



# **Marshall County, Indiana Multi-Jurisdictional Natural Hazard Mitigation Plan Update**

**April 2023**

**Encompassing the Jurisdictions of:**

Marshall County, the Town of Bourbon, and Marian University – Ancilla College, Indiana



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- A Meeting Information and Survey Data
- B FEMA Approval Documentation
- C Adoption Resolutions
- D Critical Facilities



## List of Commonly Used Acronyms

| <b>Acronym</b> | <b>Meaning</b>   |
|----------------|--|
| BRIC           | Building Resilient Infrastructure and Communities                |
| CFR            | Code of Federal Regulations                                      |
| CRS            | Community Rating System  |
| DFRIM          | Digital Flood Insurance Rate Map                                 |
| DMA            | Disaster Mitigation Act  |
| EMAC           | Emergency Management Advisory Council                            |
| FEMA           | Federal Emergency Management Agency                              |
| FMA            | Flood Mitigation Assistance                                      |
| HAZUS          | FEMA Loss Estimation Software                                    |
| HMGP           | Hazard Mitigation Grant Program                                  |
| HMP            | Hazard Mitigation Planning                                       |
| MCEM           | Marshall County (Indiana) Office of Emergency Management         |
| MPC            | Mitigation Planning Committee                                    |
| NID            | National Inventory of Dams                                       |
| NCEI           | National Centers for Environmental Information                   |
| IDHS           | Indiana Department of Homeland Security and Emergency Management |
| NFIP           | National Flood Insurance Program                                 |
| NOAA           | National Oceanic and Atmospheric Administration                  |
| NRI            | National Risk Index  |
| NWS            | National Weather Service   |
| PDI            | Palmer Drought Index   |
| RL             | Repetitive Loss  |
| SRL            | Severe Repetitive Loss   |
| SFHA           | Special Flood Hazard Area  |
| SPI            | Standardized Precipitation Index                                 |





## Section 1 – Planning Process

### 1.1 Introduction

Mitigation is commonly defined as sustained action taken to reduce or eliminate long-term risk to people and their property from hazards and their effects. Hazard mitigation planning provides communities with a roadmap to aid in the creation and revision of policies and procedures, and the use of available resources, to provide long-term, tangible benefits to the community. A well-designed hazard mitigation plan provides communities with realistic actions that can be taken to reduce potential vulnerability and exposure to identified hazards.

This Multi-Jurisdictional Natural Hazard Mitigation Plan (HMP) was prepared to provide sustained actions to eliminate or reduce risk to people and property from the effects of natural and man-made hazards. This plan documents Marshall County and its participating jurisdictions planning process and identifies applicable hazards, vulnerabilities, and hazard mitigation strategies. This plan will serve to direct available community and regional resources towards creating policies and actions that provide long-term benefits to the community. Local and regional officials can refer to the plan when making decisions regarding regulations and ordinances, granting permits, and in funding capital improvements and other community initiatives.

Specifically, this hazard mitigation plan was developed to:

- Update the December 2017 Marshall County, Indiana Hazard Mitigation Plan
- Build for a safer future for all citizens
- Foster cooperation for planning and resiliency
- Identify, prioritize and mitigate against hazards
- Assist with sensible and effective planning and budgeting
- Educate citizens about hazards, mitigation and preparedness
- Comply with federal requirements

Federally approved mitigation plans are a prerequisite for mitigation project grants. Development and Federal Emergency Management Agency (FEMA) approval this plan will ensure future eligibility for federal disaster mitigation funds through the Hazard Mitigation Grant Program, Building Resilient Infrastructure and Communities, Repetitive Flood Claims, and a variety of other state and federal program.

In an effort to reduce natural disaster losses, the United States Congress passed the Disaster Mitigation Act of 2000 (DMA 2000) in order to amend the Robert T. Stafford Disaster Relief and Emergency Assistance Act (Stafford Act). DMA 2000 amended the Stafford Act by repealing the previous Mitigation Planning section (409) and replacing it with a new Mitigation Planning section (322). Section 322 of the DMA makes the development of a hazard mitigation plan a specific eligibility requirement for any local government applying for Federal mitigation grant funds. This HMP was prepared to meet the requirements of the DMA 2000, as defined in regulations set forth by the Interim Final Rule (44 Code of Federal Regulations (CFR) Part 201.6).

This plan has been designed to be a living document, a document that will evolve to reflect changes, correct any omissions, and constantly strive to ensure the safety of Marshall County's citizens.

### 1.2 Participating Jurisdictions

All eligible jurisdictions were invited to participate in the organization, drafting, completion, and adoption of this plan. The following Marshall County jurisdictions elected to participate in this plan.

- Marshall County
- Town of Bourbon
- Marian University - Ancilla College



The following jurisdictions elected not to participate in this planning effort despite repeated outreach efforts.

- City of Plymouth
- Town of Argos
- Town of Bremen
- Town of Culver
- Town of La Paz

Engagement attempts with these jurisdictions will continue over the life of this plan in order to encourage future participation.

### **1.3 Assurances**

Marshall County and all participating jurisdictions certify that they will comply with all applicable Federal statutes and regulations during the periods for which it receives grant funding, in compliance with 44 CFR 13.11(c), and will amend its plan whenever necessary to reflect changes in State or Federal laws and statutes as required in 44 CFR 13.11(d).

This hazard mitigation plan was prepared to comply with all relevant requirements of the Robert T. Stafford Disaster Relief and Emergency Assistance Act of 1988, as amended by the DMA 2000. This plan complies with all the relevant requirements of:

- Code of Federal Regulation (44 CFR) pertaining to hazard mitigation planning
- FEMA planning directives and guidelines
- Interim final, and final rules pertaining to hazard mitigation planning and grant funding
- Relevant presidential directives
- Office of Management and Budget circulars
- Any additional and relevant federal government documents, guidelines, and rules.

### **1.4 2023 Plan Update**

In 2022 Marshall County and its participating jurisdictions began the process to update the Marshall County HMP. It was determined that Marshall County Emergency Management's (MCEM) Director would serve as the project manager, directing this plan update and acting as the primary point-of-contact throughout the project. The Director's primary roles included:

- Coordinating meetings and interviews
- Collecting data for the consultants to utilize
- Reviewing deliverables
- Monitoring the overall development of the plan

Marshall County contracted with BOLDplanning to assist in updating their 2017 HMP. BOLDplanning's roles included:

- Ensure that the hazard mitigation plan meets all regulatory requirements
- Assist with the determination and ranking of hazards
- Assist with the assessment of vulnerabilities to identified hazards
- Assist with capability assessments
- Identify and determine all data needs and solicit the information from relevant sources
- Assist with the revision and development of the mitigation actions
- Development of draft and final planning documents

The Marshall County HMP has undergone significant revision and upgrading since its last edition. Not only has the county made significant efforts to improve the functionality and effectiveness of the plan itself, but it has significantly improved its hazard mitigation program. Additionally, the level of analysis and detail included in this risk assessment



is greater than the previous edition of the plan. This grants the county's improved and robust hazard mitigation program a better base to further mold and improve its mitigation strategy over the next five years.

As part of this planning effort, each section of the previous mitigation plan was reviewed and completely revised. The sections were reviewed and revised against the following elements:

- Compliance with the current regulatory environment
- Completeness of data
- Correctness of data
- Capability differentials
- Current state environment

During this process, and after a thorough review and discussion with all participating jurisdictions and stakeholders, it was determined that the priorities of the overall community in relation to hazard mitigation planning have not changed during the five years of the previous planning cycle.

While the Marshall County hazard mitigation program has matured over the years, an unfortunate lack of funding and grant opportunities has prevented the completion of any major hazard mitigation projects. As such, this revised plan reflects the static state of proposed mitigation actions.

### **1.5 Planning Process**

Marshall County and its participating jurisdictions undertook the following steps to update and create a robust HMP:

- Review of the 2017 HMP
- Review of current related planning documents
- Delivery of organizational and planning meetings
- Solicitation of public input as to plan development
- Assessment of potential risks
- Assessment of vulnerabilities and assets
- Development of the mitigation actions
- Development of a draft multi-hazard mitigation plan
- Implementation, adoption, and maintenance of the plan

The process established for this planning effort is based on DMA 2000 planning and update requirements and the FEMA associated guidance for hazard mitigation plans. The FEMA four step recommended mitigation planning process, as detailed below, was followed:

1. Organize resources
2. Assess risks
3. Develop a mitigation plan
4. Implement plan and monitor progress

To accomplish this, the following planning process methodology was followed:

- Inform, invite, and involve other mitigation plan stakeholders throughout the state, including federal agencies, state agencies, regional groups, businesses, non-profits, and local emergency management organizations.
- Conduct a thorough review of all relevant current and historic planning efforts
- Collect data on all related state and local plans and initiatives. Additionally, all related and relevant local plans were reviewed for integration and incorporation.

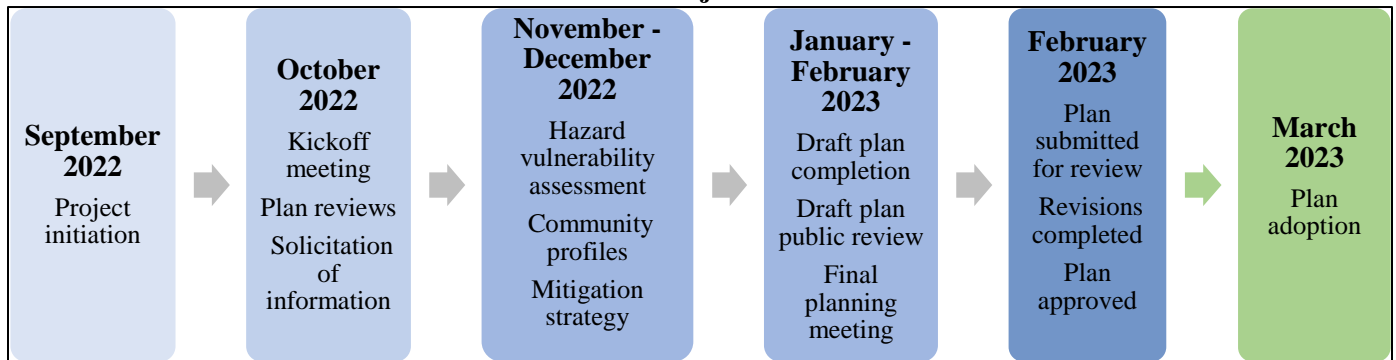


- Develop the planning and project management process, including methodology, review procedures, details about plan development changes, interagency coordination, planning integration, and the organization and contribution of stakeholders.
- Develop the profile of the county and participating jurisdictions.
- Complete a risk and vulnerability assessment using a Geographic Information System (GIS) driven approach using data from the Marshall County, the State of Indiana, FEMA, and other federal and state agency resources. Analyses were conducted at the county and jurisdictional level.
- Develop a comprehensive mitigation strategy effectively addressing their hazards and mitigation program objectives. This included identifying capabilities, reviewing pre and post disaster policies and programs, identifying objectives and goals, identifying mitigation actions and projects, and assessing mitigation actions and projects.
- Determination and implementation of a plan maintenance cycle, including a timeline for plan upgrades and improvements.
- Submission of the plan to FEMA for review and approval and the petition all participating jurisdictional governments for a letter of formal plan adoption.

**1.6 Project Timeline**

The following represents the HMP project timeline.

**Chart 1: Project Timeline**



**1.7 Mitigation Planning Committee**

Project initiation began with a selection and meeting of the primary stakeholders to establish the Mitigation Planning Committee (MPC). The core members of the MPC then established and wrote the projects operating procedures, established expectations, solidified the plan development timeline, and created project milestones. Additionally, the team reviewed and discussed how the plan would incorporate FEMA requirement and other emergency management planning efforts. The following participants were selected for the MPC.

**Table 1: Mitigation Planning Committee**

| MPC Member  | Title                      | Jurisdiction                        |
|-------------|----------------------------|-------------------------------------|
| Clyde Avery | Director, MCEM             | Marshall County                     |
| Ward Byers  | Town Board President       | Town of Bourbon                     |
| Tom Nowak   | Campus Operations Director | Marian University - Ancilla College |

Each MPC member was thoroughly interviewed regarding their jurisdiction’s mitigation related activities. These interviews were invaluable in fully integrating the resources necessary to produce this plan, document mitigation activities, and document the mitigation resources available to better increase resiliency.

In general, all MPC members were asked to participate in the following ways:

- Attend and participate in meetings



- Assist with the collection of data and information
- Review planning elements and drafts
- Integrate hazard mitigation planning elements with other planning mechanisms
- Facilitate agency coordination and cooperation
- Assist with the revision and development of mitigation actions

MPC members who were unable to attend meetings due to budgetary or personnel constraints were contacted via email or phone to discuss hazard mitigation planning, including the process, goals, mitigation actions, local planning concerns and plan review.

### 1.8 Hazard Mitigation Planning Equity

As part of this planning process, the MPC considered potential inequities within the county and encouraged the participation of potentially vulnerable citizens and communities. This process began with recognizing that disparities exist within the county, including health outcomes and living conditions for people of color, people with disabilities, and historically disadvantaged communities. It was recognized that these populations may be at greater risk to the hazards identified in this plan and may be limited in their ability to adapt, respond, and recover if an event were to occur.

As recommended in FEMA’s “Guide to Expanding Mitigation,” Marshall County took a whole community approach to this planning effort, including:

- Inviting historically underserved populations to participate in the planning and decision-making processes
- Inviting faith based and community organizations, nonprofit groups, schools, and academia to be plan stakeholders

### 1.9 Plan Stakeholders

All eligible jurisdictions were invited to participate in the organization, drafting, completion and adoption of this plan. Invited jurisdictions included, but were not limited to, elected officials, relevant State of Indiana agencies, counties, cities, school districts, non-profit agencies, and businesses.

In order to have an approved hazard mitigation plan, DMA 2000 requires that each jurisdiction participate in the planning process. Each jurisdiction choosing to participate in the development of the plan were required to meet detailed participation requirements, which included the following:

- When practical and affordable, participation in planning meetings
- Provision of information to support the plan development
- Identification of relevant mitigation actions
- Review and comment on plan drafts
- Formal adoption of the plan

Based on the above criteria, the following jurisdictions participated in the planning process, and will individually as a jurisdiction adopt the approved hazard mitigation plan:

**Table 2: Participating Jurisdictions**

| Jurisdiction                        | MPC Representative Meeting Attendance and Communication | Data Submission | Mitigation Actions |
|-------------------------------------|---|-----------------|--------------------|
| Marshall County                     | Yes   | Yes             | Yes                |
| Town of Bourbon                     | Yes   | Yes             | Yes                |
| Marian University – Ancilla College | Yes   | Yes             | Yes                |



The Marshall County MPC provided the opportunity for additional HMP stakeholders, including agencies involved in regulating and overseeing development, neighboring communities, agencies, businesses, academia, non-profits, underserved or marginalized communities, and other interested parties to be involved in the mitigation planning process. Stakeholders were notified of the process through direct communication with the Marshall County HMP project manager.

In addition, jurisdictional departments overseeing planning and development were invited to participate. The Marshall County Building Commission, which administers and enforces building codes for both Marshall County and Bourbon, and both the Marshall County Planning Department and the Bourbon Zoning/Building Department, which oversees all planning and zoning issues, were included in the planning process.

Emergency managers from neighboring Indiana counties were personally invited to attend public meetings. Invited emergency managers include Al Kirsits and Jim Lopez, Saint Joseph County, Tori Chessor, Starke County, Larry Hoover, Fulton County, Edward Rock, Kosciusko County, and Jennifer Tobey, Elkhart County. Of those invited, only St. Joseph County representatives elected to attend.

The following table represents plan stakeholders:

**Table 3: HMP Stakeholders**

| Name            | Representing      | Title   |
|-----------------|-------------------|---|
| Jon Van Vactor  | Marshall County   | County Council Member                         |
| Faith Freed     | Marshall County   | Health Department Director                    |
| Ty Adley        | Marshall County   | Plan Commission Director (Floodplain Manager) |
| Steve Howard    | Marshall County   | Building Commissioner                         |
| Kimberly Berger | Bourbon           | Clerk-Treasurer                               |
| Al Kirsits      | St. Joseph County | Emergency Management Director                 |
| Jim Lopez       | St. Joseph County | Emergency Management Director                 |

Any jurisdiction not covered in this HMP is either covered under another plan or declined to participate.

**1.10 Planning Meetings**

The Marshall County MPC held various public meetings to discuss the mitigation planning process as well as gain public support and input for the plan update. The following is a brief synopsis of those meetings.

- **HMP Update Kick-Off and Public Information Meeting – October 25, 2022:** BOLDplanning hosted a kick-off meeting for the Marshall County HMP, stakeholders, and the public. Prior to the meeting, a public announcement was published in the local newspaper and on participating jurisdiction websites. At the meeting, MPC members, plan stakeholders, and the public were invited to voice any concerns, ask questions, and provide input on the mitigation plan update. Additionally, BOLDplanning worked with MPC members and plan stakeholders to collect contact information, hazard history, facility information, and other pertinent jurisdictional information.
- **Mitigation Action Review and Revision Meeting – February 2, 2023**  
Members of the MPC convened via phone to discuss and revise hazard mitigation action items for their jurisdiction. A self-analysis method was used for determining and prioritizing mitigation actions. This methodology took all considerations into account to ensure that, based on capabilities, funding, public wishes, political climate, and legal framework and context, reasonable actions were either retained or determined.
- **HMP Update Final Review Meeting – February 28, 2023:** BOLDplanning hosted a public final plan review meeting for the Marshall County HMP. Prior to the meeting, a public announcement was published in the local paper and on the participating jurisdiction websites. At the meeting, MPC members, plan stakeholders, and the





public were invited to voice any concerns, ask questions, and provide input on the mitigation plan update. Additionally, members of the public were invited to review a draft copy of the Marshall County HMP update posted to County's website for two weeks prior to the final meeting (February 13 -28, 2023), and prior to its submission to State of Indiana Department of Homeland Security (IDHS).

Other planning events included conference phone calls with participating jurisdiction officials who could not attend scheduled meetings. Additionally, there were monthly situation reports and calls provided to Marshall County and its participating jurisdictions to provide updates concerning the phases of plan development. These situation report calls were issued and held at the beginning of each month and were facilitated by BOLDplanning.

### **1.11 Community Involvement**

As part of the overall planning process, the community was provided with numerous opportunities to contribute and comment on the creation and adoption of the plan. These opportunities included:

- Advertised meeting invitations
- Comment period upon completion of draft plan
- Online surveys

The public was notified of open meetings via participating jurisdiction websites and print media. Further, an online HMP survey was created for Marshall County. The Marshall County, IN Hazard Mitigation Plan Update Survey (<https://publicinput.com/x4344>) allowed all plan stakeholders and the public to provide feedback and input on the HMP update prior to its submission to IDHS and FEMA. Comments from this survey, from 58 community members, are included in Appendix A.

Input from the general public provided the MPC with a clearer understanding of local concerns, increased the likelihood of citizen buy-in concerning proposed mitigation actions, and provided elected officials with a guide and tool to set regional ordinances and regulations. This public outreach effort was also an opportunity for adjacent jurisdictions and entities to be involved in the planning process.

Additionally, as citizens were made more aware of potential hazards and the local process to mitigation against their impacts, it was believed that they would take a stronger role in making their homes, neighborhoods, schools, and businesses safer from the potential effects of natural hazards.

Meeting information, including sign-in sheets and public notification documentation can be found in Appendix A.

### **1.12 Adoption Resolutions**

Upon review and approved pending adoption status by FEMA Region V adoption resolutions will be signed by the participating jurisdictions. FEMA approval documentation may be found in Appendix B. Jurisdictional adoption resolutions may be found in Appendix C.



## Section 2 – Plan Documentation, Development, and Maintenance

### 2.1 Planning Document Resources

The hazard mitigation plan is an overarching document that is both comprised of, and contributes to, various other jurisdictional plans. In creating this plan, all the planning documents identified below were consulted and reviewed, often extensively. In turn, when each of these other plans is updated, they will be measured against the contents of the hazard mitigation plan.

Below is a list of the various planning efforts, sole or jointly administered programs, and documents reviewed and included in this hazard mitigation plan. While each plan can stand alone, their review and functional understanding was pivotal in the development of this plan and further strengthens and improves Marshall County’s resilience to disasters.

- **Marshall County 2017 Multi-Jurisdictional Natural Hazard Mitigation Plan**  
The previous HMP has been reviewed and is incorporated throughout this plan per FEMA requirements.
- **Marshall County Comprehensive Plan, 2013**  
The plan sets policies that help the county address critical issues facing the community, achieve goals based on priority, and coordinate public and private efforts for mutual success. It also provides the historical context, background, and current data necessary to understand issues and choose solutions as well as seek various forms of funding.
- **Marshall County Critical Facilities List, 2022**  
The MPC compiled a list of critical facilities and pertinent information on those facilities. This list is used throughout the plan and is the basis for the vulnerability assessments and loss estimates. The complete list is posted in Appendix D.
- **Marshall County Comprehensive Emergency Management Plan**  
MCEM developed this plan to develop procedures for the protection of personnel, equipment, and critical records to help determine existing established policies that ensure the continuity of government and essential services during and after disasters.
- **State of Indiana Hazard Mitigation Plan, 2019**  
The State of Indiana Hazard Mitigation Plan is intended to provide the framework for hazard mitigation. This plan set a baseline for standards and practices for hazard mitigation planning and was used as a resource for information and data.
- **Envision Bourbon 2030 Comprehensive Plan**  
This plan establishes a long-term vision on what the community aspires to be for the next 10 to 15 years. It serves as the Town’s official policy guide in making land use and development decisions and provides a road map detailing how Bourbon will achieve its vision.
- **Marshall County and Participating Jurisdiction Planning and Zoning Documents and Ordinances**  
Marshall County and the Town of Bourbon provided a host of planning, zoning, and development related documents, including the 2020 Marshall County Zoning Ordinance and the 2015 Bourbon Zoning Ordinance. These documents were reviewed, assessed, and cataloged to compile each participating jurisdiction’s capabilities.

Information from each of these plans and programs is utilized within the applicable hazard sections to provide data and fully inform decision making and prioritization.

### 2.2 Technical Resources

The Marshall County MPC employed a variety of technical resources in its plan development. These technical resources were instrumental in completing an accurate vulnerability and risk assessment.





- **BOLDplanning Inc.:** With over 18 years of experience in hazard mitigation planning, BOLDplanning was the principal plan writer.
- **ESRI ArcGIS v10:** Assisted with the development of maps for this plan, along with the HAZUS® models.
- **FEMA Digital Flood Insurance Rate Maps (DFIRMs):** FEMA’s National Flood Hazard Layer data was instrumental in mapping floodplain locations and estimating potential flood impacts and loss estimates.
- **FEMA National Risk Index (NRI):** An online mapping application that identifies communities most at risk to natural hazards. The mapping service visualizes natural hazard risk metrics and includes data about expected annual losses from natural hazards, social vulnerability, and community resilience. The NRI's interactive web maps are at the county and Census tract level and made available via geographic information system services for custom analyses.
- **National Oceanic and Atmospheric Administration (NOAA)/National Centers for Environmental Information (NCEI):** Weather data and historical events were primarily provided by NCEI.

In addition, relevant federal, regional, state, local, and any private and non-profit entities were also invited to provide input and utilized for information and technical expertise. The following table indicates these entities.

**Table 4: Technical Input Agencies**

| Agency                | Entities   | Data Input   |
|-----------------------|--|--|
| Federal Agencies      | NOAA, U.S. Army Corps of Engineers (USACE), U.S. Department of Agriculture National Resources Conservation Service, U.S. Geological Survey, National Weather Service | Provided weather data, dam data, land use data, and geological data  |
| State Agencies        | IDHS, Indiana Department of Natural Resources  | Provided oversight and technical assistance; provided hazard records |
| Local Governments     | Marshall County Emergency Management, Participating Municipalities   | Provided input as MPC members / principal subjects                   |
| Private Organizations | BOLDplanning   | Directed planning effort as principal planners                       |

**2.3 Continued Public Involvement**

Marshall County is dedicated to involving the public in the continual shaping of its mitigation plan and the development of its mitigation projects and activities.

The Marshall County MPC will continue to keep the public informed about its hazard mitigation projects and activities through County’s website. The public will also be invited to participate in regular MPC meetings to review and discuss the mitigation-related events of the past year.

Copies of the Marshall County HMP will be available online at County’s website and distributed to all the participating jurisdictions.



**2.4 Plan Maintenance Process**

The Marshall County MPC has developed a method to ensure monitoring, evaluation, and updating of its mitigation plan. Upon adoption of the Marshall County HMP update, MCEM will utilize its Emergency Management Advisory Council (EMAC) to provide plan updates, revisions, and data collection for future HMP planning purposes. The EMAC chair will form a subcommittee for proposed mitigation projects comprised of MCEM’s director and jurisdictional representatives from the MPC. The chair of the subcommittee will be determined by a vote in the subcommittee. Additional members may be added based on necessity. The sub-committee will submit a quarterly report to the EMAC, which in turn, will submit an annual report to MCEM. The Marshall County HMP Update Quarterly Report is as follows:



**Local Emergency Planning Committee  
Multi-Jurisdictional Natural Hazard Mitigation Plan  
Evaluation Report**

Pre-Disaster Mitigation Plan Sub-Committee Chair: \_\_\_\_\_  
 Meeting Date: \_\_\_\_\_  
 Plan Approval Date: \_\_\_\_\_  
 Plan Expiration Date: \_\_\_\_\_  
 Have there been any disasters or training event since the last report? If so, list them below:

| Disaster Number/<br>Training Event  | Hazard<br>Type(s)        | Was the hazard expected<br>or unforeseen? | Is a plan update<br>required? |
|-------------------------------------|--------------------------|---|-------------------------------|
|                                     |                          |   |                               |
|                                     |                          |   |                               |
|                                     |                          |   |                               |
|                                     |                          |   |                               |
| <i>Example: DR-1000</i>             | <i>Volcanic Eruption</i> | <i>Unforeseen</i>                         | <i>Yes</i>                    |
| <i>Example: Annual<br/>Training</i> | <i>Flash Flooding</i>    | <i>Expected</i>                           | <i>No</i>                     |

**Mitigation Projects:**

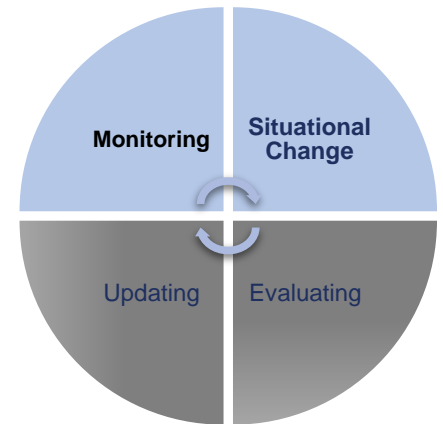
| Mitigation<br>Project                     | Participating<br>Jurisdictions | Proposed/Scheduled<br>/In Progress/<br>Completed | Behind/Ahead/<br>On-Schedule | Estimated<br>Completion<br>Date |
|---|--------------------------------|--|------------------------------|---------------------------------|
|   |                                |  |                              |                                 |
|   |                                |  |                              |                                 |
|   |                                |  |                              |                                 |
|   |                                |  |                              |                                 |
|   |                                |  |                              |                                 |
|   |                                |  |                              |                                 |
|   |                                |  |                              |                                 |
|   |                                |  |                              |                                 |
|   |                                |  |                              |                                 |
| <i>Example:<br/>Tornado Safe<br/>Room</i> | <i>Cash</i>                    | <i>In Progress</i>                               | <i>On-Schedule</i>           | <i>1/1/2021</i>                 |

**Miscellaneous Notes:**

MCEM may request a non-scheduled report on the monitoring, evaluation, or updating of any portion of the MHMP plan due to irregular progress on mitigation actions and or projects, in the aftermath of a hazard event, or for any reason deemed appropriate.

**Plan Monitoring and Situational Change**

Plan monitoring can be defined as the ongoing process by which stakeholders obtain regular feedback on the progress being made towards achieving their goals and objectives. In the more limited approach, monitoring may focus on tracking projects and the use of the agency’s resources. In the broader approach, monitoring also involves tracking strategies and actions being taken by partners and non-partners, and figuring out what new strategies and actions need to be taken to ensure progress towards the most important results.



A monitoring report will be written and submitted for review to the EMAC and after the annual MPC meeting or when triggered by situational change. The monitoring report answers the following questions:

- Is the mitigation project under, over, or on budget?
- Is the mitigation project behind, ahead of, or on schedule?
- Are there any changes in Marshall County’s capabilities which impact the PDM plan?
- Are there any changes in Marshall County’s hazard risk?
- Has the mitigation action been initiated, or its initiation planned?
- Is the current process of prioritizing mitigation actions and projects appropriate and accurate?
- Has the current method of incorporating mitigation actions and projects yielded a comprehensive action and project strategy to address seen and unforeseen hazards?
- If applicable, has participation in a mitigation action’s collaboration been regular?
- Was a negative result caused directly or indirectly by insufficient levels of public outreach?
- If any, what plan updates occurred, why they occurred, and what is their impact?

The plan maintenance process is cyclical and maintenance items can operate simultaneously within the process.

**Plan Evaluating**

A plan evaluation is a rigorous and independent assessment of either completed or ongoing activities to determine the extent to which they are achieving stated objectives and contributing to decision making.

An evaluation report will be written and submitted to Marshall County’s EMAC when the situation dictates.

The following situations are typical examples of when an evaluation will be necessary.



- Post hazard event
- Post training exercise
- Post tabletop or drill exercise
- Significant change or completion of a mitigation project
- Significant change or completion of a mitigation action

An evaluation report will ask the following questions in response to the previously listed events.

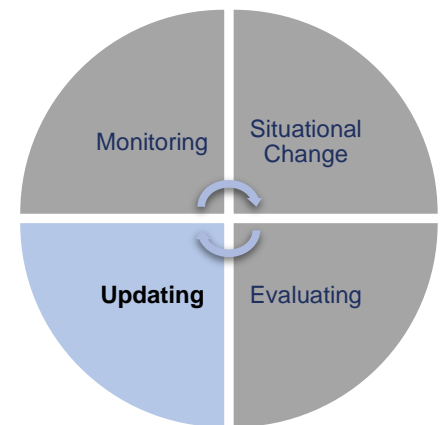
- Do the mitigation objectives and goals continue to address the current hazards?
- Are there new or previously unforeseen hazards?
- Does a change in hazard vulnerability demand a change of or addition of mitigation actions or projects?
- Does a change in the mitigation strategy demand a change of or addition of mitigation actions or projects?
- Are current resources appropriate for implementing a mitigation project?
- Was the outcome of a mitigation action/project expected?
- Are there implementation problems?
- Was the public engaged to the point where they were satisfied with current engagement strategies?
- Did the public participate in a number that produced a positive yield on the plan, action, or project?
- Are there coordination problems?

### Plan Updating

Typically, the updating of a HMP is initiated upon the completion of a plan evaluation and even then, only when the evaluation determines an update is appropriate. A plan update also occurs every five years per FEMA guidelines. Additionally, when new hazard data becomes available it will be added to the HMP. New data will be confirmed or denied at annual MPC meetings. Additionally, a plan update can be written any time it is deemed necessary by MCEM.

According to FEMA DMA 2000 guidelines for mitigation planning, Marshall County will begin the update process three years from this plan's adoption. It will do so under the direction of the County's Emergency Management Director. MCEM will coordinate and facilitate a bi-annual meeting within the five-year cycle with stakeholders from participating jurisdictions and stakeholders from neighboring counties.

These meetings will allow MCEM, the MPC Chair, MPC members, and stakeholders to gather relevant information needed for the next plan update. These meetings will ensure the appropriate status of certain goals (mitigation activities and projects) identified in mitigation strategy are up to date to be included in the next FEMA-required, five-year plan update.



### 2.5 HMP Incorporation

The hazard mitigation plan is an overarching document that is both comprised of, and contributes to, various county and local plans. Unfortunately, previous versions of the Marshall County HMP have not been incorporated into jurisdictional planning efforts. Under the leadership of the MPC, it is hoped that when future revisions occur to these other plans, they will be measured against the contents of this HMP.

Below is a list of the various jurisdictional planning efforts, either solely or jointly administered, and relevant planning documents. While each plan can stand alone, each participating jurisdiction, under the leadership of their MPC member, will actively work to incorporate relevant parts of this hazard mitigation plan into the following:

- Operation Plans
- Codes and Ordinances
- Emergency Operations Plans
- Comprehensive Plans
- Land and Resource Management Plans and Policies
- Critical Facility Plans



Additionally, in cooperation with the MPC, each participating jurisdiction will be actively courted on incorporating elements of this hazard mitigation plan for any relevant plan, code or ordinance revision or creation.

Finally, each participating jurisdiction has committed to actively encourage all departments to implement actions that minimize loss of life and property damage from hazards. Whenever possible, each participating jurisdiction will use existing plans, policies, procedures, and programs to aid in the implementation of identified hazard mitigation actions. Potential avenues for implementation may include:

- Operation plans
- General or master plans
- Ordinances
- Capital improvement plans
- Budget revisions or adoptions
- Hiring of staff
- Stormwater planning
- Land use planning

Where appropriate, Marshall County will take the lead in integrating this HMP into overarching, countywide plans, codes, ordinances and any other relevant documents, policies, or procedures.

## **2.6 Hazard Mitigation Challenges**

As always, challenges exist due to the day-to-day demands of the working environment including staffing issues, budget restrictions, and staffing turnover. These issues can, and do, impact the utilization and incorporation of the HMP and the completion of identified hazard mitigation projects. Additionally, a severe lack of funding remains a challenge as local tax revenues have been impacted by smaller populations and, recently, the Covid-19 pandemic. Identifying public-private partnerships and investigation and obtaining non-standard funding mechanisms would help alleviate these challenges. Finally, despite repeated attempts to engage all jurisdictions within Marshall County, many eligible jurisdictions elected not to participate. It is noted that despite past participation none of the jurisdictions has seen any benefit from participation. Additionally, conversations indicate that both the requirements to obtain grant funding through available programs and the required matching funds are large barriers to small communities who do not have the necessary resources to compete with larger, better funded, and better staffed jurisdictions.



## Section 3 – Planning Area

### 3.1 Introduction to the Planning Area



Marshall County, organized in 1836, is situated in the north-central portion of Indiana. According to the U.S. Census (2020), the county encompasses approximately 444 square miles of land area. It adjoins the Indiana counties of St. Joseph (north), Starke (west), Fulton (south) and Elkhart and Kosciusko (west).

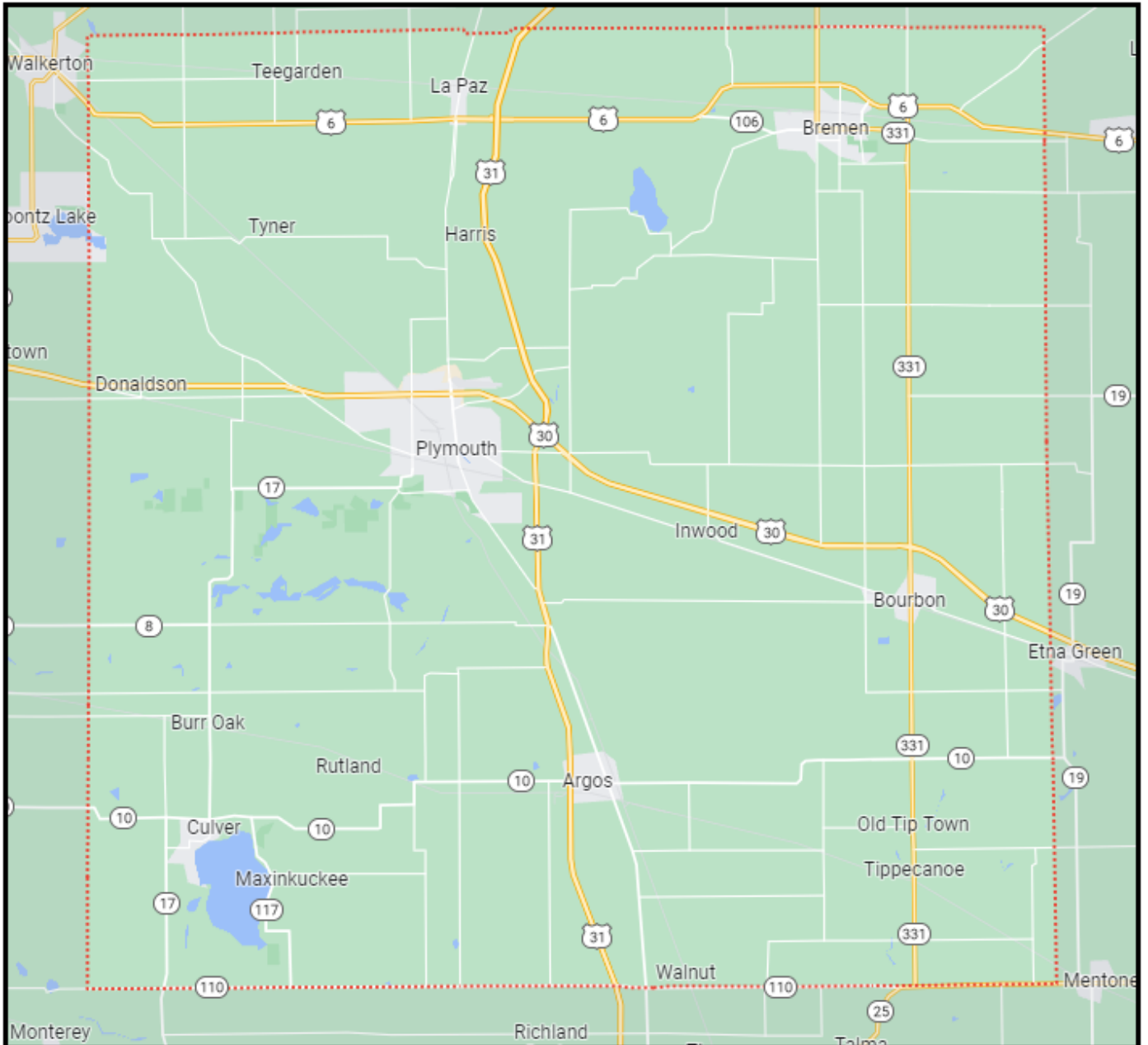
Marshall County has six incorporated cities and towns, the City of Plymouth, the Town Argos, the Town of Bourbon, the Town of Bremen, the Town of Culver, and the Town of La Paz. In addition to these municipalities, the county contains ten townships. Marshall County remains largely an agricultural county with large, unincorporated portions which are sparsely populated. The majority of the county is broad flatlands and rolling plains, with the highest point approximately 895 above sea level and the lowest point is approximately 705 above sea level.

The climate in Marshall County reflects the characteristics of northern Indiana, with winter temperatures regularly falling below freezing between October and April, and summer temperatures rising to 80 to 90 degrees Fahrenheit. The average summer high (July) is around 83 degrees Fahrenheit, and the winter low (January) is 31 degrees Fahrenheit. The county, on average, receives 40 inches of rain and 70 inches of snow per year.

The following map details the Marshall County planning area and participating jurisdictions.



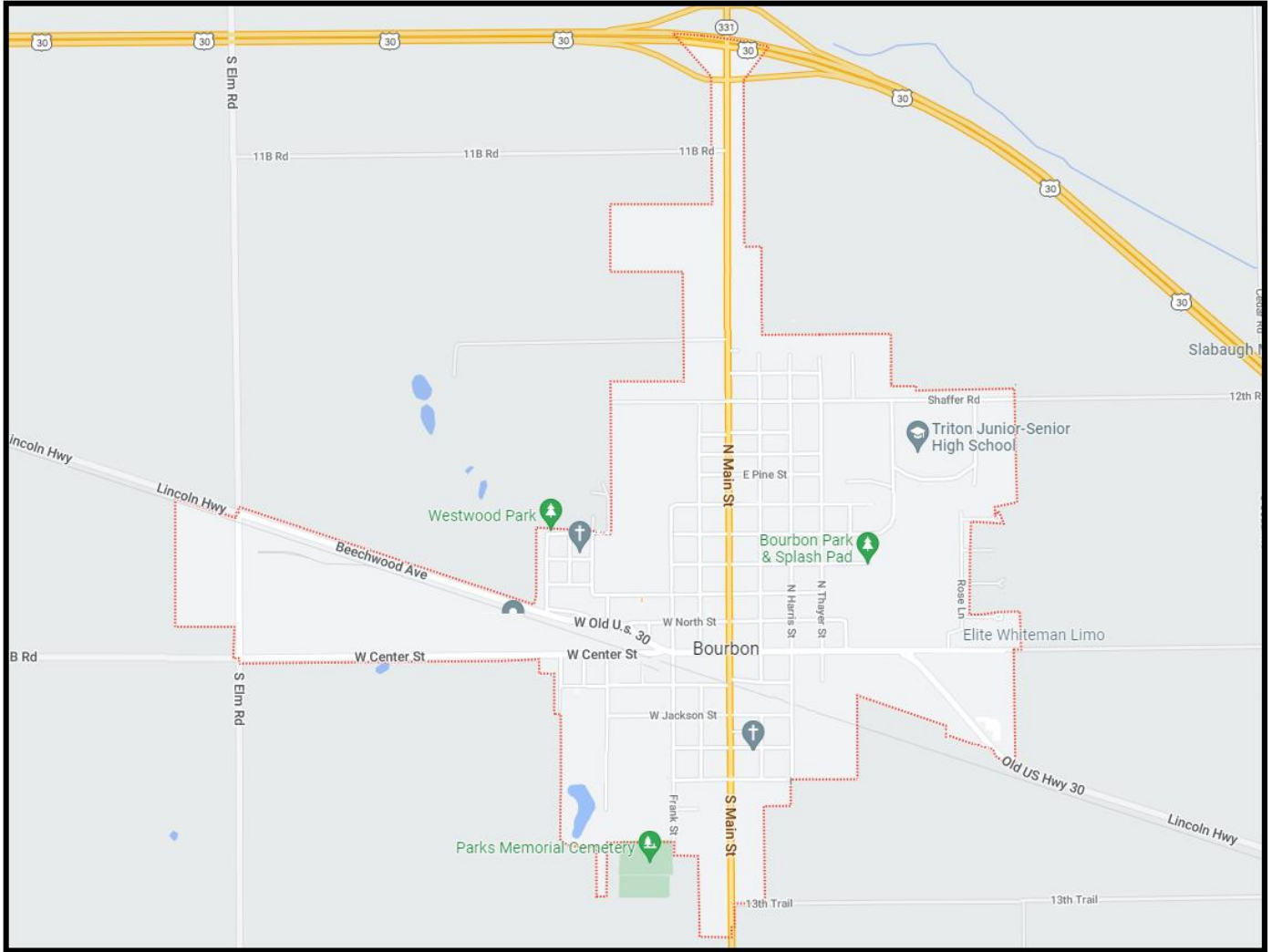
**Map 1: Marshall County, Indiana**







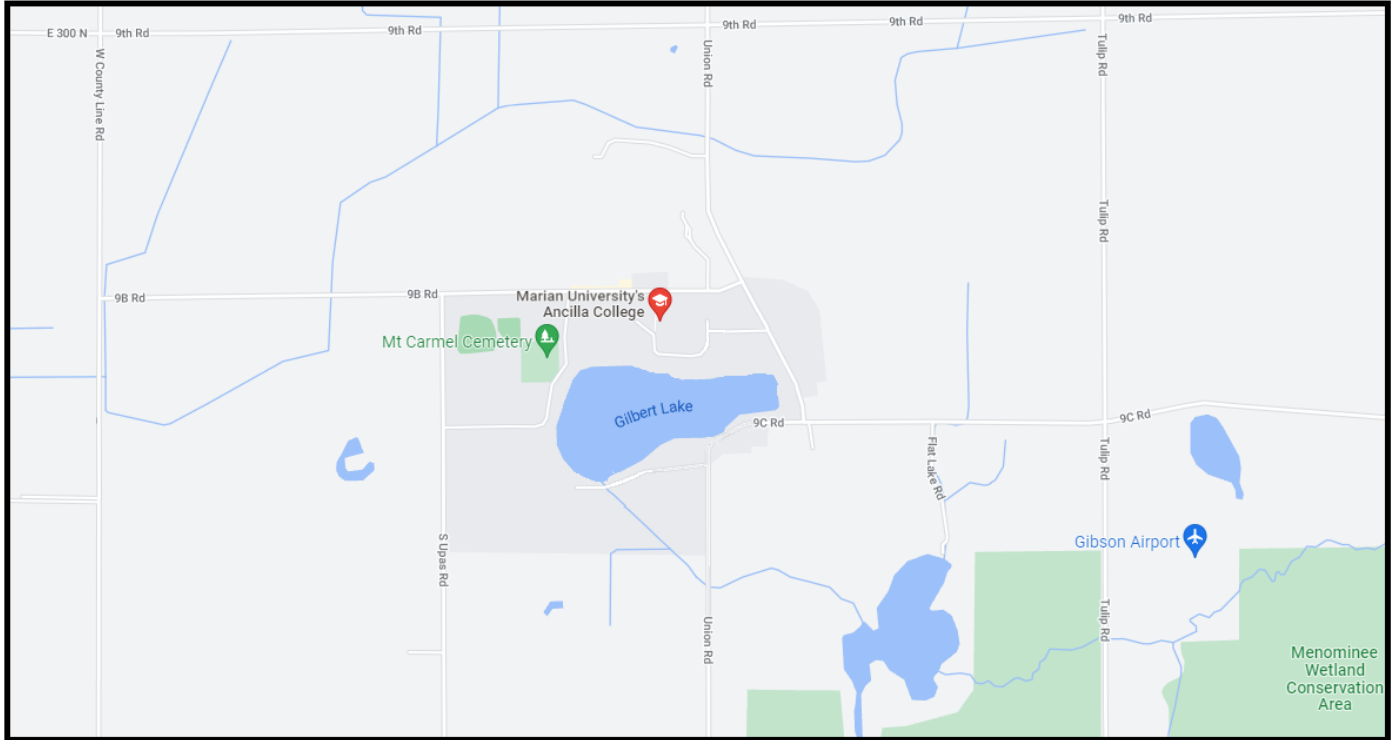
**Map 2: Town of Bourbon, Indiana**







**Map 3: Marian University – Ancilla College**



**3.2 Demographics**

In general, Marshall County is a rural area with smaller sized urban centers. Of the 92 counties in the State of Indiana, Marshall County is ranked as number 24 in land area and 32<sup>nd</sup> in population size. Data from the United States Census Bureau from the 2020 Decennial Census in the table below details the participating jurisdictions’ demographic information.

**Table 5: Population Data**

| Jurisdiction    | Land Area (Sq. Mi.) | Population |        |        | Percentage Population Change |                    |
|-----------------|---------------------|------------|--------|--------|------------------------------|--------------------|
|                 |                     | 2000       | 2010   | 2020   | 2010-2020                    | Population Density |
| Marshall County | 444                 | 45,126     | 47,007 | 46,095 | (-1.9)%                      | 104                |
| Bourbon         | 1.2                 | 1,664      | 1,810  | 1,698  | (-3.1)%                      | 1,415              |

Source: U.S. Census Bureau

Marshall County and its jurisdictions have experienced slight population changes since 2010. Of note:

- Marshall County has seen a slight population decrease for the period 2010-2020
- Bourbon has seen a population decrease for the period 2010-2020

**3.3 Social Vulnerabilities**

Each participating jurisdiction has socially vulnerable and at-risk populations, populations that may have difficulty with medical issues, poverty, extremes in age, and communications due to language barriers. Several principles may be considered when discussing potentially at-risk populations, including:

- Not all people who are considered at risk are at risk
- Outward appearance does not necessarily mark a person as at risk
- The hazard event will, in many cases, affect at risk population in differing ways



The National Response Framework defines at risk populations as "populations whose members may have additional needs before, during, and after an incident in functional areas, including but not limited to: maintaining independence, communication, transportation, supervision, and medical care." The following tables present information on potentially at risk populations within Marshall County.

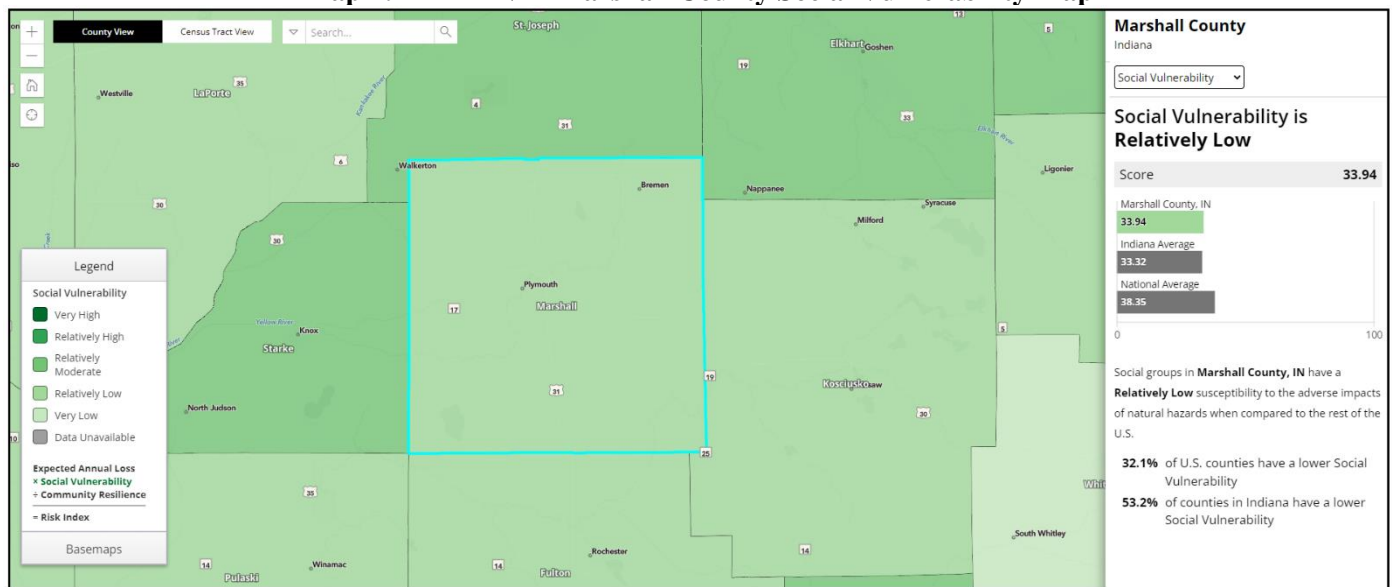
**Table 6: Potential at Risk Population Data**

| Jurisdiction    | Population 5 and Under (2021) | Population Over 65 (2021) | Speak a Language Other Than English (2021) | Estimated People in Poverty (2021) |
|-----------------|-------------------------------|---------------------------|--|------------------------------------|
| Marshall County | 2,979 (6.4%)                  | 8,159 (17.7%)             | 5,946 (12.9%)                              | 5,255 (11.4%)                      |
| Bourbon         | 198                           | 202 (11.9%)               | 152 (0.9%)                                 | 202 (11.9%)                        |

Source: United States Census Bureau

Data collection and mapping from the NRI is used to determine social vulnerability, the susceptibility of social groups to the adverse impacts of natural hazards, including disproportionate death, injury, loss, or disruption of livelihood. A Social Vulnerability score and rating represent the relative level of a community’s social vulnerability compared to all other communities at the same level. A community’s Social Vulnerability score is proportional to a community’s risk. The following map indicates the Social Vulnerability score of Marshall County (Relatively Low):

**Map 4: FEMA NRI Marshall County Social Vulnerability Map**

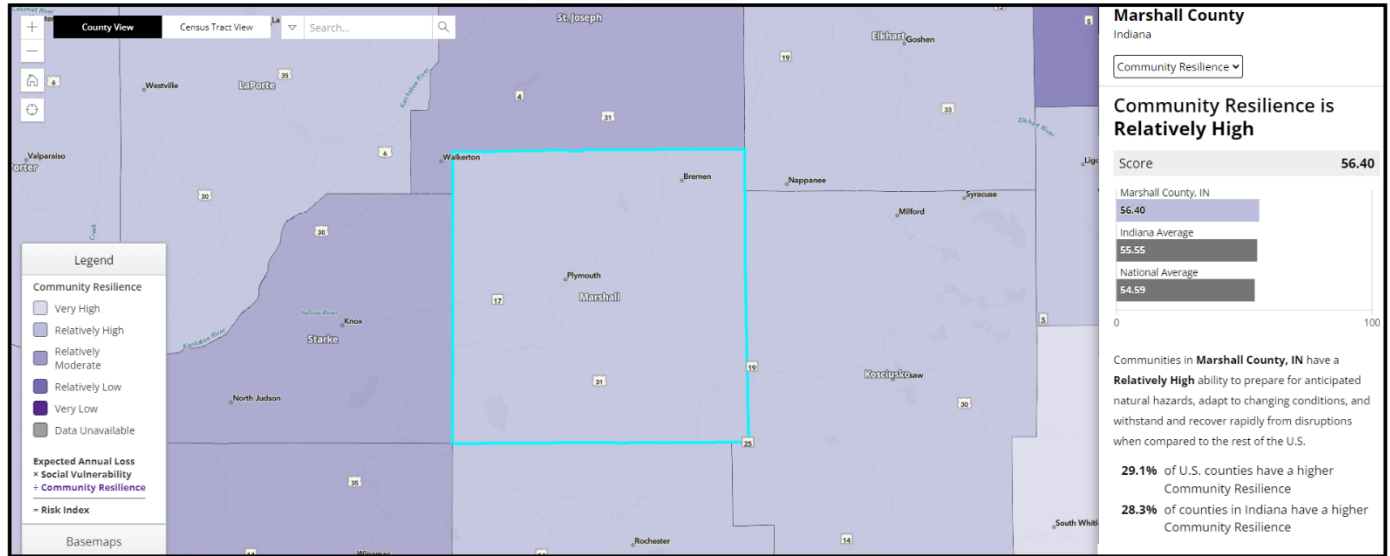


Source: FEMA

Community resilience is the ability of a community to prepare for anticipated natural hazards, adapt to changing conditions, and withstand and recover rapidly from disruptions. As a consequence reduction risk component of the NRI, a Community Resilience score and rating represent the relative level of a community’s resilience compared to all other communities at the same level. A Community Resilience score is inversely proportional to a community’s risk. The following map indicates the Community Resilience score of Marshall County (Relatively High):



**Map 5: FEMA NRI Marshall County Community Resilience Map**



Source: FEMA

**3.4 – Assessor and Housing Data**

This section quantifies the buildings exposed to potential hazards in Marshall County. Data from the Marshall County Assessor’s Office indicates the following assessed property value, including improvements for residential and non-residential properties to be \$4,658,227,200. The following table indicates 2022 assessor data.

**Table 7: Marshall County 2022 Residential Property Assessor Data**

|                              |                 |
|------------------------------|-----------------|
| <b>Parcel Count</b>          | 30,345          |
| <b>Land Valuation</b>        | \$1,622,937,700 |
| <b>Improvement Valuation</b> | \$3,035,289,500 |
| <b>Total Valuation</b>       | \$4,658,227,200 |

Source: Marshall County

Additionally, the following data from HAZUS indicates the total value of property within Marshall County by occupancy types:

**Table 8: Marshall County HAZUS Valuations**

| <b>Agricultural</b> | <b>Commercial</b> | <b>Government</b> | <b>Industrial</b> | <b>Residential</b> | <b>Educational</b> | <b>Religious</b> |
|---------------------|-------------------|-------------------|-------------------|--------------------|--------------------|------------------|
| \$15,929,000        | \$1,678,216,000   | \$65,189,000      | \$1,583,005,000   | \$6,352,696,000    | \$416,194,000      | \$63,312,000     |

Source: FEMA HAZUS

The total HAZUS estimated value for real property in Marshall County is estimated at \$10,174,541,000.

Data from the United States Census Bureau in the table below details the participating jurisdictions’ housing information.

**Table 9: Marshall County Housing Data**

| <b>Jurisdiction</b> | <b>Occupied Housing Units (2010)</b> | <b>Occupied Housing Units (2020)</b> | <b>Percentage Change in Occupied Housing Units (2010-2020)</b> |
|---------------------|--------------------------------------|--------------------------------------|--|
| Marshall County     | 17,631                               | 17,430                               | (-1.1)%  |
| Bourbon             | 689                                  | 702                                  | 1.9%   |

Source: United States Census Bureau



Marshall County and its jurisdictions have experienced slight housing changes since 2010. Of note:

- Marshall County has seen a slight housing decrease for the period 2010-2020
- Bourbon has seen a slight housing increase for the period 2010-2020

Of particular concern are mobile home residences. Data from the NOAA National Severe Storms Laboratory indicates that since 1975 fatalities in mobile homes have accounted for one-third of all tornado deaths in the United States. Additionally, study data from Michigan State University reported that the two biggest factors related to tornado fatalities were housing quality (measured by mobile homes as a proportion of housing units) and income level. When a tornado strikes, a county with double the number of mobile homes as a proportion of all homes will experience 62% more fatalities than a county with fewer mobile homes, according to the study data. The following indicates the percentage of mobile homes for each participating jurisdiction:

**Table 10: Marshall County Mobile Home Data**

| Jurisdiction    | Percentage Of Housing Stock as Mobile Homes (2010) | Percentage Of Housing Stock as Mobile Homes (2020) | Percentage Change in Mobile Homes (2010-2020) |
|-----------------|--|--|---|
| Marshall County | 6.0%   | 6.2%   | 0.2%  |
| Bourbon         | 0.3%   | 1.0%   | 0.7%  |

Source: United States Census Bureau

### 3.5 – Schools and Colleges

Available data indicates that for the 2022 school year there are seven public school districts with 15 public schools serving 7,145 students and eight private schools serving 1,244 students in Marshall County. In addition, Marian University - Ancilla College serves Marshall County with 530 students enrolled.

**Table 11: Marshall County Public School Enrollment Information**

| School                                    | Location  | Enrollment (2022) | Grades Served |
|---|-----------|-------------------|---------------|
| Argos Community Elementary School         | Argos     | 268               | PreK-5        |
| Argos Community Junior Senior High School | Argos     | 347               | 6-12          |
| Bremen Elementary Middle School           | Bremen    | 952               | K-8           |
| Bremen Senior High School                 | Bremen    | 507               | 9-12          |
| Culver Elementary School                  | Culver    | 333               | PreK-5        |
| Culver Community Middle/High School       | Culver    | 425               | 6-12          |
| Jefferson Elementary School               | Plymouth  | 284               | PreK-4        |
| Lincoln Junior High School                | Plymouth  | 562               | 6-8           |
| Menominee Elementary School               | Plymouth  | 354               | K-5           |
| Plymouth High School                      | Plymouth, | 1,095             | 9-12          |
| Riverside Intermediate                    | Plymouth  | 477               | 5-6           |
| Triton Elementary School                  | Bourbon   | 148               | PreK-6        |
| Triton Junior Senior High School          | Bourbon   | 405               | 7-12          |
| Washington Discovery Academy              | Plymouth  | 268               | K-4           |
| Webster Elementary School                 | Plymouth  | 148               | K-8           |

Source: Marshall County

**Table 12: Marshall County Private School Enrollment Information**

| School                      | Location | Enrollment (2022) | Grades Served |
|-----------------------------|----------|-------------------|---------------|
| Culver Academies            | Culver   | 832               | 9-12          |
| Borkholder Parochial School | Bremen   | 28                | 1-8           |
| Bourbon Christian School    | Bourbon  | 39                | 1-12          |





**Table 12: Marshall County Private School Enrollment Information**

| School                              | Location | Enrollment (2022) | Grades Served |
|-------------------------------------|----------|-------------------|---------------|
| Creekside School                    | Bourbon  | 33                | 1-8           |
| Grace Baptist Christian School      | Plymouth | 68                | K-8           |
| House of the Lord Christian Academy | Plymouth | 22                | PreK-12       |
| St. Michael School                  | Plymouth | 148               | K-8           |
| St. Paul's Lutheran School          | Bremen   | 74                | PreK-8        |

Source: Marshall County

The following table presents participating college enrollment information.

**Table 13: Marshall County College Enrollment Information**

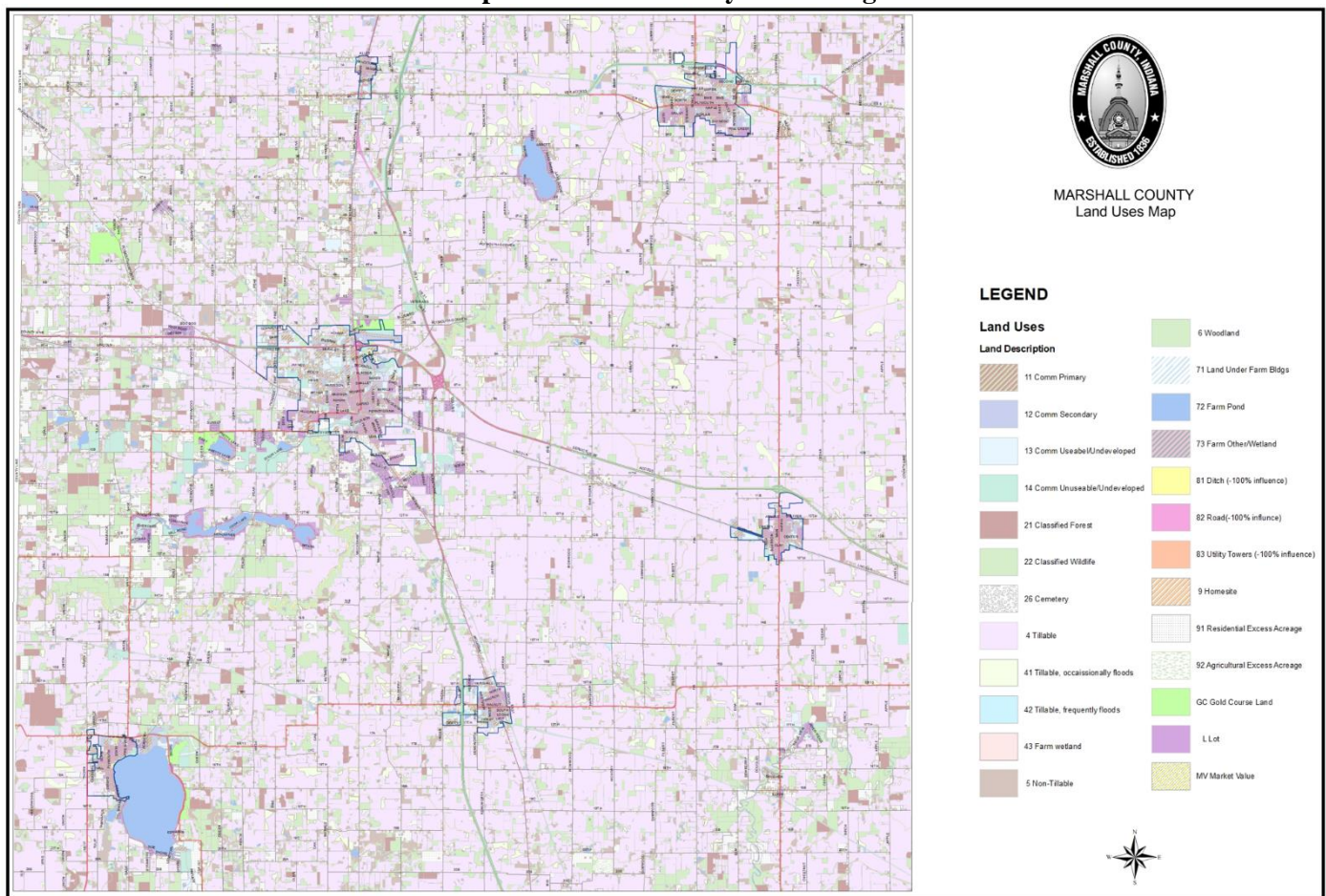
| College                             | Location | Enrollment (2022) |
|-------------------------------------|----------|-------------------|
| Marian University – Ancilla College | Plymouth | 21                |

Source: Marian University - Ancilla College

### 3.6 Land Use

The following map, provided by Marshall County, shows land usage types for the county (predominantly agricultural):

**Map 6: Marshall County Land Usage**



Source: Marshall County

Based on the available data, it is likely that Marshall County will retain its mostly rural and agricultural character during the life of this plan. Based on demographic data, Marshall County and all participating jurisdictions will see a static, or slightly decreased risk to identified hazards due to changing populations.



### 3.7 Critical Facilities

Certain facilities have a net positive value on the community as they contribute to the public good by facilitating the basic functions of society. These facilities maintain order, public health, education, and help the economy function. Additionally, there are infrastructure and facilities integral to disaster response and recovery operations. Conversely, some infrastructure and facilities are of extreme importance due to the negative externalities created when they are impacted by a disaster. What fits these definitions will vary slightly from community to community, but the definitions remain as a guideline for identifying critical facilities and infrastructure. For Marshall County and its participating jurisdictions, the table below lists the identified critical facilities. A complete list can be found in Appendix D.

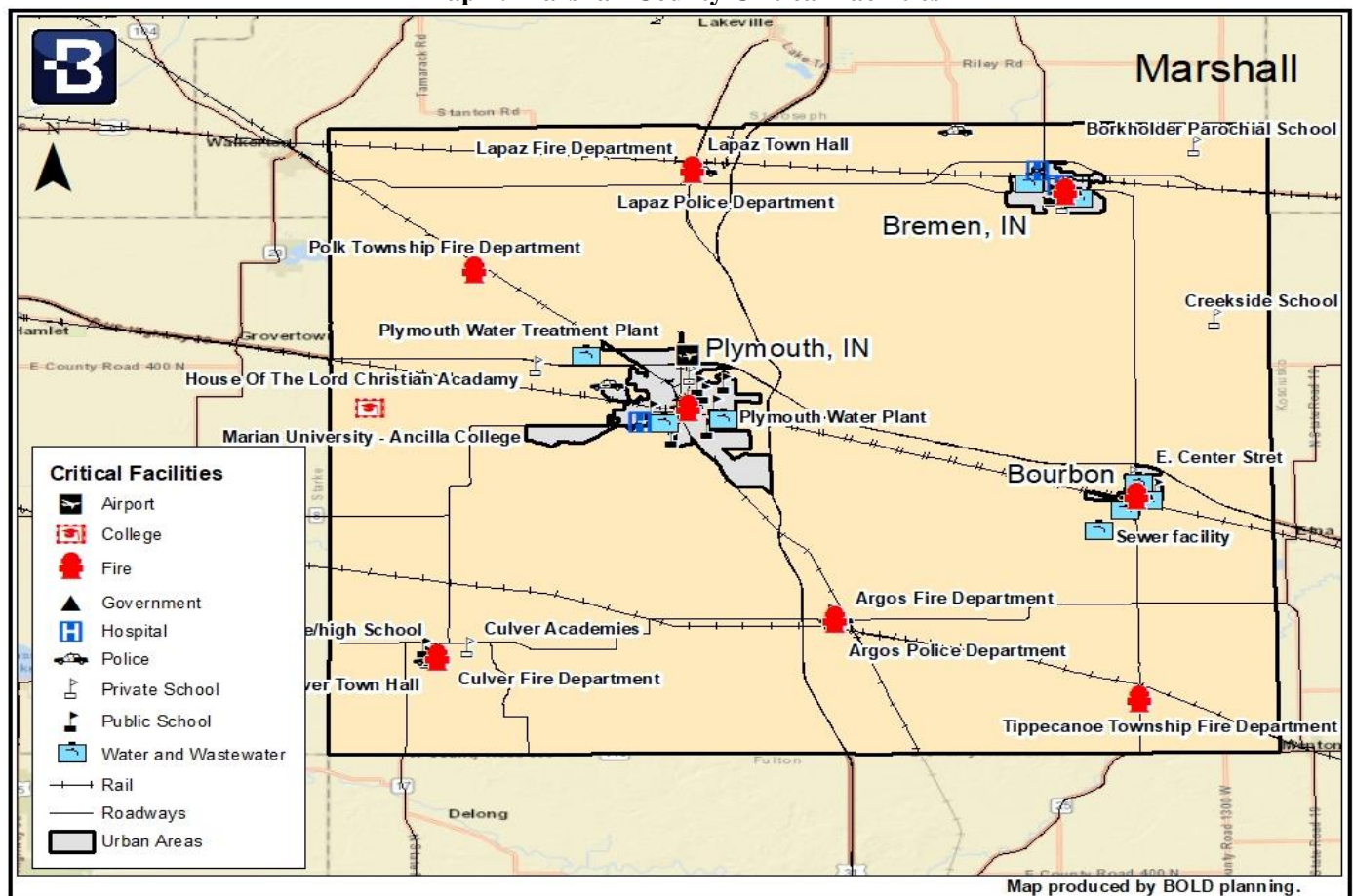
**Table 14: Marshall County Critical Facilities**

| Facility Type                       | Total, Marshall County | Bourbon |
|-------------------------------------|------------------------|---------|
| Airport                             | 1                      | 0       |
| Educational Facilities              | 22                     | 4       |
| Emergency Operations Center         | 1                      | 0       |
| Fire Stations                       | 9                      | 1       |
| Hospital                            | 3                      | 0       |
| Law Enforcement Facilities          | 8                      | 1       |
| Major Government Building           | 5                      | 1       |
| Public Health Department            | 1                      | 0       |
| Water and Wastewater Infrastructure | 9                      | 2       |

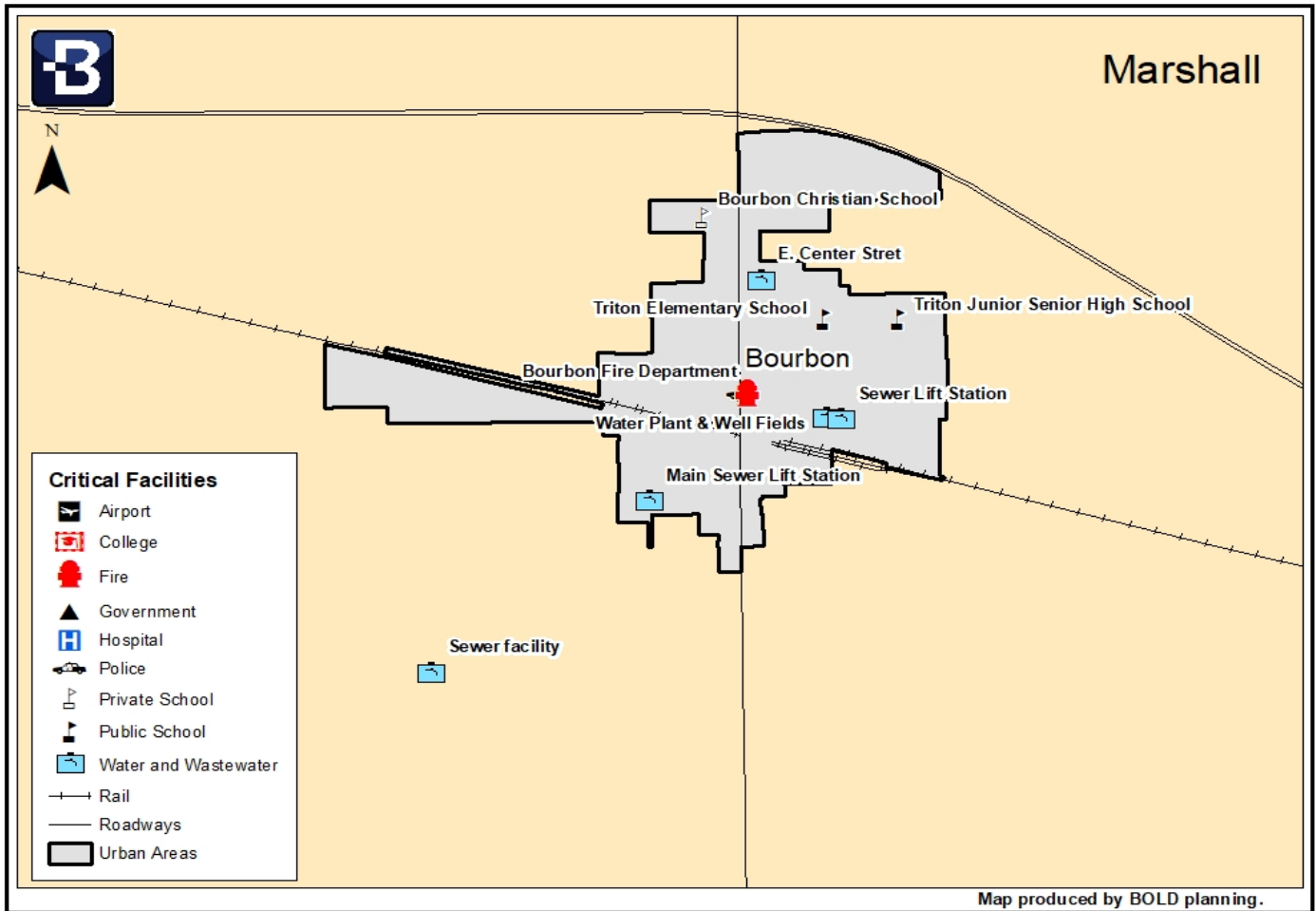
Source: Marshall County and Participating Jurisdictions

The following maps detail critical facility locations for participating jurisdictions.

**Map 7: Marshall County Critical Facilities**



**Map 8: Bourbon Critical Facilities**



**3.8 Agricultural Data**

Agriculture forms a very important part of both the economic and social fabric of Marshall County. The United States Department of Agriculture (USDA) National Agricultural Statistics Service data was used to develop agricultural information for Marshall County.

**Table 14: Marshall County Agricultural Data**

| Agricultural Census Year       | Number of Farms | Farm Acreage | Cropland Acreage | Number of Cattle | Market Value of Agricultural Products Sold |
|--------------------------------|-----------------|--------------|------------------|------------------|--|
| 2007                           | 866             | 179,016      | 155,981          | 17,796           | \$97,034,000                               |
| 2012                           | 878             | 206,306      | 181,845          | 16,820           | \$147,628,000                              |
| 2017                           | 829             | 199,083      | 177,259          | 20,681           | \$145,167,000                              |
| Percentage Change, 2007 - 2017 | (-4.3%)         | 11.2%        | 13.6%            | 16.2%            | 49.6%                                      |

Source: United States Department of Agriculture National Agricultural Statistics Service

**3.9 Development Trends**

A summary assessment for development trends and growth (as they apply to changes in a jurisdiction’s vulnerability and risk) can be broken down into two categories, area-wide hazards and point hazards. Area-wide hazards indiscriminately impact the entire planning area. Since it is beyond scientific measurement where an area-wide hazard, such as winter storms, will impact, and likely it will impact everywhere, it is reasonable to assume any significant growth and development will increase vulnerability and risk. Additionally, if a jurisdiction develops or populates a

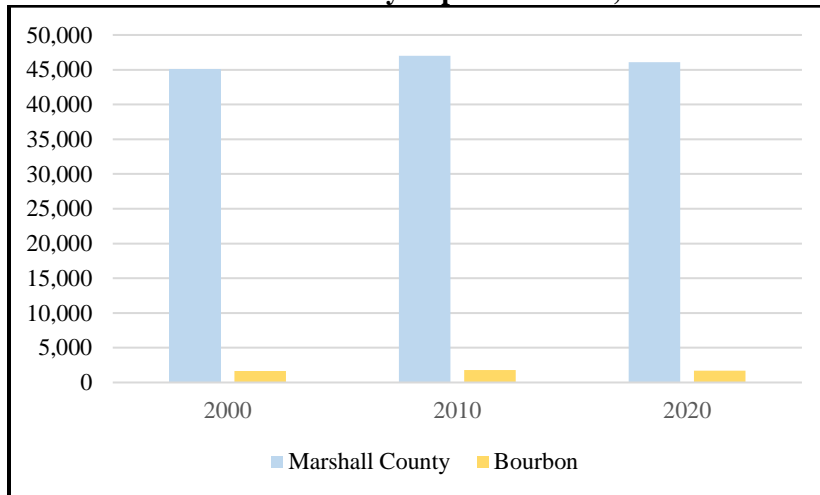




known hazard area (point hazard) that jurisdiction’s vulnerability and risk increase by an amount equal to the development or growth that now exists in that identified hazard area.

It is anticipated that Marshall County and all participating jurisdictions will see static population levels over the life of this plan. This static nature will likely equate to static vulnerability to identified hazards for all participating jurisdictions. The following chart details population trends for Marshall County and Bourbon from 2000 to 2020.

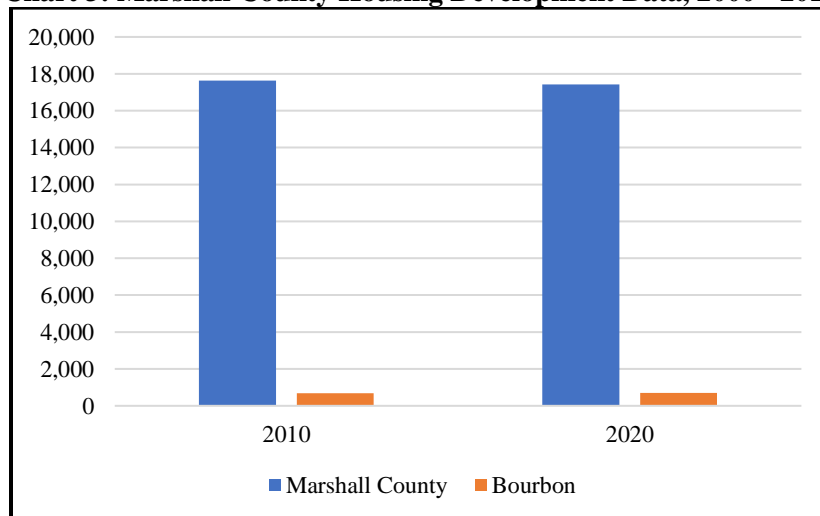
**Chart 2: Marshall County Population Data, 2000 - 2010**



Source: United States Census Bureau 2020

It is anticipated that Marshall County and all participating jurisdictions will see static housing levels over the life of this plan. This static nature will likely equate to static vulnerability to identified hazards for all participating jurisdictions. The following chart details housing development trends for Marshall County and Bourbon from 2000 to 2020.

**Chart 3: Marshall County Housing Development Data, 2000 - 2010**



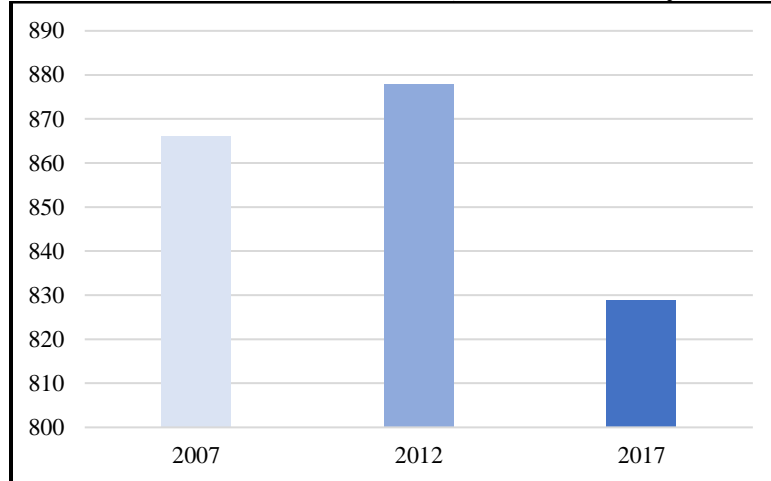
Source: United States Census Bureau 2020

However, the continued increase in the market value of agricultural products sold in the county could represent an increase in vulnerability for the agricultural sector over the life of this plan. Data from the USDA indicates that Marshall County is seeing growth in all agricultural sectors despite a reduction in the number of farms. The following charts illustrate the above data.



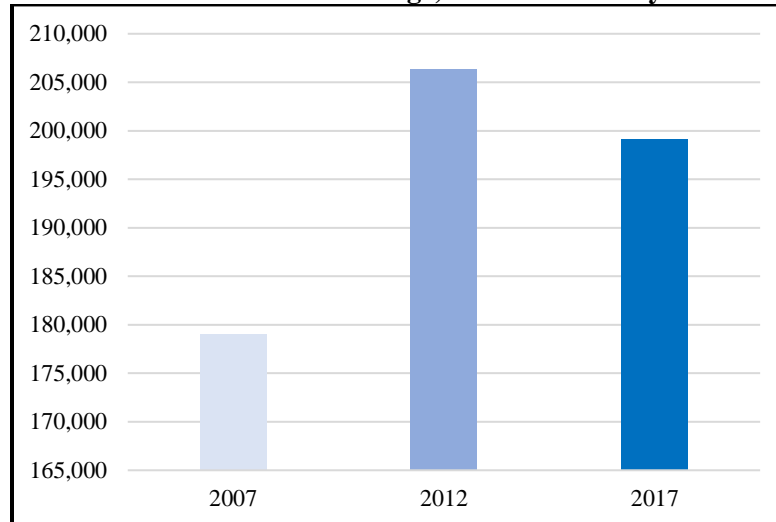


**Chart 3: Number of Farms, Marshall County**



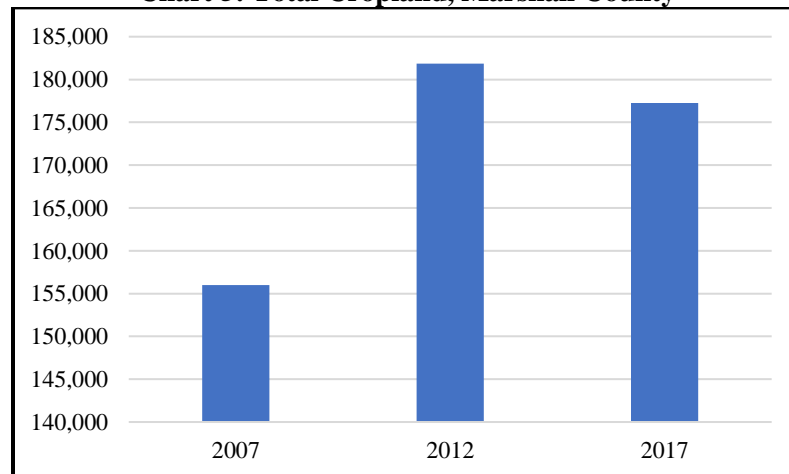
Source: USDA

**Chart 4: Farm Acreage, Marshall County**



Source: USDA

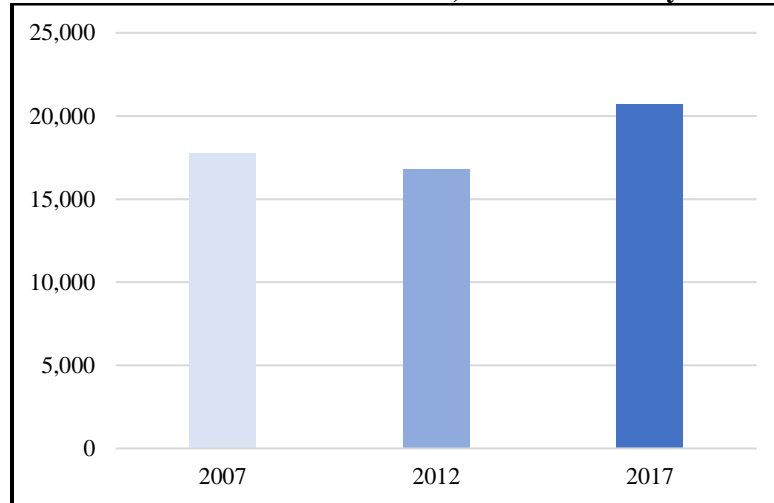
**Chart 5: Total Cropland, Marshall County**



Source: USDA

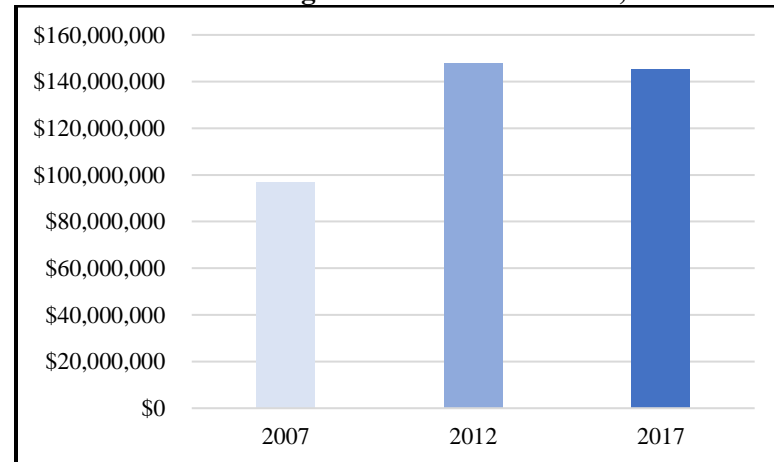


**Chart 6: Number of Cattle, Marshall County**



Source: USDA

**Chart 7: Market Value of Agricultural Products Sold, Marshall County**



Source: USDA

### 3.10 Climate Change

For hazards related to weather patterns, climate change may cause significant changes in patterns and event frequency. There is a scientific consensus that climate change is occurring, and recent climate modeling results indicate that extreme weather events may become more common. Rising average temperatures produce a more variable climate system which may result in an increase in the frequency and severity of some extreme weather events, including:

- Longer and more intense heat waves
- An increased risk of wildfires
- Higher wind speeds
- Greater rainfall intensity
- Increased tornado activity

Specifically, according to the United State Environmental Protection Agency’s “What Climate Change Means for Indiana:”

- Changing the climate is likely to increase the frequency of floods in Indiana. Over the last half century, average annual precipitation in most of the Midwest has increased by 5 to 10 percent. But rainfall during the four wettest days of the year has increased about 35 percent, and the amount of water flowing in most streams during the



worst flood of the year has increased by more than 20 percent. During the next century, spring rainfall and average precipitation are likely to increase, and severe rainstorms are likely to intensify. Each of these factors will tend to further increase the risk of flooding.

- Changing the climate will have both beneficial and harmful effects on farming. Longer frost-free growing seasons and higher concentrations of atmospheric carbon dioxide would increase yields for some crops during an average year. But increasingly hot summers are likely to reduce yields of corn and possibly soybeans. Seventy years from now, much of Indiana is likely to have 5 to 15 more days per year with temperatures above 95°F than it has today. More severe droughts or floods would also hurt crop yields.
- Rising temperatures can harm air quality and amplify existing threats to human health. Warmer weather can increase the production of ground-level ozone, a pollutant that causes lung and heart problems. High air temperatures can cause heat stroke and dehydration, and affect people’s cardiovascular and nervous systems. Midwestern cities are vulnerable to heat waves because many houses and apartments lack air conditioning. Heat stress is expected to increase as climate change brings hotter summer temperatures and more humidity. Certain people are especially vulnerable, including children, the elderly, the sick, and the poor.

Additionally, information from the Purdue Climate Change Research Center’s “Indiana’s Past & Future Climate: A Report from the Indiana Climate Change Impacts Assessment” indicates:

- Temperatures in Indiana are projected to rise about 5°F to 6°F by mid-century, with significantly more warming by century’s end. A rising average temperature increases the chance of extreme heat and reduces the chance of extreme cold, and it also changes the timing and length of the frost-free season when plants grow. These shifts will impact air quality, extend the growing season and the allergy season, and create more favorable conditions for some pests and invasive species.
- The number of extremely hot days will rise significantly in all areas of the state. Extreme heat raises the likelihood of heat-related illnesses, such as heat exhaustion and heat stroke, which can lead to increased hospitalizations and medical costs. Children and the elderly are especially vulnerable. Extreme heat also reduces crop yields, counteracting the benefits of a longer growing season.
- Extreme cold events are declining. By mid-century, the northern third of Indiana will experience on average only six days per year below 5°F, down from 13 days in the past. Cold temperatures control populations of disease-carrying insects such as mosquitoes and ticks, as well as forest pests. Warmer winters would allow some of these species to remain active for longer periods or to expand their ranges into Indiana.
- Average annual precipitation has increased 5.6 inches since 1895, and more rain is falling in heavy downpours. Winters and springs are likely to be much wetter by mid-century, while expected changes in summer and fall precipitation are less certain. Increased precipitation, especially in the form of heavy rain events, will increase flooding risks and pollute water as combined sewer systems overflow and fertilizers run off of farm fields. Warmer summers with the same or less rain would increase stress on agricultural crops and drinking water supplies.
- The frost-free season has lengthened by nine days per year statewide since 1895. This trend is projected to continue and intensify. By mid-century, central Indiana’s frost-free season is projected to increase by 3.5 to 4.5 weeks compared to the past. Longer growing seasons can increase the productivity of food crops and forests, and could expand crop-production opportunities in northern latitudes or the possibility of double-cropping further south. But they also increase growth of less desirable plants like ragweed and create favorable conditions for some invasive species.



## Section 4 – Hazard Profiles

### 4.1 Introduction

The ultimate purpose of this HMP is to minimize the loss of life and property. To accomplish this, all relevant hazards and vulnerabilities Marshall County and its participating jurisdictions face have been identified. Once this identification has been completed, Marshall County and all participating jurisdictions can use the accumulated data to assist in the development and prioritization of mitigation action to defend against these potential risks.

### 4.2 Methodology

Each hazard that has historically, or could potentially, affect Marshall County and its participating jurisdictions is reviewed and discussed in detail. In general, each hazard details the following information:

- Hazard description
- Location and extent
- Previous occurrences
- Probability of future events
- Potential vulnerability and impact
- Critical facilities and infrastructure
- Land use and development trends
- Potential impact of climate change
- Unique and varied risk

Data sets used for this HMP were designed to follow the lead of the 2017 Marshall County HMP. Twenty-year data sets from the National Oceanic and Atmospheric Administration (NOAA) National Centers for Environmental Information (NCEI) were used, where applicable, for hazard occurrence and impact data. Where data sets were unavailable for a hazard, local reporting from participating jurisdictions was relied upon.

### 4.3 Declared Federal Disasters

Historical events of significant magnitude or impact can result in a Presidential Disaster Declaration. The MPC reviewed the historical federal disaster declarations to assist in hazard identification. In the 20-year period from 2003 to 2022, with the years 2003 and 2022 being full dataset years, Marshall County has experienced five Presidential Disaster Declarations, reflected in the following table.

**Table 15: Marshall County Presidential Disaster Declarations**

| Designation | Declaration Date | Incident Type                          |
|-------------|------------------|--|
| DR-1573     | 1/21/2005        | Severe Winter Storms and Flooding      |
| DR-1740     | 1/30/2008        | Severe Winter Storms and Flooding      |
| DR-1832     | 4/22/2009        | Severe Storms, Tornadoes, and Flooding |
| DR-4363     | 5/4/2018         | Severe Storms and Flooding             |
| DR-4515-IN  | 03/12/2020       | COVID-19 Pandemic                      |

Source: FEMA

In the 20-year period from 2003 to 2022, Marshall County has experienced three Emergency Declarations, reflected in the following table.

**Table 16: Marshall County Emergency Declarations**

| Designation | Declaration Date | Incident Type                |
|-------------|------------------|------------------------------|
| EM-3238     | 09/10/2005       | Indiana Hurricane Evacuation |
| EM-3274     | 03/12/2007       | Indiana Snow                 |
| EM-3456-IN  | 03/13/2020       | Indiana COVID                |

Source: FEMA



#### 4.4 Identified Potential Hazards

The first step in developing a hazard assessment is to identify the hazards that have a reasonable risk of occurring in Marshall County and its participating jurisdictions. Proper identification allows for appropriate and well-planned action in order to mitigate the extent and cascading impacts of an incident. Furthermore, while not all disaster contingencies can be planned for, applying an all-hazards approach to the mitigation process does yield greater awareness and better preparedness for unforeseen hazard incidents overall. The following table lists the natural hazards identified in the 2019 State of Indiana HMP and indicates if they are included in the Marshall County HMP.

**Table 17: State of Indiana Identified Natural Hazards**

| State Plan Identified Hazard                                  | Marshall County HMP |
|---|---------------------|
| Dam Failure   | Included            |
| Drought   | Included            |
| Earthquake  | Excluded            |
| Extreme Temperatures  | Included            |
| Flood/Flash Floods  | Included            |
| Ground Failure  | Excluded            |
| Severe Thunderstorms (Lightning, Thunderstorm Wind, and Hail) | Included            |
| Tornadoes   | Included            |
| Wildfires   | Excluded            |
| Winter Storms   | Included            |

Based on discussion with the MPC, a lack of identified risk or history, and geographic improbability, numerous FEMA identified hazards such as coastal erosion, hurricane, tsunami, and volcanoes were not included in the scope of this plan. Additionally, four natural hazards included in the State of Indiana HMP, detailed below, were not included for the enumerated reasons:

- **Earthquake:** There have been no recorded damaging earthquakes in Marshall County. Additionally, multiple earthquake scenario maps generated for the 2019 State of Indiana HMP indicate that Marshall County and all participating jurisdictions would expect very light damage from all modeled earthquakes. Due to the lack of documented and predicted impacts on both structures and population the MPC opted to not allocate potential resources or funding to mitigate against this hazard in favor of prioritizing other hazards.
- **Ground Failure:** For purposes of this HMP, ground failure events are classified as landslides, sinkholes caused by subsurface conditions or activities, and fluvial erosion. There have been no recorded incidences of ground failure events in Marshall County. Additionally:
  - The 2019 State of Indiana HMP indicates that Marshall County possesses low susceptibility for landslides, borne out by topographical mapping.
  - Geologic and mining maps indicate that Marshall County has no areas of Karst topography or subsurface mining, known contributors to land subsidence.
  - Mapping generated for the 2019 State of Indiana indicates all rivers and streams within Marshall County are classified as having relatively stationary stream corridors and have a low susceptibility to fluvial erosion. Due to a lack of documented history, the MPC opted to not allocate potential resources or funding to mitigate against this hazard in favor of prioritizing other hazards.
- **Wildfires:** There have been no recently reported damaging wildfires within Marshall County. Additionally, FEMA NRI data indicates that the potential risk to Marshall County from wildfire is very low. Finally, wildland fires tend to thrive in forested environments. The agricultural nature of Marshall County has limited forested areas to provide wildfire fuel. Due to the lack of documented and predicted impacts on both structures and population the MPC opted to not allocate potential resources or funding to mitigate against this hazard in favor of prioritizing other hazards.
- **Levee Failure:** A review of the National Levee Database, maintained by the United States Army Corps of Engineers, indicates there are no identified levees in Marshall County. Additionally, the National Levee database indicates that none of the surrounding counties have any identified levees systems. As such, the MPC



opted to not allocate potential resources or funding to mitigate against this hazard in favor of prioritizing other hazards.

#### **4.5 Hazard Profiles**

Each identified hazard is profiled in the subsequent sections, with the level of detail varying based on available information. Sources of information are cited in the detailed hazard profiles below.

With each update of this plan, new information will be incorporated to provide for better evaluation and prioritization of the hazards.

The following hazards are presented in alphabetical order, and not by planning significance, for ease of reference.

## 4.6 Dam Failure

### 4.6.1 Hazard Description

A dam is a barrier across flowing water that obstructs, directs, or slows down the flow, often creating a reservoir, lake, or impoundment. Most dams have a section called a spillway or weir, over or through, which water flows, either intermittently or continuously. Dams commonly come in two types, embankment (the most common) and concrete (gravity, buttress, and arch), as well as sizes. They also serve a number of purposes and provide essential benefits, including drinking water, irrigation, hydropower, flood control, and recreation.

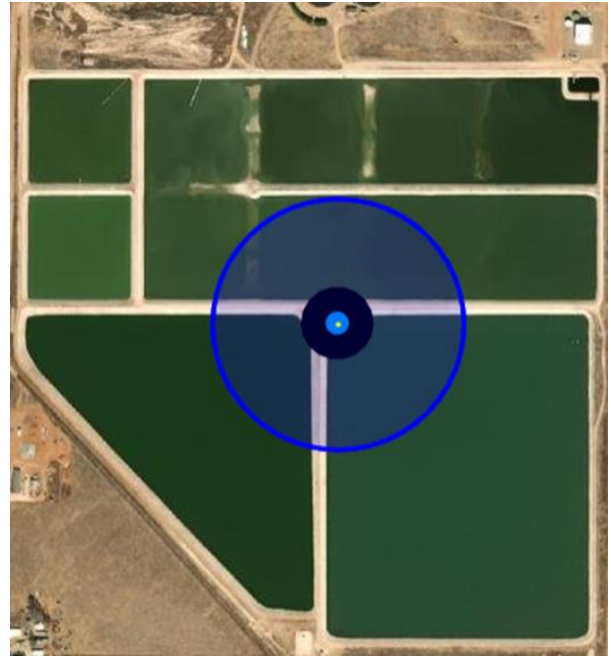
Large or small, dams have a powerful presence that is frequently overlooked until a failure occurs. Dams fail in two ways: 1) a controlled spillway release done to prevent full failure, or 2) the partial or complete collapse of the dam itself. In each instance, an overwhelming amount of water, and potentially debris, is released. Dam failures are rare, but when they do occur, they can cause loss of life and immense damage to property, critical infrastructure, and the environment.

Possible reasons for dam failure include but are not limited to:

- Sub-standard construction materials/techniques
- Spillway design error
- Geological instability caused by changes to water levels during filling or poor surveying
- Sliding of a mountain into the reservoir
- Poor maintenance, especially of outlet pipes
- Human, computer, or design error
- Internal erosion, especially in earthen dams
- Earthquakes
- Terrorism

There are three classifications of dam failure, hydraulic, seepage, and structural. The following is an explanation of each these failure classifications:

- **Hydraulic:** This failure is a result of an uncontrolled flow of water over and around the dam structure as well as the erosive action on the dam and its foundation. The uncontrolled flow causing the failure is often classified as wave action, toe erosion, or gullyng. Earthen dams are particularly susceptible to hydraulic failure because earthen materials erode more quickly than other materials, such as concrete and steel. This type of failure constitutes approximately 40% of all dam failures.
- **Seepage:** Seepage is the velocity of an amount of water controlled to prevent failure. This occurs when the seepage occurs through the structure to its foundation, where it begins to erode within. This type of failure accounts for approximately 4% of all dam failures.
- **Structural:** A failure that involves the rupture of the dam or the foundation by water movement, earthquake, or sabotage. When weak materials construct dams (large, earthen dams) are the primary cause of this failure. Structural failure occurs with approximately 30% of dam failures.







### 4.6.2 Location & Extent

The Indiana Department of Natural Resources oversees all dam safety programs. These programs are responsible for developing and maintaining an inventory of dams, classifying dams, and ensuring the compliance of all regulated dams.

Dams in the State of Indiana are ranked by Dam Hazard Classification, which is determined by the potential for infrastructure and property damage downstream if a dam failure were to occur. Current Dam Hazard Classifications are:

**Table 18: Dam Hazard Potential Classification**

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

Source: Indiana Department of Natural Resources

The U.S. Army Corps of Engineers National Inventory of Dams (NID) program indicates that there are four dams in Marshall County, as detailed in the following table:

**Table 19: Marshall County Dams**

| Dam Name                     | NID Number | Owner Name                               | Hazard Rank | Dam Type | Capacity (acre feet) | Condition Assessment | Incident and Emergency Action Plan |
|------------------------------|------------|--|-------------|----------|----------------------|----------------------|------------------------------------|
| Lake Latonka Dam             | IN00117    | Lake Latonka Property Owners Association | High        | Earth    | 754                  | Poor                 | Yes                                |
| Zehner Mill Pond Dam         | IN00783    | James Clevenger                          | High        | Earth    | 2,400                | Poor                 | No                                 |
| Myers Lake Control Structure | IN03534    | INDR                                     | Low         | Unknown  | 166                  | Not Rated            | Not required                       |
| Schori Lake Dam              | IN00784    | R. Schori                                | Low         | Earth    | 95                   | Not Rated            | Not required                       |

Source: NID

The definition of dam condition assessment are as follows:

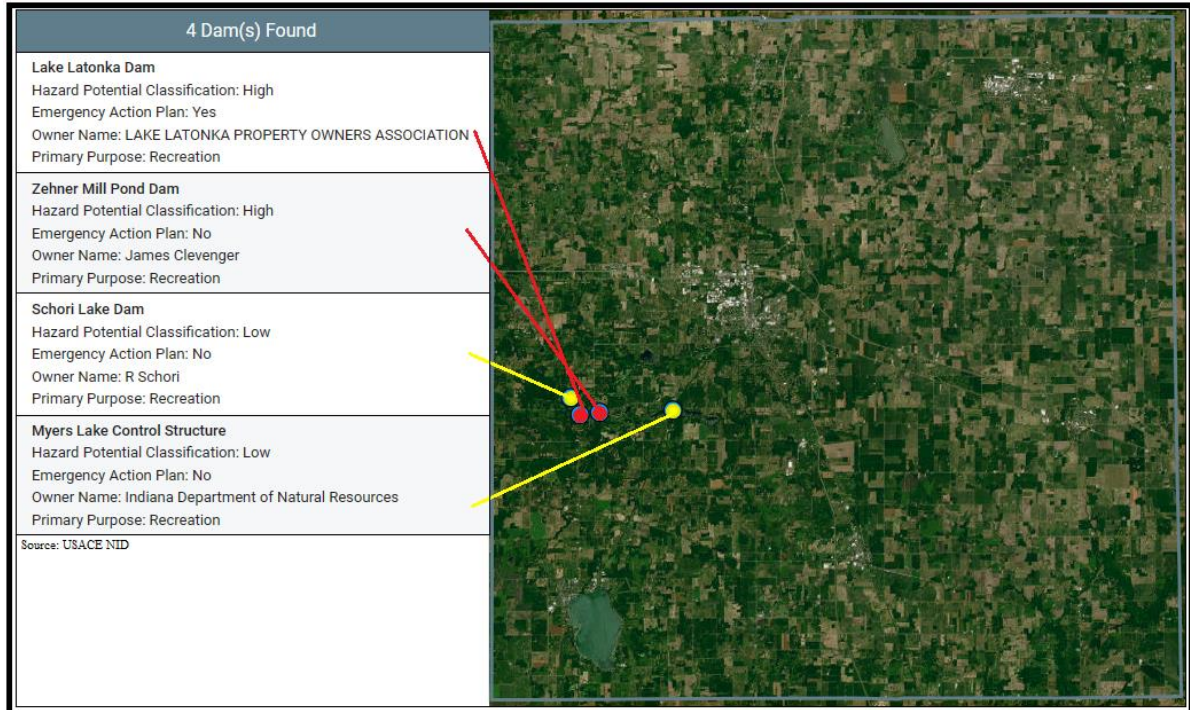
- **Satisfactory:** No existing or potential dam safety deficiencies are recognized. Acceptable performance is expected under all loading conditions in accordance with state engineer's rules and regulations for dams or tolerable risk guidelines.
- **Fair:** No existing dam safety deficiencies are recognized for normal loading conditions. Rare or extreme hydrologic and/or seismic incidents may result in a dam safety deficiency. Risk may be in the range to take further action.
- **Poor:** A dam safety deficiency is recognized for loading conditions, which may realistically occur. Remedial action is necessary. A poor condition is used when uncertainties exist as to critical analysis parameters, which identify a potential dam safety deficiency. Further investigations and studies are necessary.
- **Unsatisfactory:** A dam safety deficiency is recognized that requires immediate or emergency remedial action for problem resolution.

The following maps detail the locations of identified Marshall County dams.



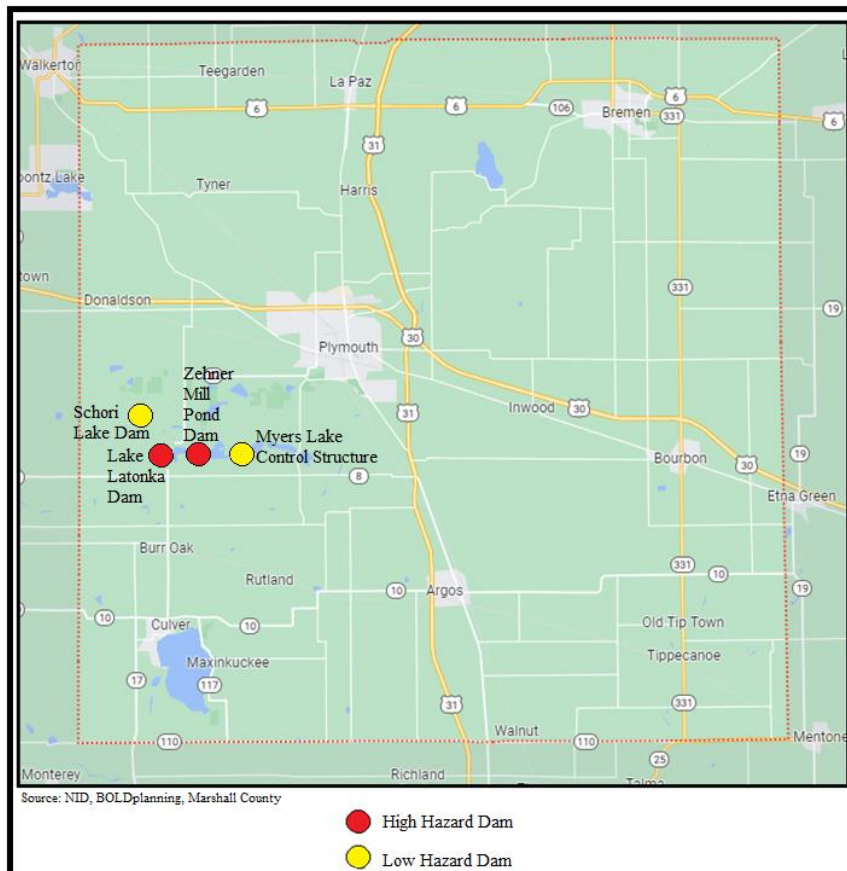


**Map 9: Marshall County Summary of Dams**



Source: NID

**Map 10: Marshall County Dam Location**



Map Source: NID, BOLDplanning, Marshall County



#### **4.6.3 Previous Occurrences**

There is no single, comprehensive source of open-source information about a dam failure in the State of Indiana. However, according to the Indiana State Hazard Mitigation Plan and information provided by MPC members, there have been no instances of dam failure in Marshall County.

#### **4.6.4 Probability of Future Incidents**

As previously stated there can be advanced warning to no warning at all for a dam failure event. At present, there is no history of a dam failure of any size in Marshall County or its participating jurisdictions. In lieu of any historical events, the next best prediction tool would be based on the structural state of the dam. However, maintenance and structural information on the dams in Marshall County and its participating jurisdictions is not available for public use. Available historic occurrence data suggests that there is a near zero percent probability of dam failure in a given year. However, it is important to note that the lack of past incidents does not protect against future incidents.

#### **4.6.5 Vulnerability and Impact**

Marshall County and its participating jurisdictions have recorded no incidences of dam failure. Still, a dam failure could have an impact on the portions of the planning area, including the environment, much like a flood event.

The State of Indiana requires High Hazard dams to have Incident and Emergency Action Plans, which detail potential dam failure inundation areas and at-risk structures identified. Of the two identified High Hazard dams within Marshall County (Lake Latonka Dam and Zehner Mill Pond Dam), an Incident and Emergency Action Plan has only been created for Lake Latonka Dam.

The Incident and Emergency Action Plan for Lake Latonka Dam indicates that potential inundation areas extend along Harry Cool Ditch, Eagle Creek, and Eagle Lake. The area within the projected flood zone is mostly rural but includes several homes and numerous roads including State Route 17 which is located approximately 300 feet west of the dam, giving the dam a high hazard rating.

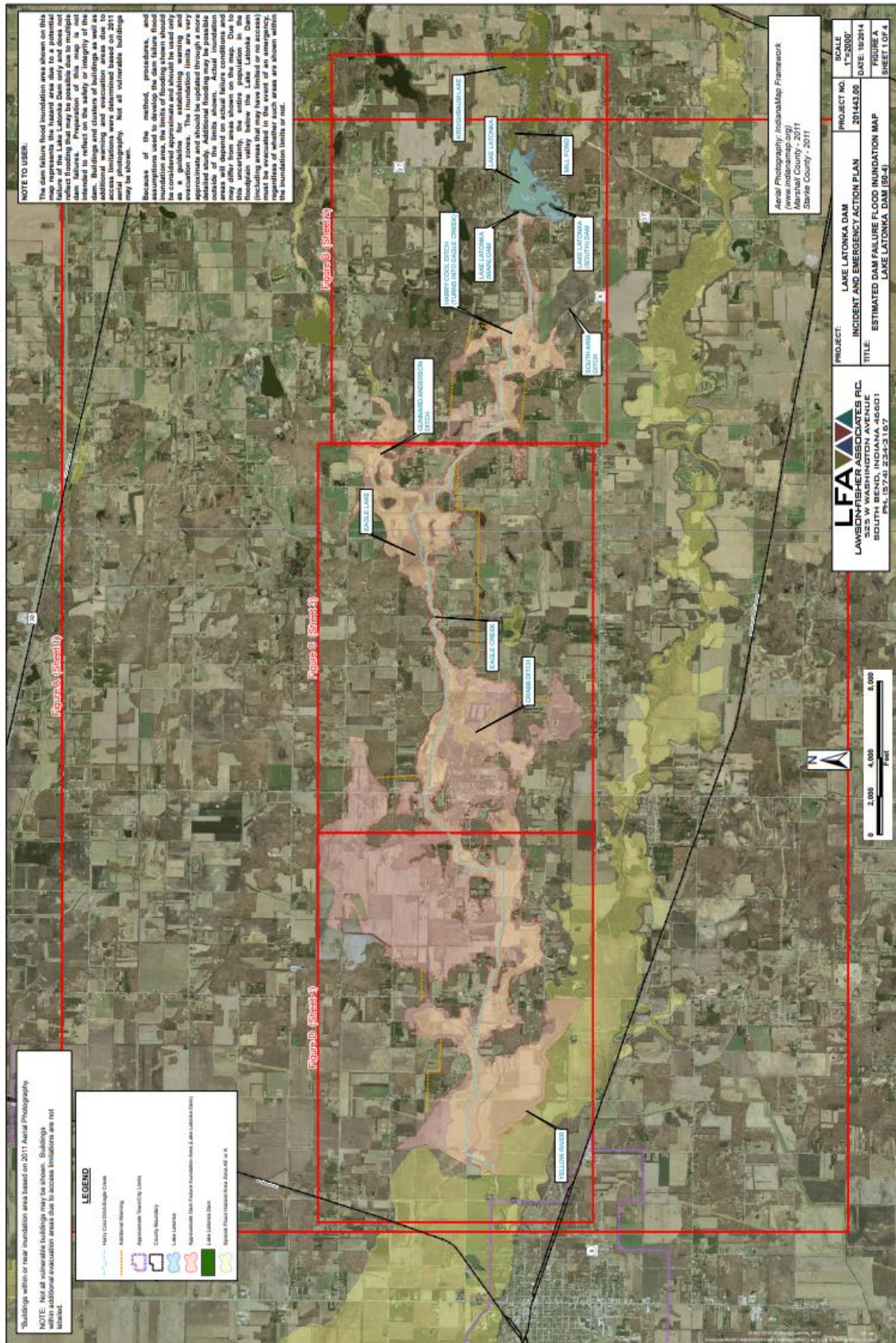
The approximate dam failure flood inundation mapping was performed only to determine the general limits of a potential failure of the Lake Latonka Dam for notification purposes. The terrain in the vicinity downstream of the dam is such that floodwaters could potentially flow into areas beyond what is mapped. This type of scenario is beyond the limits of the one-dimensional steady-flow model used. Actual flooding conditions will also depend on the actual failure conditions during the flood emergency and may differ from the areas shown on the map.

The following maps indicate potential Lake Latonka Dam failure inundation zones.





### Map 11: Lake Latonka Inundation Areas

















An Incident and Emergency Action Plan has not been created for Zehner Mill Pond Dam, causing a data deficiency for this plan. While the Indiana Department of Natural Resources does provide basic inundation mapping through its DAM Breach Inundation Area ARCGIS mapping service, no mapping has been completed for Zehner Mill Pond Dam. The following map, from the Indiana Department of Natural Resources DAM Breach Inundation Area ARCGIS mapping service is provided to illustrate nearby housing and transportation infrastructure that may be impacted by a dam failure.

**Map 12: Location Map of Zehner Mill Pond Dam**







Dam failure can impact critical infrastructure. Critical infrastructure can be impacted in the following ways:

- Unable to be accessed by personnel due surrounding conditions
- Loss of utilities due to downed lines
- Structural damage
- Complete structural failure

The greatest potential vulnerability of a jurisdiction’s population is the inability to predict a dam failure and evacuate potential inundation areas in a timely manner. As such, Incident Emergency Action Plans should be regularly exercised and revised, and information should be regularly provided to residents in potential inundation zones, to help minimize potential loss of life. Critical infrastructure and facilities are not anticipated to be impacted beyond possible power loss and transportation route disruption.

#### **4.6.6 Potential Impact of Climate Change**

As indicated by the United State Environmental Protection Agency’s “What Climate Change Means for Indiana,” Marshall County is likely to see an increase in the frequency of floods. Over the last half century, average annual precipitation in most of the Midwest has increased by 5 to 10 percent. But rainfall during the four wettest days of the year has increased about 35 percent, and the amount of water flowing in most streams during the worst flood of the year has increased by more than 20 percent. During the next century, spring rainfall and average precipitation are likely to increase, and severe rainstorms are likely to intensify. Each of these factors will tend to further increase the risk of flooding and potential dam failure.

#### **4.6.7 Land Use and Development Trends**

Any future development in identified or suspected inundation areas would increase the potential impact of this hazard. However, the generally static nature of the Marshall County population during the past ten years indicates that future development will likely be minimal.

#### **4.6.8 Unique or Varied Risk**

Citizens of Marshall County and any structures located within identified or potential inundation areas are at an increased risk for injury, death and property loss due to dam failures. Neither the Town of Bourbon nor staff and students at Marian University - Ancilla College have any population or structures at risk from a dam failure event due to their distance from identified high hazard dams.

#### **4.6.9 Data Failure**

An Incident and Emergency Action Plan has not been completed for Zehner Mill Pond High Hazard Dam. To alleviate this data deficiency, Marshall County has added an action to its list of mitigation action items.

Local observations indicate the potential presence in Marshall County of Non-Levee Embankments. Non-Levee Embankments are typically artificial mounds of soil or broken rock that support infrastructure, such as highways or railroads, in low areas, or are used to impound water. These Non-Levee Embankments are of concern because they can impose lateral constraints on flood flows, reducing the floodplain storage capacity and increasing the flood velocity. As a result, downstream flooding and the potential for stream erosion can increase. Additionally, their failure could result in the immediate, and potentially dangerous flooding of adjacent areas.

Two factors compound this potential hazard. To date, no mapping or identification of Non-Levee Embankments has occurred in Marshall County or in the greater State of Indiana and, Non-Levee Embankments are neither certified or engineered to provide flood protection. As such, Marshall County has elected to add Non-Levee Embankment identification and mapping to its list of mitigation action items.

## 4.7 Drought

### 4.7.1 Hazard Description

Drought is defined as an abnormally dry period lasting months or years when an area has a deficiency of water and precipitation in its surface and or underground water supply. It is, however, a normal, seasonal, and recurrent feature of climate that occurs in virtually all climate zones—typically in late spring through early fall. The duration of drought varies widely. There are cases when drought develops relatively quickly and lasts a very short period of time, exacerbated by extreme heat and/or wind, and there are other cases when drought spans multiple years, or even decades. The hydrological imbalance can be grouped into the following non-exclusive categories:



- Agricultural: When the amount of moisture in the soil no longer meets the needs of previously grown crops
- Hydrological: When surface and subsurface water levels are significantly below their normal levels
- Meteorological: When there is a significant departure from the normal levels of precipitation
- Socio-Economic: When the water deficiency begins to significantly affect the population

When below average, little or no rain falls, soil can dry out, and plants can die. If unusually dry weather persists and water supply problems develop the period is defined as a drought. Human activity such as over-farming, excessive irrigation, deforestation, and poor erosion controls can exacerbate a drought’s effects. It can take weeks or months before the effects of below average precipitation on bodies of water are observed. Depending upon the region, droughts can happen more quickly, noticed sooner, or have their effects naturally mitigated. The more humid and wet an area is, the faster the effects will be realized. A naturally dry region, which typically relies more on subsurface water will take more time to actualize its effects.

Periods of drought can have significant environmental, agricultural, health, economic, and social consequences. The effects vary depending upon vulnerability and regional characteristics. Droughts can also reduce water quality through a decreased ability for natural rivers and streams to dilute pollutants and increase contamination. The most common effects are diminished crop yield, increased erosion, dust storms, ecosystem damage, reduced electricity production due to reduced flow through hydroelectric dams, shortage of water for industrial production, and increased risk of wildland fires.

Droughts are regularly monitored by multiple federal agencies using a number of different indices. Among them are the U.S. Drought Monitor, the Palmer Drought Index, and the Standardized Precipitation Index, as next described.

The U.S. Drought Monitor provides a summary of drought conditions across the U.S. and Puerto Rico. Often described as a blend of art and science, the map is updated weekly by combining a variety of data-based drought indices and indicators, along with local expert input, into a single composite drought indicator.

The Palmer Drought Index (PDI), devised in 1965, was the first drought indicator to assess moisture status comprehensively. It uses temperature and precipitation data to circulate water supply and demand; incorporates soil moisture; and is considered most effective for non-irrigated cropland. It primarily reflects long-term drought and has been used extensively to initiate drought relief.

**Table 20: Palmer Drought Severity Index**

| Category       | Range (Per Year) |
|----------------|------------------|
| Extremely Wet  | 4.0 or more      |
| Very Wet       | 3.0 to 3.99      |
| Moderately Wet | 2.0 to 2.99      |



**Table 20: Palmer Drought Severity Index**

| Category            | Range (Per Year) |
|---------------------|------------------|
| Slightly Wet        | 1.0 to 1.99      |
| Incipient Wet Spell | 0.5 to 0.99      |
| Near Normal         | 0.49 to -0.49    |
| Incipient Dry Spell | -0.5 to -0.99    |
| Mild Drought        | -1.0 to -1.99    |
| Moderate Drought    | -2.0 to -2.99    |
| Severe Drought      | -3.0 to -3.99    |
| Extreme Drought     | -4.0 or less     |

Source: U.S. Drought Monitor

The Standardized Precipitation Index (SPI) is a way of measuring drought that is different from the PDI. Like the PDI, this index is negative for drought, and positive for wet conditions. However, the SPI is a probability index that considers only precipitation, while PDI indices are water balance indices that consider water supply (precipitation), demand (evapotranspiration) and loss (runoff).

**Table 21: Standard Precipitation Index**

| Category       | Range (Per Year) |
|----------------|------------------|
| Extremely Wet  | 2.0+             |
| Very Wet       | 1.5 to 1.99      |
| Moderately Wet | 1.0 to 1.49      |
| Near Normal    | -.99 to .99      |
| Moderately Dry | -1.0 to -1.49    |
| Severely Dry   | -1.5 to -1.99    |
| Extremely Dry  | -2 and less      |

Source: U.S. Drought Monitor

One of the best indicators of historic drought periods is provided by the U.S. Drought Monitor, which lists weekly drought conditions for the State of Indiana. The following table details the U.S. Drought Monitor categories.

**Table 22: U.S. Drought Monitor Categories**

| Rating | Described Condition   |
|--------|-----------------------|
| None   | No drought conditions |
| D0     | Abnormally Dry        |
| D1     | Moderate Drought      |
| D2     | Severe Drought        |
| D3     | Extreme Drought       |
| D4     | Exceptional Drought   |

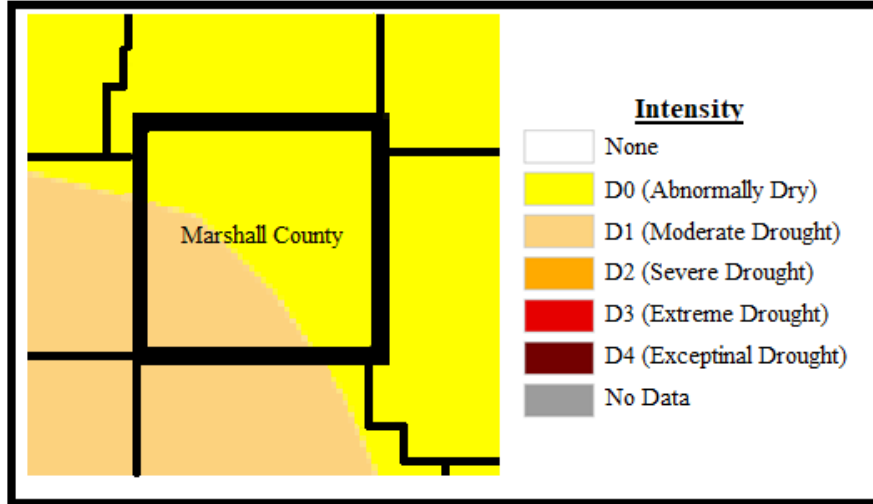
Source: U.S. Drought Monitor

**4.7.2 Location & Extent**

Drought is a persistent problem across the State of Indiana, as evidenced by its widespread presence in 2022. The U.S. Drought Monitor is currently reporting that for December 2022, the majority of the State of Indiana is impacted by drought conditions.

Drought can impact the entire planning area, and as indicated in the following maps, at the time of this plan, 100% of Marshall County is indicated to have an abnormally dry or moderate drought rating.

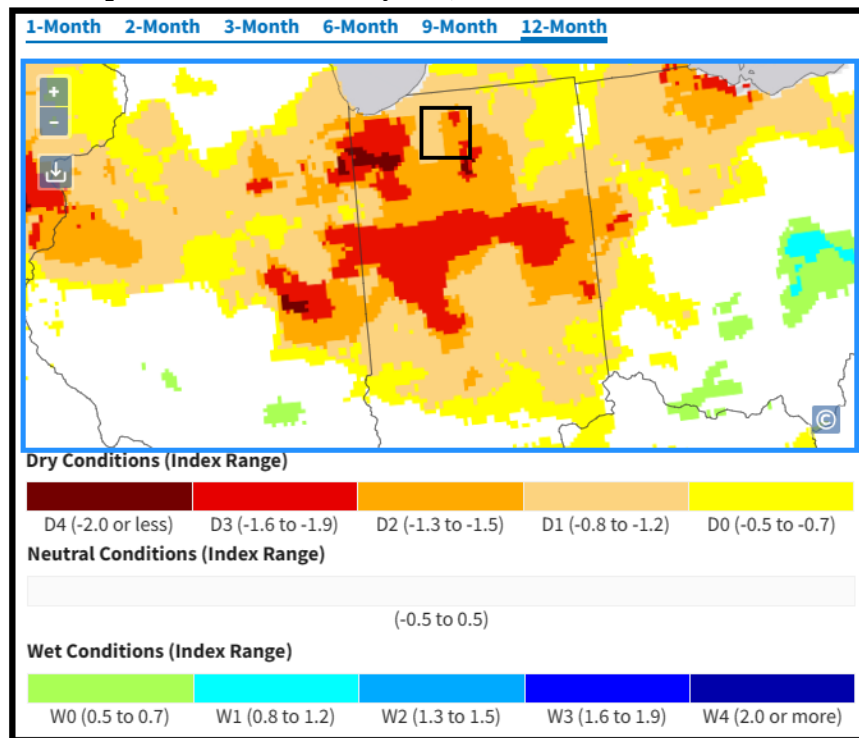
**Map 13 - Marshall County Drought Conditions, January 2023**



Map Source: U.S. Drought Monitor

The following map indicates the SPI for the 12-month period from December 2012 to December 2022.

**Map 14 - Marshall County SPI, November – December 2021**



Map Source: NOAA

### 4.7.3 Previous Occurrences

Comprehensive data on droughts, drought impacts, and drought forecasting is extremely limited and often inaccurate. Due to the complexity of drought monitoring and the large areas droughts impact, agencies have difficulty quantifying and standardizing drought data.

One of the best indicators of historic drought periods is provided by the U.S. Drought Monitor, which lists weekly drought conditions for the Marshall County. Historical data was gathered from the U.S. Drought Monitor weekly reports



for the 10-year period between 2013 and 2022 (with the years 2103 and 2022 being full dataset years). This data was compiled and aggregated to provide a yearly estimate of the percentage of Marshall County in each Drought Monitor category.

**Table 23: Percentage Area in U.S. Drought Monitor Category**

| Year | None  | D0-D4 | D1-D4 | D2-D4 | D3-D4 | D4   |
|------|-------|-------|-------|-------|-------|------|
| 2022 | 56.0% | 45.9% | 4.9%  | 0.0%  | 0.0%  | 0.0% |
| 2021 | 53.6% | 46.4% | 20.2% | 0.0%  | 0.0%  | 0.0% |
| 2020 | 44.4% | 55.6% | 35.5% | 0.0%  | 0.0%  | 0.0% |
| 2019 | 82.4% | 19.5% | 8.9%  | 0.0%  | 0.0%  | 0.0% |
| 2018 | 88.8% | 11.2% | 0.0%  | 0.0%  | 0.0%  | 0.0% |
| 2017 | 96.3% | 3.7%  | 0.0%  | 0.0%  | 0.0%  | 0.0% |
| 2016 | 88.7% | 11.3% | 0.0%  | 0.0%  | 0.0%  | 0.0% |
| 2015 | 62.7% | 37.3% | 0.0%  | 0.0%  | 0.0%  | 0.0% |
| 2014 | 96.1% | 3.9%  | 0.0%  | 0.0%  | 0.0%  | 0.0% |
| 2013 | 72.0% | 29.9% | 5.8%  | 0.0%  | 0.0%  | 0.0% |

Source: U.S. Drought Monitor

As a result of drought conditions, Marshall County has observed the following impacts for each of the identified drought monitor categories that have impacted the county over the last 10 years:

**Table 24: Marshall County Drought Impacts**

| Category | Historically Observed Impacts              |
|----------|--|
| D0       | Low soil moisture                          |
|          | Fire danger increase                       |
| D1       | Livestock need supplemental feed and water |
|          | Crops need supplemental water              |
|          | Fire danger increases                      |

**4.7.4 Probability of Future Events**

Historically, drought has affected the Marshall County region on a reoccurring basis. In reviewing historical data from the U.S. Drought Monitor weekly reports from January 2013 through December 2022 a yearly average can be created indicating the percentage time in each Drought Monitor category. This average can be used to extrapolate the potential likelihood of future drought conditions.

**Table 25: Estimated Probability of Marshall County Being in U.S. Drought Monitor Category, Calendar Year**

| None  | D0-D4 | D1-D4 | D2-D4 | D3-D4 | D4   |
|-------|-------|-------|-------|-------|------|
| 74.1% | 26.5% | 7.5%  | 0.0%  | 0.0%  | 0.0% |

Data: U.S. Drought Monitor

**4.7.5 Vulnerability and Impact**

The impacts of drought can be categorized as economic, environmental, or social. Many economic impacts occur in agriculture and related sectors, including increasing food prices globally. In addition to obvious losses in yields in both crop and livestock production, drought is associated with increases in insect infestations, plant disease, and wind erosion. Droughts also bring increased problems with insects and disease to forests and reduce growth. The incidence of wildfires increases substantially during extended droughts, which in turn places both human and wildlife populations at higher levels of risk. Income loss is another indicator used in assessing the impacts of drought because so many sectors are affected.

Although environmental losses are difficult to quantify, increasing public awareness and concern for environmental quality has forced public officials to focus greater attention and resources on these effects. Environmental losses are the



result of damage to plant and animal species, wildlife habitat, and air and water quality, wildfires, degradation of landscape quality, loss of biodiversity, and soil erosion. Some of the effects are short-term and conditions quickly return to normal following the end of the drought. Other environmental effects linger for some time or may even become permanent. Wildlife habitat, for example, may be degraded through the loss of wetlands, lakes, and vegetation. However, many species will eventually recover from it if it is a temporary aberration. However, the degradation of landscape quality, with increased soil erosion, may lead to a more permanent loss of biological productivity of the landscape.

Droughts are rarely a direct cause of death, though the associated heat, dust, and stress can all contribute to increased mortality. However, drought can severely challenge a public water supplier through depletion of the raw water supply and greatly increased customer water demand. Even if the raw water supply remains adequate, problems due to limited treatment capacity or limited distribution system capacity may be encountered. Water supply planning is the key to minimizing the effects of drought on the population. Public water suppliers should continue to work to identify vulnerabilities and develop infrastructure, conservation plans, and partnerships to reduce the likelihood of running out of water during a drought. It is worth noting that population effects will likely be minimized by predicted population decreases for all participating jurisdictions within Marshall County.

In general, critical facilities and infrastructure are not directly vulnerable to losses as a result of drought. However, there is a potential that operations could be impacted by power failures caused by either increased utility demand or damaged power delivery infrastructure.

The largest impact to Marshall County will likely be felt in the agricultural community. As previously indicated by USDA National Agricultural Statistics Service data in the following table, Marshall County is seeing growth in all agricultural sectors. USDA Risk Management Agency crop loss data relating to drought for the five-year period of 2018 to 2022, with 2018 and 2022 being full dataset years, allows us to quantify the monetary impact of drought conditions on the agricultural sector. While it is likely that the market value of crops sold is higher for each subsequent year, the latest available data is for 2017. The higher the percentage loss, the higher the related vulnerability to drought events.

**Table 26: Marshall County Crop Insurance Paid for Drought Loss, 2018 - 2022**

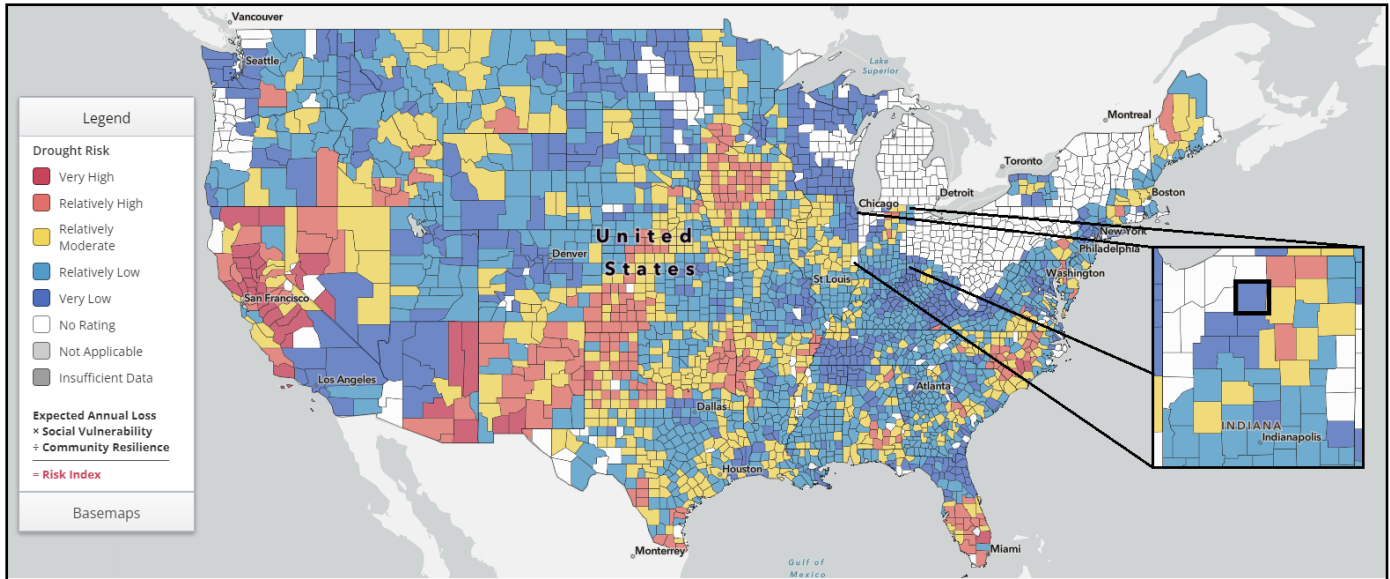
| Year | Market Value of Agricultural Products Sold (2017) | Annualized Crop Insurance Paid | Percentage of Market Value Impacted |
|------|---|--------------------------------|-------------------------------------|
| 2022 | \$145,167,000                                     | \$39,218                       | 0.03%                               |
| 2021 | \$145,167,000                                     | \$71,963                       | 0.04%                               |
| 2020 | \$145,167,000                                     | \$985,691                      | 0.7%                                |
| 2019 | \$145,167,000                                     | \$660,569                      | 0.5%                                |
| 2018 | \$145,167,000                                     | \$242,062                      | 0.2%                                |

Source: USDA

Using the FEMA NRI, and consisting of three input components (expected annual loss, social vulnerability, and community resilience), the following map was created indicating the potential risk to Marshall County from drought (Very Low):



**Map 15: FEMA NRI Drought Risk**

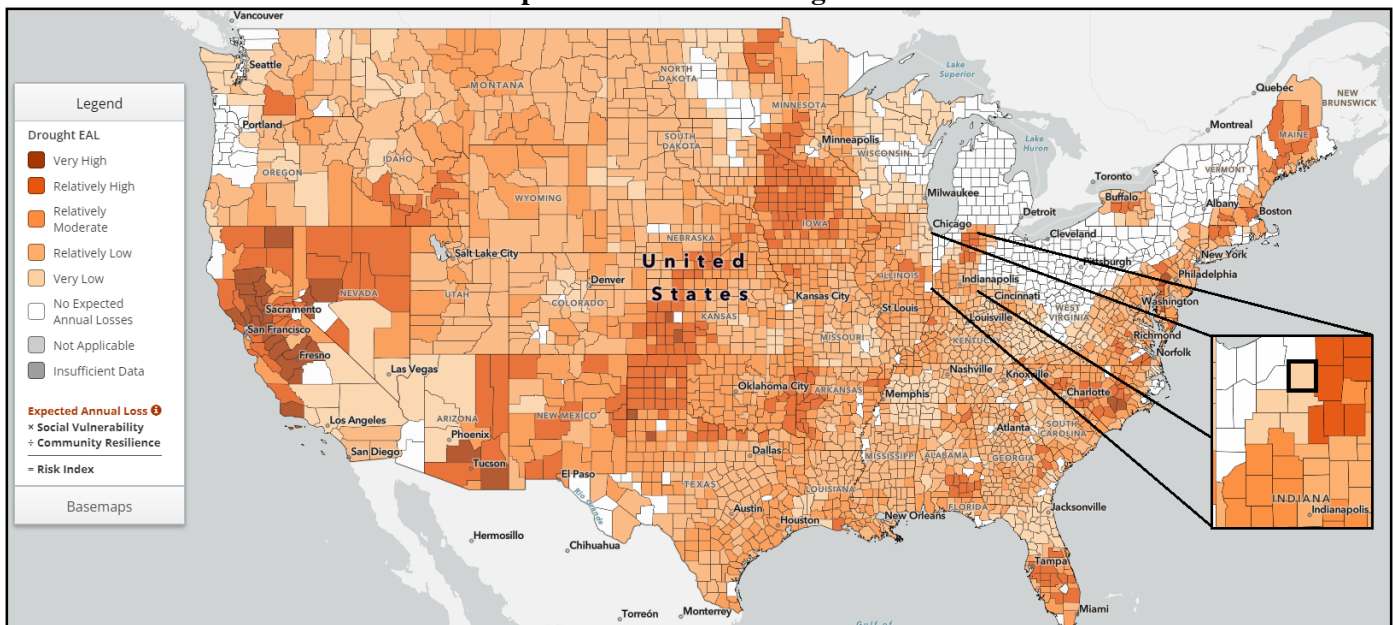


Source: FEMA NRI

As part of the NRI, Expected Annual Loss (EAL) represents the average economic loss in dollars resulting from a hazard each year. It quantifies loss for relevant consequence types, buildings, people, and agriculture. An EAL score and rating represent a community's relative level of expected losses each year when compared to all other communities at the same level. EAL is calculated using an equation that includes exposure, annualized frequency, and historic loss ratio risk factors. Exposure is a factor that measures the building value, population, and agriculture value potentially exposed to a natural hazard occurrence. Annualized frequency is a factor that measures the expected frequency or probability of a hazard occurrence per year. Historic loss ratio is a factor that measures the percentage of the exposed consequence type value (building, population, or agriculture) expected to be lost due to an occurrence. EAL represents the average economic loss in dollars resulting from natural hazards each year and is proportional to a community's risk.

The following map indicates the EAL for drought for Marshall County (Very Low)

**Map 16: FEMA NRI Drought EAL**



Source: FEMA NRI





#### **4.7.6 Potential Impact of Climate Change**

Over the last half century, average annual precipitation in most of the Midwest has increased by 5 to 10 percent. During the next century, spring rainfall and average precipitation are likely to increase, and severe rainstorms are likely to intensify. Each of these factors will tend to further decrease the likelihood of drought occurrences.

#### **4.7.7 Land Use and Development Trends**

Future development speaks to the potential impacts of land use and demographic changes in hazard prone areas. Data in this section is speculative, as future conditions are subject to numerous unpredictable factors. While past trends are used to inform the discussion, previous historical trends are no guarantee of future conditions.

The agriculture base of Marshall County is vulnerable to the short- and long-term effects of drought. Continued development in the agricultural sector will likely increase both the exposure to, and damages from, a drought event. As indicated in the data above, Marshall County is seeing a continuing projected increase in agricultural activities and thus potential greater future vulnerability to drought events. However, as also indicated in the data above, Marshall County and all participating jurisdictions have been seeing generally static or declining populations. These potential declines could decrease the impact to their populations from a drought event from decreased water demands.

#### **4.7.8 Unique and Varied Risk**

All participating jurisdictions are at equal risk to drought events. Especially at risk may be vulnerable populations of each participating jurisdiction, including the especially young, the elderly, and those below the poverty level. The following Census data indicates at risk population levels for Marshall County and Bourbon:

- Marshall County:
  - Population under the age of five: 2,979
  - Population over the age of 65: 8,159
  - Population below the poverty level: 5,255
  
- Bourbon:
  - Population under the age of five: 198
  - Population over the age of 65: 202
  - Population below the poverty level: 202



## 4.8 Extreme Temperatures

### 4.8.1 Hazard Description

Extreme temperature events occur when climate conditions produce temperatures well outside of the predicted norm. These extremes can have severe impacts on human health and mortality, natural ecosystems, agriculture, and other economic sectors.

The Center for Disease Control identifies the following six groups as being especially vulnerable to extreme temperatures:

- Older Adults (aged 65)
- Infants and Children
- Individuals with Chronic Conditions
- Low-income Individuals
- Athletes
- Outdoor workers



### 4.8.2 Location & Extent

In general, Marshall County has a humid continental climate that sees wet, warm summers, cold winters, and evenly distributed rainfall throughout the year. However, all of Marshall County is at risk to extreme temperatures, defined as:

- Extreme heat is defined as temperatures that hover 10 degrees or more above the average high temperature for the region and last for several weeks. Ambient air temperature is one component of heat conditions, with relative humidity being the other. Humid or muggy conditions, which add to the discomfort of high temperatures, occur when an area of high atmospheric pressure traps moisture laden air near the ground.
- Although no specific definition exists for extreme cold, an extreme cold event can generally be defined as temperatures at or below freezing for an extended period of time. Extreme cold events are usually part of winter storm events but can occur during anytime of the year and can have devastating effects on agricultural production.

The following table and chart present average climate data for Marshall County.

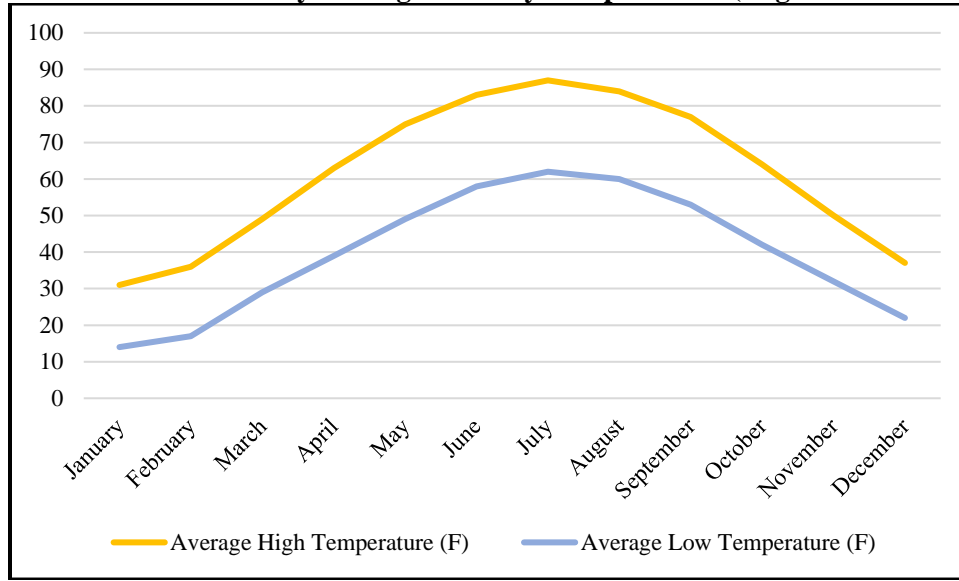
**Table 27: Regional Average High Temperatures (Degrees Fahrenheit)**

|                                 | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Average Maximum Temperature (F) | 31  | 36  | 49  | 63  | 75  | 83  | 87  | 84  | 77  | 64  | 50  | 37  |
| Average Minimum Temperature (F) | 14  | 17  | 29  | 39  | 49  | 58  | 62  | 60  | 53  | 42  | 32  | 14  |

Source: NOAA



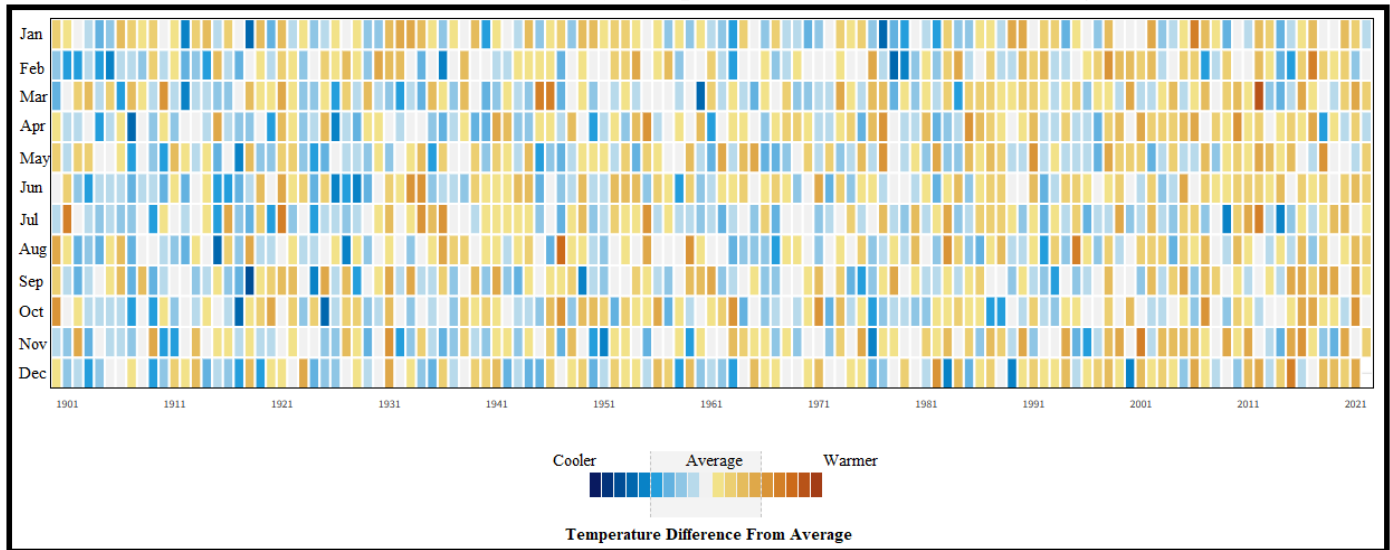
Chart 8: Marshall County Average Monthly Temperatures (Degrees Fahrenheit)



Source: NOAA

Data from NOAA indicates that Marshall County experienced a record high temperature of 109(F) in 1936, and a record low temperature of -26(F) in 1972. However, it is believed that both the average high temperatures and the record high temperature will likely increase over the coming years. As indicated by the below graph, using data generated from the NCEI, temperatures for Marshall County are more frequently exceeding average temperatures, likely an impact of climate change.

Chart 9: Marshall County Temperature Difference from Average



Source: NCEI

Based on available data, Marshall County can continually expect sporadic, and potentially more frequent incidences of extreme temperatures.

4.8.3 Previous Occurrences

The following table presents NCEI identified extreme heat temperature events and the resulting damage totals in Marshall County from 2003 to 2022. with the years 2003 and 2022 being full dataset years, for the region. Data was reviewed regionally as the extreme temperature events covered large areas.



**Table 28: Marshall County NCEI Extreme Temperature Events, 2003 - 2022**

| Event Type     | Number of Events | Property Damage | Deaths | Injuries |
|----------------|------------------|-----------------|--------|----------|
| Excessive Heat | 0                | \$0             | 0      | 0        |
| Extreme Cold   | 3                | \$0             | 0      | 0        |

Source: NOAA NCEI

**4.8.4 Probability of Future Events**

Predicting the probability of extreme heat occurrences is tremendously challenging due to the large number of factors involved. Data from the NCEI indicates that Marshall County can expect on a yearly basis, relevant to extreme heat events:

**Table 29: Marshall County Extreme Temperature Probability Summary**

| Data   | Days |
|--|------|
| Number of Days with NCEI Reported Excessive Heat Event (2003-2022) | 0    |
| Average Events per Year  | 0    |
| Number of Days with NCEI Reported Extreme Cold Event (2003-2022)   | 3    |
| Average Extreme Temperature Events per Year                        | <1   |

Source: NCEI

**4.8.5 Vulnerability and Impact**

Data from the NCEI indicates that Marshall County can expect on a yearly basis, relevant to extreme temperature events:

**Table 30: Marshall County Extreme Temperature Impact Summary**

| Data  | Recorded Impact |
|---|-----------------|
| Deaths or Injuries (2003-2022)                  | 0               |
| Average Number of Deaths or Injuries            | 0               |
| Total Reported NCEI Property Damage (2003-2022) | \$0             |
| Average Property Damage per Year                | \$0             |

Source: NCEI

In general, critical facilities and infrastructure are not directly vulnerable to losses as a result of extreme temperatures. However, there is a potential that operations could be impacted by power failures caused by either increased utility demand or damaged power delivery infrastructure.

The largest impact to Marshall County from extreme temperature events will likely be felt in the agricultural community. As previously indicated by USDA National Agricultural Statistics Service data in the following table, Marshall County is seeing growth in all agricultural sectors. USDA Risk Management Agency crop loss data relating to extreme temperatures for the five-year period of 2018 to 2022, with 2018 and 2022 being full dataset years, allows us to quantify the monetary impact of extreme temperature conditions on the agricultural sector. While it is likely that the market value of crops sold is higher for each subsequent year, the latest available data is for 2017. The higher the percentage loss, the higher the related vulnerability to extreme temperature events.

**Table 31: Marshall County Crop Insurance Paid for Extreme Temperature Loss, 2018 - 2022**

| Year | Market Value of Agricultural Products Sold (2017) | Annualized Crop Insurance Paid | Percentage of Market Value Impacted |
|------|---|--------------------------------|-------------------------------------|
| 2022 | \$145,167,000                                     | \$688                          | 0.0%                                |
| 2021 | \$145,167,000                                     | \$25,998                       | 0.02%                               |
| 2020 | \$145,167,000                                     | \$44,964                       | 0.03%                               |
| 2019 | \$145,167,000                                     | \$10,474                       | 0.007%                              |
| 2018 | \$145,167,000                                     | \$5,746                        | 0.004%                              |

Source: USDA



While difficult to quantify, as the impacts of future extreme temperature may have far reaching impacts. The incidence of wildfires increases substantially during extended periods of extreme heat, which in turn places both human and wildlife populations at higher levels of risk. Although environmental impacts are difficult to quantify, losses to plant and animal species, wildlife habitat, and air and water quality, wildfires, degradation of landscape quality, loss of biodiversity, and soil erosion may result from extended periods of extreme temperatures.

A primary concerns with this hazard are human health safety issues, as extreme temperatures can be a direct cause of death. Specific at-risk groups include outdoor workers, farmers, young children, and senior citizens. Compounding these concerns is the potential loss of electric power due to increased strain on power generation and distribution due to increased air conditioning or heating needs.

Extreme temperature impacts on humans can be measured for both heat and cold. The following table discusses potential impacts on human health related to excessive heat.

**Table 32: Extreme Heat Impacts on Human Health**

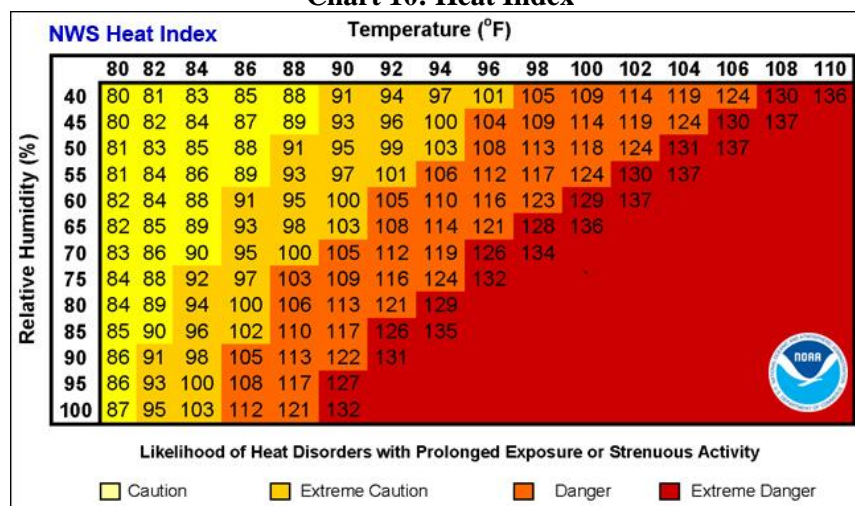
| Heat Index (HI) Temperature | Potential Impact on Human Health  |
|-----------------------------|---|
| 80-90° F                    | Fatigue possible with prolonged exposure and/or physical activity                                     |
| 90-105° F                   | Sunstroke, heat cramps, and heat exhaustion possible with prolonged exposure and/or physical activity |
| 105-130° F                  | Heatstroke/sunstroke highly likely with continued exposure  |

Source: National Weather Service Heat Index Program

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

The following graph, from the NWS, indicates Heat Index values.

**Chart 10: Heat Index**



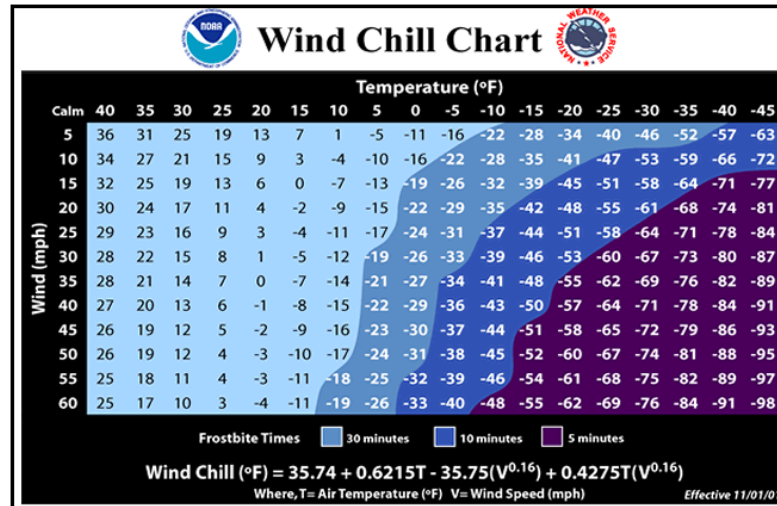
Source: NWS

Extreme cold temperatures can result in a variety of concerns, including:

- Frostbite: The freezing of skin and the body tissue just beneath it
- Hypothermia: Dangerously low body temperature (and the most common winter weather killer)

When extremely cold temperatures are accompanied by strong winds the result can be potentially lethal wind chills. Wind chill is the temperature your body feels when the air temperature is combined with the wind speed. It is based on the rate of heat loss from exposed skin caused by the effects of wind and cold. As the speed of the wind increases, it can carry heat away from your body much more quickly, causing skin temperature to drop. The wind chill chart shows the difference between the actual air temperature and the perceived temperature due to wind, and amount of time until frostbite occurs.

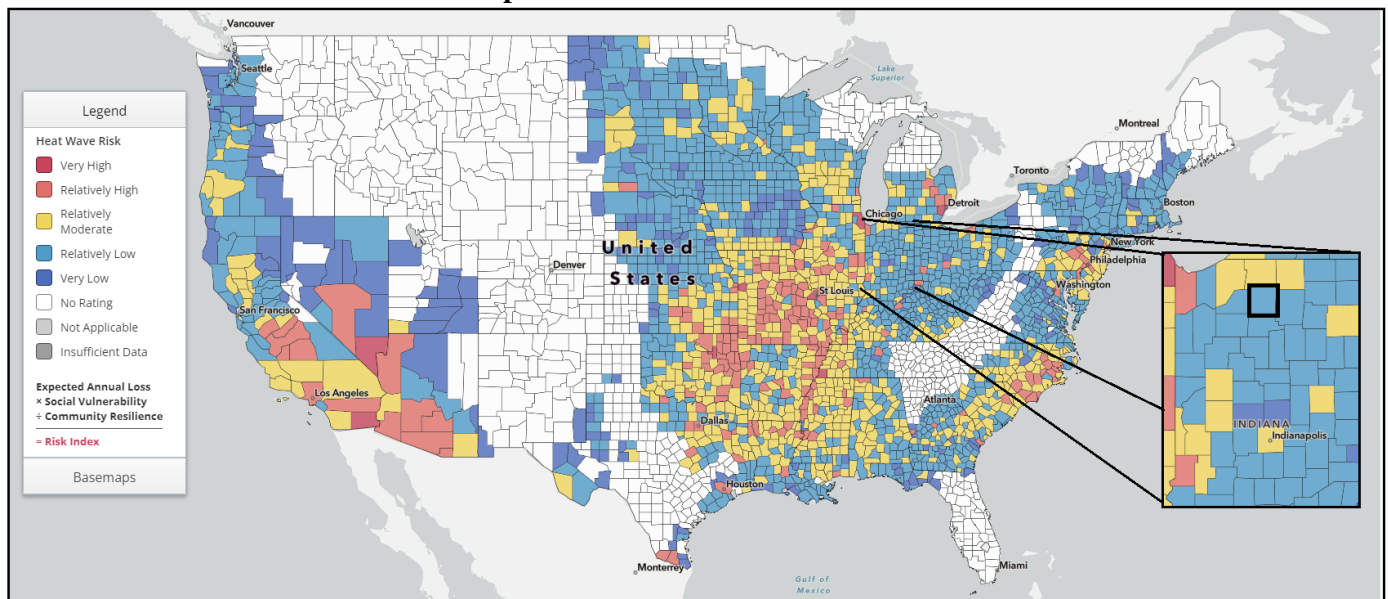
**Chart 11: Wind Chill Chart**



Source: NOAA

Using the FEMA NRI, and consisting of three input components (expected annual loss, social vulnerability, and community resilience), the following maps were created indicating the potential risk to Marshall County from heat waves (Relatively Low) and cold waves (Relatively Moderate):

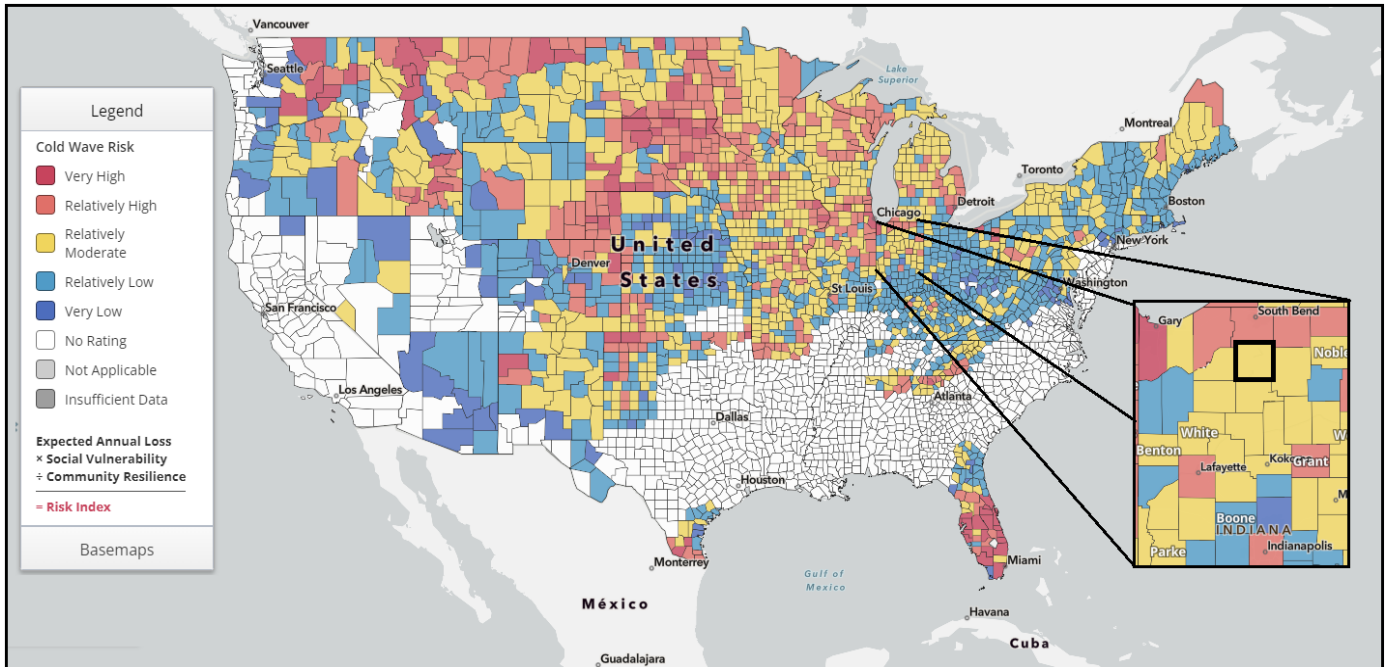
**Map 17: FEMA NRI Heat Wave Risk**



Source: FEMA NRI



**Map 18: FEMA NRI Cold Wave Risk**



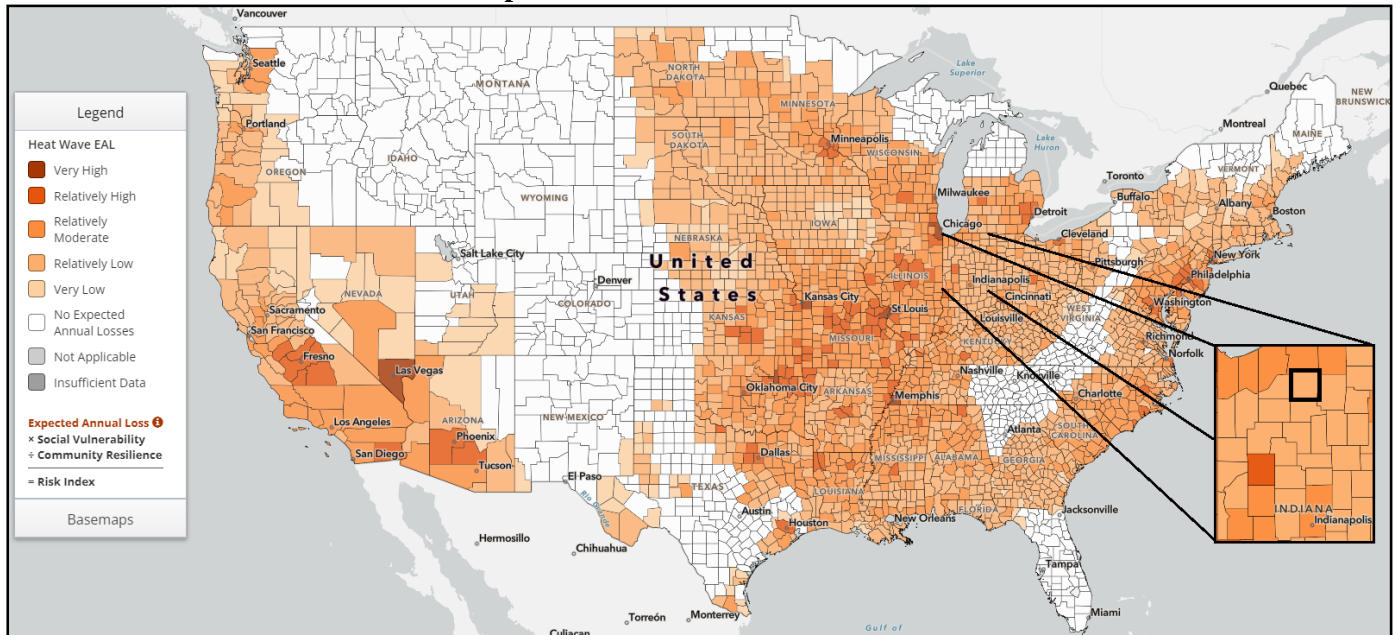
Source: FEMA NRI

As part of the NRI, EAL represents the average economic loss in dollars resulting from a hazard each year. It quantifies loss for relevant consequence types, buildings, people, and agriculture. An EAL score and rating represent a community's relative level of expected losses each year when compared to all other communities at the same level. EAL is calculated using an equation that includes exposure, annualized frequency, and historic loss ratio risk factors. Exposure is a factor that measures the building value, population, and agriculture value potentially exposed to a natural hazard occurrence. Annualized frequency is a factor that measures the expected frequency or probability of a hazard occurrence per year. Historic loss ratio is a factor that measures the percentage of the exposed consequence type value (building, population, or agriculture) expected to be lost due to an occurrence. EAL represents the average economic loss in dollars resulting from natural hazards each year and is proportional to a community's risk.

The following maps indicate the EAL for heat waves (Very Low) and cold waves (Relatively Low) for Marshall County:

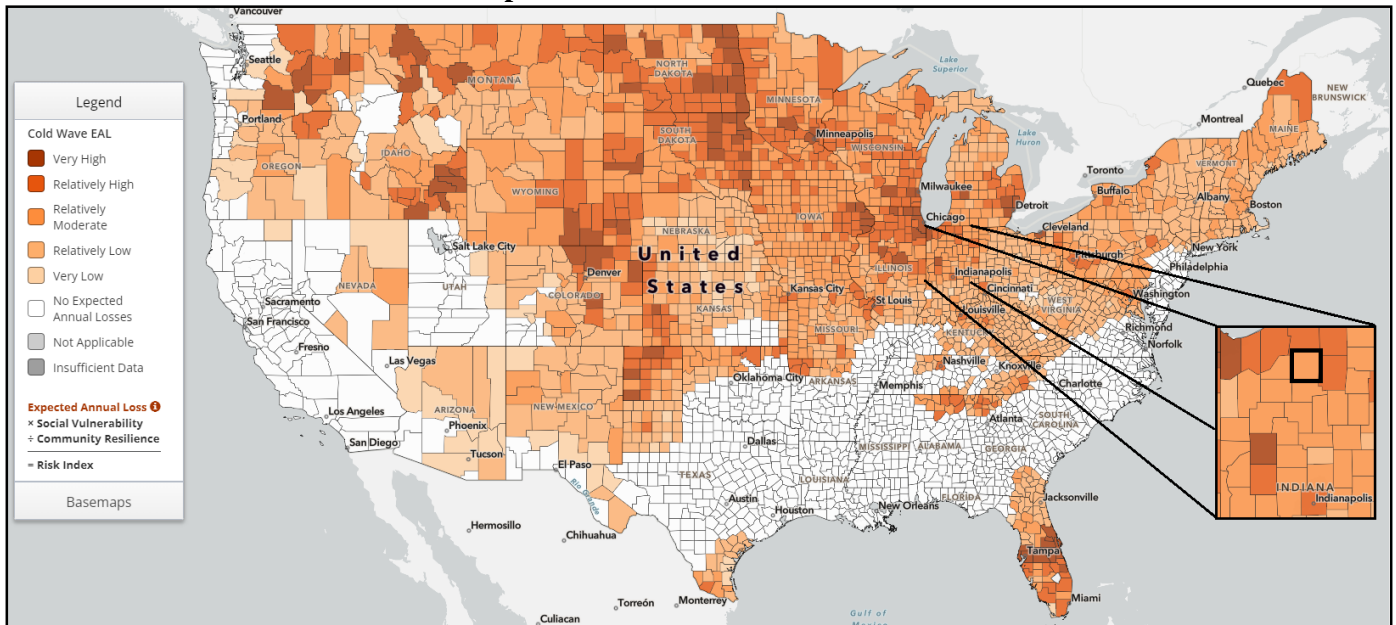


**Map 19: FEMA NRI Heat Wave EAL**



Source: FEMA NRI

**Map 20: FEMA NRI Cold Wave EAL**



Source: FEMA NRI

#### 4.8.6 Potential Impact of Climate Change

When discussing weather patterns, climate change should be considered as it may markedly change future weather-related events. Recent climate modeling results indicate that extreme temperature events may become more common for Marshall County. Rising average temperatures produce a more variable climate system which may result in an increase in the frequency and severity of some extreme weather events including longer and hotter heat waves (and by correlation, an increased risk of wildfires, higher wind speeds, and tornado formation). Additionally, rising temperatures can harm air quality and amplify existing threats to human health. Warmer weather can increase the production of ground-level ozone, a pollutant that causes lung and heart problems. Heat stress is expected to increase as climate



change brings hotter summer temperatures and more humidity. Certain people are especially vulnerable, including children, the elderly, the sick, and the poor.

#### **4.8.7 Land Use and Development Trends**

Future development speaks to the potential impacts of land use and demographic changes in hazard prone areas. Data in this section is speculative, as future conditions are subject to numerous unpredictable factors. While past trends are used to inform the discussion, previous historical trends are no guarantee of future conditions.

The agriculture base of Marshall County is increasingly vulnerable to the short- and long-term effects of extreme temperatures. Future development of agricultural resources would tend to increase the risk and impact of an extreme temperature event. As indicated in the data above, Marshall County is seeing a continuing projected increase in agricultural activities and thus a potential greater future vulnerability to extreme temperature events. However, as indicated in the data above, Marshall County and all participating jurisdictions have been seeing generally static or declining populations. This static or declining population could decrease the impact to citizens from an extreme temperature event through the reduction of demand on infrastructure systems.

#### **4.8.8 Unique and Varied Risk**

All participating jurisdictions are at risk from extreme temperatures. However, lower income communities, or communities poorly served by power infrastructure may suffer disproportionate impacts. Especially at risk may be vulnerable populations of each participating jurisdiction, including the especially young, the elderly, and those below the poverty level. The following Census data indicates at risk population levels for Marshall County and Bourbon:

- Marshall County:
  - Population under the age of five: 2,979
  - Population over the age of 65: 8,159
  - Population below the poverty level: 5,255
  
- Bourbon:
  - Population under the age of five: 198
  - Population over the age of 65: 202
  - Population below the poverty level: 202

## 4.9 Flood/Flash Flood

### 4.9.1 Hazard Description

Flooding, as defined by the National Weather Service (NWS), is the rising and overflowing of a body of water onto normally dry land. It can result from any overflow of inland or tidal waters, or an unusual accumulation or runoff of surface waters from any source. Flooding is loosely classified as inland, riverine, or coastal.

Inland flooding, also known as “urban flooding” or “flash flooding,” can be caused by intense, short-term rain or by moderate rainfall over several days, which can overwhelm existing drainage infrastructure. Other factors that affect the dynamics of this type of flood include slope, width, and vegetation in place along the watercourse banks. The slope that a flash flood traverses has a definite relationship to the overall speed in which the water will travel. The incline on which the water moves affects the width of the flooding area. Generally, the faster the water moves, the narrower that channel will be created, since the water digs the channel deeper as it flows. When water flows over shallower slope, it tends to spread out more, decreasing its potential to cause mass damage but still considered dangerous. Finally, the type of vegetation located along the flood’s path can prevent further erosion of the channel banks. A structure that lies along a flood channel with no surrounding vegetation is at risk of having its foundation undercut, which can cause structural damage, or in some cases, a building’s complete collapse. Riverine or alluvial, flooding occurs when excessive rainfall over an extended period of time causes a river to exceed its capacity. Typical causes of flooding, both inland and riverine, include tropical cyclonic systems, frontal systems, and isolated thunderstorms combined with other environmental variables such as changes to the physical environment, topography, ground saturation, soil types, basin size, drainage patterns, and vegetative cover. The rate of onset and duration of flooding events depends on the type of flooding (typical flood or flash flood). The spatial extent of a flooding event depends on the amount of water overflow but can usually be mapped because of existing floodplains.



*Photo Source: NOAA, Flooding*

A floodplain is a flat or nearly flat land adjacent to a river or stream that experiences occasional or periodic flooding environment, topography, ground saturation, soil types, Floodplains, or Special Flood Hazard Areas (SFHAs), are made when floodwaters exceed the capacity of the main channel or escape the channel by eroding its banks. The sediments (rock and debris) that build up over time from the floodplain’s floor. Floodplains also include a floodway, which consists of the water channel and adjacent areas that carry flood flows and the flood fringe, which are areas covered by the flood but do not experience a strong current.

In its common usage, floodplains refer to areas inundated by the 100-year flood, i.e., the flood that has a 1% chance of being equaled or exceeded in any given year and the 500-year flood, i.e., the flood that has a 0.2% chance of being equaled or exceeded in any given year. The 100-year flood is the national minimum standard to which communities regulate their floodplains through the National Flood Insurance Program (NFIP). The NFIP aims to reduce the impact of flooding on private and public structures. It does so by providing affordable insurance to property owners, renters, and businesses and by encouraging communities to adopt and enforce floodplain management regulations. These efforts help mitigate the effects of flooding on new and improved structures. Overall, the program reduces the socio-economic impact of disasters by promoting the purchase and retention of general risk insurance and flood insurance.

The adverse impacts of flooding can include structural damage; agricultural crop loss; the death of livestock; loss of access to critical facilities due to roads being washed out or overtopped; unsanitary conditions resulting from materials such as dirt, oil, solvents, and chemicals being deposited during the recession; infestations of disease-carrying mosquitoes; mold and mildew, which pose a severe health risk to small children and the elderly; and temporary backwater effects in sewers and drainage systems. Raw sewage is a breeding ground for bacteria, such as E.coli and



other disease-causing agents. A boil order may need to be issued to protect people and animals from contaminated water.

Of equal concern is the long-term psychological effect that flooding has on the people impacted by it. They must contend with the loss of life, property, livelihood, etc., as they cope with the aftermath. The clean-up can take months. The cost to restore a home may be too much, especially for the unprepared or uninsured. Plus, there is the looming fear that it may flood again. The resulting stress on floodplain residents takes its toll in the form of aggravated physical and mental health problems.

Unfortunately, the risks from future floods are significant, given expanded development in coastal areas and floodplains, unabated urbanization, land-use changes, and climate change. Because of this, flooding may intensify in many regions across the country, even in areas where total precipitation is projected to decline.

According to the FEMA, water, and flooding account for about 40% of the Presidential declared disasters in the United States.

#### **4.9.2 Location and Extent**

A variety of factors affect the severity of flash and riverine flooding within the planning area. These include topography, weather characteristics, development, and geology. Intense flooding will create havoc in any jurisdiction affected. The predicative magnitude of flash and riverine floods varies greatly.

##### **Flash Flooding**

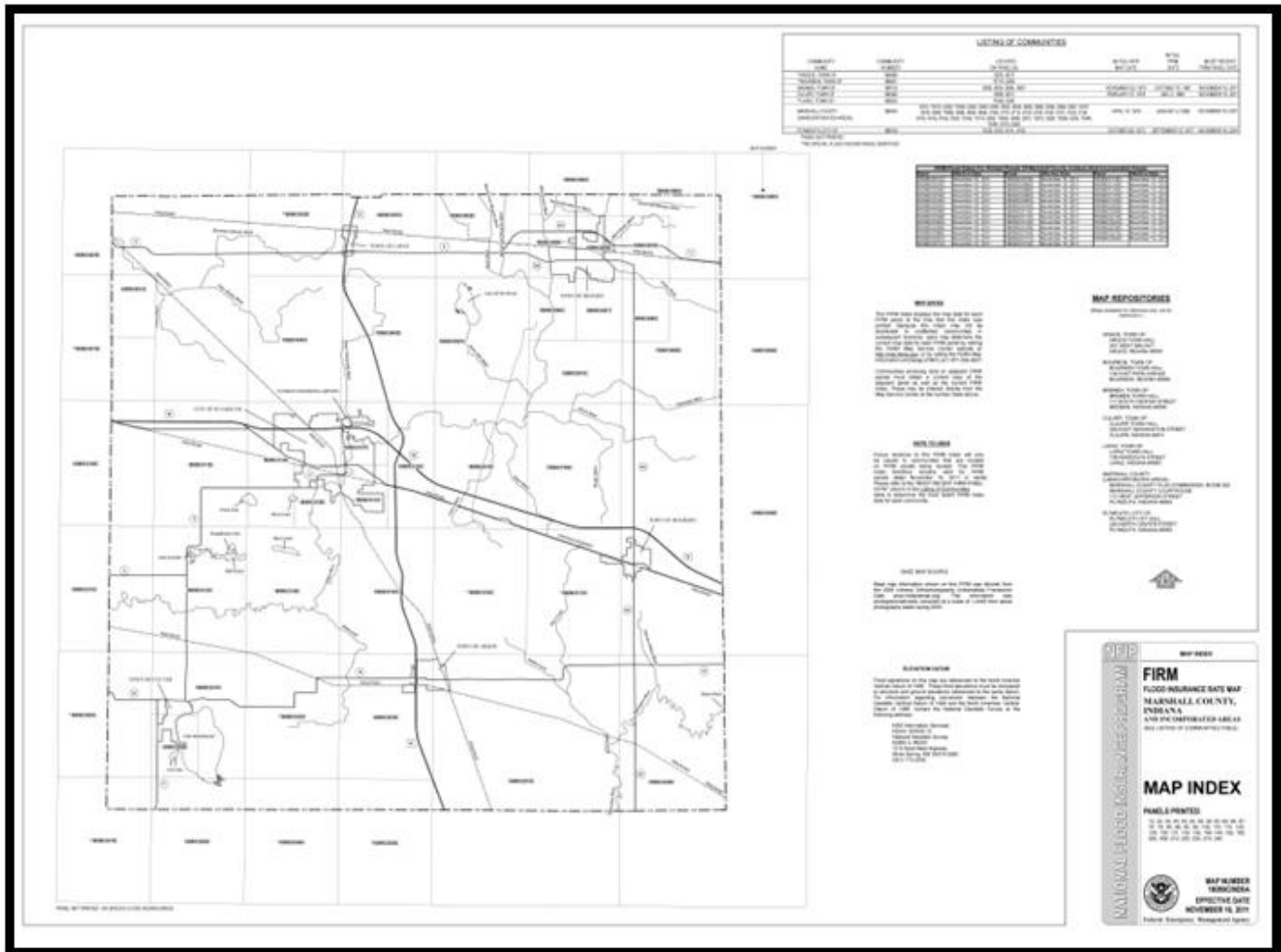
Flash flooding is unpredictable and can occur anywhere throughout the entire planning area. Marshall County and its participating jurisdictions do not have any centralized, or identified reoccurring, locations that are more likely to experience flash flooding than other areas, based on previous events and historical documentation. The reviewed historical documentation repeatedly mentions roads and ditches being flooded, but no specific areas continually experiencing flash flooding. Additionally, when property damage occurred, none of the locations were repeatedly mentioned. Historically, Marshall County and its participating jurisdictions have seen sporadic, severe flash floods. All participating jurisdictions are exposed to flash floods.

##### **Riverine Flooding**

Riverine flooding potential throughout the county varies and is identified via FEMA's FIRM maps. The following map identifies areas of the county with completed FEMA mapping.



**Map 21: Marshall County 100 Year Floodplain Map**



Source: FEMA

The following table details FEMA’s FIRM flood zone classifications.

**Table 33: Flood Zone Classifications**

| <b>Zone</b> | <b>Description</b>  |
|-------------|---|
| A           | An area inundated by 1% annual chance flooding, for which no BFEs have been determined. (100-Year Floodplain)   |
| AE          | An area inundated by 1% annual chance flooding, for which BFEs have been determined. (100-Year Floodplain)  |
| Shaded X    | Areas of 500-year flood; areas of 100-year flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 100-year flood. An area inundated by 0.2% annual chance flooding. |
| Unshaded X  | Area of minimal flood hazard, usually depicted on FIRMs as above the 500-year flood level. Zone X is the area determined to be outside the 500-year flood and protected by levee from 100- year flood.  |

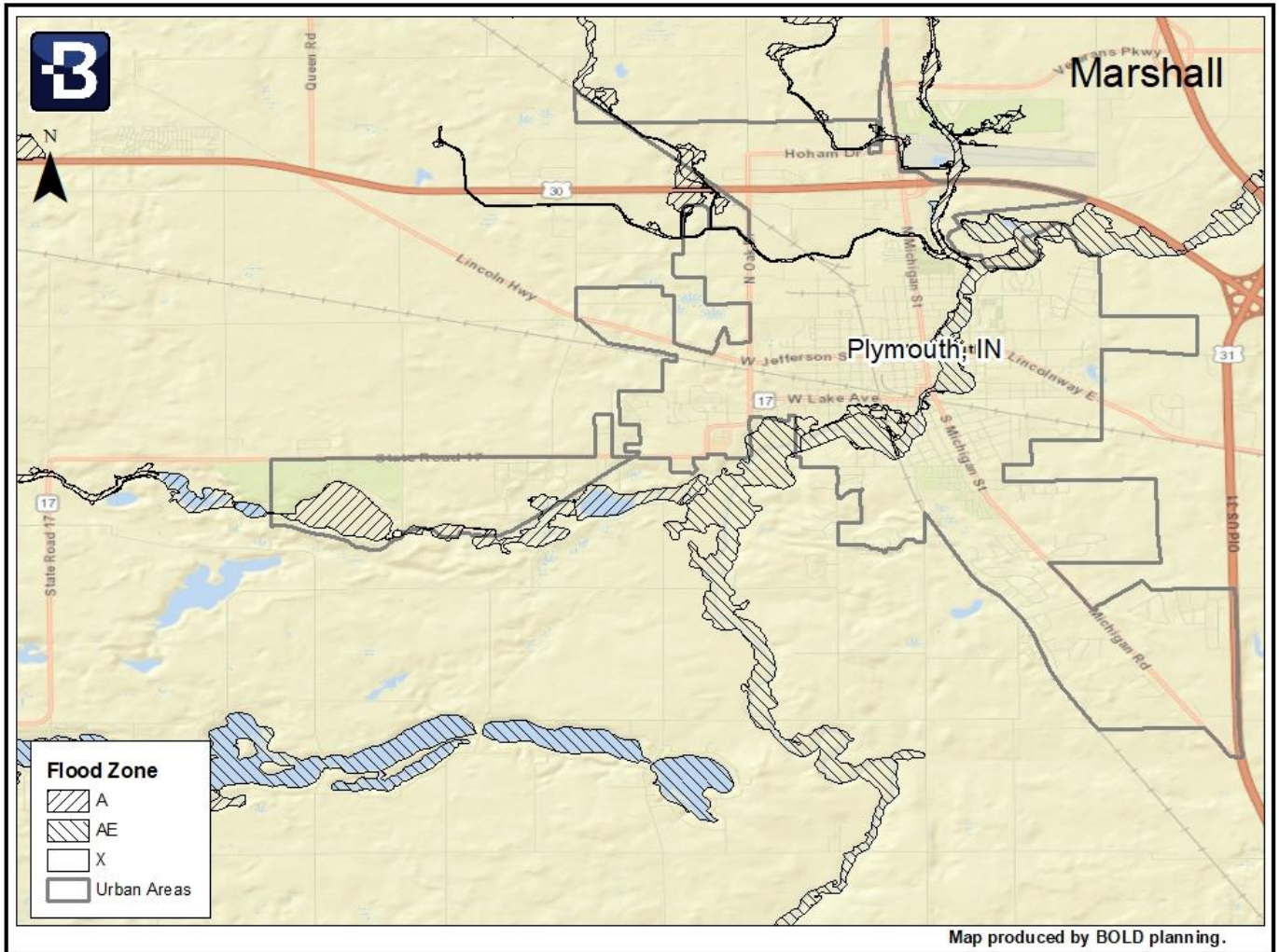
Source: FEMA





The following maps use FEMA FIRM data to depict the location of identified flood zones within Marshall County. Please note that no flood zones were identified in either Bourbon or on the campus of Marian University – Ancilla College.

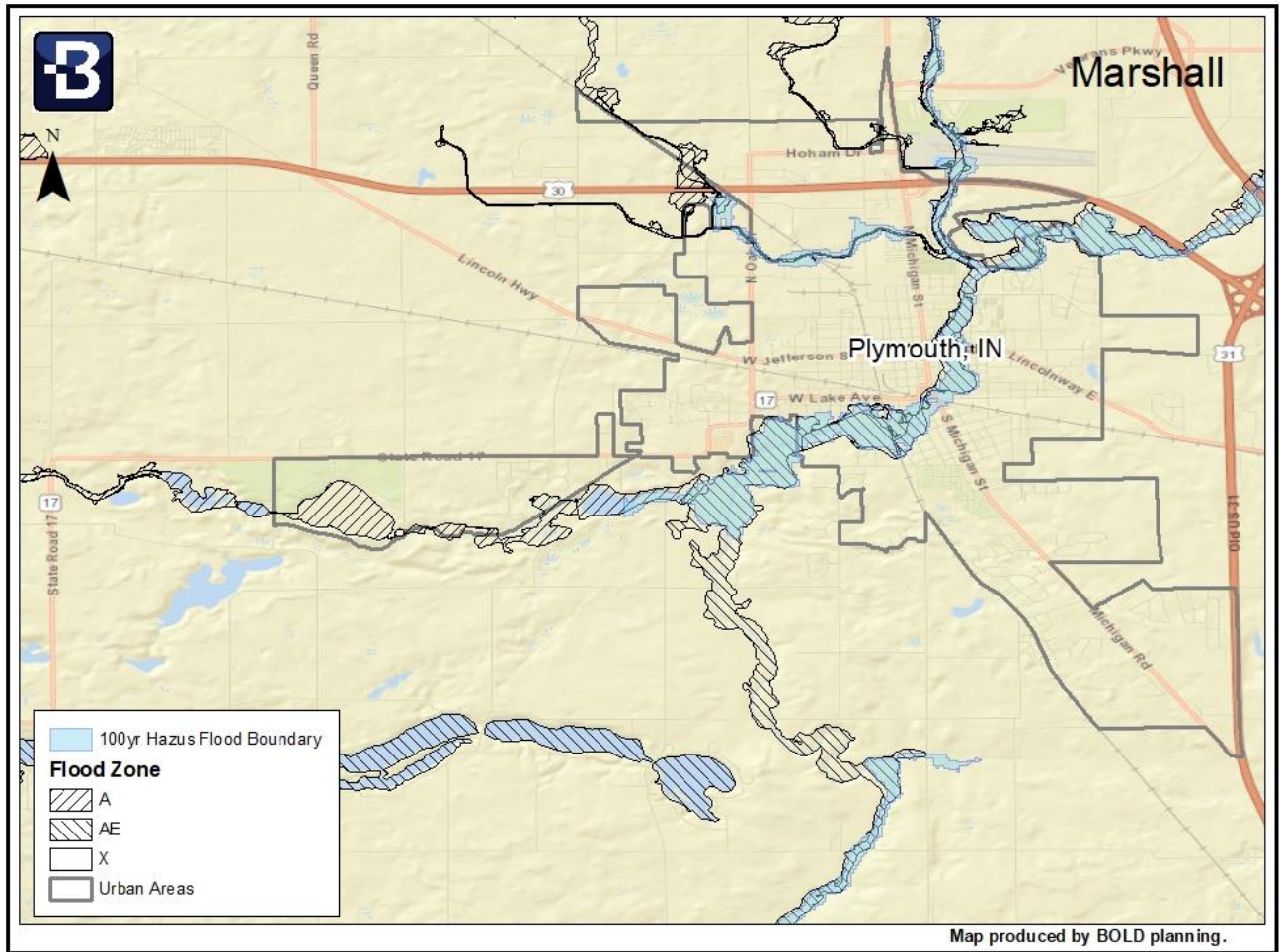
**Map 22: Marshall County Flood Zones**





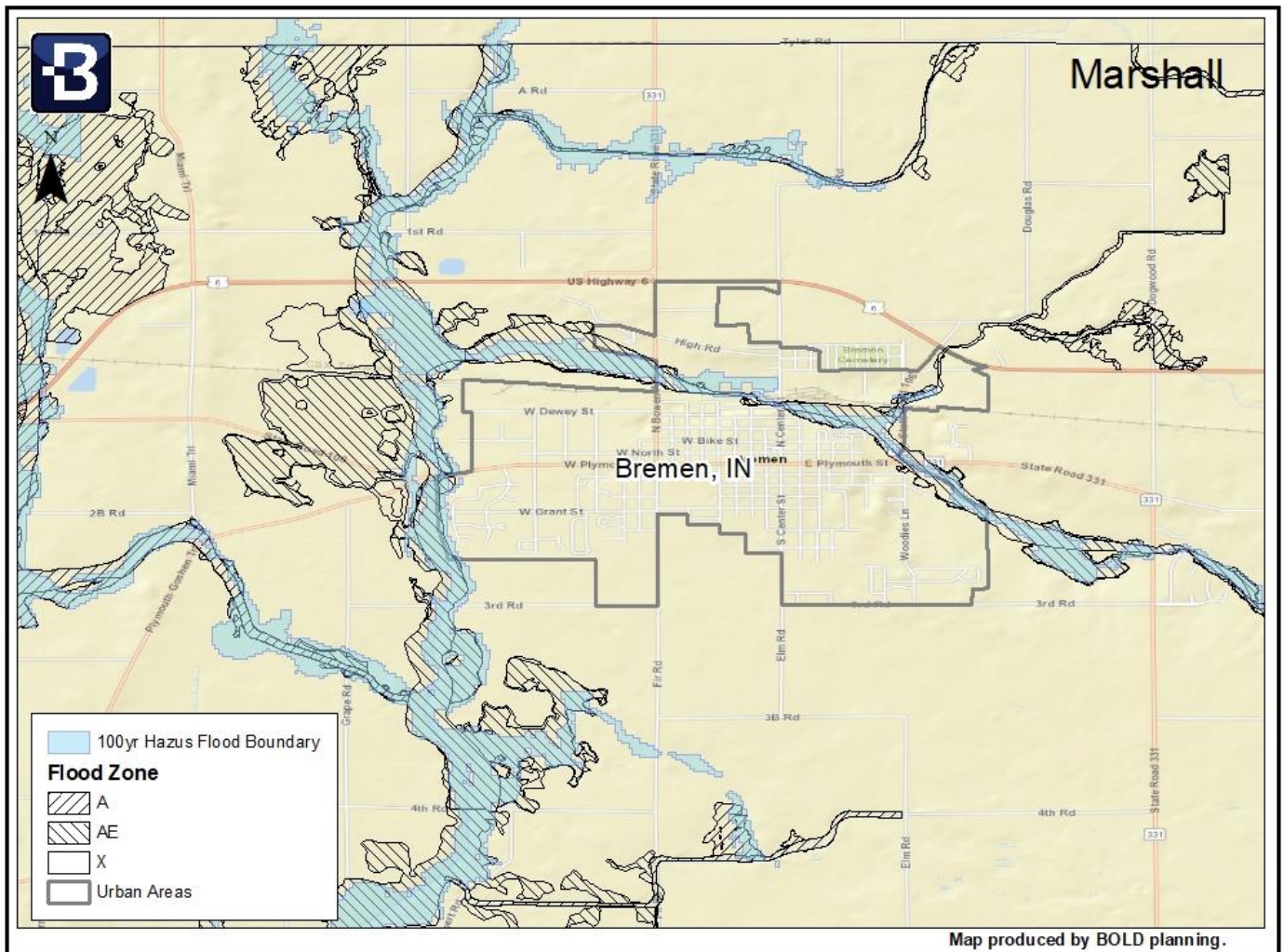


Map 23: Marshall County Flood Zones





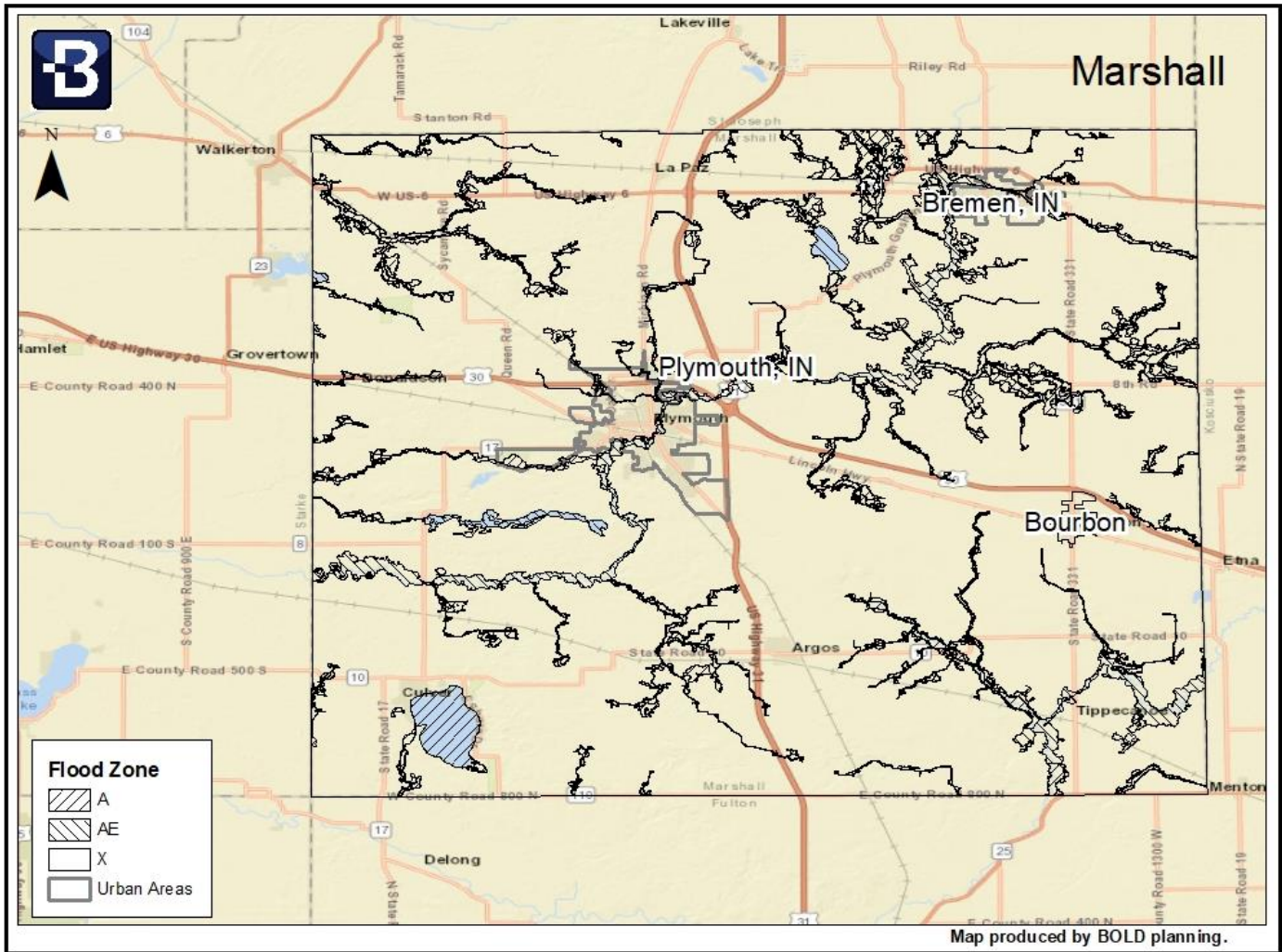
Map 24: Marshall County Flood Zones





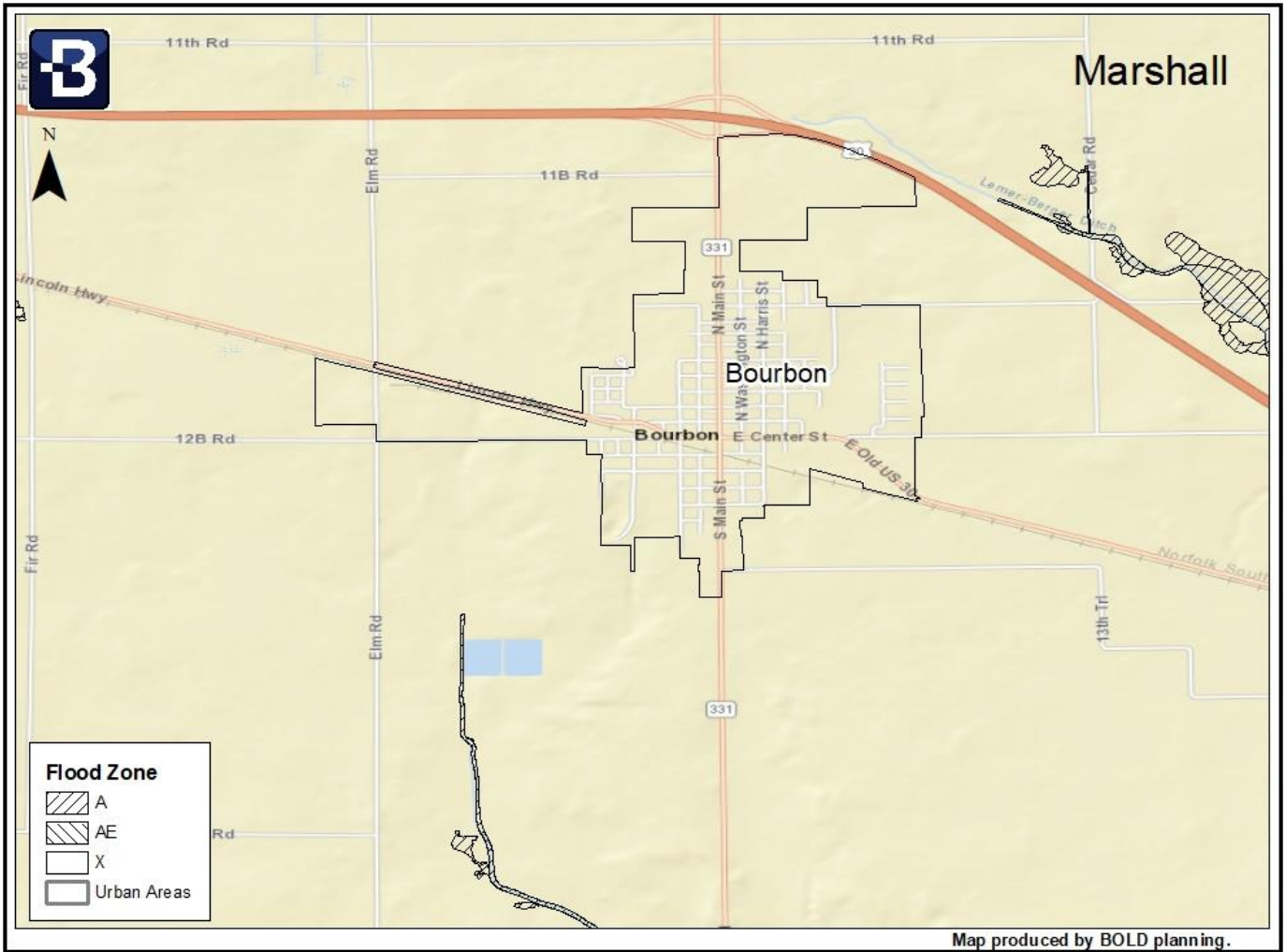


Map 25: Marshall County Flood Zones





**Map 26: Bourbon, Marshall County Flood Zones**



**4.9.3 Previous Occurrences**

Historical events of significant magnitude or impact can result in a Presidential Disaster Declaration. In the 20-year period from 2003 to 2022, with the years 2003 and 2022 being full dataset years, Marshall County has experienced four Presidential Disaster Declarations related to flooding, reflected in the following table.

**Table 34: Marshall County Presidential Disaster Declarations**

| Designation | Declaration Date | Incident Type                          |
|-------------|------------------|--|
| DR-1573     | 1/21/2005        | Severe Winter Storms and Flooding      |
| DR-1740     | 1/30/2008        | Severe Winter Storms and Flooding      |
| DR-1832     | 4/22/2009        | Severe Storms, Tornadoes, and Flooding |
| DR-4363     | 5/4/2018         | Severe Storms and Flooding             |

Source: FEMA

In addition to the Presidentially Declared Disasters, the following table presents NCEI identified flood events and the resulting damage totals in Marshall County from 2003 to 2022, with the years 2003 and 2022 being full dataset years.



**Table 35: Marshall County NCEI Flood and Flash Flood Events, 2003-2022**

| Jurisdiction            | Event Type  | Number of Days with Events | Property Damage | Deaths | Injuries |
|-------------------------|-------------|----------------------------|-----------------|--------|----------|
| Marshall County (total) | Flood       | 5                          | \$1,650,000     | 0      | 0        |
|                         | Flash Flood | 3                          | \$15,000        | 0      | 0        |

Source: NCEI

As a subset of the above information, the following table presents NCEI identified flood events and the resulting damage totals in Bourbon from 2003 to 2022. with the years 2003 and 2022 being full dataset years. Please note that the major flood event of 2018 impacted a large portion of the county, and as such damage data is not specific to jurisdictions.

**Table 36: Bourbon NCEI Flood and Flash Flood Events, 2003-2022**

| Jurisdiction | Event Type  | Number of Days with Events | Property Damage | Deaths | Injuries |
|--------------|-------------|----------------------------|-----------------|--------|----------|
| Bourbon      | Flood       | 1                          | \$0             | 0      | 0        |
|              | Flash Flood | 0                          | \$0             | 0      | 0        |

Source: NCEI

The following provides both local accounts and NCEI descriptions of notable recorded events:

- February 20, 2018, Marshall County:** A slow release of a snowpack, containing one to over two inches of water, occurred in the days leading to the event which started the process of river rises in many areas. Damage occurred to several roads because of the record flooding from the Yellow River and associated drainage basin. Many county roads were closed for a period, with even State Routes 30, 331 and 6 being impacted by flood waters. Nearly every town in the county suffered damage from the flood waters with Plymouth, Argos and Bremen suffering the most damage, and Bourbon suffering damage to eight houses. Evacuations were necessary in some areas with water rescues due to rapid rise in the rivers. Preliminary damage estimates exceed \$1,200,000.
- March 12, 2009, Marshall County:** The Yellow River came out of its banks, cresting around 14.2 feet. This resulted in streets and some properties in the flood plains of the river to become inundated with water. Some evacuations were necessary as water levels rose quickly. Water entered the Boys and Girls Club in Plymouth, resulting in shutting off both electricity and gas to the building and forcing its closure for a few days. Damages were estimated at \$300,000.
- March 13, 2006, La Paz:** A low area of Oak Road, near La Paz, had 12 to 18 inches of water across the road.

#### 4.9.4 Probability of Future Incidents

The definition of each flood zone’s classification is used for the purpose of calculating the yearly probability of a riverine flood. Jurisdictions with property in a 100-year floodplain can expect a 1% annual chance of flooding within the designated areas. Jurisdictions with property in a 500-year floodplain can expect a 0.2% annual chance of flooding within the designated areas.

Further, data from the NCEI indicates that Marshall County can expect on a yearly basis, relevant to riverine flood events:

**Table 37: Marshall County Riverine Flood Probability Summary**

| Data  | Days |
|---|------|
| Number of Days with NCEI Reported Event (2003-2022) | 5    |
| Average Events per Year                             | <1   |

Source: NCEI



Data from the NCEI indicates that Marshall County can expect on a yearly basis, relevant to flash flood events:

**Table 38: Marshall County Flash Flood Probability Summary**

| Data  | Days |
|---|------|
| Number of Days with NCEI Reported Event (2003-2022) | 3    |
| Average Events per Year                             | <1   |

Source: NCEI

As a subset of the above data, the NCEI indicates that Bourbon can expect on a yearly basis, relevant to riverine flood events:

**Table 39: Bourbon Riverine Flood Probability Summary**

| Data  | Days |
|---|------|
| Number of Days with NCEI Reported Event (2003-2022) | 1    |
| Average Events per Year                             | <1   |

Source: NCEI

As a subset of the above data, the NCEI indicates that Bourbon can expect on a yearly basis, relevant to flash flood events:

**Table 40: Bourbon Flash Flood Probability Summary**

| Data  | Days |
|---|------|
| Number of Days with NCEI Reported Event (2003-2022) | 0    |
| Average Events per Year                             | 0    |

Source: NCEI

**4.9.5 Vulnerability and Impact**

Data from the NCEI indicates that Marshall County can expect on a yearly basis, relevant to riverine flood events:

**Table 41: Marshall County Riverine Flood Impact Summary**

| Data  | Recorded Impact |
|---|-----------------|
| Deaths or Injuries (2003-2022)                  | 0               |
| Average Number of Deaths or Injuries            | 0               |
| Total Reported NCEI Property Damage (2003-2022) | \$1,650,000     |
| Average Property Damage per Year                | \$82,000        |

Source: NCEI

Data from the NCEI indicates that Marshall County can expect on a yearly basis, relevant to flash flood events:

**Table 42: Marshall County Flash Flood Impact Summary**

| Data  | Recorded Impact |
|---|-----------------|
| Deaths or Injuries (2003-2022)                  | 0               |
| Average Number of Deaths or Injuries            | 0               |
| Total Reported NCEI Property Damage (2003-2022) | \$15,000        |
| Average Property Damage per Year                | \$750           |

Source: NCEI

Data from the NCEI indicates that Bourbon can expect on a yearly basis, relevant to riverine flood events:





**Table 43: Bourbon Riverine Flood Impact Summary**

| Data  | Recorded Impact |
|---|-----------------|
| Deaths or Injuries (2003-2022)                  | 0               |
| Average Number of Deaths or Injuries            | 0               |
| Total Reported NCEI Property Damage (2003-2022) | \$0             |
| Average Property Damage per Year                | \$0             |

Source: NCEI

Data from the NCEI indicates that Bourbon can expect on a yearly basis, relevant to flash flood events:

**Table 44: Bourbon Flash Flood Impact Summary**

| Data  | Recorded Impact |
|---|-----------------|
| Deaths or Injuries (2003-2022)                  | 0               |
| Average Number of Deaths or Injuries            | 0               |
| Total Reported NCEI Property Damage (2003-2022) | \$0             |
| Average Property Damage per Year                | \$0             |

Source: NCEI

The results of the HAZUS analysis were utilized to estimate potential losses for riverine flooding. The intent of this analysis was to enable Marshall County to estimate where flood losses could occur and the degree of severity using a consistent methodology. The HAZUS model helps quantify risk along known flood-hazard corridors as well as lesser streams and rivers that have a drainage area of 10 square miles or more. HAZUS®, version 5.0, was used to perform the analysis for Marshall County using essential facility data available through HAZUS databases and HIFLD data. The analysis was completed by BOLDplanning. For this hazard, the risk assessment data and maps involved were from an analysis of 1% annual chance flood event (100-Year Flood). The reported losses are based upon essential facility and census data as part of HAZUS. We are also mapping updated essential facilities provided by Marshall County Emergency Management in relation to the flooded areas from HAZUS Level One modeling efforts.

HAZUS determines the displaced population based on the inundation area, not necessarily impacted buildings. As a result, there may be a population vulnerable to displacement even if the structure is not vulnerable to damage. Individuals and households will be displaced from their homes even when the home has suffered little or no damage either because they were evacuated or there was no physical access to the property because of flooded roadways.

Flood sheltering needs are based on the displaced population, not the damage level of the structure. HAZUS determines the number of individuals likely to use government-provided short-term shelters through determining the number of displaced households as a result of the flooding. To determine how many of those households and the corresponding number of individuals will seek shelter in government-provided shelters, the number is modified by factors accounting for income and age. Displaced people using shelters will most likely be individuals with lower incomes and those who do not have family or friends within the immediate area. Since the income and age factors are taken into account, the proportion of displaced population and those seeking shelter will vary from county to county.

Additionally, HAZUS takes into account flood depth when modeling damage (based on FEMA’s depth-damage functions). Generated reports capture damage by occupancy class (in terms of square footage impacted) by damage percent classes. Occupancy classes include agriculture, commercial, education, government, industrial, religion, and residential. Damage percent classes are grouped by 10 percent increments up to 50%. Buildings that sustain more than 50% damage are considered to be substantially damaged.

The following table provides the HAZUS results for vulnerable populations and the population estimated to seek short term shelter as well as the numbers of damaged and substantially damaged buildings for Marshall County.



**Table 45: Marshall County HAZUS Flood Scenario Displaced Population Building Damages**

| Displaced Population | Person Seeking Shelter | Damaged Buildings | Destroyed Buildings |
|----------------------|------------------------|-------------------|---------------------|
| 646                  | 162                    | 51                | 0                   |

Source: FEMA HAZUS

The HAZUS analysis also provides an estimate of the repair costs for impacted buildings as well as the associated loss of building contents and business inventory. Building damage can also cause additional losses to a community by restricting a building’s ability to function properly. Income loss data accounts for losses such as business interruption and rental income losses as well as the resources associated with damage repair and job and housing losses. These losses are calculated by HAZUS using a methodology based on the building damage estimates.

The damaged building counts generated by HAZUS are susceptible to rounding errors and are likely the weakest output of the model due to the use of census blocks for analysis. Generated reports include this disclaimer: “Unlike the earthquake and hurricane models, the flood model performs its analysis at the census block level. This means that the analysis starts with a small number of buildings within each census block and applies a series of distributions necessary for analyzing the potential damage. The application of these distributions and the small number of buildings make the flood model more sensitive to rounding errors that introduces uncertainty into the building count results.” Additionally, losses are not calculated for individual buildings, but instead are based on the performances of entire classes of buildings obtained from the general building stock data. In the flood model, the number of grid cells (pixels) at each flood depth value is divided by the total number of grid cells in the census block. The result is used to weight the flood depths applied to each specific occupancy type in the general building stock. First floor heights are then applied to determine the damage depths to analyze damages and losses.

The following table provides the HAZUS results for building damages and business interruption loss due to these damages.

**Table 46: Marshall County HAZUS Flood Scenario Structural Damage and Income Loss**

| Structural Damage | Contents Damage | Inventory Loss | Total Direct Loss | Total Business Interruption Loss | Total Loss   |
|-------------------|-----------------|----------------|-------------------|----------------------------------|--------------|
| \$18,160,000      | \$33,760,000    | \$2,960,000    | \$54,880,000      | \$35,180,000                     | \$90,006,000 |

Source: FEMA HAZUS

The HAZUS model also indicated that the following number of critical facilities are estimated to be damaged or suffer loss of use from the flood scenario.

**Table 47: HAZUS Flood Scenario Number of Critical Facilities Damaged or Impacted**

| Jurisdiction    | Fire Stations | Hospitals | Police Stations | Schools |
|-----------------|---------------|-----------|-----------------|---------|
| Marshall County | 0             | 0         | 0               | 0       |
| Bourbon         | 0             | 0         | 0               | 0       |

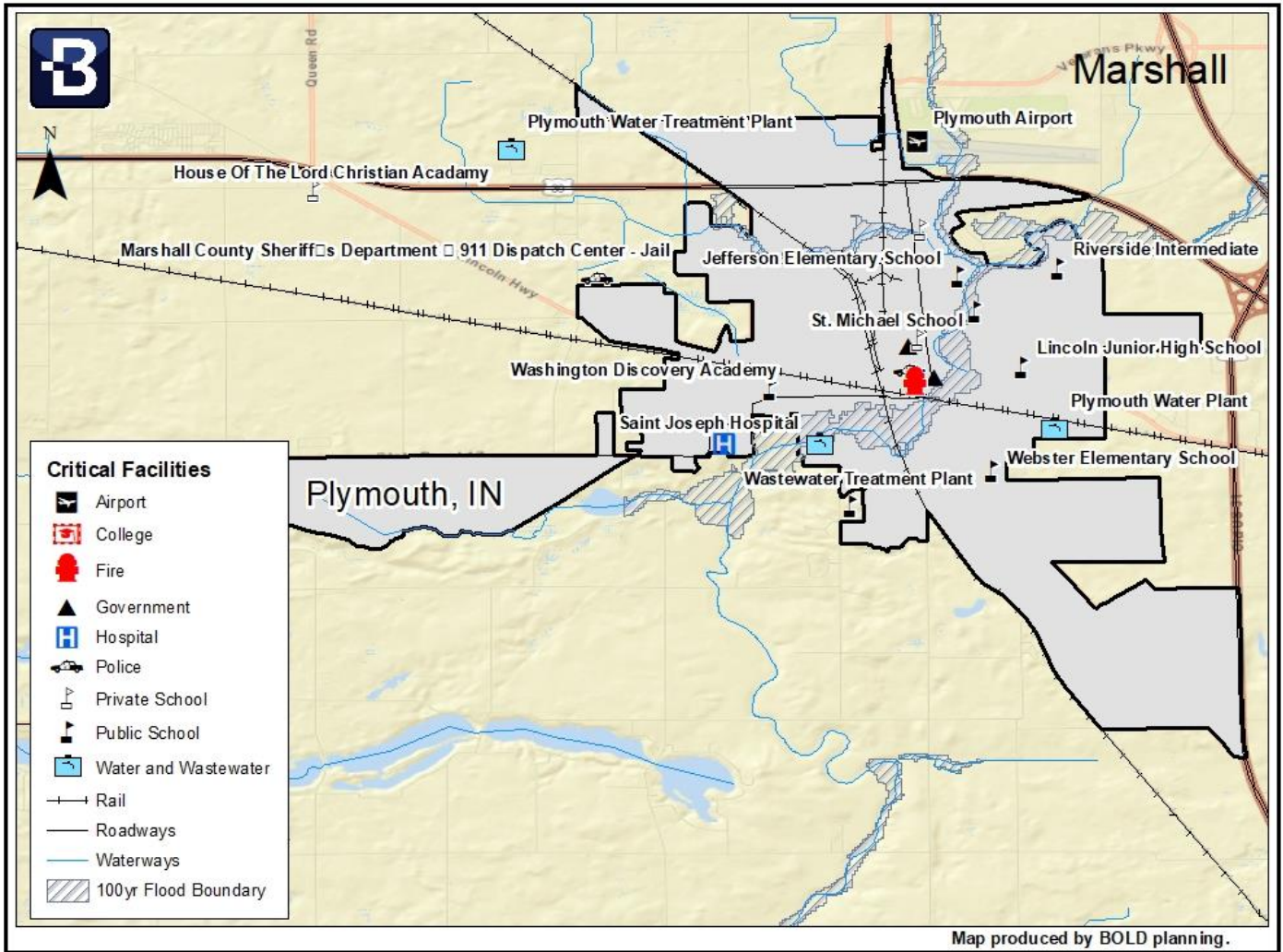
Source: FEMA HAZUS

HAZUS indicates that no critical facilities will be impacted by the scenario.

A HAZUS analysis was performed to determine critical facility locations relative to the potential flood areas. Using GIS, flood zones were overlaid on the critical facility location data. As indicated in the following maps, no critical facilities are located in identified flood zones:

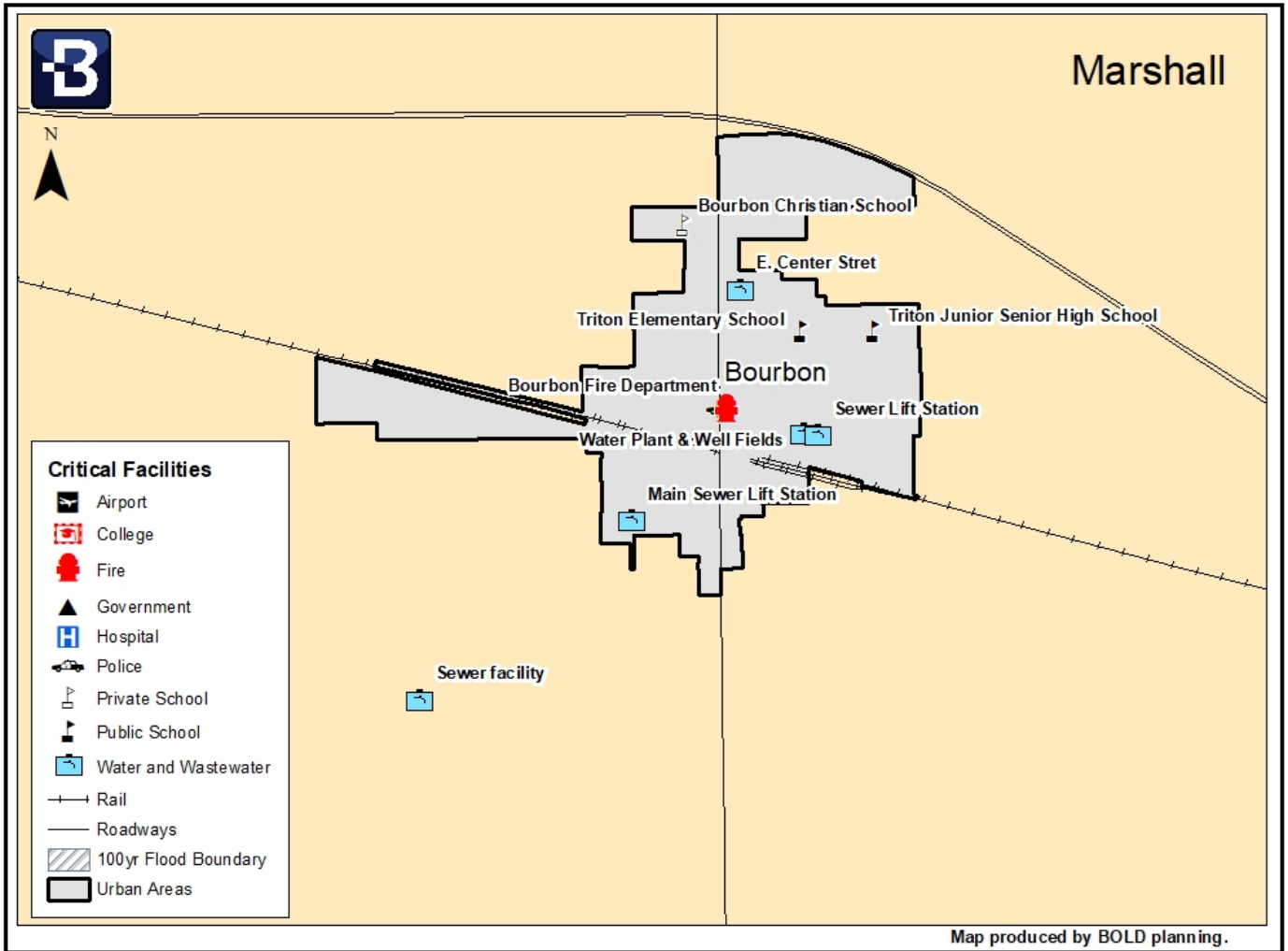


Map 27: Critical Facilities in Potential Flood Areas





**Map 28: Critical Facilities in Potential Flood Areas**



As per HAZUS, before the flood analyzed in this scenario, the region had 160 hospital beds available for use. On the day of the scenario flood event, the model estimates that 160 hospital beds are available in the region.

A potentially large impact to Marshall County from flood events will likely be felt in the agricultural community. As previously indicated by USDA National Agricultural Statistics Service data in the following table, Marshall County is seeing growth in all agricultural sectors. USDA Risk Management Agency crop loss data relating to flood and excess moisture/precipitation/rain for the five-year period of 2018 to 2022, with 2018 and 2022 being full dataset years, allows us to quantify the monetary impact of flood conditions on the agricultural sector. While it is likely that the market value of crops sold is higher for each subsequent year, the latest available data is for 2017. The higher the percentage loss, the higher the related vulnerability to flood events.

**Table 48: Marshall County Crop Insurance Paid for Flood Loss, 2018 - 2022**

| Year | Market Value of Agricultural Products Sold (2017) | Annualized Crop Insurance Paid | Percentage of Market Value Impacted |
|------|---|--------------------------------|-------------------------------------|
| 2022 | \$145,167,000                                     | \$50,617                       | 0.04%                               |
| 2021 | \$145,167,000                                     | \$340,307                      | 0.2%                                |
| 2020 | \$145,167,000                                     | \$353,382                      | 0.2%                                |
| 2019 | \$145,167,000                                     | \$3,100,088                    | 2.1%                                |
| 2018 | \$145,167,000                                     | \$796,760                      | 0.6%                                |

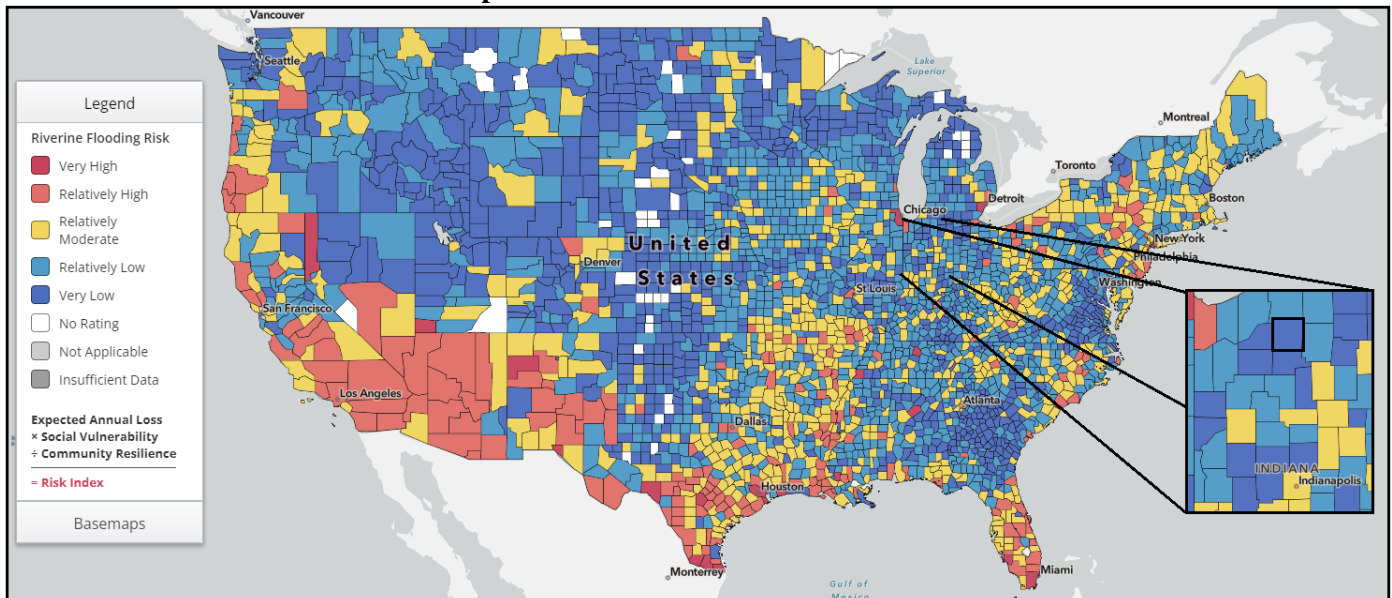
Source: USDA



Of particular concern related to flooding is the safety of citizens. Especially critical is timely evacuation orders, and adherence to those orders. If evacuation is not heeded, or flood waters rise quickly enough, citizens could drown or become trapped for extended periods of time with no access to services or medical care. Of special concern are long term care and medical facilities where it can take longer to evacuate, or evacuation may be impossible. Additionally, lower income citizens may not have the means to relocate, whether it be lack of transportation or lack of resources to afford temporary shelter.

Using the FEMA NRI, and consisting of three input components (expected annual loss, social vulnerability, and community resilience), the following map was created indicating the potential risk to Marshall County from riverine flooding (Very Low):

**Map 29: FEMA NRI Riverine Flood Risk**

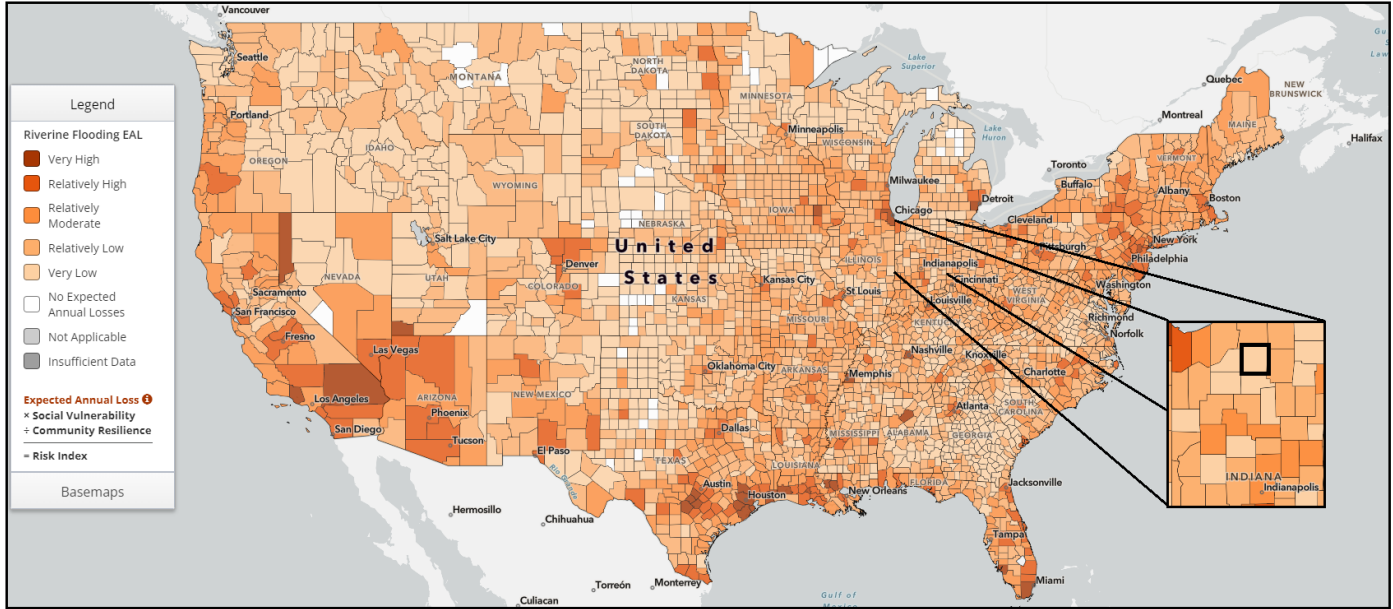


Source: FEMA NRI

As part of the NRI, EAL represents the average economic loss in dollars resulting from a hazard each year. It quantifies loss for relevant consequence types, buildings, people, and agriculture. An EAL score and rating represent a community's relative level of expected losses each year when compared to all other communities at the same level. EAL is calculated using an equation that includes exposure, annualized frequency, and historic loss ratio risk factors. Exposure is a factor that measures the building value, population, and agriculture value potentially exposed to a natural hazard occurrence. Annualized frequency is a factor that measures the expected frequency or probability of a hazard occurrence per year. Historic loss ratio is a factor that measures the percentage of the exposed consequence type value (building, population, or agriculture) expected to be lost due to an occurrence. EAL represents the average economic loss in dollars resulting from natural hazards each year and is proportional to a community's risk.

The following maps indicate the EAL for riverine flooding for Marshall County (Very Low):

**Map 30: FEMA NRI Riverine Flood EAL**



Source: FEMA NRI

#### 4.9.6 Potential Impact of Climate Change

Changing the climate is likely to increase the frequency of floods in Marshall County. Over the last half century, average annual precipitation in most of the Midwest has increased by 5 to 10 percent. But rainfall during the four wettest days of the year has increased about 35 percent, and the amount of water flowing in most streams during the worst flood of the year has increased by more than 20 percent. During the next century, spring rainfall and average precipitation are likely to increase, and severe rainstorms are likely to intensify. Each of these factors will tend to further increase the risk of flooding.

#### 4.9.7 Land Use and Development Trends

Marshall County’s current land-use regulations require the consideration of flood hazards during the development review process. Additionally, the generally static, or declining, nature of population growth during the past ten years in all participating jurisdictions indicates that both current and future development may decline. As such, the vulnerability to flood events may decrease.

#### 4.9.8 Unique and Varied Risk

Due to the nature of flash flooding, each jurisdiction in the planning area has an equal risk to a flash flood impact. All identified critical facilities (Appendix D), and all populations, are at risk of damages, death or injury due to flash flood events.

Due to the location specific parameters of riverine flooding, only the above FEMA FIRM mapped areas are considered to be at risk. Both Bourbon and Marian University – Ancilla College are not in any identified floodplains. As such, neither identified critical facilities or jurisdiction specific populations are at risk to riverine flooding.

#### 4.9.9 National Flood Insurance Program Communities

The NFIP is a federal program, managed by FEMA, that exists to provide flood insurance for property owners in participating communities, to improve floodplain management practices, and to develop maps of flood hazard areas. The following table presents NFIP participating communities.





**Table 49: Marshall County NFIP Communities**

| Community       | Initial Flood Hazard Boundary Map Identified | Initial Flood Insurance Rate Map Identified | Current Effective Map Date |
|-----------------|--|---|----------------------------|
| Marshall County | 04/07/78                                     | 01/05/89                                    | 11/16/11                   |
| Bourbon         | -  | -   | -                          |

-: Does not participate in NFIP

Bourbon has elected not to participate in the NFIP due to lack perceived need.

Additionally, the NFIP’s Community Rating System (CRS) incentive rewards communities for the work they do managing their floodplains. Eligible communities that qualify for this voluntary program go above the minimum NFIP requirements and can offer their citizens discounted flood insurance in both SFHAs areas and non-SFHA areas. No Marshall County communities currently participate in the CRS.

**4.9.10 FEMA Flood Policy Data**

Marshall County flood policy information was sourced from FEMA’s Flood Insurance Data and Analytic, Marshall County, and the State of Indiana. The number of flood insurance policies in effect may not include all structures at risk to flooding, and some properties are under-insured. The flood insurance purchase requirement is for flood insurance in the amount of federally backed mortgages, not the entire value of the structure. Additionally, contents coverage is not required.

The following table shows the details of NFIP policy statistics for Marshall County.

**Table 50: Marshall Policy and Loss Statistics**

| Jurisdiction    | Number of Policies in Force | Buildings in SFHA | Replacement Cost of Buildings in SFHA* | Total Coverage |
|-----------------|-----------------------------|-------------------|--|----------------|
| Marshall County | 73                          | 254               | \$17,829,701                           | \$16,007,300   |
| Bourbon         | 0                           | 0                 | 0                                      | \$0            |

Source: FEMA Flood Insurance Data and Analytic, Marshall County, State of Indiana

\*: 2019 valuation

**4.9.11 Repetitive Loss Structures**

A high priority to Marshall County is the reduction of losses to Repetitive Loss (RL) and Severe Repetitive Loss (SRL) structures. The NFIP defines a RL property as:

- Any insurable building for which two or more claims of more than \$1,000 were paid by the NFIP within any rolling 10-year period, since 1978. At least two of the claims must be more than 10 days apart.

The definition of severe repetitive loss as applied to this program was established in section 1361A of the National Flood Insurance Act, as amended, 42 U.S.C. 4102a. An SRL property is defined as a residential property that is covered under an NFIP flood insurance policy and:

- That has at least four NFIP claim payments (including building and contents) over \$5,000 each, and the cumulative amount of such claims payments exceeds \$20,000; or
- For which at least two separate claims payments (building payments only) have been made with the cumulative amount of the building portion of such claims exceeding the market value of the building.

For both of the above, at least two of the referenced claims must have occurred within any ten-year period and must be greater than ten days apart.

The following table details information concerning RL and SRL identified properties in Marshall County.



**Table 51: Marshall County RL and SRL Properties**

| <b>Jurisdiction</b> | <b>Number of Repetitive Loss Properties</b> | <b>Number of Severe Repetitive Loss Properties</b> |
|---------------------|---|--|
| Marshall County     | 1   | 1  |
| Bourbon             | 0   | 0  |

Source: Marshall County

The following table details information on RL and SRL claims and payments.

**Table 52: Marshall County RL and SRL Property Claims**

| <b>Jurisdiction</b> | <b>RL Claims</b> | <b>RL Payments</b> | <b>SRL Claims</b> | <b>SRL Payments</b> |
|---------------------|------------------|--------------------|-------------------|---------------------|
| Marshall County     | 60               | \$523,218          | 12                | \$187,578           |
| Bourbon             | 0                | \$0                | 0                 | \$0                 |

Source: FEMA and Marshall County

## 4.10 Severe Thunderstorms

### 4.10.1 Hazard Description

Severe thunderstorms comprise the hazardous and damaging weather effects often found in violent storm fronts. They can occur together or separate, they are common and usually not hazardous, but on occasion they can pose a threat to life and property.

This plan defines severe thunderstorms as a combination of the following severe weather effects as defined by NOAA and the National Weather Service (NWS).



- **Hail:** Precipitation in the form of irregular pellets or balls of ice more than 5 mm in diameter, falling from a cumulonimbus cloud.
- **Lightning:** A visible electrical discharge produced by a thunderstorm. The discharge may occur within or between clouds, between the cloud and air, between a cloud and the ground or between the ground and a cloud.
- **Thunderstorm Winds:** The same classification as high or strong winds but accompanies a thunderstorm. It is also referred to as a straight-line wind to differentiate from rotating or tornado associated wind. Additionally, these winds can rapidly create dust storms that severely impact visibility.

Severe thunderstorms have been so consistent throughout modern history that much of the vulnerability is mitigated. However, this section is not concerned with everyday wind, lightning in the sky, or mild precipitation. This section is concerned with common storm elements when they behave such that they pose a threat to property and life.

### 4.10.2 – Location and Extent

Severe thunderstorms can rapidly descend on an area, but in many cases are predictable. Most weather forecasts focus on more than just temperature but on quickly changing conditions that may lead to the onset of severe storms. All of Marshall County is susceptible to severe thunderstorms.

The NWS classifies thunderstorms, often the generator of hail, lightning and high winds, using the following categories.

- **Marginal:** Isolated severe thunderstorms, limited in duration and/or coverage and/or intensity
- **Slight:** Scattered severe storms possible, short-lived and/or not widespread, isolated intense storms possible
- **Enhanced:** Numerous severe storms possible, more persistent and/or widespread, a few intense
- **Moderate:** Widespread severe storms likely, long-lived, widespread and intense
- **High:** Widespread severe storms expected, long-lived, very widespread and particularly intense

Additionally, the combination of hot and humid weather conditions can cause a specific type of severe thunderstorm known as a derecho. A derecho is a widespread, long-lived windstorm associated with rapidly moving thunderstorms. Derechos are generally defined by the following parameters:

- Wind gusts of at least 58 mph or greater along most of its length
- Wind damage extends in a line greater than 240 miles

Derechos can produce destruction similar to tornadoes.

In the United States, hail causes billions of dollars in damage to property, crops and livestock each year. Because of the large agricultural industry in Marshall County, crop damage and livestock losses due to hail are a concern. Vehicles, roofs of buildings and homes, and landscaping are the other things most commonly damaged by hail. Hail has been known to cause injury and the occasional fatality to humans, often associated with traffic accidents.



Based on information provided by the Tornado and Storm Research Organization, the following table describes typical damage impacts of the various sizes of hail.

**Table 53: Tornado and Storm Research Organization Hail Damage Descriptions**

| Intensity Category   | Diameter (inches) | Size Description           | Typical Damage Impacts   |
|----------------------|-------------------|----------------------------|--|
| Hard Hail            | 0.2-0.4           | Pea                        | No damage  |
| Potentially Damaging | 0.4-0.6           | Mothball                   | Slight general damage to plants, crops   |
| Significant          | 0.6-0.8           | Marble, grape              | Significant damage to crop and vegetation  |
| Severe               | 0.8-1.2           | Walnut                     | Severe damage to crops, damage to glass and plastic, paint and wood scored                       |
| Severe               | 1.2-1.6           | Pigeon's egg > squash ball | Widespread glass damage, vehicle bodywork damage   |
| Destructive          | 1.6-2.0           | Golf ball > Pullet's egg   | Wholesale destruction of glass, damage to tiled roofs, significant risk of injuries              |
| Destructive          | 2.0-2.4           | Hen's egg                  | Bodywork of grounded aircraft dented, brick walls pitted   |
| Destructive          | 2.4-3.0           | Tennis ball > cricket ball | Severe roof damage, risk of serious injuries   |
| Super Hailstorms     | 3.6-3.9           | Grapefruit                 | Extensive structural damage. Risk of severe or even fatal injuries to persons caught in the open |
| Super Hailstorms     | 4.0+              | Melon                      | Extensive structural damage. Risk of severe or even fatal injuries to persons caught in the open |

Source: Tornado and Storm Research Organization

A recent report by the Insurance Information Institute says lightning strikes caused \$1,300,000,000 in damage across the United States in 2021. There is currently no scale to indicate the severity of a lightning strike, but data from NOAA indicates that there approximately 25 million cloud-to-ground lightning strikes per year in the United States.

To measure wind speed and its correlating potential for damage, experts use the Beaufort scale as shown below.

**Table 54: Beaufort Scale**

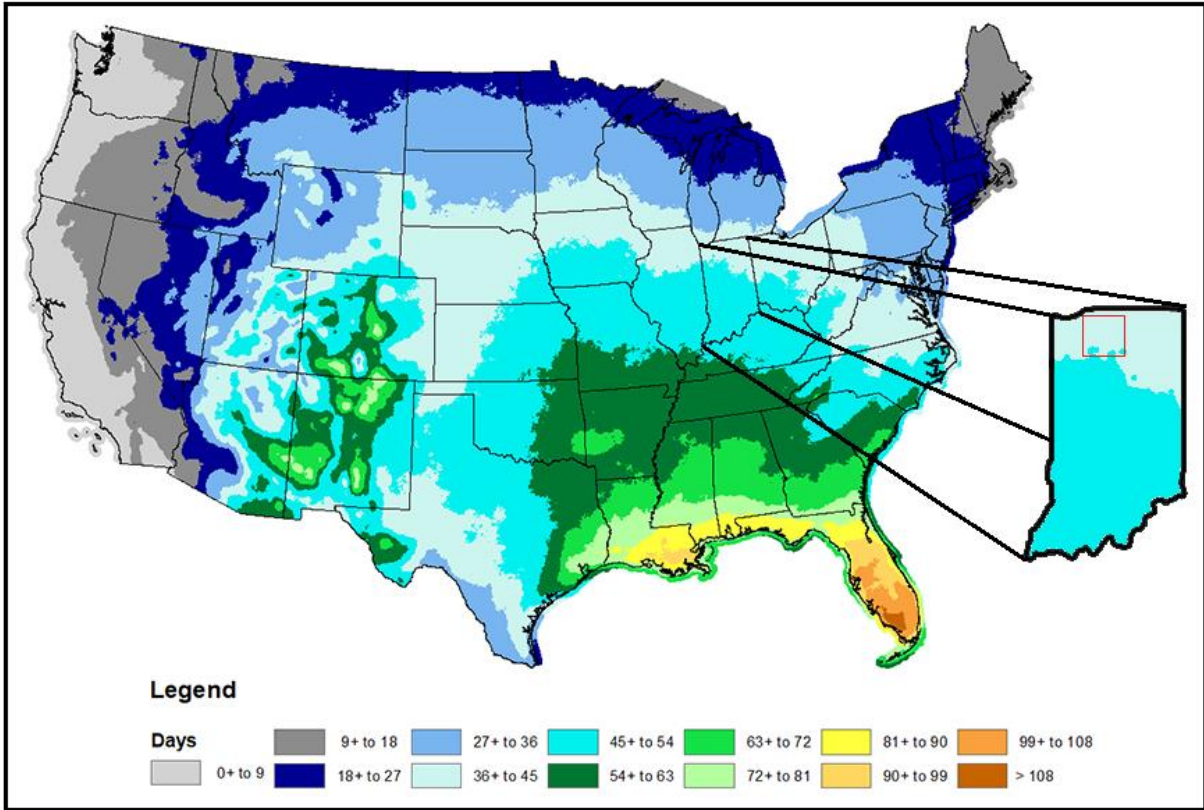
| Beaufort Number | Wind Speed (mph) | Effects on Land  |
|-----------------|------------------|--|
| 0               | Under 1          | Calm, smoke rises vertically                                       |
| 1               | 1-3              | Smoke drift indicates wind direction, vanes do not move            |
| 2               | 4-7              | Wind felt on face, leaves rustle, vanes begin to move              |
| 3               | 8-12             | Leaves, small twigs in constant motion. Light flags extended.      |
| 4               | 13-18            | Dust, leaves and loose paper raised up; small branches move        |
| 5               | 19-24            | Small trees begin to sway  |
| 6               | 25-31            | Large branches of trees in motion, whistling heard in wires        |
| 7               | 32-38            | While trees in motion, resistance felt in walking against the wind |
| 8               | 39-46            | Twigs and small branches broken off trees                          |
| 9               | 47-54            | Slight structural damage occurs, slate blown from roofs            |
| 10              | 55-63            | Seldom experienced on land, trees broken, structural damage occurs |
| 11              | 64-72            | Very rarely experienced on land, usually with widespread damage    |
| 12              | 73 or higher     | Violence and destruction   |

Source: NOAA



The widespread and frequent nature of thunderstorms makes hail, lightning, and high wind a relatively common occurrence for Marshall County. The following map, from NOAA, indicates annual mean thunderstorm days from 1993 to 2018.

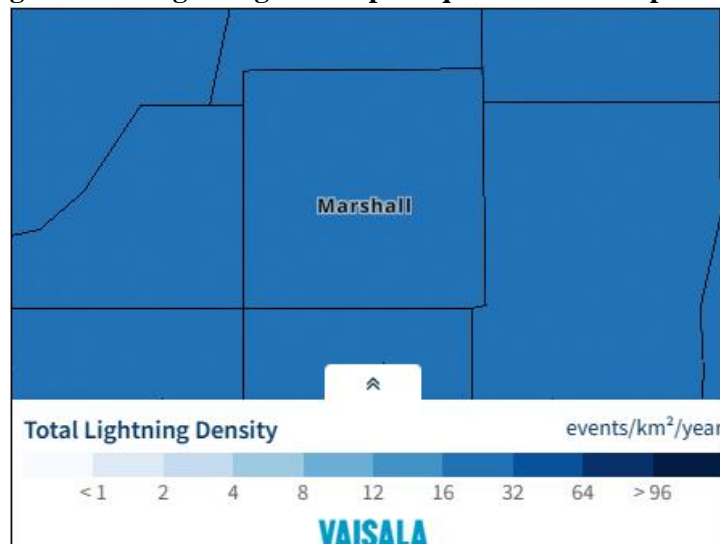
**Map 31: Annual Mean Thunderstorm Days, 1993-2018**



Source: NOAA

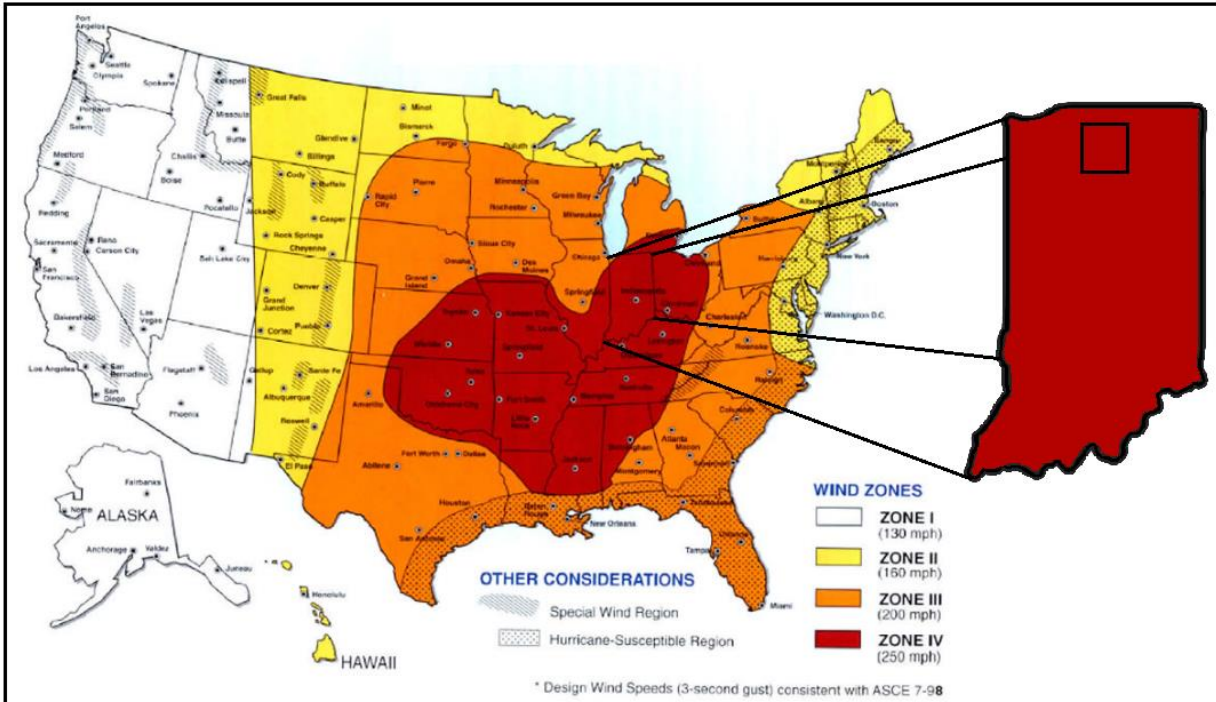
The following map, from Vaisala, indicates the average annual light events per square kilometer per year for Marshall County.

**Map 32: Average Annual Lightning Events per Square Kilometer per Year, 2016 - 2022**



Source: Vaisala

**Map 33: Wind Zones**



Source: National Institute of Standards and Technology

**4.10.3 Previous Occurrences**

Historical events of significant magnitude or impact can result in a Presidential Disaster Declaration. In the 20-year period from 2003 to 2022, with the years 2003 and 2022 being full dataset years, Marshall County has experienced two Presidential Disaster Declarations related to severe thunderstorms, reflected in the following table.

**Table 55: Marshall County Presidential Disaster Declarations**

| Designation | Declaration Date | Incident Type                          |
|-------------|------------------|--|
| DR-1832     | 4/22/2009        | Severe Storms, Tornadoes, and Flooding |
| DR-4363     | 5/4/2018         | Severe Storms and Flooding             |

Source: FEMA

In addition to the Presidentially Declared Disasters, the following table presents NCEI identified severe thunderstorm events and the resulting damage totals in Marshall County from 2003 to 2022. with the years 2003 and 2022 being full dataset years. Please note that as severe thunderstorm events tend to cover larger areas occurrence data is being presented as representative of all participating jurisdictions.

**Table 56: Marshall County NCEI Severe Thunderstorm Events, 2003-2022**

| Event Type         | Number of Events | Property Damage | Crop Damage | Deaths | Injuries |
|--------------------|------------------|-----------------|-------------|--------|----------|
| Hail               | 21               | \$0             | \$0         | 0      | 0        |
| Lightning          | 4                | \$90,000        | \$0         | 1      | 4        |
| Thunderstorm Winds | 68               | \$719,000       | 0           | 0      | 1        |

Source: NCEI

The following provides both local accounts and NCEI descriptions of notable recorded events:

- July 20, 2019 – Lake of the Woods:** A 65-year-old male and a friend were heading for shore getting away from a thunderstorms when lightning struck the. CPR was started but they were unable to save him. The other passenger was not harmed.



- **June 26, 2021 – LaPaz:** Trees were knocked down across much of Marshall County, including a large portion of the northern end of the county along US 6. A couple of trees in La Paz fell and hit power lines that caused residential fires, but they were quickly extinguished. Damages were recorded at \$40,000.
- **August 15, 2008 – Culver:** Numerous trees, limbs, and power lines were blown down in and around Culver. Several of the trees and limbs fell onto houses or businesses. Damage in the area is estimated at \$250,000.
- **August 7, 2008 – Plymouth:** Lightning struck a three-car garage attached to a house in the 11000 block of south Michigan Road. When firefighters arrived, the garage was engulfed in flames. Severe damage occurred to the garage and three vehicles, as well as smoke and water damage to portions of the house. Damage was estimated at \$90,000.
- **June 28, 2006 – Bremen:** A 12-year-old girl and 15-year-old boy in a paddle boat were struck by lightning. The strike occurred on Lake of the Woods, and the children suffered severe burns.
- **August 1, 2003 – Plymouth:** Two Plymouth residents were struck by lightning near Dixon Lake. Two men were waiting for a ride home after a day of fishing on the lake when they were struck by lightning. Both gentlemen suffered burns on their arms, shoulders and portions of their back and were likely knocked unconscious briefly. Both were treated at a nearby hospital and released.

**4.10.4 Probability of Future Events**

Predicting the probability of severe thunderstorm occurrences is tremendously challenging due to the large number of factors involved and the random nature of formation. Data from the NCEI indicates that Marshall County, can expect on a yearly basis, relevant to severe thunderstorm events:

**Table 57: Marshall County and Participating Jurisdictions Severe Thunderstorm Probability Summary**

| Data  | Days |
|---|------|
| Number of Days with NCEI Reported Event (2003-2022) | 93   |
| Average Events per Year                             | 5    |

Source: NCEI

**4.10.5 Vulnerability and Impact**

Data from the NCEI indicates that Marshall County can expect on a yearly basis, relevant to severe thunderstorm events. Please note that damages and injuries, as represented above, are not broken down into participating jurisdictions due to the random and widespread nature of occurrence.

**Table 58: Marshall County Severe Thunderstorm Impact Summary**

| Data  | Recorded Impact |
|---|-----------------|
| Deaths or Injuries (2003-2022)                  | 6               |
| Average Number of Deaths or Injuries            | <1              |
| Total Reported NCEI Property Damage (2003-2022) | \$809,000       |
| Average Property Damage per Year                | \$40,450        |

Source: NCEI

Data from HAZUS was used to provide a county building stock valuation. This data was then compared to NCEI structural damage figures to determine the percentage of impacted building within the county for the period of 2003-2022 for each severe storm component. Data was only available at a county level.

**Table 59: Marshall County Severe Storm Percentage Loss Data**

| Hazard    | HAZUS Valuation  | NCEI Structure Damage, 2003-2022 | Percentage of Building Valuation Damaged |
|-----------|------------------|----------------------------------|--|
| Hail      | \$10,174,541,000 | \$0                              | 0.0%                                     |
| Lightning | \$10,174,541,000 | \$90,000                         | 0.001%                                   |
| Wind      | \$10,174,541,000 | \$719,000                        | 0.007%                                   |

Source: NCEI and Marshall County



While difficult to quantify, as the impacts of future severe storms will be determined by many factors, the impacts of severe storms may be widespread. In the absence of proper shelter, hail, lightning, and high winds can cause serious injury. In general, if potentially exposed persons take shelter in a solid, well-constructed structure protection from these severe thunderstorm components would be provided. However, old or poorly constructed facilities may be more prone to damage, potentially increasing the impact on economically disadvantaged populations.

Severe storms can impact critical infrastructure in the following ways:

- Unable to be accessed by personnel due surrounding conditions
- Loss of utilities due to downed lines
- Structural damage
- Complete structural failure

A potentially large impact to Marshall County from severe thunderstorm events could be felt in the agricultural community. As previously indicated by USDA National Agricultural Statistics Service data in the following table, Marshall County is seeing growth in all agricultural sectors. USDA Risk Management Agency crop loss data relating to severe thunderstorms for the five-year period of 2018 to 2022, with 2018 and 2022 being full dataset years, allows us to quantify the monetary impact of severe thunderstorm conditions on the agricultural sector. While it is likely that the market value of crops sold is higher for each subsequent year, the latest available data is for 2017. The higher the percentage loss, the higher the related vulnerability to severe thunderstorm events.

**Table 60: Marshall County Crop Insurance Paid for Severe Thunderstorm Loss, 2018 - 2022**

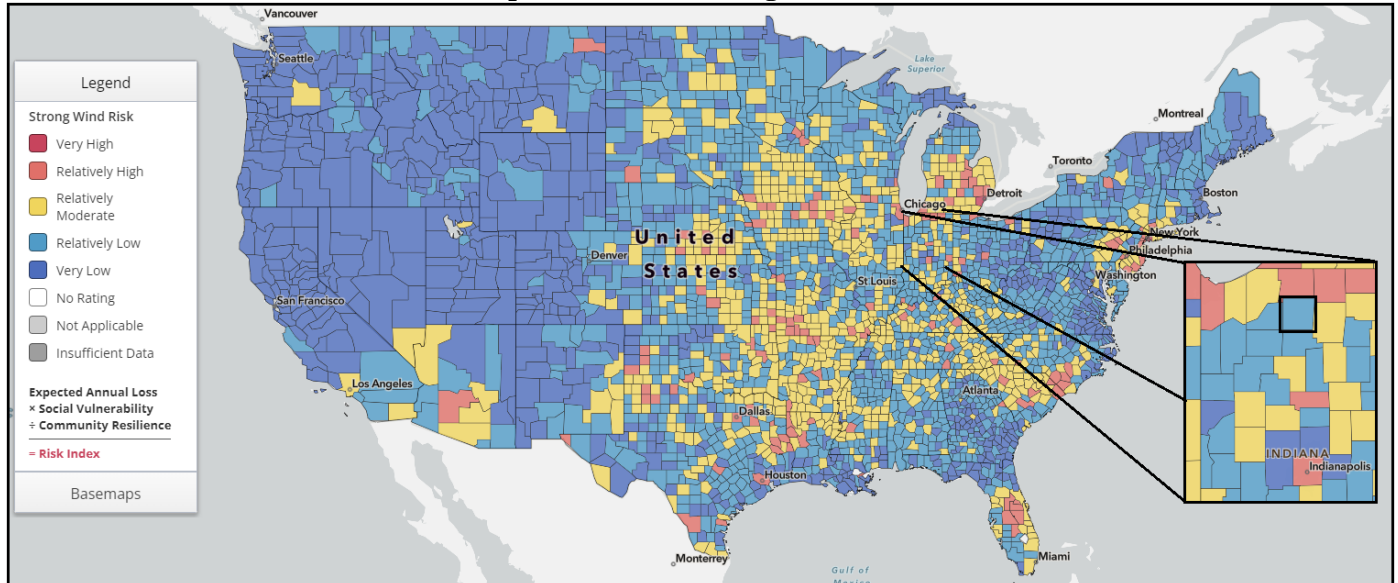
| Year | Market Value of Agricultural Products Sold (2017) | Annualized Crop Insurance Paid | Percentage of Market Value Impacted |
|------|---|--------------------------------|-------------------------------------|
| 2022 | \$145,167,000                                     | \$0                            | 0.0%                                |
| 2021 | \$145,167,000                                     | \$4,171                        | 0.003%                              |
| 2020 | \$145,167,000                                     | \$13,131                       | 0.009%                              |
| 2019 | \$145,167,000                                     | \$6,955                        | 0.005%                              |
| 2018 | \$145,167,000                                     | \$46,909                       | 0.03%                               |

Source: USDA

Using the FEMA NRI, and consisting of three input components (expected annual loss, social vulnerability, and community resilience), the following maps were created indicating the potential risk to Marshall County from high wind (Relatively Low), lightning (Relatively Low), and hail (Relatively Low):

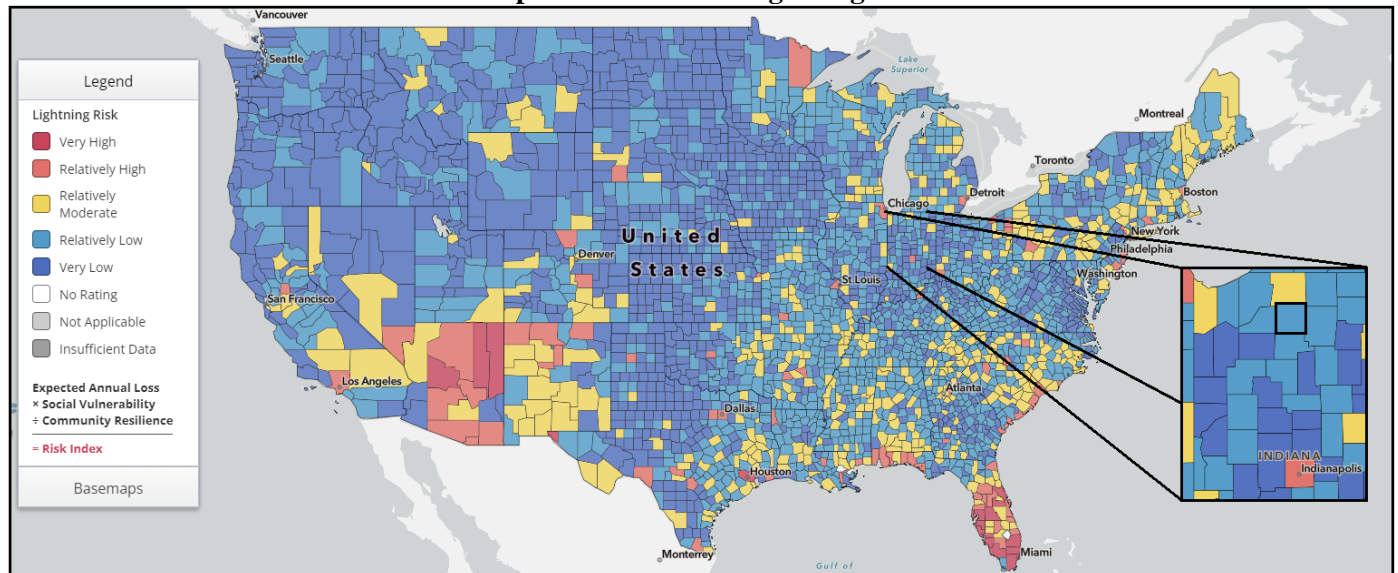


**Map 34: FEMA NRI High Wind Risk**



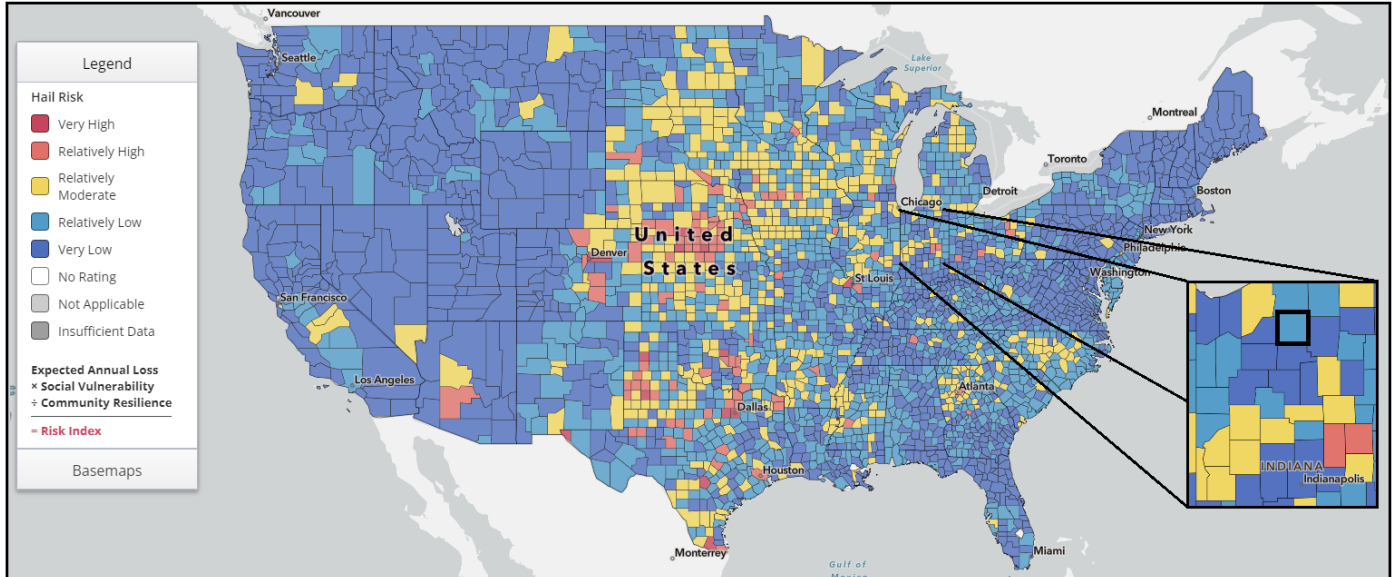
Source: FEMA NRI

**Map 35: FEMA NRI Lightning Risk**



Source: FEMA NRI

### Map 36: FEMA NRI Hail Risk

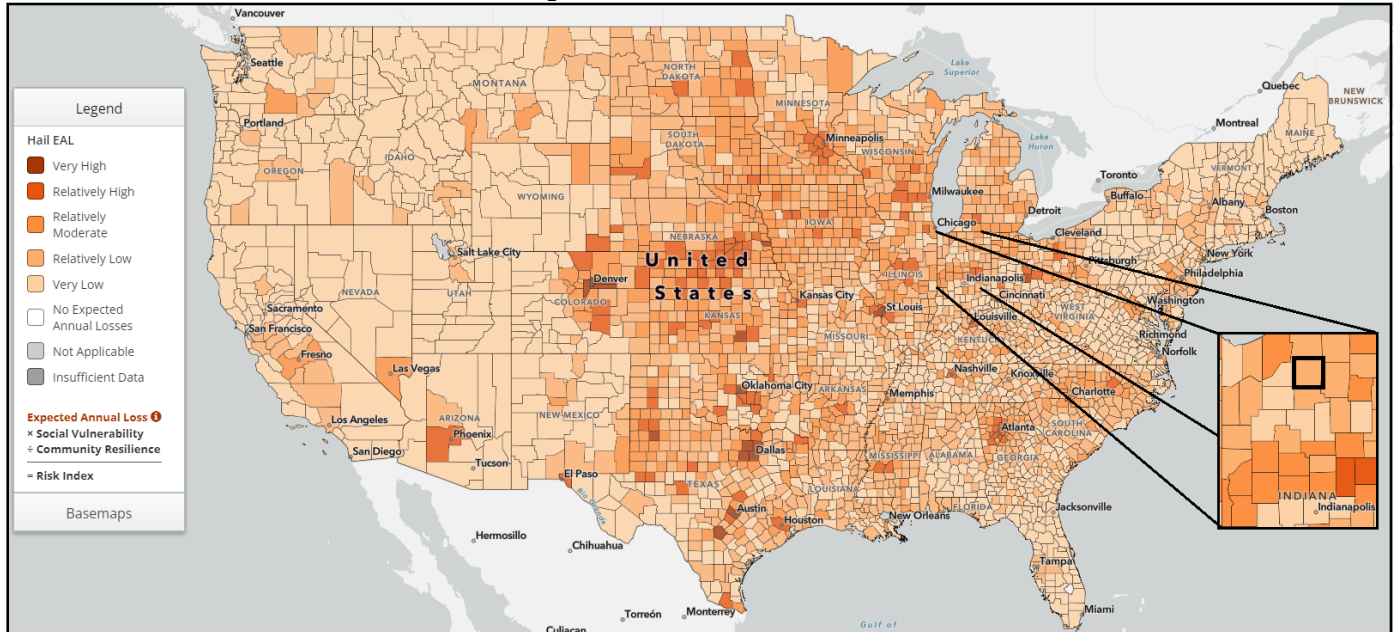


Source: FEMA NRI

As part of the NRI, EAL represents the average economic loss in dollars resulting from a hazard each year. It quantifies loss for relevant consequence types, buildings, people, and agriculture. An EAL score and rating represent a community's relative level of expected losses each year when compared to all other communities at the same level. EAL is calculated using an equation that includes exposure, annualized frequency, and historic loss ratio risk factors. Exposure is a factor that measures the building value, population, and agriculture value potentially exposed to a natural hazard occurrence. Annualized frequency is a factor that measures the expected frequency or probability of a hazard occurrence per year. Historic loss ratio is a factor that measures the percentage of the exposed consequence type value (building, population, or agriculture) expected to be lost due to an occurrence. EAL represents the average economic loss in dollars resulting from natural hazards each year and is proportional to a community's risk.

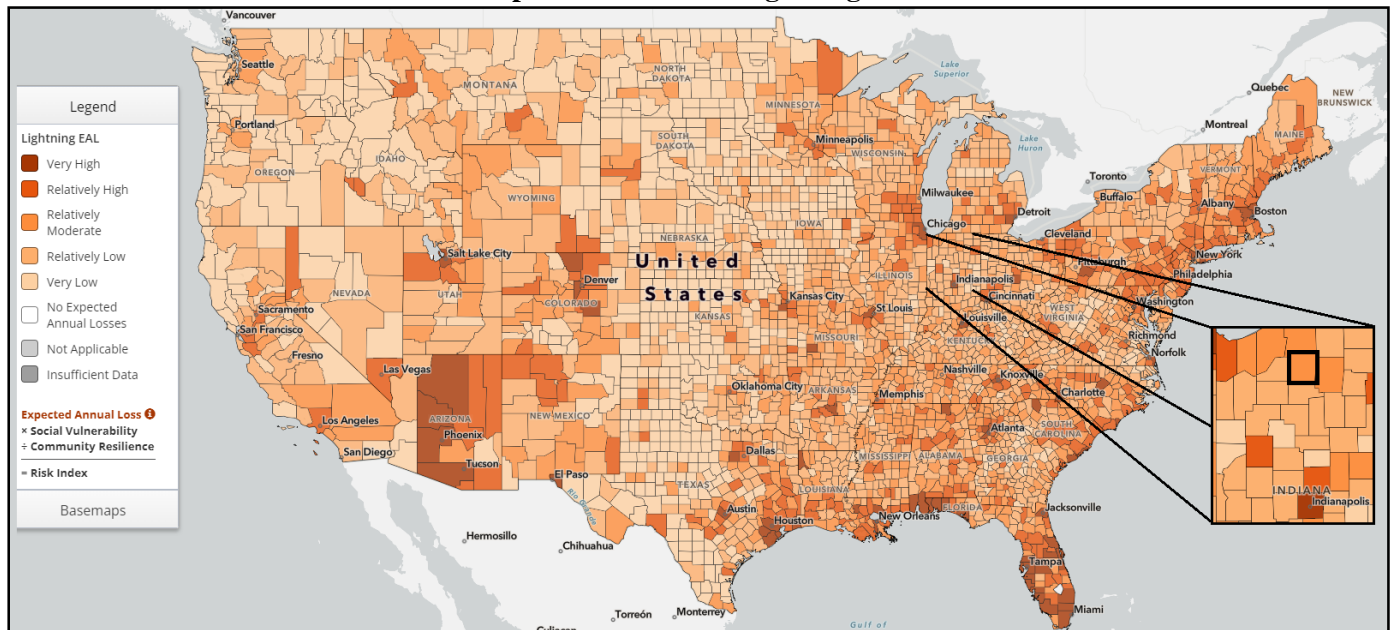
The following maps indicate the EAL for hail (Relatively Low), lightning (Relatively Low), and strong wind (Relatively Low) for Marshall County:

**Map 37: FEMA NRI Hail EAL**



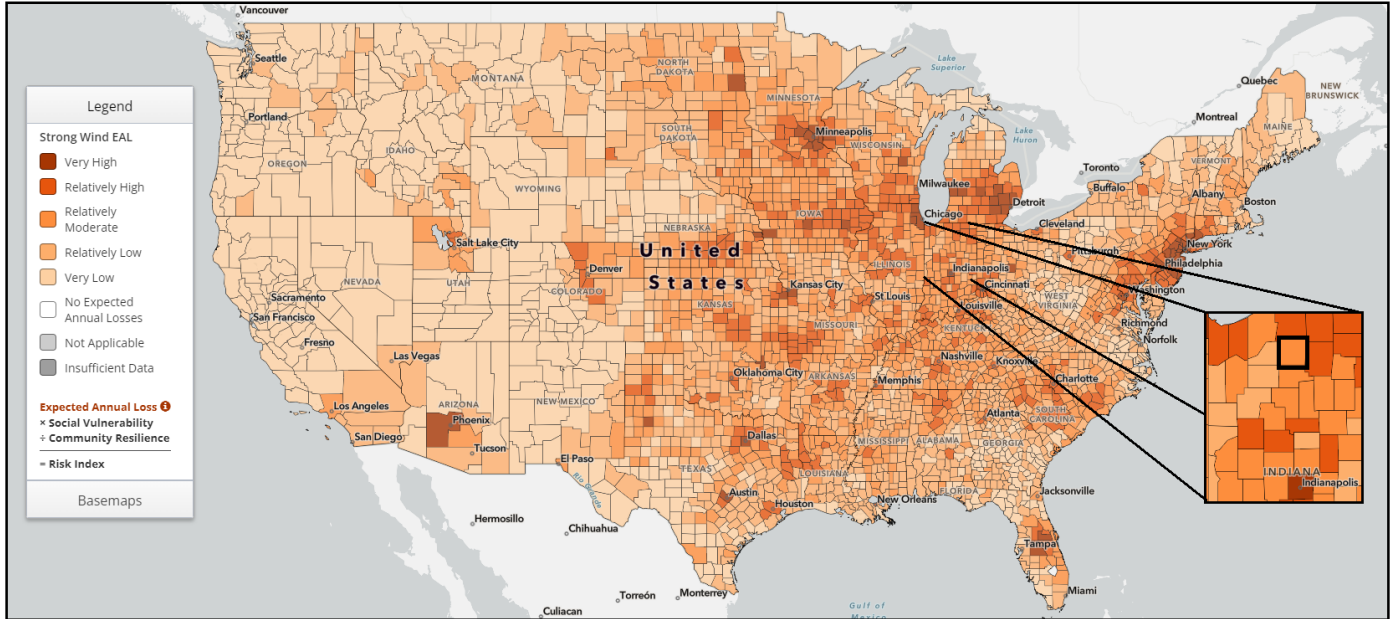
Source: FEMA NRI

**Map 38: FEMA NRI Lightning EAL**



Source: FEMA NRI

**Map 39: FEMA NRI Strong Wind EAL**



Source: FEMA NRI

#### 4.10.6 Potential Impact of Climate Change

Rising global average temperature can be associated with more frequent and more intense severe thunderstorms. One of the major factors that drive thunderstorm formation is convective available potential energy, a measure of how much energy is available for storm formation. Available scientific evidence indicates that increasing temperatures should increase convective available potential energy by warming the surface and putting more moisture in the air through evaporation, potentially increasing formation occurrence and severity.

#### 4.10.7 Land Use and Development Trends

Development trends speak to the potential impacts of land use and demographic changes in hazard prone areas. Data in this section is speculative, as future conditions are subject to numerous unpredictable factors.

As indicated in the data above, Marshall County and all participating jurisdictions have been seeing generally static or declining populations. A static or declining population could decrease population risks to severe storms by nature of their being fewer citizens to negatively impact.

Marshall County’s current land-use regulations require the consideration of building codes during the development review process. A building-by-building structural review, including roof profile, type and strength of windows, and foundation systems would need to be considered to determine structural risk. However, enforced building codes can ensure that newly built and renovated structures can withstand all but the most extreme weather incidents.

The agriculture base of Marshall County is increasingly vulnerable to the effects of severe storms. Future development of agricultural resources would tend to increase the risk and impact of an event. As indicated in the data above, Marshall County is seeing a continuing projected increase in agricultural activities and thus a potential greater future vulnerability.

#### 4.10.8 Unique and Varied Risk

Severe thunderstorms have the ability to impact the entire planning area. Unfortunately, there is no accurate method of predicting the location or extent of a severe storm’s impact or location. It is not possible to predict any varying probability between the participating jurisdictions with the exception of varying risk as it is proportionate to a participating jurisdiction’s demographics. Logically, participating jurisdictions with a greater population are at a higher risk as participating jurisdictions with a lower population are at a lower risk.





Lower income communities, including communities with a large percentage of mobile homes, may suffer disproportionate impacts. The following Census data indicates at risk population levels for Marshall County and Bourbon:

- Marshall County:
  - Percentage of housing stock as mobile homes: 6.0%
- Bourbon:
  - Percentage of housing stock as mobile homes: 6.0%

Additionally, all critical facilities identified in Appendix D are at risk to severe thunderstorm events.

## 4.11 Tornadoes

### 4.11.1 Hazard Description

A tornado is a violent, dangerous, rotating column of air that is in contact with both the surface of the earth and a cumulonimbus cloud or, in rare cases, the base of a cumulus cloud. Tornadoes come in many shapes and sizes but are typically in the form of a visible condensation funnel, whose narrow end touches the earth and is often encircled by a cloud of debris and dust.



Tornadoes can cause several kinds of damage to buildings. Tornadoes have been known to lift and move objects weighing more than 3 tons, toss homes more than 300 feet from their foundations, and siphon millions of tons of water. However, less spectacular damage is much more common. Houses and other obstructions in the path of the wind cause the wind to change direction. This change in wind direction increases pressure on parts of the building. The combination of increased pressures and fluctuating wind speeds creates stress on the building that frequently causes connections between building components, roofing, siding, windows, etc., to fail. Tornadoes can also generate a tremendous amount of flying debris. If wind speeds are high enough, airborne debris can be thrown at buildings with enough force to penetrate windows, roofs, and walls.

### 4.11.2 – Location and Extent

Tornadoes can strike anywhere in Marshall County or its participating jurisdictions placing the entire planning area at risk. A tornado may arrive with a squall line or cold front and touch down quickly. Smaller tornadoes can strike without warning. Other times tornado watches and sirens will alert communities of high potential tornado producing weather or an already formed tornado and its likely path.

Since 2007, the United States uses the Enhanced Fujita (EF) Scale to categorize tornadoes. The scale correlates wind speed values per F level and provides a rubric for estimating damage.

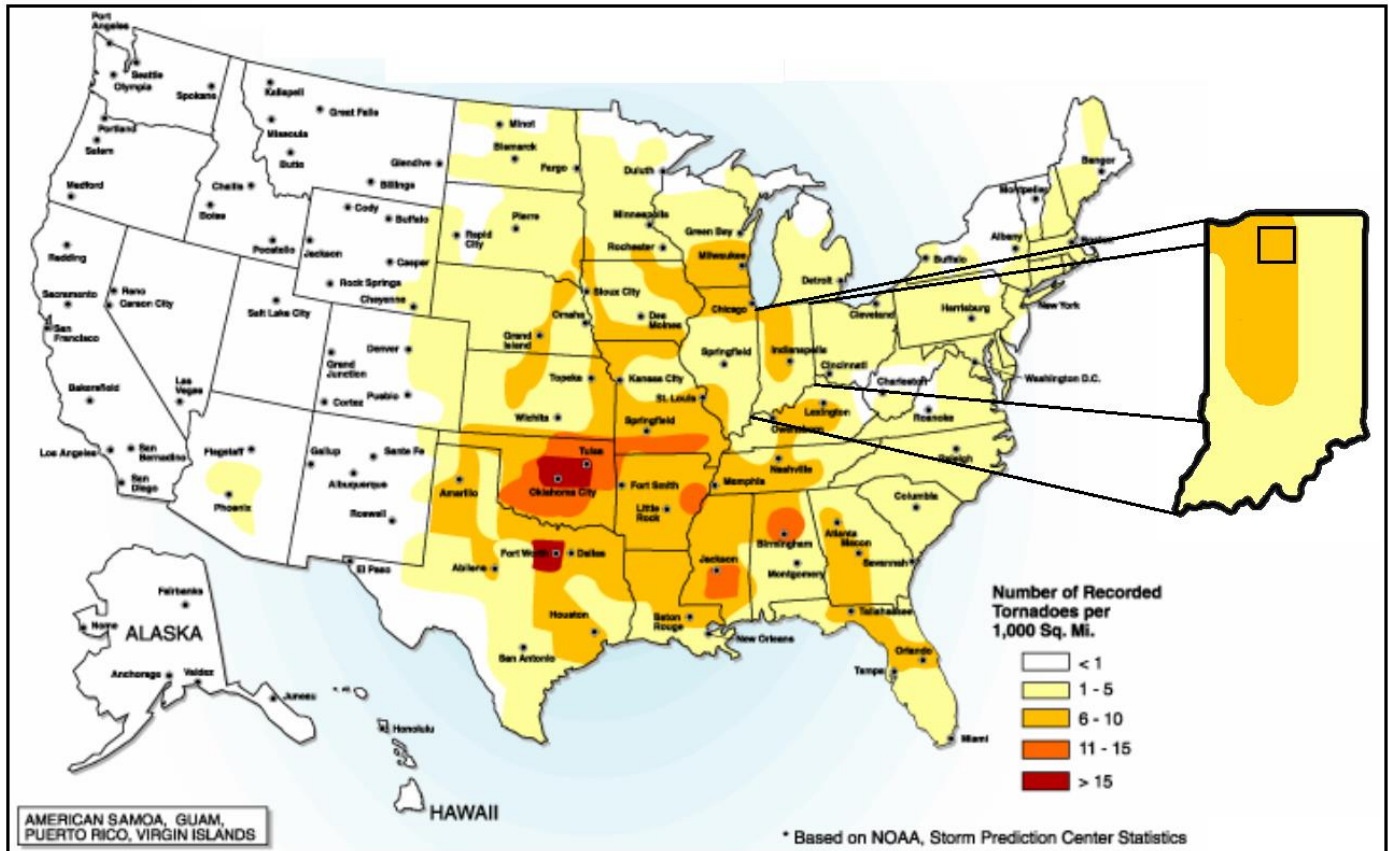
**Table 61: Enhanced Fujita Scale**

| Scale | Wind Speed (mph) | Relative Frequency | Potential Damage  |
|-------|------------------|--------------------|---|
| EF0   | 65-85            | 53.5%              | Light. Peels surface off some roofs; some damage to gutters or siding; branches broken off trees; shallow-rooted trees pushed over. Confirmed tornadoes with no reported damage (i.e., those that remain in open fields) are always rated EF0.  |
| EF1   | 86-110           | 31.6%              | Moderate. Roofs severely stripped; mobile homes overturned or badly damaged; loss of exterior doors; windows and other glass broken.  |
| EF2   | 111-135          | 10.7%              | Considerable. Roofs torn off well-constructed houses; foundations of frame homes shifted; mobile homes complete destroyed; large trees snapped or uprooted; light object missiles generated; cars lifted off ground.  |
| EF3   | 136-165          | 3.4%               | Severe. Entire stores of well-constructed houses destroyed; severe damage to large buildings such as shopping malls; trains overturned; trees debarked; heavy cars lifted off the ground and thrown; structures with weak foundations blown away some distance.                             |
| EF4   | 166-200          | 0.7%               | Devastating. Well-constructed houses and whole frame houses completely leveled; cars thrown and small missiles generated.   |
| EF5   | >200             | <0.1%              | Explosive. Strong frame houses leveled off foundations and swept away; automobile-sized missiles fly through the air in excess of 300 ft.; steel reinforced concrete structure badly damaged; high rise buildings have significant structural deformation; incredible phenomena will occur. |

Source: NOAA Storm Prediction Center

The following map, from FEMA, indicates that Marshall County can expect, on average, six to ten tornadoes per 1,000 square miles, a moderate category.

**Map 40: Tornado Activity per 1,000 Square Miles**



Source: FEMA

**4.11.3 Previous Occurrences**

Historical events of significant magnitude or impact can result in a Presidential Disaster Declaration. In the 20-year period from 2003 to 2022, with the years 2003 and 2022 being full dataset years, Marshall County has experienced one Presidential Disaster Declaration related to tornadoes, reflected in the following table.

**Table 62: Marshall County Presidential Disaster Declarations**

| Designation | Declaration Date | Incident Type                          |
|-------------|------------------|--|
| DR-1832     | 4/22/2009        | Severe Storms, Tornadoes, and Flooding |

Source: FEMA

In addition to the Presidentially Declared Disasters, the following table presents NCEI identified tornado events and the resulting damage totals in Marshall County from 2003 to 2022. with the years 2003 and 2022 being full dataset years. Please note that as tornadoes events tend to cover larger areas occurrence data is being presented as representative of all participating jurisdictions.

**Table 63: Marshall County NCEI Tornado Events, 2003-2022**

| Event Type | Number of Events | Property Damage | Crop Damage | Deaths | Injuries |
|------------|------------------|-----------------|-------------|--------|----------|
| Tornado    | 4                | \$1,100,000     | \$0         | 0      | 0        |

Source: NCEI



The following provides both local accounts and NCEI descriptions of notable recorded events:

- October 18, 2007 - Marshall County:** The tornado touched down near the intersection of 12B and Gumwood Roads, just west of Bourbon. Initial damage comprised of damage to shingles on a few roofs as well as some tree damage. As the tornado moved northeast and intensified it blew down a 3/8-mile-long stretch of power poles. A total of 16 homes suffered damage from the tornado, 3 were destroyed, 1 suffered major damage and 12 suffered minor damage. Some barns, storage sheds, silos and garages suffered damage of varying degrees as well. The tornado reached the higher end of EF2 as it entered Kosciusko County. A Bourbon Fire Department grass truck crashed into a ditch during the storm, with the driver being taken to the hospital for unknown injuries. It is not known as to why the crash occurred. 3 other non-specific minor injuries were reported. Damage is estimated at around \$600,000.
- August 15, 2007 – Argos:** The initial touchdown of the tornado was located a large grove of trees along Maple Road west of Argos and proceeded rapidly southeast to the southeast side of Argos. The tornado skipped along its track, snapping and uprooting numerous trees, downing power poles and lines and damaging some structures. Two businesses on the south side of Argos, near the intersection of US 31 and State Rd 10 suffered moderate damage. The roof of the Topp Industries plant suffered damage. A McDonalds/BP Station suffered metal siding and roofing damage along with the removal of a few gas pumps. A stationary police cruiser was spun by a combination of the strong winds and a signpost striking the car. Neither the officer, nor anyone else in the path of the tornado was injured. The tornado lifted southeast of this point. Exact damage figures were not available but are estimated to be at least \$500,000.

#### 4.11.4 Probability of Future Events

Predicting the probability of tornado occurrences is tremendously challenging due to the large number of factors involved and the random nature of formation. Data from the NCEI indicates that Marshall County can expect on a yearly basis, relevant to tornado events:

**Table 64: Marshall County Tornado Probability Summary**

| Data  | Events |
|---|--------|
| Number of Days with NCEI Reported Event (2003-2022) | 4      |
| Average Events per Year                             | <1     |
| Strongest EF Rated Tornado                          | EF2    |

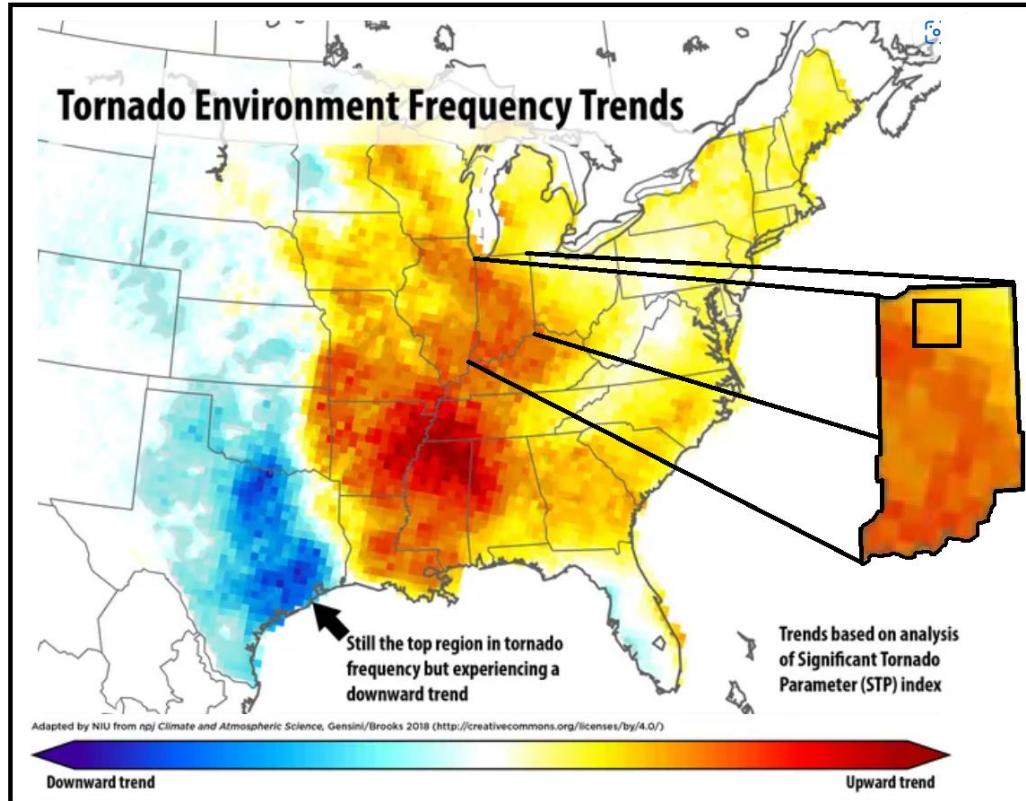
Source: NCEI

Available historical tornado data suggests that Marshall County can expect future tornadoes to range from EF0 to EF2 on the Enhanced Fujita Scale.

Research conducted by the National Severe Storms Lab looked at Significant Tornado Parameters to help determine future tornado probability. Significant Tornado Parameters are a measurement of the major parameters of tornado conditions, including wind speed and direction, wind at differing altitudes, unstable air patterns, and humidity. The following map, generated by Northern Illinois University and compiled from Significant Tornado Parameter data, indicates that Marshall County may see an increasing number of tornados.



**Map 41: Tornado Frequency Trends**



Source: Northern Illinois University

**4.11.5 Vulnerability and Impact**

Data from the NCEI indicates that Marshall County can expect on a yearly basis, relevant to tornado events:

**Table 65: Marshall County Tornado Impact Summary**

| Data  | Recorded Impact |
|---|-----------------|
| Deaths or Injuries (2003-2022)                  | 0               |
| Average Number of Deaths or Injuries            | 0               |
| Total Reported NCEI Property Damage (2003-2022) | \$1,100,000     |
| Average Property Damage per Year                | \$55,000        |

Source: NCEI

Data from HAZUS was used to provide a county building stock valuation. This data was then compared to NCEI structural damage figures to determine the percentage of impacted building within the county for the period of 2003-2022 for tornadoes. Data was only available at a county level.

**Table 66: Marshall County HAZUS and NCEI Tornado Percentage Loss Data**

| Hazard  | HAZUS Building Valuation | NCEI Structure Damage, 2002-2022 | Percentage of Building Valuation Damaged |
|---------|--------------------------|----------------------------------|--|
| Tornado | \$10,174,541,000         | \$1,100,000                      | 0.01%                                    |

Source: FEMA HAZUS

While difficult to quantify, as the impacts of future tornadoes will be determined by many factors, the impacts of a tornado may be widespread. An EF4 or EF5 tornado has the potential to level the smaller jurisdictions. A lesser magnitude tornado can rip off roofs and walls while launching airborne missiles born from debris. In the absence of proper shelter tornadoes can cause serious injury. In general, if potentially exposed persons take shelter in a solid, well-

constructed shelter protection from tornadoes would be provided. However, old or poorly constructed facilities may be more prone to damage, potentially increasing the impact on economically disadvantaged populations.

Severe storms can impact critical infrastructure in the following ways:

- Unable to be accessed by personnel due surrounding conditions
- Loss of utilities due to downed lines
- Structural damage
- Complete structural failure

A potential impact to Marshall County from tornado events could be felt in the agricultural community. As previously indicated by USDA National Agricultural Statistics Service data in the following table, Marshall County is seeing growth in all agricultural sectors. USDA Risk Management Agency crop loss data relating to tornadoes for the five-year period of 2018 to 2022, with 2018 and 2022 being full dataset years, allows us to quantify the monetary impact of tornadic conditions on the agricultural sector. While it is likely that the market value of crops sold is higher for each subsequent year, the latest available data is for 2017. The higher the percentage loss, the higher the related vulnerability to tornado events.

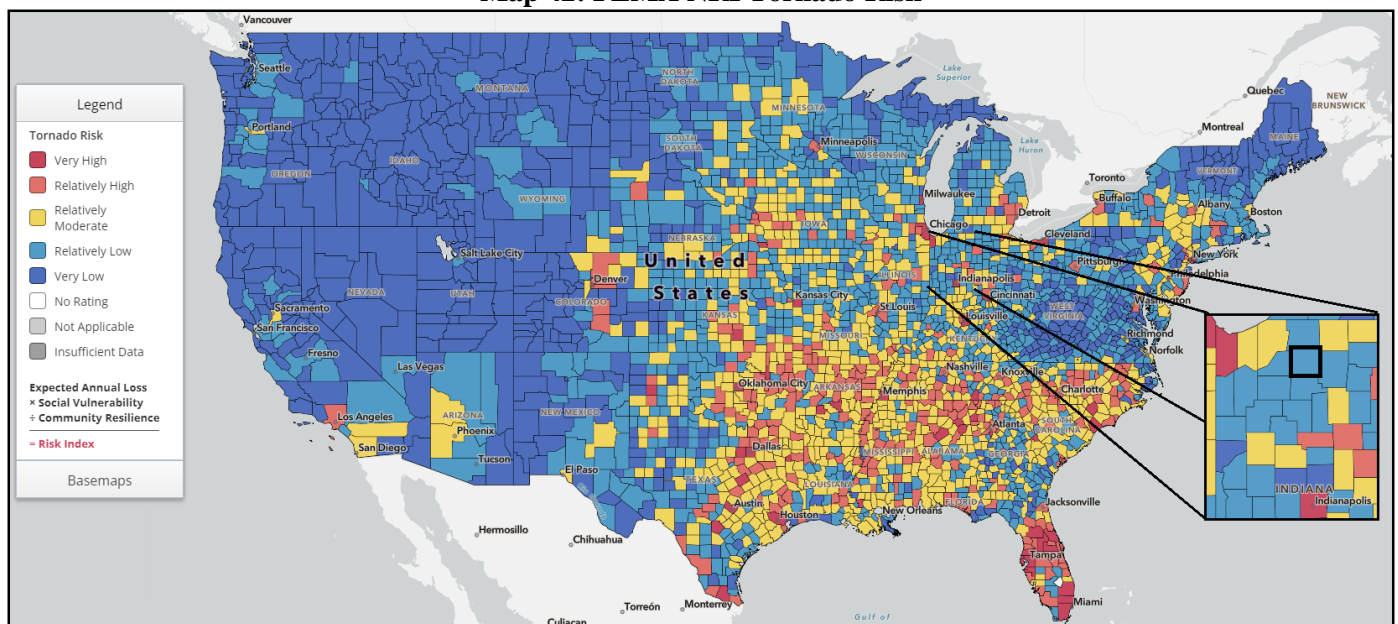
**Table 67: Marshall County Crop Insurance Paid for Severe Thunderstorm Loss, 2018 - 2022**

| Year | Market Value of Agricultural Products Sold (2017) | Annualized Crop Insurance Paid | Percentage of Market Value Impacted |
|------|---|--------------------------------|-------------------------------------|
| 2022 | \$145,167,000                                     | \$0                            | 0.0%                                |
| 2021 | \$145,167,000                                     | \$0                            | 0.0%                                |
| 2020 | \$145,167,000                                     | \$0                            | 0.0%                                |
| 2019 | \$145,167,000                                     | \$0                            | 0.0%                                |
| 2018 | \$145,167,000                                     | \$0                            | 0.0%                                |

Source: USDA

Using the FEMA NRI, and consisting of three input components (expected annual loss, social vulnerability, and community resilience), the following map was created indicating the potential risk to Marshall County from tornadoes (Relatively Low):

**Map 42: FEMA NRI Tornado Risk**

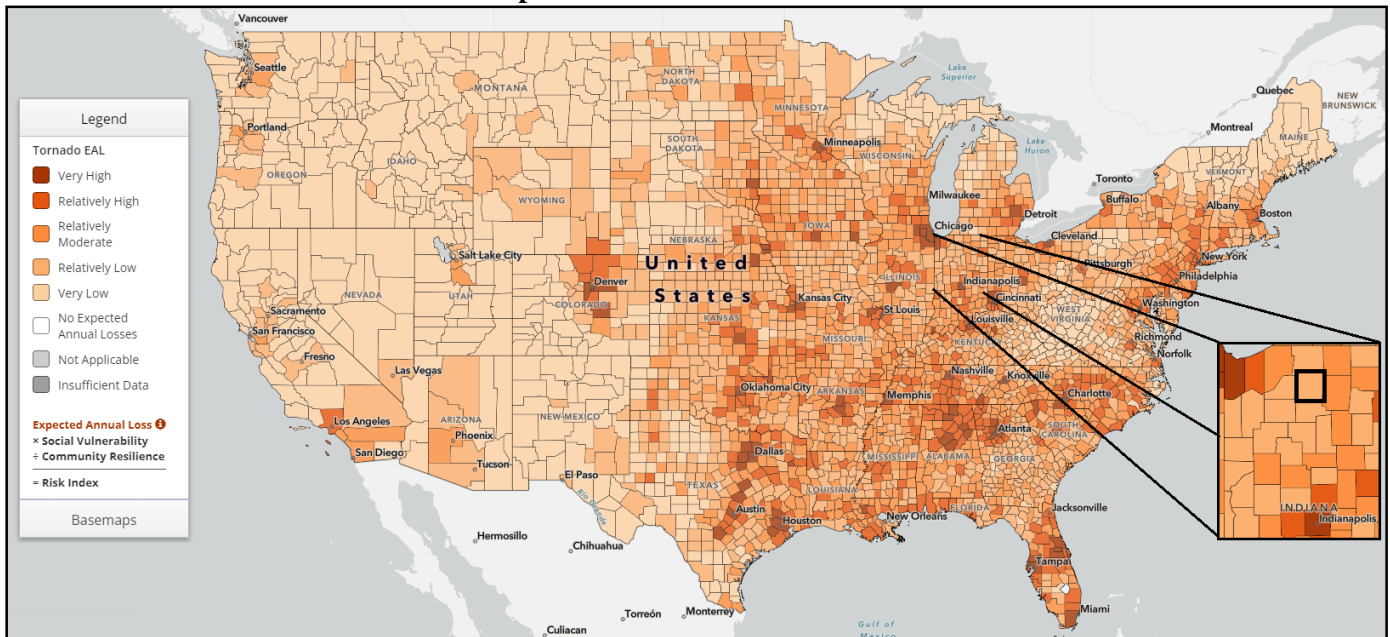


Source: FEMA NRI

As part of the NRI, EAL represents the average economic loss in dollars resulting from a hazard each year. It quantifies loss for relevant consequence types, buildings, people, and agriculture. An EAL score and rating represent a community's relative level of expected losses each year when compared to all other communities at the same level. EAL is calculated using an equation that includes exposure, annualized frequency, and historic loss ratio risk factors. Exposure is a factor that measures the building value, population, and agriculture value potentially exposed to a natural hazard occurrence. Annualized frequency is a factor that measures the expected frequency or probability of a hazard occurrence per year. Historic loss ratio is a factor that measures the percentage of the exposed consequence type value (building, population, or agriculture) expected to be lost due to an occurrence. EAL represents the average economic loss in dollars resulting from natural hazards each year and is proportional to a community's risk.

The following maps indicate the EAL for Marshall County (Relatively Low):

**Map 43: FEMA NRI Tornado EAL**



Source: FEMA NRI

#### 4.11.6 Potential Impact of Climate Change

In general, the components of tornado formation include ground level warm and moist air, atmospheric cool dry air, and wind shear. Each of these components may be differently affected by climate change making predictions about the impact on tornado formation difficult to quantify.

#### 4.11.7 Land Use and Development Trends

Development trends speak to the potential impacts of land use and demographic changes in hazard prone areas. Data in this section is speculative, as future conditions are subject to numerous unpredictable factors.

As indicated in the data above, Marshall County and all participating jurisdictions have been seeing generally static or declining populations. A static or declining population could decrease population risks to tornadoes by nature of their being fewer citizens to negatively impact.

Marshall County's current land-use regulations require the consideration of building codes during the development review process. A building-by-building structural review, including roof profile, type and strength of windows, and foundation systems would need to be considered to determine structural risk. However, enforced building codes can ensure that newly built and renovated structures can better withstand tornado events.



The agriculture base of Marshall County is increasingly vulnerable to the effects of tornadoes. Future development of agricultural resources would tend to increase the risk and impact of an event. As indicated in the data above, Marshall County is seeing a continuing projected increase in agricultural activities and thus a potential greater future vulnerability.

#### **4.11.8 Unique and Varied Risk**

Tornadoes can impact the entire planning area. Unfortunately, there is no accurate method of predicting the location or extent of a tornado's impact. Additionally, it is not possible to predict any varying probability between the participating jurisdictions with the exception of varying risk as it is proportionate to a participating jurisdiction's demographics and the previously mentioned factors. Logically, participating jurisdictions with a greater population are at a higher risk as participating jurisdictions with a lower population are at a lower risk.

Lower income communities, including communities with a large percentage of mobile homes, may suffer disproportionate impacts. The following Census data indicates at risk population levels for Marshall County and Bourbon:

- Marshall County:
  - Percentage of housing stock as mobile homes: 6.0%
- Bourbon:
  - Percentage of housing stock as mobile homes: 6.0%

Additionally, all critical facilities identified in Appendix D are at risk to tornado events.



## 4.12 Winter Storms

### 4.12.1 Hazard Description

A winter storm encompasses multiple effects caused by winter weather. Included are strong winds, ice storms, heavy or prolonged snow, sleet, and extreme temperatures. Winter storms can be increasingly hazardous in areas and regions that only see winter storms intermittently.

This plan defines winter storms as a combination of the following winter weather effects as defined by NOAA and the NWS.



- **Ice Storm:** An ice storm is used to describe occasions when damaging accumulations of ice are expected during freezing rain situations. Significant accumulations of ice pull down trees and utility lines resulting in loss of power and communication. These accumulations of ice make walking and driving extremely dangerous. Significant ice accumulations are usually accumulations of ¼" or greater.
- **Heavy Snow:** This generally means snowfall accumulating to 4" or more in depth in 12 hours or less; or snowfall accumulating to 6" or more in depth in 24 hours or less.
- **Winter Storm:** Hazardous winter weather in the form of heavy snow, freezing rain, or heavy sleet. It may also include extremely low temperatures and increased wind.
- **Cold Wave/Extreme Cold:** As described by NWS, a cold wave is a rapid fall in temperature within a 24-hour period requiring substantially increased protection to agriculture, industry, commerce, and social activities. As evidenced by past incidents across the U.S., extreme cold can cause impact to human life and property.

### 4.12.2 – Location and Extent

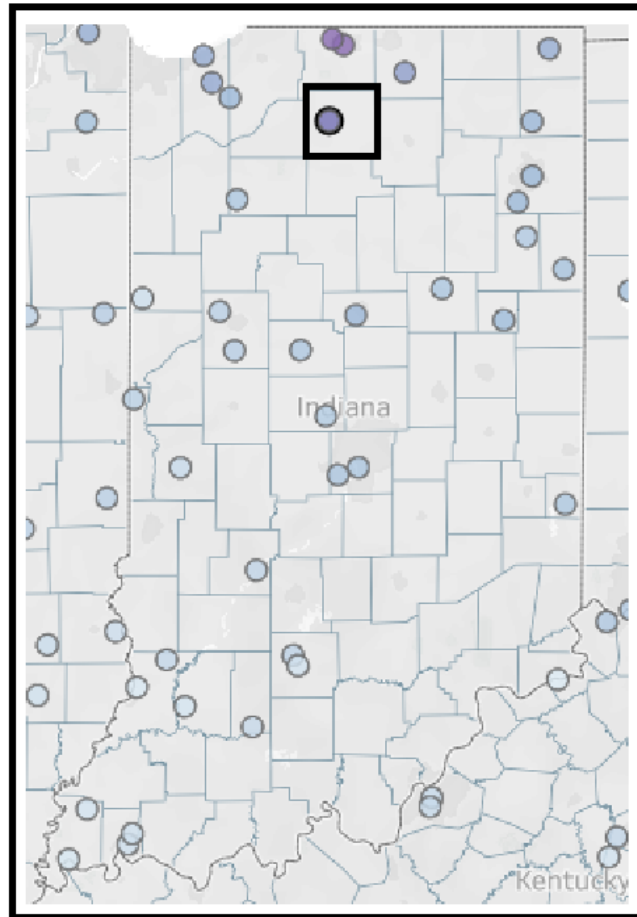
Winter storms occur regularly throughout Marshall County and its participating jurisdictions, and often affect the entire planning area. These events occur on a large geographic scale, often affecting multiple counties, regions, and states.

Winter storms typically form with warning and are often anticipated. Like other large storm fronts, the severity of a storm is not as easily predicted and when it is, the window of notification is up to few hours to under an hour. Although meteorologists estimate the amount of snowfall a winter storm will drop, it is not known exactly how many feet of snow will fall, whether or not it will form an ice storm, or how powerful the winds will be until the storm is already affecting a community.

Winter storms can range from moderate snow over a few hours to blizzard conditions with high winds, freezing rain or sleet, heavy snowfall with blinding wind-driven snow and extremely cold temperatures that last several days.

The Midwest Region Climate Center maintains a snow collection point in Plymouth, Marshall County. The following map shows the location of the station.

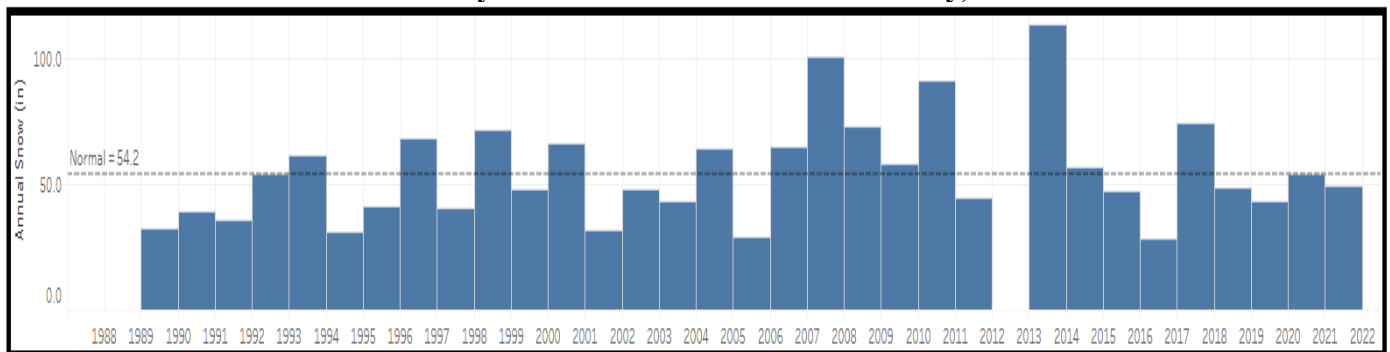
### Map 44: Marshall County Snow Measurement Station



Source: Midwest Regional Climate Center

Historically data from the station indicates that Marshall County and its participating jurisdictions will typically see an average of 54.2 inches of snowfall each year.

### Chart 12: Yearly Snowfall Totals for Marshall County, 1988 - 2022



Source: Midwest Regional Climate Center



Severe winter storms can be accompanied by extremely cold temperatures accompanied by strong winds result in potentially lethal wind chills. The Wind Chill is the temperature your body feels when the air temperature is combined with the wind speed. It is based on the rate of heat loss from exposed skin caused by the effects of wind and cold. As the speed of the wind increases, it can carry heat away from your body much more quickly, causing skin temperature to drop. The Wind Chill chart (Table 11, above) shows the difference between actual air temperature and perceived temperature, and amount of time until frostbite occurs.

#### 4.12.3 Previous Occurrence

Historical events of significant magnitude or impact can result in a Presidential Disaster Declaration. In the 20-year period from 2003 to 2022, with the years 2003 and 2022 being full dataset years, Marshall County has experienced two Presidential Disaster Declarations related to severe winter storms, reflected in the following table.

**Table 68: Marshall County Presidential Disaster Declarations**

| Designation | Declaration Date | Incident Type                     |
|-------------|------------------|-----------------------------------|
| DR-1573     | 1/21/2005        | Severe Winter Storms and Flooding |
| DR-1740     | 1/30/2008        | Severe Winter Storms and Flooding |

Source: FEMA

In addition to the Presidentially Declared Disasters, the following table presents NCEI identified ice storm and winter storm events and the resulting damage totals in Marshall County from 2003 to 2022, with the years 2003 and 2022 being full dataset years. Please note that as these storms events tend to cover larger areas occurrence data is being presented as representative of all participating jurisdictions.

**Table 69: Marshall County NCEI Winter Storm Events, 2003 - 2022**

| Event Type   | Number of Events | Property Damage | Crop Damage | Deaths | Injuries |
|--------------|------------------|-----------------|-------------|--------|----------|
| Ice Storm    | 3                | \$25,000        | \$0         | 0      | 0        |
| Winter Storm | 23               | \$0             | \$0         | 0      | 0        |

Source: NCEI

#### 4.12.4 Probability of Future Events

Predicting the probability of winter storm occurrences is tremendously challenging due to the large number of factors involved and the random nature of formation. Data from the NCEI indicates that Marshall County can expect on a yearly basis, relevant to winter storm events:

**Table 70: Marshall County Winter Storm Probability Summary**

| Data  | Events |
|---|--------|
| Number of Days with NCEI Reported Event (2003-2022) | 26     |
| Average Events per Year                             | 1      |

Source: NCEI

#### 4.12.5 Vulnerability and Impact

Data from the NCEI indicates that Marshall County can expect on a yearly basis, relevant to Winter Storm events:

**Table 71: Marshall County Winter Storm Impact Summary**

| Data  | Recorded Impact |
|---|-----------------|
| Deaths or Injuries (2003-2022)                  | 0               |
| Average Number of Deaths or Injuries            | 0               |
| Total Reported NCEI Property Damage (2003-2022) | \$25,000        |
| Average Property Damage per Year                | \$1,250         |

Source: NCEI



The entire Marshall County region is vulnerable to winter and ice storms. Based on the non-geographic specific aspect of this hazard, i.e., no one area is at a greater risk, all of the planning area’s structural inventory and population is vulnerable to these storms. Extremely cold temperatures are a threat to anyone exposed to them. Extreme cold can cause frostbite and hypothermia. Bitterly cold temperatures can also burst water and create an excessive demand on providers to deliver energy for household heating. There are also fire dangers associated with home heating. Heavy snow and/or ice can paralyze communities. Roads can become hazardous which may cause accidents, disrupted flow of supplies, and challenges in the delivery of emergency and medical services. Large accumulations of snow and/or ice can collapse roofs of buildings and knock down trees and power lines. Heavy snow can also isolate rural communities and kill livestock on farms.

Ice storms can bring down trees and topple utility poles and communication towers. Ice can disrupt communications and power for days while utility companies repair extensive damage. Ice covered roads are dangerous and may cause accidents, disrupted flow of supplies, and challenges with the delivery of emergency and medical services.

Both winter storms and ice storms can impact critical infrastructure. Critical infrastructure can be impacted in the following ways:

- Unable to be accessed by personnel due to road conditions
- Burst pipes from freezing temperatures
- Loss of utilities due to downed lines
- Collapsed roofs under heavy snow loads

A potential impact to Marshall County from winter storm events could be felt in the agricultural community. As previously indicated by USDA National Agricultural Statistics Service data in the following table, Marshall County is seeing growth in all agricultural sectors. USDA Risk Management Agency crop loss data relating to winter storms for the five-year period of 2018 to 2022, with 2018 and 2022 being full dataset years, allows us to quantify the monetary impact of winter storm conditions on the agricultural sector. While it is likely that the market value of crops sold is higher for each subsequent year, the latest available data is for 2017. The higher the percentage loss, the higher the related vulnerability to winter storm events.

**Table 72: Marshall County Crop Insurance Paid for Winter Storm Loss, 2018 - 2022**

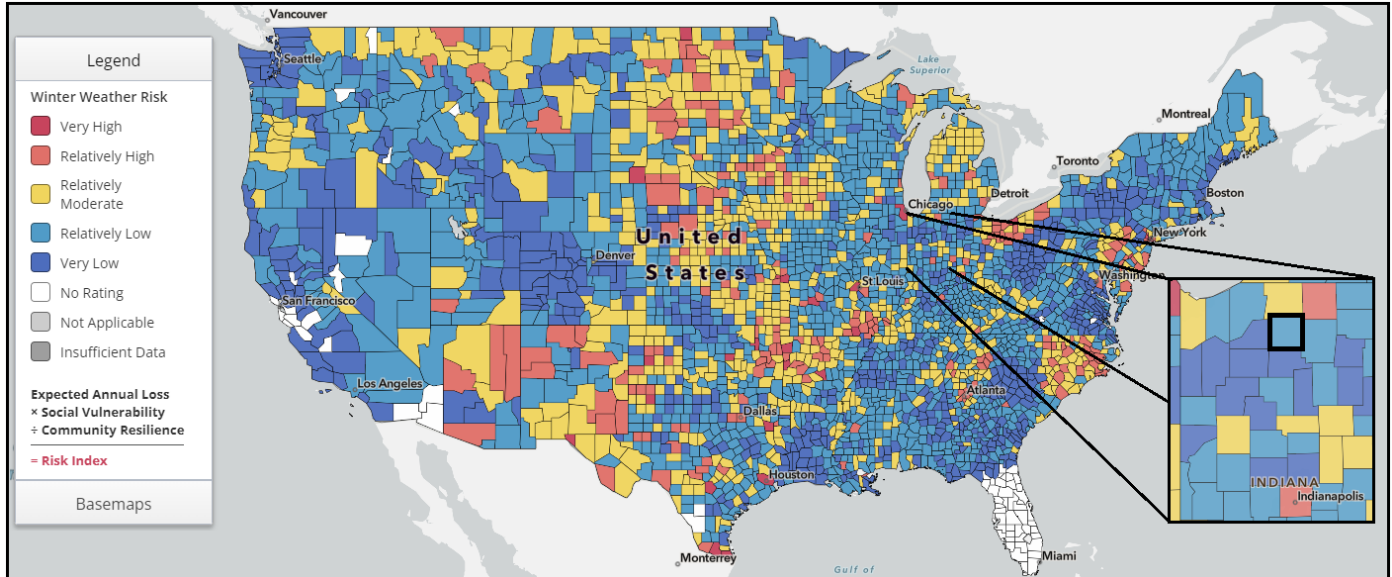
| Year | Market Value of Agricultural Products Sold (2017) | Annualized Crop Insurance Paid | Percentage of Market Value Impacted |
|------|---|--------------------------------|-------------------------------------|
| 2022 | \$145,167,000                                     | \$0                            | 0.0%                                |
| 2021 | \$145,167,000                                     | \$15,324                       | 0.01%                               |
| 2020 | \$145,167,000                                     | \$0                            | 0.0%                                |
| 2019 | \$145,167,000                                     | \$17,224                       | 0.01%                               |
| 2018 | \$145,167,000                                     | \$52,665                       | 0.03%                               |

Source: USDA

Using the FEMA NRI, and consisting of three input components (expected annual loss, social vulnerability, and community resilience), the following maps were created indicating the potential risk to Marshall County from winter weather (Relatively Low), ice storms (Very Low):

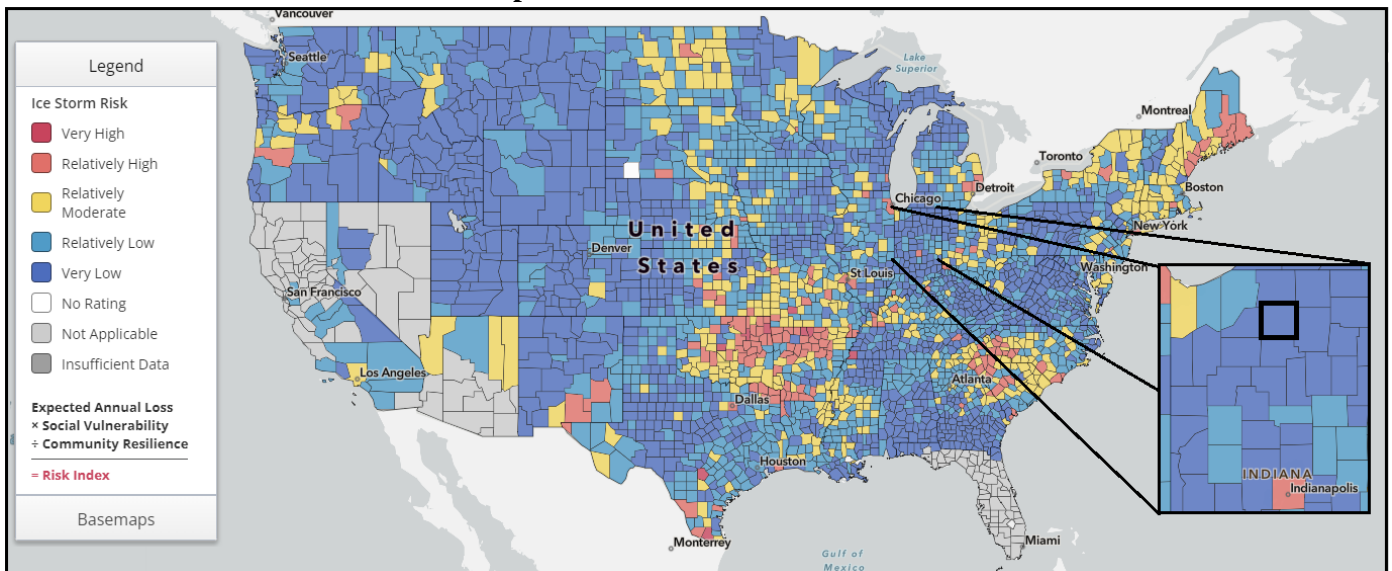


**Map 45: FEMA NRI Winter Weather Risk**



Source: FEMA NRI

**Map 46: FEMA NRI Ice Storm Risk**

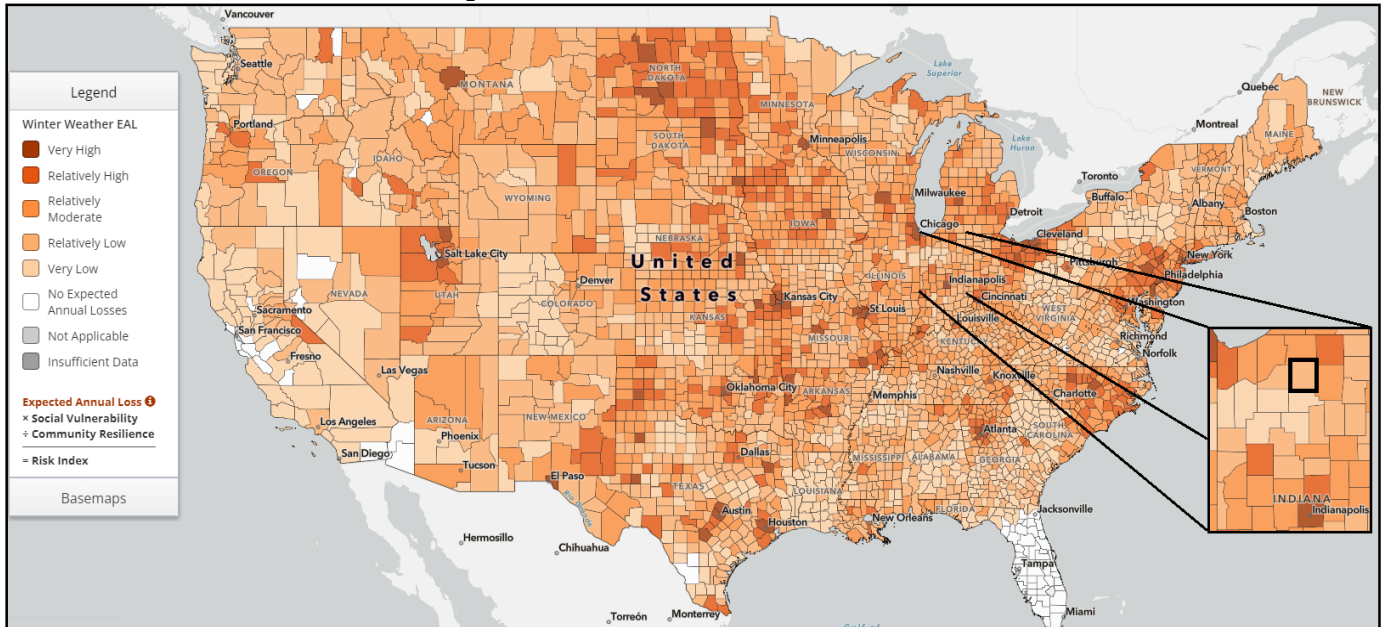


Source: FEMA NRI

As part of the NRI, EAL represents the average economic loss in dollars resulting from a hazard each year. It quantifies loss for relevant consequence types, buildings, people, and agriculture. An EAL score and rating represent a community's relative level of expected losses each year when compared to all other communities at the same level. EAL is calculated using an equation that includes exposure, annualized frequency, and historic loss ratio risk factors. Exposure is a factor that measures the building value, population, and agriculture value potentially exposed to a natural hazard occurrence. Annualized frequency is a factor that measures the expected frequency or probability of a hazard occurrence per year. Historic loss ratio is a factor that measures the percentage of the exposed consequence type value (building, population, or agriculture) expected to be lost due to an occurrence. EAL represents the average economic loss in dollars resulting from natural hazards each year and is proportional to a community's risk.

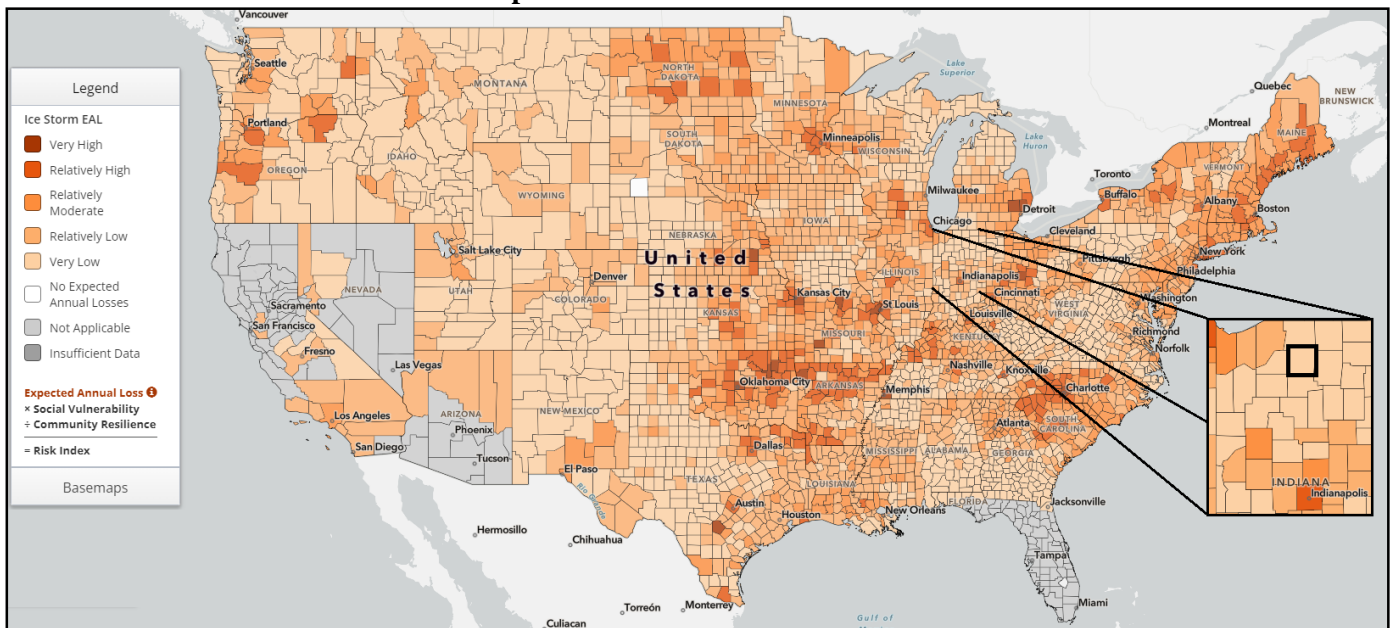
The following maps indicate the EAL for winter weather (Relatively Low) and ice storms (Very Low) for Marshall County:

**Map 47: FEMA NRI Winter Weather EAL**



Source: FEMA NRI

**Map 48: FEMA NRI Ice Storm EAL**



Source: FEMA NRI

**4.12.6 Climate Change**

Rising temperatures caused by climate change are expected to result in more winter precipitation falling as rain and the last spring frost of the year getting steadily earlier. As such, it is expected that climate change may reduce the risk to Marshall County of winter storms events in the coming years

**4.12.7 Land Use and Development Trends**

Development trends speak to the potential impacts of land use and demographic changes in hazard prone areas. Data in this section is speculative, as future conditions are subject to numerous unpredictable factors.



As indicated in the data above, Marshall County and all participating jurisdictions have been seeing generally static or declining populations. A static or declining population could decrease population risks to winter storms by nature of their being fewer citizens to negatively impact.

Marshall County's current land-use regulations require the consideration of building codes during the development review process. A building-by-building structural review, including roof profile and strength would need to be to determine structural risk to snow and ice loads. However, enforced building codes can ensure that newly built and renovated structures can better withstand the loads.

The agriculture base of Marshall County is increasingly vulnerable to the effects of winter storms. Future development of agricultural resources would tend to increase the risk and impact of an event. As indicated in the data above, Marshall County is seeing a continuing projected increase in agricultural activities and thus a potential greater future vulnerability.

#### **4.12.8 Unique and Varied Risk**

Winter storms have the ability to impact the entire planning area. Unfortunately, there is no accurate method of predicting the location or extent of a winter storm. Additionally, it is not possible to predict any varying probability between the participating jurisdictions with the exception of varying risk as it is proportionate to a participating jurisdiction's demographics and the previously mentioned factors. Logically, participating jurisdictions with a greater population are at a higher risk as participating jurisdictions with a lower population are at a lower risk.

Lower income communities, or communities poorly served by power infrastructure may suffer disproportionate impacts. Especially at risk may be vulnerable populations of each participating jurisdiction, including the especially young, the elderly, and those below the poverty level. The following Census data indicates at risk population levels for Marshall County and Bourbon:

- Marshall County:
  - Population under the age of five: 2,979
  - Population over the age of 65: 8,159
  - Population below the poverty level: 5,255
  
- Bourbon:
  - Population under the age of five: 198
  - Population over the age of 65: 202
  - Population below the poverty level: 202

All critical facilities identified in Appendix D are at risk from winter storm events due to heavy snow and/or ice accumulation. These facilities are at additional risk due to resultant utility failure from a winter storm event.



## Section 5 – Mitigation Strategy

### 5.1 Introduction

As part of this planning effort, Marshall County and its participating jurisdictions worked to minimize the risk of future impacts from identified hazards to all citizens of the county. In an attempt to shape future regulations, ordinances and policy decisions, the MPC reviewed and developed a hazard mitigation strategy. This comprehensive strategy includes:

- The consistent review and revision, as necessary, of obtainable goals and objectives
- The consistent review, revision and development of a comprehensive list of potential hazard mitigation actions

The development of a robust mitigation strategy allows for:

- The ability to effectively direct limited resources for maximum benefit
- The ability to prioritize identified hazard mitigation projects to maximize positive outcomes
- The increase in public and private level participation in hazard mitigation through transparency and awareness
- The potential direction of future policy decisions through awareness and education
- The achievement of the ultimate goal of a safer Marshall County for all our citizens

As per the previous hazard mitigation plan, and considering all of the factors listed above, the MPC continues to implement the following mitigation strategy:

- **Implement** the action plan recommendations of this plan.
- **Use** existing regulations, policies, programs, procedures, and plans already in place.
- **Monitor** multi-objective management opportunities, share and package funding opportunities, and garner broader constituent support.
- **Communicate** the hazard information collected and analyzed through this planning process so that local governments and residents better understand where disasters occur, and what they can do to mitigate their impacts. In doing so, also publicize the success stories that have been achieved through the County's ongoing mitigation efforts.

### 5.2 Identification of Goals

The following goals for hazard mitigation were established from the MPC's discovery and deliberation process, which consisted of:

- A review of identified hazards, vulnerabilities and impacts
- A review of hazard events subsequent to the last hazard mitigation plan revision
- A review of demographic, infrastructure and built environment data
- A review of the goals and objectives identified in previous hazard mitigation plans
- A review of local mitigation strategies and goals
- A review completed and remaining hazard mitigation actions

These goals represent a vision for hazard mitigation and disaster resistance for Marshall County. Each mitigation goal was reviewed and approved by both MPC members and stakeholders. Through group discussions at meetings, the MPC refined and combined the identified goals from the previous hazard mitigation plan. During this process it was determined that the priorities of the overall community in relation to hazard mitigation planning have not changed during the five years of the previous planning cycle. The identified goals are as follows:

- **Goal 1:** Reduce the risk to the people and property from the identified hazards in this plan.
- **Goal 2:** Work to protect all vulnerable populations, structures, and critical facilities from the impacts of the identified hazards.





- **Goal 3:** Improve public outreach initiatives to include education, awareness, and partnerships with all entities in order to enhance the understanding identified hazards and hazard mitigation opportunities.

### 5.3 Mitigation Capabilities

Marshall County and its participating jurisdictions' governments utilize a single emergency management agency for their services, this being the MCEM. Local initiatives, programs, and policies are often facilitated by the MCEM in coordination with local governments, and other emergency related entities, as it is the sole, primary agency responsible for emergency management. The MCEM does this by fostering local partnerships and relationships, an active EMAC, and assisting local governments with funding and training initiatives.

All future implemented mitigation projects will be overseen by the MCEM and will coordinate with the corresponding local municipal government. The corresponding local government involvement will vary by jurisdiction and be decided by that jurisdictional government as they see it fit to best plan, design, and implement mitigation projects.

Each jurisdiction has the ability to levee their own taxes through law. Each jurisdiction has their own budget to appropriate towards hazard mitigation as they deem appropriate or necessary. Additionally, the MCEM will seek out grant opportunities through the State of Indiana and FEMA to help decrease the financial burden on local government.

The development and implementation of this plan comes with the full authority of the MCEM, through the participating jurisdictions, and all resources deemed appropriate and necessary.

The Marshall County Building Commission has been established by local ordinance in compliance with state code. It grants counties the right to create an agency to assure that construction and modification of all structures within the unincorporated areas meet the minimum standards as established by the State of Indiana. The Department administers and enforces building, heating, ventilation, air conditioning, electrical, and plumbing standards for the protection of life, health, environment, public safety, and the conservation of energy in the design and construction of buildings and structures. This Department also serves as the building permit and inspection agency for Bourbon to ensure compliance with all applicable building laws. Current Codes enforced by Marshall County including:

- International Building Code, 2006 Edition with Indiana Amendments
- International Residential Code 2003 Edition with Indiana Amendments
- Uniform Plumbing Code 1997 Edition with Indiana Amendments
- International Mechanical Code 2006 Edition with Indiana Amendments
- National Electrical Code 2008 Edition with Indiana Amendments

The Marshall County Planning Department works to guide the growth and development of the County in accordance with the Marshall County Comprehensive Plan. Current planning involves administering the Marshall County Zoning Ordinance, Subdivision Ordinance and related regulations. This includes processing applications for Improvement Location Permits, subdivisions, variances and other land use applications.

The Marshall County Comprehensive Plan is a document which guides the County's growth. The Marshall County Planning Department is responsible for the development of the Comprehensive Plan as well as other long-term planning projects and studies.

The Bourbon Zoning/Building Department is responsible for ensuring that all buildings within the town are safe. It is also responsible for zoning issues for residential and commercial structures under the 2015 Bourbon Zoning Ordinance.

The Envision Bourbon 2030 Comprehensive Plan establishes a long-term vision on what the community aspires to be for the next 10 to 15 years. It serves as the Town's official policy guide in making land use and development decisions and provides a road map detailing how the Town will achieve its vision.





Of all participating jurisdictions, only Marshall County has implemented a floodplain ordinance as required by participation in the NFIP.

The following tables outline participating jurisdictional capabilities related to hazard mitigation planning.

**Table 73: Local Mitigation Capabilities**

| Jurisdiction    | Building Codes                   | Zoning Ordinance | Comprehensive Plan | Emergency Operations Plan | NFIP Participation and Floodplain Ordinance |
|-----------------|----------------------------------|------------------|--------------------|---------------------------|---|
| Marshall County | 2006 International Building Code | Yes              | Yes                | Yes                       | Yes   |
| Bourbon         | 2006 International Building Code | Yes              | Yes                | Yes, under county         | No  |

Capability improvements could be realized by:

- Creation of a capital improvement plan to guide the funding of future projects
- Participation in the NFIP and adoption of a floodplain ordinance for Bourbon

**5.4 Jurisdictional Compliance with NFIP**

NFIP participating jurisdictions in Marshall County are required to meet the minimum standards set forth by participating in the NFIP through the local NFIP Coordinator. The county’s NFIP coordinator currently ensures all new construction projects are properly surveyed and receive an elevation certificate.

Participating jurisdictions are committed to continued involvement and compliance with the NFIP. To help facilitate compliance, each participating jurisdiction:

- Adopts floodplain regulations through local ordinance
- Enforces floodplain ordinances through building restrictions as detailed in relevant ordinance
- Regulates new construction in Special Flood Hazard Areas as outlined in their floodplain ordinance
- Utilizes FEMA DFIRMs
- Monitors floodplain activities

Key to achieving across the board reduction in flood damages is a robust community assistance, education and awareness program. As such, Marshall County and its participating jurisdictions will continue to develop both electronic (including social media) and in person outreach activities.

For jurisdictional mitigation actions, specific mitigation actions supporting regional commitment to NFIP compliance are identified with a bold type **NFIP** in the subsequent mitigation action sections.

**5.5 Classification of Mitigation Actions**

For this plan update members of the MPC were provided with a complete list of previous mitigation actions and asked to review them to determine if they had been achieved, are in process or on hold, or had been cancelled. Additionally, MPC members and stakeholders were provided with forms to identify and incorporate newly identified actions.

In preparing a mitigation strategy all reasonable and obtainable mitigation actions were considered to help achieve the general goals. Priorities were developed based on past damages, existing exposure to risk, other community goals, and weaknesses identified by the local government capability assessments. In identifying mitigation actions, the following activities were considered:

- The use of applicable building construction standards



- Hazard avoidance through appropriate land-use practices
- Relocation, retrofitting, or removal of structures at risk
- Removal or elimination of the hazard
- Reduction or limitation of the amount or size of the hazard
- Segregation of the hazard from that which is to be protected
- Modification of the basic characteristics of the hazard
- Control of the rate of release of the hazard
- Provision of protective systems or equipment for both cyber or physical risks
- Establishment of hazard warning and communication procedures
- Redundancy or duplication of essential personnel, critical systems, equipment, and information materials.

In preparing the county’s mitigation strategy all reasonable and obtainable mitigation actions were considered to help achieve the identified goals. In general, all identified mitigation actions can be classified under one of the following broad categories:

**Emergency services:** Although not typically considered a “mitigation” technique, these are actions that protect people and property during and immediately after a disaster or hazard event, including:

- Warning systems
- Evacuation planning and management
- Emergency response training and exercises
- Sandbagging for flood protection
- Installing temporary shutters for wind protection

**Natural resource protection:** Actions that, in addition to minimizing hazard losses, also preserve or restore the functions of natural systems, including

- Floodplain protection
- Watershed management
- Riparian buffers
- Forest/ vegetation management
- Erosion and sediment control
- Wetland preservation and restoration
- Habitat preservation
- Slope stabilization

**Prevention:** Administrative or regulatory actions or processes that influence the way land and buildings are developed and built, including:

- Planning and zoning
- Building codes
- Open space preservation
- Floodplain regulations
- Stormwater management regulations
- Drainage system maintenance
- Capital improvements programming
- Shoreline and riverine setbacks

**Property protection:** Actions that involve the modification of existing buildings or structures to protect them from a hazard or remove them from the hazard area, including:



- Acquisition
- Relocation
- Building elevation
- Critical facilities protection
- Retrofitting
- Safe room and shatter-resistant glass
- Insurance

**Public education and awareness:** Actions to inform and educate citizens, elected officials, and property owners about the hazards and potential ways to mitigate them, including:

- Outreach projects
- Speaker and/ or demonstration events
- Hazard map information
- Real estate disclosure
- Library materials
- School children’s educational programs

**Structural:** Actions that involve the construction of structures to reduce the impact of hazard, including:

- Reservoirs
- Dams and levees
- Diversion, detention and/or retention
- Channel modification
- Storm sewers

### 5.6 Prioritization of Mitigation Actions

The MPC and subject matter experts worked together to prioritize both previously identified and newly identified hazard mitigation actions. The methodology used to determine mitigation action priorities was based upon the following:

- Review of the updated risk assessments
- Review of revised goals and objectives
- Review of local capabilities

In formulating a mitigation strategy, a wide range of activities were considered to help achieve identified goals and to lessen the vulnerability to the effects of identified hazards.

A self-analysis method was used for determining and prioritizing mitigation actions. This methodology takes all considerations into account to ensure that, based on capabilities, funding, public wishes, political climate, and legal framework and context, reasonable actions are determined. The following provides a brief description of each consideration:

- Are all people within the jurisdiction being treated equally and fairly?
- Will the action disrupt the social fabric of the jurisdiction?
- Does the proposed action work and is it technically feasible?
- Does the action offer a long-term solution to the problem?
- Does the jurisdiction have adequate staffing?
- Is there someone to coordinate and lead the effort?
- Is there sufficient funding available?
- Are there ongoing administrative requirements that need to be met?



- Does the action have political and public support?
- Does the jurisdiction have the legal authority to implement the action?
- Will the jurisdiction be liable for the action or for any inaction?
- Could the action face any legal challenges?
- What are the costs and benefits of this action?
- Do the benefits exceed the costs?
- Has funding for the action been identified?

Identified actions were prioritized and were given one of the following rankings:

- **High:** Actions that should be implemented as soon as possible
- **Medium:** Actions that should be implemented in the long-term
- **Low:** Actions that should be implemented if and when funding becomes available

Of major concern was the potential or identified cost of each action. In general, identified actions were proposed to reduce future damage. As such, it is critical that selected and implemented actions provide a greater saving over the life of the action than the initial cost.

For structural and property protection actions cost effectiveness is primarily assessed on:

- Likelihood of damages occurring
- Severity of the damages
- Potential effectiveness

For all other types of actions cost effectiveness is primarily assessed on likely future benefits as these actions may not easily result in a quantifiable reduction in damage.

## 5.7 Mitigation Action Funding Sources

It is generally recognized that mitigation actions help communities realize long term savings by preventing future losses due to hazard events. However, many mitigation actions are beyond the budgetary capabilities of a single jurisdiction. This section provides a general description of some of the avenues available to jurisdictions to defray the cost of implementing mitigation actions. The following are potential available funding streams:

- **Hazard Mitigation Grant Program (HMGP) and HMGP Fire:** The HMGP grants assist in implementing long-term hazard mitigation measures following Presidential disaster declarations, including fire declarations. Funding is available to implement projects in accordance with State, Tribal, and local priorities.
- **Building Resilient Infrastructure and Communities (BRIC):** BRIC supports states, local communities, tribes and territories as they undertake hazard mitigation projects, reducing the risks they face from disasters and natural hazards. The BRIC program guiding principles are supporting communities through capability- and capacity-building; encouraging and enabling innovation; promoting partnerships; enabling large projects; maintaining flexibility; and providing consistency. Working in coordination with BRIC, the National Mitigation Investment Strategy is intended to provide a national, whole-community approach to investments in mitigation activities and risk management.
- **Flood Mitigation Assistance (FMA) Grant Program:** FMA is a competitive grant program that provides funding to states, local communities, federally recognized tribes and territories. Funds can be used for projects that reduce or eliminate the risk of repetitive flood damage to buildings insured by the NFIP. FEMA chooses recipients based on the applicant's ranking of the project and the eligibility and cost-effectiveness of the project. FEMA requires state, local, tribal and territorial governments to develop and adopt hazard mitigation plans as a condition for receiving certain types of non-emergency disaster assistance, including funding for hazard mitigation assistance projects.





- **Public Assistance Grant Program:** The mission of FEMA's Public Assistance program is to provide assistance to State, Tribal and local governments, and certain types of Private Nonprofit organizations so that communities can quickly respond to and recover from major disasters or emergencies declared by the President. Through the Public Assistance program, FEMA provides supplemental Federal disaster grant assistance for debris removal, emergency protective measures, and the repair, replacement, or restoration of disaster-damaged, publicly owned facilities and the facilities of certain private non-profit organizations. The Public Assistance Program also encourages protection of these damaged facilities from future events by providing assistance for hazard mitigation measures during the recovery process. The Federal share of assistance is not less than 75% of the eligible cost for emergency measures and permanent restoration. The grantee determines how the non-Federal share (up to 25%) is split with the eligible applicants.
- **Small Business Administration Disaster Loans:** The Small Business Administration provides low-interest disaster loans to homeowners, renters, businesses of all sizes, and most private nonprofit organizations. Small Business Administration disaster loans can be used to repair or replace the following items damaged or destroyed in a declared disaster: real estate, personal property, machinery and equipment, and inventory and business assets.
- **The Housing and Urban Development Agency** provides flexible grants to help cities, counties, and States recover from Presidentially declared disasters, especially in low-income areas, subject to availability of supplemental appropriations.
- **Community Development Block Grant Program:** The Community Development Block Grant program is a flexible program that provides communities with resources to address a wide range of unique community development needs. The program provides annual grants on a formula basis to general units of local government and States.
- **Individual and Households, Other Needs Assistance Program:** The Other Needs Assistance program provides financial assistance to individuals or households who sustain damage or develop serious needs because of a natural or man-made disaster. The funding share is 75% federal funds and 25% state funds. The program provides grants for necessary expenses and serious needs that cannot be provided for by insurance, another federal program, or other source of assistance. The current maximum allowable amount for any one disaster to individuals or families is \$25,000. The program gives funds for disaster-related necessary expenses and serious needs, including the following categories:
  - Personal property
  - Transportation
  - Medical and dental
  - Funeral
  - Essential tools
  - Flood insurance
  - Moving and storage
- **WUI Grants:** The 10-Year Comprehensive Strategy focuses on assisting people and communities in the WUI to moderate the threat of catastrophic fire through the four broad goals of improving prevention and suppression, reducing hazardous fuels, restoring fire-adapted ecosystems, and promoting community assistance. The WUI Grant may be used to apply for financial assistance towards hazardous fuels and educational projects within the four goals of: improved prevention, reduction of hazardous fuels, restoration of fire-adapted ecosystems and promotion of community assistance.

## **5.8 Completed Mitigation Actions**

Marshall County and its participating jurisdictions remain committed to investigating and obtaining all available grant funding for the completion of hazard mitigation projects. Since the completion of the previous HMP, the MPC has been tracking the completion status of all identified hazard mitigation actions. Unfortunately, no hazard mitigation projects have been completed.

## **5.9 Jurisdictional Mitigation Actions**

During this plan update, the MPC assessed existing actions and developed new actions for consideration based on:



- Updated state risk assessment and information from local risk assessments
- Goals and objectives
- Existing state actions
- State and local capabilities
- Actions identified in local plans

While the Marshall County hazard mitigation program has matured over the years, and unfortunate lack of funding and grant opportunities has prevented the completion of any major hazard mitigation projects. As such, relevant actions from the previous hazard mitigation plan are identified as carried over and are awaiting funding to start. Additionally, Marshall County elected to delete mitigation actions not related to any identified hazards detailed in this plan and elected to delete any actions that were significantly cost prohibitive. Deleted actions are identified in the following table along with the reason for deletion

For each identified action, the following applies:

- New actions that have been added to this plan update are identified as such.
- Some actions have been reassigned or reclassified. In these cases, not all information is provided under the original listing, rather the newly assigned responsible entity has been given the opportunity to detail the requested information.
- All mitigation action information was provided by jurisdictional officials through outreach from the MPC.

The following table provides a mitigation action cross check for each participating jurisdiction.

**Table 74: Participating Jurisdiction Mitigation Action Cross Check**

| Hazard                      | Marshall County Mitigation Action Number | Bourbon Mitigation Action Number | Marian University – Ancilla College |
|-----------------------------|--|----------------------------------|-------------------------------------|
| <b>Dam Failure</b>          | 1, 2                                     | -                                | -                                   |
| <b>Drought</b>              | 3, 4, 5                                  | 1, 2                             | 1, 2, 3                             |
| <b>Extreme Temperatures</b> | 6, 7, 8                                  | 3, 4                             | 1, 4, 5                             |
| <b>Flood/Flash Flood</b>    | 8, 9, 10, 11, 12, 13, 14, 15             | 5, 6                             | 1, 6, 7                             |
| <b>Severe Thunderstorm</b>  | 8, 16, 17, 18, 19, 20                    | 7, 8, 9, 10                      | 1, 8, 9, 10, 11, 12                 |
| <b>Tornado</b>              | 8, 18, 19, 20, 21                        | 7, 11                            | 1, 8, 12                            |
| <b>Winter Storms</b>        | 8, 19, 22, 23, 24                        | 4, 7, 8, 12                      | 1, 5, 8, 9, 13, 14                  |
| <b>Levee Failure</b>        | 25*                                      | *                                | *                                   |

-: Jurisdiction not impacted by identified hazard

\*: Action identified to explore potential hazard on county level

The following tables identify mitigation action items for each participating jurisdiction, along with the following information:

- Hazard addressed
- Responsible party
- Overall priority
- Goal(s) addressed
- Estimated cost
- Potential funding source
- Proposed completion timeframe
- Current status



**Table 75: Marshall County Mitigation Actions**

| Action Identification | Description  | Hazard Addressed  | Responsible Party   | Overall Priority | Goal(s) Addressed | Estimated Cost                  | Potential Funding Source  | Proposed Completion Timeframe | Status  |
|-----------------------|--|---|---|------------------|-------------------|---------------------------------|---------------------------|-------------------------------|---|
| Marshall County 1     | Complete inundation mapping for all jurisdictional dams.                             | Dam Failure   | Emergency Manager   | Low              | 1, 2              | \$5,000 - \$50,000 per location | HMGP, BRIC, Local budgets | Ten years                     | New   |
| Marshall County 2     | Purchase and install dam failure warning alert equipment.                            | Dam Failure   | Emergency Manager   | Low              | 1, 2, 3           | \$50,000 per location           | HMGP, BRIC, Local budgets | Five years                    | New   |
| Marshall County 3     | Conduct agricultural education program on water reduction methods.                   | Drought   | Emergency Manager   | High             | 1, 3              | Staff Time                      | Local budgets             | Five years                    | Carried over due to lack of staff             |
| Marshall County 4     | Revise building codes to require low water flow toilets and faucets.                 | Drought   | Building Commissioner, Marshall County Administration     | High             | 1, 2              | Staff Time                      | Local budgets             | Five years                    | Carried over due to lack of political backing |
| Marshall County 5     | Conduct a Xeriscaping program for all jurisdictional owned facilities                | Drought   | Emergency Manager, Director of Public Works               | Low              | 1, 2              | \$5,000 - \$50,000 per location | HMGP, BRIC, Local budgets | Five years                    | New   |
| Marshall County 6     | Modernization air conditioning and ventilation systems in jurisdictional facilities. | Extreme Temperatures  | Building Commissioner                                     | Low              | 1, 2              | \$25,000 per facility           | HMGP, BRIC, Local budgets | Five years                    | Carried over due to lack of funding           |
| Marshall County 7     | Purchase extreme cold gear for first responders.                                     | Extreme Temperatures  | Emergency Manager, Local Fire Chiefs, Local Police Chiefs | Low              | 1, 2              | \$35,000                        | Local budgets             | Five years                    | New   |
| Marshall County 8     | Identify and establish new shelter locations throughout the county.                  | Extreme Temperatures, Flood, Severe Thunderstorm, Tornado, Winter Storm | Emergency Manager   | Medium           | 1, 2              | Staff time                      | Local budgets             | Five years                    | Carried over due to lack of staff             |



**Table 75: Marshall County Mitigation Actions**

| Action Identification | Description   | Hazard Addressed              | Responsible Party                            | Overall Priority | Goal(s) Addressed | Estimated Cost          | Potential Funding Source       | Proposed Completion Timeframe | Status                              |
|-----------------------|---|-------------------------------|--|------------------|-------------------|-------------------------|--------------------------------|-------------------------------|-------------------------------------|
| Marshall County 9     | Continued participation and compliance with the <b>NFIP</b> .         | Flood                         | NFIP Administrator                           | High             | 1, 2              | Staff Time              | Local budgets                  | Continuous                    | Continuous                          |
| Marshall County 10    | Assess and upgrade drainage system along Highway 31                   | Flood                         | Floodplain Manager, Director of Public Works | High             | 1, 2              | Per location cost       | HMGP, BRIC, Local budgets      | Five years                    | Carried over due to lack of funding |
| Marshall County 11    | Purchase and demolish flood prone properties (RL and SRL)             | Flood                         | Emergency Manager, Floodplain Manager        | High             | 1, 2              | Per property cost       | FMA, HMGP, BRIC, Local budgets | Ten years                     | Carried over due to lack of funding |
| Marshall County 12    | Install a flood gauge at State Road 10 and Deep Ditch                 | Flood                         | Director of Public Works, Floodplain Manager | High             | 1, 2              | \$10,000                | HMGP, BRIC, Local budgets      | Five years                    | Carried over due to lack of funding |
| Marshall County 13    | Conduct a flood insurance awareness program.                          | Flood                         | Floodplain Manager                           | High             | 1, 3              | Staff Time              | Local budgets                  | Five years                    | New                                 |
| Marshall County 14    | Construct rainwater retention/detention ponds at strategic locations. | Flood                         | Floodplain Manager, Director of Public Works | Medium           | 1, 2              | Facility size dependent | HMGP, BRIC, Local budgets      | Ten years                     | Carried over due to lack of funding |
| Marshall County 15    | Procure permanent signage to warn of flood hazard areas               | Flood                         | Floodplain Manager, Emergency Manager        | Medium           | 1, 2              | Location dependent      | HMGP, BRIC, Local budgets      | Five years                    | Carried over due to lack of funding |
| Marshall County 16    | Install surge protectors in all jurisdictional facilities.            | Severe Thunderstorms          | Building Commissioner                        | Medium           | 1, 2              | \$10,000 per location   | HMGP, BRIC, Local budgets      | Five years                    | New                                 |
| Marshall County 17    | Install hail resistant roofing on all jurisdictional facilities.      | Severe Thunderstorms          | Building Commissioner                        | Low              | 1, 2              | \$50,000 per location   | HMGP, BRIC, Local budgets      | Five years                    | New                                 |
| Marshall County 18    | Purchase and install new warning sirens throughout the county.        | Severe Thunderstorms, Tornado | Emergency Manager                            | Medium           | 1, 2, 3           | \$300,000               | HMGP, BRIC, Local budgets      | Five years                    | Carried over due to lack of funding |



**Table 75: Marshall County Mitigation Actions**

| Action Identification | Description   | Hazard Addressed                     | Responsible Party                                     | Overall Priority | Goal(s) Addressed | Estimated Cost                    | Potential Funding Source  | Proposed Completion Timeframe | Status                              |
|-----------------------|---|--------------------------------------|---|------------------|-------------------|-----------------------------------|---------------------------|-------------------------------|-------------------------------------|
| Marshall County 19    | Purchase and install critical facility backup generators.   | Severe Storms, Tornado, Winter Storm | Emergency Manager                                     | High             | 1, 2              | \$25,000 - \$50,000 per facility  | HMGP, BRIC, Local Budgets | Five years                    | New                                 |
| Marshall County 20    | Construct community safe rooms throughout the county to required building standards   | Severe Storms, Tornado               | Emergency Manager                                     | Medium           | 1, 2              | \$1,000,000 per facility          | HMGP, BRIC, Local budgets | Ten years                     | Carried over due to lack of funding |
| Marshall County 21    | Research and adopt an ordinance requiring installation of onsite tornado shelters for any new locations with more than 10 mobile home spaces. | Tornado                              | Building Commissioner, Marshall County Administration | Medium           | 1, 2              | Staff time                        | Local budget              | Five years                    | New                                 |
| Marshall County 22    | Conduct an insulation and energy upgrade efficiency program for all jurisdictional buildings.   | Winter Storm                         | Emergency Manager                                     | Low              | 1, 2              | \$75,000 - \$125,000              | HMGP, BRIC, Local budgets | Five years                    | Carried over due to lack of funding |
| Marshall County 23    | Construct snow fences along major transportation routes.  | Winter Storm                         | Director of Public Works                              | Low              | 1, 2              | \$25,000 - \$100,000 per location | HMGP, PDM, Local budgets  | Ten years                     | Carried over due to lack of funding |
| Marshall County 24    | Insulate water lines in all jurisdictional facilities.  | Winter Storm                         | Building Commissioner                                 | Low              | 1, 2              | \$10,000 - \$50,000 per location  | HMGP, BRIC, Local budgets | Five years                    | Carried over due to lack of funding |
| Marshall County 25    | Non-Levee Embankment identification and mapping   | Levee Failure                        | Floodplain Manager, Emergency Manager                 | Low              | 1, 2              | \$10,000 - \$50,000 per location  | HMGP, BRIC, Local budgets | Five years                    | New                                 |





**Table 76: Bourbon Mitigation Actions**

| Action Identification | Description   | Hazard Addressed                       | Responsible Party      | Overall Priority | Goal(s) Addressed | Estimated Cost                   | Potential Funding Source  | Proposed Completion Timeframe | Status                              |
|-----------------------|---|--|------------------------|------------------|-------------------|----------------------------------|---------------------------|-------------------------------|-------------------------------------|
| Bourbon 1             | Install low flow utilities in all jurisdictional buildings.                                   | Drought                                | Bourbon Administration | Medium           | 1, 2              | \$25,000 - \$50,000 per facility | HMGP, BRIC, Local Budgets | Five years                    | Carried over due to lack of funding |
| Bourbon 2             | Conduct a xeriscaping program for all jurisdictional owned facilities                         | Drought                                | Bourbon Administration | Low              | 1, 2              | \$5,000 - \$20,000 per location  | HMGP, BRIC, Local Budgets | Ten years                     | Carried over due to lack of funding |
| Bourbon 3             | Prepare local facilities to serve as local cooling centers.                                   | Extreme Temperatures                   | Bourbon Administration | Low              | 1, 2              | \$3,000 per facility             | HMGP, BRIC, Local Budgets | Five years                    | Carried over due to lack of funding |
| Bourbon 4             | Conduct an insulation and energy upgrade efficiency program for all jurisdictional buildings. | Extreme Temperatures, Winter Storm     | Bourbon Administration | Low              | 1, 2              | \$75,000 - \$125,000             | HMGP, BRIC, Local Budgets | Five years                    | Carried over due to lack of funding |
| Bourbon 5             | Construct rainwater retention/detention ponds at strategic locations.                         | Flood                                  | Bourbon Administration | Low              | 1, 2              | Location and size dependent      | HMGP, BRIC, Local Budgets | As required                   | Carried over due to lack of funding |
| Bourbon 6             | Clean and repair drainage ditches and culverts to maintain capacity.                          | Flood                                  | Bourbon Administration | Low              | 1, 2              | \$300,000                        | HMGP, BRIC, Local Budgets | Five years                    | New                                 |
| Bourbon 7             | Purchase and install critical facility backup generators.                                     | Severe Storms, Tornadoes, Winter Storm | Bourbon Administration | Medium           | 1, 2              | \$25,000 - \$50,000 per facility | HMGP, BRIC, Local Budgets | Five years                    | New                                 |
| Bourbon 8             | Conduct a tree trimming program along all roadways.   | Severe Thunderstorm, Winter Storm      | Bourbon Administration | High             | 1, 2              | \$50,000                         | HMGP, BRIC, Local Budgets | Five years                    | Carried over due to lack of funding |
| Bourbon 9             | Install surge protectors in all jurisdictional facilities.                                    | Severe Thunderstorms                   | Bourbon Administration | Medium           | 1, 2              | \$10,000 per location            | HMGP, BRIC, Local Budgets | Five years                    | Carried over due to lack of funding |



**Table 76: Bourbon Mitigation Actions**

| Action Identification | Description  | Hazard Addressed       | Responsible Party      | Overall Priority | Goal(s) Addressed | Estimated Cost                   | Potential Funding Source  | Proposed Completion Timeframe | Status                              |
|-----------------------|--|------------------------|------------------------|------------------|-------------------|----------------------------------|---------------------------|-------------------------------|-------------------------------------|
| Bourbon 10            | Install hail resistant roofing on all jurisdictional facilities. | Severe Thunderstorms   | Bourbon Administration | Low              | 1, 2              | \$50,000 per location            | HMGP, BRIC, Local Budgets | Five years                    | New                                 |
| Bourbon 11            | Construct community safe rooms to required building standards    | Severe Storms, Tornado | Bourbon Administration | Medium           | 1, 2              | \$1,000,000 per facility         | HMGP, BRIC, Local budgets | Ten years                     | Carried over due to lack of funding |
| Bourbon 12            | Insulate water lines in all jurisdictional facilities.           | Winter Storm           | Bourbon Administration | Low              | 1, 2              | \$10,000 - \$50,000 per location | HMGP, BRIC, Local Budgets | Five years                    | Carried over due to lack of funding |



**Table 77: Marian University – Ancilla College Mitigation Actions**

| Action Identification                 | Description   | Hazard Addressed  | Responsible Party      | Overall Priority | Goal(s) Addressed | Estimated Cost                   | Potential Funding Source   | Proposed Completion Timeframe | Status |
|---------------------------------------|---|---|------------------------|------------------|-------------------|----------------------------------|----------------------------|-------------------------------|--------|
| Marian University – Ancilla College 1 | Update existing communications systems to improve student notification capabilities.          | Extreme Temperatures, Flood, Severe Storms, Tornado, Winter Storm | College Administration | Medium           | 1, 2              | \$25,000 - \$50,000 per facility | HMGP, BRIC, College Budget | Five years                    | New    |
| Marian University – Ancilla College 2 | Install low flow utilities in all jurisdictional buildings.                                   | Drought   | Facility Director      | Medium           | 1, 2              | \$25,000 - \$50,000 per facility | HMGP, BRIC, College Budget | Five years                    | New    |
| Marian University – Ancilla College 3 | Conduct a xeriscaping program for all jurisdictional owned facilities                         | Drought   | Facility Director      | Low              | 1, 2              | \$10,000 -per location           | HMGP, BRIC, College Budget | Ten years                     | New    |
| Marian University – Ancilla College 4 | Prepare college facility to serve as student heating and cooling centers.                     | Extreme Temperatures  | Facility Director      | Low              | 1, 2              | \$3,000 per facility             | HMGP, BRIC, College Budget | Five years                    | New    |
| Marian University – Ancilla College 5 | Replace water in all unit heaters with glycol to prevent freezing                             | Extreme Temperatures, Winter Storm                                | Facility Director      | High             | 1, 2              | \$50,000 -- \$75,000 - \$125,000 | HMGP, BRIC, College Budget | Five years                    | New    |
| Marian University – Ancilla College 6 | Conduct an insulation and energy upgrade efficiency program for all jurisdictional buildings. | Extreme Temperatures, Winter Storm                                | Facility Director      | Low              | 1, 2              | \$75,000 - \$125,000             | HMGP, BRIC, College Budget | Five years                    | New    |
| Marian University – Ancilla College 7 | Install/upgrade drainage throughout campus.   | Flood   | Facility Director      | High             | 1, 2              | \$750,000                        | HMGP, BRIC, College Budget | Five years                    | New    |
| Marian University – Ancilla College 8 | Construct rainwater gardens adjacent to paved areas.  | Flood   | Facility Director      | Low              | 1, 2              | Location and size dependent      | HMGP, BRIC, College Budget | As required                   | New    |



**Table 77: Ancilla College Mitigation Actions**

| Action Identification                  | Description  | Hazard Addressed                     | Responsible Party      | Overall Priority | Goal(s) Addressed | Estimated Cost                   | Potential Funding Source   | Proposed Completion Timeframe | Status |
|--|--|--------------------------------------|------------------------|------------------|-------------------|----------------------------------|----------------------------|-------------------------------|--------|
| Marian University – Ancilla College 9  | Purchase and install mobile and fixed backup generators.         | Severe Storms, Tornado, Winter Storm | Facility Director      | Medium           | 1, 2              | \$25,000 - \$50,000 per facility | HMGP, BRIC, College Budget | Five years                    | New    |
| Marian University – Ancilla College 10 | Conduct a tree trimming program along throughout campus.         | Severe Thunderstorm, Winter Storm    | Facility Director      | High             | 1, 2              | \$50,000                         | HMGP, BRIC, College Budget | Five years                    | New    |
| Marian University – Ancilla College 11 | Install surge protectors in all college buildings.               | Severe Thunderstorms                 | Facility Director      | Medium           | 1, 2              | \$10,000 per location            | HMGP, BRIC, College Budget | Five years                    | New    |
| Marian University – Ancilla College 13 | Construct community safe rooms to required building standards    | Severe Storms, Tornado               | Facility Director      | Medium           | 1, 2              | \$1,000,000 per facility         | HMGP, BRIC, College Budget | Ten years                     | New    |
| Marian University – Ancilla College 14 | Conduct winter driving education programs for students and staff | Winter Storm                         | College Administration | Low              | 1, 2              | \$2,500                          | College Budget             | As required                   | New    |
| Marian University – Ancilla College 15 | Insulate water lines in all facilities.                          | Winter Storm                         | Facility Director      | Low              | 1, 2              | \$10,000 - \$50,000 per location | HMGP, BRIC, College Budget | Five years                    | New    |



## 5.10 Mitigation Action Implementation and Monitoring

Marshall County and all participating jurisdictions, along with relevant identified positions for each mitigation action, are responsible for implementing each mitigation action. To foster accountability and increase the likelihood that actions will be implemented, every proposed action is assigned to a specific department or position as a champion. In general:

- The identified champion will be responsible for tracking and reporting on action status.
- The identified champion should provide input on whether the action as implemented is successful in reducing vulnerability, if applicable.
- If the action is unsuccessful in reducing vulnerability, the identified champion will be tasked with identifying deficiencies and additional required actions.

Additionally, each action has been assigned a proposed completion timeframe to determine if the action is being implemented according to plan.

In general, MCEM is responsible for monitoring the progress of mitigation activities and projects throughout the county in conjunction with participating jurisdictions. To facilitate the tracking of any awarded hazard mitigation grants, MCEM, in conjunction with participating jurisdictions, will compile a list of projects funded throughout the calendar year, if any, and add it to an electronic database. Additionally, the MPC will be solicited annually to provide information on any other mitigation projects that were not funded through hazard mitigation grants for addition to the electronic database.

To track mitigation projects from initiation to closeout, participating jurisdictions will use a project tracking spreadsheet that includes, at a minimum, the following information:

- Applicant/Subrecipient
- Grant Identifier
- Contractor
- Total Cost Estimate
- Federal/Local share
- Award Date
- Period of Performance
- Quarterly Reports
- Subrecipient Risk
- Reimbursements

Upon completion of a project, a member of the MCEM or the awarded participating jurisdiction will conduct a closeout site visit to:

- Review all files and documents
- Review all procurement files and contracts to third parties
- Take photos of the completed project

Project closeout packages will generally be submitted 90 days after a project has been completed, and will include the following:

- Summary of documentation
- Pictures of completed project
- Materials, labor and equipment forms, if required
- Close-out certification





## 5.11 Plan Integration

The Marshall County HMP will be incorporated into existing planning mechanisms in varying processes. These processes will be tailored to the unique characteristics of the planning mechanism and the governing structure of each participating jurisdiction. The HMP will be integrated, when possible, into the following:

- **Emergency Management Planning**

All jurisdictions in the Marshall County HMP have deferred their emergency management authority to the MCEM. MCEM will utilize the HMP in all planning decisions.

- **Emergency Operations Plans**

The Marshall County Emergency Operations Plan will be reviewed and updated to reflect the most probable and dangerous hazard event scenarios from the HMP's risk assessment. This revision is the responsibility of the MCEM for all of the jurisdictions participating in this plan. Upon revision completion, all participating jurisdictions and appropriate emergency services will be notified of the revisions and send out new copies.

- **State of Indiana Hazard Mitigation Plan**

The state's HMP is required by FEMA regulation to include all local HMPs. The process of integrating the Marshall County HMP into this plan is already an established process and is managed by IDHS.

- **Infrastructure, Development & Construction Projects**

All jurisdictions in Marshall County approach infrastructure, development, and construction projects in the same way. The demographics of Marshall County allows for planning to exist only through collaboration with their EMAC, which will be advised by the HMP

- **Marshall County EMAC**

The Marshall County EMAC is a conduit for all mitigation actions and projects. It is headed by the MCEM and meets regularly, although there is flexibility in their schedule. The location of the meetings is not fixed so as to increase jurisdictional participation. Members of the EMAC come from all jurisdictions and a wide variety of local agencies and departments.

- **Capital Improvement & Economic Development Planning**

Upon adoption of this plan, the MCEM will notify each participating jurisdiction's authority. The notification will also contain a special notice to incorporate the following procedure into any capital improvement projects or economic development planning they may initiate.

- In Marshall County and its participating jurisdictions improvement and development projects rely on grant funding. If requested, MCEM will advise the project proposing jurisdiction on which grant program is appropriate.
- Following a funding source decision, a project proposal will be written by the jurisdiction and undergo a vote by the appropriate governing body for approval.
- Upon approval, the governing body will apply for and manage the grant funding for the new improvement or development project.
- All economic development plans initiated or supported by a jurisdiction will undergo a hazard application process in which all hazard risk assessments from the HMP will be weighed into the cost to benefit analysis of a capital improvement project or economic development planning. This can be done at the local level or exist as a known future consideration and requirement.



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## Appendix A – Meeting Information and Survey Data





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## Appendix B – FEMA Approval Documentation



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## Appendix C – Jurisdictional Resolutions of Adoption





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## Appendix D – Critical Facilities



| <b>Airport</b>  |                          |                       |
|---|--------------------------|-----------------------|
| Plymouth Airport  | 301 Airport Road         | Plymouth, IN. 46563   |
| <b>Law Enforcement Facilities</b>                                 |                          |                       |
| Argos Police Department   | 125 N. Walnut Street     | Argos, IN. 46501      |
| Bourbon Police Department   | 224 N. Main Street       | Bourbon, IN. 46504    |
| Bremen Police Department  | 123 S. Center Street     | Bremen, IN. 46506     |
| Culver Police Department  | 200 E. Washington Street | Culver, IN. 46511     |
| Lapaz Police Department   | 400 Hudson Street        | Lapaz, IN.            |
| Marshall County Sheriff's Department – 911 Dispatch Center - Jail | 1400 Pioneer Drive       | Plymouth, IN. 46563   |
| Plymouth Police Department  | 215 W. Washington Street | Plymouth, IN. 46563   |
| Indiana State Police Post Bremen District 24                      | 145 Miami Trail          | Bremen, IN. 46506     |
| <b>Fire Departments</b>   |                          |                       |
| Argos Fire Department   | 101 S. First Street      | Argos, IN. 46501      |
| Bourbon Fire Department   | 104 E. Park Street       | Bourbon, IN. 46504    |
| Bremen Fire Department  | 123 S. Center Street     | Bremen, IN. 46506     |
| Culver Fire Department  | 508 E. Lakeshore Drive   | Culver, IN. 46511     |
| Lapaz Fire Department   | 411 S. Michigan Street   | Lapaz, IN. 46537      |
| Plymouth Fire/EMS Department                                      | 111 N. Center Street     | Plymouth, IN. 46563   |
| Polk Township Fire Department                                     | 4836 French Street       | Plymouth, IN. 46563   |
| Tippecanoe Township Fire Department                               | State Road 331           | Tippecanoe, IN. 46570 |
| <b>Governmental Buildings</b>                                     |                          |                       |
| City of Plymouth Central Office                                   | 124 N. Michigan Street   | Plymouth, IN. 46563   |
| Bourbon Town Hall   | 104 E. Park Ave          | Bourbon, IN. 46504    |
| Culver Town Hall  | 200 E. Washington Street | Culver, IN. 46511     |
| Lapaz Town Hall   | 108 East Randolph Street | Lapaz, IN 46537       |
| Marshall County Building  | 211 W Madison St Ste 101 | Plymouth, IN 46563    |
| <b>Water and Wastewater Infrastructure</b>                        |                          |                       |
| Plymouth Water Plant  | 900 Ledyard Street       | Plymouth, IN. 46563   |
| Plymouth Water Treatment Plant                                    | 3600 Commerce Drive      | Plymouth, IN. 46563   |
| Wastewater Treatment Plant  | 900 Oakhill Avenue       | Plymouth, IN. 46563   |
| Bremen Water Department – North Plant                             | 416 Spencer Street       | Bremen, IN. 46506     |
| Bremen Water Department – South Plant                             | 530 Alexander Street     | Bremen, IN. 46506     |
| Water Plant & Well Fields   | 409 ½ E. Center St.      | Bourbon, IN. 46504    |
| Main Sewer Lift Station   | 700 S. Ecker St          | Bourbon, IN. 46504    |
| Sewer facility  | 13478 Elm Rd             | Bourbon, IN 46504     |
| Sewer Lift Station  | E. Center Street         | Bourbon, IN. 46504    |
| <b>Hospitals</b>  |                          |                       |
| Saint Joseph Hospital   | 1915 Lake Ave            | Plymouth, IN 46563    |
| Community Hospital of Bremen                                      | 1020 High Road           | Bremen, IN 46506      |
| Doctors NeuroPsychiatric Hospital                                 | 417 Whitlock Street      | Bremen, IN 46506      |
| <b>Public Schools</b>   |                          |                       |
| Triton Junior Senior High School                                  | 300 Triton Dr            | Bourbon, IN 46504     |
| Argos Community Elementary School                                 | 600 Yearick Ave          | Argos, IN 46501       |
| Argos Community Junior Senior High School                         | 500 Yearick Ave          | Argos, IN 46501       |
| Bremen Senior High School   | 511 W Grant St           | Bremen, IN 46506      |
| Washington Discovery Academy                                      | 1500 Lake Ave            | Plymouth, IN 46563    |
| Riverside Intermediate  | 905 E Baker              | Plymouth, IN 46563    |
| Triton Elementary School  | 200 Triton Dr            | Bourbon, IN 46504     |
| Plymouth High School  | 810 N Randolph St        | Plymouth, IN 46563    |



|                                     |                    |                    |
|-------------------------------------|--------------------|--------------------|
| Bremen Elementary Middle School     | 700 W South St     | Bremen, IN 46506   |
| Culver Elementary School            | 401 School         | Culver, IN 46511   |
| Lincoln Junior High School          | 830 Gibson St      | Plymouth, IN 46563 |
| Jefferson Elementary School         | 401 E Klinger Ave  | Plymouth, IN 46563 |
| Webster Elementary School           | 1101 S Michigan St | Plymouth, IN 46563 |
| Menominee Elementary School         | 815 Discovery Ln   | Plymouth, IN 46563 |
| Culver Community Middle/high School | 701 School         | Culver, IN 46511   |
| <b>Colleges</b>                     |                    |                    |
| Marian University - Ancilla College | 20097 9B Road      | Plymouth, IN 46563 |
| <b>Private Schools</b>              |                    |                    |
| Culver Academies                    | 1300 Academy Rd    | Culver IN 46511    |
| Borkholder Parochial School         | 1589 B Rd          | Bremen, IN 46506   |
| Bourbon Christian School            | 1325 N Main Street | Bourbon, IN 46504  |
| Creekside School                    | 6378 Beech Rd      | Bourbon, IN 46504  |
| Grace Baptist Christian School      | 1830 N Michigan St | Plymouth, IN 46563 |
| House of the Lord Christian Academy | 16493 Lincoln Hwy  | Plymouth, IN 46563 |
| St. Michael School                  | 612 N Center St    | Plymouth, IN 46563 |
| St. Paul's Lutheran School          | 605 S Center St    | Bremen, IN 46506   |