member or through various other group meetings. During these meetings, the Committee:

- revisited existing (in the 2016 MHMP) and identified new critical infrastructure and local hazards
- reviewed the State's mitigation goals and updated the local mitigation goals
- reviewed the most recent local hazard data, vulnerability assessment, and maps
- evaluated the effectiveness of existing mitigation measures and identified new mitigation projects
- reviewed materials for public participation.

A sign-in sheet recorded those present at each meeting to document participation. Meeting agendas and summaries are included in **Appendix 2**. Members of the Committee also reviewed a draft MHMP, provided comments and suggestions, and assisted with adoption of the Owen County MHMP Update.

1.3.2 Public Involvement

A draft of the Owen County MHMP Update was posted to the Owen County website (www.owencounty.in.gov) for public review and comment. A media release indicating the posting of the draft MHMP and the ability to comment was submitted for publishing to *The Spencer Evening World* and social media sites for the EMA, and the *Evening World.* Committee members were provided with an informational flyer regarding the same information to display in their respective offices and to provide to family, friends and colleagues. No comments or corrections were received from the public or the Committee. The media release, informational flyer, and any comments received are included in **Appendix 3**.

1.3.3 Involvement of Other Interested Parties

Neighboring EMAs (Clay, Greene, Monroe, Morgan, and Putnam Counties) were also invited to review and comment on the MHMP update. Information related to the planning process and the availability of the draft Owen County MHMP was directly provided to representatives via personal conversations, informational flyer, and email correspondence. Successful implementation and future updates of the Owen County MHMP Update will rely on the partnership and coordination of efforts between such groups. No comments or corrections were received from the neighboring EMA offices.

1.4 PLANS, STUDIES, REPORTS, AND TECHNICAL INFORMATION

REQUIREMENT §201.6(c)(1):
The plan shall include a review and incorporation, if appropriate, of existing plans, studies, reports, and technical information.

During the development of the Owen County MHMP Update, several relevant sources of information were reviewed either as a document or through discussions with local personnel. This exercise was completed to gather updated information since the development of the previous Owen County MHMP, and to assist the Committee in developing potential mitigation measures to reduce the social, physical, and economic losses associated with hazards affecting Owen County.

For the purposes of this planning effort, the following materials (among others) were discussed and utilized:

- Owen County Economic Development Strategy, 2020
- Owen County Quality of Place and Workforce Attraction Plan, 2019
- Owen County MHMP, 2016
- Owen County Comprehensive Plan, 2010
- Owen County Zoning Ordinance, 2003
- Owen County GIS data

The Owen County Building Department provides services for Gosport and Spencer.

In addition to local agencies and offices such as those listed above, several regional and state agencies were contacted and subsequently provided data for this planning effort. Those contacts, and the information they provided, include:

- Indiana Department of Natural Resources, Division of Water – *Flood insurance policies, claims, and payment information*

- Indiana Department of Natural Resources, Division of Water – *Dam records*
- FEMA, Region V – Repetitive loss structure counts and payments

The CRS program credits NFIP communities a maximum of 155 points for organizing a planning committee composed of staff from various departments; involving the public in the planning process; and coordinating among other agencies and departments to resolve common problems relating to flooding and other known natural hazards.

CHAPTER 2: COMMUNITY INFORMATION

Although much of the information within this section is not required by DMA 2000, this section contains important background information about the physical, social, and economical composition of Owen County necessary to better understand the Risk Assessment discussed in **Chapter 3**.

Owen County, originally established in 1818, and was named to honor Abraham Owen, a Colonel in the American Army killed during the Battle of Tippecanoe in 1811. Portions of the already developed Daviess County to the north and Sullivan County to the east to create the boundaries for Owen County. Later in 1819, the county was made smaller to help create Putnam and Clay Counties. Owen County is the 60th of the 92 Indiana counties to be organized. The total area of Owen County is approximately 388 square miles and the location of the county within the State of Indiana is identified in **Figure 2**.

2.1 POPULATION AND DEMOGRAPHICS

The most recent data for Owen County estimates that the 2020 population was 21,321, which ranks 68th in the State. Of that total, the Town of Spencer accounts for 2,262 or 10.6% of the county's population while the Town of Gosport is the second largest community with 797 or 3.7% of the population.

Figure 2 Owen County Location

In 2020, the median age of the population in the county was 45.0 years of age. The largest demographic age groups in the county are older adults (45-64) with a population of 6,202 and young adults (25-44 years) with a population of 4,618. Seniors (65 and older) are the third largest age group with a population of 4,225 individuals living in Owen County. The approximate median household income in 2019 was reported to be $53,387 while the poverty rate in the same year was reported at 12.0% county-wide. In total, 15.8% of households are married with children, and 34.9% of households are married without children.

Within the county, 85.4% of the adults older than 25, have reportedly completed a High School education. Further, 13.1% of those same adults have also completed a Bachelor of Arts or higher degree.

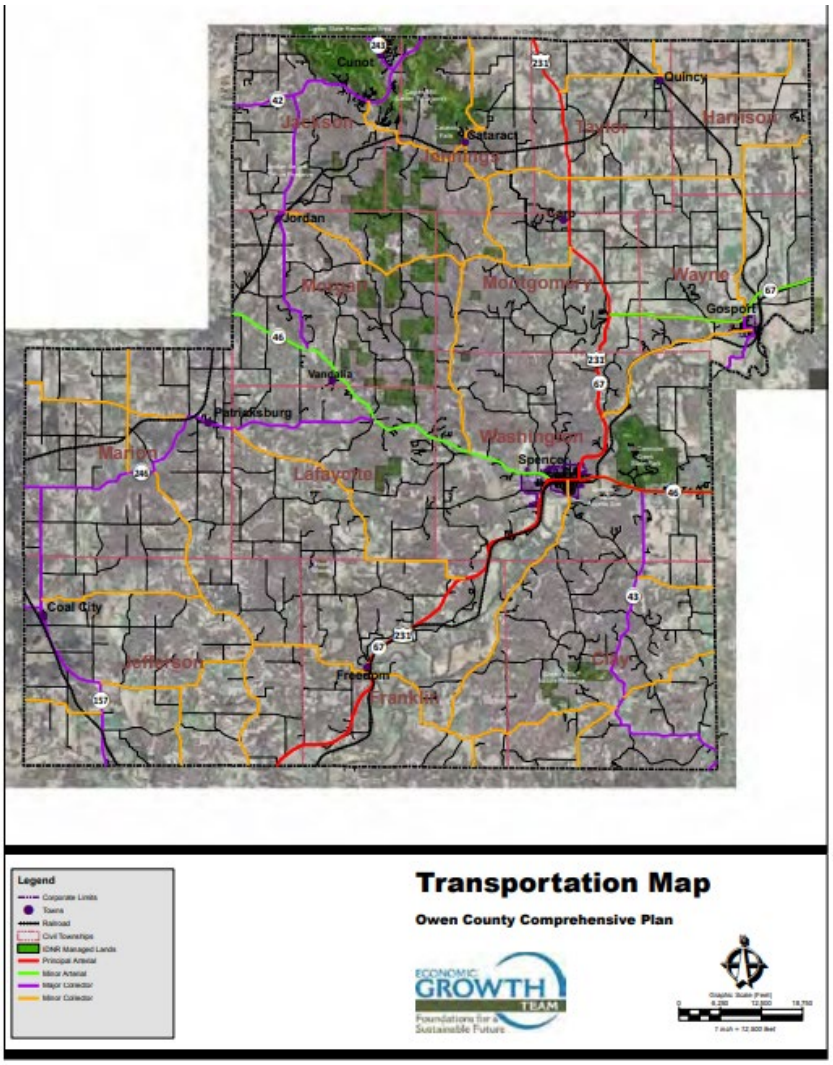
2.2 EMPLOYMENT

US Census data indicate that of the Owen County workforce, 29.3% are employed in manufacturing positions. Government and retail trade account for 10.6% and 9.0% respectively. The total resident labor force according to estimates in 2020 is 9,015 (with 568 unemployed) and a September 2021 unemployment rate of 3.5% which places Owen County as 22nd of 92 counties in the State. **Table 2** lists the ten largest employers within Owen County as of 2020.

Table 2: List of Major Employers

Boston Scientific (Spencer)	Trilogy (Spencer)
Cook Urological Inc (Spencer)	Canyon Inn (Spencer)
Owen Valley High School (Spencer)	Walmart (Spencer)
Spencer Elementary School (Spencer)	World Arts Inc (Spencer)
Babb's Supervalu (Spencer)	McDonalds (Spencer)

2.3 TRANSPORTATION AND COMMUTING PATTERNS



Several major transportation routes pass through Owen County and the municipalities within. US Highways 231; and State Roads 42, 43, 46, 67, 157, 243, and 246 serve as main routes between the various municipalities. Indiana Southern travels through the county from southwest (north of Washington in Greene County) to northeast of Gosport. These transportation routes are identified in **Figure 3** from the Owen County 2010 Comprehensive Plan.

According to STATSIndiana, nearly 1,133 people commute into Owen County daily. Approximately 50% of commuters travel from Monroe County. Further, approximately 3,888 Owen County residents commute to other counties, with the majority traveling to Monroe County (58%).

Figure 3 Owen County Transportation Routes

Figure 4 indicates the number of workers 16 and older who do not live within Owen County but commute into the County for employment purposes. Similarly, **Figure 5** indicates the number of Owen County residents 16 and older that commute out of the county for employment.

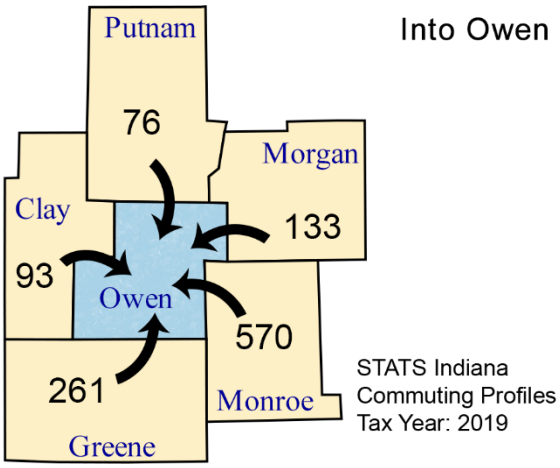


Figure 4 Commuters into Owen County, Indiana

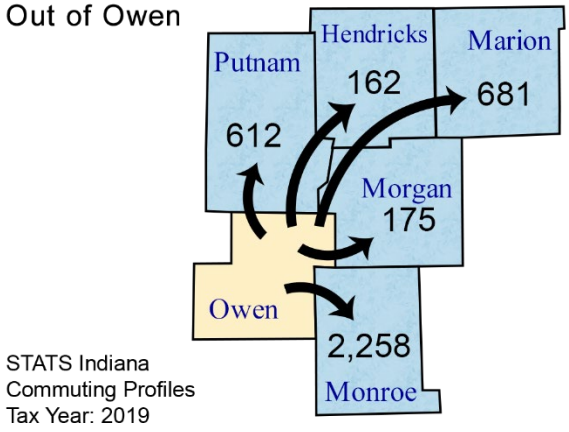


Figure 5 Commuters out of Owen County, Indiana

2.4 CRITICAL AND NON-CRITICAL INFRASTRUCTURE

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….

Critical facilities, or critical infrastructure, are the assets, systems, and networks, whether physical or virtual, so vital to the local governments and the United States that their incapacitation or destruction would have a debilitating effect on security, economic security, public health or safety, or any combination thereof.

These structures are vital to the community's ability to provide essential services and protect life and property; are critical to the community's response and recovery activities; and/or are the facilities, the loss of which, would have a severe economic or catastrophic impact. The operation of these facilities becomes especially important following a hazard event.

The Owen County EMA and Building and Mapping Department provided the listing and locations of the following 162 critical infrastructure points for the MHMP update:

- 2 Airports
- 44 Churches
- 19 Communication Facilities
- 2 Community Gathering Places
- 27 Dams
- 7 Daycares
- 1 Emergency Management Agency
- 9 Energy
- 8 Fire/EMS Stations
- 12 Government Facilities
- 15 Large Employers
- 3 Medical Facilities
- 12 Mobile Home Communities
- 2 Nursing Home
- 4 Police Stations
- 3 Red Cross Shelters
- 7 Schools
- 14 Tier II Facilities
- 6 Water Towers
- 3 Wastewater Treatment Plants
- 4 Water Treatment Plants

Information provided by the EMA, Building and Mapping Department, and the MHMP Planning Committee members was utilized to identify the types and locations of critical structures throughout Owen County. Draft maps were provided to the Planning Department and EMA, along with the Planning Committee for their review and all comments were incorporated into the maps and associated databases.

Exhibit 1 illustrates the critical infrastructure identified throughout unincorporated Owen County and the individual municipalities. **Appendix 4** lists the critical structures in Owen County by community. Non-critical structures include residential, industrial, commercial, and other structures not meeting the definition of a critical facility and are not required for a community to function. The development of this MHMP focused only on critical structures; non-critical structures are neither mapped nor listed.

2.5 MAJOR WATERWAYS AND WATERSHEDS

According to the United States Geological Survey (USGS), there are 44 waterways in Owen County, which are listed in **Appendix 5**. The county's main waterways are the Fisk Creek, West Fork Fish Creek, West Fork White River, and White River and the county lies within two 8-digit Hydrologic Unit Code (HUC): Lower Eel and Lower White. These major waterways, and others, are identified on **Exhibit 2**.

2.6 NFIP PARTICIPATION

The NFIP is a FEMA program that enables property owners in participating communities to purchase insurance protection against losses from flooding. Owen County and the town of Spencer, participate in the NFIP. The Town of Gosport does not participate in the NFIP. At the time of this planning effort, the Owen County Building and Mapping Department Director is responsible for the administration of the floodplain program in the unincorporated areas of the County. Spencer's Clerk-Treasurer is responsible for administering the floodplain program within the Town of Spencer.

Table 3 lists the NFIP number, effective map date, and the date each community joined the NFIP program.

Table 3: NFIP Participation

NFIP Community	NFIP Number	Effective Map Date	Join Date
Owen County	180481#	03/03/2014	04/01/1993
Town of Gosport			
Town of Spencer	180191#	03/03/2014	09/01/1989

2.7 TOPOGRAPHY

Owen County is bordered geographically to the west by Clay County, to the east by Monroe and Morgan Counties, to the north by Putnam County, and to the south by Greene County. The county has three physiographic regions; the Wabash Lowland; Crawford Upland; and the Mitchell Plain. The Wabash Lowland, in the far western portion of the county, is typically nearly level uplands with gentle to strongly sloping drainageways. The Crawford Upland in the central region, is primarily gentle to moderately sloping ridges with steep to very steep valleys. Finally, the Mitchell Plain, in the eastern area, is rolling upland areas underlain by limestone and Karst topography. The lowest elevation is near the White River as it leaves Owen County and enters Greene County (520 ft above sea level) and the highest is 930 ft above sea level in Taylor Township.

2.8 CLIMATE

The Midwestern Regional Climate Center (MRCC) provided climate data that includes information retrieved from a weather station located Spencer Indiana, identified as station USC00128290. The average annual precipitation is 48.12 inches per year, with the wettest month being May averaging 5.49 inches of precipitation and the driest month being February with an average of 2.66 inches of precipitation. The highest 1-day maximum precipitation was recorded in June of 2008 with 7.15 inches of rain. On average, there are 79.1 days of precipitation greater than or equal to 0.1 inch; 33.4 days with greater than or equal to 0.5 inch; and 12.2 days with greater than or equal to 1.0 inch of precipitation.

Studies have recently been completed by the Indiana Climate Change Impacts Assessment, which is overseen by Purdue University Climate Change Research Center and comprised of a Steering Committee and several topic-oriented Working Groups. These studies indicate that average annual precipitation for Indiana is increasing seasonally during the winter and spring. Conversely, summers and autumns are trending toward less precipitation. In addition, their report shows changes in rain intensity and duration, along with frost-free days and growing seasons. These changes in climate, especially in Indiana, will impact natural hazards and how municipalities prepare for them.

CHAPTER 3: RISK ASSESSMENT

REQUIREMENT §201.6(c)(2):
[The risk assessment shall provide the] factual basis for activities proposed in the strategy to reduce losses from identified hazards. Local risk assessment must provide sufficient information to enable the jurisdiction to identify and prioritize appropriate mitigation actions to reduce losses from identified hazards.

A risk assessment measures the potential loss from a hazard incident by assessing the vulnerability of buildings, infrastructure, and people in a community. It identifies the characteristics and potential consequences of hazards, how much of the community may be affected by a hazard, and the impact on community assets. The risk assessment conducted for Owen County and the communities within is based on the methodology described in the Local Multi-Hazard Mitigation Planning Guidance published by FEMA in 2011 and is incorporated into the following sections:

Section 3.1: Hazard Identification lists the natural, technological, and political hazards selected by the Planning Committee as having the greatest direct and indirect impact to the county as well as the system used to rank and prioritize the hazards.

Section 3.2: Hazard Profile for each hazard, discusses 1) historic data relevant to the county where applicable; 2) vulnerability in terms of number and types of structures, repetitive loss properties (flood only), estimation of potential losses, and impact based on an analysis of development trends; and 3) the relationship to other hazards identified by the Planning Committee.

Section 3.3: Hazard Summary provides an overview of the risk assessment process; a table summarizing the relationship of the hazards; and a composite map to illustrate areas impacted by the hazards.

3.1 HAZARD IDENTIFICATION

3.1.1 Hazard Selection

The MHMP Planning Committee reviewed the list of natural and technological hazards from the 2016 Owen County MHMP and discussed recent events and the potential for future hazard events. The Committee identified those hazards that affected Owen County and each community and selected the hazards to study in detail as part of this planning effort. As shown in **Table 4** these hazards include dam failure; drought; earthquake; extreme temperature; fire; flooding; hailstorms, thunderstorms, and windstorms; hazardous materials incident; land subsidence/landslides; snowstorms and ice storms; and tornado.

All hazards studied within the 2016 Owen County MHMP are included in the update.

Table 4: Hazard Identification

Type of Hazard	List of Hazards	Detailed Study	
		2016 MHMP	MHMP UPDATE
Natural	Drought	Yes	Yes
	Earthquake	Yes	Yes
	Extreme Temperature	Yes	Yes
	Fire	Yes	Yes
	Flood	Yes	Yes
	Hail/Thunder/Wind	Yes	Yes
	Land Subsidence/Landslide	Yes	Yes
	Snow / Ice Storm	Yes	Yes
	Tornado	Yes	Yes
Technological	Dam Failure	Yes	Yes
	Hazardous Material Incident	Yes	Yes

3.2 HAZARD RANKING

The Planning Committee ranked the selected hazards in terms of importance and potential for disruption to the community using a modified version of the Calculated Priority Risk Index (CPRI). The CPRI, adapted from MitigationPlan.com, is a tool by which individual hazards are evaluated and ranked according to an indexing system. The CPRI value (as modified by Burke) can be obtained by assigning varying degrees of risk probability, magnitude/severity, warning time, and the duration of the incident for each event, and then calculating as index value based on a weighted scheme. For ease of communications, simple graphical scales are used.

3.2.1 Probability

Probability is defined as the likelihood of the hazard occurring over a given period. The probability can be specified in one of the following categories:

- Unlikely – incident is possible, but not probable, within the next 10 years
- Possible – incident is probable within the next five years
- Likely - incident is probable within the next three years
- Highly Likely – incident is probable within the next calendar year

3.2.2 Magnitude / Severity

Magnitude/severity is defined by the extent of the injuries, shutdown of critical infrastructure, the extent of property damage sustained, and the duration of the incident response. The magnitude can be specified in one of the following categories:

- Negligible – few injuries OR critical infrastructure shutdown for 24 hours or less OR less than 10% property damaged OR average response duration of less than six hours
- Limited – few injuries OR critical infrastructure shut down for more than one week OR more than 10% property damaged OR average response duration of less than one day
- Significant – multiple injuries OR critical infrastructure shut down of at least two weeks OR more than 25% property damaged OR average response duration of less than one week
- Critical – multiple deaths OR critical infrastructure shut down of one month or more OR more than 50% property damaged OR average response duration of less than one month

3.2.3 Warning Time

Warning time is defined as the length of time before the event occurs and can be specified in one of the following categories:

- More than 24 hours
- 12-24 hours
- 6-12 hours
- Less than six hours

3.2.4 Duration

Duration is defined as the length of time that the actual event occurs. This does not include response or recovery efforts. The duration of the event can be specified in one of the following categories:

- Less than six hours
- Less than one day
- Less than one week
- Greater than one week

3.2.5 Calculating the CPRI

The following calculation illustrates how the index values are weighted and how the CPRI value is calculated. CPRI = Probability x 0.45 + Magnitude/Severity x 0.30 + Warning Time x 0.15 + Duration x 0.10. For the purposes of this planning effort, the calculated risk is defined as:

- **Low** if the CPRI value is between 1 and 2
- **Elevated** if the CPRI value is between 2 and 3
- **Severe** if the CPRI value is between 3 and 4

The CPRI value provides a means to assess the impact of one hazard relative to other hazards within the community. A CPRI value for each hazard was determined for each community in Owen County, and then a weighted CPRI value was computed based on the population size of each community. **Table 5** presents each community, population, and the weight applied to individual CPRI values to arrive at a combined value for the entire county. Weight was calculated based on the average percentage of each community's population in relation to the total population of the county. Thus, the results reflect the relative population influence of each community on the overall priority rank.

Table 5: Determination of Weighted Value for Communities

Community	Population (2020)	% of Total Population	Weighted Value
Owen County	18,262	85.7%	0.86
Town of Gosport	797	3.7%	0.04
Town of Spencer	2,262	10.6%	0.10
Total	**21,321**	**100.0%**	**1.00**

3.3 HAZARD PROFILES

The hazards studied for this report are not equally threatening to all communities throughout Owen County. While it would be difficult to predict the probability of an earthquake or tornado affecting a specific community, it is much easier to predict where the most damage would occur in a known hazard area such as a floodplain or near a facility utilizing an Extremely Hazardous Substance (EHS). The magnitude and severity of the same hazard may cause varying levels of damages in different communities.

This section describes each of the hazards that were identified by the Planning Committee for detailed study as a part of this MHMP Update. The discussion is divided into the following subsections:

- **Hazard Overview** provides a general overview of the causes, effects, and characteristics that the hazard represents
- **Historic Data** presents the research gathered from local and national courses on the hazard extent and lists historic occurrences and probability of future incident occurrence
- **Assessing Vulnerability** describes, in general terms, the current exposure, or risk, to the community regarding potential losses to critical infrastructure and the implications to future land use decisions and anticipated development trends
- **Relationship to Other Hazards** explores the influence one hazard may have upon another hazard.

3.3.1 Drought

Drought: Overview

Drought, in general, means a moisture deficit extensive enough to have social, environmental, or economic effects. Drought is not a rare and random climate incident; rather, it is a normal, naturally recurring feature of climate. Drought may occur in virtually all climactic zones, but its characteristics vary significantly from one region to another. Drought is a temporary aberration and is different from aridity, which is restricted to low rainfall regions.

Figure 6 Urban Drought Affects

There are four academic approaches to examining droughts; these are meteorological, hydrological, agricultural, and socio-economic. Meteorological drought is based on the degree, or measure, of dryness compared to a normal, or average amount of dryness, and the duration of the dry period. Hydrological drought is associated with the effects of periods of precipitation (including snowfall) shortfalls on surface or subsurface water supply. Agricultural drought is related to agricultural impacts; and focuses on precipitation shortages, differences between actual and potential evapo-transpiration, soil water deficits, reduced ground water or reservoir levels, and crop yields. Socioeconomic drought relates the lack of moisture to community functions in the full range of societal functions, including power generation, the local economy, and food source **Figure 6** shows urban grassed areas affected by drought conditions.

Drought: Recent Occurrences

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

Figure 7 US Drought Monitor Severity Classification

Data gathered from the U.S. Drought Monitor indicated that between November 2016 and May 2022, there were 59 weeks where some portions of Owen County was considered to be in "Abnormally Dry" or D0. According to the Drought Monitor, there were only two times within that period where any portion of Owen County was in a drought state higher than a D0. Between September and October 2017 and September and November 2020 portions of the county reached D1 or "Moderate Drought". During this phase, damages to crops and pastures are beginning, streams and reservoirs begin to lower and water use restrictions may be suggested. **Figure 7**, from the U.S. Drought Monitor, describes the rationale to classify the severity of droughts.

The National Climate Data Center (NCDC) does not report any events or property or crop losses within Owen County during this planning period. During discussions with the Planning Committee, effects from the 2020 drought were highlighted. Attendees noted hay yields were decreased to two cuttings from the typical three cuttings. This increases costs for producers as hay then needs to be sourced elsewhere. In addition, some ponds were noted as having gone dry or certainly lower in water levels.

The Planning Committee, utilizing the CPRI, determined the overall risk of drought throughout Owen County is "Elevated". The impact of drought was determined to be the same for all communities and unincorporated area throughout the county due to the possible agricultural impacts and impacts to water wells. The committee agreed that a drought is "Likely" (to occur within the next three years) and the magnitude of drought is anticipated to be "Limited" to "Significant". Further it is anticipated that with the enhanced weather forecasting abilities, the warning time for a drought is greater than 24 hours and the duration will be greater than one week. A summary is shown in **Table 6**.

Table 6 CPRI for Drought

	Probability	Magnitude/ Severity	Warning Time	Duration	CPRI
Owen County	Likely	Significant	> 24 Hours	> 1 Week	Elevated
Town of Gosport	Likely	Significant	> 24 Hours	> 1 Week	Elevated
Town of Spencer	Likely	Limited	> 24 Hours	> 1 Week	Elevated

According to the National Drought Mitigation Center, scientists have difficulty predicting droughts more than one month in advance due to the numerous variables such as precipitation, temperature, soil moisture, topography, and air-sea interactions. Further anomalies may also enter the equation and create more dramatic droughts or lessen the severity of droughts. Based on the previous occurrences of significant droughts and drought related impacts felt within Owen County, the Committee estimated that the probability of a drought occurring in the area is "Likely"; or occurrence is probable within the next three years.

"Limited" to "Significant" damages are anticipated throughout the county as the municipalities rely on groundwater supplies for fire response efforts and face a higher risk during times of prolonged drought. It is anticipated that the Town of Spencer has better infrastructure and water sourcing to be able to withstand the effects of a drought. The Town of Gosport has experienced issues with the water tower and other water related infrastructure in previous years and a drought may exacerbate any existing issues related to water storage and distribution. Throughout the unincorporated areas of the county, increased crop and livestock damages would also be expected during a significant drought.

Drought: Assessing Vulnerability

This type of hazard will generally affect entire counties and even multi-county regions at one time. Within Owen County, direct and indirect effects from a long period of drought may include:

Direct Effects:

- Urban and developed areas may experience revenue losses from landscaping companies, golf courses, restrictions on industry cooling and processing demands, businesses dependent on crop yields; and increased potential for fires
- Rural areas within the county may experience revenue losses from reductions in livestock and crop yields as well as increased field fires

- Citizens served by drinking water wells may be impacted during low water periods and may require drilling of deeper wells or loss of water service for a period of time

Indirect Effects:

- Loss of income of employees from businesses and industry affected; loss of revenue to support services (food service, suppliers, etc.)
- Loss of revenue from recreational or tourism sectors associated with reservoirs, streams, and other open water venues
- Lower yields from domestic gardens increasing the demand on purchasing produce and increased domestic water usage for landscaping
- Increased demand on emergency responders and firefighting resources

Estimating Potential Losses

Figure 8 Crops Affected by Drought

It is difficult to estimate the potential losses associated with a drought for Owen County because of the nature and complexity of this hazard and the limited data on past occurrences. However, for the purpose of this MHMP update, a scenario was used to estimate the potential crop loss and associated revenue lost due to a drought similar to that experienced during the drought of record from 1988. In 2021, Owen County produced approximately 3.8M bushels of corn and 1.5M bushels of soybeans, as reported by the United States Department of Agriculture (USDA) National Agricultural Statistics Service. Using national averages of $6.10 per bushel of corn and $14.40 per bushel of soybeans, the estimated crop receipts for 2021 would be $44.8M. Using the range of crop yield decreases reported in 1988 and 1989, just after the 1988 drought period (50%-86%) and assuming a typical year, economic losses could range between $22.4M-$38.5M; depending on the crop produced and the market demand. Effects of drought on corn crops can be seen in **Figure 8**.

Purdue Agriculture News reports that as of March 2013, Indiana producers received more than $1.0B in crop insurance payments for 2012 corn, soybean, and wheat losses. This amount is nearly double that of the previous record, $522M following 2008 losses, also due to drought. These losses are still considered to be record-setting in terms of drought effects, damages, and costs for Indiana.

According to a July 5, 2012 article in The Times (Noblesville, IN), "The effects of drought also could touch agricultural businesses, such as handlers and processors, equipment dealers, and see, fertilizer and pesticide providers". Additional losses associated with a prolonged drought are more difficult to quantify. Drought has lasting impacts on urban trees: death to all or portions of a tree, reduction in the tree's ability to withstand insects and diseases, and interruption of normal growth patterns. Such effects on trees, especially urban trees can lead to additional impacts, both environmentally and monetarily in terms of the spread of Emerald Ash Borer insect and the weakening of tree limbs and trunks which may lead to increased damages during other hazard events such as wind and ice storms.

Future Considerations

Advancements in plant hybrids and development have eased the impacts from short-lived droughts. Seeds and plants may be more tolerant of drier seasons and therefore fewer crop losses may be experienced.

As the municipal areas of the county continue to grow and expand, protocols may need to be developed which create a consistency throughout the communities and the unincorporated portions of the county for burn bans and water usage advisories.

According to the Indiana Climate Change Impacts Assessment, Indiana has experienced a rise in the average annual precipitation between 1895 and 2016; an increase of 6.5 inches for the area of Owen County. This increase in precipitation may lessen the likelihood or overall impact of a drought in Owen County. However, the assessment also notes seasonal shifts in precipitation which may lead to seasonal short-term droughts. In either scenario, changes in precipitation are not anticipated to relieve the area of a probability of a drought occurring.

Prior to municipalities expanding, provisions and considerations should be given regarding the potential additional demand for both water usage and fire response efforts. Following such expansion or development plans, alternative water sources should be explored. Since the previous MHMP was prepared, large scale and significant development has not occurred throughout the county. The majority of Owen County remains largely unincorporated and rural in nature.

Drought: Relationship to Other Hazards

Discussions with the Planning Committee were held regarding the similar effects of prolonged periods of extreme heat and the similar impacts that may be experienced during these times. Planning and mitigation efforts for one hazard may benefit the other. It is anticipated that rural areas of the county may be more susceptible to cropland or woodland fires during a drought, while urban areas may experience these impacts in areas where several abandoned buildings or overgrown lots exist, and this may lead to increased losses associated with a fire.

3.3.2 Earthquake

Earthquake: Overview

An earthquake is a sudden, rapid shaking of the earth caused by the breaking and shifting of rock beneath the earth's surface. For hundreds of millions of years, the forces of plate tectonics have shaped the earth as the huge plates that form the earth's surface move slowly over, under, and past each other. Sometimes the movement is gradual. At other times, the plates are locked together, unable to release the accumulating energy. When the accumulated energy grows strong enough, the plates break free, causing the ground to shake. Most earthquakes occur at the boundaries where the plates meet; however, some earthquakes occur in the middle of the plates.

Ground shaking from earthquakes can collapse buildings and bridges; disrupt gas, electric, and phone service; and sometimes trigger landslides, avalanches, flash floods, fires, and huge destructive ocean waves (tsunamis). Buildings with foundations resting on unconsolidated landfill and other unstable soil, and trailers and homes not tied to their foundations are at risk because they can move off their mountings during an earthquake. When an earthquake occurs in a populated area, it may cause deaths, injuries, and extensive property damage.

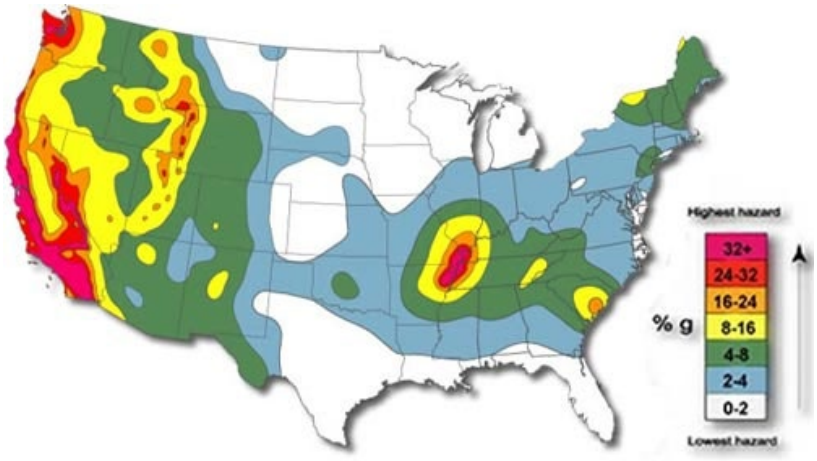


Figure 9 Earthquake Hazard Areas in the US

Earthquakes strike suddenly, without warning. Earthquakes can occur at any time of the year and at any time of the day or night. On a yearly basis, 70-75 damaging earthquakes occur throughout the world. Estimates of losses from a future earthquake in the United States approach $200B.

One method of measuring the magnitude or energy of an earthquake is the Richter Scale. This scale uses whole numbers and decimal fractions whereby each increase of a whole number represents a release of 31 times more energy than the amount associated with the previous whole number on the scale. Scientists are currently studying the New Madrid fault area and have predicted that the chances of an earthquake in the M8.0 range occurring within the next 50 years are approximately 7%-10%. However, the chances of an earthquake at a M6.0 or greater, are at 90% within the next 50 years.

There are 45 states and territories in the United States at moderate to very high risk from an earthquake, and they are located in every region of the county (**Figure 9**). California experiences the most frequent damaging earthquakes; however, Alaska experiences the greatest number of large earthquakes – most located in uninhabited areas. The largest earthquakes felt in the United States were along the New Madrid Fault in Missouri, where a three-month long series of quakes from 1811 to 1812 occurred over the entire Eastern United States, with Missouri, Tennessee, Kentucky, Indiana, Illinois, Ohio, Alabama, Arkansas, and Mississippi experiencing the strongest ground shaking.

Earthquake: Recent Occurrences

Indiana, as well as several other Midwestern states, lies in the most seismically active region east of the Rocky Mountains. Regarding Owen County, the nearest areas of concern are the Wabash Seismic Zone and the New Madrid Fault Zone.

On June 17, 2021 an earthquake centered near Bloomingdale, Indiana in Parke County was felt as far north as Chicago, Illinois and as far east as Cincinnati, Ohio. With a magnitude of 3.8 several localized reports included descriptions of shaking buildings and feelings of tremors. No injuries or severe damages were reported due to this incident. As reported by the NBC 5 Chicago, "Once the earthquake was confirmed, officials said the 9-1-1 phone line "started ringing immediately."" Previous to this event, the last earthquake to be felt in Indiana was a magnitude 5.1 centered in Sparta, North Carolina and the last event to actually occur within the state was a magnitude 2.3 earthquake centered in Haubstadt, IN on May 28, 2015. No injuries or damages were reported with either of these events.

On December 30, 2010, central Indiana experienced an earthquake with a magnitude of 3.8; rare for this area in Indiana as it is only the 3rd earthquake of notable size to occur north of Indianapolis. Even rarer is the fact that scientists believe that the quake was centered in Greentown, Indiana approximately 13 miles southeast of Kokomo, Indiana. According to The Kokomo Tribune, "113 people called 911 in a 15-minute period after the quake, which was the first tremblor centered in Indiana since 2004". Further, a geophysicist from the USGS in Colorado stated, "It was considered a minor earthquake", and "Maybe some things would be knocked off shelves, but as far as some significant damage, you probably wouldn't expect it from a 3.8".

Figure 10 Earthquake Damaged Porch

A M5.8 centered in Mineral, Virginia affected much of the East Coast on August 23, 2011. According to USA Today, 10 nuclear power plants were shutdown of precautionary inspections following the quake, over 400 flights were delayed, and the Washington Monument was closed indefinitely pending detailed inspections by engineers.

Based on historical earthquake data, local knowledge of previous earthquakes, results of HAZUS-MH scenarios, and that Owen County has not been directly impacted by an earthquake, the Committee determined that the probability of an earthquake occurring in Owen County or any of the communities is "Possible". Should an earthquake occur, the impacts associated with this hazard are anticipated to be "Significant" within all areas of the county. As with all earthquakes, it was determined that the residents of Owen County would have little to no warning time (less than six hours) and that the duration of the event would be expected to also be less than one day. A summary is shown in **Table 7**.

Table 7 CPRI for Earthquake

	Probability	Magnitude/ Severity	Warning Time	Duration	CPRI
Owen County	Possible	Significant	< 6 Hours	< 1 Day	Elevated
Town of Gosport	Possible	Significant	< 6 Hours	< 1 Day	Elevated
Town of Spencer	Possible	Significant	< 6 Hours	< 1 Day	Elevated

Per the Ohio Department of Natural Resources Division of Geological Survey, "…it is difficult to predict the maximum-size earthquake that could occur in the state and certainly impossible to predict when such an event would occur. In part, the size of an earthquake is a function of the area of a fault available for rupture. However, because all known earthquake-generating faults in Ohio are concealed beneath several thousand feet of Paleozoic sedimentary rock, it is difficult to directly determine the size of these faults." Further according to the Indiana Geological Survey, "…no one can say with any certainty when or if an earthquake strong enough to cause significant property damage, injury, or loss of life in Indiana will occur…we do indeed face the possibility of experiencing the potentially devastating effects of a major earthquake at some point in the future". The Committee felt that an earthquake occurring within or near to Owen County is "Possible" to occur within the next five years.

Figure 11 Minor Earthquake Damages

Earthquake: Assessing Vulnerability

Earthquakes generally affect broad areas and potentially many counties at one time. Within Owen County, direct and indirect effects from an earthquake may include:

Direct Effects:

- Urban areas may experience more damages due to the number of structures and critical infrastructure located in these areas
- Rural areas may experience losses associated with agricultural structures such as barns and silos
- Bridges, buried utilities, and other infrastructure may be affected throughout the county and municipalities

Indirect Effects:

- Provide emergency response personnel to assist in the areas with more damage
- Provide shelter for residents of areas with more damage
- Delays in delivery of goods or services originating from areas more affected by the earthquake

Types of loss caused by an earthquake could be physical, economic, or social in nature. Due to the unpredictability and broad impact regions associated with an earthquake, all critical and non-critical infrastructure are at risk of experiencing earthquake related damages. Damages to structures, infrastructure, and even business interruptions can be expected following an earthquake. Examples of varying degrees of damages are shown in **Figure 10** and **Figure 11**.

Estimating Potential Losses

In order to determine the losses associated with an earthquake, the HAZUS-MH software was utilized in the Owen County MHMP update to determine the potential impacts anticipated from an arbitrary earthquake scenario. This scenario placed a magnitude 5.0 within Owen County located between 1100 E and 1200 at the intersection with S CR 225 E, just west of Coal City. This type of modeling is useful for planning efforts such as this.

Per the HAZUS-MH scenario noted above, total economic losses are anticipated to be near $18.9M with moderate damages to approximately 302 buildings, of which 3 are anticipated to be damaged beyond repair. Further, there are no anticipated damages to critical facilities, transportation segments, or utilities. Approximately 4,000 tons of debris would need to be removed from the area requiring 160 dump trucks. Four households are expected to be displaced following the event with two residents seeking assistance with shelter.

The HAZUS-MH model computes anticipated economic losses for the hypothetical earthquake due to direct building losses and business interruption losses. Direct building losses are the costs to repair or to replace the damage caused to the building and contents, while the interruption losses are associated with the inability to operate a business due to the damage sustained. Business interruption losses also include the temporary living expenses for those people displaced from their homes.

The HAZUS-MH Earthquake Model allows local building data to be imported into the analysis. However, these local data are imported as "general building stock", meaning that the points are assigned to a census tract rather than a specific XY coordinate. HAZUS performs the damage analysis as a county wide analysis and reports losses by census tract. While the results of the hypothetical scenario appear to be plausible, care should be taken when interpreting these results.

Future Considerations

While the occurrence of an earthquake in or near to Owen County may not be the highest priority hazard studied for the development of the plan, it is possible that residents, business owners, and visitors may be affected should an earthquake occur anywhere within the state. For that reason, Owen County should continue to provide education and outreach regarding earthquakes and even earthquake insurance along with education and outreach for other hazards. As Owen County and the communities within the county grow and develop, the proper considerations for the potential of an earthquake to occur may help to mitigate against social, physical, or economic losses in the future.

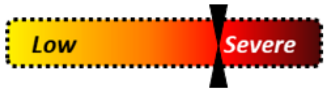
It can be anticipated that while all structures in Owen County will remain at-risk to earthquake damages and effects, new construction or redevelopment may reduce the overall risks. As redevelopment or growth occurs, the new construction may be significantly sturdier. Further, as blighted or abandoned areas are addressed, those communities and the county as a whole, are less susceptible to economic and physical damages associated with earthquakes. Since the last planning effort, no significant development has occurred within the county.

Earthquake: Relationship to Other Hazards

Hazardous materials incidents may occur as a result of damage to material storage containers or transportation vehicles involved in road crashes or train derailments. Further, dam failures or landslides may occur following an earthquake or associated aftershocks due to the shifting of the soils in these hazard areas. These types of related hazards may have greater impacts on Owen County communities than the earthquake itself. It is not expected that earthquakes will be caused by other hazards studied within this plan.

3.3.3 Extreme Temperature

Extreme Temperatures: Overview



Extreme Heat

Extreme heat is defined as a temporary elevation of average daily temperatures that hover 10 degrees or more above the average high temperature for the region for the duration of several weeks. Humid or muggy conditions, which add to the discomfort of high temperatures, occur when a dome of high atmospheric pressure traps water-laden air near the ground. In a normal year, approximately 175 Americans die from extreme heat.

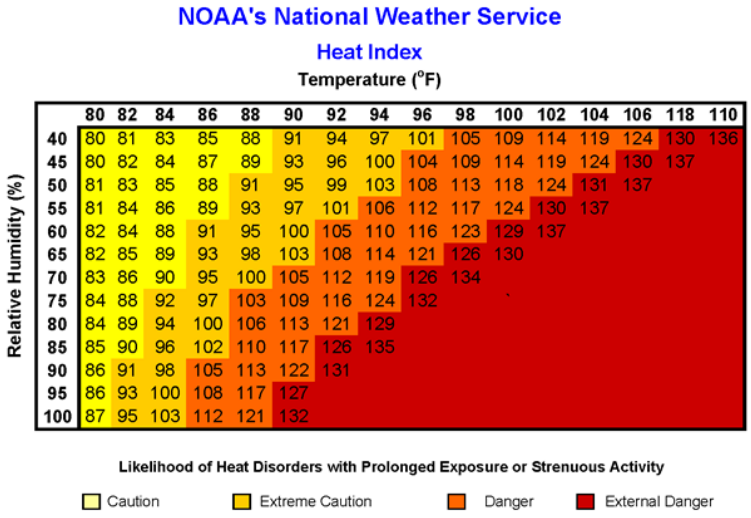


Figure 12 Heat Index Chart

According to the NWS, "The Heat Index or the "Apparent Temperature" is an accurate measure of how hot it really feels when the Relative Humidity is added to the actual air temperature". To find the Heat Index Temperature, refer to the Heat Index Chart in **Figure 12**. As an example, if the air temperature is 96°F and the relative humidity is 65%, the heat index – how hot it feels – is 121°F. The Weather Service will initiate alert procedures when the Heat Index is expected to exceed 105°-110°F for at least two consecutive days.

It is important to also note that these heat index values were devised for shady, light wind conditions. Exposure to full sunshine may increase heat index values by up to 15°F. Further, strong winds, particularly with very hot, dry air, can also be extremely hazardous.

As Figure 3-9 indicates, there are four cautionary categories associated with varying heat index temperatures.

- Caution: 80°-90°F: Fatigue is possible with prolonged exposure and physical activity
- Extreme Caution: 90°-95°F: Sunstroke, heat cramps, heat exhaustion may occur with prolonged physical activity
- Danger: 105°-130°F: Sunstroke, heat cramps, or heat exhaustion is likely
- Extreme Danger: >130°F: Heatstroke is imminent

Extreme Cold

Extreme cold is defined as a temporary, yet sustained, period of extremely low temperatures. Extremely low temperatures can occur in winter months when continental surface temperatures are at their lowest point and the North American Jet Stream pulls arctic air down into the continental United States. The jet stream is a current of fast-moving air found in the upper levels of the atmosphere. This rapid current is typically thousands of kilometers long, a few hundred kilometers wide, and only a few kilometers thick. Jet streams are usually found somewhere between 10-15 km (6-9 miles) above the Earth's surface. The position of this upper-level jet stream denotes the location of the strongest surface temperature contrast over the continent. The jet stream winds are strongest during the winter months when continental temperature extremes are greatest. When the jet stream pulls arctic cold air masses over portions of the United States, temperatures can drop below 0° F for one week or more. Sustained extreme cold poses a physical danger to all individuals in a community and can affect infrastructure function as well.

Wind chill is a guide to winter danger

New wind chill chart

Frostbite occurs in 15 minutes or less

Wind (MPH) \ Temperature (°F)	30	25	20	15	10	5	0	-5	-10	-15	-10	-25
5	25	19	13	7	1	-5	-11	-16	-22	-28	-34	-40
10	21	15	9	3	-4	-10	-16	-22	-28	-35	-41	-47
15	19	13	6	0	-7	-13	-19	-26	-32	-39	-45	-51
20	17	11	4	-2	-9	-15	-22	-29	-35	-42	-48	-55
25	16	9	3	-4	-11	-17	-24	-31	-37	-44	-51	-58
30	15	8	1	-5	-12	-19	-26	-33	-39	-46	-53	-60
35	14	7	0	-7	-14	-21	-27	-34	-41	-48	-55	-62
40	13	6	-1	-8	-15	-22	-29	-36	-43	-50	-57	-64
45	12	5	-2	-9	-16	-23	-30	-37	-44	-51	-58	-65
50	12	4	-3	-10	-17	-24	-31	-38	-45	-52	-60	-67
55	11	4	-3	-11	-18	-25	-32	-39	-46	-54	-61	-68
60	10	3	-4	-11	-19	-26	-33	-40	-48	-55	-62	-69

Figure 13 NWS Wind Chill Chart

In addition to strictly cold temperatures, the wind chill temperature must also be considered when planning for extreme temperatures. The wind chill temperature, according to the NWS, is how cold people and animals feel when outside and it is based on the rate of heat loss from exposed skin. **Figure 13** identifies the Wind Chill Chart and how the same ambient temperature may feel vastly different in varying wind speeds.

Extreme Temperature: Recent Occurrences

The effects of extreme temperatures extend across large regions, typically affecting several counties, or states, during a single event. According to the NCDC, there have been no extreme heat event or extreme cold events between November 2016 and February 2022. Local reports did not provide any additional information regarding a period of excessive heat during this time period. However, local

Figure 14 Frozen Cataract Falls, *Fox 59*

reports provided information related to January 2018 when extreme cold conditions led to the freezing of Cataract Falls (**Figure 14**), the state's largest waterfall. No additional reports were provided relevant to damages or losses associated with the prolonged cold temperatures.

It is difficult to predict the probability that an extreme temperature event will affect Owen County residents within any given year. However, based on historic knowledge and information provided by the community representatives, an extreme temperature event is "Highly Likely" (possible within the calendar years) to occur and if an event did occur, it would result in "Limited" to "Significant" magnitude. The variations of severity are **Table 8** identifies the CPRI for extreme temperature-heat events for all communities in Owen County.

Table 8 CPRI for Extreme Temperatures - Heat

	Probability	Magnitude/ Severity	Warning Time	Duration	CPRI
Owen County	Highly Likely	Limited	> 24 Hours	>1 Week	Elevated
Town of Gosport	Highly Likely	Significant	> 24 Hours	>1 Week	Elevated
Town of Spencer	Highly Likely	Significant	> 24 Hours	>1 Week	Elevated

As shown in the table, index values are increased within the communities due to the centralized populations and location of critical infrastructure potentially impacted by higher temperatures. The anticipation of experiencing "Limited" damages within the unincorporated area is due to the number of livestock operations and acres of cropland.

Table 9 identifies the CPRI for extreme temperatures – cold events for all communities within Owen County.

Table 9 CPRI for Extreme Temperatures - Cold

	Probability	Magnitude/ Severity	Warning Time	Duration	CPRI
Owen County	Highly Likely	Significant	> 24 Hours	>1 Week	Severe
Town of Gosport	Highly Likely	Limited	> 24 Hours	>1 Week	Severe
Town of Spencer	Highly Likely	Limited	> 24 Hours	>1 Week	Severe

As shown in the table, index values are reversed from the heat and lower within the communities due to the centralized populations and location of critical infrastructure. People are closer to resources and travel routes are more accessible within the communities. The anticipation of experiencing "Significant" damages within the unincorporated area is due to the number of livestock operations and increase in response time and increases in vulnerabilities elderly, rural populations may experience in colder temperatures.

Extreme Temperatures: Assessing Vulnerability

As noted above, this type of hazard will generally affect entire counties and even multi-county regions at one time; however, certain portions of the population may be more vulnerable to extreme temperatures. For example, outdoor laborers, very young and very old populations, low-income populations, and those in poor physical condition are at an increased risk to be impacted during these conditions.

By assessing the demographics of Owen County, a better understanding of the relative risk that extreme temperatures may pose to certain populations can be gained. In total, just over 20% of the county's population is over 65 years of age, 5% of the population is below the age of 5, and approximately 12% of the population is considered to be living below the poverty line. People within these demographic categories are more susceptible to social or health related impacts associated with extreme heat.

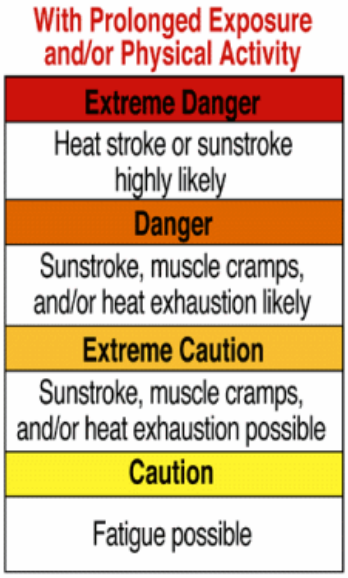


Figure 15 Danger Levels with Prolonged Heat Exposure

Extreme heat can affect the proper function of organ and brain systems by elevating core body temperatures above normal levels. Elevated core body temperatures, usually in excess of 104°F are often exhibited as heat stroke. For weaker individuals, an overheated core body temperature places additional stress on the body, and without proper hydration, the normal mechanisms for dealing with heat, such as sweating in order to cool down, are ineffective. Examples of danger levels associated with prolonged heat exposure are identified in **Figure 15**.

Extreme cold may result in similar situations as body functions are impacted as the temperature of the body is reduced. Prolonged exposure to cold may result in hypothermia, frostbite, and even death if the body is not warmed.

Within Owen County, direct and indirect effects from a long period of extreme temperature may include:

Direct Effects:

- Direct effects are primarily associated with health risks to the elderly, infants, people with chronic medical disorders, lower income families, outdoor workers, and athletes

Indirect Effects:

- Increased need for cooling or warming shelters
- Increased medical emergency response efforts
- Increased energy demands for heating or cooling

Estimating Potential Losses

It is difficult to estimate the potential losses due to extreme temperatures as damages are not typically associated with buildings but instead, with populations and persons.

This hazard is not typically as damaging to structures or critical infrastructure as it is to populations so monetary damages associated with the direct effects of the extreme temperature are not possible to estimate. Indirect effects would cause increased expenses to facilities such as healthcare or emergency services, manufacturing facilities where temperatures are normally elevated may need to alter work hours or experience loss of revenue if forced to limit production during the heat of the day, and energy suppliers may experience demand peaks during the hottest and/or coldest portions of the day.

Future Considerations

As more and more citizens are experiencing economic difficulties, local power suppliers along with charitable organizations have implemented programs to provide cooling and heating mechanisms to

residents in need. Often, these programs are donation driven and the need for such assistance must be demonstrated. As susceptible populations increase, or as local economies are stressed, such programs may become more necessary to protect Owen County's at-risk populations.

The Climate Change Assessment identifies several temperature related considerations of which communities should be aware and begin planning to avoid further impacts. For example, rising temperatures will increase the number of extreme heat days, thereby increasing the potential for heat related illnesses, potential hospitalizations, and medication costs to vulnerable populations. In addition, added days of extreme heat will impact agriculture, manufacturing, and potentially, water sources.

New construction associated with development of residential areas often brings upgraded and more efficient utilities such as central heating and air units further reducing vulnerabilities to the aging populations in those municipalities mentioned above. Conversely, new development associated with industrial or large commercial structures in the inner-urban centers often result in increased heat over time, which may cause additional stress to labor-related populations. Since the last planning effort, there has not been significant residential and commercial development within the county.

Extreme Temperatures: Relationship to Other Hazards

While extreme temperatures may be extremely burdensome on the power supplies in Owen County, the Committee concluded that this type of hazard is not expected to cause any hazards studied. It is anticipated that due to prolonged extreme temperatures, primarily long periods of high temperatures, citizens may become increasingly agitated and irritable, and this may lead to a disturbance requiring emergency responder intervention.

3.3.4 Fire

Fire: Overview

Figure 16 Wildfire in Forested Area

A wildfire, also known as a forest fire, vegetation fire, or a bushfire, is an uncontrolled fire in wildland areas and is often caused by lightning; other common causes are human carelessness and arson. Small wildfires may be contained to areas less than one acre, whereas larger wildfires can extend to areas that cover several hundred or even thousand acres. Generally, ambient weather conditions determine the nature and severity of a wildfire event. Very low moisture and windy conditions can help to exacerbate combustion in forested or brush areas (**Figure 16**) and turn a small brush fire into a major regional fire event in a very short period. Wildfires can be very devastating for residents and property owners.

A structural fire is an incident where a fire starts within a structure and is largely contained to that structure. Causes of structure fires can be related to electrical shorts, carelessness with ignition sources, poor storage of flammable materials, as well as arson. These types of fires can be deadly if no warning or prevention measures are present. The most dangerous aspect of structural fires is the production of toxic gases and fumes that can quickly accumulate in enclosed areas of structures and asphyxiate those who might be in the structure.

Problems associated with structural fires are compounded when high-rise buildings catch fire. High-rise fires hinder the ability of rescue workers to fight the fire, reach impacted building occupants, and evacuate impacted occupants. Rescue efforts also become more complicated when handicapped or disabled persons are involved. Complications associated with high-rise fires typically increase as the height and occupancy levels of the buildings increase. Structural collapse is another concern associated with high-rise fires. Structural collapse often results in persons becoming trapped and severely injured. However, it is important to note that the concern associated with structural collapse, is not limited to high-rise buildings; the collapse of smaller residential buildings can also lead to severe injury and death.

Typically, a fire will incinerate all structures and objects in its path. A resident may lose all possessions and structures to a wildfire event. Additionally, combating a wildfire or a structure fire may be extremely dangerous. If weather conditions change suddenly, the wildfire may change course and overtake firefighters, causing severe injury or death. Fires can travel at speeds greater than 45 mph. Therefore, these hazard events can pose a serious threat to county residents and response agencies.

Fire: Recent Occurrences

Within the NCDC, there are no reports of wildfires occurring within Owen County between January 1950 and February 2022. Within the same time parameter, there were only two reported events within the State of Indiana, both within Pike County and both within 2006. During each of these events over 350 acres were burned.

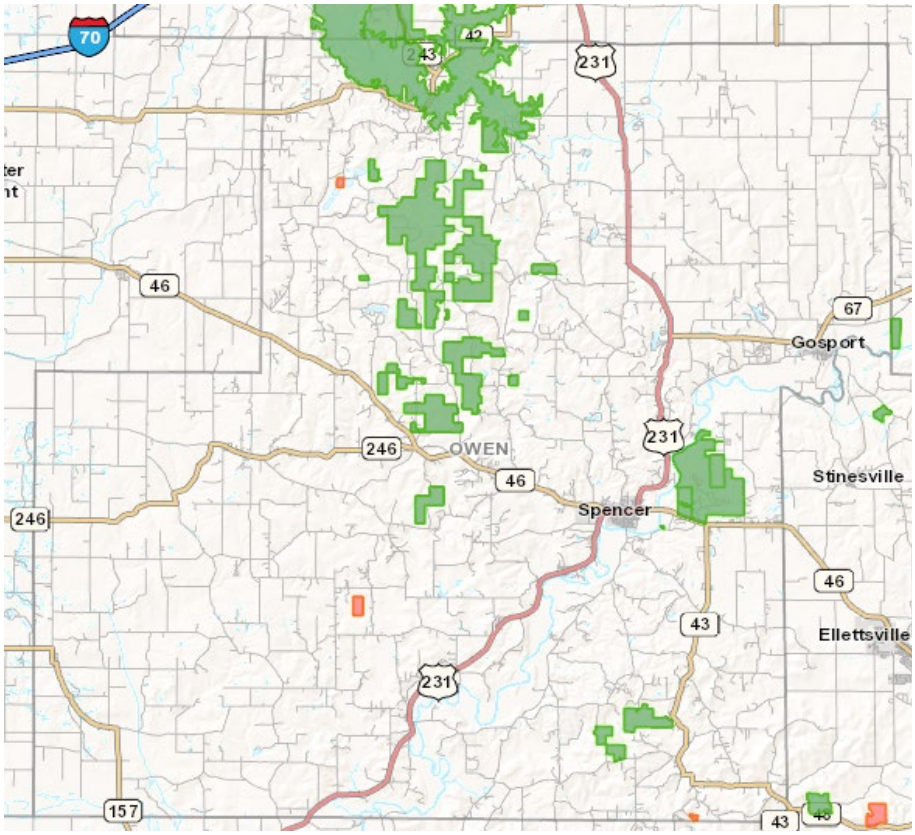


Figure 17 Managed Lands in Owen County, Indiana

The NCDC does not report structure fires; therefore, local sources were utilized to provide information regarding several small residential fires as the typical hazard affecting Owen County in the last several years.

Discussions took place regarding the vulnerability of the Town of Spencer as there are no fire walls between the buildings in the downtown area. Thankfully, there has not been an event of a larger nature occurring in Spencer to date. There are also several areas managed as a State Park, State Forest, or other managed area that may increase the risk for a forest fire affecting large areas of the county. **Figure 17** identifies those areas (in green) relevant to Owen County.

Due to the expansive acreage of cropland and woods within Owen County, and the potential for urban areas to be at risk due to abandoned homes, blighted areas, or industrial activities, the Planning Committee determined the probability to be "Possible" throughout the County. **Table 10** identifies the CPRI rankings for fire in Owen County.

Table 10 CPRI for Fire

	Probability	Magnitude/ Severity	Warning Time	Duration	CPRI
Owen County	Likely	Limited	< 6 Hours	< 1 Day	Elevated
Town of Gosport	Likely	Limited	< 6 Hours	< 1 Day	Elevated
Town of Spencer	Likely	Limited	< 6 Hours	< 1 Day	Elevated

Information provided in **Table 11** highlights the number of fire runs for some of the Owen County fire departments for the time period January 2016 through December 2020. Based on this information, annual damages to structures, contents, and vehicles may be significant for each municipality on an annual basis. Social losses, such as being unable to work following a residential structure fire or losses associated with a business fire should also be considered as an impact.

Table 11 Owen County Fire Runs

	2018	2019	2020	2021
Cataract Fire	147	159	100	180
Clay Township Fire	104	132	134	191
Cloverdale Fire	85	97	79	111
Coal City Fire	38	40	37	125
Franklin Township Fire	100	89	95	76
Gosport Fire	122	157	140	215
Owen Valley Fire	213	251	336	402
Patricksburg Fire	74	63	107	186
Poland Fire	137	117	131	192
Owen County EMS	2,580	2,910	3,049	3,867
Totals	**3,600**	**4,015**	**4,208**	**5,545**

Fire: Assessing Vulnerability

A fire typically affects a large regional area with potential for physical, economic, and/or social losses. Typically, a structural fire affects one or two structures, as one of the main functions of fire response is to prevent the fire from spreading to neighboring structures. This type of action works to reduce the magnitude and severity from "Limited" throughout the county and municipalities.

Much of the county is rural and agricultural in land use, which may be more susceptible to brush or crop fires, especially in times of drought. As most development has continued to occur within eastern Owen County (around Spencer) since the last planning effort, vulnerabilities to this hazard have not shifted in location. Municipal areas within Owen County are susceptible to urban and industrial fires, while the remainder of Owen County remains vulnerable to field, crop, and woodland fires.

Direct and indirect effects of such an event within Owen County may include:

Direct Effects:

- Loss of structures
- Loss of production crop
- Loss of natural resources

Indirect Effects:

- Loss of revenue as businesses may be closed
- Increased emergency response times based on safety of roads
- Loss of income if dependent on crop production

Estimating Potential Losses

Given the nature and complexity of a potentially large hazard such as a wildfire, it is difficult to quantify potential losses to property and infrastructure. As a result, all critical and non-critical structures and infrastructure may be at some degree of risk.

Monetary damages associated with the direct effects of the fires are difficult to estimate, other than utilizing historic information as provided. Indirect effects would cause increased efforts associated

with emergency response services as wildfires are difficult to contain and may accelerate very quickly. Further, multi-level business or residential structures place increased risks to those who work or live within those structures or nearby structures.

Future Considerations

As populations increase and communities continue to grow in size, the need to respond to fire will remain an important municipal effort. As new construction or re-development occurs, especially new or existing critical infrastructure, it is important to ensure that these new structures are equipped to deal with the potential risks associated with this hazard. Those may include increased risk for wooden or flammable outer structures and potential lengthy power outages.

In addition, increased populations require increased housing. Many urban communities develop large multi-family residential structures, or apartment complexes, where structures are not only in close proximity to each other, but also contain a large number of citizens. As communities age, some structures may become abandoned, significantly increasing the risk of fire due to potential vagrant populations and lack of maintenance. These areas should be considered at-risk and potentially demolished to avoid such risk and potential hazard.

Fires can also result in substantial indirect costs. Increased emergency response times, loss of work or the inability to get to work, as well as business interruption, are possible indirect effects of a fire and how it may affect those businesses directly related to cropland or natural resource areas.

Fire: Relationship to Other Hazards

Fires may certainly result in a hazardous materials incident if storage structures are within the path of the burn. Material storage containers farther away from the burn path may become damaged by high winds and embers resulting in a spill or release of materials. Fires may result from lightning associated with a thunderstorm. Typical wind speeds during a thunderstorm may also exacerbate the impacts from any ignitions from the lightning.

3.3.5 Flood

Flood: Overview

Floods are the most common and widespread of all the natural disasters. Most communities in the United States have experienced some kind of flooding, after spring rains, heavy thunderstorms, or winter snow melts. A flood, as defined by the NFIP, is a general and temporary condition of partial or complete inundation or two or more acres of normally dry land area or of two or more properties from overflow of inland or tidal waters and unusual and rapid accumulation or runoff of surface waters from any sources, or a mudflow. Floods can be slow or fast rising but generally develop over a period of days.

Flooding and associated flood damages is most likely to occur during the spring because of heavy rains combined with melting snow. However, provided the right saturated conditions, intense rainfall of short duration during summer rainstorms are capable of producing damaging flash flood conditions.

The traditional benchmark for riverine or coastal flooding is a 1% Annual Exceedance Probability (AEP), or the 100-year flood. This is a benchmark used by FEMA to establish a standard of flood protection in communities throughout the country. The 1% AEP is referred to as the "regulatory" or "base" flood. Another term commonly used, the "100-year flood", can be misleading. It does not mean that only one flood of that size will occur every 100 years, but rather there is a 1% chance of a flood of that intensity and elevation happening in any given year. In other words, the regulatory flood elevation has a 1% chance of being equaled, or exceeded, in any given year and it could occur more than once in a relatively short time period. Yet another term for this area is the Special Flood Hazard Area (SFHA).

Flood: Recent Occurrences

The NCDC indicates that between November 2016 and February 2022, there were no floods and four flash floods reported. For these events, a total of $20.01M in property damages and an additional $10.0K in crop damages were reported. No reports of injuries or deaths have been provided regarding these events.

The narrative report through NCDC regarding the April 2018 flash flood event was that several roads were flooded including Bush Road where portions were actually washed out due to floodwaters. During this same event, Highway 231 North and Atkinsonville Roads were flooded and impassable.

Reports from an event in June 2019 indicates approximately $20.0M in damages as 30 county roads were closed, over 20 culverts were washed out and two bridges were significantly damaged. **Figure 18** shows one of the bridges washed nearly completely away by flood waters.

Figure 18 Flood Damaged Bridge in Owen County, Indiana

Stream gages are utilized to monitor surface water elevations and/or discharges at key locations and time periods. Some such gages are further equipped with NWS' Advanced Hydrologic Prediction Service (AHPS) capabilities. These gages have the potential to provide valuable information regarding historical high and low water stages, hydrographs representing current and forecasted stages, and a map of the surrounding areas likely to be flooded. Within Owen County, there are two active USGS stream gages, the Mill Creek near Cataract and White River near Spencer. The Mill Creek gage reports observed stages only and does not provide forecasted water levels.

Any property having received two insurance claim payments for flood damages totaling at least $1,000, paid by the NFIP within any 10-year period since 1978 is defined as a repetitive loss property. These properties are important to the NFIP because they account for approximately 1/3 of the country's flood insurance payments. According to FEMA Region V, there are a total of eight single-family repetitive loss structures within the unincorporated areas of Owen County and 13 additional single-structures (10 single-family and three non-residential) in Spencer.

There have been a number of claims made for damages associated with flooding in Owen County since 1978. Within the unincorporated areas of the county, there have been 50 claims resulting in slightly over $1.1M in payments. Further, within the Town of Spencer, there were 85 payments totaling approximately $2.1M. **Table 12** identifies the number of claims per community as well as payments made, as provided by IDNR. Information was not provided for the Town of Gosport as the Town does not participate in the NFIP.

Table 12 Repetitive Properties, Claims, and Payments

Community	# of Repetitive Loss Properties	Claims Since 1978	$$ Paid
Owen County	8	50	$1.1M
Town of Gosport			
Town of Spencer	13	85	$2.1M
TOTAL	**21**	**135**	**$3.2M**

Mandatory flood insurance purchase requirements apply to structures in 1% AEP delineated areas. Total flood insurance premiums for Owen County and the communities is approximately $77.4K. Total flood insurance coverage for Owen County and the communities is slightly over $10M. **Table 13** further indicates the premiums and coverage totals for individual communities. Information was not provided for the Town of Gosport as the Town does not participate in the NFIP.

Table 13 Insurance Premiums and Coverage

Community	Flood Insurance Premiums	Flood Insurance Coverage
Owen County	$33.0K	$5.3M
Town of Gosport		
Town of Spencer	$44.4K	$4.8M
TOTAL	**$77.4K**	**$10.1M**

As determined by the Committee, the probability of riverine based flooding occurring throughout Owen County ranges from "Possible" to "Highly Likely". This is largely based on the presence or absence of rivers or water systems in or near the communities. Impacts from riverine events are anticipated to range from "Negligible" to "Significant". The Committee also determined that the warning time would be greater than 24 hours based on forecasting methods, local knowledge of stream

activities, and the warning provided by gages upstream. However, in some of the unincorporated areas, only 6 – 12 hours of warning may be provided. Finally, the duration of such an event is anticipated to last less than one week for all areas. A summary for riverine flooding is shown in **Table 14**.

Table 14 CPRI for Flood - Riverine

	Probability	Magnitude/ Severity	Warning Time	Duration	CPRI
Owen County	Highly Likely	Significant	6 - 12 Hours	> 1 Week	Severe
Town of Gosport	Possible	Negligible	> 24 Hours	> 1 Week	Low
Town of Spencer	Likely	Limited	> 24 Hours	> 1 Week	Elevated

The Planning Committee felt it necessary to separately discuss flash flooding and the impacts typical for each municipality. Many attendees felt flash flooding is more prominent throughout Owen County and brings a different set of considerations when completing the risk index as well as developing a set of potential mitigation measures as will be completed later in the plan. The greatest difference is the duration associated with flash flooding is anticipated to be less than one day instead of less than one week as with the riverine flooding. **Table 15** provides the summary for flash flooding.

Table 15 CPRI for Flood - Flash

	Probability	Magnitude/ Severity	Warning Time	Duration	CPRI
Owen County	Highly Likely	Significant	6 - 12 Hours	< 1 Day	Severe
Town of Gosport	Possible	Negligible	> 24 Hours	< 1 Day	Low
Town of Spencer	Likely	Limited	> 24 Hours	< 1 Day	Elevated

As mentioned within this section, there is a 1% chance each year that the regulatory flood elevation will be equaled or exceeded, and these types of events may occur more than once throughout each year. Further, based on information provided by the NCDC, and previous experiences, the Committee determined that flooding is "Possible" to "Highly Likely" throughout the county for both riverine and flash flooding.

Flood: Assessing Vulnerability

Flood events may affect large portions of Owen County at one time as river systems and areas with poor drainage cover much of the county and several communities. Due to terrain, poor drainage systems, and increased high volume rain events, the predominantly gravel roads within the county are vulnerable to the erosive forces of the flowing water. Wooded areas and farm fields provided ample supply of debris causing clogs and damages to culverts, low water crossings and bridges.

In addition to riverine flooding or flooding in poorly drained areas, is the consideration of fluvial erosion hazard (FEH). This represents the risk associated with natural stream movements and losses associated with buildings and infrastructure. In some cases, this may be represented by a gradual movement of a stream across a farm field. In other, more extreme instances, homes or other infrastructure may actually be lost as steep riverbanks or bluffs sluff into the water below. This will be discussed more within the landslide/land subsidence discussion.

Many Planning Committee members also participated in the 2010 planning effort to develop a Flood Response Plan (FRP) for the Town of Spencer. The FRP is developed to serve as an action plan when the USGS gage located along the White River in Spencer reaches Action Stage (9ft) flood events are

detected in the Town, or upstream in the unincorporated areas of the county. As a result of flood modeling, historical events, and participant knowledge, areas of concern for various flood events were identified and mapped.

Figure 19 is an example of inundation mapping developed to identify areas impacted by a Moderate Stage (20ft) flood. Since the last planning effort in 2016, this gage has reached the Moderate Flood stage during six different events.

The FRP also provides:

- Event detection and level determination guidance
- Notification information for local officials
- Pre-scripted messages for communicating flood levels and actions needed
- Annual review and exercise of the FRP

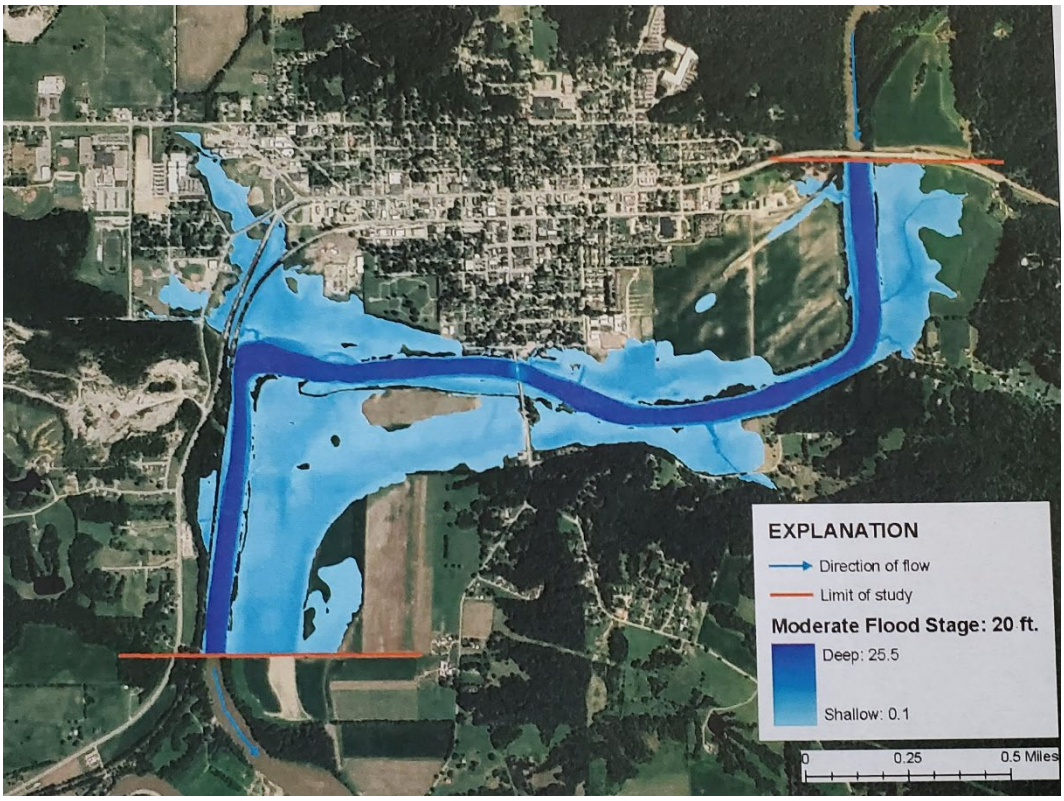


Figure 19 Inundation Mapping for White River at Spencer Moderate Stage Flood Event

A great vulnerability within Owen County lies near the Owen County/Monroe County boarder just south of the Town of Gosport. This area, where the County Line Road and Texas Road cross the White River, floods approximately six times each year. When flood waters overtop these roads, Owen County Highway staff close permanent flood gates to prevent drivers from driving through high water, resulting in a more dangerous situation. When these floodgates are closed, drivers commuting to their workplace in Bloomington are required to travel a greater distance. This also includes the Owen County EMS transporting patients to IU Health which adds several minutes to crucial transport times.

Within Owen County, direct and indirect effects of a flood event may include:

Direct Effects:

- Structural and content damages and/or loss of revenue for properties affected by increased water
- Increased costs associated with additional response personnel, evacuations, and sheltering needs
- Increased potential impacts to infrastructure and buildings located within the FEH area

Indirect Effects:

- Increased response times for emergency personnel if roads are impassable
- Increased costs associated with personnel to carry out evacuations in needed areas
- Increased risk of explosions and other hazards associated with floating propane tanks or other debris
- Losses associated with missed work or school due to closures or recovery activities
- Cancellations of special events in impacted areas or water related activities that become too dangerous due to high water

In the time since the last planning effort, significant development has not occurred within the municipalities and populations have not increased. The development and redevelopment that has occurred, has been directed away from the floodplains. This mitigation measure helps to reduce the county-wide flood risk and vulnerability. Structures have prevented from being built in the high-risk areas while growth has been directed to more appropriate areas, less at risk from riverine flooding.

Estimating Potential Losses

Critical and non-critical structures located in regulated floodplains, poorly drained areas, or low-lying areas are most at risk for damages associated with flooding. For this planning effort, a GIS Desktop Analysis methodology was utilized to estimate flood damages.

For the GIS Desktop Analysis method, an analysis was completed utilizing the effective Digital FIRMs (DFIRMs) overlaid upon a Modified Building Inventory developed with information provided by Owen County. Structures located within each flood zone were tallied using GIS analysis techniques.

In the assessment, any structure listed as less than 400 ft^2 in area or classified in the Assessor's database as a non-habitable structure was assumed to be an outbuilding. It was assumed that a building was located on a parcel if the value listed in the "Assessed Value (Improvements)" showed a value greater than zero dollars. Parcels that intersected any portion of the FEMA flood zones were considered to be flood prone, and subsequently, further analyzed separately from parcels without structures. were excluded from the analysis. Structure values were calculated using:

Residential = Assessed Value x 0.5
Commercial = Assessed Value x 1.0
Industrial = Assessed Value x 1.5
Agricultural = Assessed Value x 1.0
Education = Assessed Value x 1.0
Government = Assessed Value x 1.0
Religious = Assessed Value x 1.0

In order to estimate anticipated damages associated with each flood zone in Owen County and communities, it was estimated that 25% of structures in the flood zones would be destroyed, 35% of structures would be 50% damaged, and 40% of structures would be 25% damaged. **Table 16** identifies

the estimated losses associated with structures in the floodway, the 1% AEP (100-year floodplain), and the 0.2% AEP (500-year floodplain) areas by community within Owen County.

Table 16 Manual GIS Analysis Utilizing Best Available Data and Owen County Building Inventory

	Floodway		1% AEP		0.2% AEP		Unnumbered	
	#	$	#	$	#	$	#	$
Owen County	28	$1.8M	12	$0.8M	2	$0.1M	183	$15.3M
Town of Gosport	0	0	0	0	0	0	0	0
Town of Spencer	11	$1.2	146	$10.5M	99	$6.9M	0	0
Total	**39**	**$3.0M**	**158**	**$11.3M**	**101**	**$7.0M**	**183**	**$15.3M**

Utilizing the same GIS information and process, critical infrastructure within each of the flood hazard areas in Owen County was assessed and are included in **Table 17**. These buildings are included in the overall number of structures and damage estimate information provided in Table 14.

Table 17 Critical Infrastructure in Flood Zones in Owen County

Community	Floodway	1% AEP	0.2% AEP
Owen County			
Town of Gosport			
Town of Spencer		Spencer WWTP Church of God Daycare Owen County Fairgrounds Church of God Prophecy	Owen County Sheriff Owen County EMS Purdue Extension Truax Mobile Home Park Cummings Mobile Home Park Headstart Owen County Coroner

Utilizing the information in Table 16 regarding the number of structures within each of the flood hazard areas, it is also important to note the number of flood insurance policies within each area in Owen County. **Table 18** provides the comparison between the number of structures in the 1.0% AEP and the number of flood insurance policies. It is also important to note that flood insurance is voluntary unless the property owner carries a federally subsidized mortgage; insurance coverage may be discontinued when the mortgage is completed.

Table 18 Number of Structures in the 1.0% AEP and Number of Flood Insurance Policies

COMMUNITY	# STRUCTURES IN 1.0% AEP	# POLICIES
Owen County	42	35
Town of Gosport	0	0
Town of Spencer	256	32
Total	**298**	**67**

Future Considerations

As the municipalities within Owen County grow in population and redevelop, it can be anticipated that the number of critical and non-critical infrastructure will also increase accordingly. Within Owen County, it is strongly discouraged for new schools, medical facilities, community centers, municipal buildings, and other critical infrastructure to be located within the 1% AEP (100-year) floodplain. New

structures must also be protected to that level along with a flood-free access to reduce the risk of damages caused by flooding and to ensure that these critical infrastructures will be able to continue functioning during major flood events. Flooding due to poor drainage, low-lying land, or flash flooding is also an important consideration. It will be important for recognition of potential flood impacts to residents and businesses in these areas to be coupled with proper planning for future development and redevelopment of the flood zones. This would also include utilizing the inundation areas mapped through the development of the Spencer FRP. Since the previous planning effort, no development has occurred within the flood zones of Owen County.

It is important to ensure that owners and occupants of residences and businesses within the known hazard areas, such as delineated or approximated flood zones and FEH, are well informed about the potential impacts from flooding incidents as well as proper methods to protect themselves and their property.

Increased precipitation, as predicted in the Indiana Climate Change Assessment, is anticipated to come in the form of heavier, shorter events which lead to the increased potential for flooding and stress on infrastructure such as sanitary and storm sewers. Heavy precipitation events are anticipated to occur more frequently as temperatures rise, replacing rain when previously there was snow.

Despite these efforts, the overall vulnerability and monitory value of damages is expected to increase in the area unless additional measures, such as those discussed later in Chapter 4 of this report, are implemented.

Figure 20 Fire Engine in Flood Waters

Indirect effects of flooding may include increased emergency response times due to flooded or redirected streets (**Figure 20**), the danger of dislodged and floating propane tanks causing explosions, and the need for additional personnel to carry out the necessary evacuations. Additional effects may include sheltering needs for those evacuated, and the loss of income or revenue related to business interruptions. As many communities within Owen County are closely tied to the river systems, special events occurring near to or on these rivers and waterways may be cancelled or postponed during periods of flooding or high-water levels.

Flood: Relationship to Other Hazards

While flooding creates social, physical, and economic losses, it may also cause other hazards to occur. For example, flooding may increase the potential for a hazardous materials incident to occur. Above ground storage facilities may be toppled or become loosened and actually migrate from the original location. In less severe situations, the materials commonly stored in homes and garages such as oils, cleaners, and de-greasers, may be mobilized by flood waters. Should access roads to hazardous

materials handlers become flooded, or if bridges are damaged by flood waters, response times to more significant incidents may be increased, potentially increasing the damages associated with the release.

Increased volumes of water during a flood event may also lead to a dam failure. As the water levels rise in areas protected by dams, at some point, these structures will over-top or will breach leading to even more water released. These two hazards, flood and dam failure, when combined, may certainly result in catastrophic damages.

In a similar fashion, a snowstorm or ice storm can also lead to flooding on either a localized or regional scale. When a large amount of snow or ice accumulates, the potential for a flood is increased. As the snow or ice melts, and the ground becomes saturated or remains frozen, downstream flooding may occur. Ice jams near bridges and culverts may also result in flooding of localized areas and potentially damage the bridge or culvert itself.

Repeated flooding may also create impacts associated with landslides along riverbanks and bluff areas. As floodwaters travel through the systems, saturating shorelines and increasing volumes and velocities of water, the natural process of fluvial erosion may be exacerbated. As these processes are increased, structures and infrastructure located on bluffs or in proximity to the river may be at risk.

Flooding in known hazard areas may also be caused by dams that experience structural damages or failures not related to increased volumes or velocities of water. These "sunny day failures", while not typical, may occur wherever these structures exist.

3.3.6 Hailstorms, Thunderstorms, and Windstorms

Hailstorms, Thunderstorms, and Windstorms: Overview

Hail occurs when frozen water droplets form inside a thunderstorm cloud, and then grow into ice formations held aloft by powerful thunderstorm updrafts, and when the weight of the ice formations becomes too heavy, they fall to the ground as hail. Hail size ranges from smaller than a pea to as large as a softball, and can be very destructive to buildings, vehicles (**Figure 21**), and crops. Even small hail can cause significant damage to young and tender plants. Residents should take cover immediately in a hailstorm, and protect pets and livestock, which are particularly vulnerable to hail, and should be under shelter as well.

Thunderstorms are defined as strong storm systems produced by a cumulonimbus cloud, usually accompanied by thunder, lightning, gusty winds, and heavy rains. All thunderstorms are considered dangerous as lightening is one of the by-products of the initial storm. In the United States, on average, 300 people are injured, and 80 people are killed each year by lightning. Although most lightning victims survive, people struck by lightning often report a variety of long-term, debilitating symptoms. Other associated dangers of thunderstorms included tornados, strong winds, hail, and flash flooding.

Windstorms or high winds can result from thunderstorm inflow and outflow, or downburst winds when the storm cloud collapses, and can result from strong frontal systems, or gradient winds (high- or low-pressure systems). High winds are speeds reaching 50 mph or greater, either sustained or gusting.

Hailstorm, Thunderstorm, and Windstorm: Recent Occurrences

Figure 21 Damaging Hail on Vehicles

In Owen County, the NCDC has recorded 5 hailstorms and 10 thunderstorms/windstorms between November 2016 and February 2022. The largest recorded hail stone was 1.75 inches in diameter and occurred on May 19, 2017 near Spencer. The average diameter hail stone occurring throughout Owen County is approximately 1.0 inch.

Significant windstorms are characterized by the top wind speeds achieved during the incident, characteristically occur in conjunction with thunderstorms, and have historically occurred year-round with the greatest frequency and damage occurring in May, June, and July. Within Owen County, NCDC reports seven instances between May 2015 and February 2022 where top wind speeds were greater than 60 mph.

Total NCDC recorded damages for hailstorms, thunderstorms, and windstorms throughout Owen County are $122.0K in property damages, no additional crop damages, and no injuries or deaths associated with these events. Many event reports included in the NCDC did not provide descriptive information on the social, physical, and economic losses resulting from individual storms specific to Owen County. Even in instances where monetary damages were reported, narrative descriptions of the event rarely extended beyond reports of damages to broken tree limbs, downed power lines, or roof damages.

During the June 2019 event in Southport, thunderstorms and heavy winds accompanied the heavy rains that also caused widespread flooding in the area. Wind gusts caused a tree to fall onto a house along Freeman Road and several other trees were downed from Freeman Road to SR 43. A pole barn was also moderately damaged during this event. Appendix 6 provides the NCDC information regarding hailstorms, thunderstorms, and windstorms that have resulted in injuries, deaths, and monetary damages to property and/or crops.

According to the Institute for Business and Home Safety, central Indiana can expect to experience damaging hailstorms three to four times over 20 years; the average life of a residential roof. Further, thunderstorms and windstorms are considered a high frequency hazard and may occur numerous times per year.

The Committee determined the probability of a hailstorm, thunderstorm, or windstorm occurring anywhere throughout Owen County is "Highly Likely" and will typically affect broad portions of the county at one time resulting in potentially "Negligible" to "Limited" damages. As advancements in technologies such as weather radar systems and broadcast alerts are continually made, the warning time for such incidents may increase. Currently, the Committee feels that the warning time is anticipated to be less than six hours (for pop-up storm events) and the duration is expected to last less than one day.

Indicative of a regional hazard, the probability, magnitude, warning time, and duration of a hailstorm, thunderstorm, or windstorm are expected to be similar throughout the county. These events are highly unpredictable, and the occurrences are distributed through the county, sometimes impacting one community more often or more severely than another. Therefore, the CPRI values reflect the distributed risk and associated priority for a hailstorm, thunderstorm, or windstorm. A summary is provided in **Table 19**.

Table 19 CPRI for Hailstorm, Thunderstorm, and Windstorm

	Probability	Magnitude/ Severity	Warning Time	Duration	CPRI
Owen County	Highly Likely	Limited	> 6 Hours	< 1 Day	Severe
Town of Gosport	Highly Likely	Negligible	> 6 Hours	< 1 Day	Elevated
Town of Spencer	Highly Likely	Negligible	> 6 Hours	< 1 Day	Elevated

Specific locations and frequency of hailstorms, thunderstorms, and windstorms are difficult to predict as many of these individual events are without significant warning time and may have impacts to very limited areas or may affect broader areas. However, based on NCDC data and personal experiences of the Committee, it was determined that all areas within the County are anticipated to experience a hailstorm, thunderstorm, or windstorm within the calendar year. More likely, these communities will be impacted by several of these hazard events each year. The magnitude is anticipated to be similar based on the number of critical infrastructure and populations of each of the municipalities, or "Negligible" to "Limited".

Hailstorm, Thunderstorm, and Windstorm: Assessing Vulnerability

The effects of a hailstorm, thunderstorm, or windstorm may be minimal to extensive in nature and may affect small or broad ranges of land area. Within Owen County, direct and indirect effects from a hailstorm, thunderstorm, or windstorm may include:

Direct Effects:

- Damages to infrastructure (power lines)

- Damages to individual properties (homes, cars)

Indirect Effects:

- Downed power lines due to falling tree limbs
- Losses associated with power outages
- Damages sustained from blowing debris

Estimating Potential Losses

Figure 22 Home Damaged During Windstorm

Due to the unpredictability of this hazard all critical infrastructure and non-critical structures in Owen County are at risk of damage including temporary or permanent loss of function. For hailstorms, thunderstorms, and windstorms, it is not possible to isolate specific critical infrastructure or non-critical structures that would be vulnerable to damages. However, areas where utility lines are above ground and areas where dead or dying trees have not been removed may be at a higher risk of property damages or power outages during hailstorms, thunderstorms, and windstorms. Additionally, mobile homes and accessory buildings such as pole barns and sheds may also be at a higher risk of damages from hailstorms, thunderstorms, and windstorms if not properly anchored to the ground. Damages from falling limbs or uprooted trees such as that shown in **Figure 22**, are common.

Future Considerations

As the populations of the communities in Owen County develop and redevelop, it can be anticipated that the number of critical and non-critical structures will also increase. To reduce the vulnerability for damages resulting from a hailstorm, thunderstorm, or windstorm, measures such as proper anchoring, enforcement of the International Building Codes, and burial of power lines should be completed. While measures can be taken to remove existing structures or prevent future structures from being built in known hazard areas such as floodplains and hazardous materials facility buffers, such measures are not applicable to hailstorms, thunderstorms, and windstorms due to the diffuse nature and regional impacts of this hazard.

Indirect effects resulting from a hailstorm, thunderstorm, or windstorm can include power outages caused by downed tree limbs or flying debris, damages resulting from prolonged power outages, and damages to structures or property as a result of debris.

Hailstorm, Thunderstorm, and Windstorm: Relationship to Other Hazards

Hailstorms, thunderstorms, and windstorms may be the precursor for other hazards. For example, hazardous materials incidents can be the result of a hailstorm, thunderstorm, or a windstorm. Material

storage containers can become damaged by high winds, debris, or even lightning, and can result in a spill or release of materials. With wind speeds greater than 58 mph, tankers and other transportation vehicles carrying hazardous materials are also at risk while on the road. High winds may also cause gaseous substances to travel farther distances at a much faster rate, increasing the evacuation area necessary to protect residents and visitors of Owen County.

Additionally, rainfall typically occurs with a thunderstorm and this additional precipitation may lead to localized flooding or riverine flooding depending on the amount of rain during the event. Debris from a windstorm may also lead to localized flooding if debris is deposited over drains or if obstructions are created by downed limbs, trees, or other storm related debris. A similar concern due to the potential precipitation would be dam failure. High winds may also lead to structural damages to a dam or may cause damages to nearby trees or other structures, leading to indirect damages.

The risk of social losses also increases during a hailstorm, thunderstorm, or windstorm, as these hazards often result in downed power lines, utility poles, and trees. Debris such as this may impede traffic patterns and make it difficult for emergency vehicles (Fire, EMS, and Police) to pass through affected areas or people may be directly injured because of falling debris.

3.3.7 Landslide/Subsidence

Landslide/Subsidence: Overview

The term landslide includes a wide range of ground movement, such as rock falls, deep failure of slopes, and shallow debris flows. Although gravity acting on an over steepened slope is the primary reason for a landslide, there are other contributing factors. For example, erosion by rivers, glaciers, or ocean waves can cause rock to fall. Rock and soil slopes may be weakened through saturation by snowmelt or heavy rains, earthquakes can create stresses that make weak slopes fail, and excess weight from accumulation of rain or snow, stockpiling of rock or ore, from waste piles, or man-made structures that may stress weak slopes to the point of collapse.

Another important consideration is FEH. This represents the risk associated with natural stream movements and losses associated with buildings and infrastructure. In some cases, this may be represented by a gradual movement of a stream across a farm field. In other, more extreme instances, homes or other infrastructure may actually be lost as steep riverbanks or bluffs sluff into the water below.

Land subsidence, according to the USGS, is "a gradual settling or sudden sinking of the Earth's surface owing to subsurface movement of earth materials". Further, there are three processes that attribute to subsidence: compaction of aquifer systems, drainage and subsequent oxidation of organic soils, and dissolution and collapse of susceptible rocks.

Landslide/Subsidence: Recent Occurrences

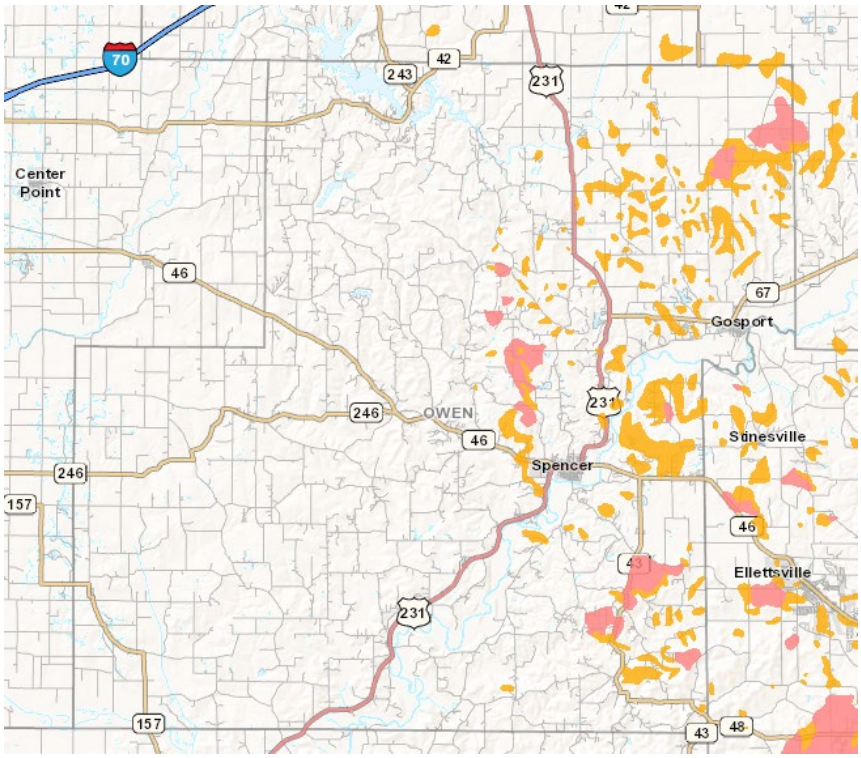


Figure 23 Karst Geology Areas in Owen County, Indiana

The potential for any of landslides or land subsidence within Owen County was discussed by the Planning Committee. As identified through IndianaMap, there are Karst areas along the eastern edge of the County (**Figure 23**). The areas in pink are areas identified as a sinking stream basin where a small stream disappears underground and is indicative of variations in geology. The orange areas identify sinkhole areas based on studies of the soils and local geology. To the knowledge of the Planning Committee, there are no active underground mining operations within Owen County. In addition of this, to date, there has not been any landslides or subsidence events in Owen

County. Discussions were held regarding recent events, following heavy rains in June 2021 where hillsides were in danger of sliding and approximately 18 homes were at risk. The Soil and Water Conservation District was able to provide assistance to this area near Mount Zion.

The Committee determined the probability of a landslide or subsidence occurring in Owen County is "Unlikely" in the Towns and "Likely" in the unincorporated areas due to the presence of ravines and high banks along some of the water courses. Any event is expected to result in potentially "Negligible" damages. Currently, the Committee feels that the warning time is anticipated to be less than six hours and similarly, the duration is expected to last less than six hours. These events are highly unpredictable and the risk, although very low according to the Committee, is distributed throughout the county. Therefore, the CPRI values reflect the distributed risk and associated priority for a landslide or subsidence event. A summary is provided in **Table 20.**

Table 20 CPRI for Landslide/Land Subsidence

	Probability	Magnitude/ Severity	Warning Time	Duration	CPRI
Owen County	Likely	Negligible	< 6 Hours	< 6 Hours	Elevated
Town of Gosport	Unlikely	Negligible	< 6 Hours	< 6 Hours	Low
Town of Spencer	Unlikely	Negligible	< 6 Hours	< 6 Hours	Low

Landslide/Subsidence: Assessing Vulnerability

Owen County, with the limited presence of Karst geology, is at a low risk of land subsidence or sink holes; "Unlikely" to "Likely" according to the Planning Committee with "Negligible" severity.

The effects of a landslide or subsidence event may be minimal to extensive in nature and may affect small or broad ranges of land area. **Figure 24** identifies the FEMA National Risk Index regarding landslide throughout Indiana and surrounding areas. The risk index considers expected annual loss as well as vulnerabilities by census tract and community resilience. Owen County is highlighted in the center of the figure and is shown to have a Relatively Low risk associated with landslides.

Within Owen County, direct and indirect effects may include:

Direct Effects:

- Damages to infrastructure (power lines, roads, bridges)
- Damages to individual properties (homes, cars)

Indirect Effects:

- Increased response time for emergency vehicles
- Losses associated with affected land (crop loss)
- Potential contamination of groundwater resources

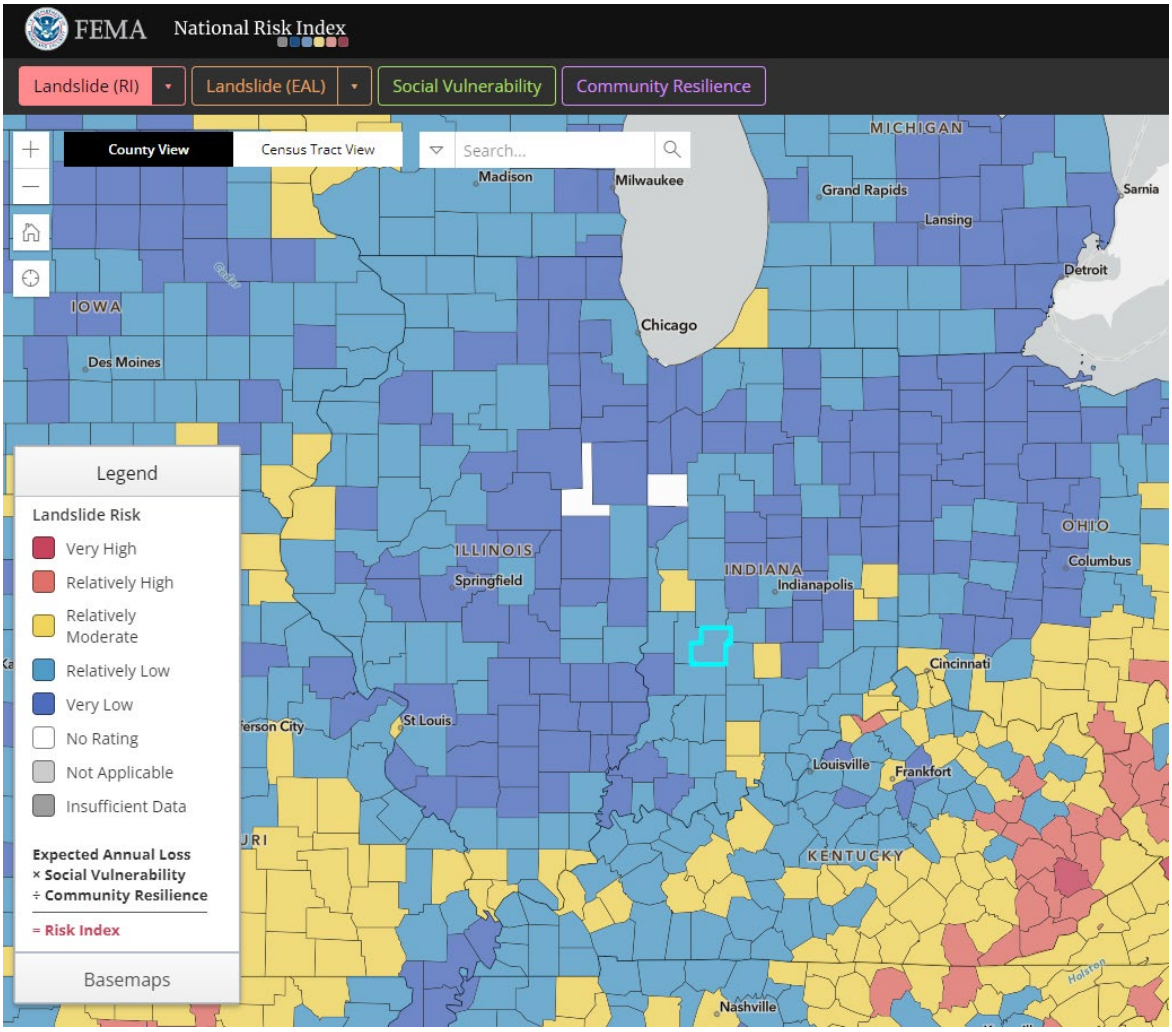


Figure 24 FEMA National Risk Index, Landslide

Estimating Potential Losses

Due to the unpredictability of this hazard all critical infrastructure and non-critical structures in Owen County are at risk of damage including temporary or permanent loss of function. For landslide and subsidence, it is difficult to isolate specific critical infrastructure or non-critical structures that would be more or less vulnerable to damages. However, areas where karst geology have been identified may be at a higher risk of property damages caused by such events. To prepare a basic "what-if" scenario, the Indiana karst geology GIS layers were overlaid onto parcel data provided by the County. **Table 21** identifies the number of structures and potential damages within the karst areas.

Table 21 Summary of Structures in Karst Areas

Community	Potential Damages	
	# Structures	$ Damages
Owen County	1,584	$126.1M
Spencer	40	$2.9M

Future Considerations

As the populations of the communities in Owen County grow, it can be anticipated that the number of critical and non-critical structures will also increase. In order to reduce the vulnerability for damages resulting from a landslide or land subsidence, FEH areas, soils and mining GIS layers should be integrated into the building permit or approval process. In recent years, no significant development has occurred within these areas of Owen County. However, depending on the location, any development may increase the vulnerability to this hazard.

Indirect effects resulting from a landslide or land subsidence event can include power outages caused by downed tree limbs, increased response times for emergency personnel if transportation routes are damaged, and potentially shot down of businesses.

Landslide/Subsidence: Relationship to Other Hazards

A landslide or a subsidence may be the precursor for other hazards. Depending on the location of the event, material storage containers can become damaged resulting in a spill or release of materials and potentially contaminating groundwater reserves. Dam failures may occur in much the same fashion if located in the potential hazard areas, or resulting from heavy saturation following a rainstorm, heavy snow, or rapid snow melt.

Similarly, these types of events may be caused by hail, thunder, or windstorms and their effects on the soils; an earthquake may release the ground enough to set a slide in motion; or a flood may add increased soil saturation or weight to at-risk areas increasing the potential for an event and resulting damages.

3.3.8 Tornado

Tornado: Overview

Tornadoes are defined as violently rotating columns of air extending from thunderstorms to the ground. Funnel clouds are rotating columns of air not in contact with the ground. However, the funnel cloud may reach the ground very quickly – becoming a tornado. If there is debris lifted and blown around by the "funnel cloud", then it has reached the ground and is a tornado.

A tornado is generated when conditions in a strong cell are produced that exhibit a wall of cool air that overrides a layer of warm air. The underlying layer of warm air rapidly rises, while the layer of cool air drops – sparking the swirling action. The damage from a tornado is a result of the high wind velocity and wind-blown debris. Tornado season is generally April through June in Indiana, although tornadoes can occur at any time of year. Tornadoes tend to occur in the afternoons and evenings; over 80 percent of all tornados strike between 3:00 pm and 9:00 pm but can occur at any time of day or night as shown in **Figure 25** Tornadoes occur most frequently in the United States east of the Rocky Mountains. Tornadoes in Indiana generally come from the south through the east.

Figure 25 Funnel Cloud During a Lightning Storm at Night

While most tornadoes (69%) have winds of less than 100 mph, they can be much stronger. Although violent tornadoes (winds greater than 205 mph) account for only 2% of all tornadoes, they cause 70% of all tornado deaths. In 1931, a tornado in Minnesota lifted an 83-ton rail car with 117 passengers and carried it more than 80 feet. In another instance, a tornado in Oklahoma carried a motel sign 30 miles and dropped it in Arkansas. In 1975, a Mississippi tornado carried a home freezer more than a mile.

Tornado: Recent Occurrences

The classification of tornadoes utilizes the Enhanced Fujita Scale of tornado intensity and damages, described in **Table 22**. Tornado intensity ranges from low intensity (EF0) tornadoes with effective wind speeds of 65-85 mph to high intensity (EF5+) tornadoes with effective wind speeds of 200+ mph. According to the NCDC, Owen County has experienced one tornado, an EF1, between November 2015 and February 2022.

Table 22 Enhanced Fujita Scale of Tornado Intensity

EF-Scale	Winds	Character of Damage	Relative Frequency	Typical Damages
EF0	65-85 mph	Light damage	29%	Shallow rooted trees blown over; damage to roofs, gutters, siding
EF1	86-110 mph	Moderate damage	40%	Mobile homes overturned, roofs stripped, windows broken
EF2	111-135 mph	Considerable damage	24%	Large trees snapped, light-object missiles generated, cars lifted
EF3	136-165 mph	Severe damage	6%	Severe damages to large buildings, trains overturned
EF4	166-200 mph	Devastating damage	2%	Whole houses destroyed; cars thrown
EF5	200+ mph	Incredible damage	<1%	High-rise buildings with significant damage, strong framed homes blown away

The NCDC reports approximately $100.0K in property damages and no injuries or deaths related to the tornado which occurred in this reporting period. On June 15, 2019 the tornado classified as an EF1 traveled through the Freedom area with wind speeds of nearing 110 mph and a path of approximately 200 yards wide. Numerous trees were damaged and uprooted as the tornado followed the White River to just south of Spencer where a new business was demolished as the roof was lifted and the walls collapsed.

The Committee estimated the probability of a tornado occurring in Owen County would be "Possible" and the magnitude and severity of such an event to be "Limited" throughout the unincorporated county and "Significant" in the communities. As with many hazardous events, the Committee anticipated a short warning time of typically less than six hours, and a short duration, also less than six hours. The summary is shown in **Table 23**.

Table 23 CPRI for Tornado

	Probability	Magnitude/ Severity	Warning Time	Duration	CPRI
Owen County	Possible	Limited	< 6 Hours	< 6 Hours	Elevated
Town of Gosport	Possible	Significant	< 6 Hours	< 6 Hours	Elevated
Town of Spencer	Possible	Significant	< 6 Hours	< 6 Hours	Elevated

The Indiana State Climate Office estimates that throughout Indiana, there is an average of 20 tornado touchdowns per year. Based on the number of tornado touchdowns previously reported through the NCDC and local weather agencies, the Committee determined the general probability of a future tornado occurring in Owen County is "Possible" (within the next five years).

Tornado: Assessing Vulnerability

As a path of a tornado is not pre-defined, it is difficult to isolate specific critical infrastructure and non-critical structures, or areas of Owen County that would be vulnerable to a tornado. Direct and indirect effects from a tornado may include:

Direct Effects:

- Damages to older construction structures, mobile homes, and accessory structures (pole barns, sheds, etc.)
- Damages to above ground utility lines and structures

Indirect Effects:

- Expenses related to debris clean-up and/or reconstruction
- Loss of revenue for affected businesses
- Loss of work if employers are affected

Estimating Potential Losses

Due to the unpredictability of this hazard, all critical and non-critical structures within the county are at risk of future damage or loss of function. Estimates of potential physical losses were determined through a hypothetical exercise where an EF2 intensity tornado traveled through portions of the county and the communities. This is intended to present a "what-if" scenario of a tornado incident and associated damages. Damage estimates were derived by assuming that 25% of all structures in the path of the tornado would be completely destroyed, 35% of the structures would be 50% damaged, and 40% of the structures would sustain 25% damage. These estimations were also determined utilizing three wind speed zones based on distance from the tornado path. Zone 1 is nearest the center of the tornado path, while Zone 3 is the farthest from the path and with a theoretically lower wind speed. **Table 24** provides summary data for the hypothetical tornado, which is identified on Exhibit 3.

Table 24 Summary of Hypothetical Tornado Damages

	Zone 1		Zone 2		Zone 3		Total	
	#	$	#	$	#	$	#	$
Gosport	67	$4.5M	61	$3.6M	61	$3.6M	**189**	**$11.7M**
Spencer	110	$7.4M	80	$5.0M	76	$5.1M	**266**	**$17.5M**
County	34	$2.6M	47	$3.8M	45	$3.6M	**126**	**$10.0M**
Totals	**211**	**$14.5M**	**188**	**$12.4M**	**182**	**$12.3M**	**581**	**$39.2M**

Utilizing the same GIS information and process, critical infrastructure within each of the hypothetical tornado zones are included in **Table 25**. These buildings are included in the over number and of structures and damage estimate information provided in Table 24.

Table 25 Critical Infrastructure in Tornado Zones

Community	Zone 1	Zone 2	Zone 3
County			
Gosport	Gosport Baptist Church Smithville Remote 27S Seventh St LZ	Gosport Volunteer Fire Dept Gosport Town Hall Gosport Town Marshal	Gosport Christian
Spencer	Jenner Mobile Home Park Terrell Mobile Home Park Speedway	Bab's Supervalu	Truesdel Daycare Duke Substation Owen County Sheriff/Jail Spencer 69 kV Substation

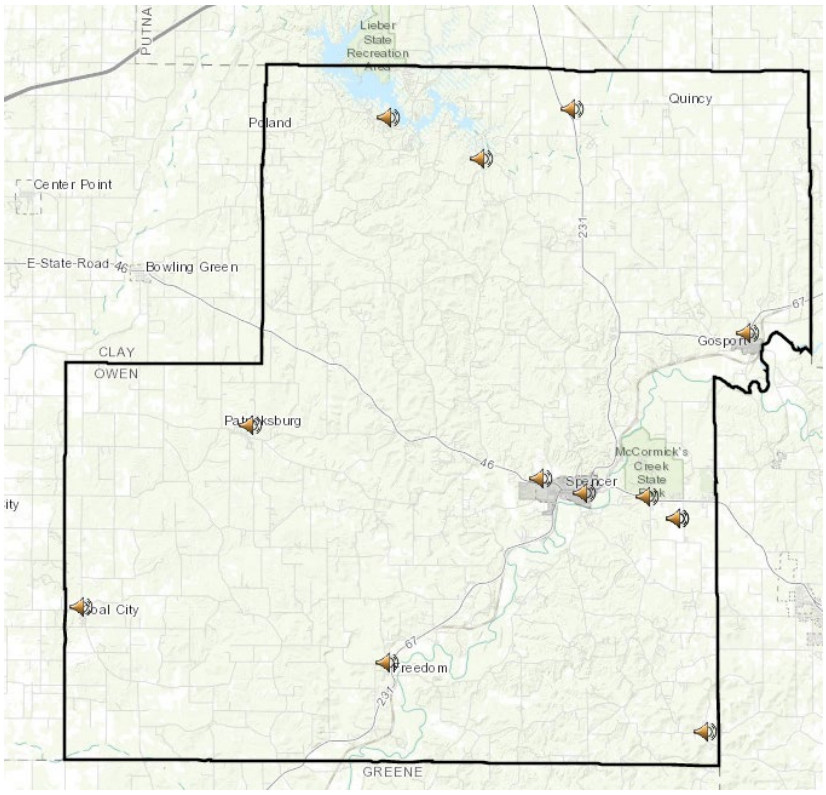


Figure 26 Owen County Outdoor Warning Sirens

Within Owen County, there are numerous events each year that draw thousands of guests. Due to this, it is imperative that the EMA place continued importance on the need to maintain their outdoor warning siren coverage. Currently, much of the more populous areas of the county are not covered by the audible ranges of the existing outdoor warning sirens. The existing siren locations are identified in **Figure 26.**

While it can be anticipated that new construction associated with development may be stronger than older or existing construction, most of Owen County will remain vulnerable in areas left uncovered by outdoor warning sirens. It is impossible to predict the path of a tornado and therefore all current and future development will continue to be at risk for damages. However, risk to the citizens of Owen County has been lessened through participation in mass notification programs and outdoor warning siren activations.

There may also be indirect effects of a tornado event. For example, post-event clean-up may result in high expenses or inability to work for property owners that have experienced damages from either the tornado directly or by debris from high winds. Affected business owners may experience loss of revenue if they are unable to continue operations following the event. Similarly, if a business is affected and unable to operate, employees may experience a loss of wages during the period of recovery.

Tornado: Relationship to Other Hazards

Tornadoes may result in a hazardous materials incident. Material storage containers can become damaged by high winds and debris can result in a spill or release of materials. As wind speeds increase, the potential for damages to above ground storage containers also increases. Tankers and other transportation vehicles carrying hazardous materials are also at an increased risk while on the road or rail.

Tornadoes may also result in a dam failure as the increased wind speeds, and debris caused by the tornado, may directly impact the dam, or cause indirect damages through large debris or downed trees. In addition, tornadoes may lead to structural fires as the destruction path is sometimes long and broad, leading to an increased number of potentially damaged homes, exposed power lines, and large amounts of debris.

3.3.9 Winter Storm and Ice

Winter Storm & Ice: Overview

A winter storm can range from moderate snow over a few hours to blizzard conditions with high winds, ice storms, freezing rain or sleet, heavy snowfall with blinding wind-driven snow, and extremely cold temperatures that can last for several days. Some winter storms may be large enough to affect several states while others may affect only a single community. All winter storms are accompanied by cold temperatures and blowing snow, which can severely reduce visibility. A winter storm is defined as one that drops four or more inches of snow during a 12-hour period, or six or more inches during a 24-hour span. An ice storm occurs when freezing rain falls from clouds and freezes immediately on impact. All winter storms make driving and walking extremely hazardous. The aftermath of a winter storm can affect a community or region for days, weeks, and even months.

Figure 27 Ice Covered Power Lines

Storm effects such as extreme cold, flooding, and snow and ice accumulation (**Figure 27**) can cause hazardous conditions and hidden problems for people in the affected area. People can become stranded on the road or trapped at home, without utilities or other services, including food, water, and fuel supplies. The conditions may overwhelm the capabilities of a local jurisdiction. Winter storms are considered deceptive killers as they may indirectly cause transportation accidents, and injury and death resulting from exhaustion/ overexertion, hypothermia and frostbite from wind chill, and asphyxiation. House fires occur more frequently in the winter due to lack of proper safety precautions.

Wind chill is a calculation of how cold it feels outside when the effects of temperature and wind speed are combined. On November 1, 2001, the NWS implemented a replacement Wind Chill Temperature (WCT) index for the 2001/2002 winter season. The reason for the change was to improve upon the current WCT Index, which was based on the 1945 Siple and Passel Index.

A winter storm watch indicates that severe winter weather may affect your area. A winter storm warning indicates that severe winter weather conditions are on the way. A blizzard warning means that large amounts of falling or blowing snow and sustained winds of at least 35 mph are expected for several hours. Winter storms are common in Owen County and the surrounding region. Such conditions can result in substantial personal and property damage, even death.

Winter Storm & Ice: Recent Occurrences

Since November 2016, the NCDC has recorded three heavy snow events, one ice storm, and one winter storm. NCDC reports indicated $60.0K in property damages, no additional crop damages and no injuries, or deaths associated with any of the events. Many narrative descriptions indicated poor travel conditions, power outages and debris associated with similar events.

The heavy snow event which occurred on December 15, 2019 resulted in $50.0K in damages as many impacts were realized as evening travel peaked and calls to 911 were increased by four to six times the average. Narrative reports do indicate six injuries associated with nearly 60 vehicle incidents due to the travel conditions as snowfall ranged from 3.5 to 5.5 inches. The most recent event occurred on February 2, 2022 as a travel warning was issued for the county following nearly 6.5 inches of snowfall.

The probability, magnitude, warning times, and duration of a snowstorm or ice storm causing disruption to residents and businesses in Owen County, as determined by the Planning Committee, is expected to be mostly consistent throughout the county and communities. It is "Highly Likely" that this type of hazard will occur in this area and will typically affect the entire county, and possibly several surrounding counties at one time, resulting in primarily "Limited" damages. The warning time for severe temperatures or several inches of snow associated with a winter storm is usually 12-24 hours while the duration of the incident is anticipated to be less than one week. A summary is shown in **Table 26**.

Table 26 CPRI for Winter Storm and Ice

	Probability	Magnitude/ Severity	Warning Time	Duration	CPRI
Owen County	Highly Likely	Limited	12-24 Hours	< 1 Week	Elevated
Town of Gosport	Highly Likely	Limited	12-24 Hours	< 1 Week	Elevated
Town of Spencer	Highly Likely	Limited	12-24 Hours	< 1 Week	Elevated

The Planning Committee determined that the probability for a snowstorm or ice storm to occur in Owen County and the communities within is "Highly Likely" or will occur within each calendar year. Based on historical data and the experience of the Planning Committee, snowstorms are frequent within Owen County, but actions have been taken to mitigate many impacts from snow and ice storms. The Committee considered only the larger, more detrimental event for this effort.

Winter Storm & Ice: Assessing Vulnerability

A snowstorm typically affects a large regional area with potential for physical, economic, and/or social losses. Direct and indirect effects of a snowstorm or ice storm within Owen County may include:

Direct Effects:

- More urban area employers may experience loss of production as employees may not be able to get to work
- Rural (County) roads may impassable
- Expenses related to snow removal or brine/sand applications

Indirect Effects:

- Loss of revenue as businesses are closed
- Increased emergency response times based on safety of roads
- Loss of income if unable to get to place of employment

Estimating Potential Losses

Given the nature and complexity of a regional hazard such as a snowstorm, it is difficult to quantify potential losses to property and infrastructure. As a result, all critical and non-critical structures and infrastructure are at risk from snowstorm and ice storm incidents.

Figure 28 Travel Impacted During Snowstorm

For planning purposes, information collected in snowstorms impacting other communities around the nation is also useful in assessing the potential social, physical, and economic impact that a winter storm could have on Owen County communities. For example, a March 2003 snowstorm in Denver, Colorado dropped approximately 31 inches of snow and caused an estimated $34M in total damages. In addition, a February 2003 winter storm dropped an estimated 15-20 inches of snow in parts of Ohio. The Federal and Ohio Emergency Management Agencies and U.S. Small Business Administration surveyed damaged areas and issued a preliminary assessment of $17M in disaster related costs. These costs included snow and debris removal, emergency loss prevention measures, and public utilities repair. The agencies found over 300 homes and businesses either damaged or destroyed in six counties. Snowstorms and blizzards also make road travel difficult and dangerous, as in **Figure 28.**

The Denver, Colorado area snowstorms from December 2006 through January 2007 surpassed the expenses and damages of the 2003 winter storms. In snow removal costs alone, it is estimated that over $19M was spent throughout the area, with approximately $6.4M of that allocated to clearing Denver International Airport. Additional economic expenses are realized when such a large storm closed local businesses and Denver International Airport for nearly 48 hours.

While the above examples indicate the wide-ranging and large-scale impact that winter storms can have on a community or region, winter storms generally tend to result in less direct economic impacts than many other natural hazards. According to the Workshop on the Social and Economic Impacts of Weather, which was sponsored by the U.S. Weather Research Program, the American Meteorological Society, the White House Subcommittee on Natural Disaster Relief, and others, winter storms resulted in an average of 47 deaths and more than $1B in economic losses per year between 1988 and 1995. However, these totals account for only 3% of the total weather-related economic loss and only 9% of fatalities associated with all weather-related hazards over the same period.

Future Considerations

As populations increase and communities continue to grow, the need to respond to snowstorms or ice storms will remain an important municipal effort. As new construction or re-development occurs, especially new or existing critical infrastructure, it is important to ensure that these new structures are equipped to deal with the potential risks associated with this hazard. Those may include lengthy power outages and potentially impassable transportation routes, making it difficult to obtain supplies or for passage of response vehicles. These hazard events will typically affect the entire county as a whole, perhaps multiple counties, and therefore all development, current and future, will be at risk for damages associated with snow and ice storms.

Winter storms can also result in substantial indirect costs. Increased emergency response times, loss of work or the inability to get to work, as well as business interruption, are possible indirect effects of a winter storm. According to a report by the National Center for Environmental Predictions, the cold and snowy winter in late 1977 and early 1978, which impacted several heavily populated regions of the country, was partially responsible for reducing the nation's Gross Domestic Product (GDP) from an estimated growth rate of between 6% and 7% during the first three quarters of 1977 to approximately -1% in the last quarter of 1977 and 3% during the first quarter of 1978.

Winter Storm & Ice: Relationship to Other Hazards

Figure 29 Flooding Caused by Snow Melt

Winter storms and ice storms can lead to flooding as the precipitation melts and enters local receiving waters. This increased volume of water on already saturated, or still frozen ground can quickly result in flood-related damages to structures and properties (**Figure 29**) as well as within the stream or river channel. The increased flooding may then lead to a dam failure within the same area, further exacerbating the damages.

Hazardous materials incidents may be caused by poor road conditions during winter storms or ice storms. Many hazardous materials are transported by rail or by tanker over highways and interstates. In the more rural areas of Owen County, or where open areas are more susceptible to snow drifts on roads, the possibility of a traffic related hazardous materials incident may increase.

Power outages and other infrastructure failures may also occur during a winter storm. Weight from snow and ice accumulations can directly or indirectly cause power lines to fail. During extreme cold temperatures, power outages may prove deadly for certain populations such as the elderly or ill.

3.3.10 Dam Failure

Dam Failure: Overview

A dam is defined as a barrier constructed across a watercourse for the purpose of storage, control, or diversion of water. Dams typically are constructed of earth, rock, concrete, or mine tailings. A dam failure is a collapse, breach, or other failure resulting in downstream flooding.

A dam impounds water in the upstream area, referred to as the reservoir. The amount of water impounded is measured in acre-feet. An acre-foot is the volume of water that covers an acre of land to a depth of one foot. As a function of upstream topography, even a very small dam may impound or detain many acre-feet of water. Two factors influence the potential severity of a full or partial dam failure: the amount of water impounded, and the density, type, and value of development and infrastructure located downstream.

Of the approximately 80,000 dams identified nationwide in the National Inventory of Dams, the majority are privately owned. Each dam is assigned a downstream hazard classification based on the potential loss of life and damage to property should the dam fail. The three classifications are high, significant, and low. With changing demographics and land development in downstream areas, hazard classifications are updated continually. The following definitions of hazard classification currently apply to dams in Indiana:

- High Hazard Dam: a structure, the failure of which, may cause the loss of life and serious damage to homes, industrial and commercial buildings, public utilities, major highways, or railroads.
- Significant Hazard Dam: a structure, the failure of which, may damage isolated homes and highways or cause the temporary interruption of public utility services.
- Low Hazard Dam: a structure, the failure of which, may damage farm buildings, agricultural land, or local roads.

A levee is a flood control structure designed to hold water away from a building. Levees protect buildings from flooding as well as from the force of water, from scour at the foundation, and from impacts of floating debris. The principle causes of levee failure are like those associated with dam failure and include overtopping, surface erosion, internal erosion, and slides within the levee embankment or the foundation walls. Levees are designed to protect against a particular flood level and may be overtopped in a more severe event. When a levee system fails or is overtopped, the result can be catastrophic and often more damaging that if the levee were not there, due to increased elevation differences and water velocity. The water flowing through the breach continues to erode the levee and increase the size of the breach until it is repaired or water levels on the two side of the levee have equalized.

Dam Failure: Recent Occurrences

Within Owen County, there are five DNR-regulated High Hazard dams (Amazon Lake, Dugan Lake, Dutton Lake, Graybrook Lake, and Hollybrook Lake), three DNR-regulated Significant Hazard dams (Bass Haven Dam, Locust Lake Dam, and Wagner Lake Dam), and five DNR-regulated Low Hazard dams (Camp Otto Dam, Ellis Lake Dam, Salter Lake Dam, Timber Ridge Dam, and Wasatch Lake Dam), shown on Exhibit 2. According to local information, there have been no dam failures within Owen County.

According to the National Levee Database (NLD) managed by the USACE, there are no levees systems within Owen County. Therefore, levees will not be considered as a hazard within this planning effort.

Based on the information provided to them and their local knowledge, experience, and expertise, the Committee determined the probability of a dam failure is "Unlikely". The magnitude of a dam failure ranges from "Significant" (areas within the potential inundation area) to "Negligible" (areas not anticipated to be within the inundation area) damages. For a dam failure that occurs on a sunny day, the warning time is anticipated to be less than six hours (for areas anticipated to be impacted by a dam failure); and the duration is anticipated to last less than one day. **Table 27** provides a summary of the Planning Committee's expectations during a dam failure.

Table 27 CPRI for Dam Failure

	Probability	Magnitude/ Severity	Warning Time	Duration	CPRI
Owen County	Unlikely	Significant	< 6 Hours	< 1 Day	Elevated
Town of Gosport	Unlikely	Negligible	> 24 Hours	< 6 Hours	Low
Town of Spencer	Unlikely	Limited	< 6 Hours	< 1 Day	Low

Dam Failure: Assessing Vulnerability

The actual magnitude and extent of damages due to a dam failure depend on the type of breach, the volume of water that is released, and the width of the floodplain valley to accommodate the flood wave. Due to the conditions beyond the control of the dam owner or engineer, there may be unforeseen structural problems, natural forces, mistakes in operation, negligence, or vandalism that may cause a structure to fail.

Within Owen County, direct and indirect effects from a dam failure may include:

Direct Effects:

- Loss of life and serious damage to downstream homes, industrial and commercial buildings, public utilities, major highways, or railroads
- Loss of use of reservoirs for flood control, recreation, and water supply

Indirect Effects:

- Loss of land in the immediate scour area
- Increased response times due to damaged or re-routed transportation routes and/or bridges

Estimating Potential Losses

As of July 1, 2022, it is required that High Hazard dams have Incident and Emergency Action Plans (IEAPs) developed. These plans have detailed potential dam failure inundation areas identified along with at-risk structures identified. Only one of the High Hazard dams within Owen County, the Graybrook Lake Dam, has a full IEAP developed. The Dutton Lake Dam does have some potential inundation mapping completed which provides an overview of the areas more at risk. The actual magnitude and extent of damages depend on the type of dam break, the volume of water that is released, and the width of the floodplain valley to accommodate the dam break flood wave.

The potential fair weather dam failure inundation areas for Graybrook Dam and Dutton Lake Dam were reviewed along with recent aerial photography to estimate the number of critical and non-critical

structures potentially affected. As with previous hazards, damage estimates were derived by assuming 25% of all structures would be completely destroyed, 35% would be 50% damaged, and the remaining 40% of structures would have only 25% in damages. **Table 28** provides overview information of each of the individual dam failures.

Table 28 Owen County Potential Dam Failure Impacts

High Hazard Dam	Potential Damages	
	# Structures	$ Damages
Dutton Lake Dam	4	$0.2M
Graybrook Lake Dam	10	$0.9M

Utilizing the same GIS process, it was determined that no critical infrastructure lies within the potential dam failure inundation area in Owen County.

Future Considerations

As areas near existing dams continue to grow in population, it can be anticipated that the number of critical and non-critical structures could also increase accordingly. Location of these new facilities should be carefully considered, and precautions should be taken to ensure that schools, medical facilities, municipal buildings, and other critical infrastructure are located outside of the delineated or estimated dam failure inundation areas. Also, flood-free access should be provided for these facilities. Large areas of new development have not yet occurred downstream of the high hazard dams in Owen County. Until such development or re-development downstream of a dam is prohibited, those areas remain vulnerable to losses and damages associated with a failure of that structure.

It is also very important to all downstream communities and property owners that dam IEAPs are developed, kept up-to-date, and routinely exercised to ensure the greatest safety to those within the hazard area. This is a good suggestion even for Significant Hazard dams as well.

Dam Failure: Relationship to Other Hazards

With the potentially large volumes and velocities of water released during a breach, it can be expected that such a failure would lead to flooding within the inundation areas downstream of the dam. Nearby bridges and roads are also in danger of being destroyed or damaged due to a dam failure. Bridges may become unstable and portions of road surfaces may be washed away, or the entire road may be undermined. Other infrastructure such as utility poles and lines may be damaged as the water flows along the surface or pipes may become exposed due to scouring; all of which may lead to utility failures within the area downstream of the dam failure.

3.3.11 Hazardous Materials Incident

Hazardous Materials Incident: Overview

Hazardous materials are substances that pose a potential threat to life, health, property, and the environment if they are released. Examples of hazardous materials include corrosives, explosives, flammable materials, radioactive materials, poisons, oxidizers, and dangerous gases. Despite precautions taken to ensure careful handling during manufacture, transport, storage, use, and disposal, accidental releases are bound to occur. These releases create a serious hazard for workers, neighbors, and emergency response personnel. Emergency response may require fire, safety/law enforcement, search and rescue, and hazardous materials response units.

Figure 30 Drums of Potentially Hazardous Waste

As materials are mobilized for treatment, disposal, or transport to another facility, all infrastructure, facilities, and residences near the transportation routes are at an elevated risk of being affected by a hazardous materials release. Often these releases can cause serious harm to Owen County and its residents if proper and immediate actions are not taken. Most releases are the result of human error or improper storage (**Figure 30**), and corrective actions to stabilize these incidents may not always be feasible or practical in nature.

Railways often transport materials that are classified as hazardous and preparations need to be made and exercised for situations such as derailments, train/vehicle crashes, and/or general leaks and spills from transport cars.

Hazardous Materials Incident: Recent Occurrences

During conversations with Committee members and through information provided by local news outlets, it was noted that numerous small and moderately sized incidents involving manufacturing facilities and transportation routes have occurred since the development of the original MHMP. However, the number of facilities utilizing, storing, and/or manufacturing chemicals and the number of high-volume transportation routes increase the likelihood of an incident.

According to the Committee, the probability of a hazardous materials release or incident is "Likely" in all areas due to the number of facilities and transportation routes within and through these municipalities. "Limited" to "Significant" damages are anticipated to result from an incident dependent upon the location of the event. As with hazards of this nature, a short warning time of less than six hours and a short duration, also less than six hours is anticipated in the event of a hazardous materials incident. A summary is shown in **Table 29**.

Table 29 CPRI For Hazardous Materials Incident

	Probability	Magnitude/ Severity	Warning Time	Duration	CPRI
Owen County	Likely	Limited	< 6 Hours	< 6 Hours	Elevated
Town of Gosport	Likely	Limited	< 6 Hours	< 6 Hours	Elevated
Town of Spencer	Likely	Significant	< 6 Hours	< 6 Hours	Elevated

Relatively small hazardous materials incidents have occurred throughout Owen County in the past and may, according to the Committee, occur again. As the number of hazardous materials producers, users, and transporters increase within or surrounding Owen County, it can be anticipated that the likelihood of a future incident will also increase.

Hazardous Materials Incident: Assessing Vulnerability

Within Owen County, direct and indirect effects from a hazardous materials incident may include:

Direct Effects:

- More densely populated areas with a larger number of structures, railroad crossings, and heavily traveled routes are more vulnerable
- Expense of reconstruction of affected structures

Indirect Effects:

- Loss of revenue or production while recovery and/or reconstruction occurs
- Anxiety or stress related to event
- Potential evacuation of neighboring structures or facilities

Figure 31 Fuel Tanker Fire

While the possibility of an incident occurring may be likely, the vulnerability of Owen County has been lowered due to the enactment of Superfund Amendments and Reauthorization Act (SARA) Title III national, state and local requirements. SARA Title III, also known as the Emergency Planning and Community Right to Know Act (EPCRA), establishes requirements for planning and training at all levels of government and industry. EPCRA also establishes provisions for citizens to have access to information related to the type and quantity of hazardous materials being utilized, stored, transported or released within their communities.

One local result of SARA Title III is the formation of the Local Emergency Planning Commission (LEPC). This commission has the responsibility for preparing and implementing emergency response plans, cataloging Material Safety Data Sheets (MSDS), creating chemical inventories of local industries and businesses, and reporting materials necessary for compliance.

In Owen County, 14 facilities are subject to SARA Title III provisions due to the presence of listed hazardous materials in quantities at or above the minimum threshold established by the Act. These facilities are also required to create and distribute emergency plans and facility maps to local emergency responders such as the LEPC, fire departments, and police departments. With this knowledge on hand, emergency responders and other local government officials can be better prepared to plan for an emergency and the response it would require, and to better prevent serious effects to the community involved.

Estimating Potential Losses

In addition, the very nature of these events makes predicting the extent of their damage very difficult. A small-scale spill or release might have a minor impact and would likely require only minimal response efforts. Another slightly larger incident might result in the disruption of business or traffic patterns, and in this situation, might require active control response measures to contain a spill or release. On the other hand, even small or moderate events could potentially grow large enough that mass evacuations or shelter in place techniques are needed, multiple levels of response are utilized, and additional hazards such as structural fires and/or additional hazardous materials releases (or explosions) may occur. Given the unpredictable nature of hazardous materials incident, an estimate of potential losses was not generated.

Future Considerations

Additional facilities, both critical and non-critical in nature may be affected if a hazardous materials release were to occur along a transportation route. Several routes including railways, US Highway 231; State Routes 42, 43, 46, 67, 157, 243, and 246 are traveled by carriers of hazardous materials.

By restricting development within the known hazardous materials facility buffer zones, future losses associated with a hazardous materials release can be reduced. Critical infrastructure should be especially discouraged from being located within these areas. Further, by restricting construction in these zones, the number of potentially impacted residents may also be greatly reduced, lowering the risk for social losses, injuries, and potential deaths. Future construction of hazardous materials facilities should be located away from critical infrastructure such as schools, medical facilities, municipal buildings, and daycares. Such construction would likely reduce the risk to highly populated buildings and populations with specials needs or considerations such as children, elderly, and medically unfit.

Many facilities constructed within close proximity to a hazardous materials facility are similar due to local zoning ordinances. This reduces the risk and vulnerability of some populations. However, there are several facilities and numerous transportation routes located throughout each of the communities making current and future development at risk for losses associated with a hazardous materials release.

Hazardous Materials Incident: Relationship to Other Hazards

Dependent on the nature of the release, conditions may exist where an ignition source such as a fire or spark ignites a flammable or explosive substance. As the fire spreads throughout the facility or the area, structural and/or property damages will increase. Response times to a hazardous materials incident may be prolonged until all necessary information is collected detailing the type and amount of chemicals potentially involved in the incident. While this may increase structural losses, it may decrease the social losses such as injuries or even deaths.

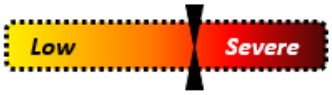
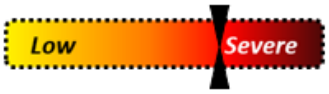
3.4 HAZARD SUMMARY

For the development of this MHMP, the Committee utilized the CPRI method to prioritize the hazards they felt affected Owen County. Hazards were assigned values based on the probability or likelihood of occurrence, the magnitude or severity of the incident, as well as warning time and duration of the incident itself. A weighted CPRI was calculated based on the percent of the county's population present in the individual communities.

Table 30 summarizes the CPRI values for the various hazards studied within this MHMP.

- "Low" hazards: none
- "Elevated" hazards: Dam Failure; Drought; Earthquake; Extreme Heat; Fire; Hazardous Materials Incident; Land Subsidence; Tornado; Winter Storm and Ice
- "Severe" hazards: Extreme Cold; Flood – Flash; Flood – Riverine; Hail, Thunder, and Windstorm

Table 30 Combined CPRI

Type of Hazard	List of Hazards	Weighted Average CPRI
Natural	Drought	
	Earthquake	
	Extreme Temperature - Cold	
	Extreme Temperature - Heat	
	Fire	
	Flood - Flash	
	Flood - Riverine	
	Hail/Thunder/Windstorm	
	Landslide/Subsidence	
	Tornado	
	Winter Storm/Ice	
Technological	Dam Failure	
	Hazardous Materials Incident	

It can be important to understand the cause-and-effect relationship between the hazards selected by the Committee. **Table 31** can be utilized to identify those relationships. For example, a winter storm (along the side of the table) can result in a flood (along the top of the table). In a similar fashion, a hazardous materials incident (along the top of the table) can be caused by an earthquake; flood; tornado; or a winter storm or ice storm (along the side of the table)

Table 31 Hazard Relationship Table

EFFECT → / CAUSE ↓	Drought	Earthquake	Extreme Temperature	Fire	Flood	Hailstorm/ Thunderstorm/ Windstorm	Landslide / Subsidence	Tornado	Winter Storm / Ice	Dam Failure	Hazardous Materials
Drought											
Earthquake				X			X			X	X
Extreme Temperature											X
Fire											X
Flood							X			X	X
Hailstorm/ Thunderstorm / Windstorm				X	X		X			X	X
Landslide / Subsidence					X						X
Tornado				X						X	X
Winter Storm/ Ice					X					X	X
Dam Failure					X		X				X
Hazardous Materials				X							

As a method of better identifying the potential relationships between hazards, the community exhibits can be referenced to indicate the proximity of one or more known hazard areas such as the delineated floodplains and the locations of EHS facilities. For this reason, many of the communities in Owen County may be impacted by more than one hazard at a time, depending on certain conditions. It can be anticipated that if a flood were to occur within these areas, there would be a potentially increased risk of a facility experiencing a hazardous materials incident. These areas may also be at a greater risk of a dam failure.

Future development in areas where multiple known hazard areas (dam failure inundation areas, floodplains and surrounding hazardous materials facilities) overlap should undergo careful design, review, and construction protocol to reduce the risk of social, physical, and economic losses due to a hazard incident. While it may certainly be difficult, critical infrastructure should not be constructed within these regions.

CHAPTER 4: MITIGATION GOALS AND PRACTICES

This section identifies the overall goal for the development and implementation of the Owen County MHMP. A summary of existing and proposed mitigation practices discussed by the Committee is also provided.

4.1 MITIGATION GOAL

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.

The Committee reviewed the mitigation goals as outlined within the 2016 Owen County MHMP and determined that each of these remain valid and effective. In summary, the overall goal of the Owen County MHMP is to reduce the social, physical, and economic losses associated with hazard incidents through emergency services, natural resource protection, prevention, property protection, public information, and structural control mitigation practices.

4.2 MITIGATION PRACTICES

REQUIREMENT §201.6(c)(3)(ii):
[The mitigation strategy shall include a] section that identifies and analyzed 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.

REQUIREMENT §201.6(c)(3)(iii):
[The mitigation strategy section shall include] an action plan describing how the actions identified in section (c)(3)(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 benefit review of the proposed projects and their associated costs.

In 2005, the Multi-Hazard Mitigation Council conducted a study about the benefits of hazard mitigation. This study examined grants over a 10-year period (1993-2003) aimed at reducing future damages from earthquake, wind, and flood. It found that mitigation efforts were cost-effective at reducing future losses; resulted in significant benefits to society; and represented significant potential savings to the federal treasury in terms of reduced hazard-related expenditures. This study found that every $1 spent on mitigation efforts resulted in an average of $4 savings for the community. The study also found that FEMA mitigation grants are cost-effective since they often lead to additional non-federally funded mitigation activities and have the greatest benefits in communities that have institutionalized hazard mitigation programs.

A more recent (2017) study by the National Institute of Building Sciences, reviewed over 20 years of federally funded mitigation grants, not only from FEMA but also from the US Economic Development Administration (EDA) and the US Department of Housing and Urban Development (HUD). From this broadened review, it has been determined that for every $1 spent on mitigation, $6 are saved on disaster costs. In addition, by designing and construction buildings which exceed select items in the 2015 International Code, $4 can be saved for every $1 invested in those changes.

Six primary mitigation practices defined by FEMA are:

- **Emergency Services** – measures that protect people during and after a hazard.
- **Natural Resource Protection** – opportunities to preserve and restore natural areas and their function to reduce the impact of hazards.
- **Prevention** – measures that are designed to keep the problem from occurring or getting worse.
- **Property Protection** – measures that are used to modify buildings subject to hazard damage rather than to keep the hazard away.
- **Public Information** – those activities that advise property owners, potential property owners, and visitors about the hazards, ways to protect themselves and their property from the hazards.
- **Structural Control** – physical measures used to prevent hazards from reaching a property.

4.2.1 Existing Mitigation Practices

As part of this planning effort, the Committee discussed the strengths and weaknesses of existing mitigation practices and made recommendations for improvements, as well as suggested new practices. The following is a summary of existing hazard mitigation practices within Owen County. Mitigation measures that were included in the 2016 Owen County MHMP are noted as such.

Emergency Services

- The County has developed a centralized system for testing the existing outdoor warning sirens.
- Stream gages are utilized for flood forecasting and flood warnings for various stream levels and along Mill Creek and the White River. *(2016 Measure)*
- Snow removal routes have been developed to keep primary streets clean during and after snowstorms.
- An IEAP has been developed, and is routinely reviewed, for the Graybrook and Dutton Lake dams. (*2016 Measure)*
- Training and table-top exercises are conducted by the LEPC and include response agencies such as police, fire, and local hospitals.
- Many response agencies have mobile data terminals and necessary software utilized by the vehicle fleet and dispatchers *(2016 Measure).*
- There are 10 trained volunteers through the Owen County Community Organizations Active in Disaster (COAD)
- Owen County maintains a swift water rescue team; Cataract Fire Department maintains a dive team *(2016 Measure)*
- Owen County has established a supply reserved of personal protective equipment to be used following a hazardous event or mass casualty *(2106 Measure)*
- A new Emergency Operations Center has been established through which personnel can coordinate response efforts during a hazardous event *(2016 Measure)*
- Owen County municipalities work with event coordinators for several large gathering events in Owen County to assist with emergency response and preparations *(2016 Measure)*

Natural Resource Protection

- Owen County and Spencer are in good standing with the NFIP Program and have flood protection ordinances which meets or exceeds the minimum requirements.
- Current facility maps and response plans are on file for all Tier II HazMat facilities

Prevention

- Owen County utilizes GIS data collection and maintenance which may be used independently and collectively in land use planning decisions and can be utilized in HAZUS-MH "what-if" scenarios. *(2016 Measure)*
- The Owen County LEPC provides routine training regarding the proper storage, transport, and disposal of hazardous materials.
- Information related to natural hazards has been incorporated into the Comprehensive Land Use Plan and other plans to better guide future growth and development (*2016 Measure)*
    - Owen County Economic Development Strategy Plan, 2020:
        i. Development constraints for subareas within the county mention hazard areas and note these should be avoided and may need additional studies, such as karst geology, floodplains and drainage issues, and steep slopes.
    - Owen County Quality of Place and Workforce Attraction Plan, 2019:
        i. One goal included as a means of workforce attraction is to "continue to address stormwater management problems" by investing in infrastructure and increasing green spaces in flood-prone areas

Property Protection

- Recommendations from completed flood protections studies are implemented as funding becomes available
- Drainage system maintenance, including repair and replacement of broken tiles and culverts occurs routinely throughout the county.

Public Information

- Outreach materials and hazard preparedness materials are routinely provided within offices and agencies throughout Owen County, large public events, speaking opportunities within schools, etc. Some of these materials are also provided in Spanish; provided through social media outlets and agency websites; and used during Severe Weather Awareness Week (and others) to raise awareness *(2016 Measure)*
- Owen County EMA provides weather radios to interested businesses and residents as available *(2016 Measure)*
- The EMA and response agencies utilize websites and social media to convey messages to the public prior to, during and following hazardous events. This includes easy to understand information and easy to follow directions.

Structural Control

- Stormwater conveyances and regulated drains are maintained on a routine basis to prevent localized flooding, increased erosion, and material deposition as a result of rainfall or snowmelt.

4.2.2 Proposed Mitigation Practices

After reviewing existing mitigation practices, the Committee reviewed mitigation ideas for each of the hazards studied and identified which of these they felt best met their needs as a community according to selected social, technical, administrative, political, and legal criteria. The following identifies the key considerations for each evaluation criteria:

- **Social** – mitigation projects will have community acceptance, they are compatible with present and future community values, and do not adversely affect one segment of the population.
- **Technical** – mitigation projects will be technically feasible, reduce losses in the long-term, and will not create more problems than they solve.
- **Administrative** – mitigation projects may require additional staff time, alternative sources of funding, and have some maintenance requirements.
- **Political** – mitigation projects will have political and public support.
- **Legal** – mitigation projects will be implemented through the laws, ordinances, and resolutions that are in place.
- **Economic** – mitigation projects can be funded in current or upcoming budget cycles.
- **Environmental** – mitigation projects may have negative consequences on environmental assets such as wetlands, threatened or endangered species, or other protected natural resources.

Table 32 lists a summary of all proposed mitigation practices identified for all hazards, as well as information on the local status, local priority, benefit-cost ratio, project location, responsible entities, and potential funding sources, associated with each proposed practice. The proposed mitigation practices are listed in order of importance to Owen County for implementation. Projects identified by the Committee to be of "high" local priority may be implemented within five years from final Plan adoption. Projects identified to be of "moderate" local priority may be implemented within 5-10 years from final Plan adoption, and projects identified by the Committee to be of "low" local priority may be implemented within 10+ years from final Plan adoptions. However, depending on availability of funding, some proposed mitigation projects may take longer to implement.

As part of the process to identify potential mitigation projects, the Planning Committee weighed the benefit derived from each mitigation practice against the estimated cost of that practice. This basic benefit-cost ratio was based on experience and professional judgement and was utilized to identify the mitigation practices as having a high, moderate, or low benefit-cost ratio. Preparing detailed benefit-cost ratios was beyond the scope of this planning effort and the intent of the MHMP.

The update of this MHMP is a necessary step of a multi-step process to implement programs, policies, and projects to mitigate the effect of hazards in Owen County. The intent of this planning effort was to identify the hazards and the extent to which they affect Owen County and to determine what type of mitigation strategies or practices may be undertaken to mitigate for these hazards. A FEMA-approved MHMP is required to apply for and/or receive project grants under the BRIC, HMGP, and FMA. Although this MHMP meets the requirements of DMA 2000 and eligibility requirements of these grant programs additional detailed studies may need to be completed prior to applying for these grants. **Section 5.0** of this plan includes an implementation plan for all high priority mitigation practices identified by the Committee.

The CRS program credits NFIP communities a maximum of 97 points for setting goals to reduce the impact of flooding and other known natural hazards; identifying mitigation projects that include activities for prevention, property protection, natural resource protection, emergency services, structural control projects, and public information.

Table 32 Proposed Mitigation Measures

Mitigation Practice	Mitigation Strategy	Hazard Addressed	Status	Priority	Benefit-Cost Ratio	Responsible Entity	Funding Source
Emergency Preparedness & Warning 1. Investigate options and select a hazard broadcast system to distribute mass notifications to residents and visitors *(2016 Measure)* 2. Evaluate flood forecasting capabilities including stream gages, flood forecast maps, and flood alerts *(2016 Measure)* 3. Evaluate overall outdoor warning siren coverage or complete software upgrades to alert populations of severe weather conditions *(2016 Measure)* 4. Coordinate with private building owners utilizing large dynamic message boards for business to use during hazard events *(2016 Measure)*	☒ Emergency Services ☒ Nat. Res. Protection ☒ Prevention ☒ Property Protection ☒ Public Information ☐ Structural Control	☒ Drought ☒ Earthquake ☒ Extreme Temperature ☒ Fire ☒ Flood ☒ Hail/Thunder/Wind ☒ Landslide/Subsidence ☒ Tornado ☒ Winter Storm/Ice ☒ Dam Failure ☒ HazMat Incident	**Ongoing –** 2. The county has one real-time AHPS stream gage (White River at Spencer) 3. Sirens provide coverage for most populated areas 4. Many private facilities throughout the county operate an electronic message board **Proposed Enhancements –** 1. Select and utilize mass notification system for the county 2. Determine if additional gages upstream (Bowling Green in Clay County) would provide advanced warning 3. Additional siren may be useful near Jordan Village area and review software/hardware needs for existing sirens 4. Coordinate with facility owners who operate dynamic message boards and provide them with pre-scripted messages to use during hazard events.	High *(mass notifications, stream gages)* Moderate *(siren coverage)* Low *(private message boards)*	High	EMA USGS Message Board Owners Facility owners	Existing Budgets Grants
Building Protection 1. Adopt construction standards and building codes to ensure that hazard protection, especially of critical facilities, are incorporated into local building codes 2. Inventory critical facilities to determine what improvements are needed to harden against various hazards 3. Enforce zoning laws and restrict the development of new critical infrastructure in 1% & 0.2% AEP, FEH, karst, and potential dam failure inundation areas. 4. Inventory which critical facilities are out of date regarding building codes *(2016 Measure)* 5. Increase the number of dry hydrants available to use for emergency fire protection *(Will assist with NFIP compliance)*	☒ Emergency Services ☒ Nat. Res. Protection ☐ Prevention ☒ Property Protection ☐ Public Information ☒ Structural Control	☐ Drought ☒ Earthquake ☒ Extreme Temperature ☒ Fire ☒ Flood ☒ Hail/Thunder/Wind ☒ Landslide/Subsidence ☒ Tornado ☒ Winter Storm/Ice ☒ Dam Failure ☒ HazMat Incident	**Ongoing –** 1. The County and Spencer follow the Indiana State Building Code 3. Ordinances discourages construction of new critical facilities in 1% AEP flood area 5. Some dry hydrants exist in rural areas **Proposed Enhancements –** 1. Review and adopt State Building Codes (Gosport) 2. Develop inventory of critical facilities and upgrades needed to harden against hazards 3. Continue to prohibit development in floodplains and include 0.2% AEP, potential dam failure inundation areas, karst geology and FEH areas 4. Develop an inventory of out-of-date structures and work to bring them up to code 5. Inventory existing dry hydrants and work with landowners to increase the number throughout the county	High *(building codes, harden facilities)* Moderate *(prohibit development critical facilities, out of date, dry hydrants)*	High	EMA Facility Owners Floodplain Administrators *County, Spencer* Owen County Commissioners Building Department *County (covers Gosport and Spencer)*	Grant Existing Budget

Mitigation Practice	Mitigation Strategy	Hazard Addressed	Status	Priority	Benefit-Cost Ratio	Responsible Entity	Funding Source
Emergency Response & Recovery 1. Inventory and prioritize needs for mobile data terminals, including hardware and software, to be placed in appropriate response vehicles 2. Investigate most efficient and protected method to back up county and municipal records 3. Coordinate communications, documentation, and record keeping between communities and agencies including a database of accurate and community specific information following each hazard events *(2016 Measure)* 4. Review and update as necessary the detailed Flood Response Plan (FRP) for Spencer to improve response and reduce losses from a flood event	☒ Emergency Services ☒ Nat. Res. Protection ☒ Prevention ☐ Property Protection ☒ Public Information ☐ Structural Control	☒ Drought ☒ Earthquake ☒ Extreme Temperature ☒ Fire ☒ Flood ☒ Hail/Thunder/Wind ☒ Landslide/Subsidence ☒ Tornado ☒ Winter Storm/Ice ☒ Dam Failure ☒ HazMat Incident	**Ongoing –** 1. Some response agencies and vehicles currently have equipment 3. Post-event information is provided in varying degrees 4. Town of Spencer has an FRP **Proposed Enhancement –** 1. Work with agency liaison to inventory needs for each response agency and prioritize on a countywide basis 2. Establish consistent protocols regarding records back up throughout the county 3. Create a more consistent reporting and documentation effort following hazard events 4. Develop team to review and update FRP	High *(mobile data terminals, records backup)* Moderate *(communications, FRP)*	High	EMA Community Contacts *County, Gosport, Spencer* Owen County Sheriff Fire Departments *(Owen County, Spencer, Volunteer Departments)* Police Departments *(Gosport, Spencer)* Owen County IT Department	Existing Budget Grant
Flood Studies and Protection 1. Conduct detailed flood studies for problem areas (such as stream crossing and culverts) and/or areas with poor drainage or repetitive flooding problems *(2016 Measure)* 2. Encourage 1 or more staff for each NFIP community to become a Certified Floodplain Manager (CFM) *(Will assist with NFIP compliance)*	☒ Emergency Services ☒ Nat. Res. Protection ☒ Prevention ☒ Property Protection ☒ Public Information ☒ Structural Control	☐ Drought ☐ Earthquake ☐ Extreme Temperature ☐ Fire ☒ Flood ☐ Hail/Thunder/Wind ☐ Landslide/Subsidence ☐ Tornado ☐ Winter Storm/Ice ☐ Dam Failure ☐ HazMat Incident	**Ongoing –** 1. Studies are completed as funding becomes available **Proposed Enhancements –** 1. Develop prioritized listing of needed studies and continue to implement recommendations as funding becomes available 2. Have at least one Owen County and one Spencer staff person certified as a CFM	High	Moderate	EMA Floodplain Administrators *County, Spencer* Planning Departments *County, Gosport, Spencer* Owen County Surveyor	Existing Budget Grant

Mitigation Practice	Mitigation Strategy	Hazard Addressed	Status	Priority	Benefit-Cost Ratio	Responsible Entity	Funding Source
Land Use Planning and Zoning 1. Incorporate hazard information, risk assessment, and hazard mitigation practices into the Comprehensive Land Use Plan to better guide future growth and development *(2016 Measure)* 2. Adopt overlay zones in the Zoning Ordinance to restrict development, especially critical facilities in known hazard areas or require setbacks of noncritical facilities *(2016 Measure)*	☐ Emergency Services ☒ Nat. Res. Protection ☒ Prevention ☒ Property Protection ☒ Public Information ☐ Structural Control	☐ Drought ☐ Earthquake ☐ Extreme Temperature ☐ Fire ☒ Flood ☐ Hail/Thunder/Wind ☒ Landslide/Subsidence ☐ Tornado ☐ Winter Storm/Ice ☒ Dam Failure ☒ HazMat Incident	**Ongoing –** **Proposed Enhancements –** 1. Increase the number of hazards considered, more definitively outline higher risk areas and those that should be avoided for future development 2. Establish overlay zones to restrict development	High	Moderate	EMA Floodplain Administrators *County, Spencer* Planning Departments *County, Gosport, Spencer* Owen County Commissioners	Existing Budget Grant
Community Rating System 1. Investigate potential to reduce flood insurance premiums through additional participation in the NFIP's CRS Program. *(2016 Measure)* *(Will assist with NFIP compliance)*	☒ Emergency Services ☒ Nat. Res. Protection ☒ Prevention ☒ Property Protection ☒ Public Information ☒ Structural Control	☐ Drought ☐ Earthquake ☐ Extreme Temperature ☐ Fire ☒ Flood ☐ Hail/Thunder/Wind ☐ Landslide/Subsidence ☐ Tornado ☐ Winter Storm/Ice ☐ Dam Failure ☐ HazMat Incident	**Ongoing –** **Proposed Enhancement –** 1. Participation from Spencer and Owen County	Moderate	Moderate	Floodplain Administrators *County, Spencer*	Existing Budget
Geographic Information Systems 1. Train GIS staff in HAZUS-MH to quantitatively estimate losses in "what if scenarios" and continue to use the most recent GIS data in land use planning efforts *(2016 Measure)*	☒ Emergency Services ☒ Nat. Res. Protection ☒ Prevention ☒ Property Protection ☐ Public Information ☒ Structural Control	☒ Drought ☒ Earthquake ☒ Extreme Temperature ☒ Fire ☒ Flood ☒ Hail/Thunder/Wind ☒ Landslide/Subsidence ☒ Tornado ☒ Winter Storm/Ice ☒ Dam Failure ☒ HazMat Incident	**Ongoing –** 1. GIS layers have been developed and are utilized by some departments **Proposed Enhancements –** 1. Provide training opportunities for GIS staff related to HAZUS-MH and continue to keep critical facilities information up to date	Moderate	Moderate	GIS Department *County (covers Gosport and Spencer)*	Existing Budget Grant
Management of Dams 1. Participate in the IEAP and annual exercise for existing and new high hazard dams 2. Review regular inspection and maintenance records of high hazard dams 3. Encourage high hazard dam owners to develop an IEAP.	☒ Emergency Services ☐ Nat. Res. Protection ☒ Prevention ☒ Property Protection ☐ Public Information ☒ Structural Control	☐ Drought ☐ Earthquake ☐ Extreme Temperature ☐ Fire ☐ Flood ☐ Hail/Thunder/Wind ☐ Landslide/Subsidence ☐ Tornado ☐ Winter Storm/Ice ☒ Dam Failure ☐ HazMat Incident	**Ongoing –** **Proposed Enhancements –** 1. Contact high hazard dam owners to remain on contact list for IEAP exercise and review 2. Contact high hazard dam owners to review inspection and maintenance records for high hazard dams 3. Contact high hazard dam owners to encourage them to develop an IEAP	Moderate	Low	High Hazard Dam Owners IDNR EMA	Existing Budget Grant

Mitigation Practice	Mitigation Strategy	Hazard Addressed	Status	Priority	Benefit-Cost Ratio	Responsible Entity	Funding Source
Power Backup Generators 1. Inventory generator, wiring, or switch capabilities at critical facilities and prioritize upgrades or installations 2. Secure a fuel reserve, or ensure contractual emergency provisions so critical infrastructure may run on power backup for extended periods of time	☒ Emergency Services ☐ Nat. Res. Protection ☒ Prevention ☒ Property Protection ☐ Public Information ☐ Structural Control	☐ Drought ☒ Earthquake ☒ Extreme Temperature ☒ Fire ☒ Flood ☒ Hail/Thunder/Wind ☒ Landslide/Subsidence ☒ Tornado ☒ Winter Storm/Ice ☒ Dam Failure ☒ HazMat Incident	**Ongoing –** 1. Many critical facilities have generators or have added since the last plan **Proposed Enhancements –** 1. Inventory generator capabilities and needs and prioritize within each community to determine needs for future purchases 2. Secure fuel reserves via contract service agreements	Moderate	Low	EMA County Commissioners Town Council *Gosport, Spencer* Facility Owners Fuel Providers	Existing Budget Grant
Safer Rooms and Community Shelters 1. Investigate critical facilities and public buildings to determine most appropriate location of safer room or area	☒ Emergency Services ☐ Nat. Res. Protection ☐ Prevention ☐ Property Protection ☒ Public Information ☒ Structural Control	☐ Drought ☒ Earthquake ☐ Extreme Temperature ☐ Flood ☒ Hail/Thunder/Wind ☐ Landslide/Subsidence ☒ Tornado ☐ Wildfire ☐ Winter Storm/Ice ☐ Dam Failure ☒ HazMat Incident	**Ongoing –** 1. Many buildings have plans on where to go in the event of a hazard **Proposed Enhancement –** 1. Inventory municipal/public buildings, large employers, and vulnerable areas to determine if safest places are being utilized	Moderate	Low	EMA COAD Red Cross	Existing budget Facility owners Event planners

CHAPTER 5: IMPLEMENTATION PLAN

The following is a proposed plan for implementing all high priority mitigation practices identified in this Plan. It should be noted that implementation of each of these proposed practices may involve several preparatory or intermediary steps. However, to maintain clarity, not all preparatory or intermediary steps are included.

5.1 BUILDING PROTECTION

Encourage Gosport to adopt construction standards and building codes to ensure that hazard protection, especially of critical facilities, are incorporated into local building codes

- Review State and International Building Codes
- Determine if localization needs to occur to protect construction in Gosport and Owen County.
- Propose and adopt localization of codes, or at a minimum, the State standards
- Provide education and outreach to planners, developers, etc. to highlight localizations

Inventory critical facilities to determine what improvements are needed to harden against various hazards

- Train and utilize local liaisons to visit critical facilities in each municipality
- Complete individual facility assessment to understand existing vulnerabilities to various hazards and determine needed improvements
- Develop county-wide prioritization listing of improvements needed
- Secure funding and make improvements as feasible

5.2 EMERGENCY PREPAREDNESS AND WARNING

Investigate options and select a hazard broadcast system to distribute mass notifications to residents and visitors

- Research options for mass notification systems
- Determine which system will work best with existing technology and capabilities
- Complete awareness campaign to encourage sign ups within each municipality
- Develop pre-scripted messages to utilize during hazard situation and provide for quick use and dissemination/posting

Evaluate flood forecasting capabilities including stream gages, flood forecast maps, and flood alerts

- Review existing capabilities and determine areas of need for increased warning time
- Prioritize areas and determine options for increased forecasting abilities such as Bowling Green in Clay County
- Secure funding and implement recommendations
- Provide updated information to appropriate response agencies

5.3 EMERGENCY RESPONSE AND RECOVERY

Inventory and prioritize needs for mobile data terminals, including hardware and software, to be placed in appropriate response vehicles

- Inventory individual response agency's software, hardware, and/or equipment needs, noting maintenance or replacement dates
- Prioritize necessary purchases, including hardware and software upgrades
- Secure funding and purchase needed equipment for additional supplies throughout the year

Investigate most efficient and protected method to digitize and back-up and digitize municipal records

- Review current protocols and procedures for county and municipal backup of records
- Research options for additional securities, redundant systems, or enhanced protections
- Begin enhanced backup and protection of municipal records

5.4 FLOOD STUDIES AND PROTECTION

Conduct detailed flood studies for problem areas (such as stream crossing and culverts) and/or areas with poor drainage or repetitive flooding problems

- Review listing of flood prone or problem areas and prioritize based on previous damages, at-risk populations, or potential for damage to critical infrastructure, especially the area where Owen County/Monroe County Line and Texas Road cross the White River
- Secure grant funding, municipal bond, or funds from existing budgets to complete floodplain studies
- Update the prioritized listing to direct future analyses and projects

Encourage one or more staff for each NFIP community to become a Certified Floodplain Manager (CFM)

- Review CFM certification requirements
- Determine most appropriate staff members for each NFIP community
- Provide staff members time to complete certification requirements and testing
- Encourage staff to maintain certification

5.5 LAND USE PLANNING AND ZONING

Incorporate hazard information, risk assessment, and hazard mitigation practices into the Comprehensive Land Use Plan to better guide future growth and development

- Draft language and prepare exhibits to incorporate into the appropriate sections of the Owen County Comprehensive Land Use Plan, individual municipalities' plans, neighborhood redevelopment plans, etc.
- Adopt amendments as appropriate

Establish overlay zones in the Zoning Ordinance to restrict development, especially critical facilities in known hazard areas or require setbacks of noncritical facilities

- Review existing known hazard areas such as 0.2% AEP, FEH areas, karst geology, downstream of High Hazard dams
- Coordinate between response agencies and planning departments to develop proposed overlay zones
- Propose and adopt an ordinance establishing hazard related overlay zones

CHAPTER 6: PLAN MAINTENANCE PROCESS

6.1 MONITORING, EVALUATING, AND UPDATING THE PLAN

REQUIREMENT §201.6(c)(4)(i):
[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.

To effectively reduce social, physical, and economic losses in Owen County, it is important that implementation of this MHMP be monitored, evaluated, and updated. The EMA Director is ultimately responsible for the MHMP. As illustrated in Section 4.2 Mitigation Practices, this Plan contains mitigation program, projects, and policies from multiple departments within each incorporated community. Depending on grant opportunities and fiscal resources, mitigation practices may be implemented independently, by individual communities, or through local partnerships. Therefore, the successful implementation of this MHMP will require the participation and cooperation of the entire Committee to successfully monitor, evaluate, and update the Owen County MHMP.

The EMA Director will reconvene the MHMP Committee on an annual basis and following a significant hazard incident to determine whether:

- the nature, magnitude, and/or type of risk have changed
- the current resources are appropriate for implementation
- there are implementation problems, such as technical, political, legal, or coordination issues with other agencies
- the outcomes have occurred as expected
- the agencies and other partners participated as originally proposed

During the annual meetings the Implementation Checklist provided in **Appendix 10** will be helpful to track any progress, successes, and problems experienced.

The data used to prepare this MHMP was based on "best available data" or data that was readily available during the development of this Plan. Because of this, there are limitations to the data. As more accurate data becomes available, updates should be made to the list of critical infrastructure, the risk assessment, and vulnerability analysis.

DMA 2000 requires local jurisdictions to update and resubmit their MHMP within five years (from the date of FEMA approval) to continue to be eligible for mitigation project grant funding. In early 2027, the EMA Director will once again reconvene the MHMP Committee for a series of meetings designed to replicate the original planning process. Information gathered following individual hazard incidents and annual meetings will be utilized along with updated vulnerability assessments to assess the risks associated with each hazard common in Owen County. These hazards, and associated mitigation goals and practices will be prioritized and detailed as in Section 3.0 this MHMP. Sections 4.0 and 5.0 will be updated to reflect any practices implemented within the interim as well as any additional practices discussed by the Committee during the update process.

Prior to submission of the updated MHMP, a public meeting will be held to present the information to residents of Owen County and to provide them an opportunity for review and comment of the draft

MHMP. A media release will be issued providing information related to the update, the planning process, and details of the public meeting.

6.2 INCORPORATION INTO EXISTING PLANNING MECHANISMS

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 the comprehensive or capital improvements, when appropriate.

Many of the mitigation practices identified as part of this planning process are ongoing with some enhancement needed. Where needed, modifications will be proposed for each NFIP communities' planning documents and ordinances during the regularly scheduled update including comprehensive plans, floodplain management plans, zoning ordinances, site development regulations, and permits. Modifications include discussions related to hazardous material facility buffers, floodplain areas, and discouraging development of new critical infrastructure in known hazard areas.

6.3 CONTINUED PUBLIC INVOLVEMENT

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.

Continued public involvement is critical to the successful implementation of the Owen County MHMP. Comments gathered from the public on the MHMP will be received by the Planning Department Director and EMA Director and forwarded to the MHMP Committee for discussion. Education efforts for hazard mitigation will be the focus of the annual Severe Weather Awareness Week as well as incorporated into existing stormwater planning, land use planning, and special projects/studies efforts. Once adopted, a copy of this Plan will be available for the public to review in the EMA Office and the Owen County website.

Updates or modifications to the Owen County MHMP will require a public notice and/or meeting prior to submitting revisions to the individual jurisdictions for approval.

The CRS program credits NFIP communities a maximum of 37 points for adopting the Plan; establishing a procedure for implementation, review, and updating the Plan; and submitting an annual evaluation report.

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