All-Hazard Mitigation Plan
Marshall County, Indiana

2017

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Chapter 1 - Overview

Introduction

The Marshall County All Hazard Mitigation Plan is the guide for the county's assessment of hazards, vulnerabilities, and risks and includes the participation of a wide range of stakeholders and the public in the planning process. This plan aids the county, cities, and towns in preventing, protecting against, responding to, and recovering from disasters that may threaten the community's economic, social, and environmental well-being. This plan documents historical disasters, assesses probabilistic disasters through Hazus-MH and GIS analyses, and addresses specific strategies to mitigate the potential impacts of these disasters.

The Marshall County Emergency planning team and The Polis Center at Indiana University-Purdue University Indianapolis (IUPUI) and the developed the Marshall County Hazard Mitigation Plan (HMP) in 2010. They have again teamed up to complete the update for the 2017 plan.

The Marshall County All Hazard Mitigation Plan Update is developed to meet the "all hazards" mitigation approach which the Indiana Department of Homeland Security (IDHS) and FEMA recommend as an option to single hazard mitigation planning. While the plan considered all of the potential hazards, it should be recognized that only limited mitigation actions are feasible for some of these hazards since they are not site-specific or repetitive in nature.

Disaster Mitigation Act of 2000

With the development of the federal Disaster Mitigation Act of 2000, FEMA requires counties to have a Hazard Mitigation Plan (HMP) in order to be eligible for Hazard Mitigation Grant Program (HMGP) funds. The purpose of a HMP plan is, "to reduce the loss of life and property, human suffering, economic disruption, and disaster assistance costs resulting from natural disasters." All jurisdictions must first have in place a multi-hazard mitigation plan and update the plan within a five-year time span. This plan update addresses changes in development, progress in local mitigation efforts, and alterations in priorities. This update will remain effective for 5 years from the community adoption.

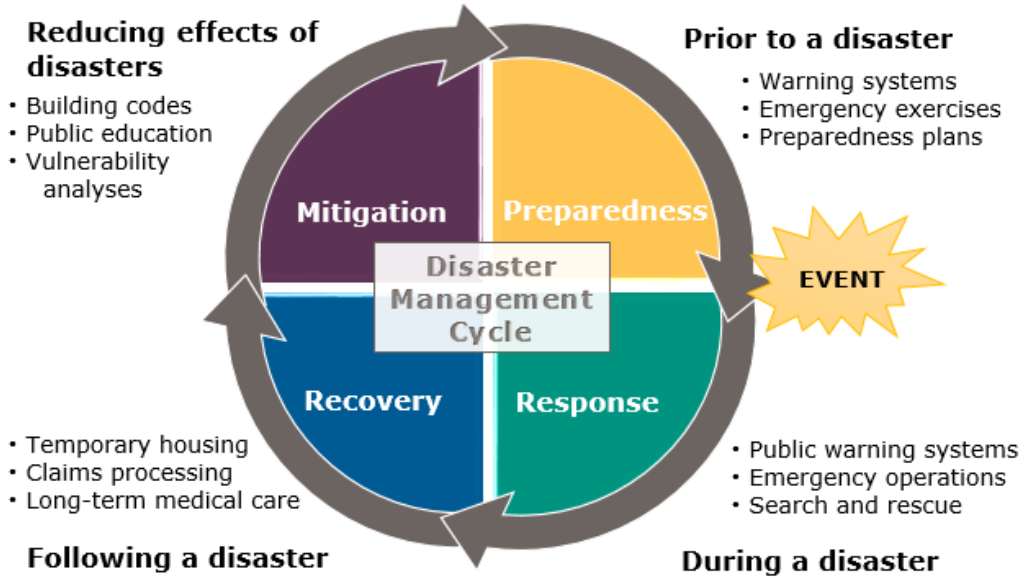
The procedures outlined in the plan are based upon guidance provided by the Federal Emergency Management Agency and is consistent with the requirements and procedures defined in the Disaster Mitigation Act of 2000. The analysis includes three components: 1) profile and analysis of

hazard events, 2) inventory of vulnerability assessment of community assets, and 3) development of hazard mitigation strategies.

Hazard Mitigation

Hazards are something that is potentially dangerous or harmful, often the root cause of an unwanted outcome. Hazards are included, both natural and human caused, which threaten loss of life and property in the county. Hazard mitigation is defined as any action taken to eliminate or reduce the long-term risk to human life and property from natural and technological hazards. The Federal Emergency Management Agency (FEMA) has made reducing hazards one of its primary goals.

Figure 1-1: An Integrated Planning Process



Hazard mitigation planning and the subsequent implementation of the projects, measures, and policies developed as part of this plan, is a primary mechanism in achieving FEMA's goal. Potential types of hazard mitigation measures include the following:

- Structural hazard control or protection projects,
- Retrofitting of facilities,
- Acquisition and relocation of structures,
- Development of mitigation standards, regulations, policies, and programs,
- Public awareness and education programs,
- Development or improvement of warning systems.

Local governments have the responsibility to protect the health, safety, and welfare of their citizens. This mitigation plan considers the importance of mitigation to:

- Protect public safety and prevent loss of life and injury.
- Reduce harm to existing and future development.
- Prevent damage to a community's unique economic, cultural, and environmental assets.
- Minimize operational downtime and accelerate recovery of government and business after disasters.
- Reduce the costs of disaster response and recovery and the exposure to risk for first responders.
- Help accomplish other community objectives, such as leveraging capital improvements, infrastructure protection, open space preservation, and economic resiliency.

Developing and putting into place long-term strategies that reduce or alleviate loss of life, injuries and property resulting from natural or human caused hazards accomplish this goal. These long-term strategies must incorporate a range of community resources including planning, policies, programs and other activities that can make a community more resistant to disaster. Mitigation planning efforts should both protect people, structures, while minimizing costs of disaster response and recovery. Mitigation is the cornerstone for emergency management and should be viewed as a method for decreasing demand on scarce and valuable disaster response resources.

Mitigation Planning Process

The process to update the HMP included a number of activities between the planning team and Polis. The planning team was comprised of a representative group of the county and incorporated communities. The emergency manager coordinated the planning team invitations to wide range of potential interested parties in the county and communities, including, elected and appointed officials, representatives of law enforcement, fire departments, public health, streets and highway coordinators, planners and engineers, local businesses, disaster relief, state IDHS district coordinators, and higher education officials. The team participated in a series of surveys and meetings, documented in the appendix, to complete the following 10-step process outlined by FEMA in the local hazard mitigation-planning handbook:

- Organize planning process. Involve key stakeholders and the public.
- Identify and screen major hazards for the county.
- Analyze the risks posed by those hazards.
- Review existing capabilities and resources and then identify the issues.
- Prioritize the hazards.
- Develop specific hazard mitigation measures. Include a timeline.
- Set implementation guidelines.

- Draft the plan.
- Adopt the plan.
- Implement, evaluate success and update regularly.

Each chapter was reviewed, revised and expanded upon with current information and included new feedback from taskforce members with an emphasis on the updating the goals, objectives and strategies. The mitigation planning requirements identified in 44 CFR 201.6 call for all jurisdictions participating in a multijurisdictional hazard mitigation plan to take part in the planning process. Examples of participation include, but are not limited to, attending planning meetings, contributing research, data, or other information, related to hazards and strategies and commenting on drafts of the plan.

State Mitigation Planning Team

The Silver Jackets program, administered by the US Army Corps of Engineers operate in states across the United States bring together multiple state, federal, and sometimes tribal and local agencies to learn from one another in reducing flood risk and other natural disaster. The Indiana Silver Jackets team works together toward its shared vision, to be a catalyst in developing comprehensive and sustainable solutions to natural hazard issues. The mission of the core agencies of the Silver Jackets team is to work together to:

- Enable the effective and efficient sharing of information
- Foster the leveraging of available agency resources
- Provide improved service to our mutual customers
- Promote wise stewardship of the tax-payers' investment

The Indiana Silver Jackets have led projects highlighted in this report, such as the Low Head Dam initiatives and the Fluvial Erosion & Non-Levee Embankment mapping projects.

Chapter 2 – Public Planning Process

This is a multijurisdictional plan that covers Marshall County, its school jurisdictions, and the incorporated communities within the county, which consist of Plymouth, Bremen, Bourbon, Culver, and La Paz. The community of Argos was invited but did participate in the plan. The Marshall County risks and mitigation activities identified in this plan also incorporate the concerns and needs of townships and other entities participating in this plan.

Table 2-1: Jurisdiction Participation

#	Jurisdiction Name	Jurisdiction Type	2010 participant	2017 participant
1	Marshall County	County	Yes	Yes
2	Argos	Town	Yes	No
3	Bremen	Town	Yes	Yes
4	Bourbon	Town	Yes	Yes
5	Culver	Town	Yes	Yes
6	La Paz	Town	Yes	Yes

Planning Team

The Marshall County Emergency Management Agency Director heads the Marshall County Emergency Management Agency and is charged with developing the Hazard Mitigation planning team. Members of the planning team include representatives from various partners involved in hazard mitigation activities, those with the authority to regulate government, and stakeholders throughout the region. All members of the planning committee were actively involved in attending meetings, providing available Geographic Information Systems (GIS) data and historical hazard information, reviewing and providing comments on the draft plans, assisting in the public input process, and coordinating the county's formal adoption of the plan. A list of which particular meetings each team member attended is located in the Appendix E. Table 1 identifies the planning team members who attended meetings related to the plan update.

Table 2-1: Hazard Mitigation Planning Team

Name	Title	Organization	Jurisdiction
Clyde Avery	EMA Director	Marshall County Emergency Management Agency	Marshall County
Terry Greene	Chairman EMA Advisory Council	Marshall County Advisory Chair	Marshall County
Matthew Hassel	Sheriff	Marshall County Sheriff's Department	Marshall County
Les McFarland	Council President	Bourbon	Bourbon
Trend Weldy*	Town Manager	Bremen	Bremen
Jim Marquardt	Street Commissioner	City of Plymouth	Plymouth
Mark Senter	Mayor	City of Plymouth	Plymouth
Ryan Young	Councilman	La Paz Town Council	La Paz
Jonathan Leist	Town Manager	Culver	Culver
Jon Van Vactor	Councilman	County Council	Marshall County
Diane Ross	GIS Director	Marshall County	Marshall County
John A Seller	Member	HAM Club - Marshall County Amateur Radio Society	Marshall County
Michael Marshall	IT Director	Marshall County IT	Marshall County
Debbie Palmer	Marshall County SWCD	Marshall County Soil and Water County Department	Marshall County
Matt Neher	Fire Chief	Bremen Fire Department	Marshall County
Roger Ecker	Councilman	La Paz Town Board	La Paz
Sally Ricciardi	Council President	Culver Town Council	Culver
Jill Hassel	Vice President	Town of Bremen Plan Commission	Bremen
Mike Diels		Town of Plymouth	Plymouth

Review of Existing Plans

Marshall County and the local communities utilize land use plans, emergency response plans, municipal ordinances, and building codes to direct community development. The planning process also incorporated the existing natural hazard mitigation elements from these previous planning efforts. Table 2 lists the plans, studies, reports, and ordinances used in the development of the plan.

Table 2-2: Planning Documents Used for HMP Planning Process

Author (s)	Year	Title	Description	Where Used
United States Department of Agriculture	1978	Soil Survey of Marshall County, Indiana	Soil survey describing the soil variety of Marshall County	Section 3
D.J. Case & Associates	2005	Lake of the Woods, Marshall County, Indiana Watershed Management Plan	Marshall County Local Watershed Management Plan update	Section 3

Marshall County	2007	Marshall County, Indiana Zoning Ordinance	A tool for identifying future development areas within the county	Section 3,4,5
City of Plymouth	2008	City of Plymouth, IN Zoning Ordinance	Guide for growth and development	Section 3,4,5
Marshall County	2011	Storm Water Drainage and Sediment Control Ordinance Marshall County, Indiana	Water and drainage policy and guidelines	Section 4
Marshall County	2013	Marshall County, Indiana Comprehensive Plan	Plan intended to guide the growth of Marshall County	Section 3
Indiana Department of Homeland Security	2014	State of Indiana Multi-Hazard Mitigation Plan	Statewide hazard mitigation plan	Section 5
Marshall County	2014	Marshall County Comprehensive Emergency Management Plan	Procedures for the protection of personnel, equipment, and critical records and establishes policies to ensure the continuity of government and essential services during and after disasters.	Section 4,5,6

Planning Process Timeline and Steps

The Marshall County planning team met on February 22, 2017 for the HMP update kickoff. Prior to the second meeting, the team completed a survey related to the hazard rank and strategy status. The team then met on April 27, 2017 to discuss survey results. The team then confirmed that hazard priorities and any conflicting survey results for the county and each community.

The planning team invited the public to a meeting on June 29, 2017. During this meeting, the overall purpose of the plan was reiterated and public input was sought. The group reviewed a copy of the draft plan and was provided a presentation on the risk assessment and mitigation strategies. The draft plan was revised based on the team and public's comments following the meetings. Appendix E includes meeting minutes and invitations to participate and Appendix F includes the published announcement of the meeting.

The county considered including representatives for local businesses, non-profits, disaster relief, and surrounding local Emergency Managers that were encouraged to participate in the planning process.

The county continually works to engage with the public with posts community meetings and trainings on the county website as well as the Marshall County Emergency Management Facebook

page: www.facebook.com/pages/Marshall-County-Emergency-Management. In addition, a final copy of the plan will be available online through the county's website.

Chapter 3 – Community Profile

In order to provide a basic understanding of the characteristics of the community, this section offers a general overview of Marshall County including the physical environment, population, and the location and distribution of services.

General County Description

Marshall County is located in northeastern Indiana and is situated approximately 126 miles north of the capital city of Indianapolis. According to the US Census, the county covers 443.6 square miles and has an estimated population of 46,556. Plymouth is the county seat and is the largest city in the county.

The county is primarily composed of slightly rolling farmland with heavily-wooded areas adjacent to the major streams and wetlands. The northeast and central parts of the county contain the bulk of the population, living in incorporated communities, which are centralized in the communities of Plymouth and Bremen. The southern and western sections of the county are predominantly rural.

The six incorporated cities and towns within Marshall County consist of Argos, Bourbon, Bremen, Culver, La Paz, and Plymouth. The county contains ten townships, which include Bourbon, Center, German, Green, North, Polk, Tippecanoe, Union, Walnut, and West.

The communities of Marshall County has received recognition for their commitment to investing in the future and supporting business development. In 2017, Culver was named among the six finalist for the Stellar Communities Program for the second year in the row. Recently, the town of Argos adopted a new comprehensive plan with assistance from the Michiana Area Council of Governments. Marshall County has had several new development projects in recent years and is forming plans for more. As part of Marshall County's recent development trend, Elkay Wood Products is announcing its 2nd major expansion in just over 2 years. Elkay plans to invest $3.9 million in expanding its operations in Culver. The Plymouth City Council encouraged local business growth by supporting a tax abatement for Farm Innovators, Inc., enabling the business to expand to Plymouth. In December 2016, it was announced that a study examining engineering, and

environmental impacts along the proposed path of a high speed rail line project was moving. Potentially, Plymouth is one of the many communities that will have a stop along the train route, linking it to Chicago, Fort Wayne, Columbus, and several other Midwest communities. According to the Marshall County Economic Development Council, limited service could begin as early as 2020.

Marshall County has primarily remained a quiet, agricultural area with small towns, which have maintained much of their historical and architectural heritage, but the county is also within easy access of the larger metropolitan areas of South Bend and Chicago. Plymouth is both the county seat and the only city in Marshall County. The county has a population density of 104.95 per square mile. The average household size is 2.7 persons compared to an average family size of 3.9 persons.

Historical Setting

Organized in 1836, Marshall County was named in honor of Chief Justice John Marshall, who was the fourth Chief Justice of the Supreme Court of the United States and who donated land for a railroad station. In the 1830s, populations were increasing rapidly and questions of forming new counties and county seats became an ongoing discussion. An Act to Organize the County of Marshall was approved on February 4, 1836 and was organized by the board of commissioners, comprised of Robert Blair, Abraham Johnson, Charles Ousterhout, and Jeremiah Muncy.

Prior to the European settlement in the area, the Potawatomi Native Americans hunted on the land that now consists of Marshall County. Originally, the area of Marshall County was a heavily timbered region, interspersed with prairies and wetlands. The *History of Indiana* notes that the region was particularly noted for its white burr, yellow and black oak, and hickory. As European settlers migrated into the area, the level forestland was found rich in timber and wildlife, and the area of Marshall County was included in the 1832 treaty of Tippecanoe River. Formerly considered poor farmland, the wetlands were drained and converted into fruitful tracks of land. The rivers and lakes permitted the creation of facilities for mills and machinery and helped with the transportation of goods to southern markets. The historic Michigan Road, which connected the Ohio River to Lake Michigan, was constructed through Marshall County making the county attractive for commerce and enabling further immigration. In the early 1800's, the Potawatomi relocated to Osawatomie, Kansas, where they shortly moved on to present day Oklahoma.

Early white settlers in the area primarily arrived from New England and traced their ancestry from English Puritans who settled New England in the colonial area. In honor of their heritage, the people of Marshall County named the community of Plymouth after the site where their *Mayflower* landed in 1620. Plymouth did not become an incorporated town until 1851; however, according to the *History of Indiana,* Plymouth was made the county seat in 1836, immediately following the county's creation. During the formation of the county, it was determined that Marshall would be attached to eighth judicial circuit of the state court and that the seat of justice would be permanently located at Plymouth.

Physical Characteristics

Climate and Precipitation

The Marshall County climate is characteristic of northern Indiana. The variables of temperature, precipitation, and snowfall can vary greatly from one year to the next. Winter temperatures can fall below freezing starting as early as October and extending as late as April. Based on National Climatic Data Center (NCDC) normal from 1971 to 2000, the lowest winter temperature is 16º F and the average high is 31º F. In summer, the average low is 62º F and average high is 83º F. Average annual precipitation is 40 inches throughout the year. The average seasonal snowfall is 70 inches.

Average wind speed and direction is 10 mph, generally from the south-southwest. Summer humidity is moderate, ranging from 60% for the mid-afternoon and rising during the evening to culminate with dawn humidity around 80%. The possibility for sunshine is 75% during the summer and 45% during the winter. Indiana is prone to strong thunderstorms that can produce strong winds, lightning, hail, and sometimes tornadoes. Historically, these storms can occur at almost any time throughout the year, but are most common in the spring and summer months.

Geology and Topography

The landscape of Marshall County is an upland consisting of broad flatlands, undulating plains, and lower areas along streams and drainage ways. The highest point in the county is about 895 feet above sea level, near the junction of Kenilworth Road and Indiana Route 110 in Green Township. The lowest point of the county is about 705 feet above sea level and is in the area directly north of US Route 6 where the railroad crosses the St. Joseph County line in Polk Township.

Marshall County's topography is dominated by the Plymouth Morainal Complex while the far western edge of the county is part of the Kankakee Drainage ways and the southeastern corner is part of the Warsaw Moraines and Drainage ways. An extensive tract of flatness marks eastern Marshall County and is a portion of the upland plain that has not yet been severely entrenched and deeply grooved by streams. The Plymouth Morainal Complex in Indiana is comprised of disorganized ridged till and stratified drift of northern, northeastern, and eastern source. The Kankakee Drainage ways are broad tracts of sandy outwash, lake plains, and scattered clusters of dunes. The Warsaw Moraines and Drainage ways are characterized by ridged till of eastern source crossed by tunnel-valleys and bounded by an alluvial-fan apron.

Soils

Soil functions as a vital part of the natural environment and sustains life by supporting plant and animal life, helping maintain the levels of atmospheric gases, and acting as a filtration system for surface water.

The mission of the Marshall County Soil and Water Conservation District is to provide a means for all interested people in the community to work together to administer programs to preserve, protect and improve soil, water, air, plant, and animal resources for future generations.

The Marshall County Indiana Soil and Water Conservation District has been the recipient of several grants in order help the community engage with educational opportunities, address environmental concerns, and to develop further knowledge of conservation. Using a grant from Clean Water Indiana, the Marshall County Soil & Water District is working on a soil health program in order to improve water quality by helping producers utilize all aspects of the conservation cropping system. Over a third of Marshall County's soil is well drained while the remainder of the soil drainage types vary from excessively drained to somewhat poorly drained.

Land Use and Ownership

Agriculture is the predominant land use in Marshall County. Other significant land uses are industrial and residential. Recent or proposed development, especially in Special Flood Hazard Areas (SFHAs) and floodways, must be carefully evaluated to ensure that no adverse impacts occur as a result. Development, whether it is a subdivision or a single lot big box commercial outlet, can result in large amounts of fill and other material being deposited in flood storage areas.

The Marshall County Comprehensive Plan prescribes that the following policies be used when deciding land use within the county:

- Establish multiple agricultural zoning districts.
- Support cluster subdivision design for rural residential development.
- Require high density residential development to be served by public sewer and water utilities.
- Support the creation of a foundation to receive and administer conservation easements.
- Require municipal sewer and water service for large scale subdivisions.
- Encourage cities and towns in Marshall County to require annexation for infrastructure extensions.
- Require lot owners in any large scale subdivisions to be responsible for street lights, street signs, and open space.
- Consider the county as a whole in efforts to address affordable housing.
- Require high-quality development design in designated commercial areas.
- Support the concentration of commercial development in key areas around the county.
- Rezone land for commercial development only after careful consideration of the potential impacts of such development.

Agriculture

As illustrated in the map of Marshall County Agricultural Areas, the densely cultivated areas, which are more than 75% cultivated, are predominantly in the central and northern parts of the county. The majority of farms and confined feeding operations are located in the southern part of the county. Some of the non-agricultural areas of the county correspond with the locations of the Menominee Wetland Conservation Area in the west of the county.

The 2012 U.S. Census of Agriculture reports that there are 878 farms in the county, covering 206,306 acres. Of this farming land, 88.1% is cropland, 6.1% is woodland, and 5.8% is classified as "other uses." In contrast, 71.5% of Indiana is harvested cropland and 45.3% of the state is woodland, but of the land on farms, 85.5% is cropland and 7.1% is woodland, meaning Marshall County has a higher percentage of harvested cropland on farms than the state as a whole. Approximately, 206,306 acres of Marshall County were actively farmed in 2012, which represents a 15% increase in the number of acres used for farmland since 2007.

Table 3-1: Agriculture Production 2016

Marshall	Harvested acres	Planted acres	Yield bushel/acre
Corn	87,000	92,000	169
Soybeans	63,700	64,100	54.4
Hay & Alfalfa	6,100	24,100	3.95
Hay (excl Alfalfa)	1,000	3,040	3.05
Winter wheat	2,200	3,100	76.8

Table 3-2: Land in Farms According To Use (acreage)

	2007	2012
Other Cropland	3,949	4,797
Woodland	521	749
Permanent pasture & rangeland	4,396	5,160
Land in farmsteads, homes, buildings, livestock facilities, ponds, roads, wasteland, etc.	6,618	6,766
Pastureland, all types	8,660	7,820
Total	**24,144**	**25,292**

Table 3-3: Conservation and Crop Insurance

	2007	2012
Land enrolled in Conservation Reserve, Wetlands Reserve, Farmable Wetlands, or Conservation Reserve Enhancement Programs		
Farms	160	128
Acres	5,226	4,316
Land enrolled in crop insurance programs		
Farms	122	129
Acres	65,891	99,583

Table 3-4: Farm Statistics

Marshall	2007	2012	Difference
Farms (producers)	866	878	+12
Total Farms	317	366	+49
Average Farm Income (gross before taxes & expenses)	$61,843	$107,284	+45,441

Managed Lands

The Department of Natural Resources maintains an inventory of managed properties. These natural and recreation areas are managed by either the, DNR Fish & Wildlife, DNR Nature Preserves, federal, local and non-profits and is maintained by the Indiana Natural Heritage Database. The county has 22 managed properties and their classification type is displayed in a map located in Appendix A.

Marshall County is home to several parks and the Menominee Wetland Conservation Area, which is 830 acres and is managed by the Indiana Department of Natural Resources. By establishing conservation areas and parkland, the county is able to preserve plant and animal species and combat air, land, pollution prevention and water quality issues.

Endangered and Threatened Species

The Federal Endangered Species Act of 1973 (Act) describes two categories of declining species of plants and animals that need the Act's protections – endangered species and threatened species – and provides these definitions, "Endangered species are those species that are in danger of extinction throughout all or a significant portion of its range. Threatened species are those species that are likely to become an endangered species within the near future throughout all or a significant portion of its range." The following table identifies the endangered or threatened species within the county and identifies the habitat characteristics where the species are identifies within the county.

Table 3-5: County Endangered or Threatened Species 2017

Species	Endangered/ Threatened	Habitat
Indiana bat *(Myotis sodalist)*	Endangered	Hibernation occurs in caves and mines, with swarming in surrounding wooded areas. Summer roosting and foraging habitat occurs in wooded stream corridors and in bottomland and upland forests and woods.
Northern long-eared bat *(Myotis septentrionalis)*	Threatened	Hibernates in caves and mines - swarming in surrounding wooded areas in autumn. Roosts and forages in upland forests and woods.
Running buffalo clover *(Trifolium stoloniferum)*	Endangered	Disturbed bottomland meadows

The US Fish and Wildlife service has more information on specific species fact sheets, brochures, and pamphlets are available for each identified species at: https://www.fws.gov/midwest/endangered/saving/outreach.html.

Bald eagles are no longer protected under the federal Endangered Species Act and Section 7 consultation with the U.S. Fish and Wildlife Service is no longer necessary. However, the bald eagle remains protected under the Bald and Golden Eagle Protection Act.

The complete Indiana Bat, Kids, and Caves - Oh My! activity book for teachers is a 157-page pdf file developed in 2007 by the Education Department of Evansville's Mesker Park Zoo & Botanic Garden

and was sponsored by the US Fish & Wildlife Service. This document provides students and teachers with a guidebook on the Indiana bats habitat, conservation, and numerous activities.

Pollution

The US Environmental Protection Agency manages the Brownfield and Superfund programs, which provide resources to local and state partners to address a hazardous substance, pollutant, or contaminants. These programs provide increases to local tax base, facilitates job growth, utilizes existing infrastructure, takes development pressures off of undeveloped, open land, and both improves and protects the environment. The primary difference between the programs is that Brownfields are focused on the remediation of active hazardous sites and also regulate the transportation of hazardous waste in which the property owners are known and are currently using managing, or disposing hazardous waste.

Hydrography

Water resources within the county are vital to the community because they provide recreational as well as enhanced economic opportunity. Important water resources include surface and groundwater from aquifers, watersheds, lakes, rivers and wetlands providing water for riparian habitats, fish, wildlife, household, livestock, recreation and aesthetic and industrial uses.

The DNR and IDEM manage many of the water regulated state programs. The DNR administers permit programs for lakes and streams related to quantity and is the Cooperating Technical Partners for the FEMA flood-mapping program. IDEM manages the EPA related quality monitoring in coordination with the assistance of the local community officials.

For more details on the roles and responsibilities of local governments & state agencies with regards to water resource management visit the Indiana Drainage Handbook:

http://www.in.gov/dnr/water/4893.htm.

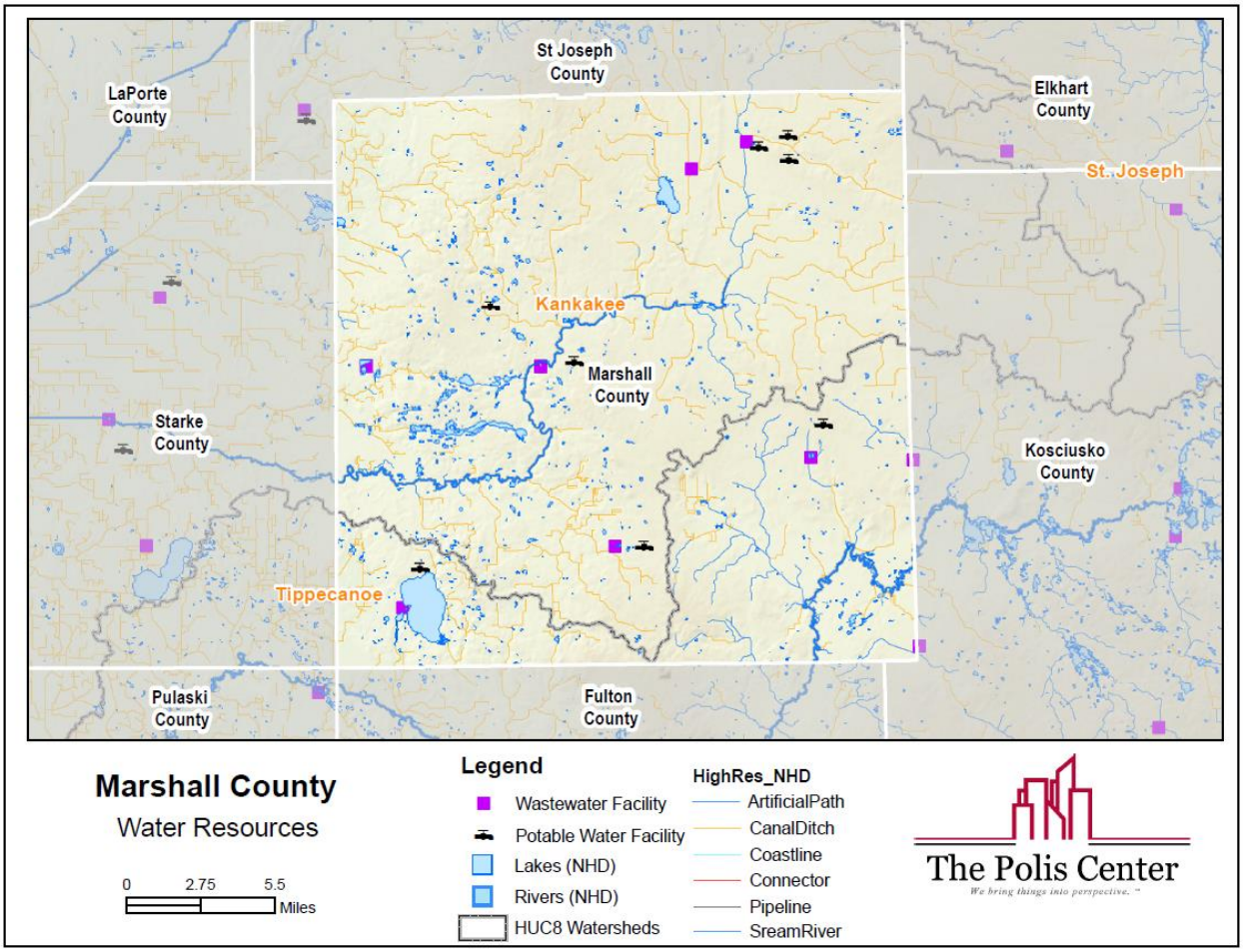
The Headwaters Yellow River Watershed encompasses approximately 187,423 acres of land across Marshall, Kosciusko, Elkhart, and St. Joseph Counties, and the communities of Plymouth, Bremen, La Paz, Lakeville and Nappanee.

Watersheds

Marshall County is located within two major watersheds: Tippecanoe and Kankakee watersheds as shown in the water resources map. North and central Marshall County are part of the Kankakee

watershed while the southern extremity and southeast corner of the county is in the Tippecanoe watershed.

Figure 3-1: Marshall County Water Resources



Rivers

The National Hydrography Dataset (NHD) is the surface water component of The National Map. Managed by the USGS. The NHD data is a digital vector dataset used by geographic information systems (GIS). It contains features such as lakes, ponds, streams, rivers, canals, dams and stream gages. These data are designed to be used in general mapping and in the analysis of surface-water systems. The NHD data provides a flow network that allows for tracing water downstream or upstream. It also uses an addressing system based on reach codes and linear referencing to link specific information about the water such as water discharge rates, water quality, and fish population. Using basic NHD features like flow network, linked information, and other

characteristics, is possible to study cause and effect relationships, such as how a source of poor water quality upstream might affect a fish population downstream.

Indiana recently concluded a statewide project led by the Indiana GIO and Geographic Information Council (IGIC) to improve the accuracy and density of the statewide NHD. Indiana Geographic Information Council has entered into a USGS partnership agreement to identify the process for state and local stewardship and maintenance of the Indiana high resolution NHD. You can download the data at: https://nhd.usgs.gov/data.html.

The Yellow River is the principal stream in the County and cuts through the City of Plymouth. Numerous tributaries feed into the Yellow River primarily east or northeast of Plymouth. The Marshall County NHD contains 533 miles of streams and rivers. According to the Indiana Natural Resources Commission, the Yellow River is Navigable to Plymouth.

The Yellow River is highly susceptible to bank stabilization erosion and continues to migrate within the portions of the alluvial channel that are not protected. Excessive sediment transport ha been the focus of many collaborative research efforts. The Yellow River is the focus of many projects centered on developing of Best Management Practices (BMP) throughout the watershed. Recent projects include initiations to contain the pollutants, as well as determine understanding stabilization methods viable in the unique geography of the region.

The Headwaters Yellow River Watershed Management Plan was initiated by the Marshall County Soil and Water Conservation District in order to identify critical areas within the watershed contributing to impaired water bodies containing E. coli and excess phosphorus. The Indiana Silver Jackets and the Center for Earth and Environmental Science at IUPUI have been coordinating research development methods developing BMP for managing excessive sediment loads and bank stabilization techniques.

Lakes

The DNR Department of Fish and Wildlife maintains a list of the lakes in Indiana and identifies nineteen lakes within Marshall County. Of these lakes, there are no designated Public Freshwater Lakes, which are regulated by the DNR Division of Water, under Lake Preservation Act (I.C. 14-26-2) and/or Lowering of 10 Acre Lakes Act or "Ditch Act" (I.C. 14-26-5).

The Indiana General Assembly defines "lake" as designating a reasonably permanent body of water that is substantially at rest. Lakes provide a habitat for a variety of fish and wildlife and

drinking water. Lakes can function as a potential source of transportation and support recreational and commercial fishing industries.

Public Lakes are determined by

- existed on March 12, 1947
- is substantially at rest in a depression in the surface of the earth that is naturally created
- is of natural origin or part of a watercourse, including a watercourse that has been dammed
- covers an area of at least five (5) acres within the shoreline and water line, including bays and coves

Table 3-6: Marshall County Lakes

Lakes	Public Lakes
Cook Lake	
Dixon Lake	
Eddy Lake	
Flat Lake	
Gilbert Lake	
Holem Lake	
Houghton Lake	
Koontz Lake	
Lake Latonka	Not Public Freshwater
Lake Maxinkuckee	
Lake of the Woods	Wooded Lake
Lawrence Lake	
Lost Lake	
Mill Pond	
Myers Lake	
Pretty Lake	
Thomas Lake	
Zehner Millpond Lake	

The goal of the Division of Fish & Wildlife's Lake and River Enhancement (LARE) Program is to protect and enhance aquatic habitat for fish and wildlife, and to insure the continued viability of Indiana's publicly accessible lakes and streams for multiple uses, including recreational opportunities. This is accomplished through measures that reduce non-point sediment and nutrient pollution of surface waters to a level that meets or surpasses state water quality standards.

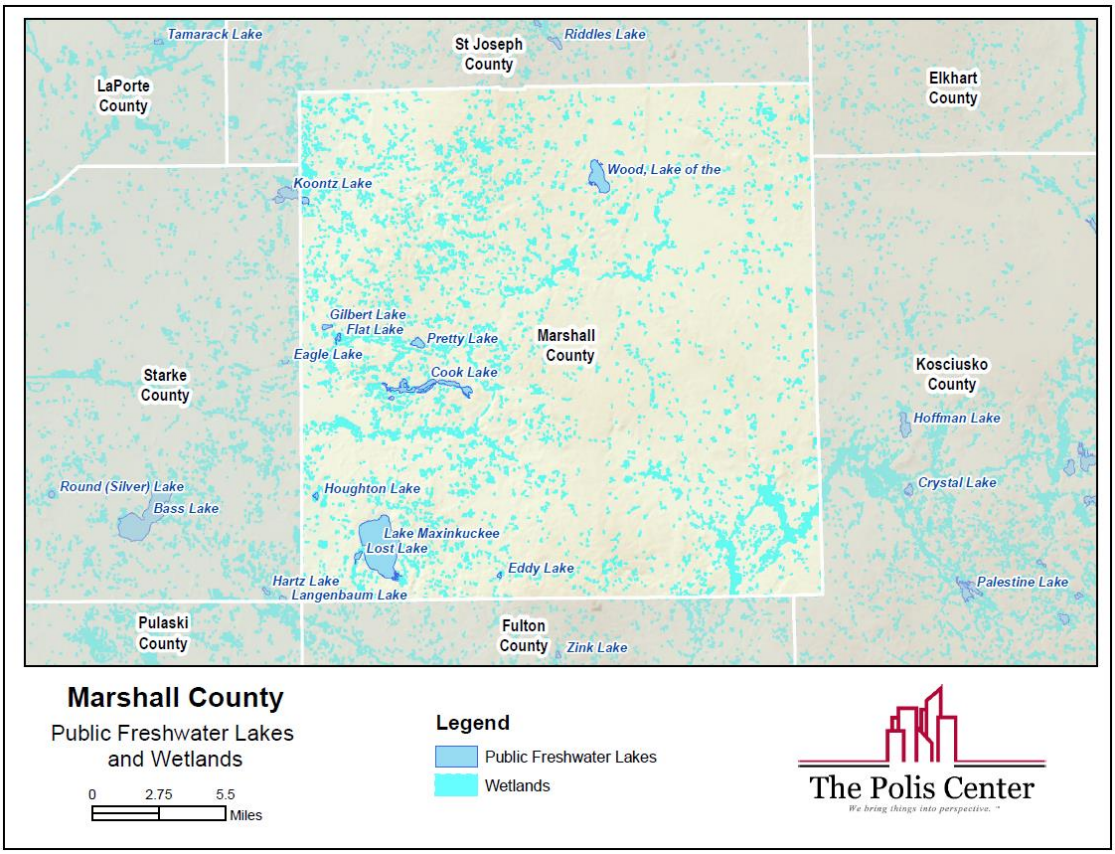
Example of LARE projects include matching federal funds for qualifying projects, Engineering designs and construction of remedial measures, water quality monitoring of public lakes,

management of invasive aquatic vegetation sediment removal from qualifying lakes, and logjam removal from qualifying rivers.

Wetlands

The US Environmental Protection Agency and the Indiana Department of Environmental Management have identified Indiana's wetlands and other aquatic resources as important features to protect and wisely use for the benefit of present and future generations. Before agriculture became more widespread, Indiana was composed of numerous broad expanses of poorly drained wetlands. Broadly defined, the term "wetlands" commonly refers to low depressions in the landscape covered with shallow and intermittent water standing long enough to be capable of supporting hydrophytic vegetation. According to the United States Protection Agency, wetlands differ in size, shape, and types of wet environment and derive their unique characteristics from climate, vegetation, soils and hydrologic conditions. Additionally, the Indiana Department of Environmental Management identifies wetlands as possessing soils, which differ from soils in dry areas, exhibiting hydric characteristics that show the soil developed in saturated conditions. Wetland communities include bogs, dunes, swales, fens, flatwoods, floodplain forests, marshes, ponds, lakes, sedge meadows, seeps, streams, creeks, rivers, and swamps. Wetlands are classified according to their depth of water, total area, and seasonal life span. The IDEM regulates the wetlands in Indiana. The county is the responsible agency for the administration of the North American Wetlands Conservation Act (NAWCA).

Figure 3-2: Public Freshwater Lakes and Wetlands



Originally, wetlands were located throughout the entire state of Indiana. In southern Indiana, floodplain and swamp forests were also widespread, particularly in the southwest lowlands. In south central Indiana, counties rich in limestone frequently have areas with dissolved bedrock, creating many sinkholes, springs, and lowland swamps. With the advent of intensive agriculture practices and the application of land drainage techniques, many of the wetlands located on lands that were flat and suited to agricultural use have been drained.

Wetlands are vital features of the Indiana landscape that provide beneficial services for people and wildlife including: protecting and improving water quality, providing fish and wildlife habitats, storing floodwaters and maintaining surface water flow during droughts and dry periods.

Table 3-7: Wetland Classification by Type

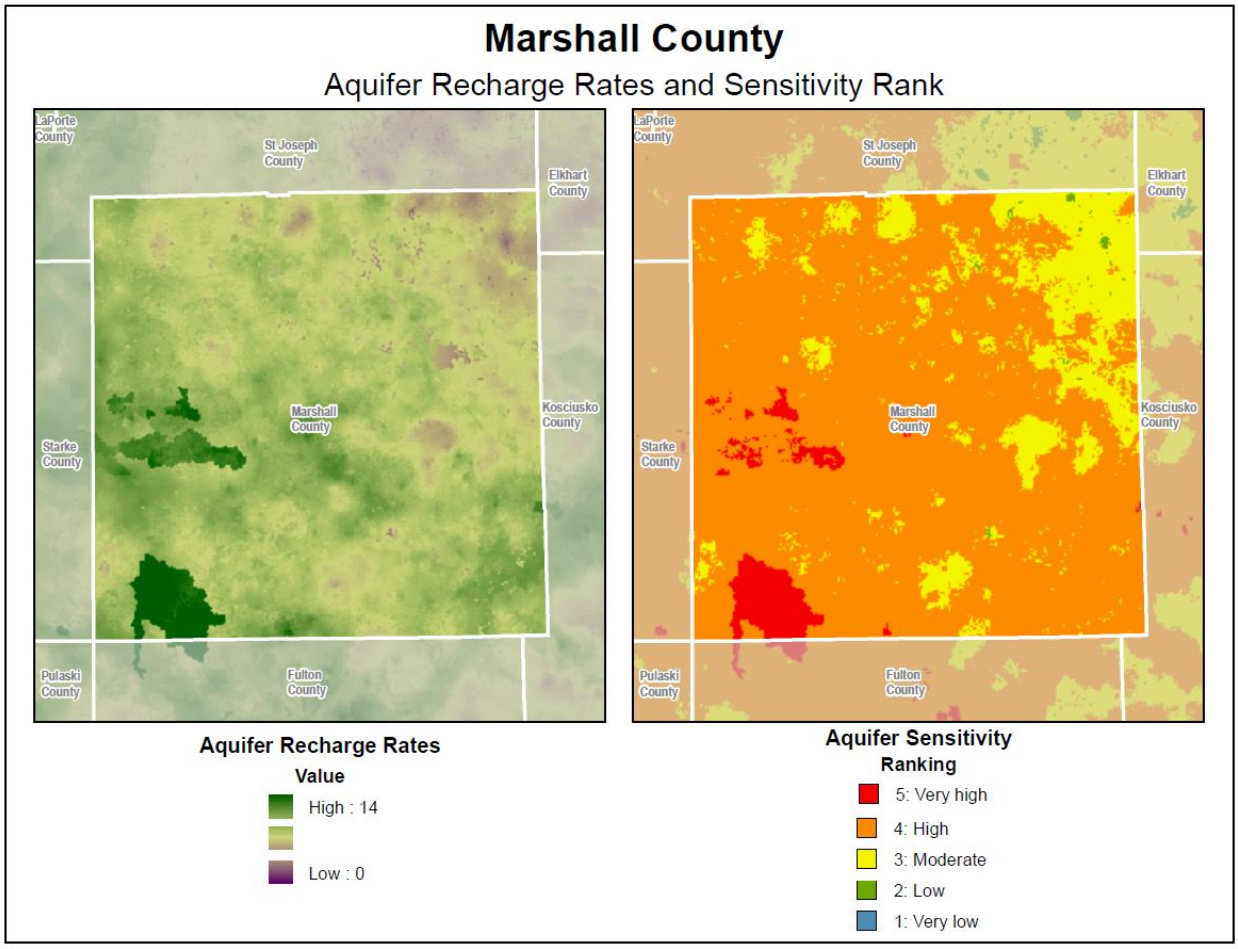
Wetland Type	acres
Freshwater Emergent Wetland	288
Freshwater Forested/Shrub Wetland	5,188
Freshwater Pond	2,641
Lake	789
Riverine	250
Total	**9,156**

The Marshall County Indiana Soil and Water Conservation District has received grants for a couple of projects related to wetland conservation. In order to identify and prioritize ways of improving water quality in the Upper Headwaters Yellow River Watershed, the Upper Headwaters Yellow River Watershed Management Plan was developed to increase knowledge of best management practices throughout the watershed. Allowing for prioritization protection and restoration of wetlands, the Landscape Level Wetland Functional Assessment analyzes existing wetlands to determine their functional significance in the Headwaters Yellow River Watershed.

Water Pollution

Water pollution contaminates lakes, rivers, wetlands, aquifers, and groundwater, and leaches into the surrounding soil. Consisting of any contamination of water with chemicals or other foreign substances that are detrimental to human, plant, or animal health, water pollution places risks on downstream water quality and water supply. Impaired waters containing pollutants can create a hazard affecting wildlife and plant species and can potentially poison underground streams and the wells of people living in the surrounding area, depriving communities of a reliable source of life-giving water and injuring opportunities for economic development and recreation.

Figure 3-3: Aquifer Recharge Rates and Sensitivity Rank

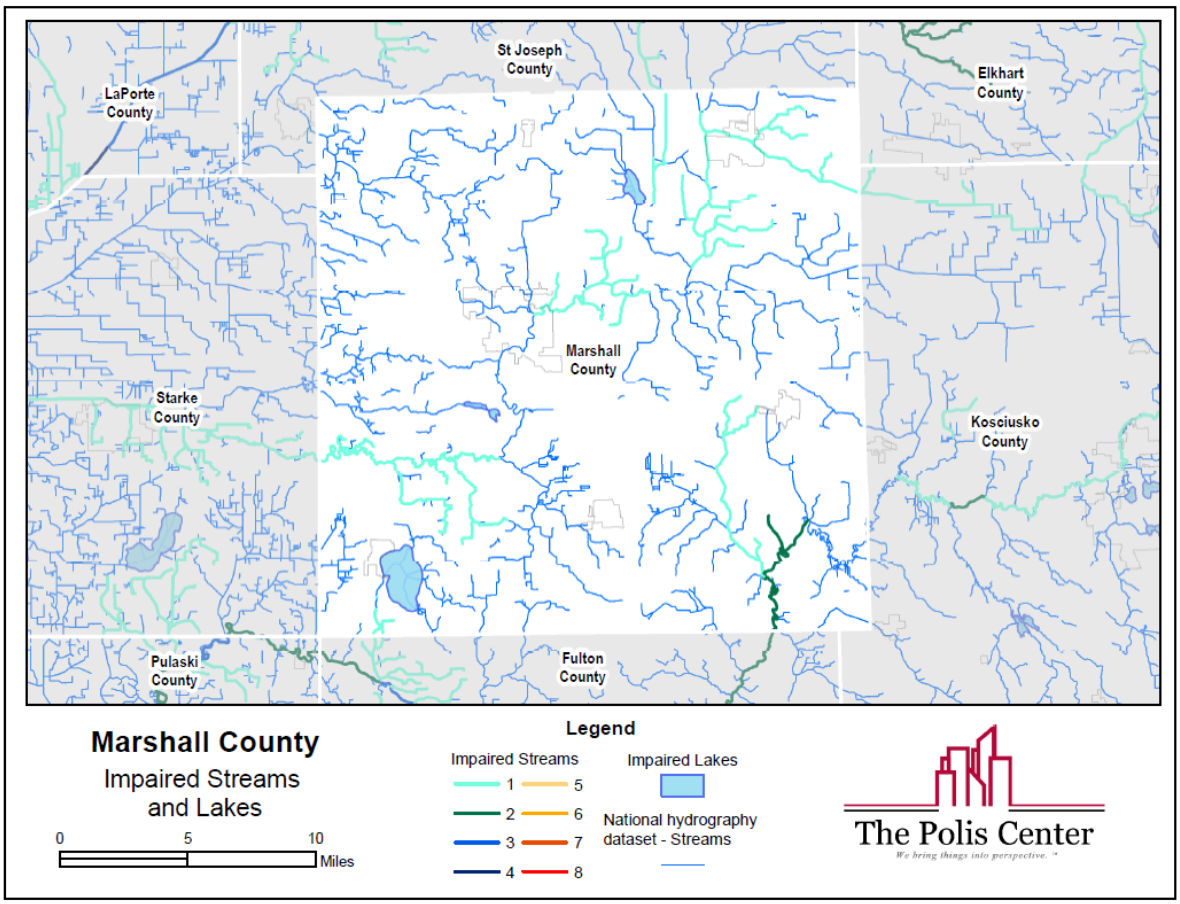


Sewage, wastewater, marine dumping, industrial waste, radioactive waste, oil pollution, and underground storage leaks are some of the most common forms of water pollution. Inadequately engineered hillside construction can endanger downslope development, and erosive soils have been known to generate stream siltation and compromise water quality. The Federal Clean Water Act encourages communities to reduce discharges of storm water pollutants and ensure that waters are safe for fishing, swimming, and drinking. In National Aeronautics and Space Administration's abstract on the Clean Water Act, agricultural runoff is estimated to have resulted in the erosion of 2.25 billion tons of soil and the deposit of large amounts of phosphorus and nitrogen into many waters.

The Federal Clean Water Act provides funding to states and communities to help them meet their clean water infrastructure needs and protects valuable wetlands and other aquatic habitats through a permitting process that ensures development and other activities are conducted in an environmentally sound manner. IDEM is required to assess the quality of the waters in the state of

Indiana and produce a list of waters that are impaired along with the specific impairments. The following figure displays the impaired streams and lakes in Indiana.

Figure 3-4: Impaired Waters



People

Populations

In 1980, Marshall County had a population of 39,155, and the population increased by 11.7 percent between 1970 and 1980. As of 2016, an estimated 46,556 people reside in Marshall County with a population density of 105 people per square mile. A region's economy thrives or dives because of the people who choose to live there. That choice may occur by being born in the community and desiring to stay, or as a deliberate result of choosing to relocate from somewhere else. Monitoring change in the size and movement of population is an important barometer of well-being and a vital part of preparing for the future.

Table 3-8: Population Over Historical Time

	1990	2000	2005	2010	2016
Total Population	42,182	45,126	46,549	47,007	46,556
Change Since 1990		2,944	4,367	4,825	4,374
Pct. Change Since 1990		7.0%	10.4%	11.4%	10.4%

Examining the alterations in the population of the county between 2009 and 2015 along with the shifts within the communities from the beginning of the century and 2015 helps provide perspective on the changing communities of Marshall County.

Comparing and contrasting the data from the beginning of the century and 2015 reveals the largest percent increases in population occurring in the northern towns of La Paz (11.76%) and eastern town like Bourbon (4.08%). With the exceptions of Culver, a community in the southwestern part of the county, all incorporated communities showed population growth.

Table 3-9: Population Change by Community

Community	2000 Population	2016 Population	% Population Change
Argos	1,692	1,647	3.17%
Bourbon	1,708	1,777	4.08%
Bremen	4,474	4,552	1.74%
Culver	1,496	1,412	-5.61%
La Paz	493	551	11.76%
Plymouth	9,853	9,949	0.97%
Marshall County	45,126	46,556	3.17%

Migration trends inform hazard mitigation by highlighting areas of population growth and decline, revealing immigration and emigration patterns, and informing public officials of changes in net adjusted gross income (AGI) because of migration.

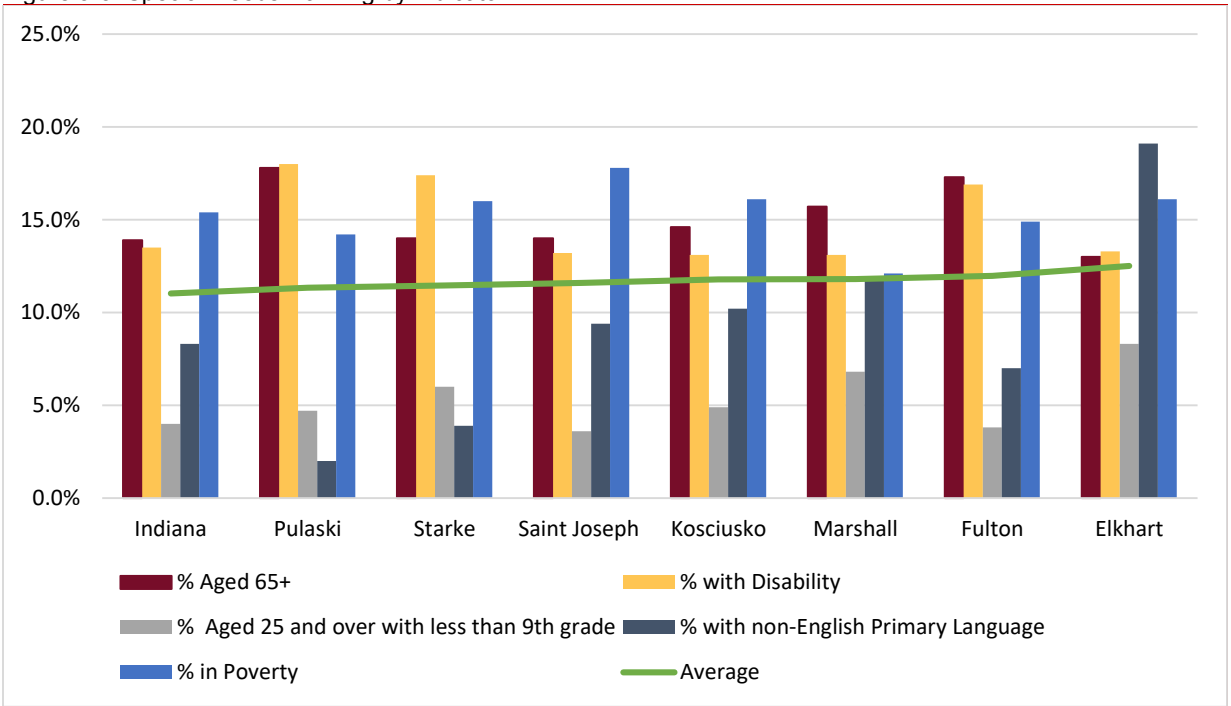
Table 3-10: Components of Population Change 2015 to 2016

	Number
Net Domestic Migration	-289
International Migration	25
Natural Increase (births minus deaths)	94
Births	565
Deaths	471

Age and Sex Characteristics

Some populations may require special attention in mitigation planning because they may suffer more severely from the impacts of disasters. These groups, termed special needs populations, can pose an added difficulty to hazard response and recovery and public resources. It is important to identify these populations and develop mitigation strategies to help them become more disaster-resilient. Although there are numerous types of vulnerable populations, there are five focus groups, which include low-income citizens, older adults, people who don't speak English at home, people with disabilities, and people without high school diplomas, highlighted in the figure below. Marshall County is compared to the nearby counties, as well as to Indiana, by averaging the percent population of each special needs category within the county/state. Of the eight geographies we compared (one state and seven counties), Marshall County ranks sixth, meaning it has a relatively high special needs population in the assessed area.

Figure 3-5: Special Needs Ranking by Indicator



Explanation of Special Needs Indicators:

- Percent population speaking language other than English at home
- Percent of all people whose income in the last 12 months is below poverty level
- Percent of population with a disability within the civilian non-institutionalized population
- Percent of population age 65 and over
- Percent of population with 25 years old and over who have completed less than 9th grade

Marshall County has a relatively low poverty rate but a slightly higher than average percent of people with a non-English primary language and people aged 25 and over with less than a 9th grade education. The remaining factors were on average with the other county data. People who do not have English as their first language and people with less than high school education may require special attention to ensure that they are reached and properly communicated with during disaster warnings or in the event of a hazard. In the event of a disaster, elderly and disabled citizens have particular challenges and concerns. They may require life-sustaining medication, electricity-operated medical equipment, and special mobility assistance. They may also require special temporary housing needs that can accommodate physical disabilities/limitations and varied levels of income. Examples of activities to improve emergency mitigation and preparedness for the elderly population include, but is not limited to, the following:

- Evacuation exercises for communities and elderly care facilities
- Fan distributions
- Public materials on when and how to shelter in place
- Training for emergency shelter staff
- Development of resource guide for seniors with available housing, medical, and basic needs services
- Development of accessible media announcements

Understanding more about the community age breakdown can be helpful in developing public outreach campaigns and understating where to target emergency service needs. The figure representing the age distribution of the Marshall County population reveals a gradually aging population. The percent of the population aged 65 and older is great in 2015 than in 2010, and the median age in Marshall County is 39.5 compared to the Indiana median age of 37.5.

Table 3-11: Population Estimates by Age in 2015

	Number	Pct. Dist
Preschool (0 to 4)	2,919	6.20%
School Age (5 to 17)	8,989	19.20%
College Age (18 to 24)	3,926	8.40%
Young Adult (25 to 44)	10,645	22.80%
Older Adult (45 to 64)	12,637	27.00%
Older (65 plus)	7,741	16.60%

Economy

Data on the types of housing and types of households can potentially provide insight into how to further develop mitigation strategies or align messages to particular groups of citizens. Similar to

the rest of the state and the nation, the average household size is decreasing which can primarily be attributed by the overall rise in the elderly population, and the delays in beginning families and overall smaller family sizes than in the past.

In 2015, the county had an average household size of 2.7 people and average family household size of 3.9. The county ranks relatively high compared to the US average of owner occupied housing and is relatively low for seasonal or recreational use.

Since the year 2000, the county has experienced a positive 36.3% increase in wage growth. Marshall County's median family income of $59,601 is slightly less than, but comparable to, the Indiana median family income of $61,119.

Table 3-12: Income and Wage

	Number
Median family income in 2015 (ACS)	$59,601
Median household income in 2015 (ACS)	$48,485
Average Wage Per Job in 2015 (BLS)	$35,659
Wage Growth since 2000 (BLS)	36.30%

Housing

Approximately, 69.1% of Marshall County households consist of families compared to 66.9% of people in Indiana living with families.

Table 3-13: Households in 2015

	Number	Pct. Dist
Total Households	17,324	100.00%
Family Households	11,976	69.10%
Married with Children	3,778	21.80%
Married without Children	5,723	33.00%
Single Parents	1,200	6.90%
Other	1,275	7.40%
Non-family Households	5,348	30.90%
Living Alone	4,643	26.80%
Average Household Size	2.7	
Average Family Household Size	3.9	

Table 3-14: Housing Units in 2015

	Number	Rank in U.S.	Pct. Dist.	Pct. Dist. in U.S.
Total Housing Units (ACS estimate)	19,948	1,109	100%	100%
Occupied	17,324	1,060	86.8 %	87.7 %
Owner Occupied	13,319	990	66.8 %	56.0 %
Renter Occupied	4,005	1,229	20.1 %	31.7 %
Vacant	2,624	1,271	13.2 %	12.3 %
For Seasonal or Recreational Use	1,108	869	5.6 %	4.0 %

Workforce

In recent years, Marshall County has incurred the most growth in the number of medium sized business establishments with 50-99 employees while larger business corporations with 100 plus employees have experienced a negative percent change.

During 2013, Marshall County reached its highest rate of unemployment (13.5% unemployed) in the past decade. Unemployment among the labor force has slowly diminished since reaching its peak in 2009, and in 2015, the county unemployment rate was the lowest it has been since 2006.

Table 3-15: County Business Patterns, 2014

Business by Number of Employees	Establishments	Number Change	Percent of Change	Percent of Total
1-9 employees	745	-44	-5.60%	71.00%
10-19 employees	137	-16	-10.50%	13.10%
20-49 employees	91	4	4.60%	8.70%
50-99 employees	40	8	25.00%	3.80%
100 plus employees	36	2	5.90%	3.40%
Total	1,049	-46	-4.20%	100.00%

Table 3-16: Labor Force Estimates

Year	Labor Force	Employment	Unemployment	Area Rate	State Rate
2006	23,038	21,800	1,238	5.4	5
2007	22,795	21,693	1,102	4.8	4.6
2008	23,183	21,490	1,693	7.3	5.9
2009	22,539	19,497	3,042	13.5	10.3
2010	23,476	20,823	2,653	11.3	10.4
2011	23,453	21,231	2,222	9.5	9.1
2012	22,969	21,085	1,884	8.2	8.3
2013	23,131	21,420	1,711	7.4	7.7
2014	23,730	22,432	1,298	5.5	5.9
2015	24,078	23,080	998	4.1	4.8

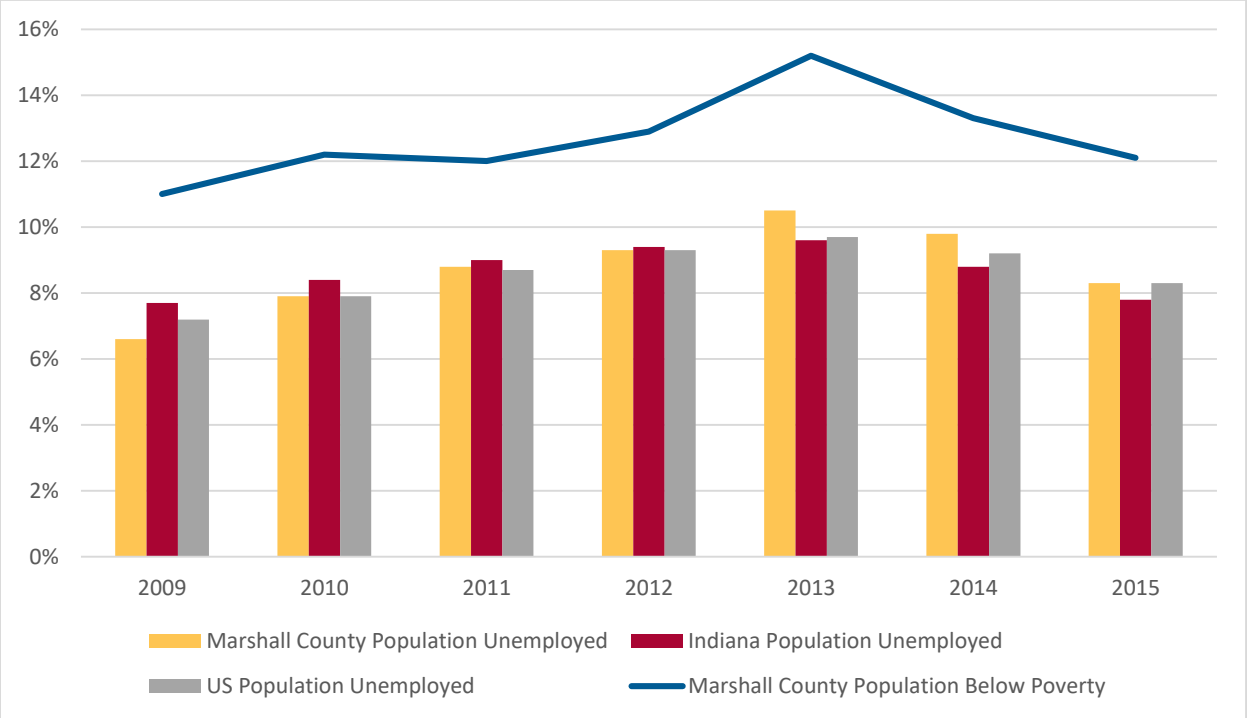
Employment

The Average Annual Earning by Sector table reveals that, from 2011-2015, Marshall County has experienced the largest positive percent increase in the accommodation and food service sector and in retail trade. In contrast, the wholesale trade sector diminished by -31.88%.

STATS Indiana reported that 87.1% of the workforce in Marshall County was employed in the private sector. According to the Bureau of Labor Statistics, manufacturing, management of companies, and healthcare and social assistance remain the top earning sectors.

The 2015 estimated annual per capita income in Marshall County is $36,958 compared to an Indiana average of $41,940. The median household income is $49,714 (1.6% lower than the state). The financial crisis has had a similar impact in Marshall County as it did in Indiana and the US, and in 2013, the county's unemployment rate was greater than both the state and the nation. This graph looks at the employment rate of the county population aged 16 years and over and illustrates how the county's unemployed population has changed over time compared to Indiana and the US. It also shows the percent of Marshall County's population below the poverty level.

Figure 3-6: County Population Unemployed and Below Poverty Level



The Marshall County Economic Development Corporation highlights the County's diverse employment industry, which includes everything from advanced manufacturing and distribution

to retail and logistics. The top major employers in terms of number of employees are listed by manufacturing and non-manufacturing.

Table 3-17: Top Manufacturing Employers

Company Name	Type of Business	Location	Employees
Southwire Co	Wire Products-Manufacturers	Bremen	600
Nishikawa Cooper Llc	Millwork	Bremen	450
Maax USA Corp	Plastics-raw/powder/resin-Manufacturers	Plymouth	350
Plymouth Precision Machine	Machine Shops	Plymouth	300
Bremen Castings	Foundries-steel	Bremen	225
L K Wood Products	Cabinets	Culver	197
Preqis	Floats-styrofoam	Plymouth	182
Del Monte Foods Inc	Food Products & Manufacturers	Plymouth	180
Bomarko Inc	Coated & Laminated Paper Nec	Plymouth	150
Bay Valley Foods Llc	Food Products & Manufacturers	Plymouth	142

Table 3-18: Top Non-Manufacturing Employers

Company Name	Type of Business	Location	Employees
Culver Academies	Schools	Culver	530
Walmart Supercenter	Department Stores	Plymouth	410
Universal Bearings Inc	Bearings (wholesale)	Bremen	280
United States Golf Academy	Golf Instruction	Plymouth	250
Valmont Site Pro 1	Telecommunication Equipment	Plymouth	250
Swan Lake Resort Golf Shop	Golf Equipment & Supplies-retail	Plymouth	250
St Joseph Regl Medical Center -Plymouth	Hospitals	Plymouth	243
Indiana Heat Transfer Corp	Radiators-automotive-wholesale	Plymouth	200
Catherine Kasper Life Ctr	Convents & Monasteries	Plymouth	200
Ancilla Domini Sisters	Convents & Monasteries	Plymouth	200

Education

The level of education of our workforce is a critical factor for economic and community development. It often provides insight into the skill levels of a local area. The type of work (occupations) residents perform can also assist in understanding skill levels. The following tables provide some more detail on the education attainment within the county over time and provide a comparison with the state averages.

Table 3-19: Educational Attainment Comparison over Time

	2000	Pct. of Pop. 25+	2015	Pct. of Pop. 25+
Less than 9th Grade	1760	0.062	2,104	6.8%
9th to 12th Grade, No Diploma	4013	0.141	2,677	8.7%
High School Graduate (incl. equivalency)	11724	0.411	12,496	40.5%
Some College, No Degree	5105	0.179	5,548	18%
Associate's Degree	1694	0.059	2,420	7.8%
Bachelor's Degree	2564	0.09	3,558	11.5%
Graduate or Professional Degree	1695	0.059	2,080	6.7%

Table 3-20: Educational Attainment

	2005	2006	2007	2008
Total Graduates	661	664	716	694
Total to Higher Education	530	550	567	547
Four-Year Institution	454	432	475	443
Two-Year Institution	42	65	50	62
Vocational/Tech.	34	53	42	42
Military	24	19	21	13

Table 3-21: High School Graduates Higher Education Intent

	2008 Pct. Dist.	Indiana Pct. Dist.
Graduates	100%	100%
Total Going on to Higher Education	78.8%	84.1%
Four-Year Institution	63.8%	61.2%
Two-Year Institution	8.9%	15.9%
Vocational and Tech.	6.1%	7%
Military	1.9%	2.6%

Culture

The development of the National Historic Preservation Act of 1966 initiated the federal fostering of the partnerships between the states, local governments, and the private sector on the preservation of our cultural resources. The Act established the National Register of Historic Places, composed of buildings, sites, structures, objects and districts significant in American history, architecture, archaeology, engineering and culture. The DNR Division of Historic Preservation & Archaeology (DHPA) is the state partner that manages the Indiana State Historic Architectural and Archaeological Research Database (SHAARD). Below the figures, display a variety of resources within the county identified within SHAARD. SHAARD is made possible by financial support from

the Federal Highway Administration, the Indiana Department of Natural Resources, and the Historic Preservation Fund of the U.S. Department of the Interior, National Park Service.

Historic and cultural resources are important because they are wonderful examples of architecture or engineering. Others are important for their connection to past people or events. Understanding what is important to the community can help develop better initiatives for project and strategies to accomplish the community's goals. Marshall County has 25 historic places, which appear on the National Register of Historic Places. There are eight established historic districts within the county. Of these historic districts, three are in Plymouth, two are in unincorporated Marshall County, one is in Argos, and two are in Culver. Another lengthy historic district area is shown stretched along the banks of Lake Maxinkuckee.

Table 3-22: Historic Places in Marshall County communities

City Of Plymouth	6
Marshall County (Unincorporated)	14
Town Of Bourbon	1
Town Of Bremen	3
Town Of Culver	1
Marshall County Total	**25**

The community of Plymouth possesses six of Marshall County's 25 recognized historic places: Hoham-Klinghammer-Weckerle House and Brewery Site, East Laporte Street Footbridge, Plymouth Fire Station, Hemminger Travel Lodge, Marshall County Courthouse, and Marshall County Jail. Marshall County's numerous historic structures are shown scattered liberally throughout the Historic Places Figure. For more information on the state historical county survey program, visit: http://www.in.gov/dnr/historic/2824.htm.

As part of the county cultural resources, Marshall County Museum and the Marshall County Historical Society are dedicated to helping preserve local history and heritage. The Marshall County Historical Museum was the recipient of 2014's Indiana Historical Society Award in recognition of the "remarkable public services and programs provided to its community." Believing that the past gives perspective on the present, the Marshall County Museum offers interactive exhibits and events on topics such as following historic highways that trace the story of Marshall County, walking the Trail of Death with Chief Menominee, and listening to World War II vets share their rich experiences.

Dotted throughout the county, Marshall County has 60 cemetery sites that serve as in memoriam to those that have past. The communities' religious sites, and cemeteries are shown on the cultural resources map.

Endowed with historic transportation structures, Marshall County contains 12 historic bridges. Six of the historic bridges are in Plymouth and six are in unincorporated Marshall County. Marshall County does not have any historic canal structures or canal segments.

Community Services & Infrastructure

The following section provides an overview on community services and infrastructure within Marshall County. Examples of community services include healthcare and public safety, while examples of community infrastructure include power utilities, water and sewer facilities, and the transportation network. The Critical Facilities Map identifies critical facilities for each community and a table of all critical facilities is provided in Appendix B.

Schools

Schools systems are valuable partners in Multi-Hazard Mitigation Planning because they can provide input in helping identify the risks from natural hazards to students, teachers, and school facilities. Communities proactively facilitate and support district policies, practices, and programs that help schools raise awareness and understanding of the potential impacts of hazards.

Marshall County is comprised of the Argos Community Schools, Bremen Public Schools, Culver Community Schools, Plymouth Community School Corporation, and Triton School Corporation. The county is also home to multiple private and alternative schools. The communities also possess a selection of private and parochial school options including Culver Academies, a boarding school.

In terms of post high school education, the Plymouth Community School Corporation provides students with the opportunity to receive vocational training and also offers adult education classes for return students. Located near Gilbert Lake, Ancilla Domini College is a two-year private liberal arts college that can prepare students to enter four year universities if they should so desire.

Recreation

Indiana has more than 21,000 miles of fishable streams and rivers, along with 452 natural lakes and 580 impoundments. The DNR manages the "Where to Fish" guide which includes an inventory of DNR-owned access areas, as well as other access sites where you can boat- or bank-fish. Dixon Lake, Koontz Lake, Lake of the Woods, Lake Maxinkuckee, Lake Lawrence, Mill Pond Lake, and Tippecanoe are all listed as DNR recommended fishing spots in Marshall County.

Throughout Marshall County, there are many campground facilities including Campers Roost Campground, Hidden Lake Paradise Campground, Lakeside Campground, Pla-Mor Camp Incorporated, Rupert's Resort, and Yogi Bear Jellystone Park. In addition, there are several rental cabins and RV campgrounds scattered around the county. The tables below outline the trails and managed lands within the communities. A map of the trails and recreational facilities is located in Appendix A.

In addition to hiking and fishing opportunities, Marshall County offers recreational sports and cultural forms of arts and entertainment. A table of Marshall County arts, entertainment, and recreation is available in Appendix B.

Table 3-23: Trail Status

	Open	Planned	Total
City of Plymouth	2	1	3
Marshall County (Unincorporated)	2	1	3
Town of Argos	3	-	3
Town of Bremen	2	-	2
Town of Culver	1	-	1
Marshall Total	10	2	12

Table 3-24: Managed Lands Type (acres)

	Federal	Local	Other	Private	State	Total
City of Plymouth	-	2	-	-	1	**3**
Marshall County (Unincorporated)	-	3	-	4	13	**20**
Town of Argos	-	2	-	-	-	**2**
Town of Bremen	-	1	-	-	-	**1**
Town of Culver	-	1	-	-	-	**1**
Total	**0**	**9**	**0**	**4**	**14**	**27**

Public Facilities

Public facilities buildings, properties, and other areas are government or community owned, operated or funded and are central to government operations and activities. Public facilities are vital for sustaining and providing the members of the community with public services related to safety, health, and wellbeing. Supporting and working with public facilities, Marshall County has eleven social service and welfare organizations that supplement public aid. The county has several senior citizen service organizations and youth centers that provide help create opportunities for community engagement. Aiding communication and outreach, seven post offices service Marshall County.

Supporting public literacy and community engagement, Marshall County boasts four libraries: Bremen Public Library, Bourbon Library, Argos Public Library, and Plymouth Public Library. Appendix B provides an extensive list of the public facilities within the county.

Public Utilities

Water and Wastewater

Surface water is the primary source of water in Marshall County. Other towns and residences obtain groundwater from individual wells. Marshall County has a sum total of 2,813,996 artificial paths, canal ditches, connectors, and Stream Rivers winding through the county, transporting and supplying water.

There are three types of wastewater treatment systems in Marshall County, including public sewer systems operated by municipalities and sanitary districts, community systems operated by homeowner associations, and individual sewage treatment systems. Water service in Marshall County is provided by municipalities, water districts, private water associations, and individual wells. Plymouth Water Department, Argos Light & Water Plant, Bremen Waste Water Treatment, Culver Wastewater Plant, and Marshall County Soil & Water help provide water supply and waste disposal needs for the county.

Other Utilities

Among its other utilities and public facilities, Marshall County contains a solid waste and recycle depot that handles both recycling and household hazardous waste disposal. Hazmat facilities seek to provide a point of control, management, and tracking of hazardous materials. Hazardous material transportation adheres to strict requirements, but in the case of a disaster, it is beneficial

for planners and responders to be aware of the locations and transportation routes of hazardous materials particularly those near or in population centers.

Health Care Providers

An emergency disaster can impact an entire community and can involve numerous medical and public health entities, including health care provider systems, public health departments, emergency medical services, medical laboratories, individual health practitioners, and medical support services. A coordinated response is essential for effective emergency management, so being aware of the locations and resources of healthcare providers is important to preparing for and responding to disasters. Vulnerable populations such as people within nursing homes and hospitals frequently require a unique response during a disaster and could be at considerable risk if their care was disrupted.

The St. Joseph Regional Medical Center in Plymouth is one of the county's key healthcare resources and one of Marshall's larger non-manufacturing employers. Other hospitals include the Community Hospital of Bremen, Doctors Neuromedical Hospital, Doctors Neuropsychiatric Hospital, and Michiana Behavioral Health Center. Marshall also contains multiple health and welfare agencies, healthcare facilities, and health services. For planning mitigation and emergency evacuation purposes, it is also important for community leaders to be aware of the locations of retirement communities and nursing and convalescent homes. Health care and social assistance providers are listed in Appendix B.

The Marshall County Health Department's mission states, "The Marshall County Health Department, in serving the people of Marshall County, helps protect and avoid potentially dangerous threats to the health, safety and welfare of the community." In order to better enable it to meet the challenges of public health issues on a daily basis, The Marshall County Health Department has balanced itself to provide services ranging from the following categories Bats, Bedbugs, Birth/Death Records, Ebola Virus, Enterovirus D68, Food Service Permits, Immunizations, Meth, Public Health Nuisance Complaints, Septic Permit, Shot Clinic, Water Testing, and Zika Virus.

Public Safety Providers/Government Services

The Marshall County Sheriff's Department is centrally located in the city of Plymouth. The county sheriff is the chief law enforcement officer in the county, but the Indiana State Police does

maintain a department in Bremen. Dedicated to community safety, Marshall County has five fire departments and four police departments. The Communities of Argos, Bourbon, Bremen, Culver, and Plymouth each support their own police department.

The community fire departments consist of Bourbon Fire Department, Bremen Community Fire Department, La Paz-north Township Plymouth Fire Department, and Tippecanoe Fire Department. Additionally, Polk Township Volunteer Fire Department- Tyner, Polk Township Volunteer Fire Department- Walkerton, and La Paz North Township Volunteer Fire Department work to fight fire hazards in the county.

Appendix B depicts government and emergency facilities, which includes city halls, fire departments, police departments, sheriff's department, and the Marshall County Courthouse.

Utilities/Communications

Utilities are vulnerable to a variety of hazards including natural disasters like tornadoes, earthquakes, flooding, wildfires, and storms. The impacts from hazards can damage utility equipment and cause disruptions of services and the loss of power, water, communication, and revenue. According to the Environmental Protection Agency, communities can mitigate damage to utilities before a disaster occurs by implementing projects to "better withstand a natural disaster, minimize damage, and rapidly recover from disruptions to service." While mitigating utilities frequently requires financially investment, mitigation could improve more costly future damage, improve the reliability of service during a disaster, and help people keep the amenities they desperately require.

During a disaster, communications and emergency management seem to become synonymous, and reliable communication can become one of the highest assets during a disaster. Communication is both one of the key elements to secure an effective disaster response as well as one of the most difficult elements to insure. The U.S. Department of Homeland Security reports that the Communications Sector provides an "enabling function" across all critical infrastructure sectors. The communications sector is closely linked to other sectors including the energy, information technology, financial services, transportation systems, and emergency services.

Located in Plymouth, Marshall County REMC is the electric cooperative providing electricity services to the residents of the county. Although the REMC primarily serves Marshall County, it also is the electric service provider for portions of St. Joseph, Elkhart, Kosciusko, Fulton

and Starke Counties. Marshall County REMC's affiliates include Wabash Valley Power, Indiana Electric Cooperatives, Touchstone Energy, and America's Electric Cooperatives. The principal gas company serving the county is Ni Source Gas Company.

Appendix B offers an overview of Marshall County utilities including power substations, electric transmission lines, and FM/AM radio towers.

Marshall County is a StormReady community which is a program administered by the National Weather Service. The StormReady program helps arm America's communities with the communication and safety skills needed to save lives and property--before, during and after the event. StormReady helps community leaders and emergency managers strengthen local safety programs.

To be officially StormReady, a community must:

- Establish a 24-hour warning point and emergency operations center
- Have more than one way to receive severe weather warnings and forecasts and to alert the public
- Create a system that monitors weather conditions locally
- Promote the importance of public readiness through community seminars
- Develop a formal hazardous weather plan, which includes training severe weather spotters and holding emergency exercises.

Transportation

Roads and Bridges

The county transportation system is composed of roads, highways, airports, public transit, railroads and trails, designed to serve all residents, businesses, industries and tourists. The Indiana Department of Transportation (INDOT) LaPorte District manages the county state transportation resources. The transportation features include county, state, and local (city) bridges, active and abandoned railroads, and the air, bus, or rail facilities within the county. The breakdown of the quantity and type of roads are presented in the transportation features table.

Table 3-25: Marshall County Transportation Features

	Bridges	Roads (mi)
State	49	
US Route		142
State		158
County	109	920
Local	8	124
Other	4	
Proposed		9
State Managed Land		<1
Total	**170**	**1,352**

There are no federally managed roads in the county. All county bridges are the responsibility of the County Engineer at the Marshall County Highway Department. Refer to the transportation features map located in Appendix A, which further detail the transportation features and facilities in the county and highlighted below.

Rail

Marshall County has four rail corridors: CSX, Chicago, Fort Wayne & Eastern Railroad (CFER), CSX and Norfolk Southern (NS), and Elkhart & Western Railroad and Fulton County Railroad (EWR). CSX and Norfolk Southern (NS) operates over 42,000 miles of track throughout 20 states east of the Mississippi River and into Canada. Passing adjacent to the Bremen Industrial Park, one of the largest industrial parks in the county, CSX is a freight railroad running from the northern part of the county to Chicago. The Chicago, Fort Wayne & Eastern Railroad (CFER) crosses through the south part of the City of Plymouth and the Town of Bourbon.

Air

The largest commercial airport is Plymouth Municipal Airport. Thirteen airports in the county provide private air service. The closest international airport is the South Bend International Airport, and it located just 20 miles north of the county seat of Plymouth. International air transportation is also available at the Chicago O'Hare International Airport and the Chicago Midway International Airport which are located within a couple hours' drive of Plymouth.

Seaports

Marshall County does not have its own port, but the Port of Indiana - Burns Harbor is located on the south shore of Lake Michigan an hour away from Marshall to the northwest. The port acts as a

gateway to the Midwest for international shippers. Inland rivers link the port to 38 states and the Gulf of Mexico.

Commute

County-to-county commuting patterns provide a gauge of the economical connectivity of neighboring communities. The US Census reports that over 27% of US workers travel outside their residential county to travel to work.

According to Stats Indiana 2014 data, there are 31,334 people who live in Marshall County and work (implied resident labor force). Of these residents, 5,860 (18.7%) work outside the county. An additional 4,929 people living in other counties commute to Marshall County for work.

The mean travel time to work in Marshall County is 21.3 minutes compared to a 25-minute average in the US. Commuter safety is an important consideration in disaster mitigation and planning. Employers can help their employees prepare by encouraging the development of Commuter Emergency Plans, such as the template developed by FEMA and available for download at http://www.fema.gov/media-library/assets/documents/90370.

Table 3-26: Commuting Patterns: Top five counties sending workers INTO county, 2015

County	Number	Pct. Five County Total
Starke County	1,529	37.8%
St Joseph County	1,231	30.4%
Fulton County	565	14%
Kosciusko County	420	10.4%
Elkhart County	300	7.4%

Table 3-27: Commuting Patterns: Top five counties receiving workers FROM county, 2015

County	Number	Pct. Five County Total
St Joseph County	2,131	42.1%
Elkhart County	1,527	30.1%
Kosciusko County	986	19.5%
Starke County	212	4.2%
Fulton County	210	4.1%

Hoosiers by the Numbers: Indiana County Highlights captured the U.S. Census Bureau & American Community Survey 5 Year Estimates that the majority (91.1%) of Marshall County residents traveling to work in 2015 went by car, truck, or van, and, of those who traveled via car, truck or van,

79.7% traveled alone. Only 0.2% of residents traveling to work relied on public transportation, and 5.6% used some other conveyance, such as motorcycle, bicycle, or walking.

Chapter 4 – Risk Assessment

The goal of mitigation is to reduce the future impacts of a hazard including loss of life, property damage, disruption to local and regional economies, and the expenditure of public and private funds for recovery. Sound mitigation practices must be based on sound risk assessment. A risk assessment involves quantifying the potential loss resulting from a disaster by assessing the vulnerability of buildings, infrastructure, and people.

Developing a priority on the hazards the community is exposed to is one of the first priorities before conducting a risk assessment. The following section will then include the descriptions of hazard, history, vulnerability & future development, relationship to other hazards, plans & programs in place and gaps & deficiencies. This risk assessment identifies the characteristics and potential consequences of a disaster, how much of the community would be affected by a disaster, and the impact on community assets.

Basing risk assessments on the best information available is important in developing effective mitigation actions that benefit communities. Geographic Information System (GIS) tools are not only helpful in producing maps, but they also show structures at risk and may determine damage estimates for potential hazard scenarios. FEMA created Hazards USA Multi-Hazard (Hazus-MH), a powerful GIS-based disaster risk assessment tool. This tool enables communities to predict estimated losses from floods, hurricanes and other related phenomena and to measure the impact of various mitigation practices that might help reduce those losses.

Assessing Hazards

The term “natural hazards” refers to those forces extraneous to man in elements of the natural environment. They are not possible to manage, and are often interrelated. Natural hazards do not always cause damage to humans or the built environment; until a hazard and development intersect, significant damage can occurs creating the natural disaster.

The term “technological hazards” refers to the origins of incidents that can arise from human activities such as the manufacture, transportation, storage, and use of hazardous materials. They can also be intentional or the result from an emergency cause by another hazard (e.g., flood,

storm). In addition, technological hazards, such as hazmat incidents and levee failures, provide the county the ability to quantifiable measure the potential results of an incident, and therefore ware included in depth in this plan. To capture the potential effects of these technological hazards within natural disasters, this plan identifies all technological hazards within one portion of a hazard profile.

Finally, "human cause" or "adversarial" disaster are intentional or by accident. The term "terrorism" refers to intentional, criminal, and malicious acts. There is no single, universally accepted definition of terrorism, and it can be interpreted in many ways. For the purposes of this plan, FEMA refers to "terrorism" as the use of Weapons of Mass Destruction (WMD), including biological, chemical, nuclear, and radiological weapons; arson, incendiary, explosive, and armed attacks; industrial sabotage and intentional hazardous materials releases; and "cyber terrorism."

Hazard Identification/Profile

Hazard Identification

The US Department of Homeland Security developed the Threat and Hazard Identification and Risk Assessment Guide, Comprehensive Preparedness Guide (CPG) 201 which was used as a guide for the hazard identification and profile development. The process of developing a THIRA helps communities identify capability targets and resource requirements necessary to address anticipated and unanticipated risks. The FEMA Preparedness Types of Threats or Hazards table provides example of each type of threat or hazard.

The cornerstone of the risk assessment is identification of hazards that affect the county and each jurisdiction. To facilitate the planning process, several sources were employed to ensure that natural hazards are identified prior to assessment.

In the FEMA publication "Comprehensive Preparedness Guide for Developing Emergency Operation Plans," FEMA defines hazards as natural, technological or human caused.

Table 4-1: FEMA Preparedness Types of Threats or Hazards

Natural	Technological	Human-caused
Animal disease outbreak	Airplane crash	Biological attack
Drought	Dam failure	Chemical attack
Earthquake	Levee failure	Cyber attack
Epidemic	Mine accident	Explosives attack
Flood	Hazardous materials release	Radiological attack
Landslide	Power failure	Sabotage
Pandemic	Radiological release	School or workplace violence
Tornado	Train derailment	
Wildfire	Urban conflagration	
Winter storm		

WebEOC is the State of Indiana's crisis information management system, which is the communications platform for local, county and state emergency managers/homeland security partners. Partners in emergency management personnel at the local, county and state lev which is where the comprehensive list of the 31 care five preparedness mission areas (preventions, protection, mitigation, response, recovery) and 31 core capabilities participated. Based on the FEMA hazards, the state identified the following specific concerns in the 2014 Indiana State Hazard Mitigation Plan.

Table 4-2: State Hazard Mitigaton Plan Identified Threats or Hazards

Natural	Technological	Human-caused
Animal disease outbreak	Airplane crash	Biological attack
Drought	Dam failure	Chemical attack
Floods	Communication System Failure	Cyber Attack
Severe Thunderstorm and Tornado	Hazardous Materials Release	Active Shooter
Earthquakes	Public Utility Failure	Arson
Winter Storms	Air Transportation Incidents	CBRNE Attack
Drought	Explosion	Hostage Situation
Extreme Temperatures	Dam/Levee Failure	Riot
Wild Fire	Structural Fire	Terrorism
Disease Outbreak	Ground Failure (Subsidence)	
Fluvial Erosion		

The primary focus of this mitigation plan will be on the development of strategies analysis related to those natural and technological hazards that are managed or affect the city, town county communities. The following sections define the natural and technological that are recognized with analysis and strategies in this plan.

Natural Hazards – Presented by the Physical World

Those forces extraneous to man in elements of the natural environment, are difficult to manage, and are often interrelated. Natural hazards do not always cause damage to humans or the built environment; until a hazard and development intersect, significant damage can occur creating the natural disaster. In general, there are three types of natural hazards, geologic, atmospheric, and other natural hazards that will be covered in this plan:

Table 4-3: Natural Hazards Idenified in Plan

Geologic	Atmospheric	Other
Flooding	Droughts	Infectious Disease Outbreak
Flash Flooding	Extreme Temperatures	Wild Fires
Ground Failure • Mine • Fluvial erosion • Karst areas	Summer Storms • Thunderstorms • Hail • Lightning • Wind	
Earthquakes	Tornadoes	
	Winter storms	

Technological Hazards – Presented by Man

Technological hazards and human caused hazards are distinct from natural hazards primarily in that they originate from human activity. In contrast, while the risks presented by natural hazards may be increased or decreased as a result of human activity, they are not inherently human-induced. Technological hazards can be incidents that can arise from human activities such as the manufacture, transportation, storage, and use of hazardous materials. These hazards can also be intentional or the result from an emergency cause by another hazard (e.g., Flood, Storm). The following table provides a summary of the technological hazards covered in depth in this plan.

Table 4-4: Technological Hazards Idenified in Plan

	Technological	
Dam failure	Hazardous Material Release	Levee failure

Calculated Priority Risk Index

The Calculated Priority Rating Index (CPRI) is a process that evaluates the probability, consequence, warning time and duration in order to develop a hazard rank. A comprehensive list of all three classifications and ungrouped hazards are maintained with WebEOC. The also committee drew on the natural probability and impact ranked in the previous plan and more

recent THIRA assessments when determining the final rank. The team reviewed previous plans hazard priority as shown in the following table.

Table 4-5: Hazards rank in previous Multi-Hazard Mitigation Plan

Hazard
Flooding
Tornado
Thunderstorms / High Winds / Hail
Hazardous Materials Release
Drought / Extreme Heat
Earthquake
Severe Winter Storms

Through the completion of a hazard risk and probability survey and discussion in meeting two, the team developed a consensus on the hazard priority for the county for the purposes of this plan. The team determined the ranking considering the natural and technological hazards outlined in the following table.

Table 4-6: Calculated Priority Risk Index for the County

Natural Hazards	Probability	Consequence	Warning Time	Duration	Risk Factor
Winter Storms	4 - Highly Likely	3 - Critical	3 - 6-12 Hours	3 - < 1 Week	3.45
Tornadoes	4 - Highly Likely	3 - Critical	4 - < 6 Hours	1 - < 6 Hours	3.4
Summer Storms	4 - Highly Likely	3 - Critical	4 - < 6 Hours	1 - < 6 Hours	3.4
Infectious Outbreak	3 - Likely	3 - Critical	4 - < 6 Hours	2 - < 24 hours	3.05
Hazardous Incident	3 - Likely	3 - Critical	4 - < 6 Hours	2 - < 24 hours	3.05
Flash Flooding	3 - Likely	3 - Critical	3 - 6-12 Hours	3 - < 1 Week	3
Wild Fires	3 - Likely	2 - Limited	4 - < 6 Hours	2 - < 24 hours	2.75
Earthquake	2 - Possible	3 - Critical	4 - < 6 Hours	2 - < 24 hours	2.6
Extreme Temperatures	3 - Likely	2 - Limited	1 - 24+ Hours	4 - > 1 Week	2.5
Drought	2 - Possible	3 - Critical	1 - 24+ Hours	4 - > 1 Week	2.35
Flooding	2 - Possible	2 - Limited	1 - 24+ Hours	4 - > 1 Week	2.05
Ground Failure	1 - Unlikely	2 - Limited	4 - < 6 Hours	2 - < 24 hours	1.85
Dam Failure	1 - Unlikely	2 - Limited	4 - < 6 Hours	2 - < 24 hours	1.85
Levee Failure	1 - Unlikely	2 - Limited	4 - < 6 Hours	2 - < 24 hours	1.85

The following formula provides the weighted factors described in the table and detailed below.

Risk Factor = [(Probability/.45) x (Consequence/.30) x (Warning Time/.15) x (Duration/.10)]

Table 4-7: Summary of Calculated Priority Risk Index (CPRI) Categories and Risk Levels

CPRI Category	DEGREE OF RISK			Assigned Weighting Factor
	Level ID	Description	Index Value	
Probability	Unlikely	Extremely rare with no documented history of occurrences or events. Annual probability of less than 0.001	1	45%
	Possible	Rare occurrences with at least one documented or anecdotal historic event. Annual probability that is between 0.01 and 0.001.	2	
	Likely	Occasional occurrences with at least two or more documented historic events. Annual probability that is between 0.1 and 0.01.	3	
	Highly Likely	Frequent events with a well-documented history of occurrence. Annual probability that is greater than 0.1.	4	
Consequence	Negligible	Negligible property damages (less than 5% of critical and non-critical facilities and infrastructure). Injuries or illnesses are treatable with first aid and there are no deaths. Negligible quality of life lost. Shutdown of critical facilities for less than 24 hours.	1	30%
	Limited	Slight property damages (greater than 5% and less than 25% of critical and non-critical facilities and infrastructure). Injuries or illnesses do not result in permanent disability and there are no deaths. Moderate quality of life lost. Shut down of critical facilities for more than 1 day and less than 1 week.	2	
	Critical	Moderate property damages (greater than 25% and less than 50% of critical and non-critical facilities and infrastructure). Injuries or illnesses result in permanent disability and at least one death. Shut down of critical facilities for more than 1 week and less than 1 month.	3	
	Catastrophic	Severe property damages (greater than 50% of critical and non-critical facilities and infrastructure). Injuries or illnesses result in permanent disability and multiple deaths. Shut down of critical facilities for more than 1 month.	4	
Warning Time	Less than 6 hours		4	15%
	6 to 12 hours		3	
	12 to 24 hours		2	
	More than 24 hours		1	
Duration	Less than 6 hours		1	10%
	Less than 24 hours		2	
	Less than one week		3	
	More than one week		4	

- **Probability** – a guide to predict how often a random event will occur. Annual probabilities are expressed between 0.001 or less (low) up to 1 (high). An annual probability of 1 predicts that a natural hazard will occur at least once per year.
- **Consequence/Impact** – indicates the impact to a community through potential fatalities, injuries, property losses, and/or losses of services. The vulnerability assessment gives information that is helpful in making this determination for each community.
- **Warning Time** – plays a factor in the ability to prepare for a potential disaster and to warn the public. The assumption is that more warning time allows for more emergency preparations and public information.
- **Duration** – relates to the span of time local, state, and/or federal assistance will be necessary to prepare, respond, and recover from a potential disaster event.

Hazard Risk Assessment by Jurisdiction

The risk assessments identify the characteristics and potential consequences of a disaster, how much of the community could be affected by a disaster, and the impact on community assets. While some hazards are widespread and will impact communities similarly, e.g. winter storms, others are localized leaving certain communities at greater risk than others, flash flooding and sewer related problems, exposure to a particular high-risk dam. The following diagrams illustrate each community's risk to flooding, dam/levee failure, hazardous materials incidents, and ground failure and are highlighted within the risk assessment.

Table 4-8: Localized Hazards for Incorporated Jurisdictions

Jurisdictions	**Hazard Probability**			
	Flooding	Dam/Levee	Hazardous Release	Ground Failure
Argos	Highly Likely	Possible	Likely	Possible
Bourbon	Possible	Possible	Likely	Possible
Bremen	Possible	Possible	Likely	Possible
Culver	Possible	Possible	Likely	Possible
La Paz	Possible	Possible	Likely	Possible
Plymouth	Highly Likely	Possible	Possible	Possible

NCDC Historical Storm Events

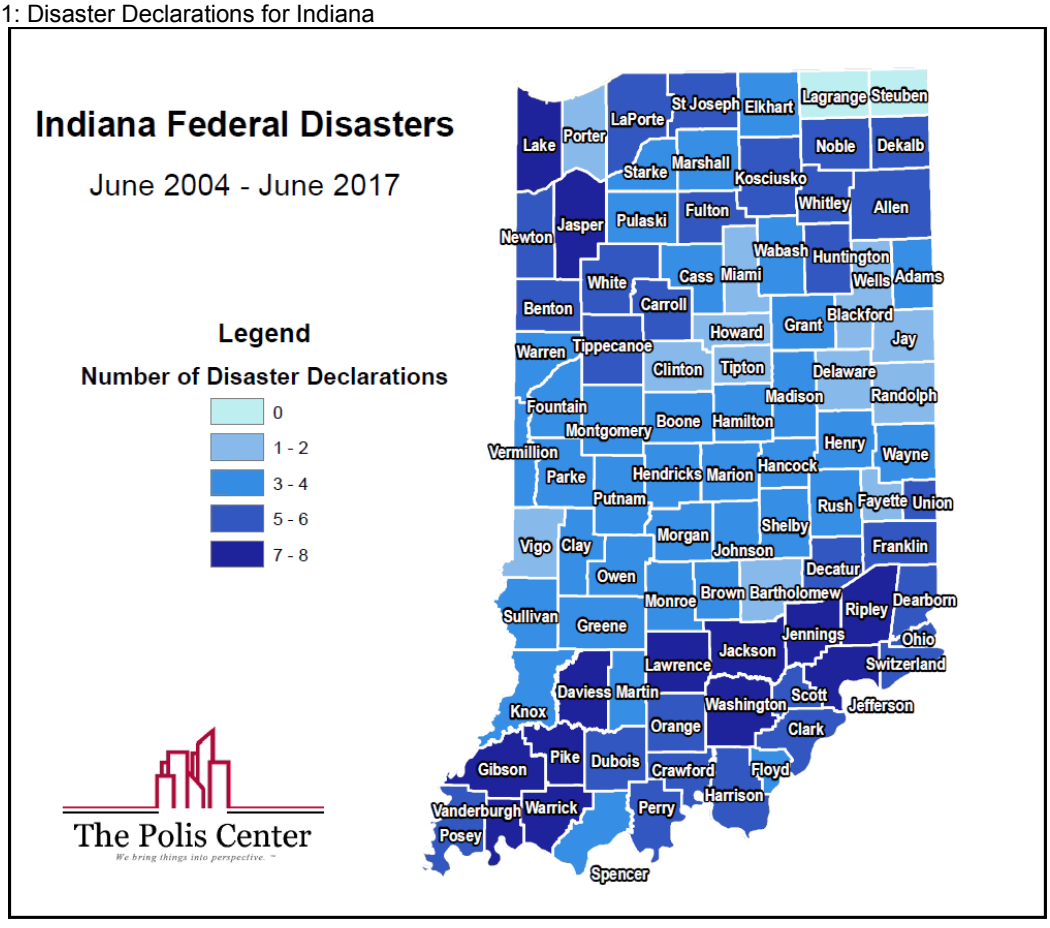
Historical storm event data was compiled from the National Climatic Data Center (NCDC). NCDC records are estimates of damage reported to the National Weather Service (NWS) from various local, state, and federal sources. Typically, the submissions are from law enforcement and emergency managers. It should be noted these estimates are often preliminary in nature and may not match the final assessment of economic and property losses related to given weather events.

The NCDC data included 275 reported events in Marshall County between 1965 and December 31, 2016. Including; 183 summer storms, 18 tornado events, 8 flood events, 63 winter storms, 3 extreme temperature events. A table listing all events, including; injury, death, and property loss statistics are included in Appendix C.

FEMA Declared Disasters

Since 2004, FEMA has declared 17 emergencies and disasters for the state of Indiana. The following map shows the number of disasters by county in the state since June 2004.

Figure 4-1: Disaster Declarations for Indiana



The FEMA-Declared Disasters and Emergencies for Marshall County (2000- 2017) table shows the details of the major disaster declarations including FEMA hazard mitigation funding and total assistance for Marshall County. Marshall County has received federal aid for three declared disasters and three emergencies since 2000.

Table 4-9: FEMA-Declared Disasters and Emergencies for Marshall County (2000- 2017) [18]

Disaster Number	Date of Incident	Date of Declaration	Disaster Description	Type of Assistance
EM-3162	12/11/2000-12/31/2000	1/24/2001	Indiana Severe Winter Storms	PA
DR-1573	1/1/2005-2/11/2005	1/21/2005	Indiana Severe Winter Storms and Flooding	IA, HMGP
EM-3238	8/29/2005-10/1/2005	9/10/2005	Indiana Hurricane Evacuation	PA
EM-3274	2/12/2007-2/14/2007	3/12/2007	Indiana Snow	PA
DR-1740	1/7/2008- 3/14/2008	1/30/2008	Severe Winter Storms and Flooding	IA, PA, HMGP
DR-1832	3/8/2009-3/14/2009	4/22/2009	Severe Storms, Tornadoes and Flooding	IA, HMGP

PA – Public Assistance Program - IA – Individual Assistance Program - HMGP – Hazard Mitigation Grant Program

In the event of a federally declared disaster, individuals, families, and businesses may apply for financial assistance to help with critical expenses. Assistance may be categorized as Individual Assistance (IA), Public Assistance (PA), or Hazard Mitigation Assistance (HMA). The following types of assistance may be available in the event of a disaster declaration:

Individuals & Household Program: Provides money and services to people in presidentially declared disaster areas.

Housing Assistance: Provides assistance for disaster-related housing needs.

Other Needs Assistance: Provides assistance for other disaster-related needs such as furnishings, transportation, and medical expenses.

Public Assistance: Disaster grant assistance available for communities to quickly respond to and recover from major disasters or emergencies declared by the president.

Emergency Work (Categories A-B): Work that must be performed to reduce or eliminate an immediate threat to life, to protect public health and safety, and to protect improved property that is significantly threatened due to disasters or emergencies declared by the president.

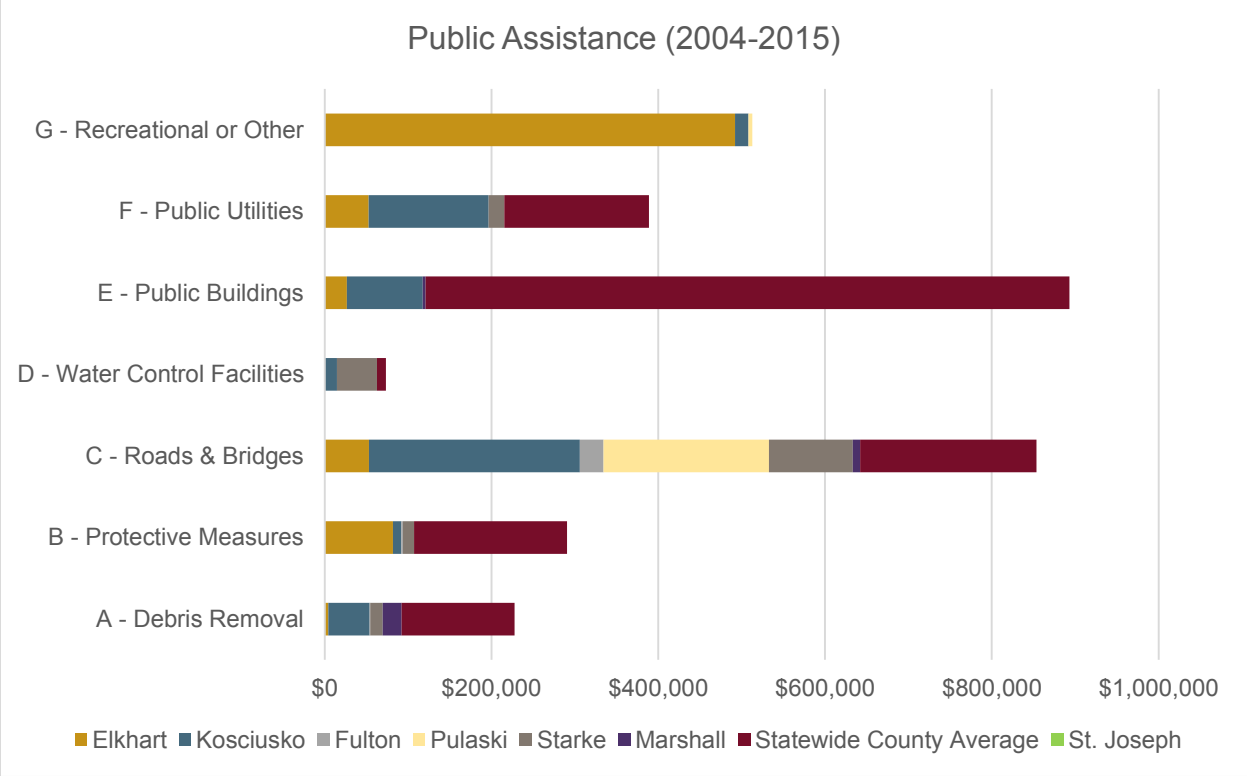
Permanent Work (Categories C-G): Work that is required to restore a damaged facility, through repair or restoration, to its pre-disaster design, function, and capacity in accordance with applicable codes and standards.

[18] Disaster declarations with multiple hazards may be regional and all hazards may not impact every community/county in the declaration.

Hazard Mitigation Assistance: Provides assistance to states and local governments through the Hazard Mitigation Grant Program (HMGP) to implement long-term hazard mitigation measures after a major disaster declaration.

Highway departments claimed significant damages from flooding and fluvial erosion, and rural electrical cooperatives have historically been vulnerable to ice storms and high winds. Below the figure identifies the category funding that has happened in the county and surrounding counties. Figure 4-2 provides a breakdown of the PA in comparison to surrounding counties and the statewide averages.

Figure 4-2: Indiana Disaster Assistance for Marshall and Surrounding Counties



Other Disaster Relief

In 2006, Indiana began appropriating funds to its State Disaster Relief Fund (SDRF) from the revenues it generated from firework sales to ensure the availability of a dedicated source of disaster funding. Through this program the state provides both public and individual assistance. The state established the disaster relief fund in 1999, it did not appropriate funds to the account due to fiscal constraints. In 2006, the state began dedicating funds from the sale of fireworks. Then

in 2007, the state established in statute that the fund would receive an annual appropriation of $500,000 from revenues generated from the firework sales.

In addition to potential state funding, homeowners and businesses can be eligible for low-interest and long-term loans through the U.S. Small Business Administration (SBA). SBA was created in 1953 as an independent agency of the federal government to aid, counsel, assist and protect the interests of small business concerns. The program also provides low-interest, long-term disaster loans to businesses of all sizes, private nonprofit organizations, homeowners and renters following a declared disaster. The loans can also provide resources for Homeowner Associations, Planned Unit Developments, co-ops, condominium and other common interest developments. SBA 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.

Through the disaster loan program, SBA provides the on loan data, including; FEMA and SBA disaster numbers, type (business or home), year, and various reporting amounts on the verified and approved amount of real estate and contents. Below, Figure 4-3 identifies the total verified loss by community, loan type, and year of event. Table 4-10 provides a breakdown of the number of claims per year and its relationship to the SBA declaration and FEMA disaster number, if applicable.

Figure 4-3: Community Total Reported Damage

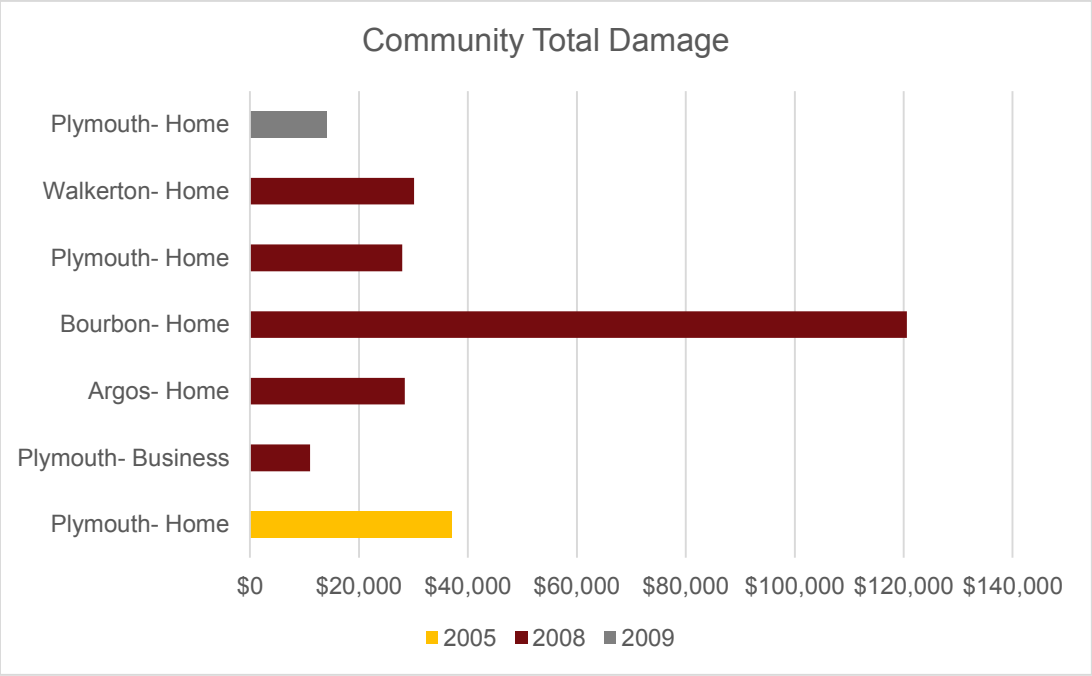


Table 4-10: SBA declaration reference

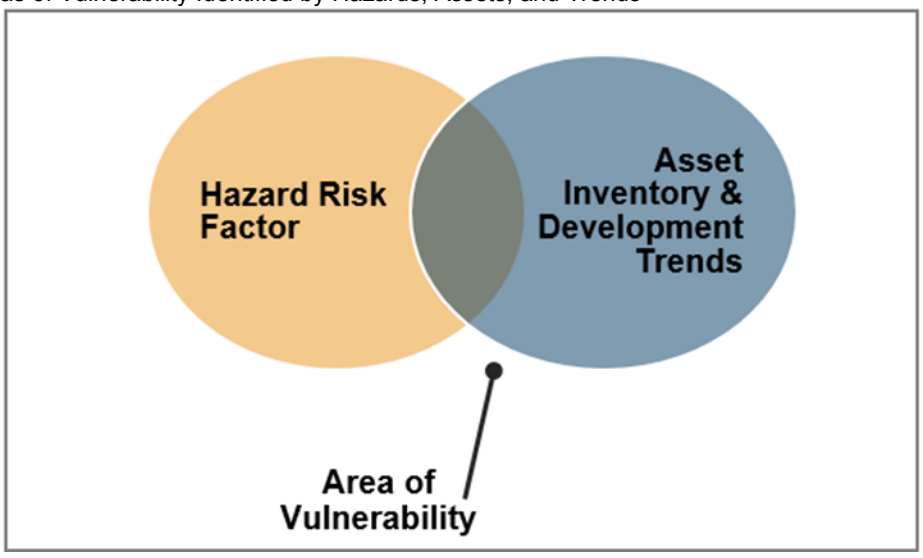
Year	FEMA Declaration	SBA Declaration	Community
2005	1573	10007	Plymouth
2008	n/a	11146	Bourbon
2008	1740	11160	Argos
2008	1740	11160	Plymouth
2008	1740	11160	Walkerton
2009	1832	11720	Plymouth
2005	1573	10007	Plymouth

Vulnerability Assessment

Asset Inventory

The vulnerability assessment builds upon the previously developed hazard information by identifying the community assets and development trends. Determining the hazard rank is pertinent to determining the area of vulnerability, as displayed in the following figure. The county infrastructure and facilities inventory are a critical part of understanding the vulnerability at risk of exposure to a hazard event.

Figure 4-4: Areas of Vulnerability Identified by Hazards, Assets, and Trends



The assets presented in the analysis results are a hybrid of the essential facilities updated by the county and the building inventory developed from the local assessor data. The facility features used the Department of Homeland Security in the Automated Critical Asset Management System (ACAMS) for guidance. Of the approximately 15 essential facilities, five are essential: schools, police and fire stations, emergency operation center (s) and medical facilities. For the purposes for

this analysis, medical facilities are a combination of numerous medical related layers (hospitals, long-term care/nursing homes, pharmacy, etc.) and are referred to in this analysis as Care Facilities. The remaining structures are related to the communities' infrastructure and utility management.

The local assessor parcel submitted to the Indiana Department of Local Government and Finance (IDLGF) are used to generate the data referred to as the Building Inventory. This data is classified as agricultural, commercial, education, government, industrial, religious/non-profit, and residential properties. The local assessor parcel submitted to the Indiana Department of Local Government and Finance (IDLGF) are used to generate the data referred to as the Building Inventory. This data is classified as agricultural, commercial, education, government, industrial, religious/non-profit, and residential properties. Parcels with improvements are used to inform the exposure analysis and are the source the structures, value, various attributes on the structures construction. Details on the steps of the building inventory development and maps on parcel attributes and facilities used in the overlay analysis are detailed in Appendix C.

Figure 4-5: Essential Facilities in Marshall County

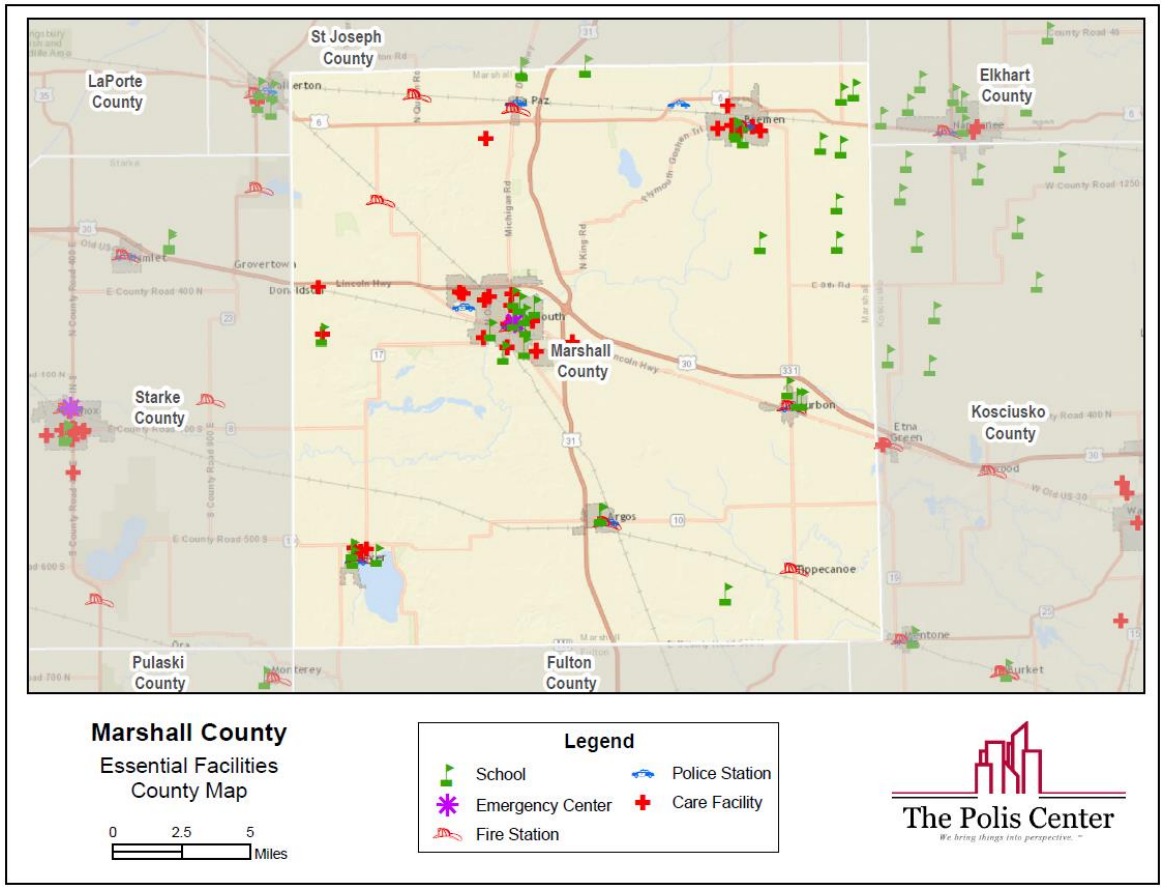
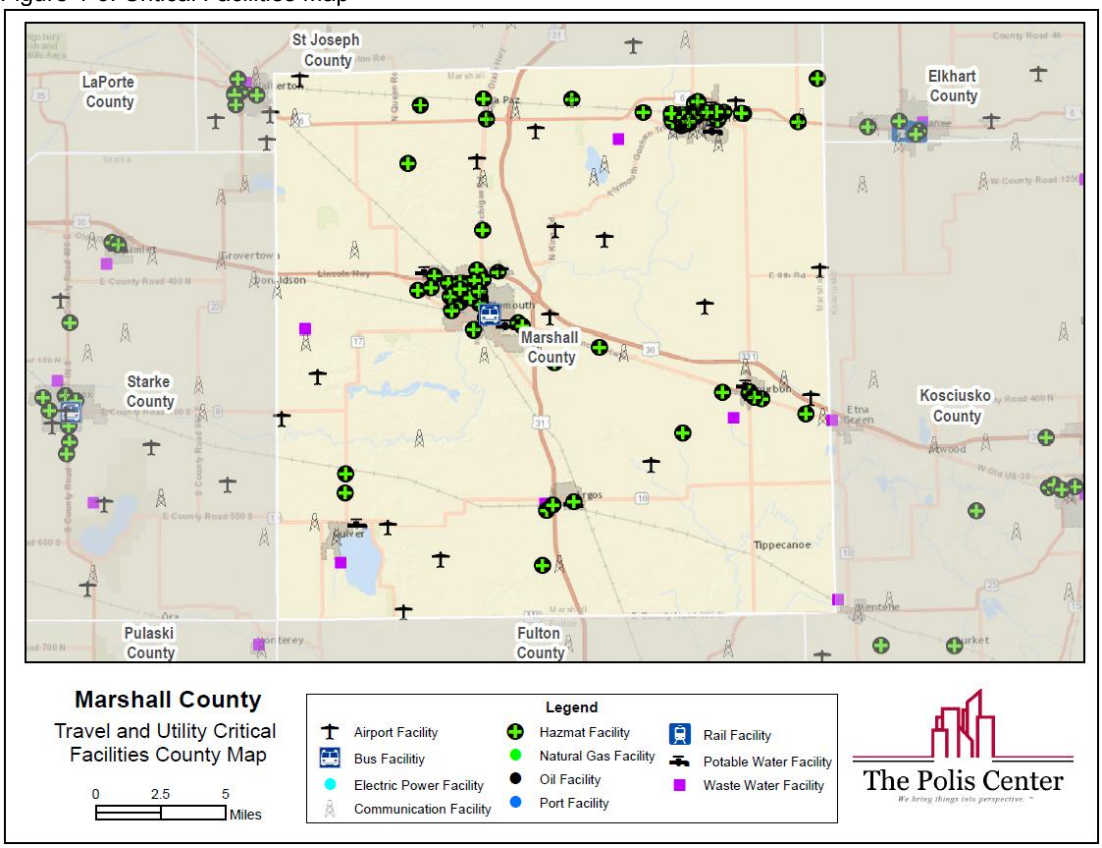


Figure 4-6: Critical Facilities Map



Facility Replacement Costs

Hazus-MH MR4 contains the base aggregated general building stock used for estimating building exposure. Hazus-MH MR4 contains aggregated general building stock updated to Dun & Bradstreet in 2014 and building valuations were updated to R.S. Means 2014. Building counts based on census housing unit counts are available for RES1 (single-family dwellings) and RES2 (manufactured housing) classifications instead of actual building counts. The total building exposure for Marshall County is identified in Table 4-11 along with the estimated number of buildings within each occupancy class. These counts and costs were derived from the county assessor and parcel data, versus the default Hazus general building stock. Exposure refers to the cost to rebuild the structure given the inputs of features such as foundation type, year, and condition. Details on the process to develop this data is provided in Appendix D.

Table 4-11: Marshall County Total Building Exposure

Occupancy Type	Estimated Total Buildings	Total Building Exposure ($)
Agricultural	13,469	$3,843,817,153
Commercial	7,616	$16,685,655,995
Education	260	$2,633,738,343
Government	1,161	$2,444,670,066
Industrial	1,006	$9,568,693,214
Religious/Non-Profit	1,927	$6,194,741,335
Residential	121,313	$30,778,451,510
Total	**146,752**	**$72,149,767,616**

GIS and Hazus-MH

FEMA's Pre-Disaster Mitigation (PDM) program is designed to provide assistance to local communities to develop and implement their hazard mitigation plan, thereby reducing risk to property and lives. The initial multi-hazard mitigation plan (MHMP) for Marshall County, Indiana was submitted to FEMA and approved in 2009. Existing Hazus-MH technology was used in the development of the vulnerability assessment for flooding and earthquakes. With the implementation of new technology and locally available parcel datasets, more accurate results are now available. Multi-hazard mitigation plan updates may document significant variances from the original MHMP.

For this analysis, Hazus-MH generated a combination of site-specific (flood) and aggregated loss (earthquake) estimates. Aggregate inventory loss estimates, which include building stock analysis, are based upon the assumption that building stock is evenly distributed across census blocks/tracts. With this in mind, total losses tend to be more reliable over larger geographic areas than for individual census blocks/tracts. Site-specific analysis based upon loss estimations for individual structures. For flooding, analysis of site-specific structures takes into account the depth of water in relation to the structure. Hazus-MH also takes into account the actual dollar exposure to the structure for the costs of building reconstruction, content, and inventory. Damages are based upon the assumption that each structure will fall into a structural class, and structures in each class will respond in a similar fashion to a specific depth of flooding. Site-specific analysis also is based upon a point location rather than a polygon; the model does not account for the percentage of a building that is inundated.

It is important to note that Hazus-MH does not a substitute for detailed engineering studies. Rather, it serves as a planning aid for communities interested in assessing their risk to flood,

earthquake, and hurricane-related hazards. This documentation does not provide full details on the processes and procedures completed in the development of this project.

Site-specific analysis is based upon loss estimations for individual structures. For flooding, analysis of site-specific structures takes into account the depth of water in relation to the structure. Hazus-MH also takes into account the acutual dollar exposure to the structure for the costs of building reconstruction, content, and inventory. However, damages are based upon the assumption that each structure will fall into a structural class, and structures in each class will respond in a similar fashion to a specific depth of flooding. Site-specific analysis is also based upon a point location rather than a polygon, therefore the model does not account for the percentage of a building that is inundated. These assumptions suggest that the loss estimates for site-specific structures as well as for aggregate structural losses need to be viewed as approximations of losses that are subject to considerable variability rather than as exact engineering estimates of losses to individual structures.

Future Development

Since Marshall County is vulnerable to a variety of natural hazards, the county government—in partnership with state government—must make a commitment to prepare for the management of these events. Marshall County is committed to ensuring that county elected and appointed officials become informed leaders regarding community hazards so that they are better prepared to set and direct policies for emergency management and county response.

The Marshall County Emergency Management Director will work to keep the jurisdictions covered by the Hazard Mitigation Plan engaged and informed during the plan's 5-year planning cycle. By keeping jurisdictional leaders actively involved in the monitoring, evaluation and update of the HMP, they will keep their local governments aware of the hazards that face their communities and how to mitigate those hazards through planning and project implementation. Each jurisdiction has identified mitigation strategies that they will seek to implement in their communities (see Appendix G: Mitigation Actions by Jurisdiction). Jurisdictions will include considerations for hazard mitigation in relation to future development when updating local comprehensive plans or other plans that may influence such development.

Hazard Profiles

4.1 Flash Flood and Riverine Flood

Hazard Description

Flooding is a significant natural hazard throughout the US. The type, magnitude, and severity of flooding are functions of the amount and distribution of precipitation over a given area, the rate at which precipitation infiltrates the ground, the geometry of the catchment, and flow dynamics and conditions in and along the river channel. Floods in Marshall County can be classified as one of two types: Flash floods or riverine floods. Both types of floods are common in Indiana.

Flash floods generally occur in the upper parts of drainage basins and are generally characterized by periods of intense rainfall over a short duration. These floods arise with very little warning and often result in locally intense damage, and sometimes loss of life, due to the high energy of the flowing water. Flood waters can snap trees, topple buildings, and easily move large boulders or other structures. Six inches of rushing water can upend a person; another 18 inches might carry off a car. Generally, flash floods cause damage over relatively localized areas, but they can be quite severe in the areas in which they occur. Urban flooding is a type of flash flood. Urban flooding involves the overflow of storm drain systems and can be the result of inadequate drainage combined with heavy rainfall or rapid snowmelt. Flash floods can occur at any time of the year in Indiana, but they are most common in the spring and summer months.

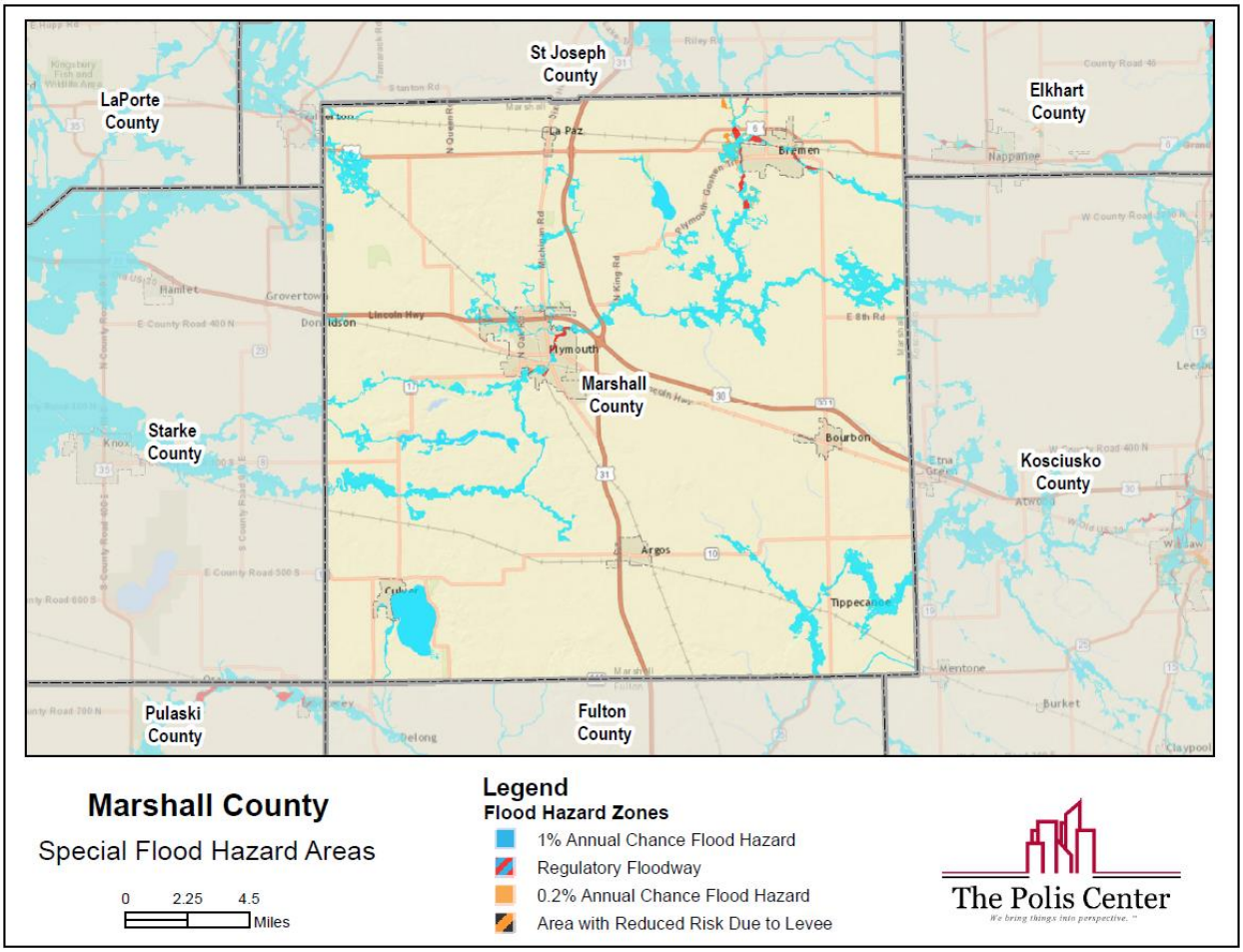
Riverine floods refer to floods on large rivers at locations with large upstream catchments. Riverine floods are typically associated with precipitation events that are of relatively long duration and occur over large areas. Flooding on small tributary streams may be limited, but the contribution of increased runoff may result in a large flood downstream. The lag time between precipitation and time of the flood peak is much longer for riverine floods than for flash floods, generally providing ample warning for people to move to safe locations and, to some extent, secure some property against damage. Riverine flooding on the large rivers of Indiana generally occurs during either the spring or summer.

The Special Flood Hazard Area (SFHA) are defined as the area that will be inundated by the flood event having a 1% chance of being equaled or exceeded in any given year. The 1% annual chance flood is also referred to as the base flood or 100-year flood. The Federal Emergency Management Agency (FEMA) provided the Digital Flood Insurance Rate Map (DFIRM) that identifies the

SFHA. Flood hazard scenarios were modeled using GIS analysis and Hazus-MH. The existing DFIRM maps were used to identify the areas of study. Planning team input and a review of historical information provided additional information on specific flood events.

If a structure is located in a high-risk area, the owner is required to purchase flood insurance if they have a mortgage through a federally regulated or insured lender. Flood insurance is not federally required in moderate- to low-risk areas, but it's still a good idea. In fact, people in these areas file more than 20 percent of all National Flood Insurance Program (NFIP) flood insurance claims. Most homeowners in moderate- to low-risk areas can get coverage at a reduced rate. Preferred Risk Policy (PRP) premiums, the lowest premiums available through the NFIP, offer building and contents coverage for one low price. If person does not qualify for a PRP, a standard-rated policy is still available. The map displays the published FEMA FIRM, which is the reference for the NFIP.

Figure 4-7: Special Flood Hazard Areas



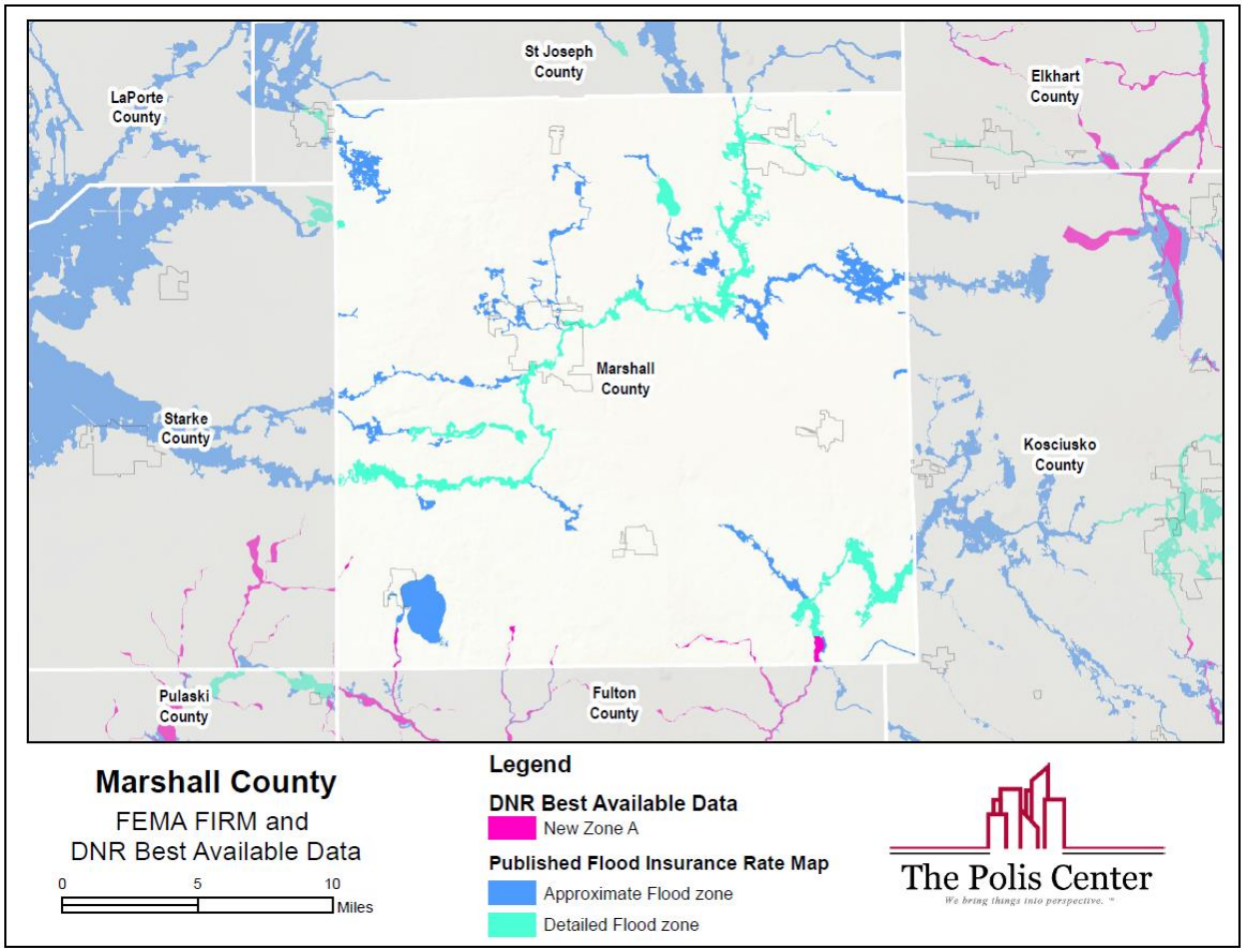
Best Available Data

The Indiana Floodplain Information Portal (INFIP) is a mapping application hosted by the IDNR. The website provides floodplain information to citizens and local officials, including floodplain data and flood elevation data for select streams. The portal displays the following floodplain layers: FEMA effective mapping (DFIRM), FEMA preliminary mapping and the IDNR Best Available Flood Hazards Areas.

The "Effective Special Flood Hazard Area" (Effective), is the National Flood Hazard Layer (NFHL) as published by FEMA. This map data is developed from Flood Insurance Rate Maps (FIRM) and Letters of Map Revisions (LOMR). The NFHL is the layer used in the Hazus-MH analysis. The preliminary mapping layer includes proposed NFHL data by FEMA.

The “Best Available Flood Hazard Area" (Best Available) includes the Effective mapping, as well as additional studies that have been approved by the IDNR. While this data has not yet been submitted to FEMA for inclusion in the NFHL, this data can be used for general planning, construction, and development purposes. These maps however, are not to be used for NFIP purposes. Figure 4-8 identifies the stream reaches that have Best Available SFHA data on the INFIP.

Figure 4-8: Marshall County Best Available Special Flood Hazard Areas



Flood History in Marshall County

According to the Marshall County Flood Insurance Study, the major flood problems in Marshall County are the overflow of the Yellow and Tippecanoe Rivers. The three largest recorded floods for the Yellow River occurred in October 1955, March 1982, and February 1985, with recurrence intervals greater than 1% annual chance for the floods of 1955 and 1982 and less than 1% annual chance for the flood of 1985. The three largest recorded floods for the Tippecanoe River occurred in April 1950, June 1981, and March 1982, with recurrence intervals of 4% annual chance for the flood of 1950 and less than 100 years for the floods of 1981 and 1982.

The City of Plymouth, Tippecanoe and German Township are prone to flooding. There have been 4 flood and 4 flash flood hazard events recorded in the hazard recorded data provided by the NWS and NOAA, from 1965-2016. A list of the hazard event dates, deaths, injuries, property damage are listed in Appendix C.

Plymouth has faced two record flash flood events, both on July 18, 2007. The 2007 event recorded $15,000 in damaged, which resulted in several roads were closed in the southern part of the county by flowing water around 1 foot deep. The 2015 event recorded 2.47 inches of rain in 1.5 hours and resulted in extensive road flooding in Plymouth.

The January 2008 was a result of an unseasonable moist atmosphere and slow moving cold front. The existing dense snowpack rapidly melted because of the warm temperatures and rainfall, resulting in several county and some city roads experienced high water on them for a few days which resulted in $150,000 in reported damage. Low areas, ditches and creeks exceeded capacity from one to three inches of rain. Residences in and around Plymouth as a result of flood waters.

The March 2009 event resulted in $300,000 in damage, as a result of averaged between two and four inches in many locations. The Yellow River came out of its banks, cresting around 14.2 feet, which 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.

The June 2015 rainfall brought flooding to many counties during a couple day period where on average, three to five inches of rain fell, often in a few hours. This rainfall occurred over already saturated ground from recent rains over the past couple of weeks. Numerous reports of high water and general flooding throughout Plymouth, with several inches of standing water. Other reports of high water were reported throughout the county, especially in the Tippecanoe area.

Figure 4-9: Historic Rainfall Figure from Tribune on August 15-16, 2016

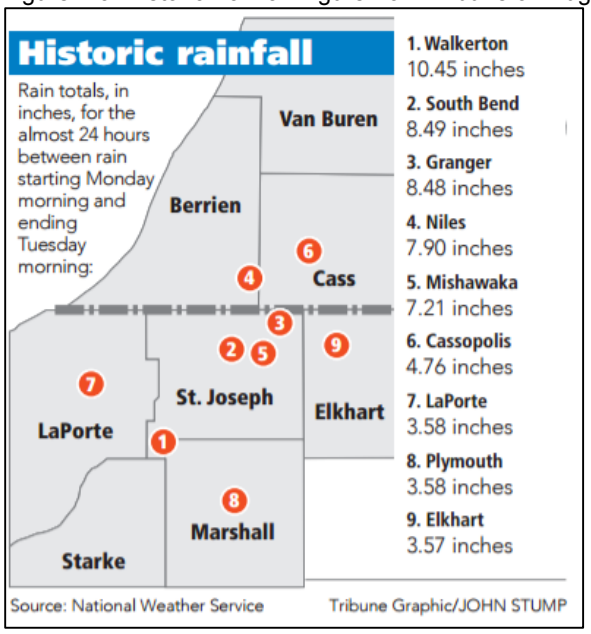


Figure 4-10: Plymouth Residential Flooding, August 15-16, 2016

Figure 4-11: Flooding Plymouth, June 2015

Stream gages

The USGS in cooperation with many state agencies and local utility and surveyor offices help maintain stream gages, which provide the capability to obtain estimates of the amount of water flowing in streams and rivers. Most USGS stream gages operate by measuring the elevation of the water in the river or stream and then converting the water elevation (called 'stage') to a streamflow ('discharge') by using a curve that relates the elevation to a set of actual discharge measurements. For many of the public freshwater lakes in northern Indiana, local and state partners utilize staff gages, which dictate the location of the last visit.

The DNR and IDEM utilize the stream gage data for water quantity and quality measurements. Local public safety officials utilize the data at these sites, along with the resources from the NWS, to determine emergency management needs during periods of heavy rainfall. There are two gages in the county, including the Yellow River at Plymouth and a recently removed gage near Bremen.

The figure below shows the locations of these gages and the available NCDC Weather Stations. The tables then display the top 10 gage events.

Figure 4-12: USGS Stream Gages and NCDC Weather Stations

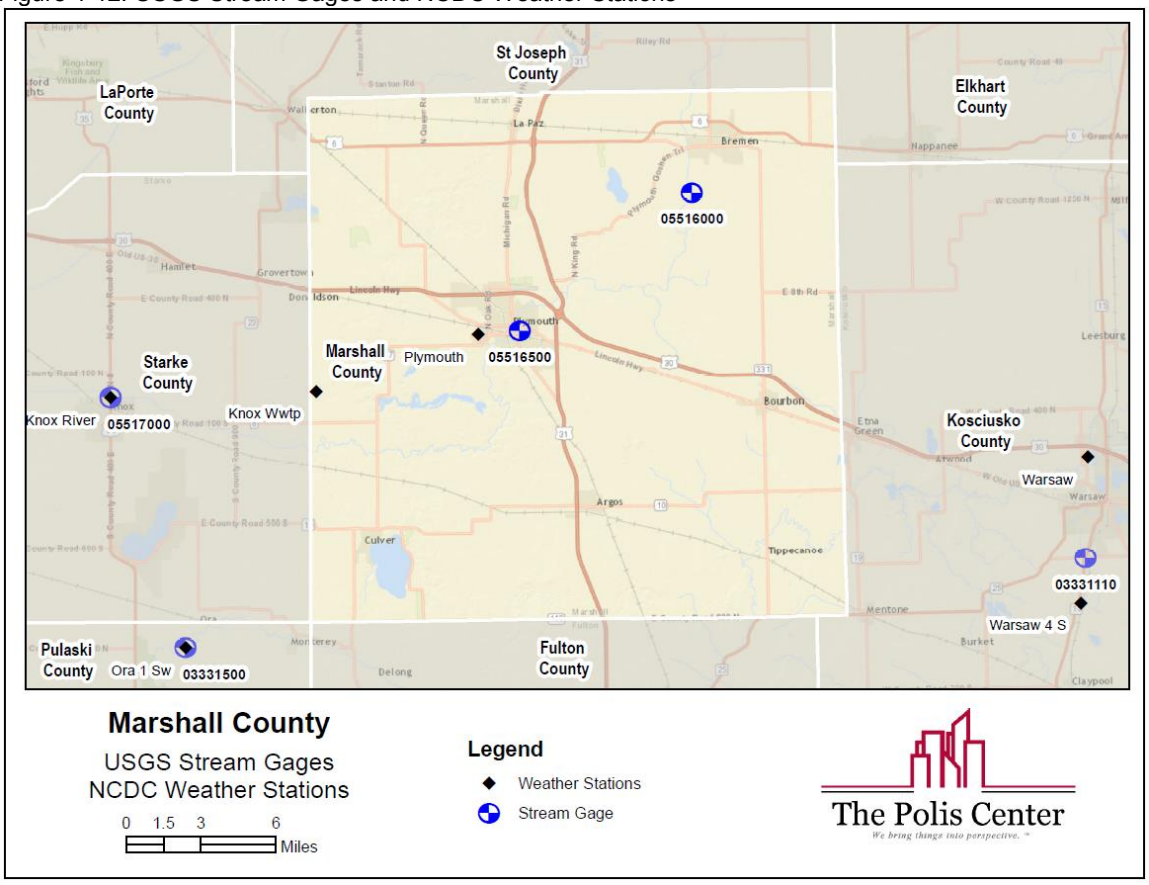


Table 4-12: Peak Streamflow at 05516500 Yellow River at Plymouth, IN

Date	Gage Height	Stream flow
Oct. 12, 1955	17.13	5,390
Mar. 16, 1982	16.37	4,730
Feb. 26, 1985	15.68	3,920
Jan. 01, 1991	15.3	3,930
Jan. 10, 2008	15.13	4,010
Mar. 24, 1978	15.01	3,380
Mar. 12, 2009	14.68	3,420
Jan. 15, 2005	14.57	3,350
Feb. 12, 2001	14.28	3,170
Jan. 06, 1993	14.25	3,200

Utilizing the data provided by the stream gage, the City of Plymouth also has a Flood Inundation Map developed for the Yellow River. This 4.9 mile stretch of the Yellow River can be accessed

through the USGS Flood Inundation Mapping Science Web site at http://water.usgs.gov/osw/flood_inundation/, depict estimates of the areal extent and depth of flooding corresponding to selected water levels (stages) at the USGS stream gage 05516500, Yellow River at Plymouth, Ind. This was initiative was in cooperation with the Indiana Office of Community and Rural Affairs.

Vulnerability and Future Development

There has been some channel cleaning in the past. Within the study, areas of the county there are no flood control reservoirs, dams, or flood control projects planned to provide protection from the effects of a 1 % chance flood. There are, however, numerous structures in the areas studied which could have significant effects on the floods of lower magnitudes.

Flash flooding may affect nearly every location within the county; therefore, all buildings and infrastructure are vulnerable to flash flooding. Currently, the Marshall County planning commission reviews new development for compliance with the local zoning ordinance.

Areas with recent development within the county may be more vulnerable to drainage issues. Storm drains and sewer systems are usually most susceptible. Damage to these can cause the back up of water, sewage, and debris into homes and basements, causing structural and mechanical damage as well as creating public health hazards and unsanitary conditions.

Controlling floodplain development is the key to reducing flood-related damages. Marshall County also seeks to protect numerous areas of environmental sensitivity—for example, riparian areas, wetland areas, and woodlands. These areas serve as wildlife habitats, provide natural filtration of water, and recharge underground aquifers; examples include the Yellow River, Lake of the Woods, and the Menominee Wetlands. The county plans to develop and implement zoning ordinances to prohibit future development in conservation and floodplain areas.

Residents that have suffered damage to their home or business from recent flooding should contact the Building Department or 311 to schedule a storm damage assessment visit.

In addition, depending on a property's location, a permit may be required from the Indiana Department of Natural Resources prior to the start of any reconstruction activity. Failure to obtain the necessary permits could result in fines. For more information on the local permitting requirements, please contact:

Marshall County Building Department
112 W. Jefferson Street Room 302
Plymouth, Indiana 46563
(574) 935-8531

The Marshall County Drainage Ordinance was adopted on April 4, 2011 and provides the county with guidance for the development and management of sewers and streams. Recognizing that smaller streams and drainage channels serving Marshall County may not have sufficient capacity to receive and convey water runoff, it is the policy of the Marshall County Commissioners that the storage and controlled release of storm water runoff shall be required of all new development, any redevelopment and other new construction in Marshall County. The release rate of storm water from developed, lands shall not exceed the release rate from the land area in its present land use. Furthermore, the Storm Water Drainage Ordinance Marshall County, Indiana states, "Because topography and the availability and adequacy of outlets for storm runoff vary with almost every site, the requirements for storm drainage tend to be an individual matter for any project. It is recommended that each proposed project be discussed with the Marshall County Surveyor and Plan Director at the earliest practical time in the planning stage."

In Plymouth, Philip Gaul, City of Plymouth Director of Public Works and City Engineer, oversees the city's public works and storm water management services and initiatives and reviews streets for problem areas.

For all new development, Marshall County's Zoning Ordinance requires that all land owners be responsible for adequate surface water drainage on any parcel used for any purpose other than agricultural cultivation. For retention, detention, and pond edges, the ordinance requires a buffer within twenty feet of the point of peak elevation. The development standards laid out in the zoning ordinance include the flowing measures for addressing surface water concerns.

Risk Analysis

User Input

Since accurate, published floodplain mapping can be difficult to manage on top of development the FIRM analysis may not always be suffice in understanding the flood exposure. In addition, the FIRM analysis, the Best Available Data can produce an improved assessment of more streams.

The original Marshall County plan identified two areas of vulnerability, which were located outside of the mapped Special Flood Hazard Area. Since these areas were in distinct locations, they have been mapped separately in Figures 4-13 and 4-14 and show are shown in relation to incorporated communities. Beginning with figure 4-15, locations of existing flooded areas, roads, and intersections have been compiled by EMA directors and provided to IDHS.

Figure 4-13: Unmapped Flooding Between Argos and Bourbon

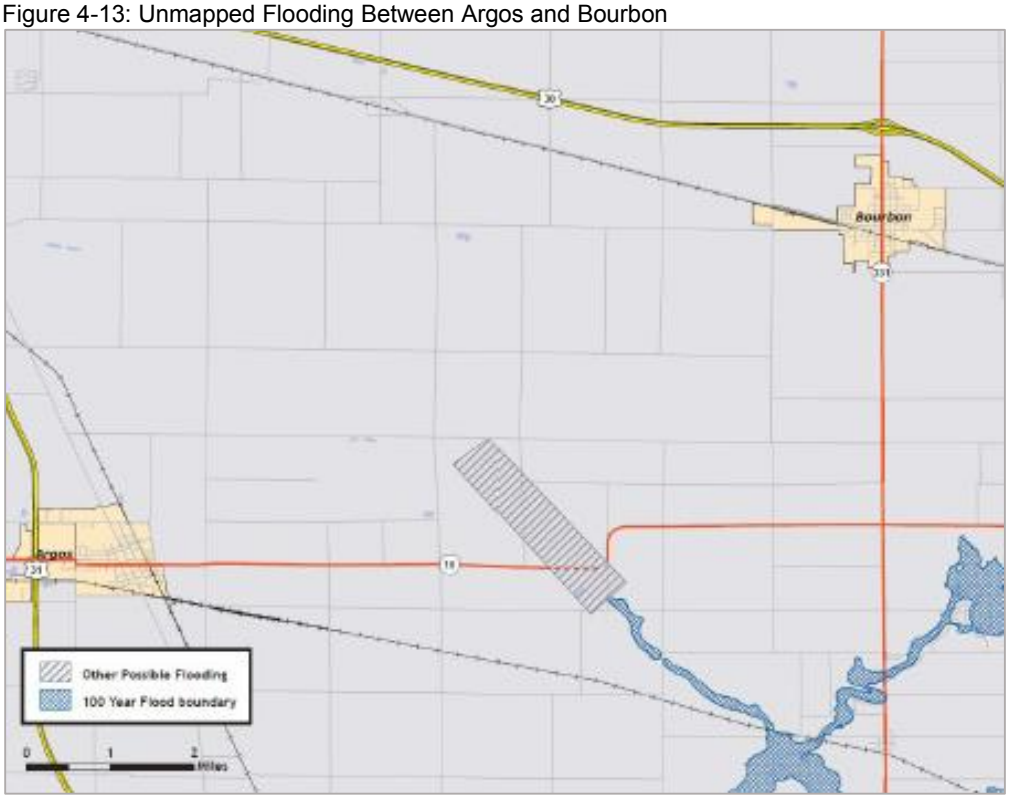


Figure 4-14: Unmapped Flooding West of Bremen

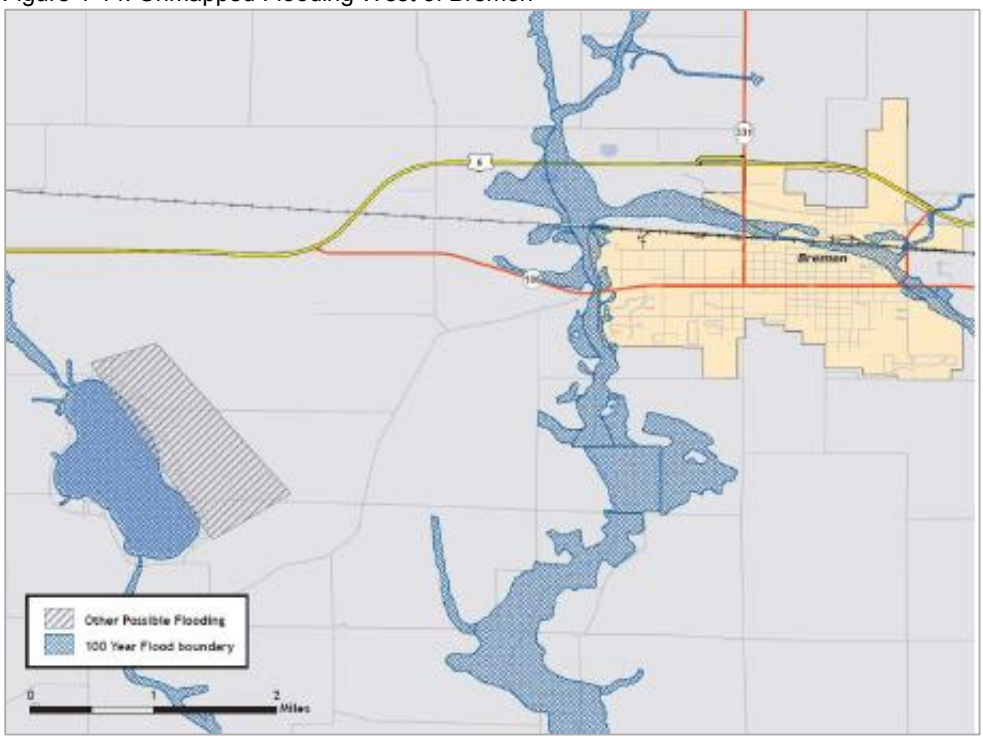


Figure 4-15: Flooded Intersections and Road Areas

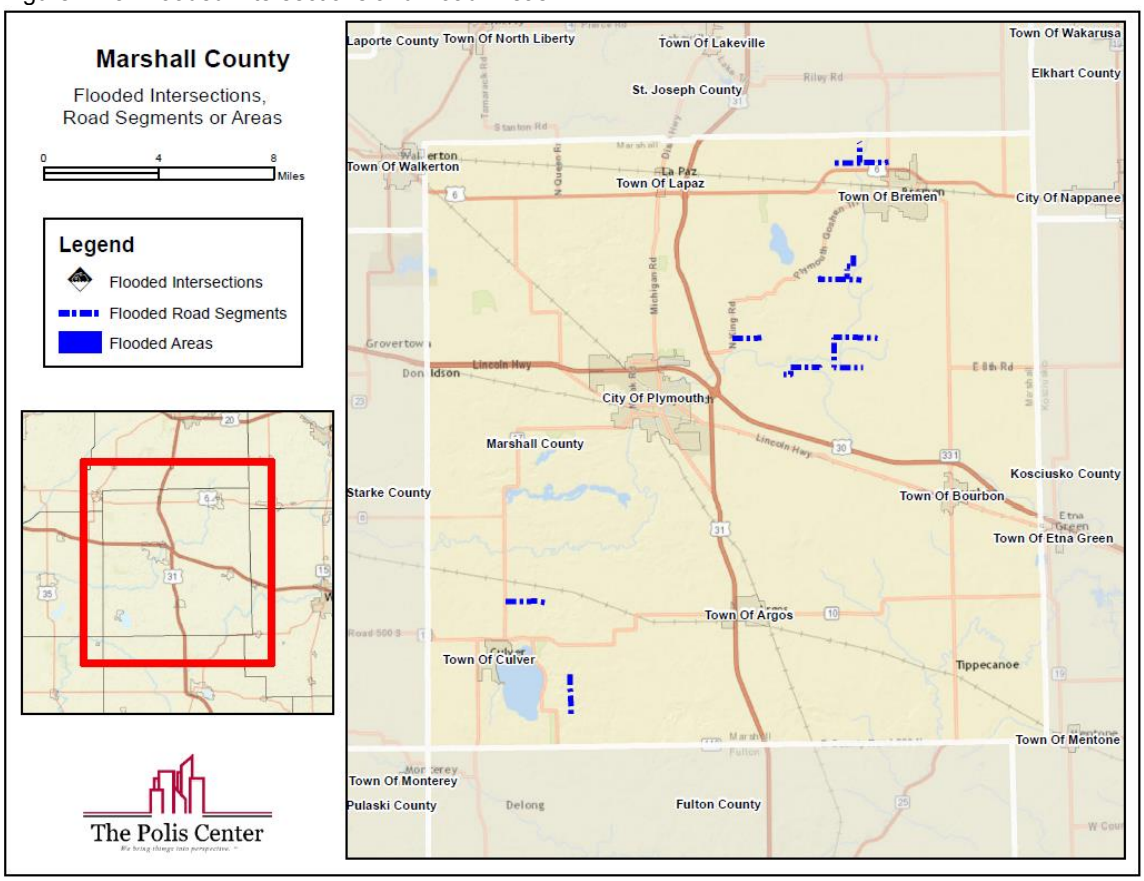


Figure 4-16: Local input Flooded Roads East of Culver

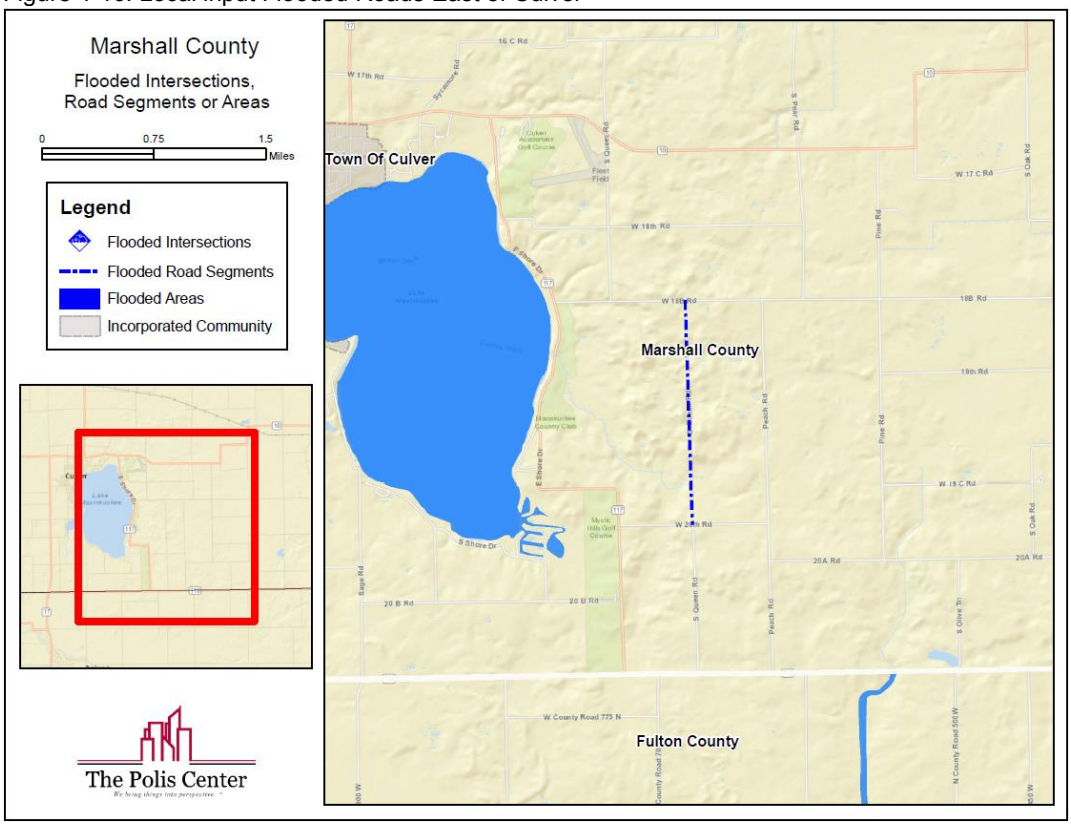


Figure 4-17: Local input Flooded Roads North of Culver

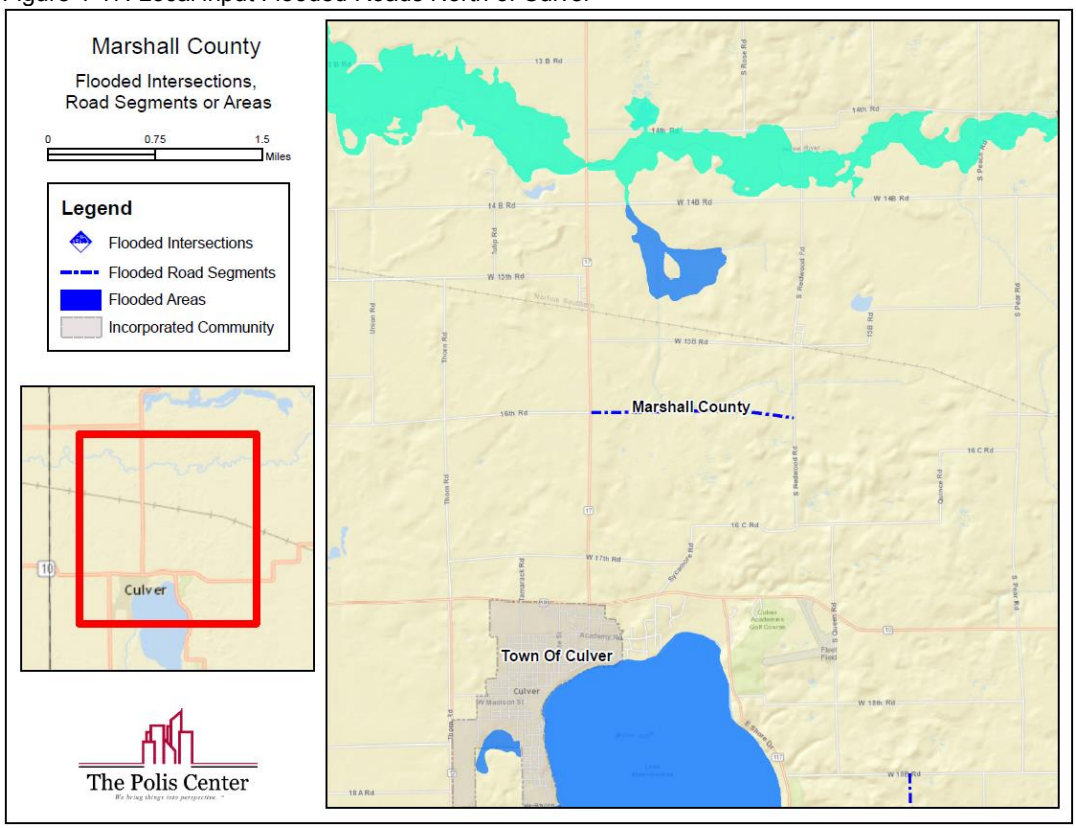


Figure 4-18: Local input Flooded Roads East of Plymouth

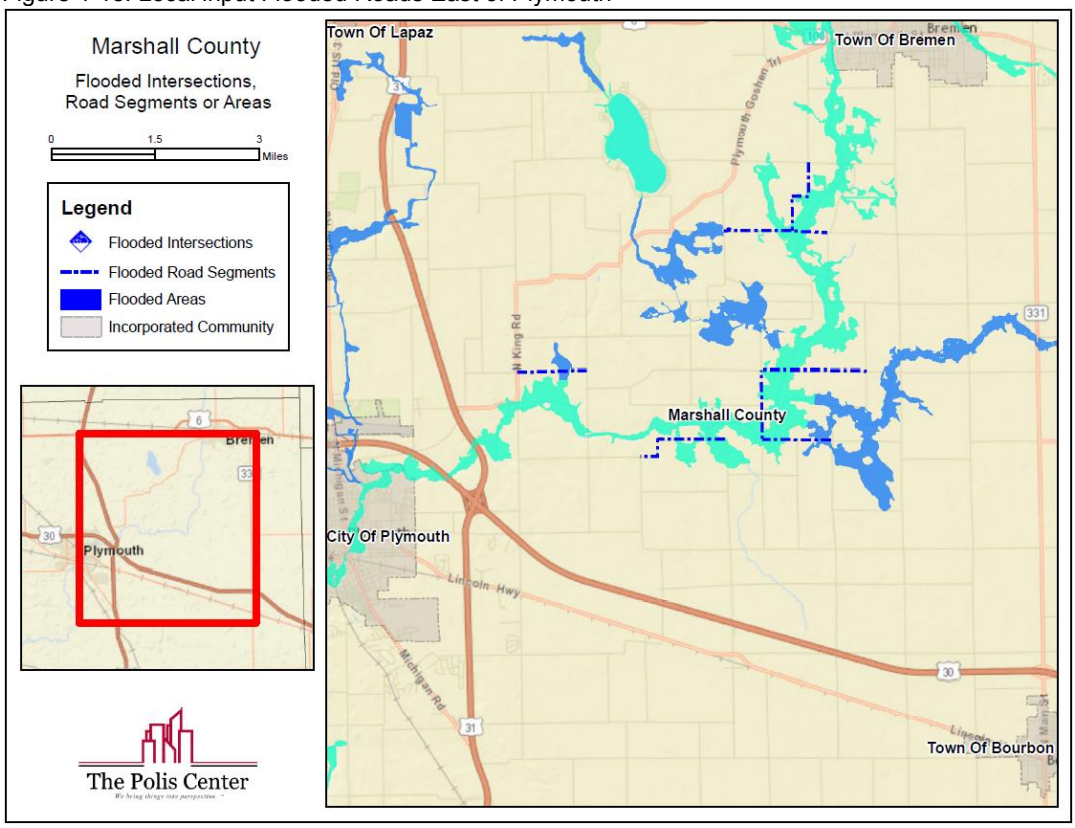


Figure 4-19: Local input Flooded Roads South of Bremen

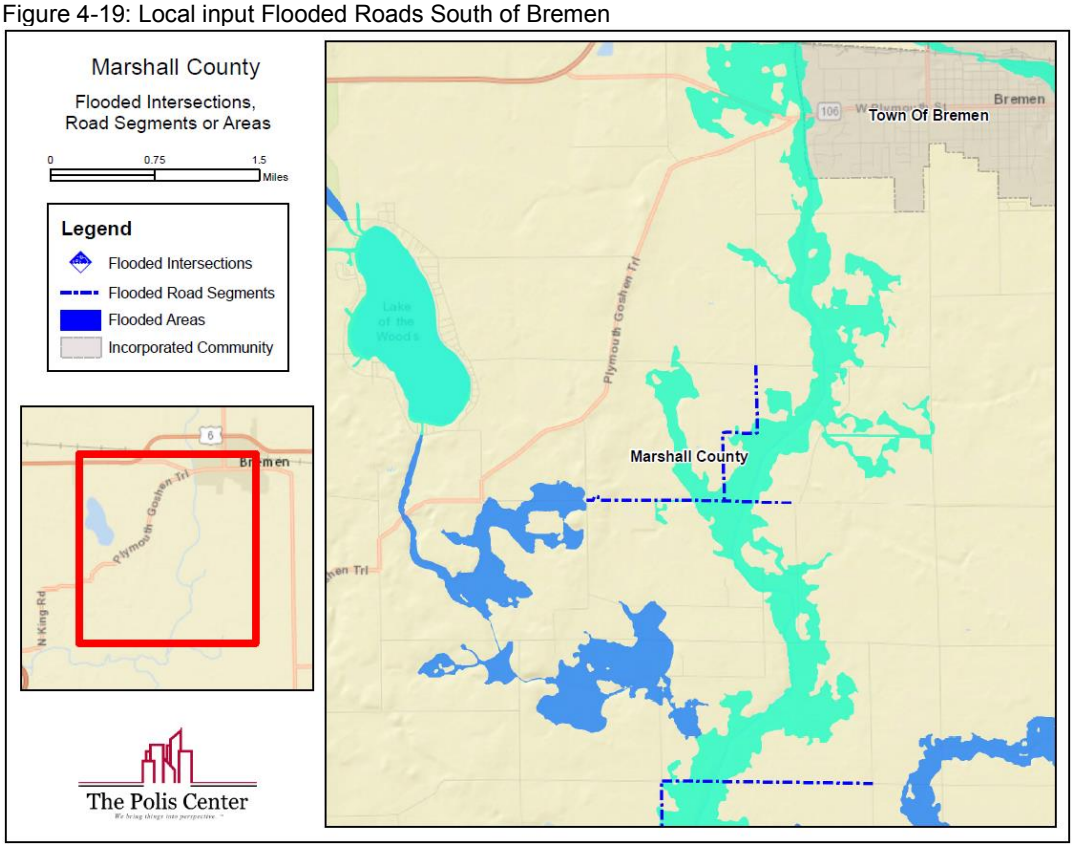
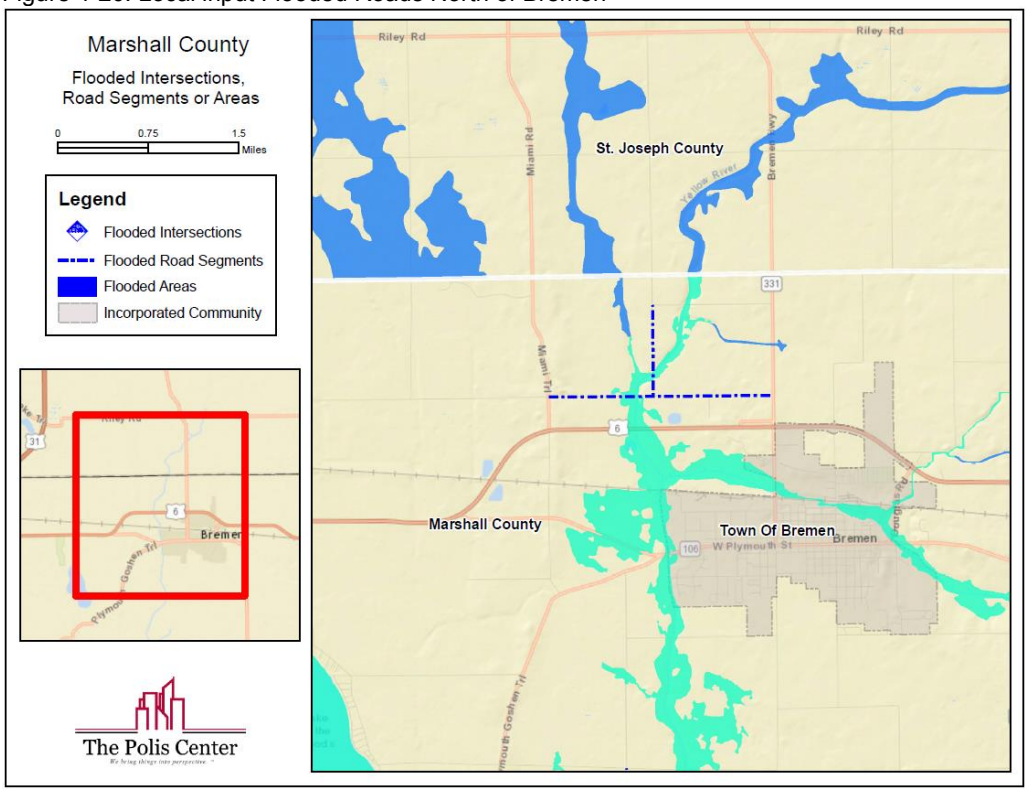


Figure 4-20: Local input Flooded Roads North of Bremen



Along with existing locations of flooding problems, the DNR tracks permit and floodplain requests. This can be an indication of locations of development or potential mapping problems. The following maps display the requests handled by the DNR from 2006 to 2016.

Figure 4-21: DNR Construction Requests

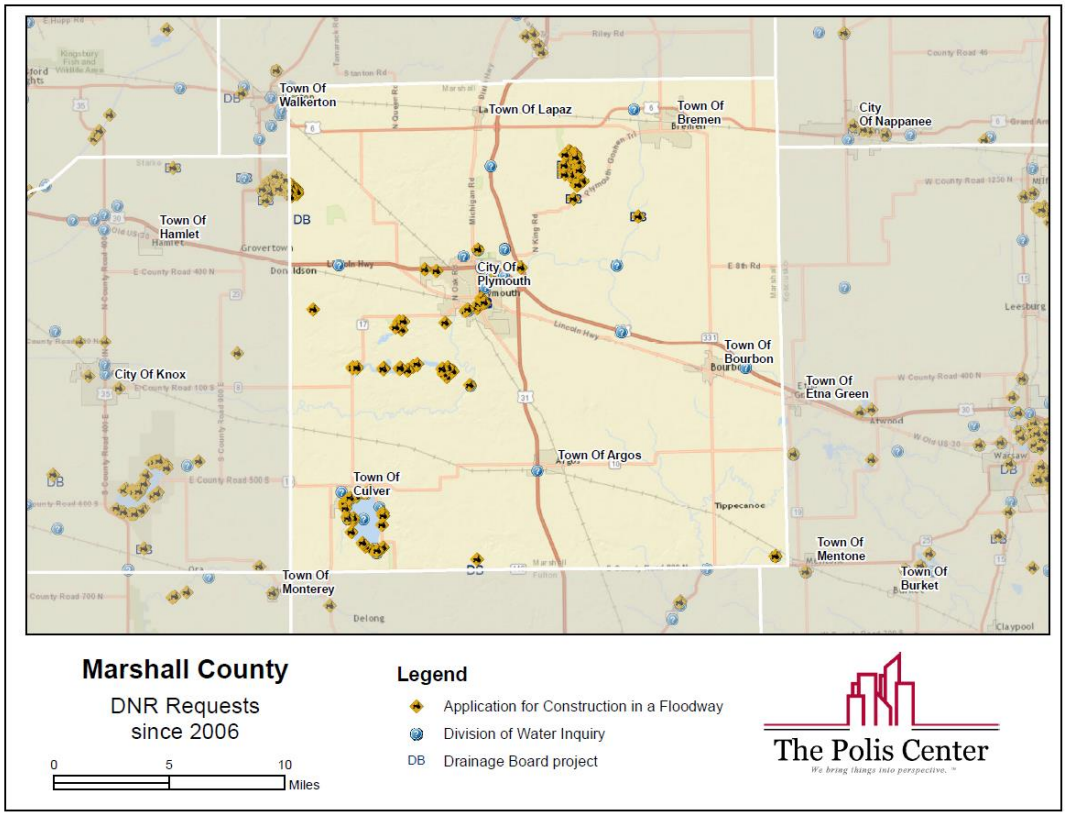
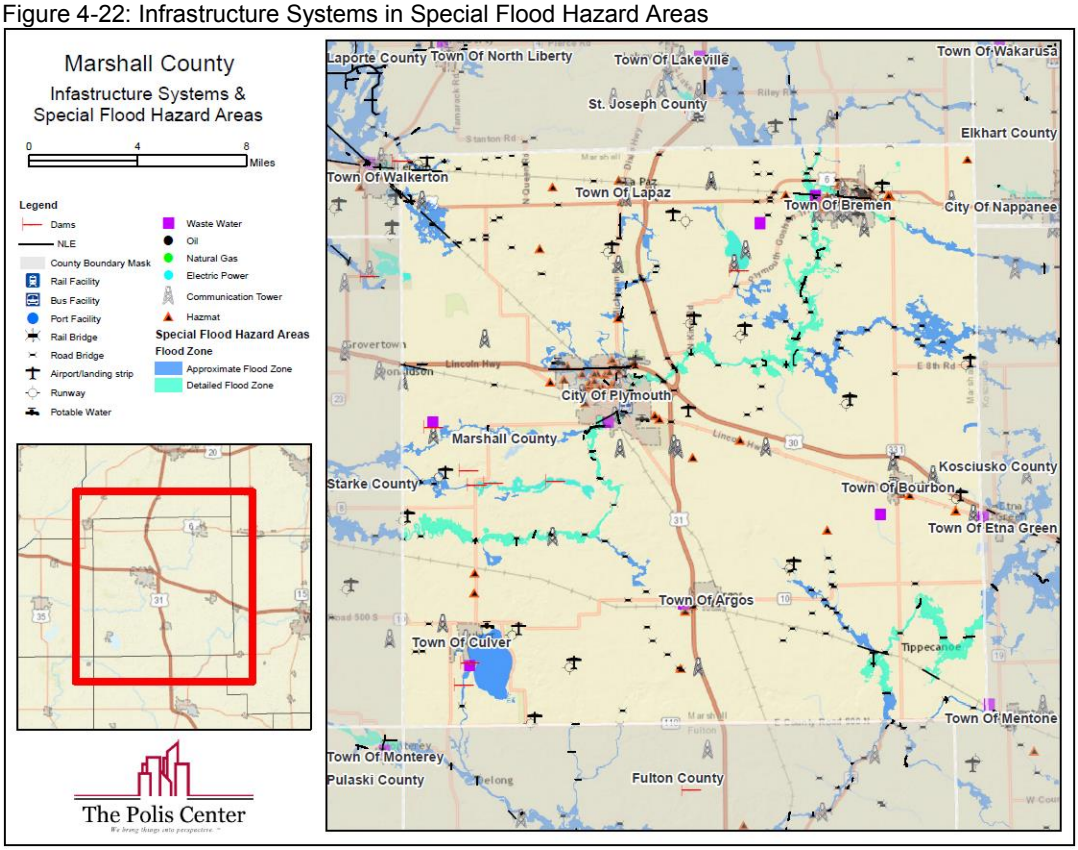


Figure 4-22: Infrastructure Systems in Special Flood Hazard Areas

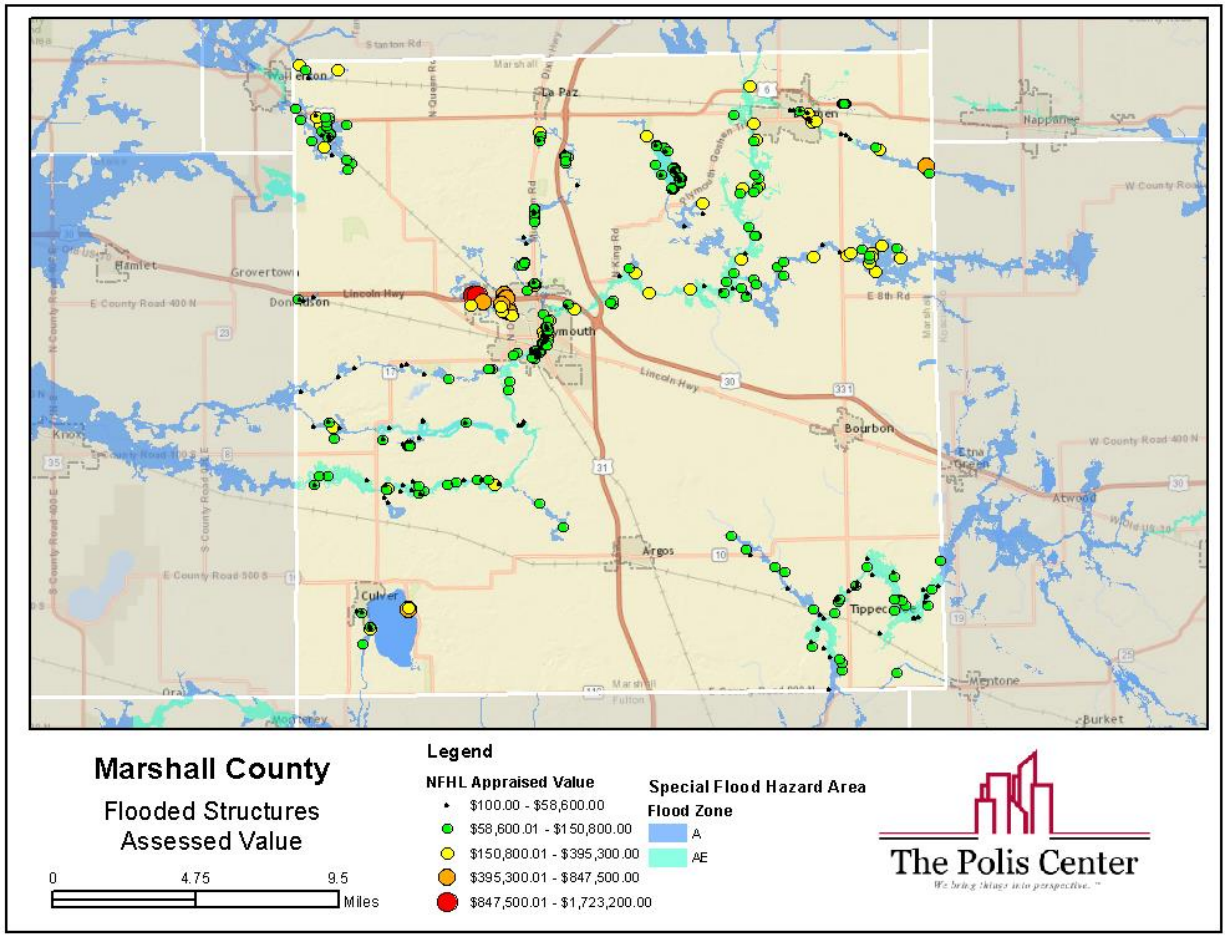


Exposure Analysis

An exposure analysis identifies the existing and future assets located in identified hazard areas, often by using GIS for analysis and maps for visualization. Exposure analysis can quantify the number, type, and value of structures, critical facilities, and infrastructure located in identified hazard areas, as well as assets exposed to multiple hazards. The analysis also can take into account the magnitude of the flood frequency area (1% annual flood, AE/Floodway and 0.2% annual flood risk).

Below the team has analyzed the structures within each community in the number 1% annual chance flood is considered a high-risk area as well as presented the appraised values for these structures.

Figure 4-23: Flooded Structures Assessed Value



Further analysis is provided on the Best Available mapping layers, which are provided by DNR for floodway references but are not to be used for flood insurance determinations. A list of all

infrastructure systems and the floodplains are located in the appendix. The following tables present the total identified structures within the type of published special flood hazard area. The first table compares the totals of Zone A and Zone AE number of structure and the total appraised value. Zone A areas, are in locations where published elevation have not been established by FEMA. Zone AE areas have a floodway identified on the FIRM map along with an associated Floodway Data table and flood profile for Base Flood Elevation (BFE) reference for local floodplain permitting. The second table then combines the total structures and appraised value and further identifies the structures located within the Zone AE/Floodway. These structures are located in areas where fast moving floodwaters as opposed to pooling.

Table 4-13: Structures in Zone A or AE Appraised Value

	Zone A		Zone AE	
	Total Structures	Appraised Value	Total Structures	Appraised Value
Marshall County	152	$27,022,540	163	$11,721,500
Town of Bremen	-	-	4	$603,130
Town of Culver	8	$443,660	-	-
City of Plymouth	15	$9,589,290	29	$1,711,530

Source: Marshall County 2016 secured roll assessor and parcel date; Marshall County DFIRM, January 2011.

Table 4-14: Structures in Floodway and Zone A/AE Appraised Value

	Zone AE/Floodway		Zone AE + Zone A = Total	
	Total Structures	Appraised Value	Total Structures	Appraised Value
Marshall County	8	$594,100	315	$11,721,500
Town of Bremen	8	$749,490	4	$603,130
Town of Culver	-	-	8	$38,744,040
City of Plymouth	40	$2,506,820	44	$11,300,820
Total	**56**	**$3,850,410**	**367**	**$62,369,490**

Source: Marshall County 2016 secured roll assessor and parcel date; Marshall County DFIRM, June 2017.

The following table presents the total number of parcels located within the Best Available and Published FIRM mapping zones.

Table 4-15: Parcel Total Counts in FIRM and BAD

	Total Parcels			
	Published FIRM		**Best Available Data**	
	Zone A/AE	Zone X	Zone A/AE	Zone X
Marshall County	3,169	22,682	3,477	22,679
Town of Bremen	115	2,583	115	2,583
Town of Culver	54	1,277	86	1,280
City of Plymouth	708	5,524	708	5,254
Town of Argos	-	1,132	-	1,132
Town of Bourbon	-	1,021	-	1,021
Town of La Paz	-	474	-	474
Total	**4,061**	**34,568**	**4,409**	**34,567**

Source: Marshall County 2016 secured roll assessor and parcel date; DFIRM- 2011, BAD- June 2017.

The total structures in the Special Flood Hazard Area are based on approximate building locations; therefore, it should not be used as an absolute comparison although this information may still be used to further mitigation through encouraging engagement with the NFIP. Additionally, this may serve as a tool to help determine if there would be an interest in becoming involved in a discount program with the Community Rating System (CRS).

Table 4-16: Community Structure Count and Number of Policies

	Structures in Zone A/AE	Number of Policies
Marshall County	315	50
Town of Bremen	4	5
Town of Culver	8	1
City of Plymouth	44	30
Total	**367**	**86**

Source: Marshall County 2011 FIRM; FEMA Indiana NFIP report, June 2017.

Historical Analysis

A historical analysis can be helpful to understand the impacts and losses from previous hazard events to protect from similar future events. A repetitive loss property: an NFIP insured structure that has had at least two paid flood losses of more than $1,000 each in any 10-year period since 1978.

FEMA Region V was contacted to determine the type of repetitive loss structures and their location. Severe repetitive loss properties single or multifamily residential properties that are covered under an NFIP flood insurance policy and:

1. That have incurred flood-related damage for which 4 or more separate claims payments have been made, with the amount of each claim (including building and contents payments) exceeding $5,000, and with the cumulative amount of such claims payments exceeding $20,000; or

2. For which at least 2 separate claims payments (building payments only) have been made under such coverage, with cumulative amount of such claims exceeding the market value of the building.

3. In both instances, at least 2 of the claims must be within 10 years of each other, and claims made within 10 days of each other will be counted as 1 claim.

The City of Plymouth has 18 residential repetitive loss properties, including; 12 single family homes and 3 non-residential properties. These non-mitigated loss properties have amounted in building payments of $422,762 totaling 60 losses. There have been 4 mitigated single family homes in Plymouth. There were no other repetitive loss properties in the county.

Continued NFIP compliance is an important cornerstone of mitigation. The NFIP program and flood insurance policies provide tools for communities to mitigate their own flood risks. The mitigation staff is committed to promoting NFIP compliance and preventing structure's from being built in harm's way. Total community losses and payments are identified in Table 4-19.

Table 4-17: Community Loss and Payments Totals

NFIP Community	Total Losses	Closed without Payment	Total Payments
Marshall County	7	2	$7,628
Town of Bremen	1	1	$0
Town of Culver	1	0	$26,200
City of Plymouth	158	20	$778,610
Total	**167**	**23**	**$812,438**

A FEMA-approved MHMP is required in order to apply for and/or receive project grants under the Hazard Mitigation Grant Program (HMGP), Pre-Disaster Mitigation (PDM), Flood Mitigation Assistance (FMA), and Severe Repetitive Loss (SRL). FEMA may require a MHMP under the Repetitive Flood Claims (RFC) program. Although the Marshall County MHMP meets the requirements of DMA 2000 and eligibility requirements of these grant programs, additional detailed studies may need to be completed prior to applying for these grants.

FEMA provides annual funding through the National Flood Insurance Fund (NFIF) to reduce the risk of flood damage to existing buildings and infrastructure. These grants include Flood Mitigation Assistance (FMA), Repetitive Flood Claims (RFC), and the Severe Repetitive Loss (SRL)

program. The long-term goal is to significantly reduce or eliminate claims under the NFIP through mitigation activities.

FEMA defines a repetitive loss structure as a structure covered by a contract of flood insurance issued under the National Flood Insurance Program (NFIP), which has suffered flood loss damage on two occasions during a 10-year period that ends on the date of the second loss, in which the cost to repair the flood damage is 25% of the market value of the structure at the time of each flood loss.

Combining Available Data and Methods

Hazus-MH was used to estimate the damages incurred for a 1% annual chance flood event in Marshall County using a Q3 and a 10-meter DEM (digital elevation model) to create a flood depth grid. Hazus-MH was used to generate a flood depth grid for a 1% annual chance food return period based upon the DFIRM boundary and a 1/3 ArcSecond DEM provided by the Indiana Geological Survey. Hazus-MH was then used to perform a user-defined facility analysis of Marshall County. This was accomplished by creating points representing building locations that were generated from IDLGF-provided assessor data linked to parcel data provided by the county (through IDHS and IndianaMap). These data were then analyzed to determine the depth of water at the location of each building point and then related to depth damage curves to determine the building losses for each structure.

Marshall County specific building data was sourced from the parcel tax databases and building location point databases included building valuations and occupancy class. Building counts were aggregated from the individual parcel records to the relevant census administrative boundaries.

Hazus-MH estimates the Special Flood Hazard Areas would damage 458 buildings county-wide at a cost of $27.9 million. In the modeled scenario Plymouth sustained the most damage with 106 buildings damaged at a cost of $14.1 million. The total estimated numbers and cost of damaged buildings by community are given in Tables 4-18 and 4-19. Figure 4-24 depicts the Marshall County buildings that fall within the SFHA. Figures 4-24 through 4-27 highlight damaged buildings within the floodplain areas in each flood prone community.

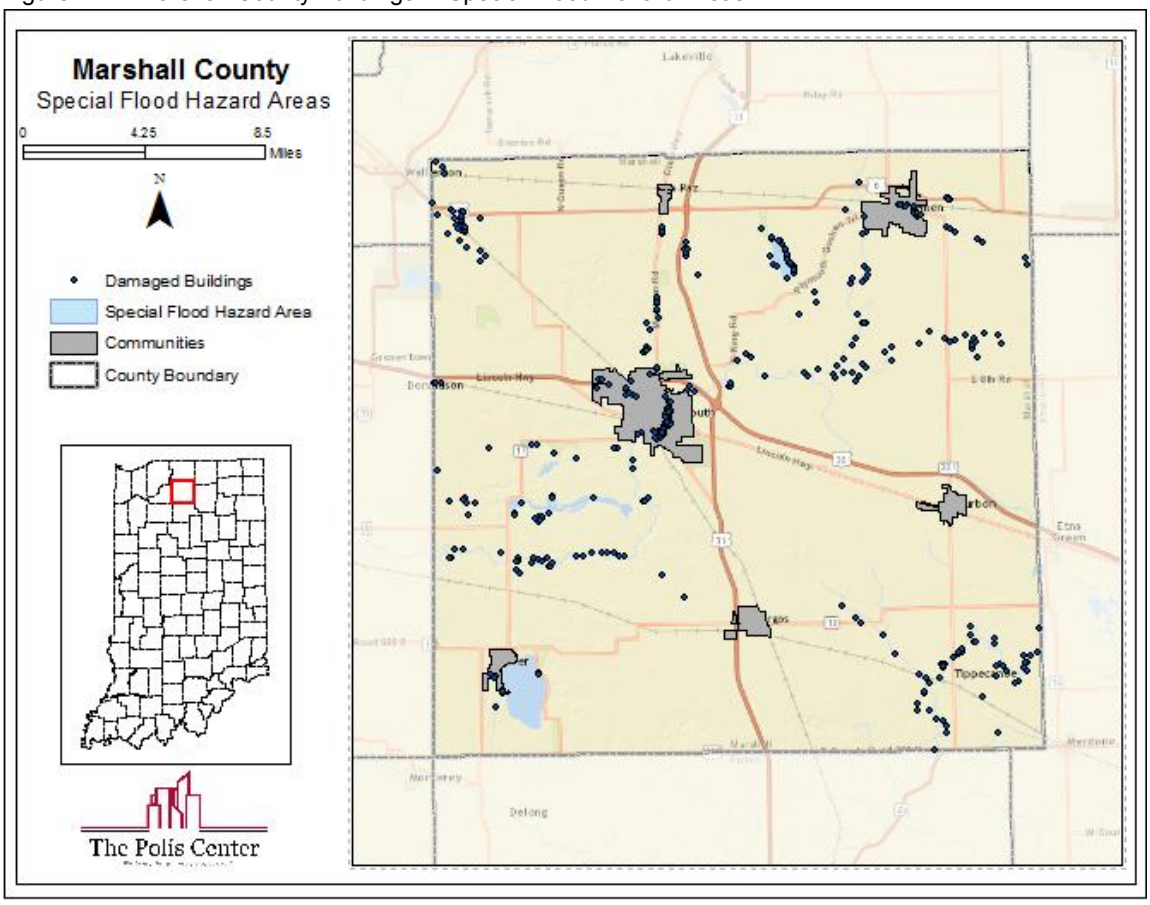
Table 4-18: Number of Buildings Damaged by Community and Occupancy Class

Community	Total Buildings Damaged	Building Occupancy Class						
		Agriculture	Commercial	Educ.	Govt.	Industrial	Religious	Residential
Marshall Co. (unincorporated)	327	92	5	0	1	2	2	225
Bremen	17	0	5	0	2	3	0	7
Culver	8	0	0	0	1	0	0	7
Plymouth	106	0	24	0	21	7	6	48
Total	**458**	**92**	**34**	**0**	**25**	**12**	**8**	**287**

Table 4-19: Cost of Buildings Damaged by Community and Occupancy Class

Community	Cost Buildings Damaged	Building Occupancy Class						
		Agriculture	Commercial	Educ.	Govt.	Industrial	Religious	Residential
Marshall Co. (unincorporated)	$11,879,966	$1,932,513	$693,029	$0	$693,029	$3,602	$10,807	$8,776,849
Bremen	$1,672,750	$0	$564,355	$0	$280,755	$583,989	$0	$243,650
Culver	$334,631	$0	$0	$0	$17,542	$0	$0	$317,089
Plymouth	$14,106,240	$0	$3,473,457	$0	$2,213,825	$5,381,958	$1,481,898	$1,555,100
Total	**$27,993,589**	**$1,932,513**	**$4,730,842**	**$0**	**$2,975,287**	**$5,969,550**	**$1,492,705**	**$10,892,689**

Figure 4-24: Marshall County Buildings in Special Flood Hazard Areas



Overlay Analysis of Essential Facilities

An essential facility will encounter many of the same impacts as other buildings within the flood boundary. These impacts can include structural failure, extensive water damage to the facility and loss of facility functionality (e.g. a damaged police station will no longer be able to serve the community). The overlay analysis estimates that only one essential facility stands to be damaged in the event of a flood. Grace Baptist Christian School is located within the special flood hazard area in the town of Plymouth. Figure 4-27depicts this facility along with other essential facilities in the town of Plymouth that are in close proximity to the special flood hazard area.

Overlay Analysis of Critical Facilities

A critical facility will encounter many of the same impacts as other buildings within the flood boundary. These impacts can include structural failure, extensive water damage to the facility and loss of facility functionality. As an example, a damaged waste water facility would no longer be able to serve the community.

The Critical Facilities in Special Flood Hazard Areas figures show the results of the overlay analysis and indicate the Critical Facilities that are at risk of flood damage in Marshall County including one cell tower, one waste water treatment plant, and two Hazmat facilities.

Table 4-20: Impacted Critical Facilities

Facility Type	Facility Name
Communication	501 W. Lake Ave. Cell Tower
Waste Water Treatment	Culver Municipal
HAZMAT	Bpc Manufacturing
HAZMAT	Graphix Unlimited

Figure 4-25: Bremen Critical Facilities in Special Flood Hazard Areas

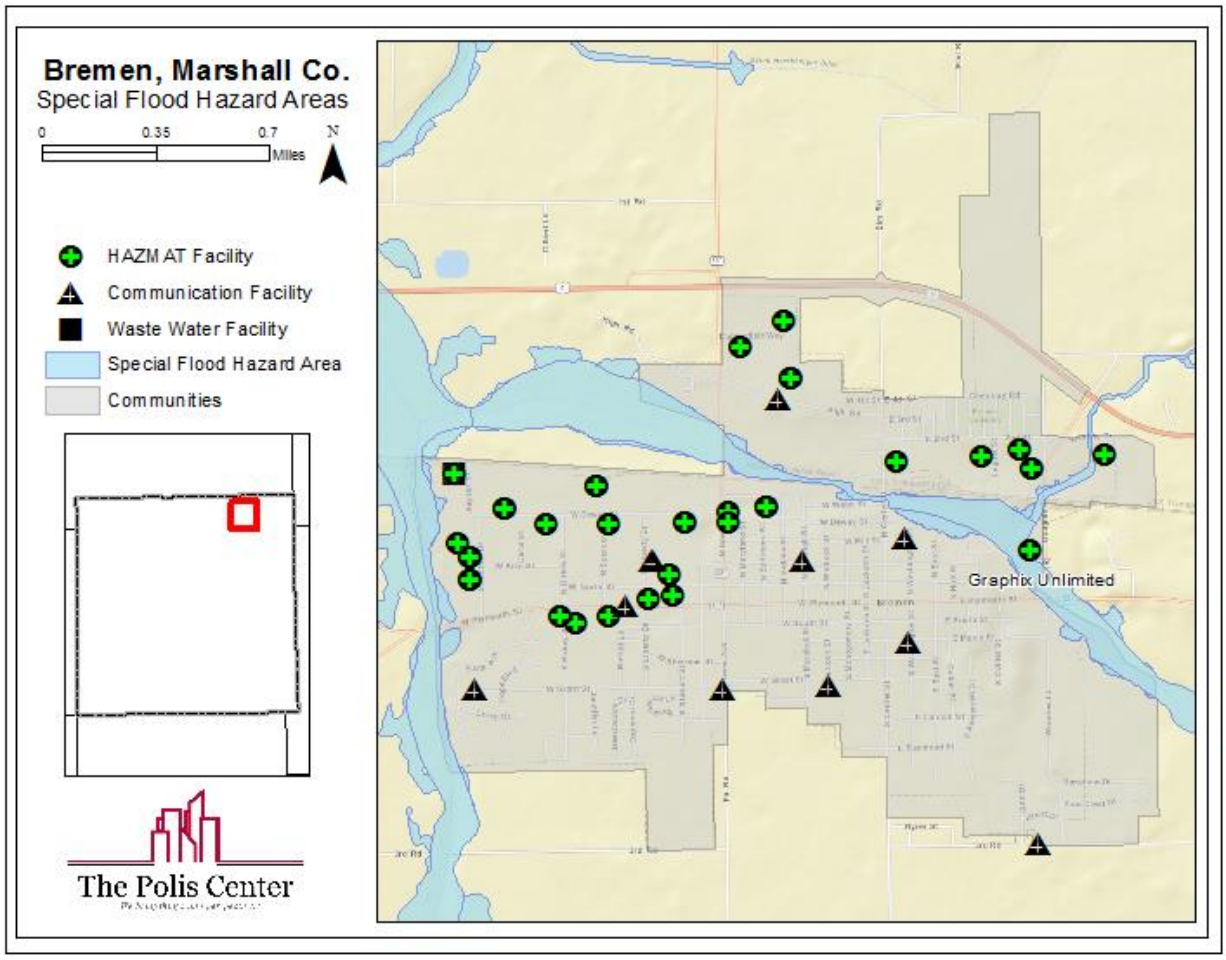


Figure 4-26: Culver Critical Facilities in Special Flood Hazard Areas

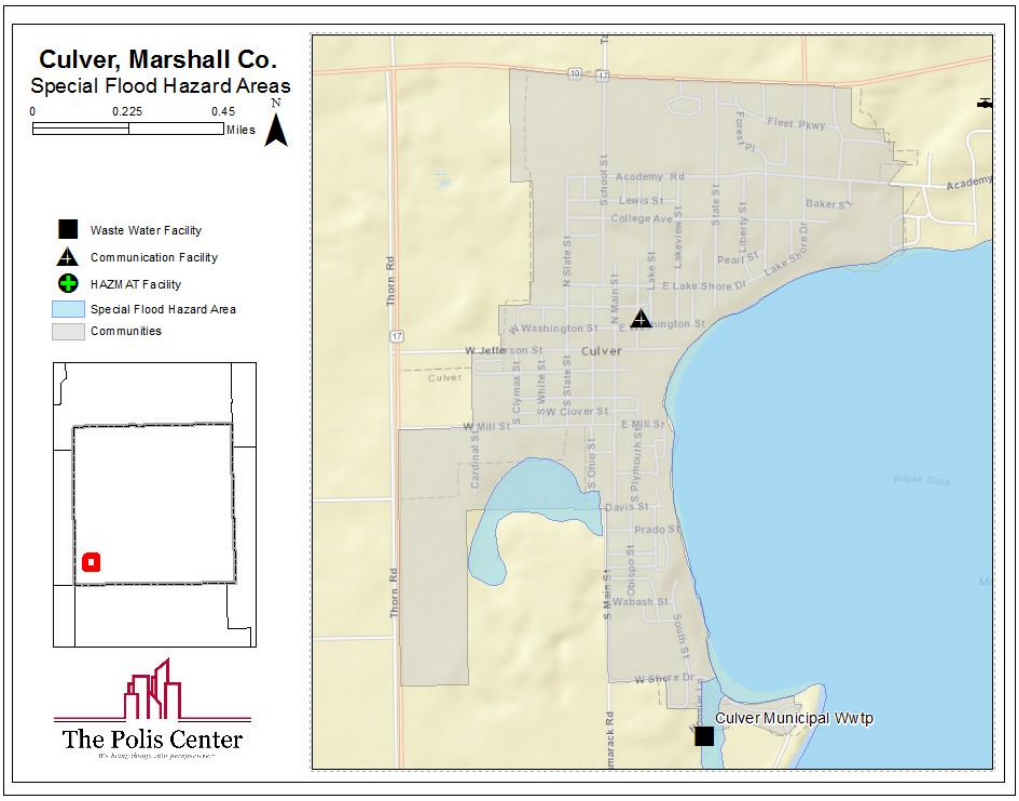
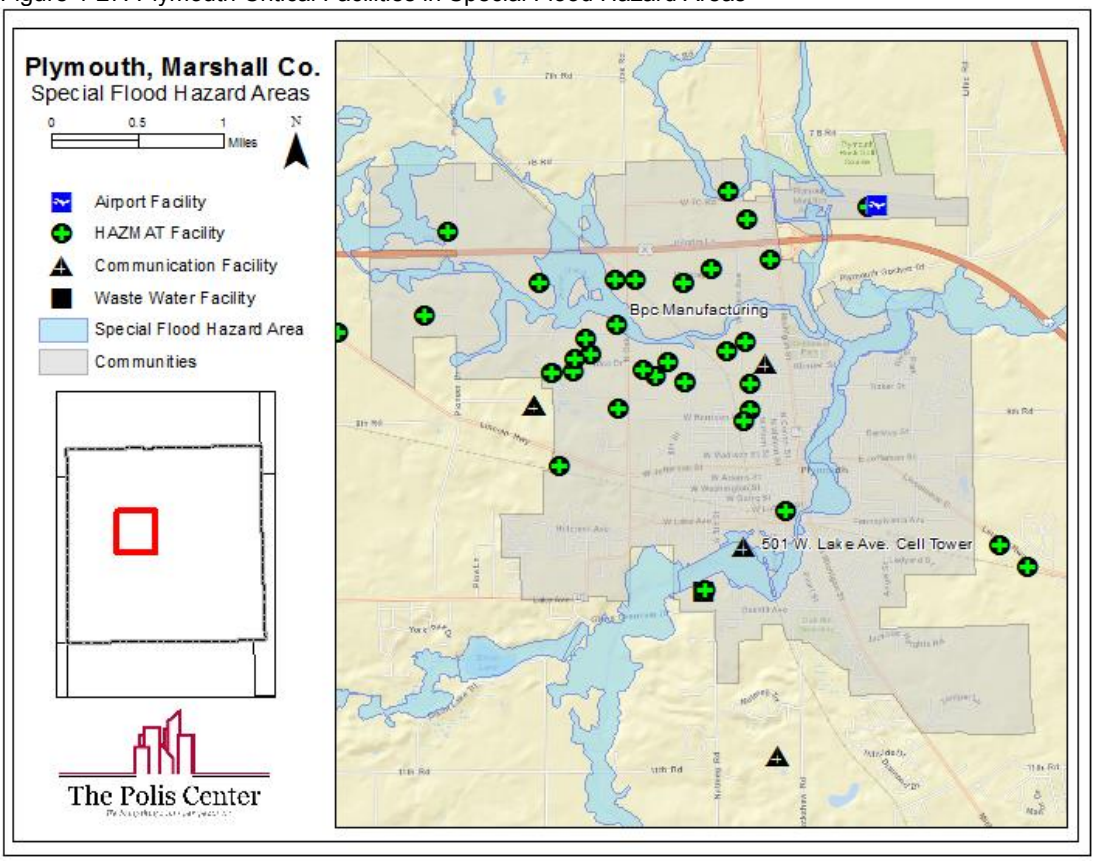


Figure 4-27: Plymouth Critical Facilities in Special Flood Hazard Areas



Short Term Shelter and Debris

Figure 4-28: Short Term Shelter Needs

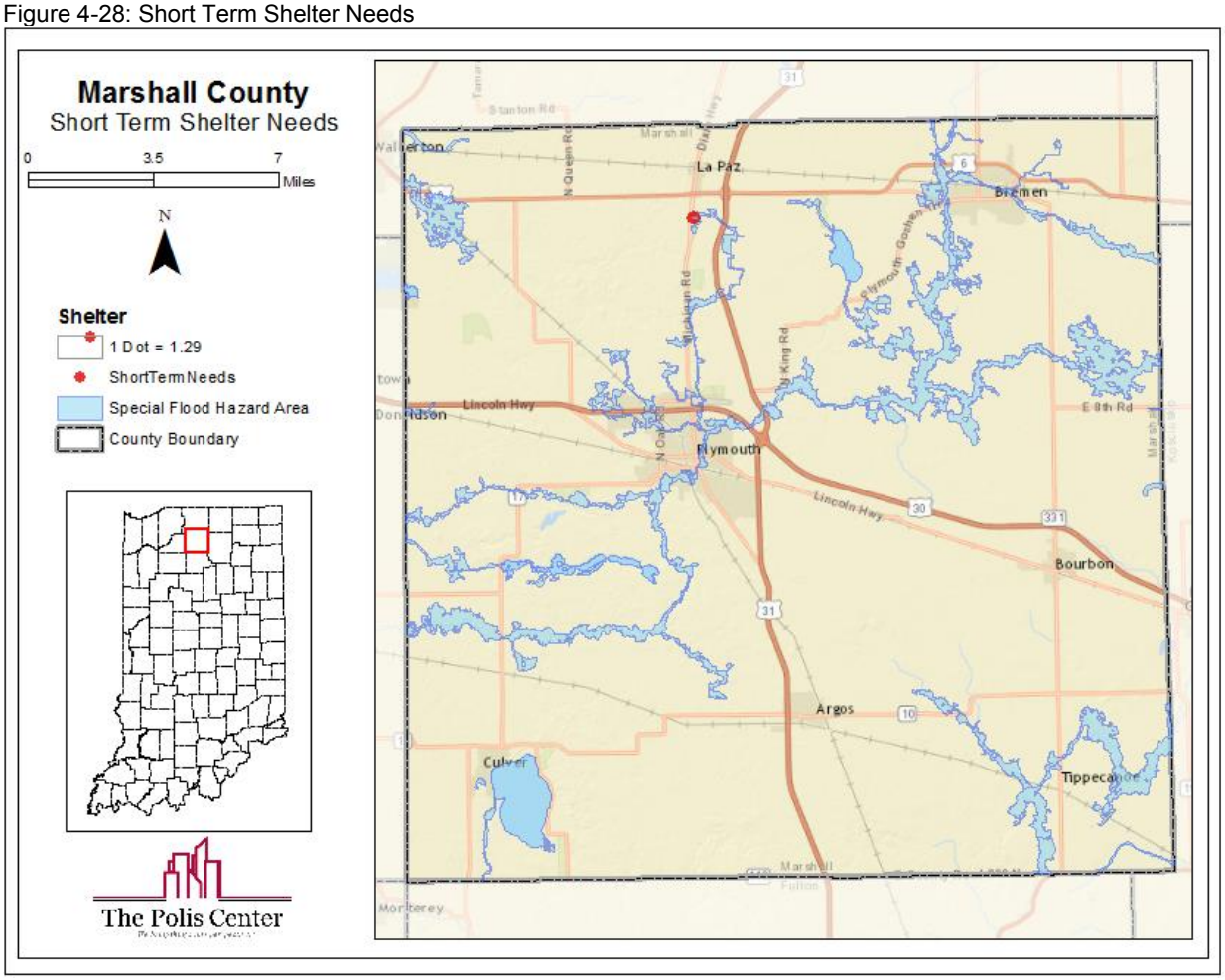
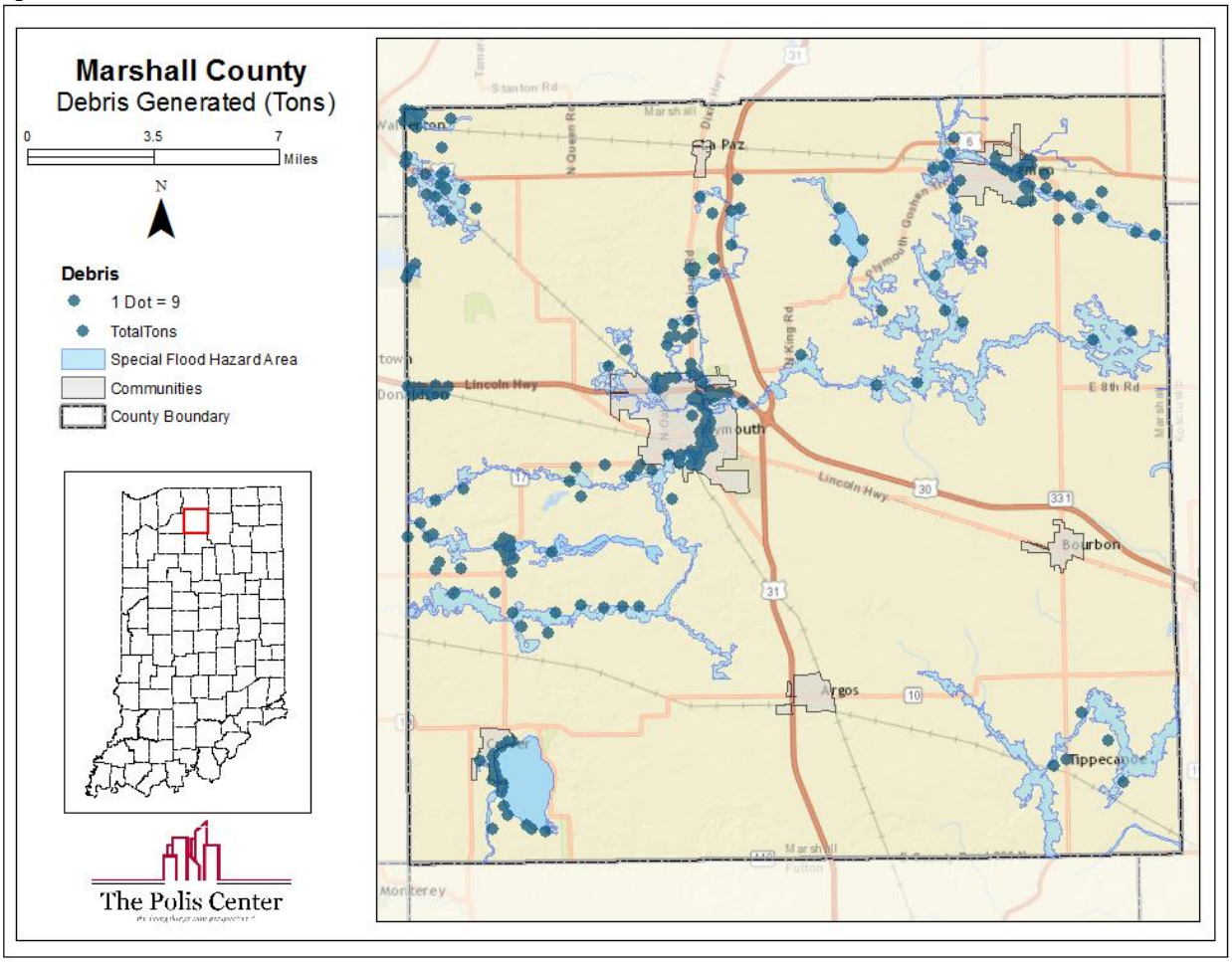


Figure 4-29: Tons of Debris Generated



Relationship to other Hazards

Severe storms and blizzards - Summer storms can potentially lead to log jams. Snow melt can contribute to flooding and, under the right circumstances, flash flooding.

Dam Failure - Flood events can compromise the structural integrity of dams.

Public Health - Public health can be affected as a result of wastewater spills due to flooding or power failures.

Water Main Breaks - Surges in water pressure as a result of water pumps starting after power outages can lead to water main breaks.

Plans and Programs in Place

Floodplain Ordinances - Marshall County and its participating NFIP communities regulate floodway development through their floodplain ordinances. All construction in the floodway requires the prior approval form the DNR Division of Water.

National Flood Insurance Program (NFIP) - The NFIP is a federal program created by Congress to mitigate future flood losses nationwide through sound, community-enforced building and zoning ordinances and to provide access to affordable, federally-backed flood insurance protection for property owners. The NFIP is designed to provide an insurance alternative to disaster assistance to meet the escalating costs of repairing damage to buildings and their contents caused by floods. Participation in the NFIP is based on an agreement between local communities and the federal government that states that if a community will adopt and enforce a floodplain management ordinance to reduce future flood risks to new construction in Special Flood Hazard Areas (SFHAs), the federal government will make flood insurance available within the community as a financial protection against flood losses.

Road Infrastructure and Drainage - Public Works staff at the county, city and township level work on culvert and ditch maintenance to prevent road flooding. Ice dams and culverts are monitored and addressed to reduce road flooding during spring thaws. The county has put a priority on culvert improvements to avoid road washouts.

Stream Gauging - The National Weather Service and the U.S. Geological Society provide real-time websites that gauge stream flow in area streams and rivers. Yellow river flowage levels for the city of Plymouth can be accessed online and used to inform the public of areas expected to be flooded as the river level rises.

Repetitive Loss Structures - Marshall County has the ability to purchase repetitive loss properties.

Public Warning and Notification - In the event of emergencies or hazardous conditions that require timely and targeted communication to the public, Marshall County utilizes the 911 Mass Notification System and the Marshall County Sheriff's Office Facebook page, as well as local news media. Marshall County promotes the use of NOAA weather radios by critical facilities and the public to receive information broadcast from the National Weather Service.

Program Gaps or Deficiencies

Stream Stabilization - Ongoing maintenance and repairs are being developed including unique design measures to include stabilization of the Yellow River in the county.

Beaver Dams and Flood Risk - Beaver dams have impounded many areas with water, and under normal rain events they are not a problem. However, in the event of flash flooding, when beaver dams break, road infrastructure is burdened with a major additional flow of water.

Road and Culvert Improvements - Marshall County strives to constantly improve its road and culvert infrastructure against flooding, but is limited by financial resources to go beyond maintenance on some projects.

4.2 Earthquake

Hazard Description

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

Ninety-five percent of earthquakes occur at the plate boundaries; however, some earthquakes occur in the middle of plates, as is the case for seismic zones in the Midwestern US. The most seismically active area in the Central US is referred to as the New Madrid Seismic Zone. Scientists have learned that the New Madrid fault system may not be the only fault system in the central US capable of producing damaging earthquakes. The Wabash Valley Fault System in Indiana shows evidence of large earthquakes in its geologic history, and there may be other currently unidentified faults that could produce strong earthquakes. Figure 4-30 depicts Indiana's historical earthquake epicenters. Tables 4-23 and 4-24 provide guidance on how to interpret the modified Mercalli intensity scale.

Ground shaking from strong earthquakes can collapse buildings and bridges; disrupt gas, electric, and communication (e.g. phone, cable, Internet) services; and sometimes trigger landslides, flash floods, and fires. Buildings with foundations resting on unconsolidated landfill and other unstable soil, and trailers or homes not tied to their foundations are at risk because they can be shaken off their mountings during an earthquake. When an earthquake occurs in a populated area, it may cause deaths, injuries, and extensive property damage.

Figure 4-30: Indiana Historical Earthquake Epicenters

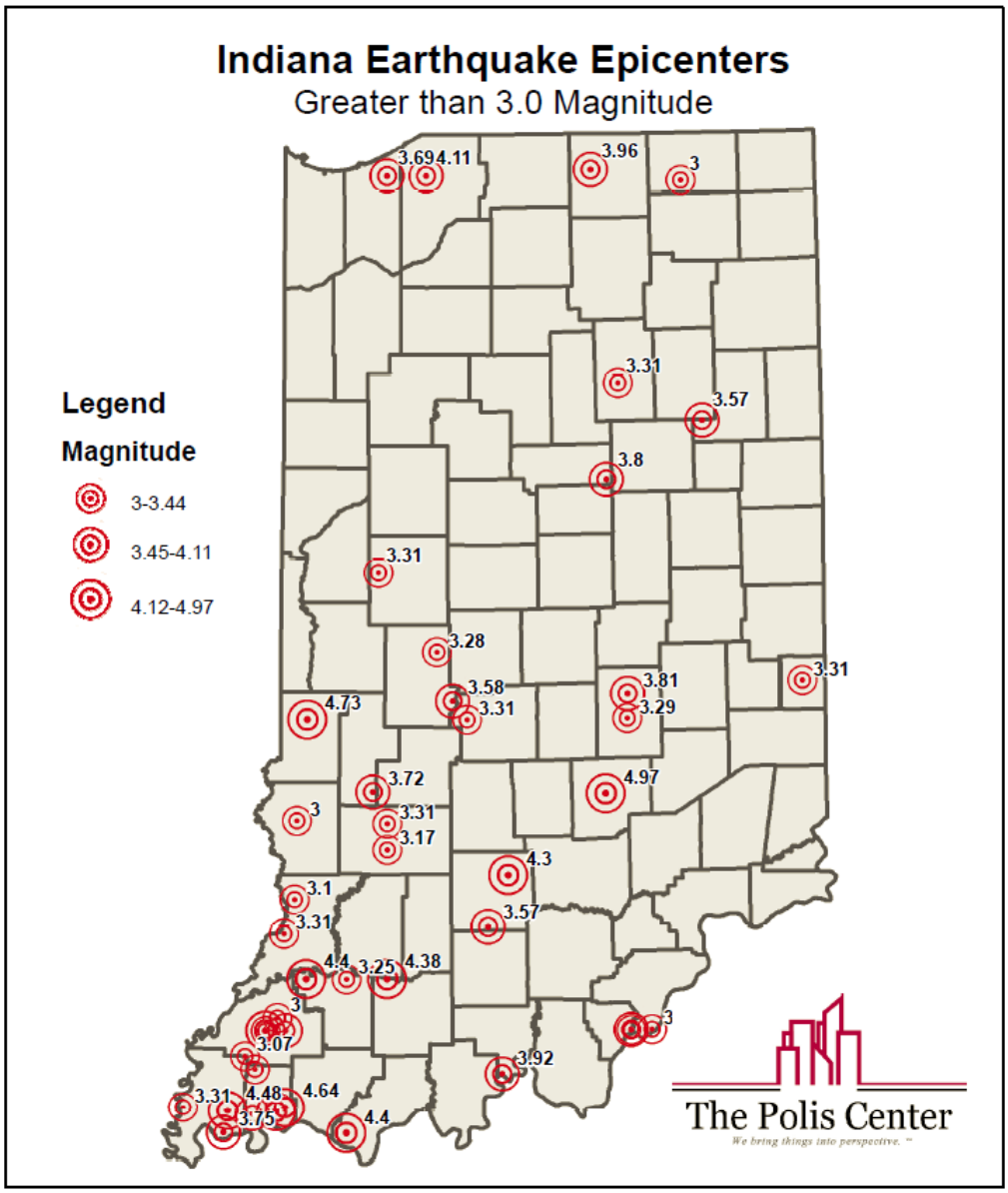


Table 4-21: Abbreviated Modified Mercalli Intensity Scale

Mercalli Intensity	Description
I	Not felt except by a very few under especially favorable conditions.
II	Felt only by a few persons at rest, especially on upper floors of buildings.
III	Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibrations similar to the passing of a truck. Duration estimated.
IV	Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like heavy truck striking building. Standing motor cars rocked noticeably.
V	Felt by nearly everyone; many awakened. Some dishes, windows broken. Unstable objects overturned. Pendulum clocks may stop.
VI	Felt by all, many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight.
VII	Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken.
VIII	Damage slight in specially designed structures; considerable damage in ordinary substantial buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned.
IX	Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations.
X	Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent.
XI	Few, if any (masonry) structures remain standing. Bridges destroyed. Rails bent greatly.
XII	Damage total. Lines of sight and level are distorted. Objects thrown into the air.

Table 4-22: Earthquake Magnitude vs. Modified Mercalli Intensity Scale

Earthquake Magnitude	Typical Maximum Modified Mercalli Intensity
1.0 - 3.0	I
3.0 - 3.9	II - III
4.0 - 4.9	IV - V
5.0 - 5.9	VI - VII
6.0 - 6.9	VII - IX
7.0 and higher	VIII or higher

Earthquake History in Marshall County

At least 43 earthquakes, M3.0 or greater, have occurred in Indiana since 1817. The last such event was a M3.1 centered just north of Vincennes on May 10, 2010. A M3.8 earthquake occurred near

Kokomo in December later that same year with approximately 10,390 individuals submitting felt reports to the USGS.

The majority of seismic activity in Indiana occurs in the southwestern region of the state. Earthquakes originate just across the boundary in Illinois and can be felt in Indiana. Elkhart and La Porte County adjacent to Marshall County have had earthquakes in the 19th century. The M4.11 event in La Porte County was on February 11, 1899. The Elkhart County event occurred on December 12, 1893 and was recorded as a M3.96.

Vulnerability and Future Development

During an earthquake, the types of infrastructure that could be impacted include roadways, runways, utility lines and pipes, railroads, and bridges. The impacts to these structures include broken, failed, or impassable roadways and runways; broken or failed utility lines, such as loss of power or gas to a community; and railway failure from broken or impassable tracks. Bridges also could fail or become impassable, causing traffic risks and ports could be damaged which would limit the shipment of goods. Typical scenarios are described to gauge the anticipated impacts of earthquakes in the county in terms of numbers and types of buildings and infrastructure.

New construction, especially critical facilities, will accommodate earthquake mitigation design standards. The discussion included strategies to harden and protect future, as well as existing, structures against the possible termination of public services and systems including power lines, water and sanitary lines, and public communication.

Risk Analysis

Combining Available Data and Methods

Four earthquake scenarios—two based on deterministic scenarios and two based on probabilistic scenarios—were developed to provide a reasonable basis for earthquake planning in Marshall County. The first deterministic scenario was a 7.1 magnitude epicenter along the Wabash Valley fault zone. Note that a deterministic scenario, in this context, refers to hazard or risk models based on specific scenarios without explicit consideration of the probability of their occurrences. Shake maps provided by FEMA were used in HAZUS-MH to estimate losses for Marshall County based on this event.

The second deterministic scenario was a Moment Magnitude of 5.5 with the epicenter located in Marshall County. This scenario was selected based upon the opinion of the IGS stating it could occur in the selected location and that it would therefore represent a realistic scenario for planning purposes.

Additionally, the analysis included two different types of probabilistic scenarios. These types of scenarios are based on ground shaking parameters derived from U.S. Geological Survey probabilistic seismic hazard curves. The first probabilistic scenario was a 500-year return period scenario. This scenario evaluates the average impacts of a multitude of possible earthquake epicenters with a magnitude that would be typical of that expected for a 500-year return period. The second probabilistic scenario allowed calculation of annualized loss. The annualized loss analysis in HAZUS-MH provides a means for averaging potential losses from future scenarios while considering their probabilities of occurrence. The HAZUS-MH earthquake model evaluates eight different return period scenarios including those for the 100-, 250-, 500-, 750-, 1000-, 1500-, 2000-, and 2500-year return period earthquake events. HAZUS-MH then calculates the probabilities of these events as well as the interim events, calculates their associated losses, and sums these losses to calculate an annualized loss. These analysis options were chosen because they are useful for prioritization of seismic reduction measures and for simulating mitigation strategies.

The following earthquake hazard modeling scenarios were performed:

- 7.1 magnitude earthquake on the Wabash Valley Fault System
- 5.5 magnitude earthquake local epicenter
- 500-year return period event
- Annualized earthquake loss

Modeling a deterministic scenario requires user input for a variety of parameters. One of the most critical sources of information that is required for accurate assessment of earthquake risk is soils data. Fortunately, a National Earthquake Hazards Reduction Program (NEHRP) soil classification map exists for Indiana. NEHRP soil classifications portray the degree of shear-wave amplification that can occur during ground shaking. The IGS supplied soils map was used for the analysis. FEMA provided a map for liquefaction potential that was used by HAZUS-MH.

An earthquake depth of 10.0 kilometers was selected based on input from IGS. HAZUS-MH also requires the user to define an attenuation function unless ground motion maps are supplied. Because Marshall County has experienced smaller earthquakes, the decision was made to use the

Central Eastern United States (CEUS) attenuation function. The probabilistic return period analysis and the annualized loss analysis do not require user input.

The building losses are broken into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the earthquake. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the earthquake.

Results for 7.1 Magnitude Earthquake Wabash Valley Scenario

The results of the 7.1 Wabash Valley earthquake are depicted in Table 4-23, Table 4-24, and Figure 4-31. HAZUS-MH estimates that approximately 12 buildings will be at least moderately damaged. This is less than 1% of the total number of buildings in the region. It is estimated that no buildings will be damaged beyond repair.

The total building related losses totaled $106.47 million; the estimated losses did not cause significant business interruption to the region. By far, the largest loss was sustained by the residential occupancies, which made up more than 37% of the total loss.

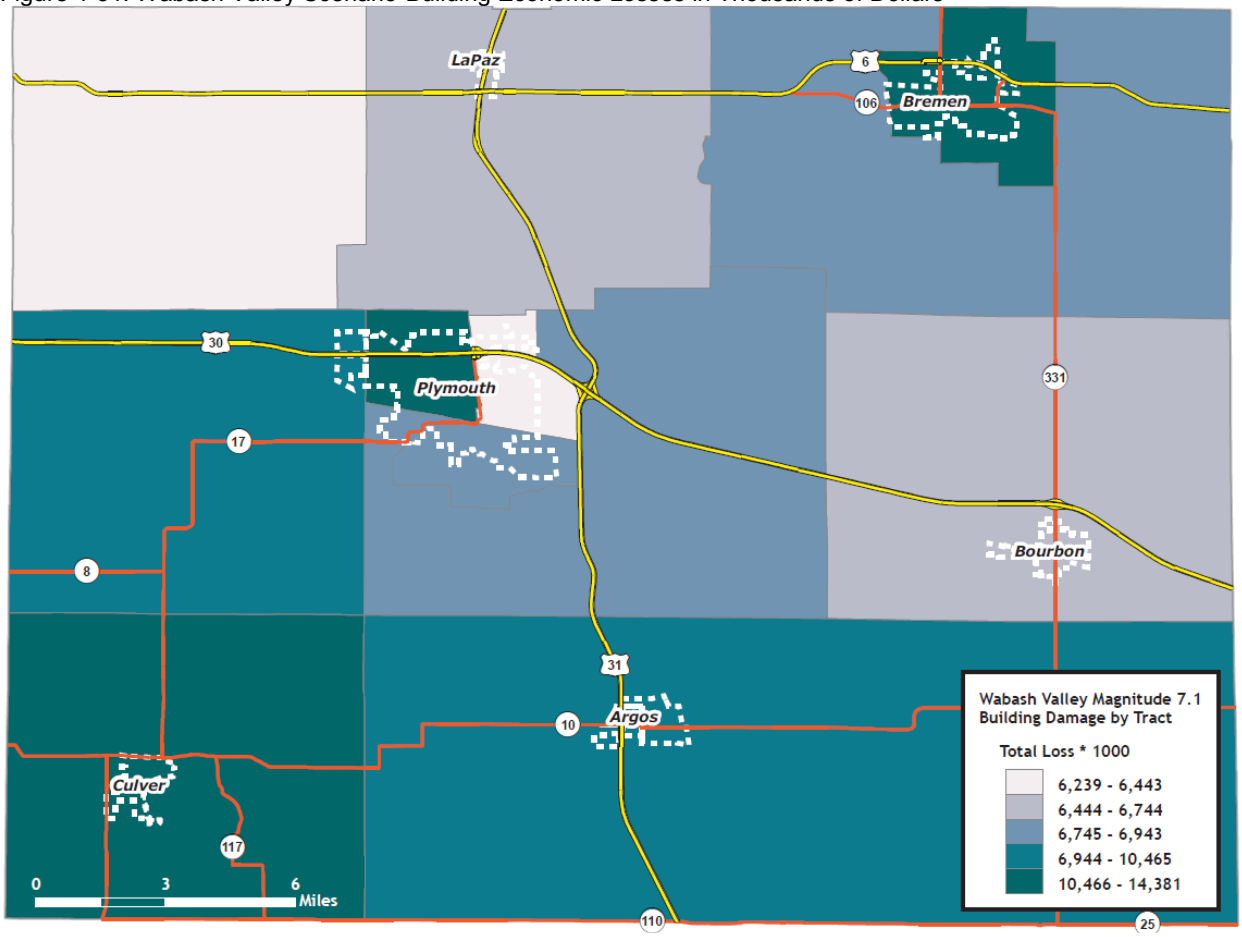
Table 4-23: Wabash Valley Scenario-Damage Counts by Building Occupancy

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	3,727	18.51	40	24.69	3	28.12	0	0.00	0	0.00
Commercial	1,012	5.03	9	5.70	1	5.88	0	0.00	0	0.00
Education	56	0.28	1	0.39	0	0.38	0	0.00	0	0.00
Government	94	0.47	1	0.60	0	0.61	0	0.00	0	0.00
Industrial	282	1.40	3	1.65	0	1.90	0	0.00	0	0.00
Other Residential	2,819	14.00	45	27.85	3	28.41	0	0.00	0	0.00
Religion	412	2.05	5	2.99	0	3.10	0	0.00	0	0.00
Single Family	11,728	58.26	58	36.13	4	31.60	0	0.00	0	0.00
Total	**20,130**		**161**		**12**		**0**		**0**	

Table 4-24: Wabash Valley Scenario-Building Economic losses in Millions of Dollars

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Loses							
	Wage	0.00	0.00	0.01	0.00	0.02	0.03
	Capital-Related	0.00	0.00	0.01	0.00	0.01	0.02
	Rental	0.01	0.00	0.02	0.00	0.00	0.03
	Relocation	0.00	0.00	0.00	0.00	0.00	0.00
	Subtotal	**0.01**	**0.00**	**0.04**	**0.01**	**0.03**	**0.08**
Capital Stock Loses							
	Structural	0.05	0.01	0.02	0.01	0.09	0.18
	Non_Structural	19.42	2.65	6.36	8.63	17.12	54.18
	Content	15.96	1.54	6.13	5.31	17.79	46.73
	Inventory	0.00	0.00	0.40	3.37	1.53	5.29
	Subtotal	**35.43**	**4.20**	**12.91**	**17.32**	**36.53**	**106.39**
	Total	**35.44**	**4.20**	**12.95**	**17.33**	**36.56**	**106.47**

Figure 4-31: Wabash Valley Scenario-Building Economic Losses in Thousands of Dollars



Wabash Valley Scenario—Essential Facility Losses

Before the earthquake, the region had 946 care beds available for use. On the day of the earthquake, the model estimates that only 437 (46%) care beds are available for use by patients already in

medical care facilities and those injured by the earthquake. After one week, 97% of the beds will be back in service. By day 30, 100% will be operational.

Results for 5.5 Magnitude Earthquake in Marshall County

The results of the initial analysis, the 5.5 magnitude earthquake with an epicenter under the courthouse, are depicted in Tables 4-25 and 4-26 and Figure 4-32. HAZUS-MH estimates that approximately 3,839 buildings will be at least moderately damaged—approximately 19% of the total number of buildings in the region. It is estimated that 157 buildings will be damaged beyond repair.

The total building related losses totaled $285.85 million; 9% of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies, which comprised more than 41% of the total loss.

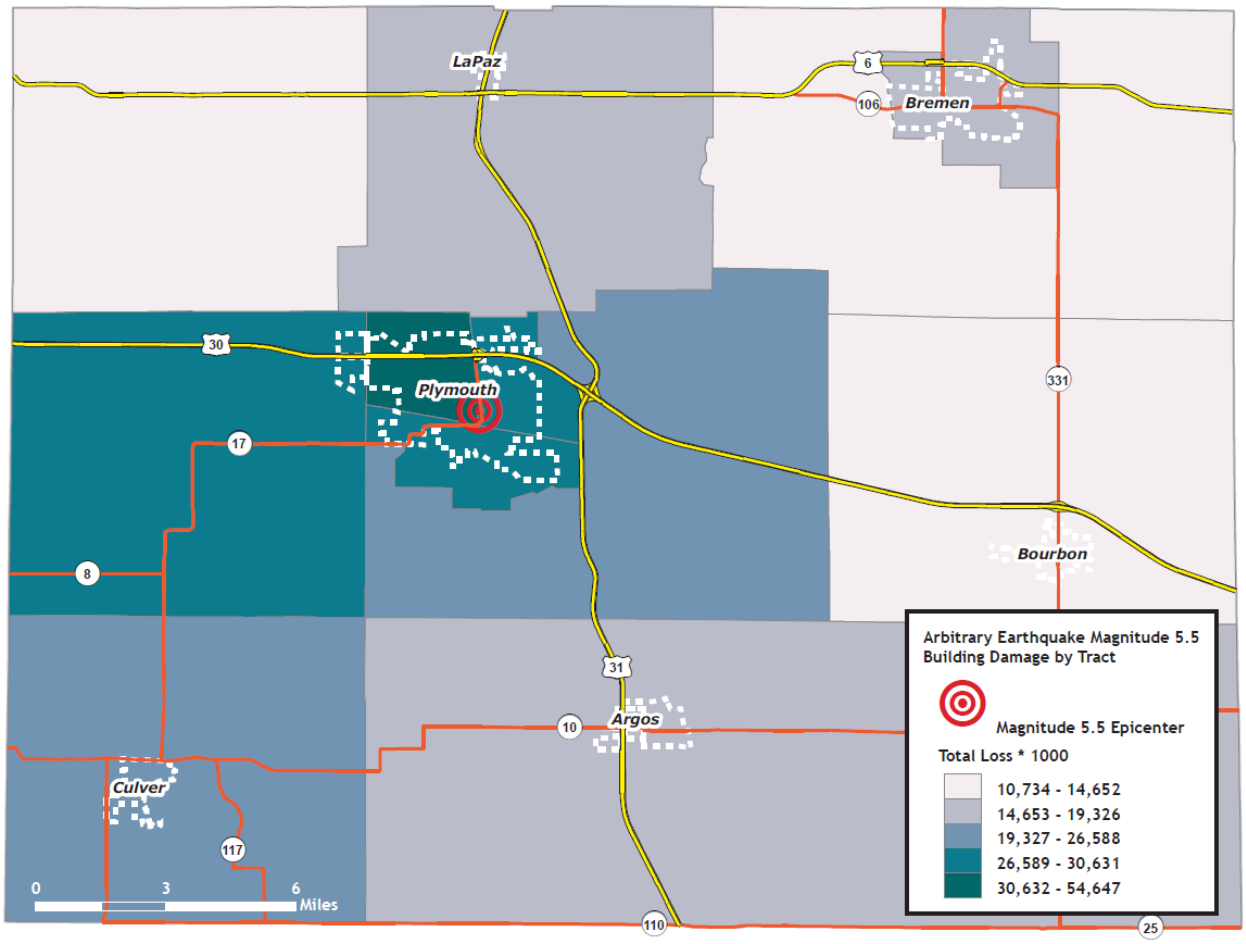
Table 4-25: Marshall County 5.5M Scenario-Damage Counts by Building Occupancy

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	2,136	18.11	729	15.61	644	22.52	227	27.55	35	22.05
Commercial	544	4.61	216	4.63	183	6.41	66	8.01	13	8.07
Education	35	0.29	11	0.23	8	0.29	3	0.30	1	0.37
Government	55	0.47	18	0.39	16	0.55	5	0.56	1	0.76
Industrial	158	1.34	53	1.14	51	1.80	20	2.39	3	1.94
Other Residential	1,470	12.47	643	13.79	555	19.42	170	20.66	28	17.57
Religion	226	1.92	90	1.93	69	2.42	25	3.09	6	3.81
Single Family	7,172	60.80	2,907	62.27	1,331	46.58	309	37.44	71	45.41
Total	**11,796**		**4,668**		**2,857**		**825**		**157**	

Table 4-26: 5.5M Scenario-Building Economic Losses in Millions of Dollars

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Loses							
	Wage	0.00	0.71	4.60	1.56	2.24	9.11
	Capital-Related	0.00	0.29	4.66	0.95	0.96	6.86
	Rental	2.73	0.64	4.32	0.92	1.44	10.06
	Relocation	0.32	0.01	0.24	0.09	0.43	1.09
	Subtotal	**3.05**	**1.66**	**13.82**	**3.52**	**5.07**	**27.12**
Capital Stock Loses							
	Structural	12.98	1.21	5.39	3.21	19.81	42.60
	Non_Structural	61.09	7.07	15.98	15.18	31.37	130.70
	Content	28.05	2.73	11.24	8.71	25.98	76.71
	Inventory	0.00	0.00	0.74	5.82	2.18	8.73
	Subtotal	**102.12**	**11.01**	**33.35**	**32.92**	**79.34**	**258.73**
	Total	**105.17**	**12.66**	**47.17**	**36.44**	**84.41**	**285.85**

Figure 4-32: 5.5M Scenario-Building Economic Losses in Thousands of Dollars



Marshall County 5.5M Scenario—Essential Facility Losses

Before the earthquake, the region had 946 care beds available for use. On the day of the earthquake, the model estimates that only 22 care beds (2%) are available for use by patients already in medical care facilities and those injured by the earthquake. After one week, 44% of the beds will be back in service. By day 30, 74% will be operational.

Results 5.0 Magnitude 500-Year Probabilistic Scenario

The results of the 500-year probabilistic analysis are depicted in Tables 4-27 and 4-28. HAZUS-MH estimates that approximately 235 buildings will be at least moderately damaged. This is more than 1% of the total number of buildings in the region. It is estimated that two buildings will be damaged beyond repair.

The total building-related losses totaled $6.29 million; 19% of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies, which made up more than 35% of the total loss.

Table 4-27: 500-Year Probabilistic Scenario-Damage Counts by Building Occupancy

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	3,548	18.23	152	25.01	61	29.81	9	32.04	0	25.12
Commercial	970	4.99	37	6.05	13	6.27	2	6.55	0	6.01
Education	54	0.28	2	0.39	1	0.43	0	0.45	0	0.61
Government	90	0.46	3	0.54	1	0.57	0	0.54	0	0.68
Industrial	270	1.39	11	1.73	4	2.00	1	2.08	0	1.45
Other Residential	2,682	13.78	128	21.12	51	24.75	6	19.80	0	15.41
Religion	394	2.02	16	2.63	6	2.98	1	3.29	0	3.78
Single Family	11,453	58.85	258	42.51	68	33.18	10	35.24	1	46.94
Total	**19,462**		**607**		**205**		**28**		**2**	

Table 4-28: 500-Year Probabilistic Scenario-Building Economic Losses in Millions of Dollars

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Loses							
	Wage	0.00	0.02	0.20	0.06	0.14	0.41
	Capital-Related	0.00	0.01	0.20	0.04	0.06	0.30
	Rental	0.11	0.02	0.20	0.05	0.07	0.46
	Relocation	0.01	0.00	0.01	0.00	0.02	0.05
	Subtotal	**0.12**	**0.05**	**0.61**	**0.15**	**0.29**	**1.22**
Capital Stock Loses							
	Structural	0.56	0.07	0.22	0.15	1.19	2.19
	Non_Structural	1.08	0.14	0.23	0.17	0.60	2.22
	Content	0.17	0.02	0.08	0.07	0.27	0.59
	Inventory	0.00	0.00	0.01	0.04	0.02	0.07
	Subtotal	**1.80**	**0.23**	**0.54**	**0.43**	**2.07**	**5.07**
	Total	**1.93**	**0.27**	**1.14**	**0.58**	**2.36**	**6.29**

500-Year Probabilistic Scenario—Essential Facility Losses

Before the earthquake, the region had 946 care beds available for use. On the day of the earthquake, the model estimates that only 492 care beds (52%) are available for use by patients already in medical care facilities and those injured by the earthquake. After one week, 97% of the beds will be back in service. By day 30, 100% will be operational.

Results Annualized Risk Scenario

HAZUS-MH estimates that approximately 105 buildings will be at least moderately damaged. This is approximately 1% of the total number of buildings in the region. It is estimated that no buildings will be damaged beyond repair.

Relationship to other Hazards

Ground Failure- According to the National Academies of Sciences Engineering Medicine, the major cause of earthquake damage is ground failure. Some ground failures induced by earthquake are the result of liquefaction of saturated sands and silts, the weakening of sensitive clays or by the crumbling and breaking away of soil and rock on steep slopes. Ground failure has been known to cause buildings to collapse and to severely hinder communication and transportation systems.

Utility Failure- Earthquakes frequently damage utilities particularly underground facilities and older storage tanks, but nearly every utility can be vulnerable to the shaking that earthquakes induce. Seismic damage to buried utilities are often influenced by ground conditions and subsurface strain distribution. Since utilities are typically part of a larger network system, damages to key locations in a network can potentially set off a chain reaction that affects significant portions of the utility system as a whole. Earthquake damage to utilities can also potentially create secondary hazards such as fires or hazmat situations since some utilities may handle volatile or flammable substances.

Plans and Programs in Place

No existing plans or programs were identified.

Program Gaps or Deficiencies

No program gaps or deficiencies were identified.

4.3 Ground Failure

Hazard Description

According to the USGS, the term ground failure is a general reference to landslides, liquefaction, lateral spreads, and any other consequence of land shaking that affects ground stability. For ground failure this plan will only address land subsidence and landslides. Landslides are a serious geologic hazard common to almost every state in the US. It is estimated that nationally they cause

up to $2 billion in damages and from 25 to 50 deaths annually. Globally, landslides cause billions of dollars in damage and thousands of deaths and injuries each year.

The term landslide is a general designation for a variety of downslope movements of earth materials. Some landslides move slowly and cause damage gradually, whereas others move so rapidly that they can destroy property and take lives suddenly and unexpectedly. Gravity is the force driving landslide movement. Factors that allow the force of gravity to overcome the resistance of earth material to landslide movement include: saturation by water, steepening of slopes by erosion or construction, alternate freezing or thawing, earthquake shaking, and volcanic eruptions. There are three main types of landslides that occur in Indiana: rotational slump, earthflow, and rock fall.

Landslides

A landslide is a rapid movement of surface land material down a slope. The main causes of landslides include:

- Earthquake or other significant ground vibration
- Slope failure due to excessive downward movement, gravity
- Groundwater table changes (often due to heavy rains)

Preventive and remedial measures include modifying the landscape of a slope, controlling the groundwater, constructing tie backs, spreading rock nets, etc.

The USGS claims that landslides are a significant geologic hazard in the US causing $1-2 billion in damage and over 25 fatalities per year. The expansion of urban and recreational development into hillside areas has resulted in an increasing number of properties subject to damage as a result of landslides. Landslides commonly occur in connection with other major natural disasters such as earthquakes, wildfires, and floods.

Although landslides may not be preventable, their effect on people and property can be mitigated. Mitigation includes any activities that prevent an emergency, reduce the chance of an emergency happening, or lessen the damaging effects of unavoidable emergencies. Investing in preventive mitigation steps now such as planting ground cover (low growing plants) on slopes, or installing flexible pipe fittings to avoid gas or water leaks, will help reduce the impact of landslides and mudflows in the future.

Karst

Southern Indiana has a network of underground caves formed by what is known as karst landscape. According to the Indiana Geological Survey, karst topography is a distinctive type of landscape largely shaped by the dissolving action of groundwater on carbonate bedrock, usually limestone. This geological process, which will take thousands of years, is characterized by unique features such as sinkholes, fissures, caves, disappearing streams, springs, rolling topography, and underground drainage systems.

These karst formations have the potential to collapse under the weight of the ground above them creating a sinkhole. Ground failure of this nature is known as land subsidence. Any structures built above a karst formation could potentially be subject to land subsidence and collapse into a resulting sinkhole. There are no known karst areas in Marshall County.

Fluvial Erosion

The Fluvial Erosion Hazard (FEH) also represents a significant concern in areas where human development and infrastructure, are established in close proximity to natural waterways. In mild cases, this may be seen as the gradual loss of a farm field or the undermining of a fence row when gradual channel migration consumes private land. In more severe cases, the FEH risk may threaten properties and/or structures to the degree that they become uninhabitable or even lost to natural channel processes. Where interaction between human activities and natural waterways within communities exist, those communities must be mindful of the tendency of waterways to shift their position across the landscape. This knowledge can help a community anticipate FEH damages thereby making the community more resilient to flood and erosion impacts.

The Indiana Silver Jackets Hazard Mitigation Task Force has initiated a multi-agency program to identify, study and provide mitigation planning resources for individuals and communities who would like to adopt FEH avoidance strategies. The resources provided by this project will enable individuals and communities to better recognize areas prone to natural stream-erosion processes and adopt strategies to avoid FEH-related risks.

Ground Failure History in Marshall County

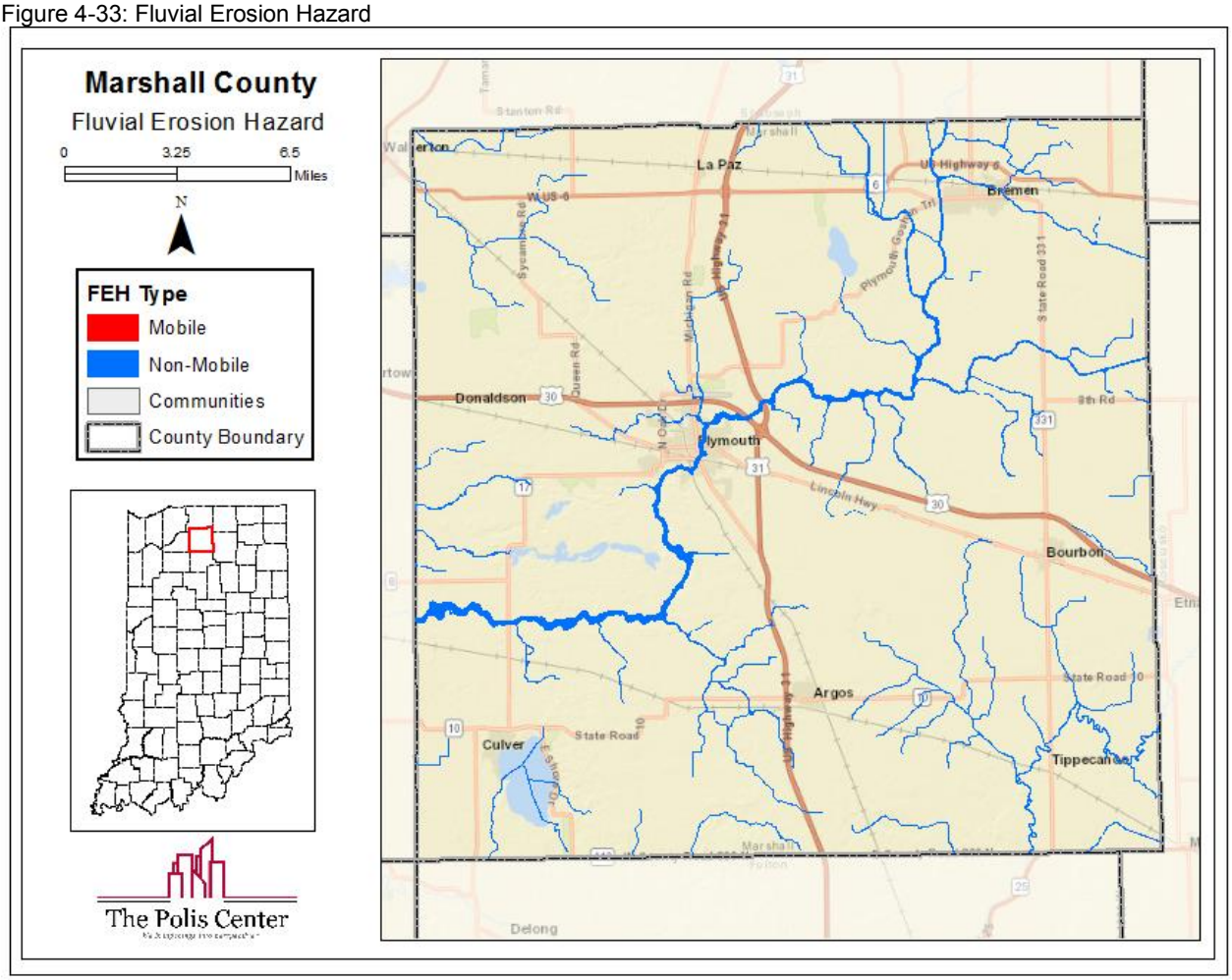
The planning team did not identify any major slope failures. Unrecorded landslide events occur throughout Marshall County with varying degrees of severity. Flash floods, which Marshall County experiences relatively frequently, can trigger mudflows, landslides, and crumbled roads. Ground

failure is less likely to cause spectacular structural collapses, but may the cause of major disruptions, particularly to lifelines, which can lead to prolonged loss of function and income, even for undamaged areas.

Vulnerability and Future Development

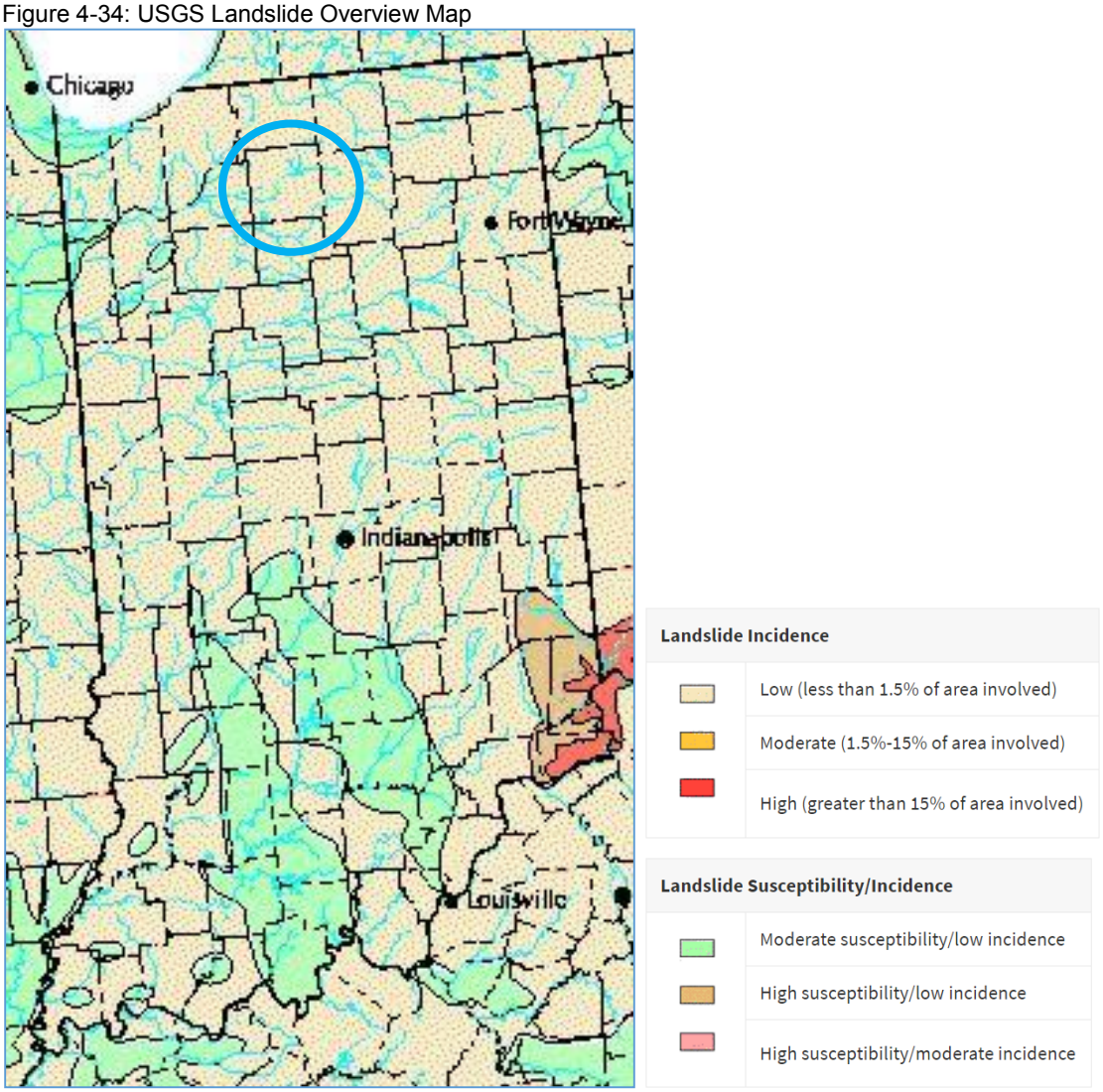
The extent of the ground failure hazard is closely related to development near the regions that are at risk. There are no reported karst areas in Marshall County and the area does not contain any highly mobile steams and thus is not prone to Fluvial Erosion Hazard (FEH) areas.

Figure 4-33: Fluvial Erosion Hazard



The US Geological Survey's Landslide Overview Map of the Conterminous United States shows two large zones in south-central Indiana as having moderate susceptibility for landslides, but with low incidence of landslides. In contrast, the majority of northern Indiana has a very low (less than 1.5% of the area involved) incidence of landslides and only the northwest is shown as having a moderate level of susceptibility. As seen in USGS Landslide Overview Map figure, Marshall County predominantly lies in the low incidence zone.

Figure 4-34: USGS Landslide Overview Map



Risk Analysis

Exposure Analysis

As seen in Figure 4-35, the terrain of Marshall County is primarily flat expanses typical of the northern portion of the state. Any variance in slope is typically found near the many streams and rivers that run primarily through the western half of the county. The existing critical facilities and infrastructures of Madison County are not subjected to any major slope failure but have been mapped for reference.

Figure 4-35: Slope Map – Marshall County

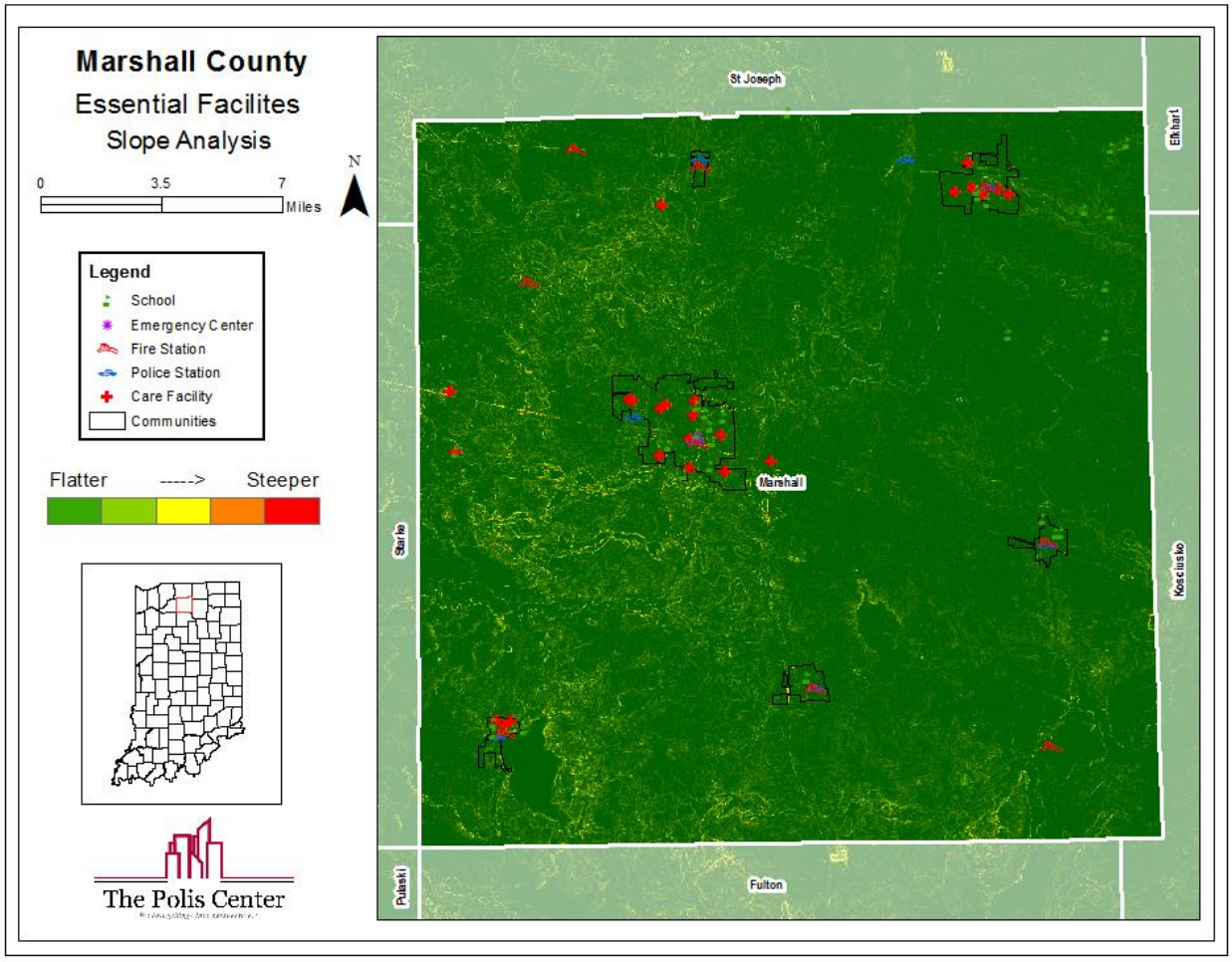
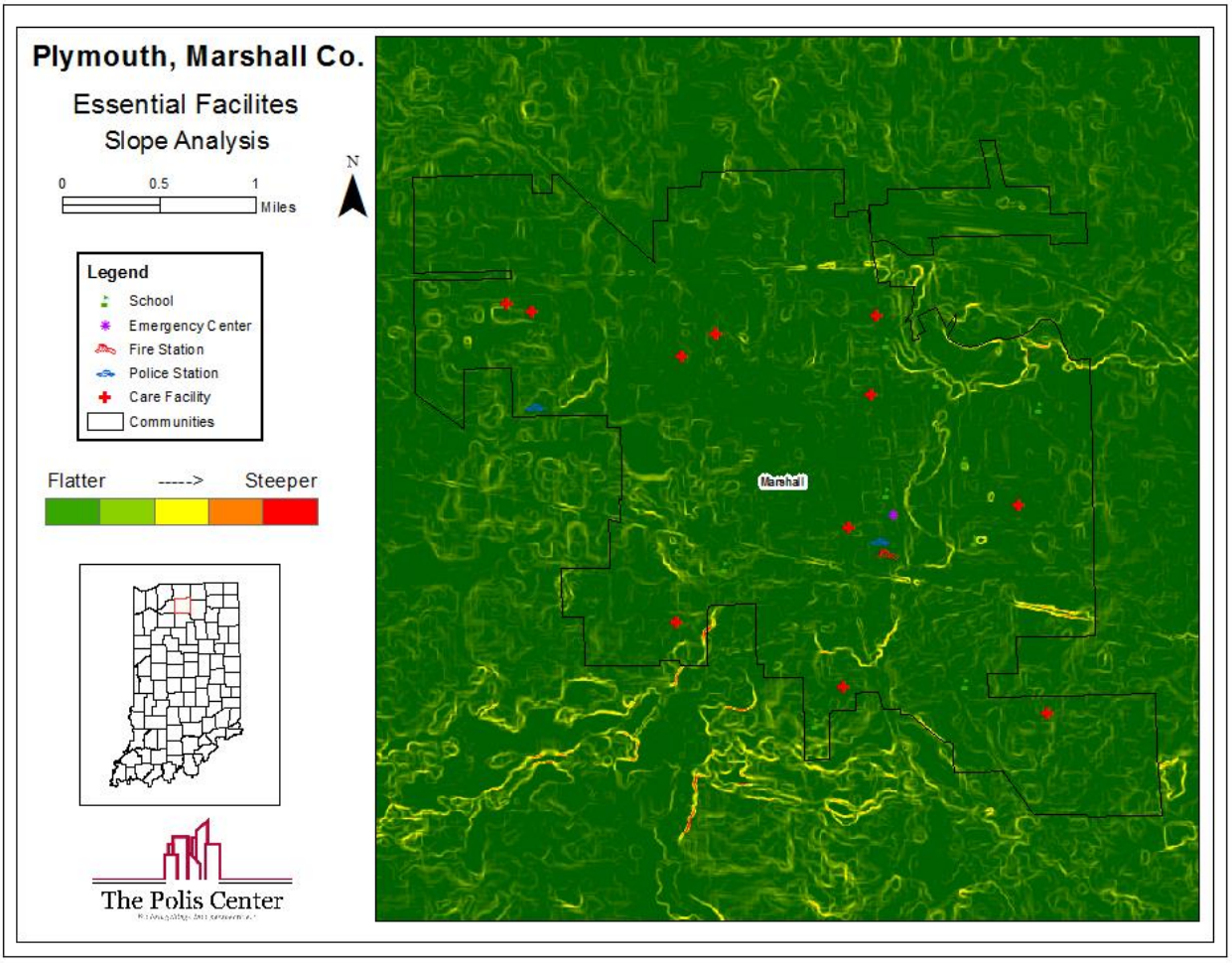


Figure 4-36 shows Plymouth and the surrounding area which displays some of the more diverse slopes in the county.

Figure 4-36: Slope Map – Plymouth, Marshall County



Relationship to other Hazards

Flooding – Flooding is typically the leading cause to ground failure, particularly along streams. Ground failure and flooding combine to impact property and infrastructure such as roads and bridges.

Plans and Programs in Place

Marshall County Erosion and Sediment Control Ordinance: - Ordinance intended to control soil erosion and sedimentation caused by land disturbing activities within Marshall County. The ordinance applies to all land disturbing activities within the boundaries and jurisdiction of Marshall County except for when superseded by a local city or town ordinance.

Program Gaps or Deficiencies

No program gaps or deficiencies were identified.

4.4 Summer Storms: Thunderstorms, Hailstorms, Lightning, Tornadoes, Windstorms

Hazard Description

Thunderstorms

Severe thunderstorms are defined as thunderstorms with one or more of the following characteristics: strong winds, large damaging hail, or frequent lightning. Severe thunderstorms most frequently occur in Indiana during the spring and summer but can occur any month of the year at any time of day. A severe thunderstorm's impacts can be localized or can be widespread in nature. A thunderstorm is classified as severe when it meets one or more of the following criteria.

- Hail of diameter 0.75 inches or higher
- Frequent and dangerous lightning
- Wind speeds equal to or greater than 58 miles an hour

Lightning

Lightning is caused by the discharge of electricity between clouds or between clouds and the surface of the earth. In a thunderstorm there is a rapid gathering of particles of moisture into clouds and forming of large drops of rain. This gathers electric potential until the surface of the cloud (or the enlarged water particles) is insufficient to carry the charge, and a discharge takes place, producing a brilliant flash of light. The power of the electrical charge and intense heat associated with lightning can electrocute on contact, split trees, ignite fires, and cause electrical failures. Most lightning casualties occur in the summer months, during the afternoon and early evening.

Hail

Hail is a product of a severe thunderstorm. Hail consists of layered ice particles which are developed when strong updrafts within the storm carry water droplets above the freezing level. They remain suspended and continue to grow larger, until their weight can no longer be supported by the winds. The NWS uses the following descriptions when estimating hail sizes: pea size is ¼ inch, marble size is ½ inch, dime size is ¾ inch, quarter size is 1 inch, golf ball size is 1 ¾ inches, and baseball size is 2 ¾ inches. Individuals who serve as volunteer "storm spotters" for the NWS are

located throughout the state, and are instructed to report hail dime size (¾ inch) or greater. Hailstorms can occur throughout the year; however, the months of maximum hailstorm frequency are typically between May and August. Although hailstorms rarely cause injury or loss of life, they can cause significant damage to property, particularly roofs and vehicles.

Windstorms and Tornadoes

Windstorms can and do occur in all months of the year; however, the most severe windstorms usually occur during severe thunderstorms in the warm months. Marshall County frequently experiences winds blowing at over 50 knots. According to NCDC records, in Marshall County there were 132 thunderstorm wind and high wind events reported between 1976 and August 2016, with wind speeds of up to 61 knots. These winds can inflict damage to buildings and in some cases overturn high-profile vehicles. On September 14, 2008, NCDC reported that a person died as a result of high winds in Marshall County.

Associated with strong thunderstorms, downbursts are severe localized downdrafts from a thunderstorm or rain shower. This outflow of cool or colder air can create damaging winds at or near the surface. Downburst winds can potentially cause as much damage as a small tornado and are often confused with tornadoes due to the extensive damage that they inflict. As these downburst winds spread out, they are frequently referred to as straight-line winds. Straight-line winds can cause major structural and tree damage over a relatively large area. The most recent severe wind and hail storms in Marshall County are shown in map and in tables in the Appendix.

Summer storms, including thunderstorms, hailstorms, and windstorms affect Marshall County on an annual basis. Thunderstorms are the most common summer hazardous event in the county, occurring primarily during the months of May through August, with the severest storms most likely to occur from mid-May through mid-July. Typically, thunderstorms are locally produced by cumulonimbus clouds, are always attended by lightning, and are often accompanied by strong wind gusts, heavy rain, and sometimes hail and tornadoes.

Tornadoes are violently-rotating columns of air extending from thunderstorms to the ground, with wind speeds between 40-300 mph. The *Glossary of Meteorology* defines a tornado as a "violently rotating column of air, in contact with the ground, either pendant from a cumuliform cloud or underneath a cumuliform cloud, and often (but not always) visible as a funnel cloud." They develop under three scenarios: (1) along a squall line; (2) in connection with thunderstorm squall lines during hot, humid weather; and (3) in the outer portion of a tropical cyclone. Funnel clouds

are rotating columns of air not in contact with the ground; however, the column of air can reach the ground very quickly and become a tornado.

The Cooperative Institute of for Mesoscale Meteorological Studies is currently conducting a Multi-Radar Multi-Sensor system project that harnesses weather data from multiple sources, integrates the information, and allows users to access live displays of data. For more information on the Cooperative Institute of for Mesoscale Meteorological Studies' Live Data projects visit http://cimms.ou.edu/index.php/research/live-data/.

Summer Storm History in Marshall County

All facilities are vulnerable to severe thunderstorms. These facilities will encounter many of the same impacts as any other building within the jurisdiction including structural failure, damaging debris (trees or limbs), roofs blown off or windows broken by hail or high winds, fires caused by lightning, and loss of building functionality, such as a damaged police station would no longer be able to serve the community.

During a severe thunderstorm, the types of infrastructure that could be impacted include roadways, utility lines and pipes, railroads, and bridges. Since the county's entire infrastructure is equally vulnerable, it is important to emphasize that any number of these structures could become damaged during a severe thunderstorm. The impacts to these structures include impassable roadways, broken or failed utility lines, causing loss of power or gas to the community, or railway failure from broken or impassable tracks. Additionally, bridges could fail or become impassable, causing risks to traffic.

Historically, tornadoes predominantly moved from west to east across the county. The extent of the hazard varies in terms of the extent of the path and the wind speed. Tornadoes can occur at any location within the county. Based on historical information, the probability of a tornado in Marshall County is high and the potential impact of a tornado is significant; therefore, the overall risk of a tornado in Marshall County is high.

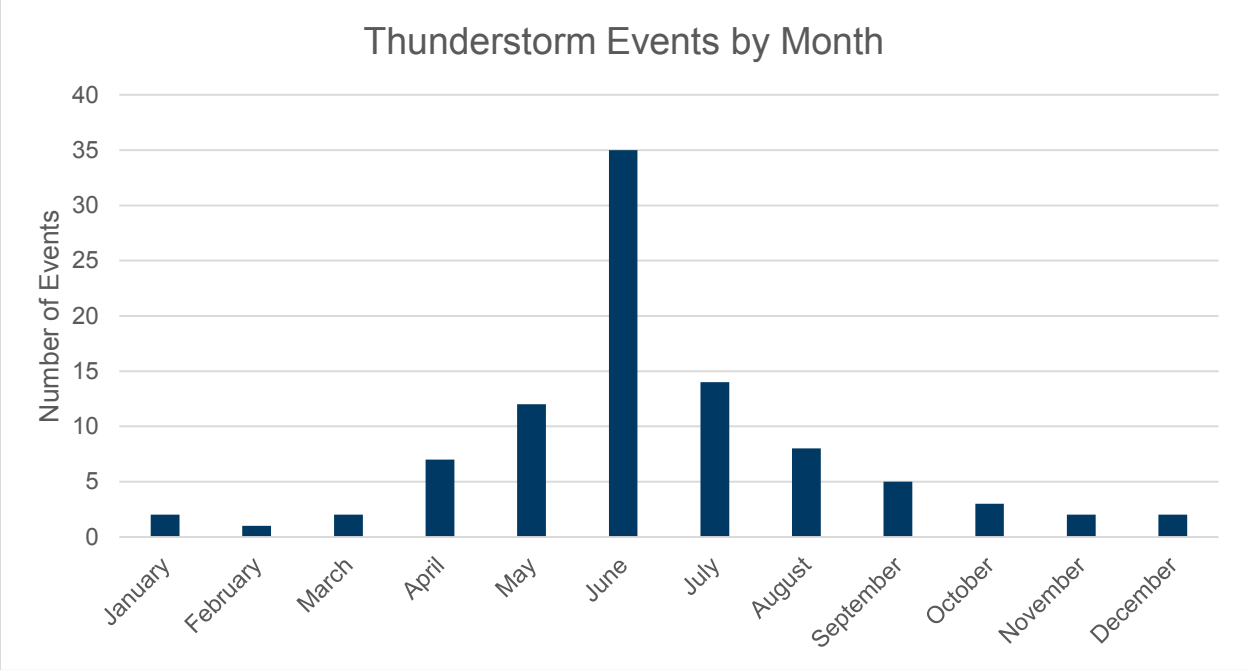
In January 2008, lightning struck a garage attached to a house in the 11000 block of south Michigan Road. When firefighters arrived, the garage was engulfed in flames. The garage and three vehicles in it sustained severe damage, and parts of the house incurred smoke and water damage. Damage was estimated at $90,000. It has been determined that, since 1998, Marshall County has incurred $1.04 million in damages relating to thunderstorms, including hail, lightning, and high winds.

There have been 183 thunderstorm events reported to the NOAA in Marshall County since 1950 as shown in the figure Marshall County Historical Thunderstorm Events by Month (1950-2016).

There have been 36 NCDC reported hail events in Marshall County since January 1965. During this time frame no deaths, injuries, or property damage were reported as a direct result of hail in Marshall County.

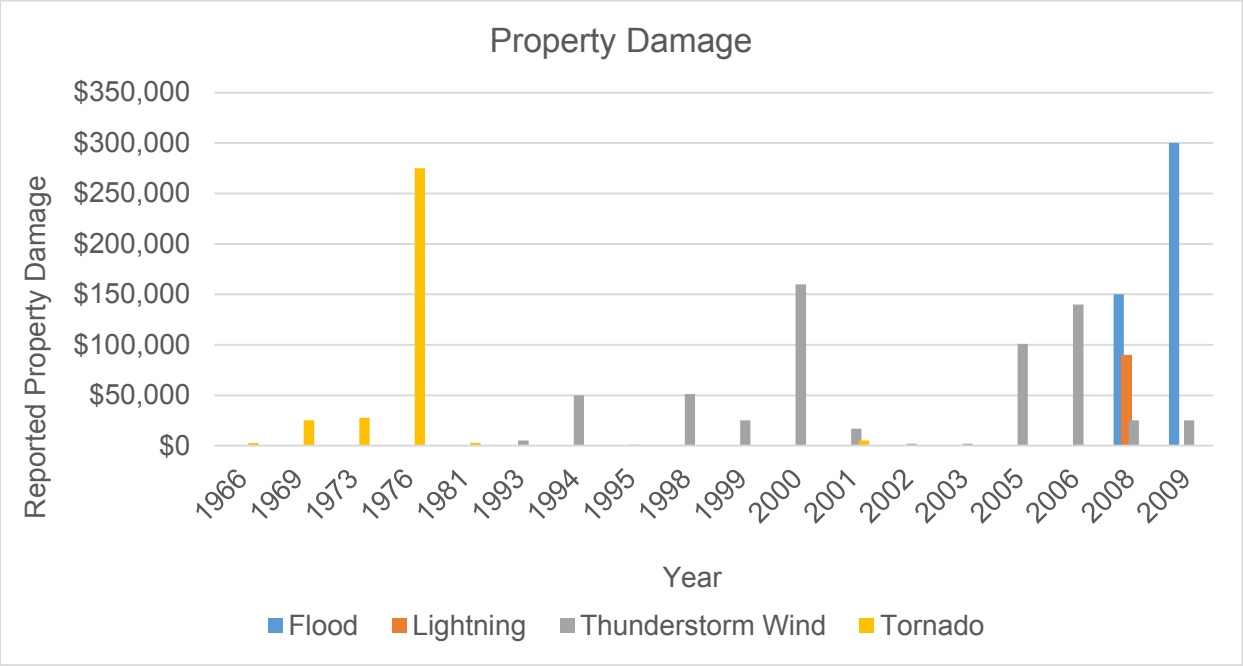
Although these storms are most typical in summer months, they can occur during every season. The Marshall County Historical Thunderstorm Events by Month (1965-2016) figure displays the number of events in all months.

Figure 4-37: Marshall County Historical Thunderstorm Events by Month (1965-2016)



Historically, several severe tornadoes have impacted Marshall County. In April 1965, a particularly severe tornado swept through Marshall County killing three people, injuring twenty-eight, and inflicting over 25 million in property damages. In 1976 another tornado injured ten people and less several displaced from their homes. There have been three tornadoes reported to NCDC in Marshall County since January 2008 and 26 since 1950.

Figure 4-38: Marshall County Tornado Property Losses (1965- 2016)



The Marshall County Historical Tornado Tracks figure shows tornado touchdown points and tracks in Marshall County since 1950. The county has experienced tornadoes in 14 of the 61 complete years on record. According to these statistics, there is a 23% chance of a tornado affecting Marshall County each year.

Vulnerability and Future Development

The Storm Water Drainage Ordinance for Marshall County, Indiana, addresses policies for the controlled release of storm water runoff and declares that the release rate of storm water from developed lands shall not exceed the release rate from the land area in it pre-construction state.

Since topography and the availability and adequacy of outlets for storm runoff vary with almost every site, the requirements for storm drainage tend to be an individual matter for any project. The Storm Water Drainage Ordinance recommends that each proposed project be discussed with the Marshall County Surveyor and Plan Director at the earliest practical time in the planning stage.

Risk Analysis

Risk analysis involves evaluating vulnerable assets, describing potential impacts, and estimating losses for each hazard. The purpose of this analysis is to help the community understand the

greatest risks facing the planning area. This step occurs after hazards and assets have been identified.

Exposure Analysis

Since all buildings are subject to exposure from summer storm events, it is important to recognize the numerous potential benefits of investing in mitigation. An ounce of prevention can be more effective than a pound of cure. Taking steps to guard against and prepare for hazardous events can be one of the most effective means of safeguarding property, community assets, and lives.

The identification of safe rooms and clear communication on the execution of the use of them during a hazardous event can be vital in providing safety to populations, particularly for those who do not inhabit buildings with basements or have easy access to designated shelters. Schools and public buildings where large groups of people will all require shelter demand special attention and planning.

During a tornado, the types of infrastructure that could be impacted include roadways, utility lines and pipes, railroads, and bridges. Since the county's entire infrastructure is equally vulnerable, it is important to emphasize that many of these structures could become damaged during a tornado. The potential impacts to these structures include broken, failed, or impassable roadways, broken or failed utility lines, such as loss of power or gas to community, and railway failure from broken or impassable tracks. Bridges could fail or become impassable, causing risk to traffic.

Combining Available Data and Methods

During a tornado the types of infrastructure that could be impacted include roadways, utility lines/pipes, railroads, and bridges. Since the county's entire infrastructure is equally vulnerable, it is important to emphasize that any number of these items could become damaged during a tornado. The impacts to these items include broken, failed, or impassable roadways, broken or failed utility lines (e.g. loss of power or gas to community), and railway failure from broken or impassable railways. Bridges could fail or become impassable causing risk to traffic.

An example scenario is described as follows to gauge the anticipated impacts of tornadoes, in terms of numbers and types of buildings and infrastructure, in the county.

GIS overlay modeling was used to determine the potential impacts of an F3 tornado. The analysis used a hypothetical path based upon an F3 tornado event that would run for 24.5 miles through the

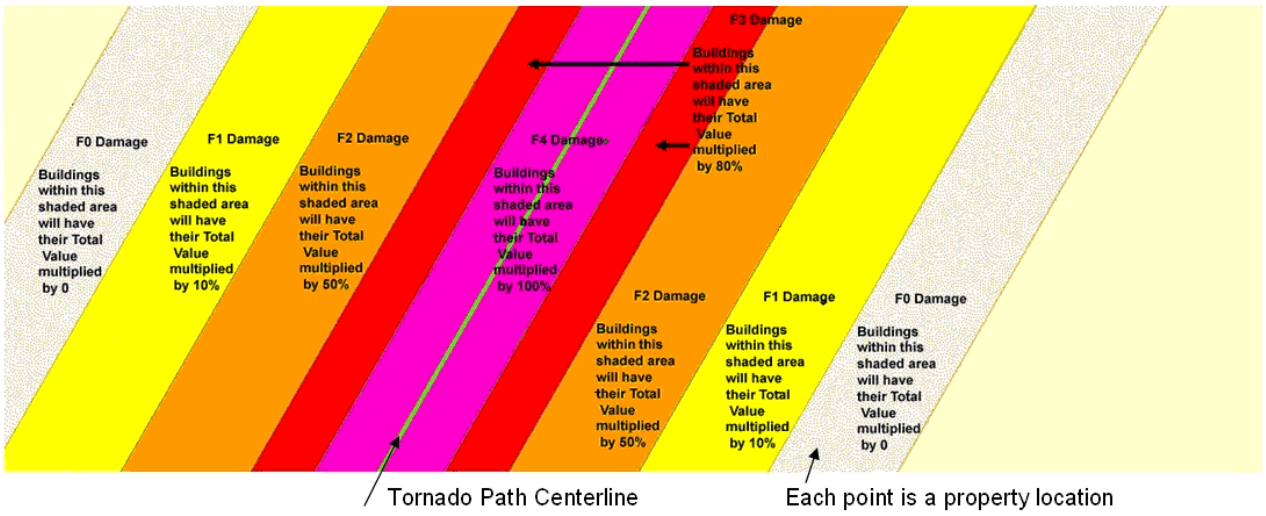
towns of Culver, Plymouth, and Bremen. The selected widths were modeled after a recreation of the Fujita-Scale guidelines based on conceptual wind speeds, path widths, and path lengths. There is no guarantee that every tornado will fit exactly into one of these six categories. Table 4-29 depicts tornado damage curves as well as path widths.

Table 4-29: Tornado Path Widths and Damage

Enhanced Fujita Scale	Path Width (feet)	Maximum Expected Damage
EF5	3,000	100%
EF4	2,400	100%
EF3	1,800	80%
EF2	1,200	50%
EF1	600	10%
EF0	300	0%

Within any given tornado path there are degrees of damage. The most intense damage occurs within the center of the damage path with a decreasing amount of damage away from the center of the path. This natural process was modeled in GIS by adding damage zones around the tornado path. Figure 4-39 and Table 4-30 describe the zone analysis.

Figure 4-39: EF4 Tornado Analysis, Using GIS Buffers



Once the hypothetical route is digitized on the map, several buffers are created to model the damage functions within each zone.

Since 2007, tornado strength in the United States is ranked based on the Enhanced Fujita scale (EF scale), replacing the Fujita scale introduced in 1971. The EF scale uses similar principles to the Fujita scale, with six categories from 0-5, based on wind estimates and damage caused by the tornado. The EF Scale is used extensively by the NWS in investigating tornadoes (all tornadoes are

now assigned an EF Scale number), and by engineers in correlating damage to buildings and techniques with different wind speeds caused by tornadoes. To see a comparative table of F and EF scales, see http://www.spc.noaa.gov/faq/tornado/ef-scale.html.

An EF3 tornado has three damage zones, as shown in Table 4-32. Maximum devastation of 80% is estimated within 150 feet of the tornado path (the darker-colored Zone 1). Within the outer buffer, between 300 and 600 feet of the tornado path (the lightest-colored Zone 3), 10% of the buildings will be damaged.

Table 4-30: F4 Tornado Zones and Damage Curves

Fujita Scale	Zone	Buffer (feet)	Damage Curve
EF-3	3	300-600	10%
EF-3	2	150-300	50%
EF-3	21	0-150	80%

Scenario

The planning team determined to recreate a historical EF3 tornado that occurred in 2002. A hypothetical EF3 tornado path that stretches from the northeastern and southcentral part of the county through Plymouth. The damage curve buffers for this hypothetical tornado path are shown in Figure 4-40.

Figure 4-40: Modeled F4 Tornado Damage Buffers in Marshall County

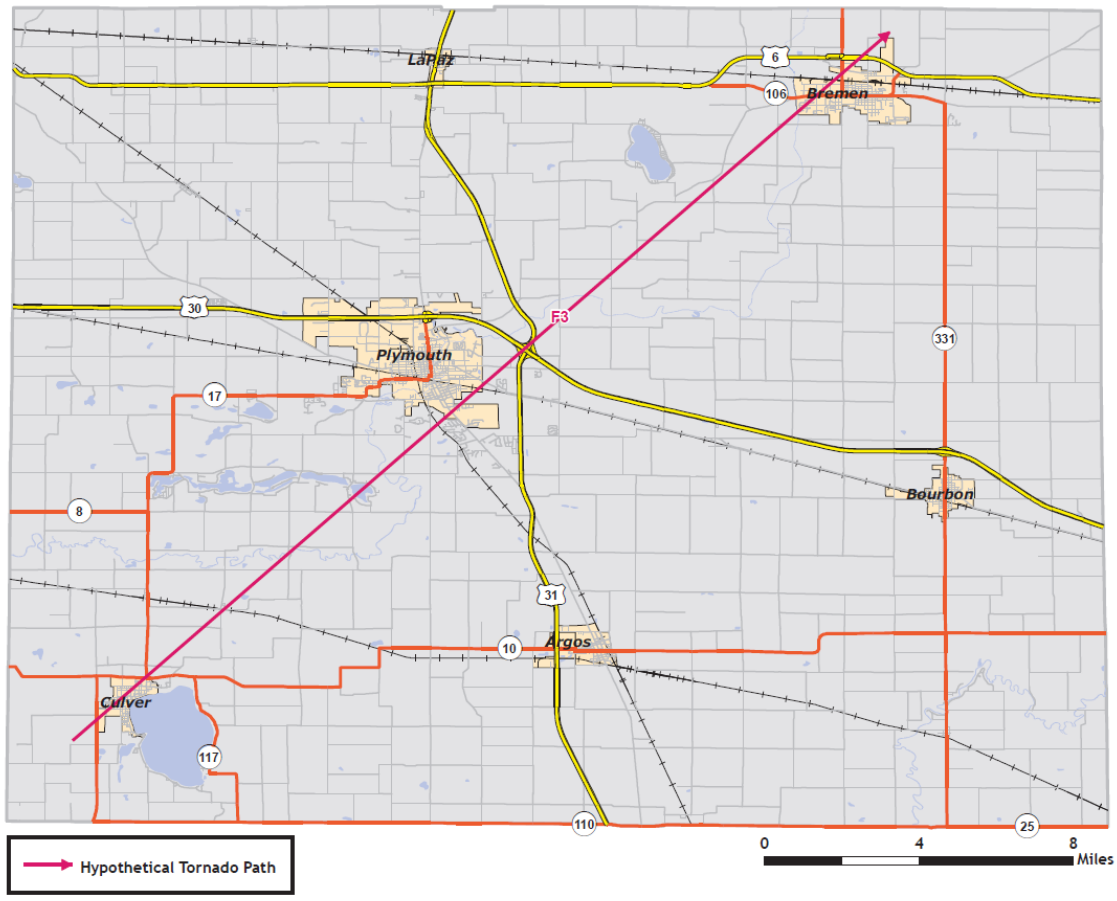
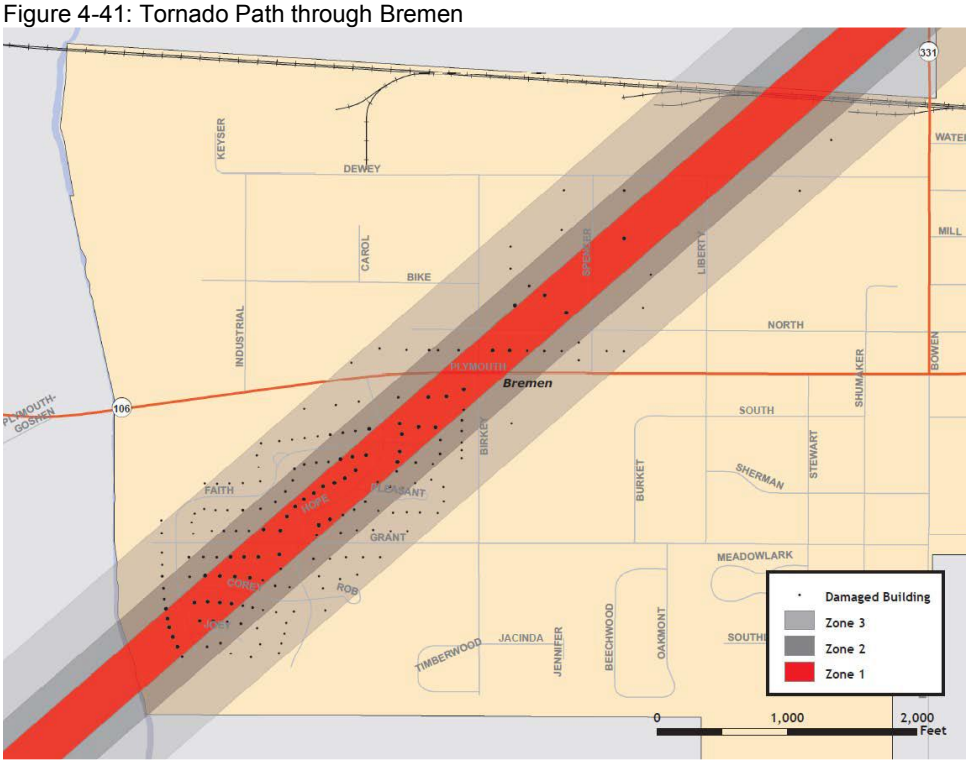


Figure 4-41: Tornado Path through Bremen



Results

The results of the analysis are depicted in Tables 4-31 and 4-32. The GIS analysis estimates that 794 buildings will be damaged. The estimated building losses are $48.6 million. The building losses are an estimate of building replacement costs multiplied by the percentages of damage. The overlay was performed against parcels provided by Marshall County that were joined with Assessor records showing property improvement.

The Assessor records often do not distinguish parcels by occupancy class when the parcels are not taxable; therefore, the total number of buildings and the building replacement costs for government, religious/non-profit, and education may be underestimated.

Table 4-31: Estimated Building Losses by Occupancy Type

Occupancy	Zone 1	Zone 2	Zone 3
Residential	167	171	292
Commercial	19	17	40
Industrial	4	4	10
Agriculture	11	11	22
Religious	1	4	11
Government	1	2	4
Education	1	0	2

Table 4-32: Estimated Losses by Zone

Occupancy	Zone 1	Zone 2	Zone 3
Residential	$16,487	$10,970	$3,408
Commercial	$3,891	$2,236	$1,250
Industrial	$1,632	$2,790	$1,779
Agriculture	$1,790	$1,031	$430
Religious	$107	$503	$220
Government	$0	$0	$0
Education	$0	$0	$34
Total	$23,907	$17,530	$7,122

There are two essential facilities located within 600 feet of the hypothetical tornado path. The model predicts that one police station and one school would experience damage. The affected facilities are identified in Table 4-3, and their geographic locations are shown in Figure 4-43.

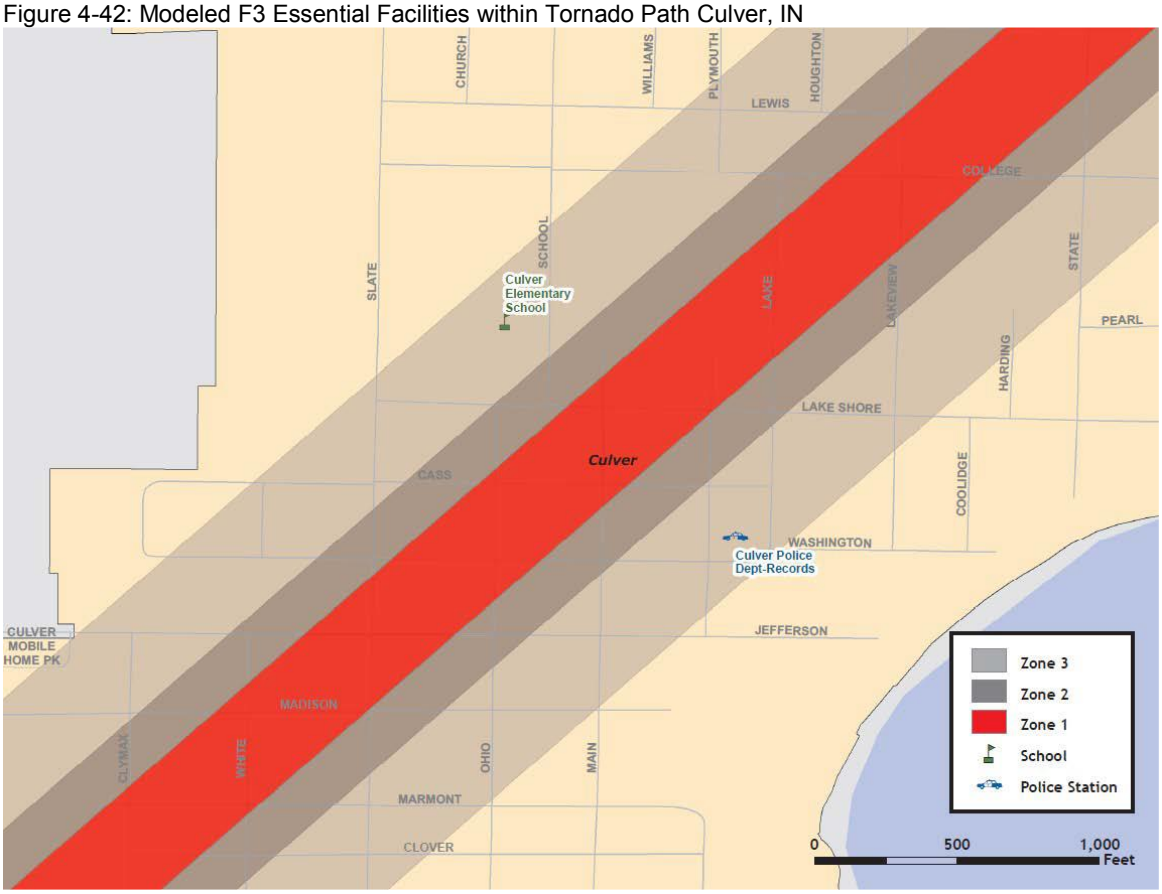
Essential Facility Damage

There were no essential facilities located within 600 feet of the hypothetical tornado path. Although other structures would be impacted, the affected essential facilities are identified in in Table 4-33. One Essential Facility – Footsteps Montessori Pre School – is situated just over 600 feet from the path, within Zone 4. Figure 4-42 depicts the locations of this essential facilities in relation to the path of the tornado.

Table 4-33: Estimated Essential Facilities Affected

Facility Type	Name
School	Culver Elementary School
Police	Culver Police Department

Figure 4-42: Modeled F3 Essential Facilities within Tornado Path Culver, IN



Relationship to other Hazards

Flooding - Thunderstorms with heavy amounts of rainfall can cause localized flooding, which can impact property and infrastructure such as roads.

Public Health - Public health can be impacted as a result of wastewater spills due to flooding.

Wildland Fire - Lighting strikes may ignite a wildland fire. Windstorms that result in downed timber increase the fuel load in a forest that may increase the risk of wildfire.

Structural Fire - Lighting strikes may ignite a wildland or structural fire.

Plans and Programs in Place

SKYWARN Program - The National Weather Services (NWS) has a Northland SKYWARN Program, offering annual training sessions to volunteers in Marshall County. Marshall County held the 2017 Skywarn Spotter Training on February 23, 2017 in Plymouth. There is a network of trained SKYWARN spotters in Marshall County. These volunteers help keep their local communities safe

by providing timely and accurate reports of severe weather to their local National Weather Service office.

Storm Shelters – There is are no Indiana Department of Health requirements for storm shelters based on number of manufactured homes and date of licensing.

In 2016, the Marshall County Emergency Management Agency announced on their faced book page that the 6/8/2016 Storm Shelter Program Re-Opened for Application after the Indiana Department of Homeland Security (IDHS) re-opened a program that will provide financial support to Indiana residents who wish to construct and install a severe weather safe room in their home.

The voluntary program reimbursed homeowners for 75 percent of the eligible costs (up to $4,500) to construct and install Federal Emergency Management Agency (FEMA) compliant safe rooms in their homes. Funding for the program was provided through FEMA.

Those who participated were required to obtain a building permit from a certified building department and had the safe room inspected during installation and/or after installation completion. Participants were also required to build their safe rooms to meet or exceed the standards dictated in FEMA 320 or 361 guidelines. These guidelines can be accessed at the following links:

http://www.fema.gov/fema-p-320-taking-shelter-storm-buildin...
https://www.fema.gov/media-library/assets/documents/3140

Outdoor Warning Sirens– Marshall County, Indiana does possess warning sirens and participated in tornado warning tests issued by the National Weather Service offices in Indiana, triggering programmed electronic devices. Sirens are activated in the event of a tornado warning or severe thunderstorms with winds of 70 mph or greater. Warning sirens are not used for the dual purpose of summoning emergency management workers in the event of an emergency rather they are used to issue a warning to the public concerning inclement weather conditions, enabling them to seek shelter.

Backup Power - For the courthouse complex there is an emergency generator for the jail. There is a small emergency generator that will power EMS, fire and police radio systems. In the city of Plymouth, the fire department has portable generators, one of which is dedicated to water supply and another that can be located as needed.

Burying Power Lines - Burying power lines help eliminate loss of power due to severe summer storms. The power company works to accommodate requests for installation of underground power lines to residents or businesses receiving connection of new power in areas where it is feasible. Some energy providers bury lines in areas where it makes sense to do so, but does not offer this as a regular customer option.

Vegetation Management - The Marshall County Transportation Department strives to clear the right of way of its improved, high-volume roads to reduce tree blowdown in the event of severe summer storms.

School Closings - All school districts within Marshall County have a school closing policy and communications plan in place if inclement weather or temperatures create a hazardous situation for students or staff. Schools have notification systems which allow them to notify all families who are registered in the school system with up-to-date information.

NOAA Weather Radio Transmitter Towers - The National Weather Service delivers storm warnings and key information during severe winter weather events over its radio towers. According to the National Weather Service Coverage Listing for Indiana, all of Marshall County is covered by the National Weather Service transmitters in South Bend and North Webster. The transmitter located Michigan City can be accessed by all of Marshall County except for the southeastern regions of the county.

Public Warning and Notification - In the event of emergencies or hazardous conditions that require timely and targeted communication to the public, Marshall County utilizes the CodeRED Mass Notification System and the Marshall County Sheriff's Office Facebook page, as well as local news media. Marshall County promotes the use of NOAA weather radios by critical facilities and the public to receive information broadcast from the National Weather Service.

Public Education and Awareness - Marshall County promotes the National Weather Service's "Severe Weather Awareness Week" held in April each year. The event seeks to educate residents on the dangers of severe summer storm events and highlights the importance of preparing for severe weather before it strikes.

Program Gaps or Deficiencies

Outdoor Warning Sirens – Some of the areas within the communities of LaPaz, Culver, Bourbon, Bremen, and Plymouth do not have warning sirens. Marshall County is in the process of equipping these communities with warning sirens as part of their mitigation action strategies.

Storm Shelters - Not all Marshall County public schools have designated safe rooms.

Backup Power - Not all county facilities have backup power in the event of a disaster.

4.5 Drought

Hazard Description

The meteorological condition that creates a drought is below normal rainfall. However, excessive heat can lead to increased evaporation, which will enhance drought conditions. Droughts can occur in any month. Drought differs from normal arid conditions found in low rainfall areas. Drought is the consequence of a reduction in the amount of precipitation over an undetermined length of time (usually a growing season or more).

There are several common types of droughts including meteorological, hydrological, agricultural, and socioeconomic. Figure 4-43 describes the sequence of drought occurrence and impacts of drought types.

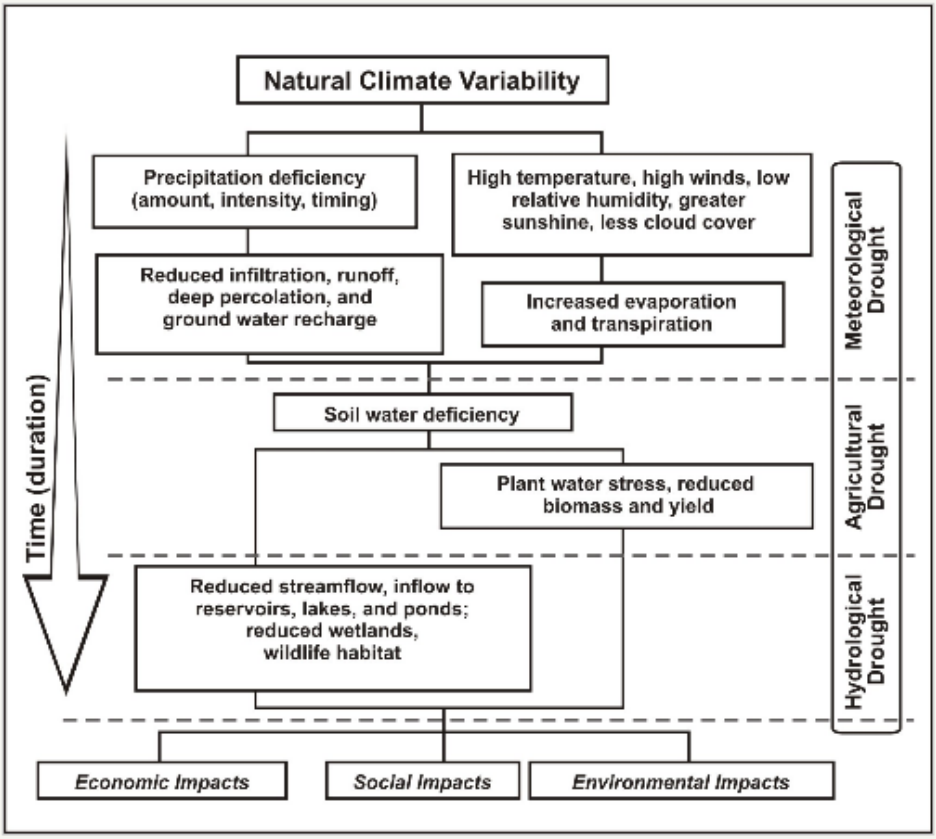
Meteorological: Defined by the degree of dryness (as compared to an average) and the duration of the dry period. These are region-specific and only appropriate for regions characterized by year-round precipitation.

Hydrological: Associated with the effects of periods of precipitation shortfalls (including snow) on surface or subsurface water supply, including stream flow, reservoir and lake levels, and groundwater. Impacts of hydrological droughts do not emerge as quickly as meteorological and agricultural droughts. For example, deficiency on reservoir levels may not affect hydroelectric power production or recreational uses for many months.

Agricultural: Links characteristics of meteorological or hydrological drought to agricultural impacts. An agricultural drought accounts for the variable susceptibility of crops during different stages of crop development from emergence to maturity.

Socioeconomic: Links the supply and demand of some economic good, e.g. water, forage, food grains, and fish, with elements of meteorological, hydrological, or agricultural droughts. This type of drought occurs when demand for an economic good exceeds supply as a result of weather-related shortfall in water supply.

Figure 4-43: Sequence of Drought Occurrence and Impacts



Sequence of drought occurrence and impacts for commonly accepted drought types. All droughts originate from a deficiency of precipitation or meteorological drought but other types of drought and impacts cascade from this deficiency. (Source: National Drought Mitigation Center, University of Nebraska-Lincoln, U.S.A.)

A drought refers to an extended period of deficient rainfall relative to the statistical mean for a region. Drought can be defined according to meteorological, hydrological, socioeconomic, and agricultural criteria. Meteorological drought is qualified by any significant deficit of precipitation. Hydrological drought is manifest in noticeably reduced river and stream flow and critically low groundwater tables. The term agricultural drought indicates an extended dry period that results in crop stress and harvest reduction. Socioeconomic drought refers to the situation that occurs when water shortages begin to affect people and their lives. It associates economic goods with the elements of meteorological, agricultural, and hydrological drought. Many supplies of economic goods (e.g., water, food grains, and hydroelectric power) are greatly dependent on the weather. Due

to natural variations in climate, water supplies are high in some years but low in others. Fluctuating long-term climate variations make drought difficult to predict.

Drought is a climatic phenomenon that occurs in Marshall County. The meteorological condition that creates a drought is below-normal rainfall. Excessive heat, however, can lead to increased evaporation, which will enhance drought conditions. Droughts can occur in any month. Drought differs from normal arid conditions found in low-rainfall areas. Drought is the consequence of a reduction in the amount of precipitation over an undetermined length of time (usually a growing season or more). Drought conditions are often accompanied by extreme heat, which is defined as temperatures that hover 10º F or more above the average high for the area and last for several weeks. Extreme heat can occur in humid conditions when high atmospheric pressure traps the damp air near the ground or in dry conditions, which often provoke dust storms.

The severity of a drought depends on location, duration, and geographical extent. Additionally, drought severity depends on the water supply, usage demands made by human activities, vegetation, and agricultural operations. Drought brings several different problems that must be addressed. The quality and quantity of crops, livestock, and other agricultural assets will be affected during a drought. Drought adversely can impact forested areas, leading to an increased potential for extremely destructive forest and woodland fires that could threaten residential, commercial, and recreational structures.

The Palmer Drought Severity Index (PDSI), developed by W.C. Palmer in 1965, is a soil moisture algorithm utilized by most federal and state government agencies to trigger drought relief programs and responses. The objective of the PDSI is to provide standardized measurements of moisture, so that comparisons can be made between locations and periods of time—usually months. The PDSI is designed so that a -4.0 in Indiana has the same meaning in terms of the moisture departure from a climatological normal as a -4.0 does in South Carolina.

The U.S. Drought Monitor (USDM) provides a national assessment on drought conditions in the United States. The following table is a reference from the classification scheme provided by the USDM, and the correlation between PDSI and the category, descriptions, and possible impacts associated with those level events. This classification is often used to refer to the severity of droughts for statistical purposes. The USDM provides weekly data for each county, noting the percent of land cover in the condition of the drought category identified below.

Table 4-34: USDMX

Category	Description	Possible Impacts	Palmer Drought Severity Index
D0	Abnormally Dry	Going into drought: -short-term dryness slowing planting, growth of crops or pastures. Coming out of drought: some lingering water deficits	-1.0 to -1.9
D1	Moderate Drought	-Some damage to crops, pastures -Streams, reservoirs, or wells low, some water shortages developing or imminent -Voluntary water-use restrictions requested	-2.0 to -2.9
D2	Severe Drought	-Crop or pasture losses likely -Water shortages common -Water restrictions imposed	-3.0 to -3.9
D3	Extreme Drought	-Major crop/pasture losses -Widespread water shortages or restrictions	-4.0 to -4.9
D4	Exceptional Drought	-Exceptional and widespread crop/pasture losses -Shortages of water in reservoirs, streams, and wells creating water emergencies	-5.0 or less

In the past decade, the US has continued to consistently experience drought events with economic impacts greater than $1 billion; FEMA estimates that the nation's average annual drought loss is $6 billion to $8 billion. For Indiana alone, the National Drought Mitigation Center reported hundreds of drought impacts in the past decade ranging from water shortage warnings to reduced crop yields and wild fires.

Droughts are natural events that can potentially lead to fires. This plan will identify four major categories of fires within the county: tire fires, structural fires, wildfires, and arson.

Fires

Fires pose a significant threat throughout the United States. According to the National Fire Protection Agency, in 2014, the United States fire department responded to an estimated 1,298,000 fires. As a direct result of these fires, 3,275 civilians died, 15,775 civilians suffered fire injuries and an estimated $11.6 billion was consumed in property damages caused by fires. During 2014, every 2 hours and 41 minutes a civilian died in a fire related incident, and every 33 minutes a civilian was injured in a fire. Despite the multitude of fire related casualties suffered in 2014, the number of fire hazards per year has actually declined compared to 1977 when over 3,264,500 fires occurred. The U.S. Fire Administration offers fire prevention and public education outreach materials and educational programs in order further diminish the number of yearly fire casualties.

Tire Fires

The state of Indiana generates thousands of scrap tires annually. Many of those scrap tires end up in approved storage sites that are carefully regulated and controlled by federal and state officials. However, scrap tires are sometimes intentionally dumped in unapproved locations throughout the state. Marshall County is part of the Southeastern Indiana Recycling District. Used tires can be brought to the Marshall County Recycling Center in Osgood for disposal. The number of unapproved locations where tires have been dumped cannot be readily determined. Illegal dumping sites are owned by private residents who have been continually dumping waste and refuse, including scrap tires, at those locations for many years. Some lonely areas may be utilized as sites for dumping without the property owners' knowledge or consent. Targeting abandoned properties in particular, offenders will haul debris to secluded areas for illegal waste disposal. Over time an extensive amount of garbage, including tires, accumulates at these sites.

Tire disposal sites can be fire hazards, in large part, because of the enormous number of scrap tires typically present at one site. This large amount of fuel renders standard firefighting practices nearly useless. Flowing and burning oil released by the scrap tires can spread the fire to adjacent areas. Tire fires differ from conventional fires in the following ways:

- Using water and/or foam to extinguish a tire fire is often futile although water may still be used to keep unburned tires form igniting.
- Relatively small tire fires can require significant fire resources to control and extinguish.
- Those resources often cost much more than Marshall County government can absorb compared to standard fire responses.
- There may be significant environmental consequences of a major tire fire. Extreme heat can convert a standard vehicle tire into approximately two gallons of oily residue that may leak into the soil or migrate to streams and waterways.

Structural Fires

Lightning strikes, poor building construction, and building condition are the main causes for most structural fires in Indiana. In 2014, approximately 74% of all structural fires took place in the home. According to the National Fire Protection Association, home fires account for 84% of civilian fire deaths in 2014. Neighborhoods and cities where buildings are constructed close together or attaching face particular risks from spreading fires. Structural fires and wildfires have both been

known to unexpectedly jump across streets and even extend across freeways igniting buildings in the surrounding vicinity and rapidly spreading.

Fires at businesses and public buildings can also cause significant damage particularly if they contain explosive or highly flammable materials. The fire at the Advanced Magnesium Alloys Corp. in Anderson, Indiana in 2005 demonstrates the dangers posed by industrial fires. The fire erupted on a skid holding 6,000 pounds of magnesium, which is a highly flammable metal that releases toxic fumes when ignited. Winds drove the smoke and toxic fumes south into a neighborhood forcing authorities to evacuate about 5,000 people. Since water can cause a flare-up or explosion, firefighters use dry sand to combat magnesium fires. Explosions forced fighters out of the company plant. Running low on sand, firefighters were forced to let the fire burn itself out. Late on Saturday the next day, the U.S. Environmental Protection Agency finally deemed the air quality safe for evacuees to return to their homes. The fire that erupted at the Advanced Magnesium Alloys Corp. in Anderson, Indiana serves as a cautionary example of the need to prepare for the possibility of company fires and identify their potential risks.

Several structural fires break out in Marshall County each year.

Wildfires

Approximately 35% to 55% of Indiana's land base is heavily wooded or forested. When hot and dry conditions develop, forests may become vulnerable to devastating wildfires. In the past few decades an increased commercial and residential development near forested areas has dramatically changed the nature and scope of the wildfire hazard. In addition, the increase in structures resulting from new development strains the effectiveness of the fire service personnel in the county. The National Weather Service in Louisville, Ky issues fire weather planning forecasts for central Kentucky and southern Indiana. During the fire weather seasons from February 15 - April 30th and October 1st - December 15, narrative forecasts are issuded at 4:00 AM and 4:00 PM Eastern time.

Arson

It is important to note that arson is a contributing factor to fire-related incidents within the county. According to the United States Fire Administration, approximately 22% of the total fires reported in the nation from 2001 to 2002 were of incendiary or suspicious nature. In a study of serial arsonists, the National Criminal Justice Reference Service identified the most common motives for settings as revenge, followed by excitement, vandalism, profit, and other crime concealment.

Drought History in Marshall County

The NCDC database did not report any recent drought events in Marshall County since the last Hazard Mitigation Plan in 2009; however, the National Drought Mitigation Center and the Indiana Drought Monitor recorded multiple drought events in the area. The Marshall County Board of Commissioners declared a state of emergency due to drought conditions on October 30, 2010. Due to the drought conditions, the Marshall County Board of Commissioners invoked the provisions of IC 10-14-3-29 and issued an open burning ban since the drought conditions created an elevated risk for potential widespread fire hazards.

The United States Department of Agriculture issued a drought declaration for Marshall County during the drought of 2012. At the peak of the drought, the county experienced a category D3 drought for seven weeks. Along with more than half of Indiana, Marshall County had open burn bans and was declared eligible for small-business administration(SBA) loans.

After the 2012 drought, Marshall County experienced category D0 events that impacted the county from September 3 through December 23, 2013, August 5 through September 1, 2014, and April 7 through June 8, 2015. The National Drought Mitigation Center did not record any impacts in Marshall County for these events, but crops and pastures are commonly affected during D0 drought.

From October 2015 through December 2015, Marshall County underwent eleven weeks of level D1 drought that negatively impacted soybeans, winter wheat, and pastures. In the summer of 2016, Marshall County endured periods of D0 drought during June 7th through July 25th and again from August 9th through 15th. The low rainfall stressed lawns and caused pastures to brown across Marshall County. The dry weather also stressed crops in both June and August 2016.

Vulnerability and Future Development

Drought impacts, as described in the drought history section, are a threat across the entire jurisdiction; therefore, the county is vulnerable to this hazard and can expect the same impacts within the affected area. Future development will remain vulnerable to drought events since all areas of the county are vulnerable to drought. Typically, some urban and rural areas are more susceptible than others. For example, urban areas are subject to water shortages during periods of drought. Excessive demands of the populated area place a limit on water resources. In rural areas,

crops and livestock may suffer from extended periods of heat and drought. Dry conditions can lead to the ignition of wildfires that could threaten residential, commercial, and recreational areas.

The hazard ranking of drought in Marshall County is moderate. Droughts in Marshall County are of particular concern because of the potential for forest fires as well as the impacts to lake levels and agricultural harvests.

Relationship to other Hazards

Wildfires - A drought situation can significantly increase the risk of wildfire.

Extreme Temperatures - A drought situation can significantly increase with long periods of high temperatures.

Plans and Programs in Place

Well Monitoring - The Marshall County SWCD routinely monitors wells throughout the county for water levels for groundwater levels.

EMS Training – The Marshall County Emergency Medical Service (EMS) provides full emergency service over 420 square miles and is dedicated to the preservation of life and quality of life and the education of the public in areas of life preservation.

Livestock Disaster Assistance Programs – The 2014 Farm Bill, alternatively known as the Agriculture Act of 2014, allows the Livestock Forage Program to provide compensation to eligible producers who suffered grazing losses due to drought and fire.

Program Gaps or Deficiencies

No program gaps or deficiencies were identified.

Winter Storms: Blizzards, Ice Storms, Snowstorms

Hazard Description

Severe winter weather consists of various forms of precipitation and strong weather conditions. This may include one or more of the following: freezing rain, sleet, heavy snow, blizzards, icy roadways, extreme low temperatures, and strong winds. These conditions can cause human-health risks such as frostbite, hypothermia, and death.

Ice Storms

Ice or sleet, even in the smallest quantities, can result in hazardous driving conditions and can be a significant cause of property damage. Sleet can be easily identified as frozen raindrops. Sleet does not stick to trees and wires. The most damaging winter storms in Indiana have been ice storms. Ice storms are the result of cold rain that freezes on contact with objects having a temperature below freezing. Ice storms occur when moisture-laden gulf air converges with the northern jet stream, causing strong winds and heavy precipitation. This precipitation takes the form of freezing rain, coating power lines, communication lines, and trees with heavy ice. The winds then will cause the overburdened limbs and cables to snap, leaving large sectors of the population without power, heat, or communication. Falling trees and limbs also can cause building damage during an ice storm. In the past few decades, numerous ice-storm events have occurred in Indiana.

Snowstorms

Significant snowstorms are characterized by the rapid accumulation of snow, often accompanied by high winds, cold temperatures, and low visibility. A blizzard is categorized as a snowstorm with winds of 35 miles an hour or greater and/or visibility of less than one-quarter mile for three or more hours. The strong winds during a blizzard blow about falling and already existing snow, creating poor visibility and impassable roadways. Blizzards have the potential to result in property damage.

Indiana has been struck repeatedly by blizzards. Blizzard conditions not only cause power outages and loss of communication, potentially for days, but can also make transportation difficult. The blowing of snow can reduce visibility to less than one-quarter mile, and the resulting disorientation makes even travel by foot dangerous, if not deadly.

Damages from blizzards can range from significant snow removal costs to human and livestock deaths. Because of the blinding potential of heavy snowstorms, drivers are also at risk of collisions

with snowplows or other road traffic. Stranded drivers can make uninformed decisions, such as leaving the car to walk in conditions that put them at risk. Drivers and homeowners without emergency plans and kits are vulnerable to the life-threatening effects of heavy snow storms such as power outages, cold weather, and inability to travel, communicate, obtain goods or reach their destinations. Heavy snow loads can cause structural damage, particularly in areas where there are no building codes or for residents living in manufactured home parks.

Winter Storm History in Marshall County

Winter weather hazards are prevalent natural events that can be expected to occur every winter in Indiana. The winter of 2013-2014 ranked among the coldest on record throughout the Midwest. The National Weather Service reported this season as "one of the coldest and snowiest winter seasons on record and certainly one of the most extreme winter seasons in several decades." NOAA's National Climatic Data Center stated that the period from December 2013 through February 2014 was the 34th coldest for the contiguous 48 states since 1895.

NCDC began recording winter storm events in 1996; therefore, historical NCDC Winter Storm data from prior years is not available. The While there have been relatively few winter storms over this timeframe, it should be noted that precipitation types vary significantly throughout the course of each storm. Each type of precipitation carries its own dangers which are combined when multiple types occur in an individual storm. There have been 20 winter events recorded in the hazard-recorded data provided by the NWS and NOAA.

Table 4-35: NOAA Winter Storms

Date	Date
12/14/2013	1/5/2015
12/16/2013	2/4/2015
1/31/2013	2/14/2015
3/24/2013	2/18/2015
1/5/2014	3/1/2015
1/17/2014	3/4/2015
1/18/2014	1/10/2016
11/16/2014	2/8/2016
11/22/2014	2/14/2016
3/2/2014	

Source: National Climatic Data Center

Relationship to other Hazards

Flooding - Melting from heavy snows can cause localized flooding which can impact property and infrastructure such as roads.

Wildland or Structural Fire - Heavy storms that result in large amounts of downed timber can result in an increase of dead or dying trees left standing, thus providing an increased fuel load for a wildfire. There is an additional risk of increased frequency of structural fires during heavy snow events, primarily due to utility disruptions and the use of alternative heating methods by residents.

Public Safety - Drivers stranded in snowstorms may make uninformed decisions that can put them at risk; residents who are unprepared or vulnerable may not be able to obtain goods or reach their destinations. EMS providers may be slowed by road conditions to respond to emergencies. Ice storms may result in power outages due to downed power lines, putting people at risk for cold temperature exposure and reducing the ability to spread emergency messages to the public via television, radio or computer.

The collision of cold and warm temperatures can create dense fog causing hazardous conditions for drivers and public service providers. Widespread dense fog developed across much of Northern Indiana during the morning hours of January 12, 2005. Visibility was reported to be at or near zero in many locations and numerous accidents were reported as a result of the fog.

Plans and Programs in Place

Snow Removal - The Marshall County Transportation Department has capabilities for snow removal and highway treatment in order to maintain safe winter driving conditions. The department carries out snow removal and ice control operations. Paved routes within Marshall County receive priority for snow plowing. INDOT handles snow removal on trunk highways within Marshall County. The county has agreements with several townships to do snow plowing. All other city and township jurisdictions either have their own equipment for snow removal or contract for services to do so.

Backup Power - In the courthouse complex there is an emergency generator for the jail, and from that power can be provided to serve the courthouse, boiler room and I.T. office. Across the street there is a small emergency generator that will serve to power EMS, fire and police radio systems. In

the city of Marshall, the fire department has portable generators, one of which is dedicated to water supply and another that can be located as needed.

Burying Power Lines - Burying power lines helps eliminate loss of power due to snow and ice storms. Mille Lacs Energy Cooperative and Lake County Power work to accommodate requests for installation of underground power lines to residents or businesses receiving connection of new power in areas where it is feasible. East Central Energy buries lines in areas where it makes sense to do so, but does not offer this as a regular customer option. *NOAA Weather Radio Transmitter Towers*- The National Weather Service delivers storm warnings and key information during severe winter weather events over its radio towers. The extreme southeastern part of Marshall County is covered by Pine County. Most of the rest of the county is covered by the Marshall transmitter which is located southeast of the city of Marshall. The Coleraine transmitter covers the extreme northeastern part of the county.

School Closings - All school districts within Marshall County have a school closing policy and communications plan in place if inclement weather or temperatures create a hazardous situation for students or staff. Schools have notification systems which allow them to notify all families who are registered in the school system with up-to-date information.

Public Warning and Notification- In the event of emergencies or hazardous conditions that require timely and targeted communication to the public, Marshall County utilizes the CodeRED Mass Notification System and the Marshall County Sheriff's Office Facebook page as well as local news media. Marshall County promotes the use of NOAA weather radios by critical facilities and the public to receive information broadcast from the National Weather Service.

Public Education and Awareness - Marshall County promotes the National Weather Service's "Winter Hazard Awareness Week" held in November each year. The event seeks to educate residents on the dangers of winter weather and how to properly deal with it.

Program Gaps or Deficiencies

Backup Power - Not all county facilities have backup power in the event of a disaster.

4.6 Wildfire

Hazard Description

The hazard extent of wildfires is greatest in the heavily forested areas of southern Indiana. The IDNR Division of Forestry assumes responsibility for approximately 7.3 million acres of forest and associated wild lands, including state and privately-owned lands. Indiana's wildfire seasons occur primarily in the spring—when the leaf litter on the ground dries out and before young herbaceous plants start to grow and cover the ground (green up)—and in the fall—after the leaves come down and before they are wetted down by the first heavy snow. During these times, especially when weather conditions are warm, windy, and with low humidity, cured vegetation is particularly susceptible to burning. When combined, fuel, weather, and topography, present an unpredictable danger to unwary civilians and firefighters in the path of a wildfire. Human action can not only intervene to stop the spread of wildfires, but can also mitigate their onset and effects. Forest and grassland areas can be cleared of dry fuel to prevent fires from starting and can be burned proactively to prevent uncontrolled burning.

Wildfire History in Marshall County

There have been no recently recorded wildfires or damage from wildfires reported to the county.

Vulnerability and Future Development

Heavily wooded areas are most vulnerable to wildfire where agricultural fields can be susceptible to brushfires. At the same time, they provides benefits to the ecosystem and society. Future development along heavily wooded areas may remain more vulnerable to wildfire events.

Relationship to other Hazards

Drought and Extreme Heat - Dry, hot conditions can reduce the protective moisture of woodlands and increase the risk of wildfire. Heat stress is a common side effect of fires that can be acerbated by already extreme temperatures.

Hazardous Material Release – Most hazardous material is flammable, volatile, highly incendiary, and some are potentially explosive. Wildfire that spreads to a facility or vehicle handling Hazmat poses increased safety and health hazards. Conversely, hazmat release can in turn trigger wildfires setting off a chain reaction of hazards.

Public Safety - Anyone exposed to extreme heat can develop heat exhaustion and heat stroke. The elderly, children and those who engage in outdoor work or recreation may be most susceptible to the danger of extreme heat.

Plans and Programs in Place

There are no existing plans or programs in place for wildfires.

4.7 Extreme Temperatures

Extreme temperatures are a dynamic hazard in that in the incident of multiple hazards the impact become compounded. In the event of a winter blizzard, followed by a utility failure, an extreme cold event would be a very concerning situation for officials and many populations.

Hazard Description

Severe Cold

What constitutes an extreme cold event, and its effects, varies by region across the US. In areas unaccustomed to winter weather, near freezing temperatures are considered "extreme cold." Extreme cold temperatures are typically characterized by the ambient air temperature dropping to approximately zero degrees Fahrenheit or below.

Exposure to cold temperatures—indoors or outdoors—can lead to serious or life-threatening health problems, including hypothermia, cold stress, frostbite or freezing of the exposed extremities, such as fingers, toes, nose, and earlobes. Certain populations—such as seniors age 65 or older, infants and young children under five years of age, individuals who are homeless or stranded, or those who live in a home that is poorly insulated or without heat (such as mobile homes) — are at greater risk to the effects of extreme cold.

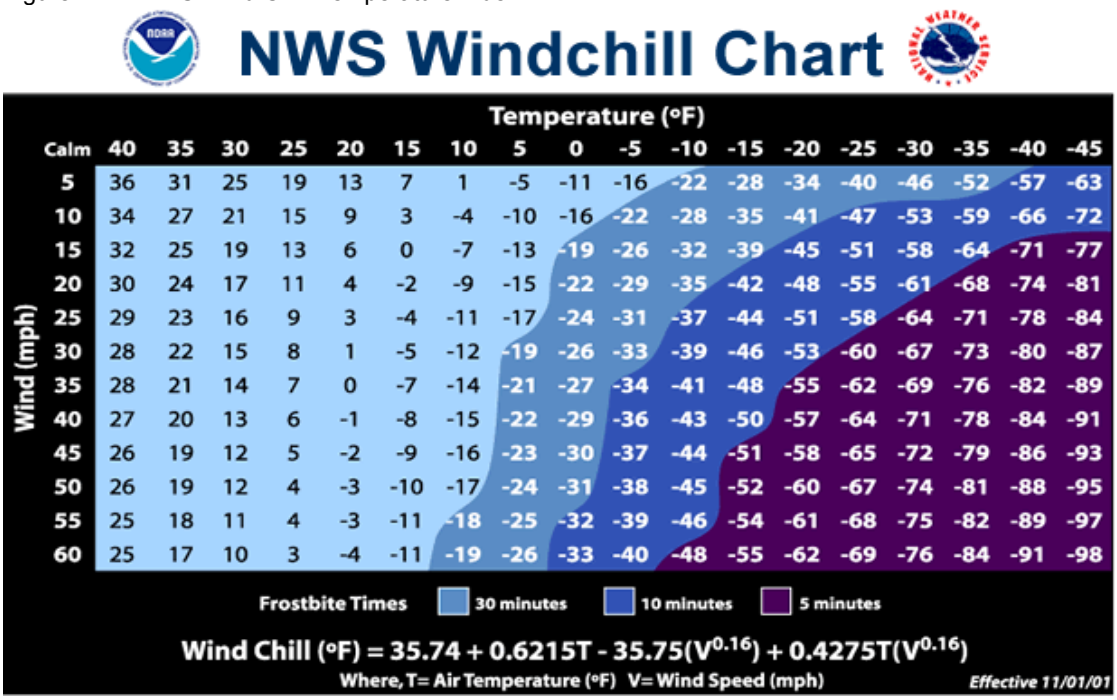
Extremely cold temperatures often accompany a winter storm, so individuals may also have to cope with power failures and icy roads. Although staying indoors can help reduce the risk of vehicle accidents and falls on the ice, individuals are susceptible to indoor hazards. Homes may become too cold due to power failures or inadequate heating systems. The use of space heaters and fireplaces to keep warm increases the risk of household fires, as well as carbon monoxide poisoning.

The magnitude of extreme cold temperatures is generally measured through the Wind Chill Temperature (WCT) Index. WCT are the temperatures felt outside and is based on the rate of heat

loss from exposed skin by the effects of wind and cold. As the wind increases, the body is cooled at a faster rate causing the skin's temperature to drop.

In 2001, the NWS implemented a new WCT Index, designed to more accurately calculate how cold air feels on human skin. The index, shown in Figure 4-44, includes a frostbite indicator, showing points where temperature, wind speed, and exposure time will produce frostbite in humans.

Figure 4-44: NWS Wind Chill Temperature Index



Each National Weather Service Forecast Office may issue the following wind chill-related products as conditions warrant:

- Wind Chill Watch: Issued when there is a chance that wind chill temperatures will decrease to at least 24° F below zero in the next 24-48 hours.
- Wind Chill Advisory: Issued when the wind chill could be life threatening if action is not taken. The criteria for this advisory are expected wind chill readings of 15° F to 24° F below zero.
- Wind Chill Warning: Issued when wind chill readings are life threatening. Wind chill readings of 25° F below zero or lower are expected.

Extreme Heat

Human beings need to maintain a constant body temperature if they are to stay healthy. Working in high temperatures induces heat stress when more heat is absorbed into the body than can be

dissipated out. Heat illness such as prickly heat, fainting from heat exhaustion, or heat cramps are visible signs that people are working in unbearable heat. In the most severe cases, the body temperature control system breaks down altogether and body temperature rises rapidly. This is a heat stroke, which can be fatal. The NWS issues a heat advisory when, during a 24-hour period, the temperature ranges from 105°F to 114°F during the day, and remains at or above 80°F at night.

Heat is the leading weather-related killer in the United States, even though most heat-related deaths are preventable through outreach and intervention (see EPA's Excessive Heat Events Guidebook at: www.epa.gov/heatisland/about/pdf/EHEguide_final.pdf). According to the National Oceanic and Atmospheric Administration, the summer of 2016 was one of the five hottest on record dating to the late 19th century.

Unusually hot summer temperatures have become more frequent across the contiguous 48 states in recent decades1 (see the High and Low Temperatures indicator), and extreme heat events (heat waves) are expected to become longer, more frequent, and more intense in the future. As a result, the risk of heat-related deaths and illness is also expected to increase.

Older adults have the highest risk of heat-related death, although young children are also sensitive to the effects of heat. Across North America, the population over the age of 65 is growing dramatically. People with certain diseases, such as cardiovascular and respiratory illnesses, are especially vulnerable to excessive heat exposure, as are the economically disadvantaged.

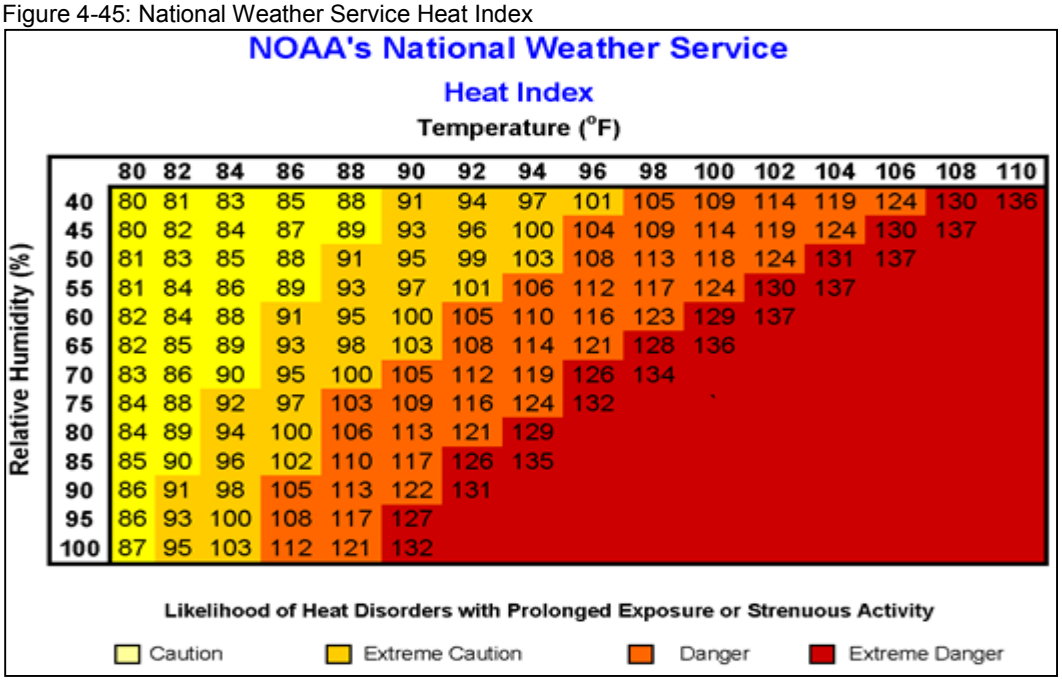
Temperatures that hover 10 degrees Fahrenheit or more above the average high temperature for a region, and last for several weeks, constitute an extreme heat event (EHE). An extended period of extreme heat of three or more consecutive days is typically referred to as a heat wave. Most summers see EHEs in one or more parts east of the Rocky Mountains. They tend to combine both high temperatures and high humidity; although some of the worst heat waves have been catastrophically dry.

Prolonged exposure to extreme heat may lead to serious health problems, including heat stroke, heat exhaustion, or sunburn. Certain populations — such as seniors age 65 and over, infants and young children under five years of age, pregnant women, the homeless or poor, the obese, and people with mental illnesses, disabilities, and chronic diseases — are at greater risk to the effects of extreme heat. Depending on severity, duration, and location, EHEs can also trigger secondary hazards, including dust storms, droughts, wildfires, water shortages, and power outages.

Criteria for EHE typically shift by location and time of year, and are dependent on the interaction of multiple meteorological variables (i.e., temperature, humidity, cloud cover). While this makes it difficult to define EHEs using absolute, specific measures, there are ways to identify conditions. Some locations evaluate current and forecast weather to identify conditions with specific, weather-based mortality algorithms. Others identify and forecast conditions based on statistical comparison to historical meteorological baselines that are the criteria for EHE conditions could be an actual or forecast temperature that is equal to or exceeds the 95th percentile value from a historical distribution for a defined time period.

Heat alert procedures are based primarily on Heat Index Values. The Heat Index—given in degrees Fahrenheit—is often referred to as the apparent temperature and is a measure of how hot it really feels when the relative humidity is factored with the actual air temperature. The National Weather Service Heat Index Chart can be seen in Figure 4-45.

Figure 4-45: National Weather Service Heat Index



Source: Office of Atmospheric Programs. (2006). Excessive Heat Events Guidebook. Unites States Environmental Protection Agency. Washington, D.C.

Each National Weather Service Forecast Office may issue the following heat-related products as conditions warrant:

- Excessive Heat Outlooks- issued when the potential exists for an EHE in the next 3-7 days. An Outlook provides information to those who need considerable lead time to prepare for the event, such as public utility staff, emergency managers, and public health officials.

- Excessive Heat Watches- issued when conditions are favorable for an EHE in the next 24 to 72 hours. A Watch is used when the risk of a heat wave has increased but its occurrence and timing is still uncertain. A Watch provides enough lead time so that those who need to prepare can do so, such as city officials who have excessive heat mitigation plans.
- Excessive Heat Warnings/Advisories- issued when an EHE is expected in the next 36 hours. These products are issued when an excessive heat event is occurring, is imminent, or has a very high probability of occurring. The warning is used for conditions posing a threat to life or property. An advisory is for less serious conditions that cause significant discomfort or inconvenience and, if caution is not taken, could lead to a threat to life and/or property.

Extreme Temperature History in Marshall County

Summer temperatures in Marshall have reached 100ºF (August 1976). July is the warmest month, with an average high of 80ºF (The Weather Channel, 2014).

Although the NCDC database does not include any reported past occurrences of excessive heat, residents of Marshall County should be prepared for such an event in any given year.

The NWS and NOAA identified extreme cold/wind chill events on January 6, 2014 and January 8, 2015.

Relationship to other Hazards

Drought and Wildfire - Dry, hot conditions can reduce the protective moisture of woodlands and increase the risk of wildfire.

Public Safety - Anyone exposed to extreme heat can develop heat exhaustion and heat stroke. The elderly, children and those who engage in outdoor work or recreation may be most susceptible to the danger of extreme heat.

Plans and Programs in Place

School Closings - All school districts in Marshall County have a school closing policy and communications plan in place if inclement weather or temperatures create a hazardous situation for students or staff. Schools have notification systems, which allow them to notify all families who are registered in the school system with up-to-date information.

Public Warning and Notification - In the event of emergencies or hazardous conditions that require timely and targeted communication to the public, Marshall County utilizes the CodeRED Mass

Notification System and the Marshall County Sheriff's Office Facebook page, as well as local news media. Marshall County promotes the use of NOAA weather radios by critical facilities and the public to receive information broadcast from the National Weather Service.

Program Gaps or Deficiencies

No program gaps or deficiencies were identified.

4.8 Harmful Organisms and Infectious Agents

Hazard Description

The spread of harmful organisms and infectious diseases are occasionally overlooked, potential natural hazards that can be exacerbated following other natural disasters.

Emerald Ash Borer

The Emerald ash borer (EAB), *Agrilus planipennis*, is an exotic beetle thought to have arrived in the United States by 2002 and was discovered near Detroit, Michigan. Indiana was one of the second states recognized to have the beetle, having been discovered in northern Indiana in 2004. The adult beetles do not pose harm to the ash trees, as they nibble on ash foliage. The immature, or larvae stage, feed on the inner bark of the ash trees, disrupting its ability to transport nutrients and water. The EAB is responsible for killing millions of ash trees in North America. It has cost municipalities, property owners, nursey owners, and forest industries millions of dollars.

Vector-Borne Illness

Vector-borne diseases are caused by infectious microorganisms and transmitted to people via living organisms including blood-sucking arthropods such as mosquitos, ticks, fleas, and spiders. Natural disasters, particularly meteorological events such as cyclones, hurricanes, and flooding, can influence transmission of vector-borne disease. The crowding of infected and vulnerable hosts, a debilitated public health infrastructure, and disruptions of ongoing control processes are risk factors for transmission of vector-borne disease. The Indiana State Department of Health (ISDH) identifies sleeping sickness (Eastern equine encephalitis virus), La Crosse encephalitis (La Crosse virus), St. Louis encephalitis (St. Louis encephalitis virus), West Nile fever (West Nile virus), and dengue fever (dengue virus), as mosquito-borne diseases that Hoosiers should take steps to protect themselves against.

The health department has also reported more than 200 cases of tick-borne illness in Indiana in 2016 alone. The ISDH highlighted Lyme disease, Rocky Mountain spotted fever, and Erlichiosis as tick-borne diseases particularly prevalent in Indiana. Over the past few years, Indiana has experienced a rise in tick-borne Lyme disease. There were approximately 100 confirmed cases of Lyme disease in 2014, but only 26 cases in 2006. Increased summer tick populations frequently follow mild winters, and back-to-back mild winters can cause a notable surge in tick numbers, along with the diseases they carry. In June of 2017, a young Indiana girl died after contracting Rocky Mountain spotted fever from a tick bite. Recently, a new tick-transmitted virus has made headlines through the state. The Centers for Disease Control confirmed two cases of Heartland virus in Indiana. Both infected patients survived.

Infections Connected to Intravenous Drug Use

In January 2015, Indiana Disease Intervention Specialists (DIS) identified 11 new HIV cases linked to a rural county in southeastern Indiana that previously had <5 new HIV cases per year. This prompted a complex outbreak investigation in order to identify additional cases and contacts potentially exposed. In addition, as of June 1, 2015, a total of 166 (163 confirmed and three preliminary positive) individuals linked to this outbreak have tested positive for HIV, and >80% are also infected with hepatitis C virus (HCV). The vast majority of these individuals reported injecting oxymorphone and sharing needles.

Harmful Organisms and Infectious Agents Outbreak History in Marshall County

Emerald Ash Borer

On December 7, 2009, Marshall County was added to the list of counties that contain the EAB and the county was placed under quarantine.

Vulnerability and Future Development

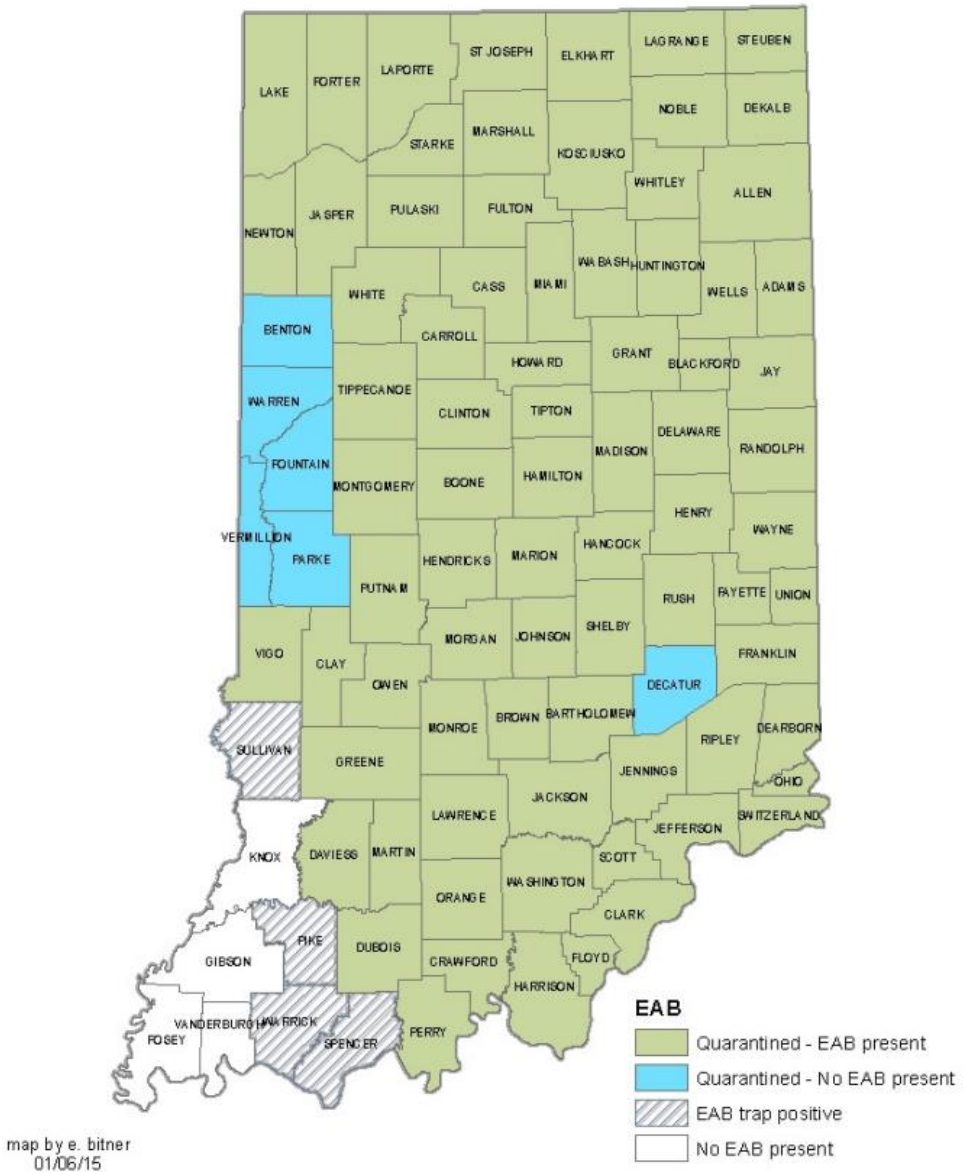
Future development will remain vulnerable to these events. EABs have killed millions of ash trees in Indiana, Michigan, Illinois, Ohio, and Ontario and will continue to do so until the insects are effectively contained or eliminated or a strain of more resistant trees is developed.

According to the National Institute of Allergy and Infectious Diseases, tick-borne illnesses will continue to remain a problem as people build homes in wilderness areas where ticks and their

animal hosts live; however, urban environments can also host ticks and the pathogens they can transmit.

All communities can be potentially at risk for an epidemic and experience increased risk during hazards the cause displacement, contamination of the water supply, and/or deprivation of essential utilities, or when residents are not exposed to educational resources outlining preventive steps.

Figure 4-46: Emerald Ash Borer Quarantine in Indiana

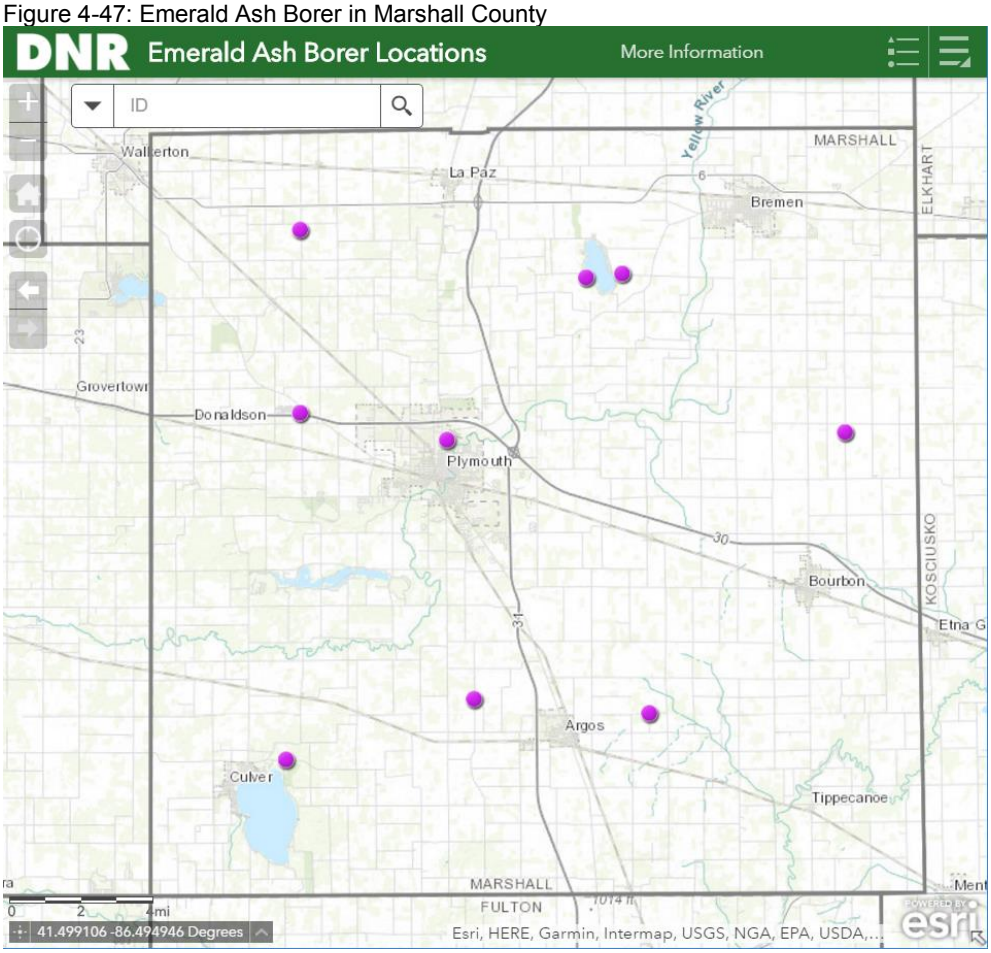


Risk Analysis

Exposure Analysis

The reported identification of the Emerald Ash Borer in Marshall County is identified in Figure 4-47 and reveals that Emerald Ash Borers have been spotted throughout the county.

Figure 4-47: Emerald Ash Borer in Marshall County



An exposure analysis identifies the existing and future assets located in identified hazard areas.

Relationship to other Hazards

The risk for infectious disease transmission is primarily associated with displacement and the characteristics of the displaced population, the proximity of sterile water and function restrooms, the nutritional status of the displaced, the level of immunity to vaccine-preventable infections, and the availability of access to healthcare services.

Flooding – Increased risk of vector-borne diseases. EAB-damaged trees may pose a risk for increased logjam events. In the aftermath of flooding, a plethora of standing water combined with a possibly weakened health infrastructure and an interruption of ongoing control programs increases the risk factors for vector-borne disease transmission. While initial flooding may wash away existing mosquito-breeding sites, standing water caused by heavy rainfall or overflow of rivers can create new breeding sites.

Earthquake – In the aftermath of earthquakes, some populations have experienced infection outbreaks associated with increased exposure to airborne dust from landslides.

Tornadoes – Natural disasters, like tornadoes, that affect communities on a large-scale and cause displacement have been associated with an increased risk in disease.

Utility Failure – Power outages and the disruption of water treatment and supply plants can affect the proper functioning of health facilities and has also been linked with an increase in diarrheal illness.

Plans and Programs in Place

Emerald Ash Borer

Once the EAB is identified, the quarantine is put in place which restricts the movement of regulated ash materials, including any ash tree, limb, branch or debris of an ash tree at least 1 inch in diameter, ash log or untreated ash lumber with bark attached, or cut firewood of any hardwood species outside of the affected county. Along with the state-level quarantine, all of Indiana is under a federal quarantine that prohibits moving regulated ash material out of Indiana without a compliance agreement or permit from the USDA Animal and Plant Health Inspection Service.

The Purdue Extension and IDNR Division of Forestry provides a plethora of excellent resources for homeowners and managers.

There are other invasive species in Indiana that can also pose a concern, such as the Gypsy Moth and Asian long horned beetle. The IDNR requests that any sighting of the beetle or trees with signs of damage are reported to the State Epidemiologist.

Note the date and location where you found the beetle or damaged tree.
Capture the beetle in a plastic jar and place it in the freezer to kill it.
Carefully wrap the beetle and send it to:

Indiana Department of Natural Resources
Division of Entomology and Plant Pathology
402 West Washington Street, Room W290
Indianapolis, IN 46204-2739

Vector-Borne Diseases

In order to help control mosquito populations, the Centers for Disease Control and Prevention recommends draining all standing water left outdoors. Typically, responding effectively to a disaster-affected population requires, among other steps, a disease risk assessment that evaluates the diseases that are common in the area, living conditions of the affected population such as the degree of exposure and density of settlements, availability of safe water and adequate sanitation facilities, access to healthcare, and effective management.

Eliminating areas of standing water may help diminish the disease-carrying mosquito population by removing areas that they like to breed. People can help protect themselves from mosquitoes that potentially carry pathogens by taking the following actions:

- avoiding places and times when mosquitoes bite, whenever possible
- using an insect repellant containing DEET (*N,N*-diethyl-*m*-toluamide)
- wearing shoes, socks, long pants, and a long-sleeved shirt when outdoors for long periods of time, or from dusk to dawn, when mosquitoes are most active
- choosing clothes that are light-colored and made of tightly woven materials to keep mosquitoes away from the skin
- making sure that all windows and doors have screens, and that all screens are in good repair
- using mosquito netting when sleeping outdoors or in an unscreened structure

In a statement, the State Health Commissioner said, "Tick bites can cause serious illness and even death, and the discovery of Heartland virus gives Hoosiers another important reason to take precautions. If you become ill after spending time outdoors, visit your health care provider immediately — especially if you found an attached tick. Prompt diagnosis of tick-borne illness helps prevent complications."

For preventive care, the ISDH recommends removing ticks immediately since ticks usually must be attached for several hours before they can transmit a pathogen. Extract attached ticks in a manner that does not leave the head embedded in the skin. Seek medical attention if a febrile illness or rash develops over the next three to four weeks.

Infections Connected to Intravenous Drug Use

As the local "eyes and ears on the ground," public health staff are critical to the identification of outbreaks. To do this, the following are important:

- Promptly report new HIV cases to the ISDH Division of HIV/STD/Viral Hepatitis.
- Promptly report new HCV cases to the ISDH Epidemiology Resources Center.
- Look for possible clusters of HIV and/or HCV: case numbers clearly above baseline, same demographics, common risk factors and contacts.
- Become familiar with local data so any increases are easily identified.
- Know who to contact for assistance and appropriate health services.

In May 2015, a law was developed to allow local health departments and law enforcement to work together to start a needle exchange program in their counties if certain local health officers declare that situational and notification parameters are met. Syringe exchange programs provide people who inject drugs with an opportunity to reduce the spread of blood-borne diseases such as HIV and Hepatitis C by encouraging them to use sterile syringes, share syringes less often, and safely dispose of used syringes. The programs serve to connect hard-to-reach people who inject drugs with important public health services, including HIV and HCV testing, substance abuse treatment, sexually transmitted disease screening and treatment, and risk-reduction counseling.

Indiana Health Codes

The Marshall County Health Department is committed to promoting public health and enhancing the quality of life and safety for all Marshall County residents and visitors by preventing, planning, and protecting against disease and injury. The Department is a highly utilized and trusted leader offering multiple public health services to better support and prepare our community. As part of its strategic approach to achieving its mission and vision, the Health Department has balanced itself to provide services to residents' health issues ranging from the following:

- Bats
- Bedbugs
- Birth/Death Records
- Ebola Virus
- Enterovirus D68
- Water Testing
- Food Service Permits
- Immunizations
- Meth
- Public Health Nuisance Complaints
- Septic Permit
- Zika Virus

The Marshall County Board of Health, including Department of Health, Environmental Sanitation, Fee Schedule, Food Establishments, Immunization Clinics, Septic Systems, Vital Records, and other resources, can be contacted at the following address:

Marshall County Health Department
510 W. Adams GL-30
Plymouth, Indiana 46563

Program Gaps or Deficiencies

No program gaps or deficiencies were identified.

4.9 Hazardous Material Release

Hazard Description

The State of Indiana has numerous active transportation lines that run through many of its counties. Active railways transport harmful and volatile substances between our borders every day. The transportation of chemicals and substances along interstate routes is commonplace in Indiana. The rural areas of Indiana have considerable agricultural commerce, creating a demand for fertilizers, herbicides, and pesticides to be transported along rural roads. Finally, Indiana is bordered by two major rivers and Lake Michigan. Barges transport chemicals and substances along these waterways daily. These factors increase the chance of hazardous material releases and spills throughout the State of Indiana.

The release or spill of certain substances can cause an explosion. Explosions result from the ignition of volatile products such as petroleum products, natural and other flammable gases, hazardous materials and chemicals, dust, and bombs. An explosion potentially can cause death, injury, and property damage. In addition, a fire routinely follows an explosion, which may cause further damage and inhibit emergency response. Emergency response may require fire, safety and law enforcement, search and rescue, and hazardous materials units.

Transportation

Roads, rails, aircrafts and pipelines, convey hazardous materials while presenting differing levels of risk of unwanted release of the hazardous materials. Transported products include hazardous materials moving from producers to users, moving between storage and use facilities, and hazardous waste moving from generators to treatment and disposal facilities.

The road and train systems in Marshall County act as transportation networks for both hazardous and nonhazardous material. Hazardous materials are transported throughout the region and between local communities as both commodities and waste. Risks of hazardous material events vary based on the classification the hazmat material being transported and the location of the road and its proximity to people and property. Along state highways and in more populated portions of the county, the risk of a major hazmat event is most severe and the damages most potent.

Meth

Methamphetamine laboratories and precursors found in a residence, apartment or motel/hotels will be ordered **unfit for human habitation** by the health department per Rule 318 IAC 1 requirements and Indiana State Department of Health guidance. These dwellings and are to be kept vacant until they are cleaned up and tested, or demolished. The Indiana Department of Environmental Management (IDEM) Rule 318 IAC 1 requires a cleanup and will not accept homeowners clean up or air out of a house as adequate. Clean up contractors and information can be found at the IDEM Website: Inspection & Cleanup of Illegal Drug Labs. The Indiana State Police maintains the listing of contaminated residences, outbuilding, vehicles & properties. A map of the properties is located in Appendix A.

Hazardous Incident History in Marshall County

Marshall County has not experienced a significantly large-scale hazardous material incident at a fixed site or during transport resulting in multiple deaths or serious injuries. However, there have been minor releases that have put local firefighters, hazardous materials teams, emergency management, and local law enforcement into action to try to stabilize these incidents and prevent or lessen harm to Marshall County residents.

Vulnerability and Future Development

The hazardous material release hazards are countywide and primarily are associated with the transport of materials by highway and/or railroad.

During a hazardous material release, the types of infrastructure that could be impacted include roadways, utility lines/pipes, railroads and bridges. The release or spill of certain substances can cause an explosion. Explosions result from the ignition of volatile products such as petroleum products, natural and other flammable gases, hazardous materials/chemicals, dust, and bombs.

An explosion potentially can cause death, injury, and property damage. In addition, a fire routinely follows an explosion, which may cause

Risk Analysis

Exposure Analysis

The extent of the hazardous material (referred to as hazmat) hazard varies in terms of the quantity of material being transported as well as the specific content of the container. Hazardous material impacts are an equally distributed threat across the entire jurisdiction; therefore the entire county is vulnerable to a hazardous material release and can expect the same impacts within the affected area. The main concern during a release or spill is the population affected. This plan will therefore consider all buildings located within the county as vulnerable.

Meth contaminated buildings per year, are tracked by the State Police, the table below identifies the total number of identified buildings in the county for the past ten years.

Table 4-36: Buildings Contaminated by Meth per Year

Year	Total	Year	Total
2007	27	**2012**	37
2008	38	**2013**	21
2009	75	**2014**	20
2010	50	**2015**	20
2011	31	**2016**	10

Combining Available Data and Methods

The Environmental Protection Agency (EPA) and the National Oceanic and Atmospheric Administration (NOAA) jointly developed a suite of software applications known as CAMEO which aid in the response to chemical emergencies. The CAMEO system integrates four separate programs that can be used together or separately. One of the programs, Areal Locations of Hazardous Atmospheres (ALOHA), is designed especially for use by people responding to chemical releases, as well as for emergency planning and training.

ALOHA generates a threat zone area where a hazard (such as toxicity or thermal radiation) has exceeded a user-specified Level of Concern (LOC). ALOHA will display up to three threat zones overlaid on a single picture. Through the development of Acute Exposure Guideline Levels (AEGLs)

are exposure guidelines designed to help responders deal with emergencies involving chemical spills or other catastrophic events where members of the general public are exposed to a hazardous airborne chemical.

AEGLs are intended to describe the health effects on humans due to once-in-a-lifetime or rare exposure to airborne chemicals. The National Advisory Committee for AEGLs is developing these guidelines to help both national and local authorities, as well as private companies, deal with emergencies involving spills or other catastrophic exposures.

- Zone 1 (AEGL 1): Above this airborne concentration of a substance, it is predicted that the general population, including susceptible individuals, could experience notable discomfort, irritation, or certain asymptomatic non-sensory effects. However, the effects are not disabling and are transient and reversible upon cessation of exposure
- Zone 2 (AEGL 2): Above this airborne concentration of a substance, it is predicted that the general population, including susceptible individuals, could experience irreversible or other serious, long-lasting adverse health effects or an impaired ability to escape
- Zone 3 (AEGL 3): Above this airborne concentration of a substance, it is predicted that the general population, including susceptible individuals, could experience life-threatening health effects or death.

Scenario

The ALOHA model was utilized to assess the area of impact for a chlorine release on the Norfolk and Southern Railway at the intersection with US 30 in Plymouth. The same location was used as the 2009 Marshall County mitigation plan in order to generate an output that could be compared to the previous analysis.

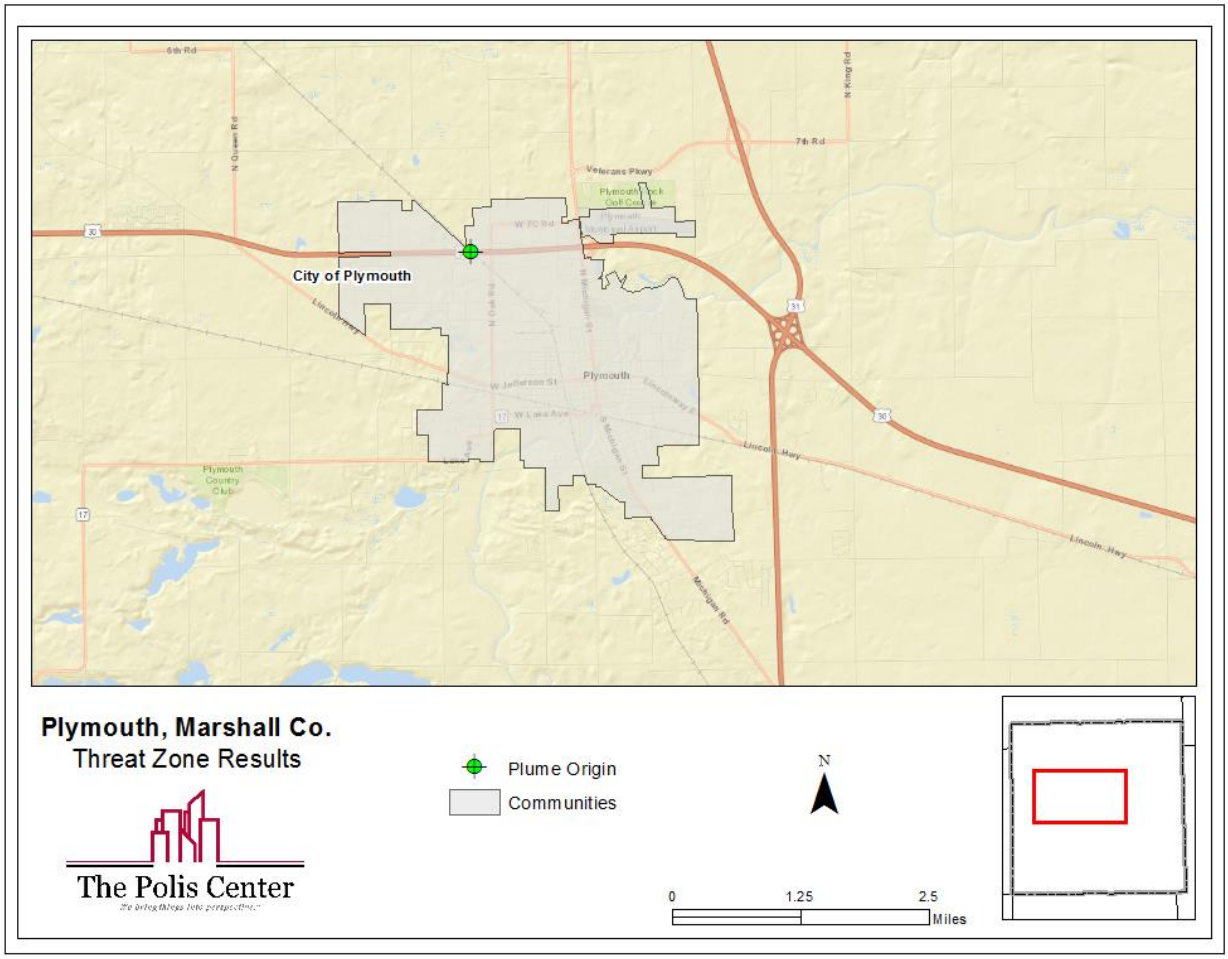
Chlorine is a greenish yellow gas with a pungent suffocating odor. The gas liquefies at -35ºC and room pressure or will liquefy from pressure applied at room temperature. Contact with unconfined liquid chlorine can cause frostbite from evaporative cooling. Chlorine does not burn, but, like oxygen, supports combustion. The toxic gas can have adverse health effects from either long-term inhalation of low concentrations of vapors or short-term inhalation of high concentrations. Chlorine vapors are much heavier than air and tend to settle in low areas. Chlorine is commonly used to purify water, bleach wood pulp, and make other chemicals.

ALOHA is a computer program designed especially for use by people responding to chemical accidents, as well as for emergency planning and training. Chlorine is a common chemical used in

industrial operations and can be found in either liquid or gas form. Rail and truck tankers commonly haul Chlorine to and from facilities.

For this scenario, moderate atmospheric and climatic conditions with a breeze from the Northwest were assumed. The wind direction was chosen based on the previous analysis, so that the hypothetical plume would reach the same significantly populated areas at risk in the previous plan.

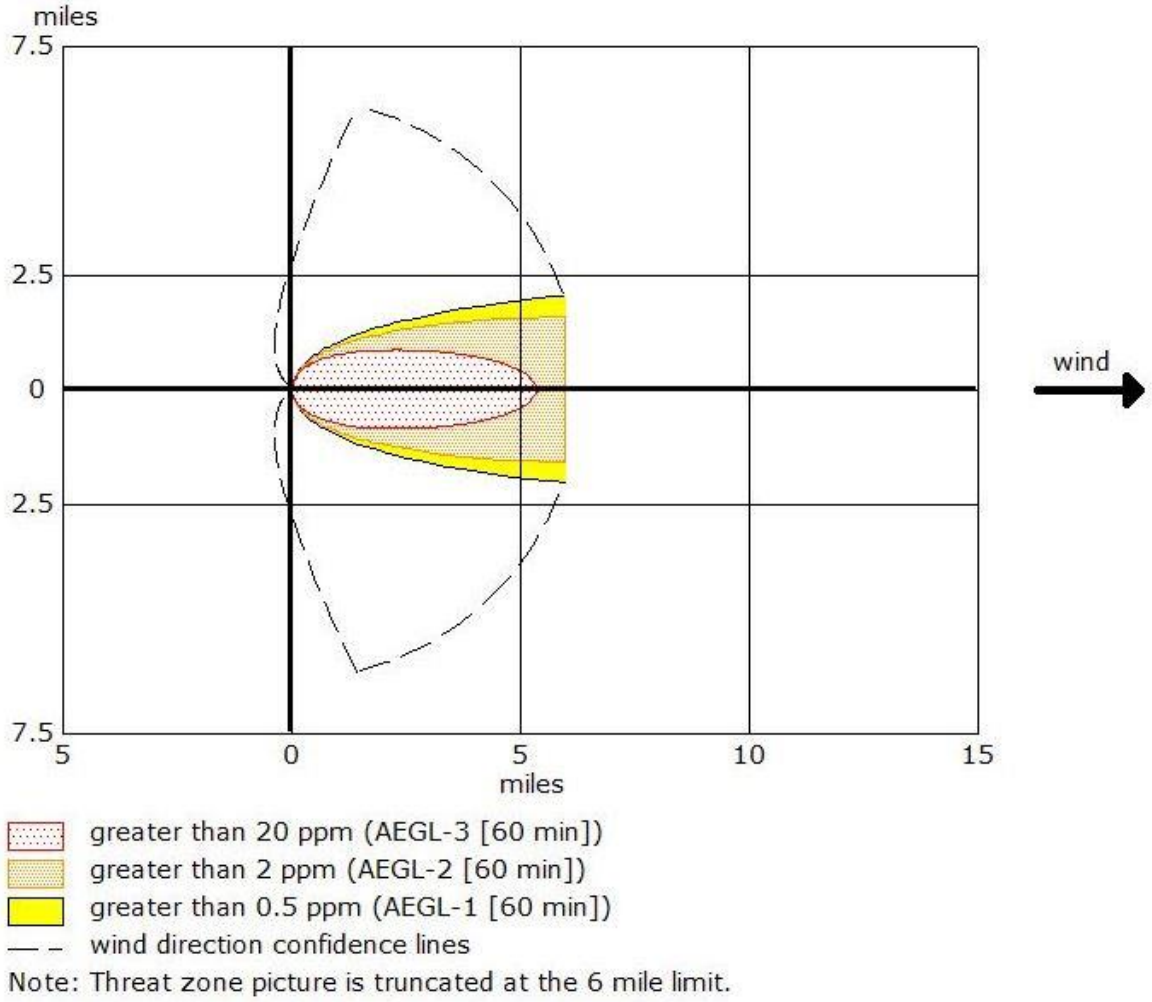
Figure 4-48: Location of Chemical Release



Results

According to the ALOHA parameters, approximately 2,100 pounds of material would be released per minute. The image in Figure 4-49 depicts an example of a plume footprint generated by ALOHA.

Figure 4-49: Toxic Threat Plume Footprint Generated by ALOHA



As the substance moves away from the source, the level of substance concentration decreases. Each color-coded area depicts a level of concentration measured in parts per million (ppm). For the purpose of clarification, this report will designate each level of concentration as a specific zone. The zones are as follows:

- Zone 3 (AEGL-3): The red buffer (>=20 ppm) extends approximately 5 miles from the point of release after one hour.
- Zone 2 (AEGL-2): The orange buffer (>=2 ppm) extends approximately 6 miles from the point of release after one hour.
- Zone 1 (AEGL-1): The yellow buffer (>=0.5 ppm) extends approximately 6 miles from the point of release after one hour.
- Confidence Lines: The dashed lines depict the level of confidence in which the exposure zones will be contained. The ALOHA model is 95% confident that the release will stay within this boundary.

The ALOHA atmospheric modeling parameters, depicted in Figure 4-50, were based upon the actual conditions at the location when the model was run. The air temperature was 68ºF with 75% humidity and clear skies. The wind speed was set for 5 mph blowing to the south east. The modeled source of the chemical spill was a tanker with a diameter of 8 feet and a length of 33 feet (12,408 gallons). The model incorporated a tank that was 100% full with the chlorine in its liquid state at the time of its release.

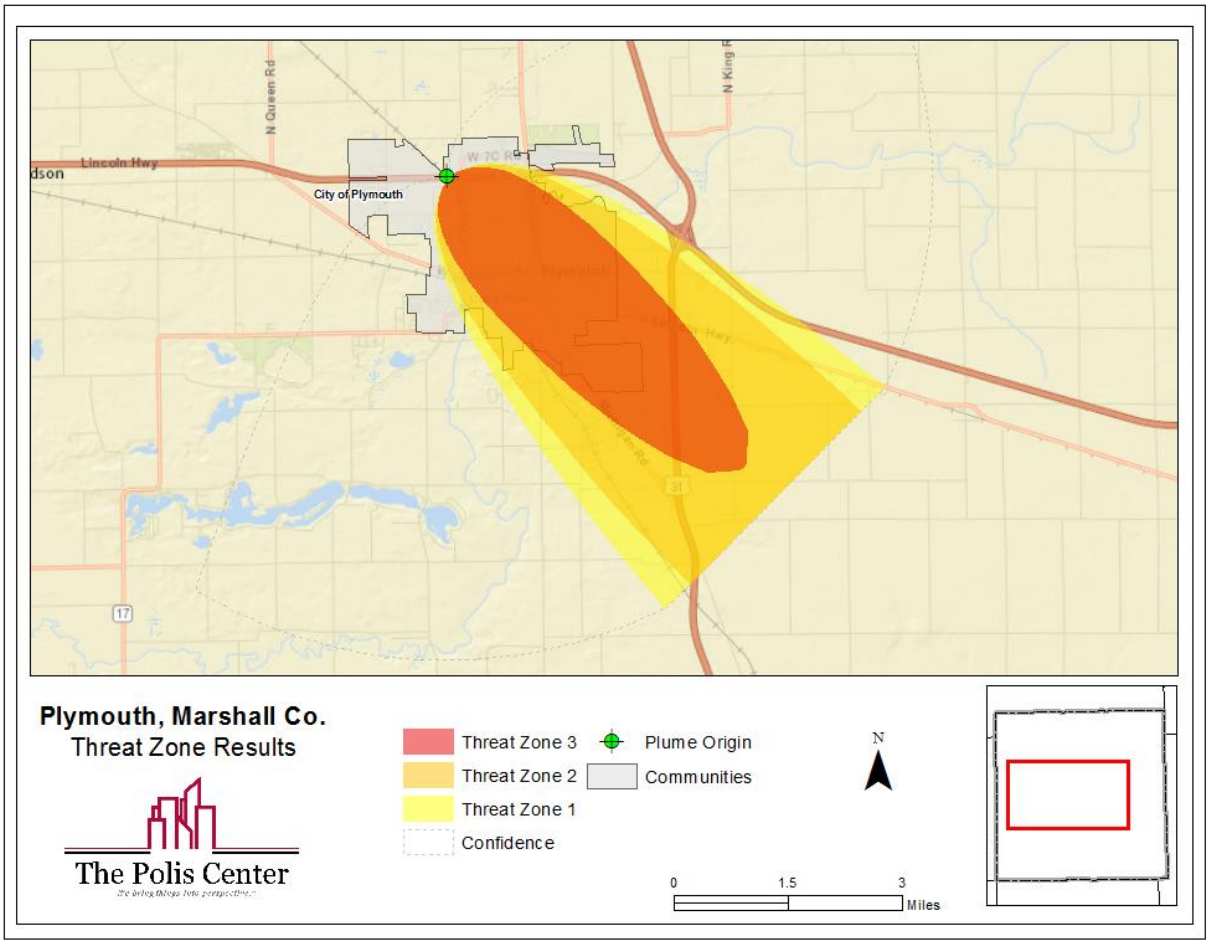
This modeled release was based on a leak from 2.5 feet-diameter hole. According to parameters, approximately 2,100 pounds of material would be released per minute.

Figure 4-50: ALOHA Modeling Parameters

```
SITE DATA:
   Location: PLYMOUTH, INDIANA
   Building Air Exchanges Per Hour: 0.40 (unsheltered single storied)
   Time: June 13, 2017  1431 hours EST (using computer's clock)

 CHEMICAL DATA:
   Chemical Name: CHLORINE
   CAS Number: 7782-50-5                  Molecular Weight: 70.91 g/mol
   AEGL-1 (60 min): 0.5 ppm   AEGL-2 (60 min): 2 ppm   AEGL-3 (60 min): 20 ppm
   IDLH: 10 ppm
   Ambient Boiling Point: -30.4° F
   Vapor Pressure at Ambient Temperature: greater than 1 atm
   Ambient Saturation Concentration: 1,000,000 ppm or 100.0%

 ATMOSPHERIC DATA: (MANUAL INPUT OF DATA)
   Wind: 5 miles/hour from NW at 10 meters
   Ground Roughness: open country         Cloud Cover: 5 tenths
   Air Temperature: 68° F                 Stability Class: B
   No Inversion Height                    Relative Humidity: 75%

 SOURCE STRENGTH:
   Leak from hole in horizontal cylindrical tank
   Non-flammable chemical is escaping from tank
   Tank Diameter: 12.5 feet               Tank Length: 33 feet
   Tank Volume: 30,294 gallons
   Tank contains liquid                   Internal Temperature: 68° F
   Chemical Mass in Tank: 178 tons        Tank is 100% full
   Circular Opening Diameter: 2.5 inches
   Opening is 1 feet from tank bottom
   Release Duration: 40 minutes
   Max Average Sustained Release Rate: 10,500 pounds/min
      (averaged over a minute or more)
   Total Amount Released: 346,507 pounds
   Note: The chemical escaped as a mixture of gas and aerosol (two phase flow).

 THREAT ZONE:
   Model Run: Heavy Gas
   Red    : 5.4 miles --- (20 ppm = AEGL-3 [60 min])
   Orange: greater than 6 miles --- (2 ppm = AEGL-2 [60 min])
   Yellow: greater than 6 miles --- (0.5 ppm = AEGL-1 [60 min])
```

The image in Figure 4-51 depicts the threat zone generated by ALOHA. Due to the relatively flat landscape, the chlorine vapor cloud was estimated to travel around 6 miles from the spill

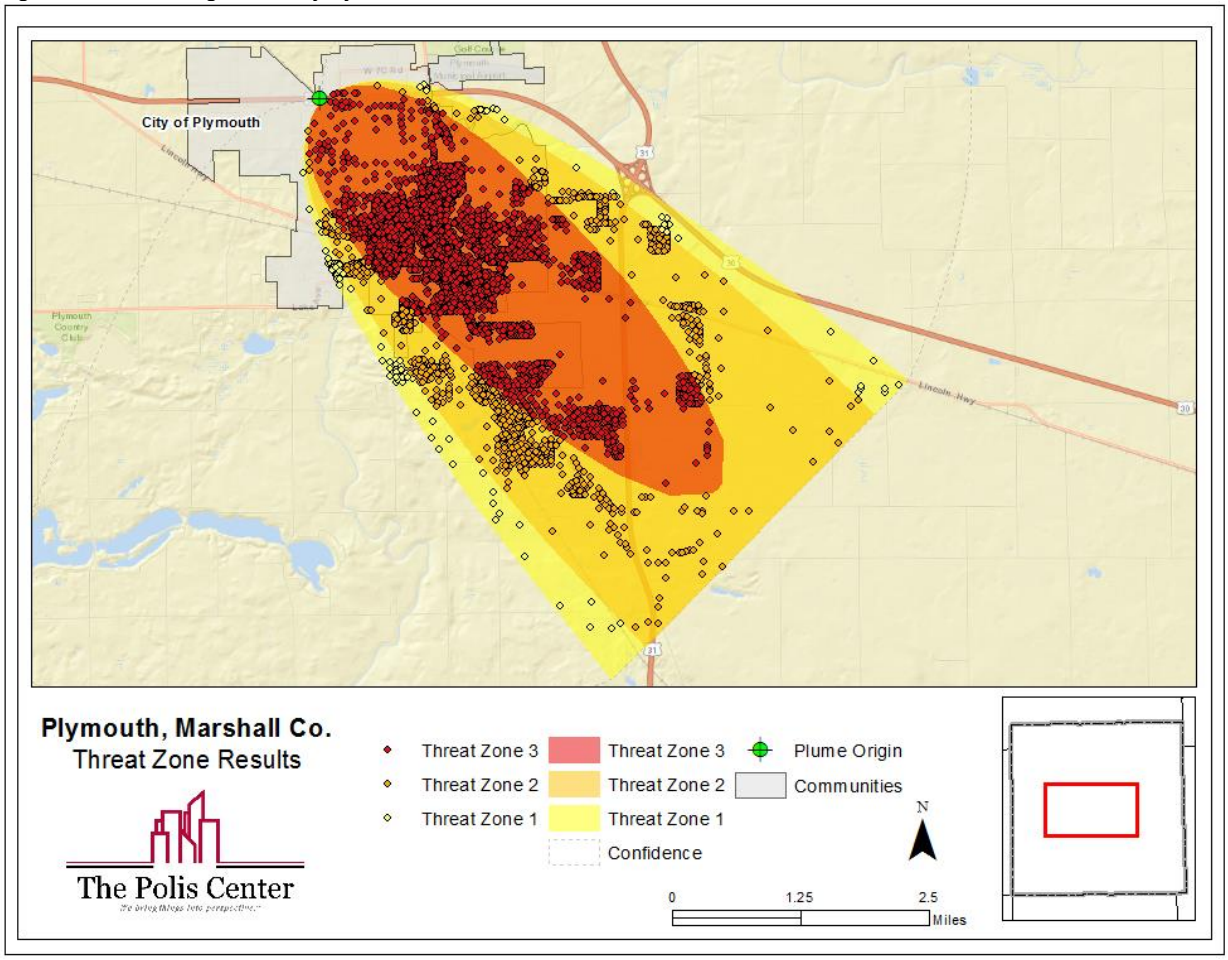
Figure 4-51: Threat Zone Results



Building Inventory Exposure

The Marshall County Building Inventory was added to ArcMap and overlaid with the threat zone footprint. The Building Inventory was then intersected with each of the three footprint areas to classify each point based upon the plume footprint in which it is located. Figure 4-52 depicts the Marshall County Building Inventory after the intersect process.

Figure 4-52: Building Inventory by Threat Zone



By summing the building inventory within the three threat zones; the GIS overlay analysis predicts that as many as 4,388 buildings and 8,923 people could be exposed. The population is estimated based on 2.5 people per residence within Marshall County. The threat zone begins on the northern portion of Plymouth and extends south east past the city limits.

The results of the analysis against the Building Inventory counts are depicted in Table 4-37 summarizes the results of the chemical spill by combining all AEGL zones.

Table 4-37: Estimated Exposure for all Threat Zones

Occupancy	Building Counts	Building Exposure
Agriculture	68	$ 25,956,052
Commercial	448	$ 818,753,166
Education	15	$ 30,250,799
Government	96	$ 110,486,376
Industrial	98	$ 668,048,267
Religious	94	$ 294,981,084
Residential	3,569	$ 733,741,774
Total	**4,388**	**$ 2,954,474,720**

Tables 4-38 summarizes the results of the chemical spill for each zone individually. Values represent only those portions of each zone that are not occupied by other zones.

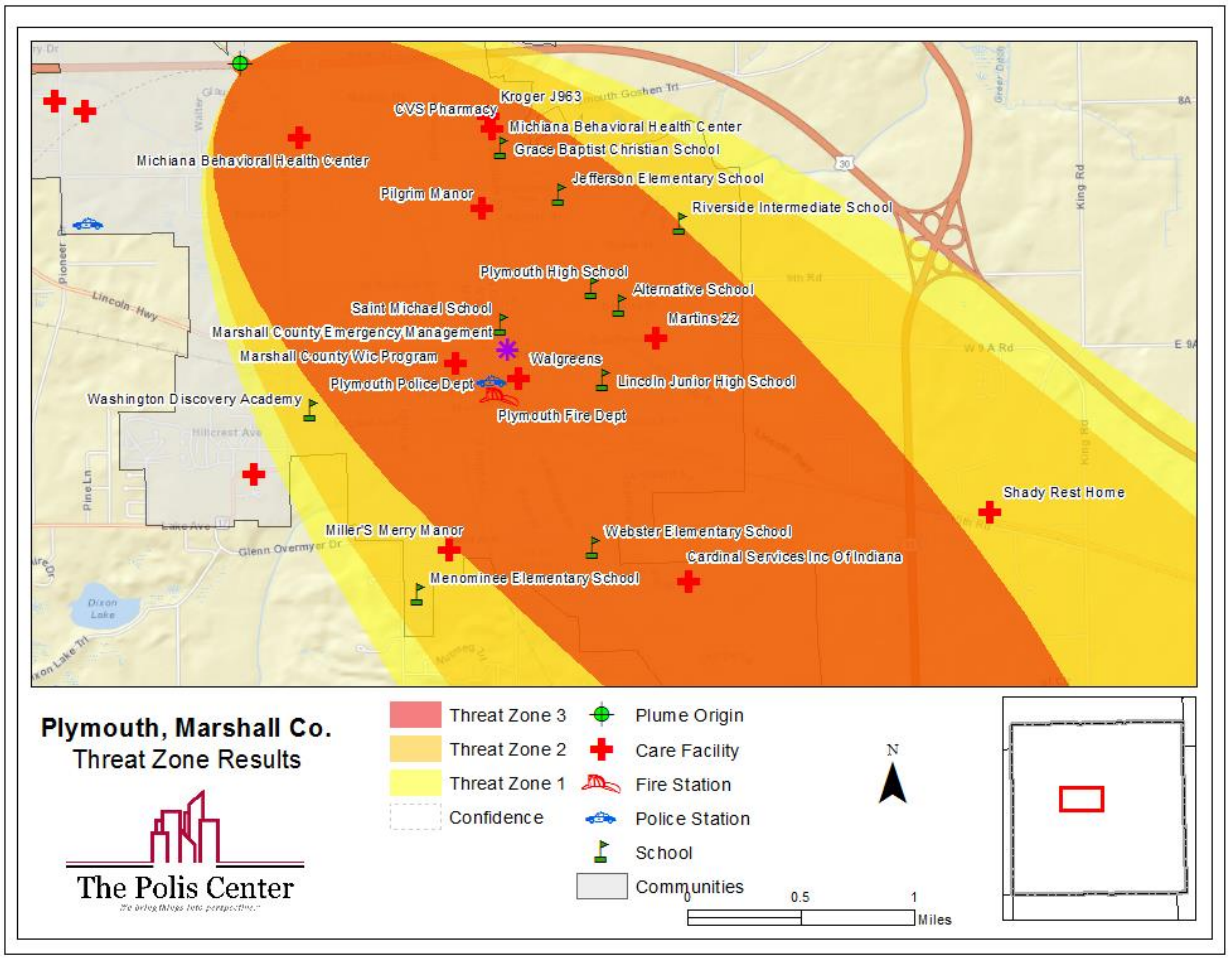
Table 4-38: Estimated Exposure for Threat Zones 1, 2, & 3

Occupancy	Threat Zone 3			Threat Zone 2			Threat Zone 1		
	People Affected	Building Counts	Building Exposure	People Affected	Building Counts	Building Exposure	People Affected	Building Counts	Building Exposure
Agriculture	0	13	$ 2,131,019	0	37	$11,821,669	0	18	$12,003,363
Commercial	0	408	$ 680,278,696	0	30	$90,415,327	0	10	$48,059,142
Education	0	11	$ 226,970,375	0	4	$75,537,624	0	0	$0
Government	0	92	$ 92,573,230	0	4	$17,913,145	0	0	$0
Industrial	0	94	$ 631,136,382	0	4	$36,911,884	0	0	$0
Religious	0	81	$ 212,378,162	0	12	$68,768,227	0	1	$13,834,695
Residential	6,934	2,773	$ 557,950,135	1,825	730	$160,178,888	195	78	$15,612,751
Total	**6,934**	**3,472**	**$ 2,403,418,000**	**1,825**	**809**	**$461,546,767**	**195**	**107**	**$38,012,795**

Essential Facilities

There were 25 essential facilities within the limits of the three threat zones. This includes 13 care facilities, including any emergency operation centers, 1 fire station, 1 police stations, and 10 schools. The affected facilities are labeled in Figure 4-53.

Figure 4-53: Plymouth, Marshall Co Essential Facilities Located in Threat Zone



Critical Facilities Exposure

There were 37 critical facilities within the limits of the three threat zones. 8 communication facilities, 2 airports, 25 Hazmat facilities, 1 potable water facility, and 1 waste water facility. These facilities are labeled in Figure 4-54.

Figure 4-54: Part 1, Plymouth, Marshall Co Critical Facilities in Threat Zones

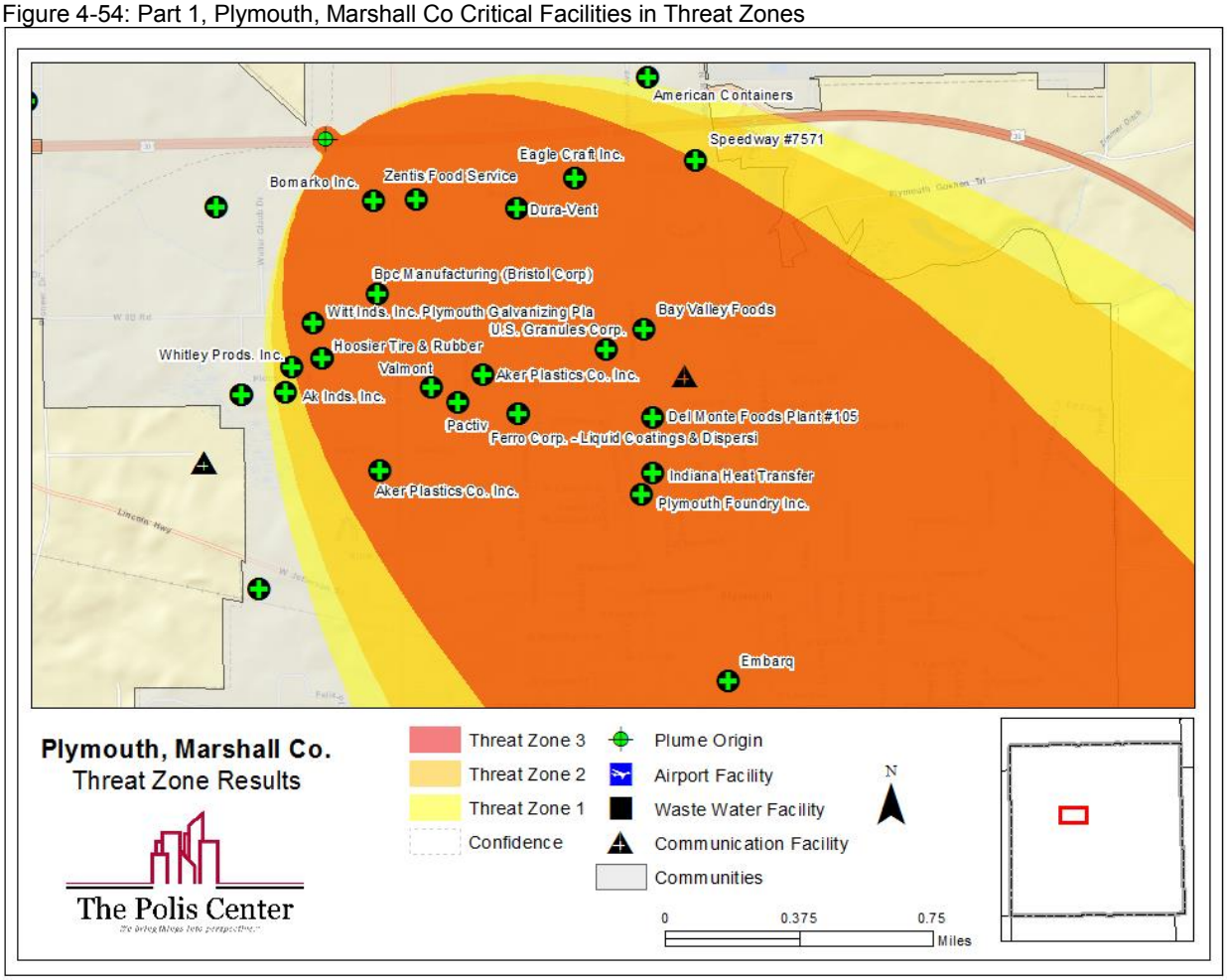
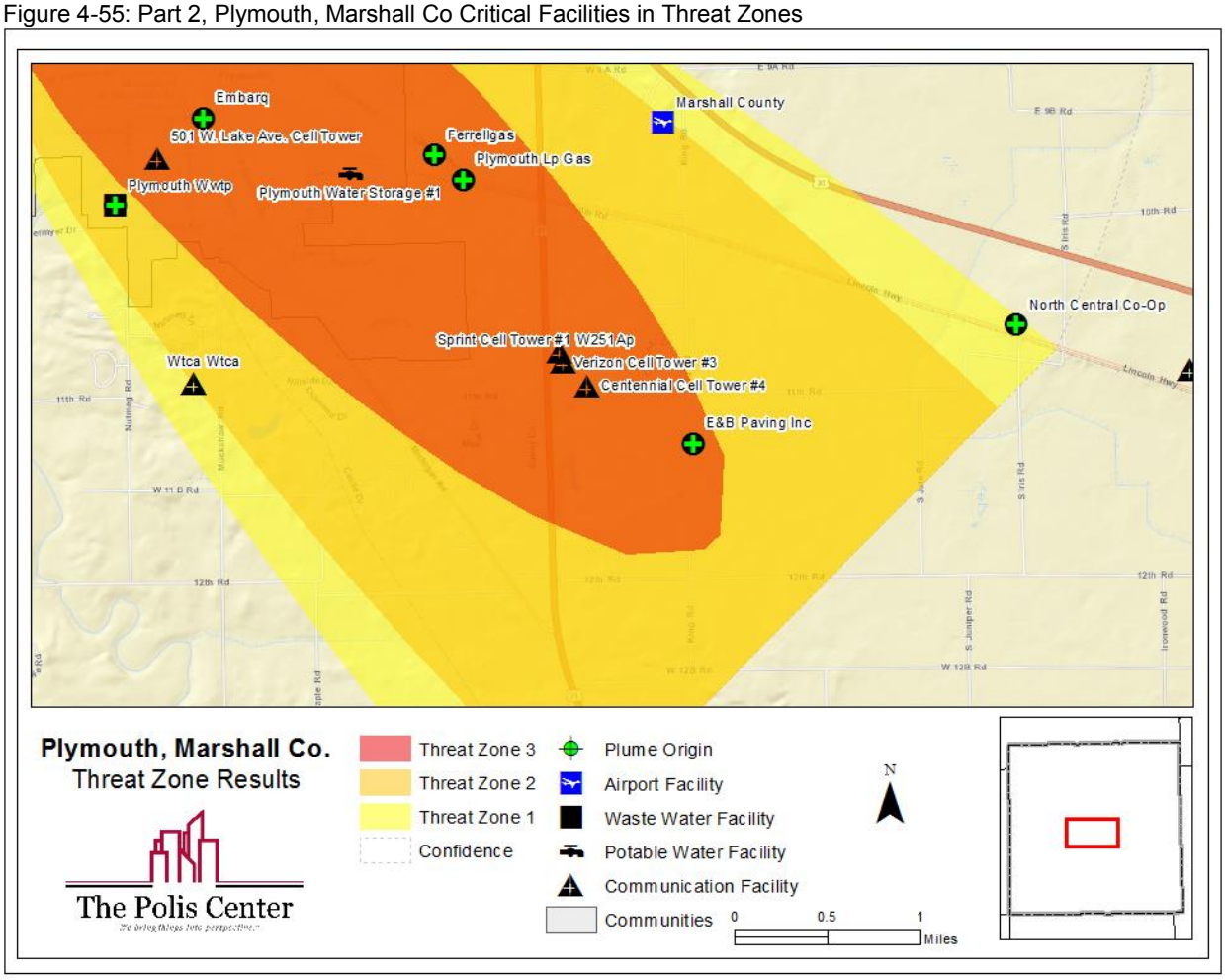
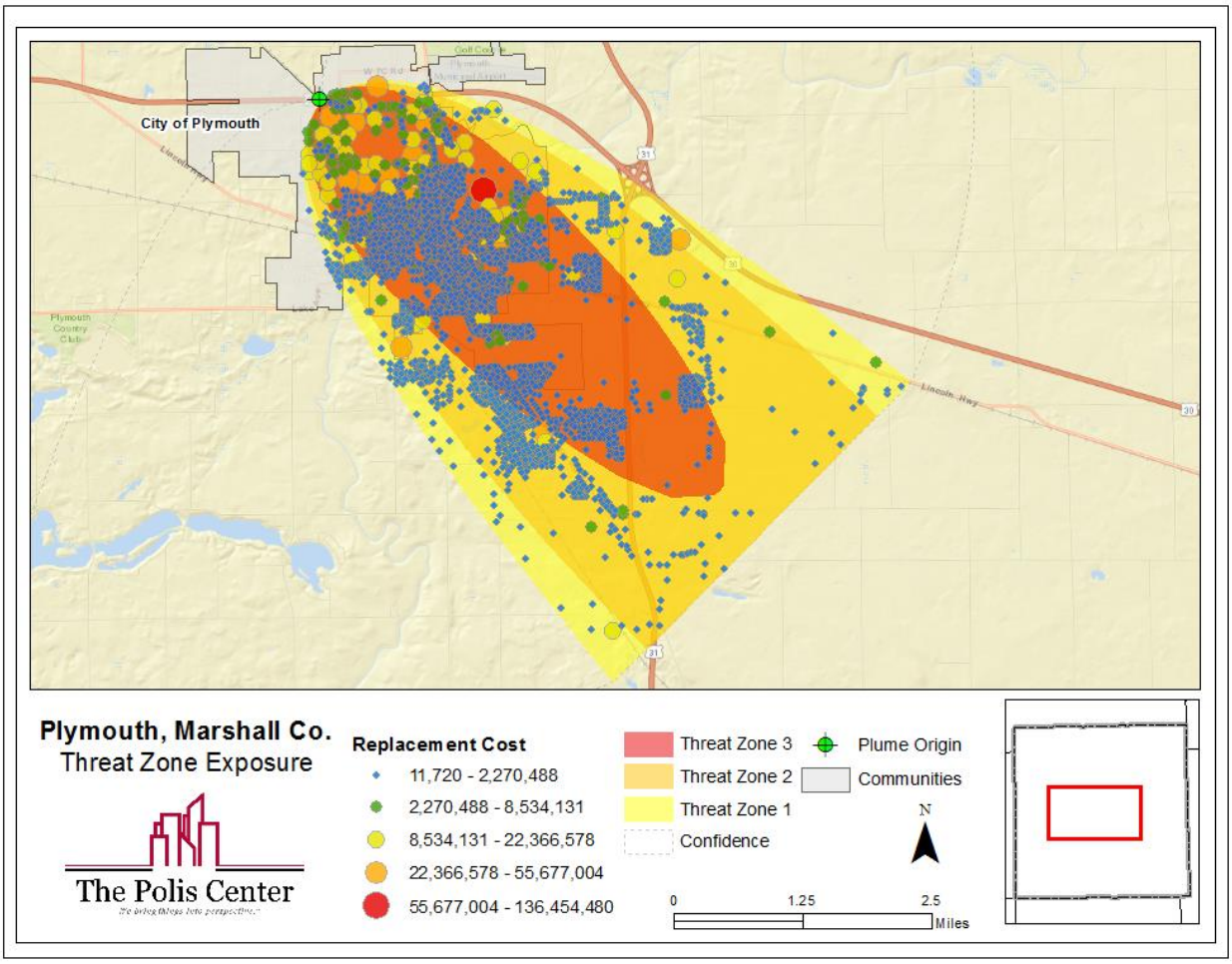


Figure 4-55: Part 2, Plymouth, Marshall Co Critical Facilities in Threat Zones



Exposure Based on Replacement Cost

Figure 4-57: Plymouth, Marshall County Building Exposure Displayed by Replacement Cost



Relationship to other Hazards

Flood- Hazmat incidents are likely when another

Plans and Programs in Place

CEMP- the IDHS State of Indiana Comprehensive Emergency Management Plan (CEMP) incorporates lists of Hazmat preparedness tasks for Emergency Support Function (ESF) personnel that include, but are not limited to, the following:

- Coordination between mass-care, housing, human services, and Hazmat teams to set-up a portable decontamination system at the evacuee/victim shelters, if necessary.
- Search and Rescue working with fire, health, and Hazmat as needed to provide support for effective search and rescue operations.

- Identify training gaps and needs relating to hazardous materials response during emergencies of disasters.
- Assist in the development of legislation, policies and administrative rules that relate directly to hazardous materials response, this ESF and its ability to provide emergency assistance.
- Train Emergency Support Function personnel on technical standards and specifications for essential pieces of equipment related to short and long-term emergency Hazmat response needs.

The Indiana Department of Homeland Security's Plans Development Branch is the entity responsible for the development and maintenance of the state CEMP and offering guidance and assistance for the development of local CEMPs.

LEPC- the Local Emergency Planning Committee is required, under the Emergency Planning and Community Right-to-Know Act, to develop an emergency response plan and to inform citizens about chemicals in their community. The United States Environmental Protection Agency outlines the following elements as requirements for an emergency response plan:

- Identification of facilities and transportation routes of extremely hazardous substances
- Description of emergency response procedures, on and off site
- Designation of a community coordinator and facility emergency coordinator(s) to implement the plan
- Outline of emergency notification procedures
- Description of how to determine the probable affected area and population by releases
- Description of local emergency equipment and facilities and the persons responsible for them
- Outline of evacuation plans
- A training program for emergency responders (including schedules)
- Methods and schedules for exercising emergency response plans

For questions or concerns, Marshall County's Local Emergency Planning Committee can be contacted at marshalllepc@gmail.com.

Commodity Flow Study- In the 2009 Multi-Hazard Mitigation Plan mitigation strategies, Marshall County began the process of conducting a commodity flow study along major roadways.

Program Gaps or Deficiencies

No gaps or deficiencies were identified at this time.

4.10 Dams

Hazard Description

Dams are structures that retain or detain water behind a large barrier. When full, or partially full, the difference in elevation between the water above the dam and below creates large amounts of potential energy, creating the potential for failure. The same potential exists for levees when they serve their purpose, which is to confine flood waters within the channel area of a river and exclude that water from land or communities land-ward of the levee. Dams and levees can fail due to either 1) water heights or flows above the capacity for which the structure was designed; or 2) deficiencies in the structure such that it cannot hold back the potential energy of the water. If a dam or levee fails, issues of primary concern include loss of human life/injury, downstream property damage, lifeline disruption (of concern would be transportation routes and utility lines required to maintain or protect life), and environmental damage.

Many communities view both dams and levees as permanent and infinitely safe structures. This sense of security may well be false, leading to significantly increased risks. Both downstream of dams and on floodplains protected by levees, this false sense of security leads to new construction, added infrastructure, and increased population over time. Levees in particular are built to hold back flood waters only up to some maximum level, often the 100-year (1% annual probability) flood event. When that maximum is exceeded by more than the design safety margin, the levee will be overtopped or otherwise fail, inundating communities occupying the land previously protected by that levee. It has been suggested that climate change, land-use shifts, and some forms of river engineering may be increasing the magnitude of large floods and the frequency of levee failure situations.

In addition to failure that results from extreme floods above the design capacity, levees and dams can fail due to structural deficiencies. Both dams and levees require constant monitoring and regular maintenance to assure their integrity. Many structures across the U.S. have been under-funded or otherwise neglected, leading to an eventual day of reckoning in the form either of realization that the structure is unsafe or, sometimes, an actual failure. The threat of dam or levee failure may require substantial commitment of time, personnel, and resources. Since dams and levees deteriorate with age, minor issues become larger compounding problems, and the risk of failure increases.

The Indiana General Assembly has established dam safety laws to protect the citizens of Indiana. Generally, the laws are intended to insure that the dam owner maintains his/her dam in a safe manner. The laws also define inspection requirements, violation conditions, and actions that the Indiana Department of Natural Resources (IDNR) will take if the dam owner violates the law.

IDNR currently regulates all dams that meet any one of the following criteria:

(1) the drainage area above the dam is greater than 1 square mile
(2) the dam embankment is greater than 20 feet high
(3) the dam impounds more than 100 acre-feet

Dam failure is a term used to describe the major breach of a dam and subsequent loss of contained water. Dam failure can result in loss of life and damage to structures, roads, utilities, crops, and livestock. Economic losses can also result from a lowered tax base, lack of utility profits, disruption of commerce and governmental services, and extraordinary public expenditures for food relief and protection. National statistics show that overtopping due to inadequate spillway design, debris blockage of spillways, or settlement of the dam crest account for one third of all US dam failures. Foundation defects, including settlement and slope instability, account for another third of all failures. Piping and seepage, and other problems cause the remaining third of national dam failures. This includes internal erosion caused by seepage, seepage and erosion along hydraulic structures, leakage through animal burrows, and cracks in the dam.

Since the responsibility for maintaining a safe dam rests with the owner, dam ownership imposes significant legal responsibilities and potential liabilities on the dam owner. A dam failure resulting in an uncontrolled release of the reservoir can have a devastating effect on persons and property downstream.

Low-Head Dams

Low-head, or in-channel, dams can present a safety hazard to the public because of their ability to trap victims in a submerged hydraulic jump formed just downstream from the dam. 38 Recent deaths and injuries around these structures in the state, has brought the attention of this issue to the surface for local, state and federal officials. Current initiatives led by the Indiana Silver Jackets—a multi-agency coalition that leverages efforts to address natural hazards—have focused on the identification of these dams statewide, as well as various efforts to notify the public on their dangers.

Dam Failure History in Marshall County

There are eight IDNR regulated dams in the county. There are no records or local knowledge of any dam failures in the county.

Vulnerability and Future Development

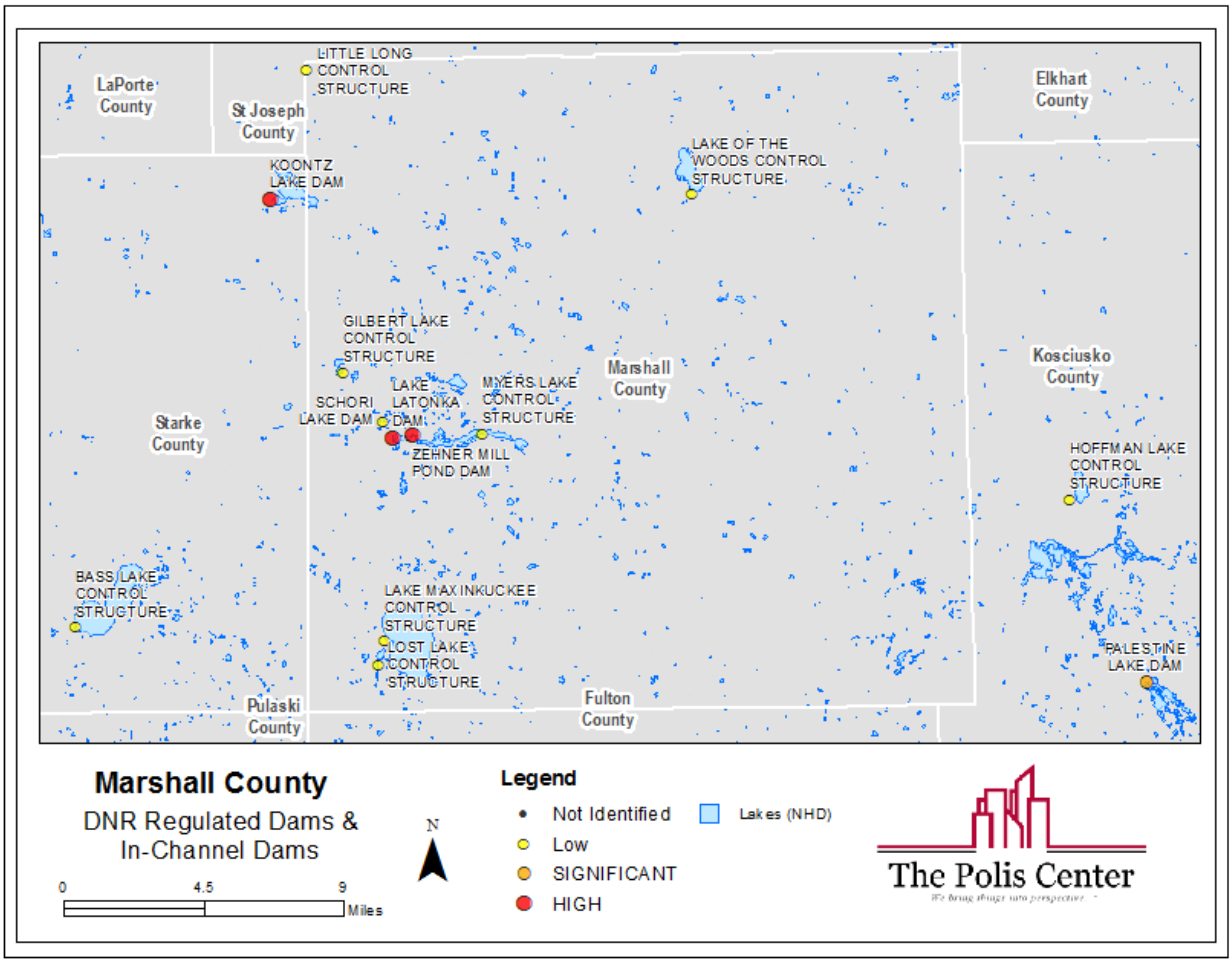
When dams are assigned the low (L) hazard potential classification, it means that failure or incorrect operation of the dam will result in no human life losses and no economic or environmental losses. Losses are principally limited to the owner's property. Dams assigned the significant (S) hazard classification are those dams in which failure or incorrect operation results in no probable loss of human life; however, it can cause economic loss, environment damage, and disruption of lifeline facilities. Dams classified as significant hazard potential dams are often located in predominantly rural or agricultural areas, but could be located in populated areas with a significant amount of infrastructure. Dams assigned the high (H) hazard potential classification are those dams in which failure or incorrect operation has the highest risk to cause loss of human life and significant damage to buildings and infrastructure.

According to IDNR and the National Inventory of Dams, two dams are classified as high hazard, and neither dam has an Emergency Action Plan (EAP). An EAP is not required by the State of Indiana but is strongly recommended in the 2003 Indiana Dam Safety & Inspection Manual.

Table 4-39: Marshall County Dams

Name	Hazard Level	EAP
Zehner Mill Pond Dam	High	No
Lake Latonka Dam	High	No
Lake Of The Woods Control Structure	Low	No
Lake Maxinkuckee Control Structure	Low	No
Gilbert Lake Control Structure	Low	No
Lost Lake Control Structure	Low	No
Myers Lake Control Structure	Low	No
Schori Lake Dam	Low	No

Figure 4-58: Marshall County Dams



Risk Analysis

Exposure Analysis

Marshall County has two high hazard level dams and no dams with Emergency Action Plans (EAP). Marshall County dams are shown in the images below. In the images depicting Lake Latonka Dam and Zehner Mill Pond Dam, the detailed dam failure inundation areas were not available. Therefore, for the purpose of this planning effort, the dams are plotted with approximate locations of downstream structures including critical facilities. The magnitude and extent of damage depend on the type of dam break, volume of water that is released, and width of the floodplain valley to accommodate the dam break flood wave. Based on preliminary analysis of vulnerable facilities in approximate dam failure inundation zone, no critical facilities would be affected by a

dam failure. These do not include bridges and roadways that are in the floodway and floodplains throughout the County that could be damaged or destroyed by a dam breach event.

Figure 4-59: High Hazard Lake Latonka Dam

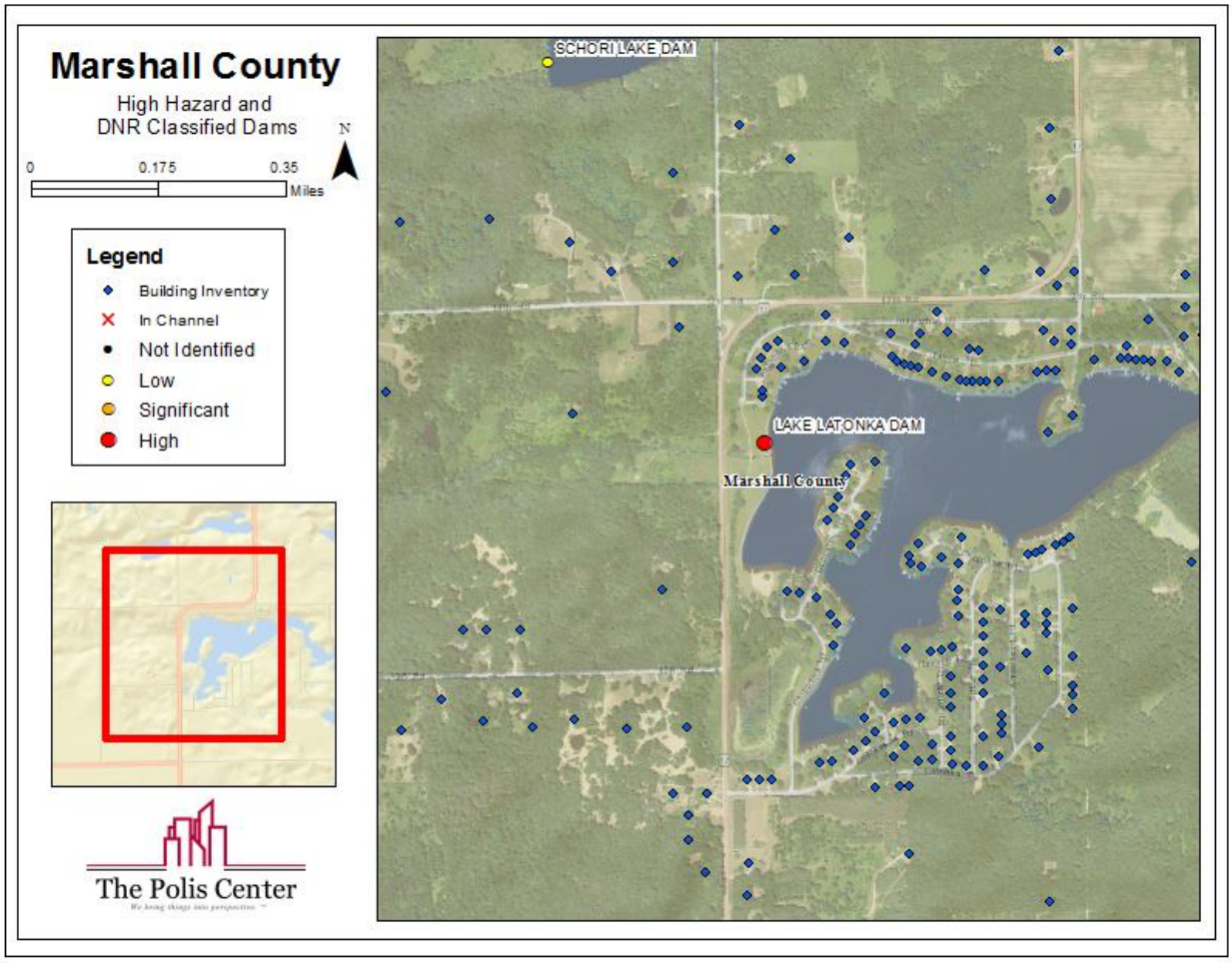


Figure 4-60: High Hazard Zehner Mill Pond Dam

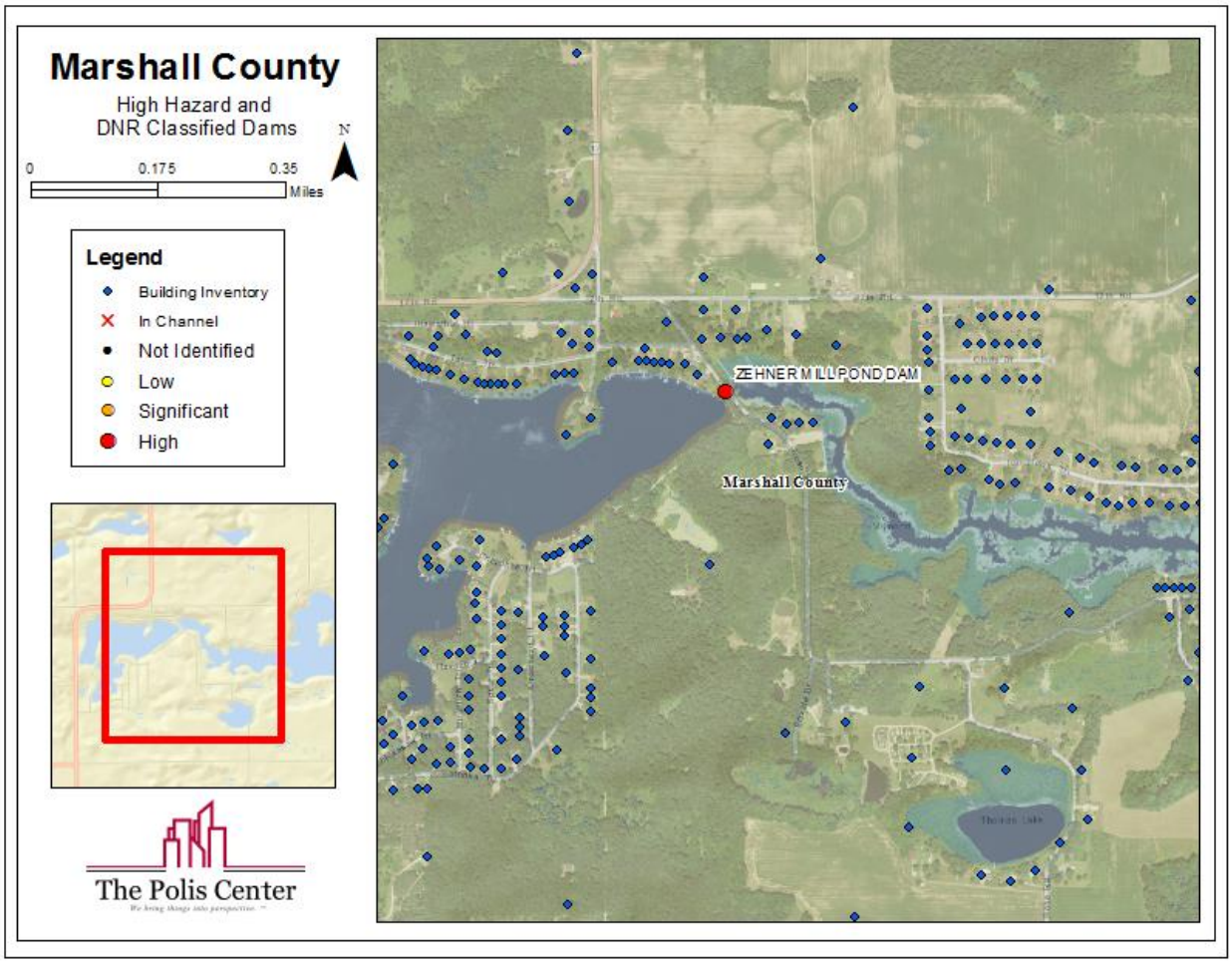


Figure 4-61: Dams in Southwest Marshall County

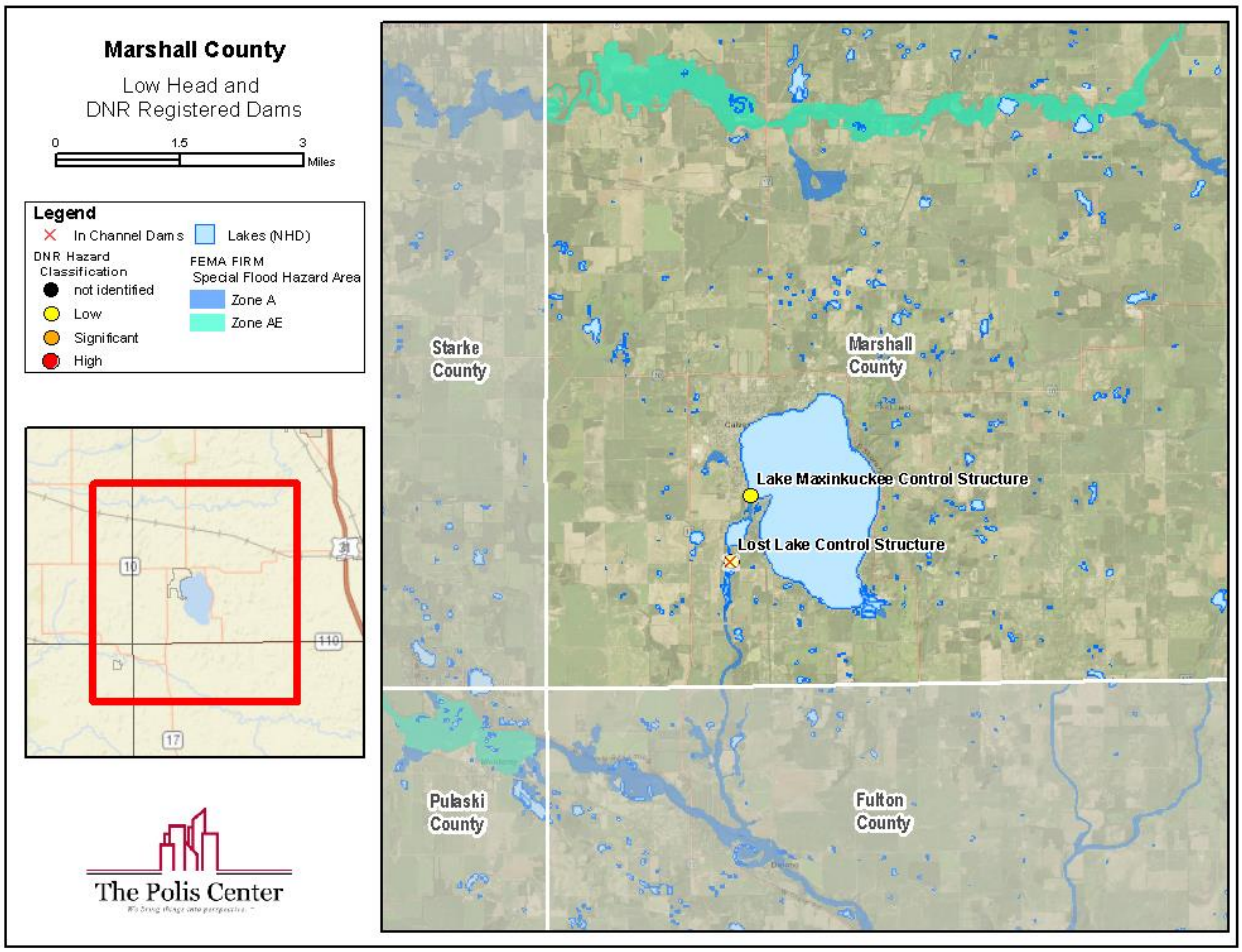


Figure 4-62: Chain O Lakes in Marshall County

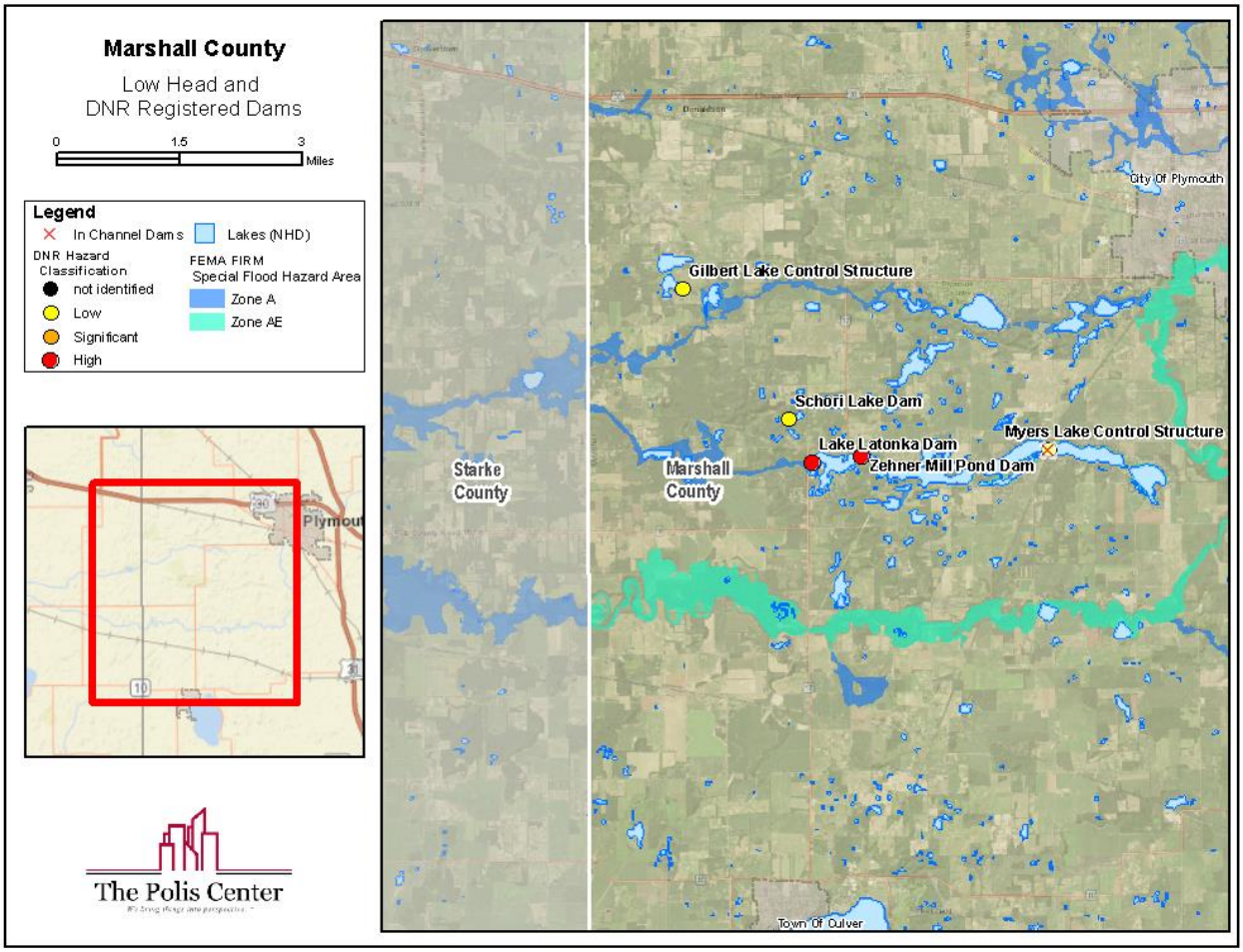


Figure 4-63: Dam in Northwest Marshall County

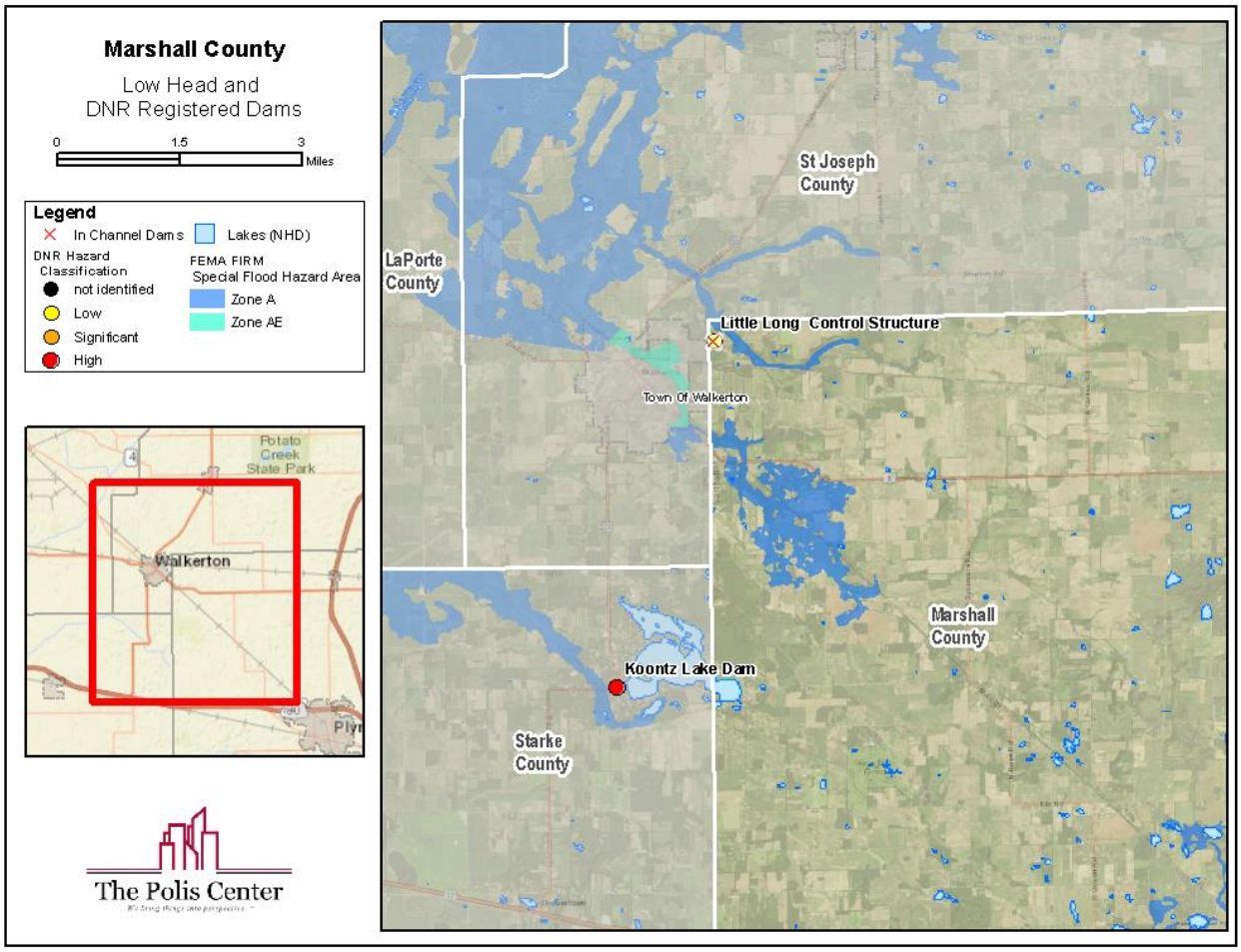
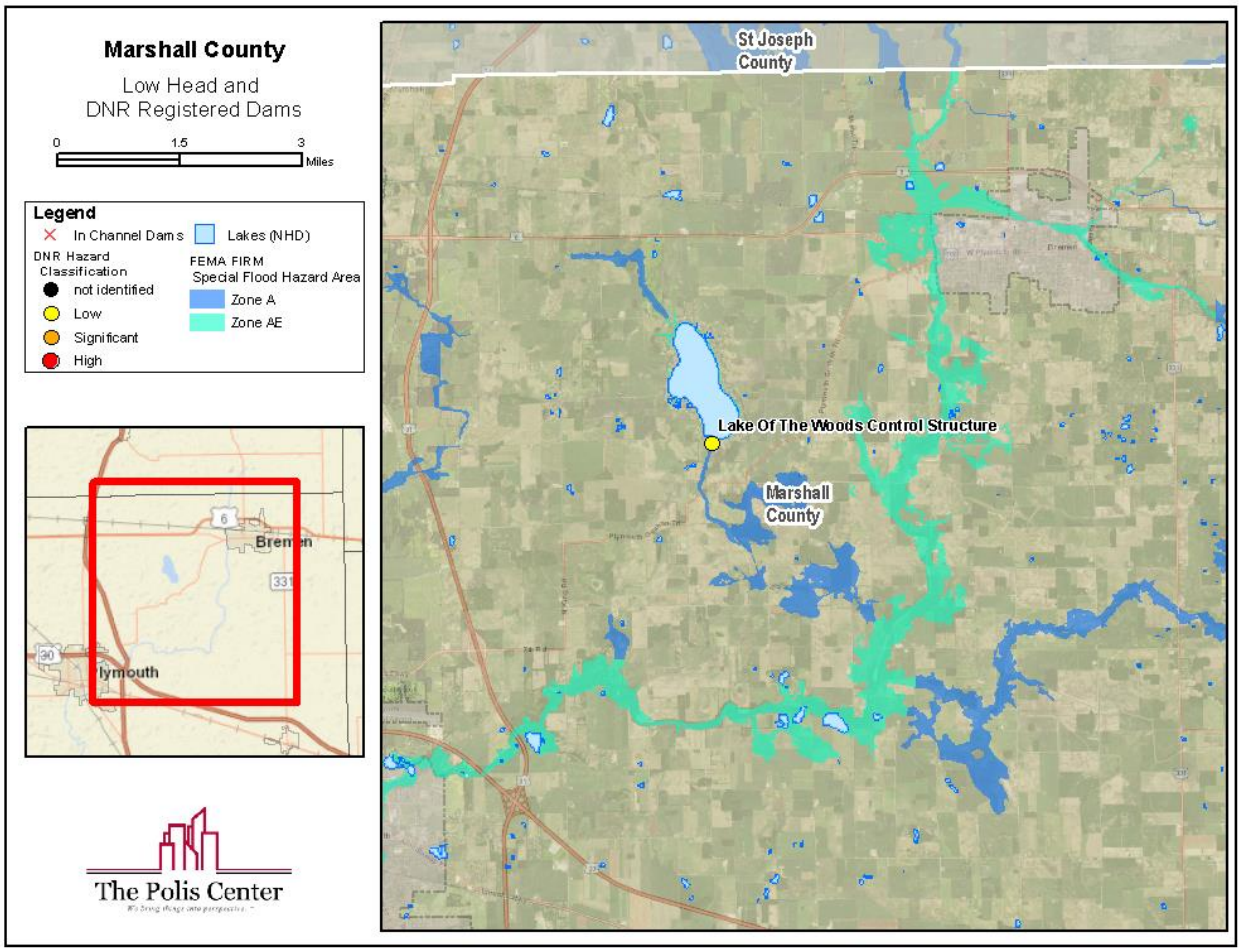


Figure 4-64: Lake of the Woods Marshall County



Relationship to other Hazards

Flooding – Flooding is typically the leading cause of dam failure incidents.

Drought – Property owners living around dams may have problems accessing boating equipment during times of drought.

Plans and Programs in Place

The county surveyor works to maintain the established Lake Levels at particular lakes.

Program Gaps or Deficiencies

No program gaps or deficiencies were identified.

4.11 Levees

Hazard Description

Levees are small, long earth dams that protect low areas of cities and towns, industrial plants, and expensive farmland from flooding during periods of high water. FEMA defines a levee as a "man-made structure, usually an earthen embankment, designed and constructed in accordance with sound engineering practices to contain, control, or divert the flow of water so as to provide a level of protection from temporary flooding." Levees reduce the risk of flooding but do not eliminate all flood risk. As levees age, their ability to reduce this risk can change and regular maintenance is required to retain this critical ability. In serious flood events, levees can fail or be overtopped and, when this happens, the flooding that follows can be catastrophic.

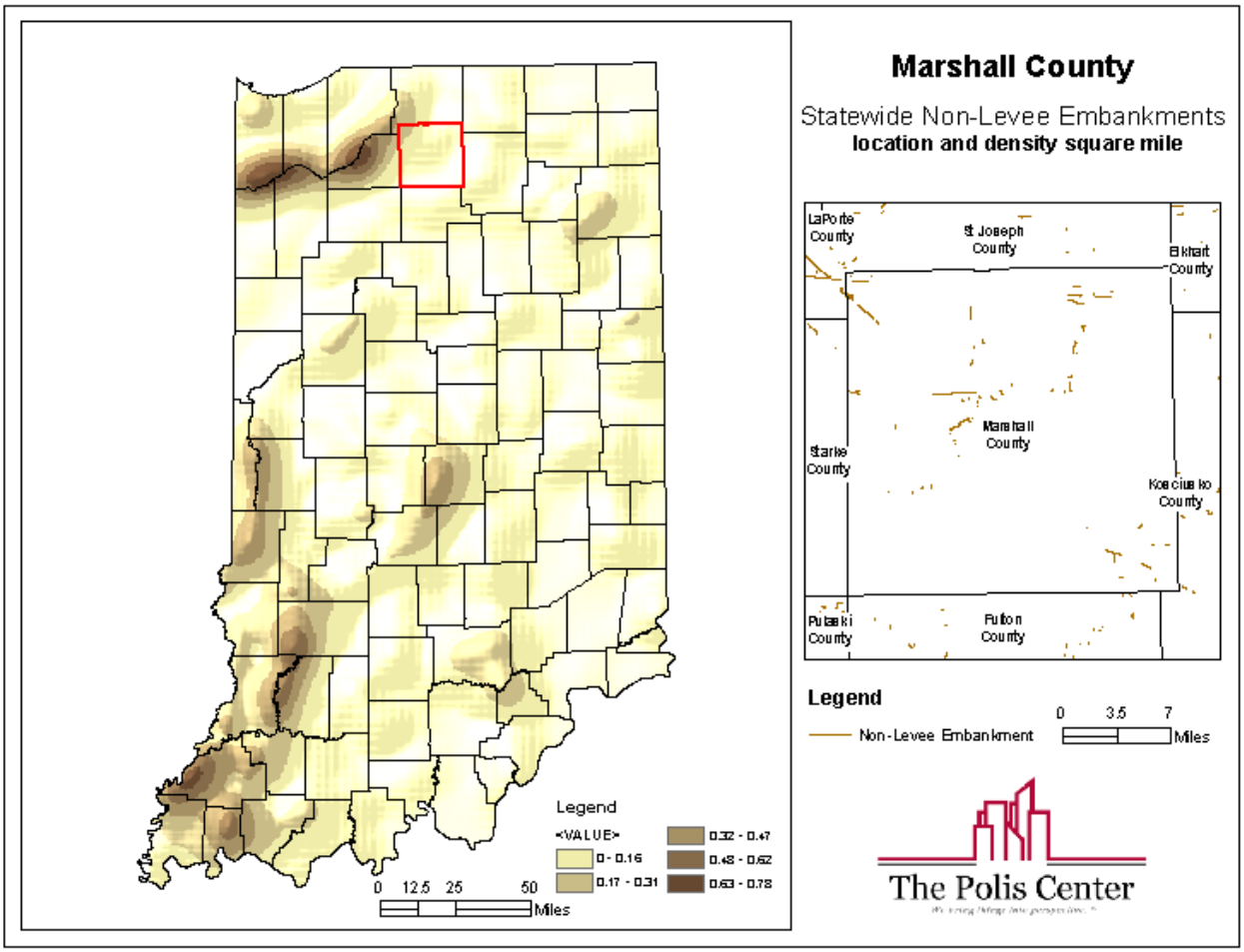
The US Army Corps of Engineers (USACE) and FEMA have different roles and responsibilities related to levees. FEMA addresses mapping and floodplain management issues related to levees, and accredits levees as meeting requirements set forth by the National Flood Insurance Program. USACE addresses a range of operation and maintenance, risk communication, risk management, and risk reduction issues as part of its responsibilities under the Levee Safety Program. FEMA may also provide accreditation for levees which means that the levee meets all the requirements of the Code of Federal Regulations Section 65.10. This ensures that the levee has adequate freeboard above the 1% annual chance flood, meets design specifications, maintenance plan in place, and that the owners take responsibility.

Along with accredited levees regulated by federal agencies, there are also what are referred to as Non-Levee Embankments (NLE), which typically parallel to the direction of natural flow. An embankment is an artificial mound of soil or broken rock that supports railroads, highways, airfields, and large industrial sites in low areas, or impounds water. NLEs are often highways or railroads built on fill in low lying areas and thus tend to impose lateral constraints on flood flows, and typically contain the following characteristics:

- NLEs are elevated linear features adjacent to waterways and within the floodplain.
- They are typically man-made and include agricultural embankments built by landowners and road and railroad embankments banks.
- They are levee-like structures, but are not certified or engineered to provide flood protection.

Figure 4-65 identifies the geographic location density (using a hill shade) of levees in the state of Indiana and an overview of the levees in Marshall County. Just East of Marshall County, there is a heavy concentration of NLE along the Kankakee River.

Figure 4-65: Non-Levee Embankment Density Indiana



The National Committee on Levee Safety estimates that the location and reliability status of 85% of the nation's NLEs are unknown. In Indiana, majority of NLEs are unidentified and are typically not maintained. NLEs 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. As such, NLE's can give a false sense of security and protection to the people residing near NLEs. For these reasons, it is extremely important to map where these features are located.

Living with levees is a shared responsibility. While operating, maintaining levee systems are the levee sponsor responsibility, local officials are adopting protocols and procedures for ensuring public safety and participation in the NFIP.

Levee Failure History in Marshall County

There are no records or local knowledge of any significant levee or non-levee embankment failures in the county.

Vulnerability and Future Development

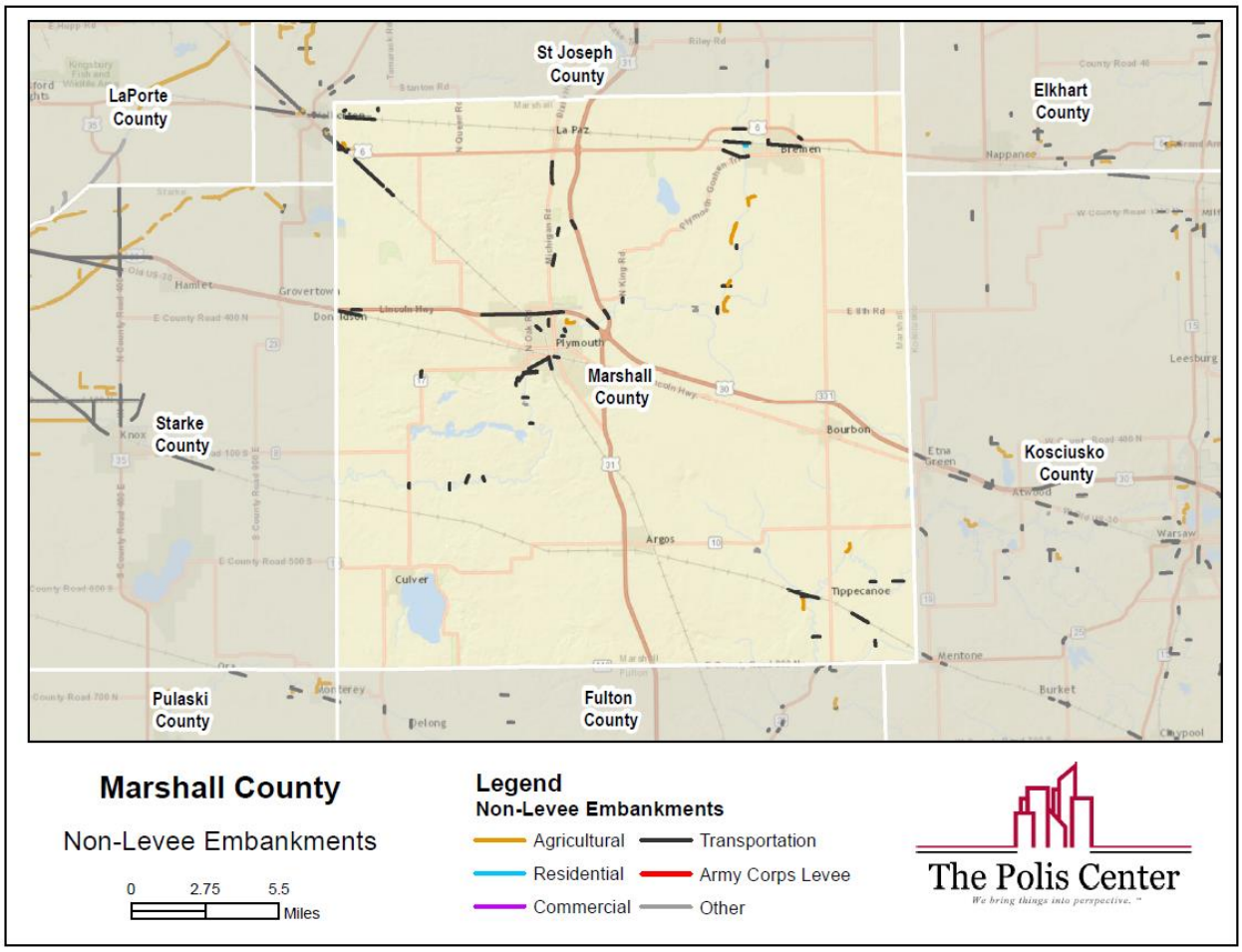
The extent of potential levee failure varies across the county. In order to be considered creditable flood protection structures on FEMA's flood maps, levee owners must provide documentation to prove the levee meets design, operation, and maintenance standards for protection against the "one-percent-annual chance" flood. If this accreditation is maintained, portions that would be mapped as Special Flood Hazard Area appear on a FIRM map as Zone X, protected by levee. A review of the USACE and FEMA data identified no certified levee segments in Marshall County.

Using LiDAR elevation data, in conjunction with multiple GIS data layers including digital elevation models (DEM) and slope maps, the Indiana Silver Jackets identified and mapped NLEs for 82 of the state's 92 counties. The team performed a literature review on existing approaches and developed new approaches before narrowing the methods to manual digitization, a semi-automated slope-derived method, and a semi-automated maximum curvature method. The team developed a set of characteristics that helped define NLE and distinguish them from natural berms or spoil banks.

- The following minimum characteristics were analyzed before capturing the extent of the NLE:
- Within or partially within the buffered 100-year floodplain (DFIRM)
- At least 100 yards (300 ft.) in length
- At least 1 meter (3 feet) in height
- At least 20 degrees of slope on either face

The identification of these embankments can aid in the further improvement of hydraulic modeling for streams. The classification of these structures is not completely objective, as the interpretation of agricultural, residential, and commercial will vary depending on the analyst interpretation. Figure 4-66 shows the extents of the NLE in the county.

Figure 4-66: Non-Levee Embankments: Marshall County



Risk Analysis

Exposure Analysis

Marshall County is predominately made of transportation-related NLEs near the Northwest of the county, Bremen, Tippecanoe, and Plymouth. The following maps provide a closer look at the areas around these NLE structures. IF there are any resources located around these structures, this has been provided to assess the potential exposure to the county and communities.

Non-Levee Embankment Types

Although considered a rough estimation the classification, at the development of the NLE dataset an analyst performed a rough assessment to estimate the function of the NLE based on any suggestions from orthophotography.

Non-Levee Embankment Assets

Figure 4-67: Non-Levee Embankments, Northeast

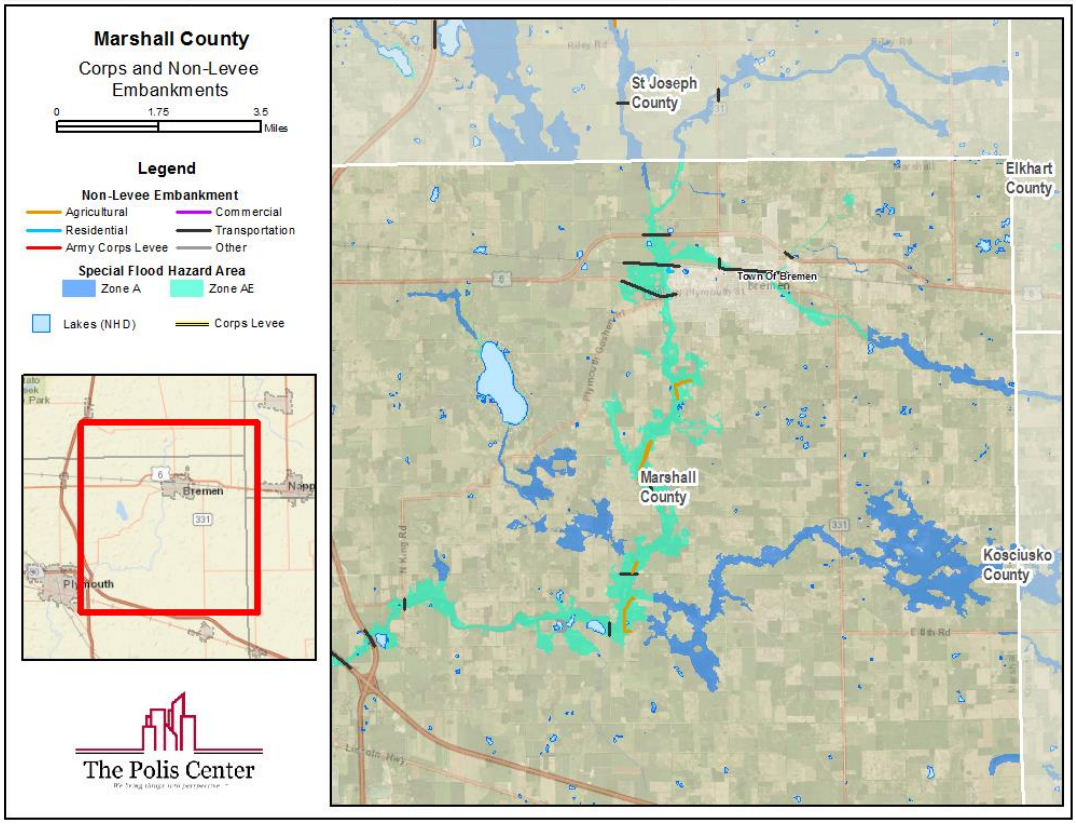


Figure 4-68: Bourbon, IN – Non-Levee Embankments, Northwest

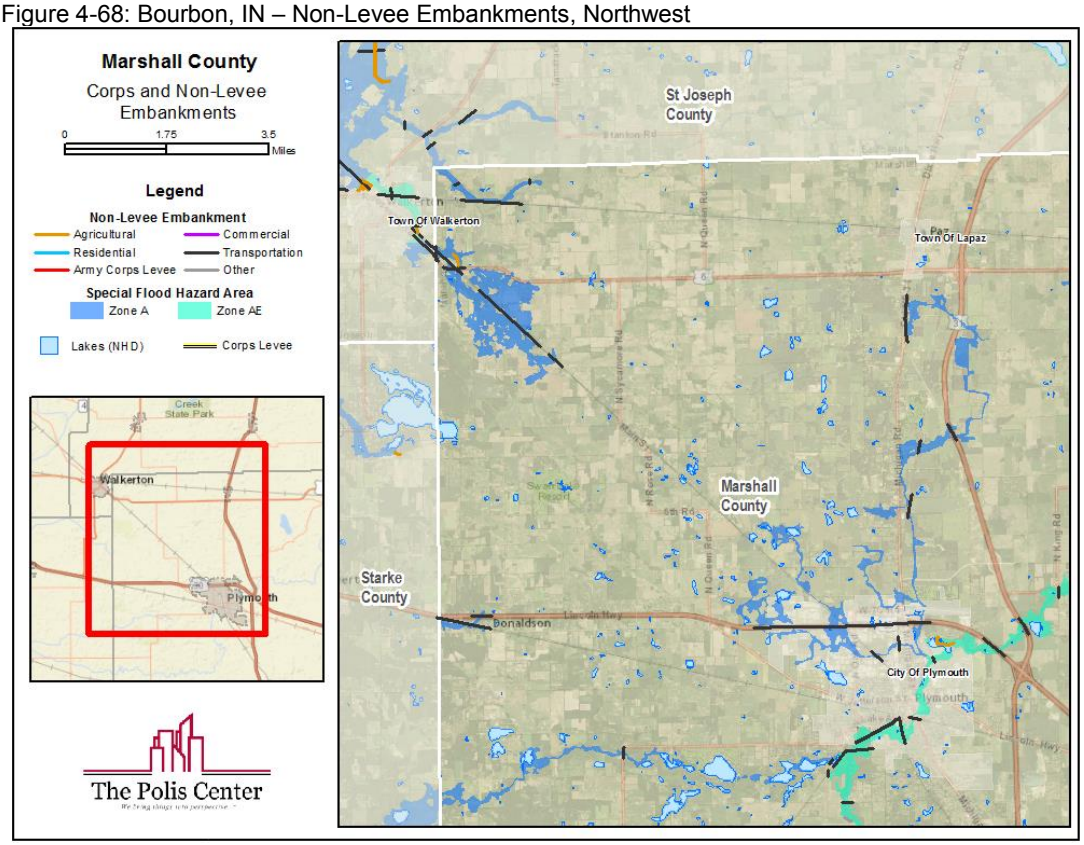


Figure 4-69: Bremen, IN – Non-Levee Embankments, Southeast

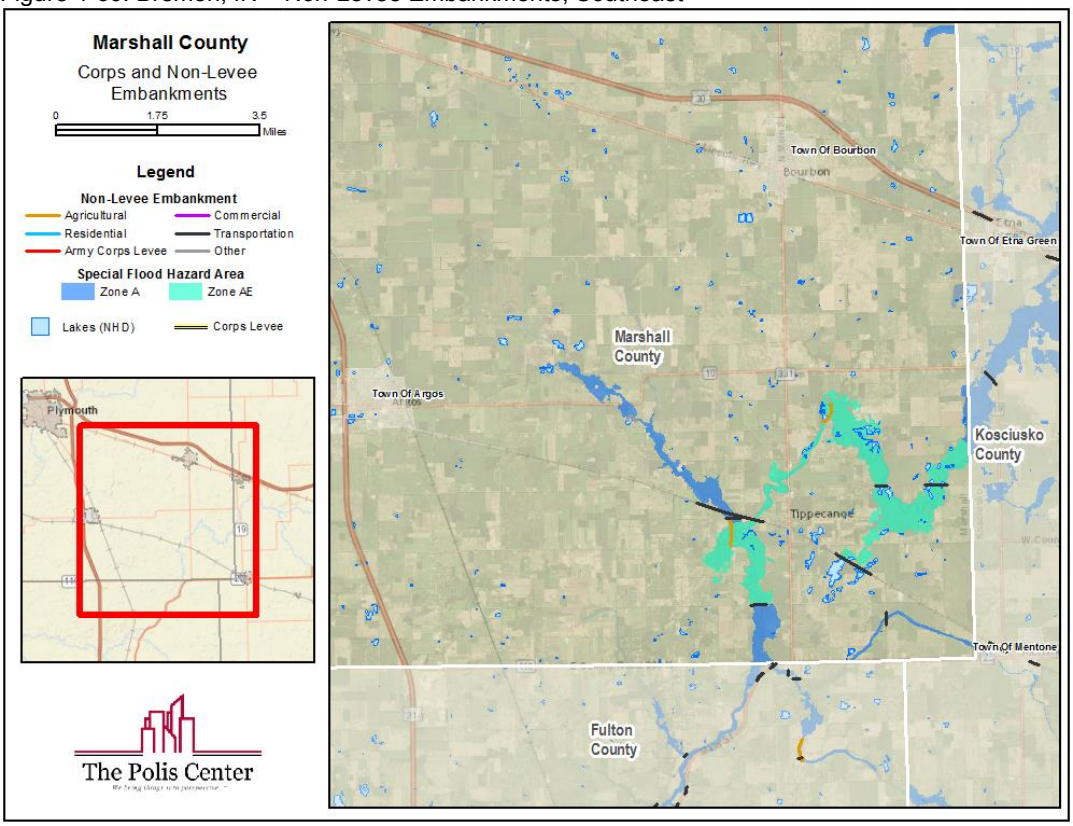
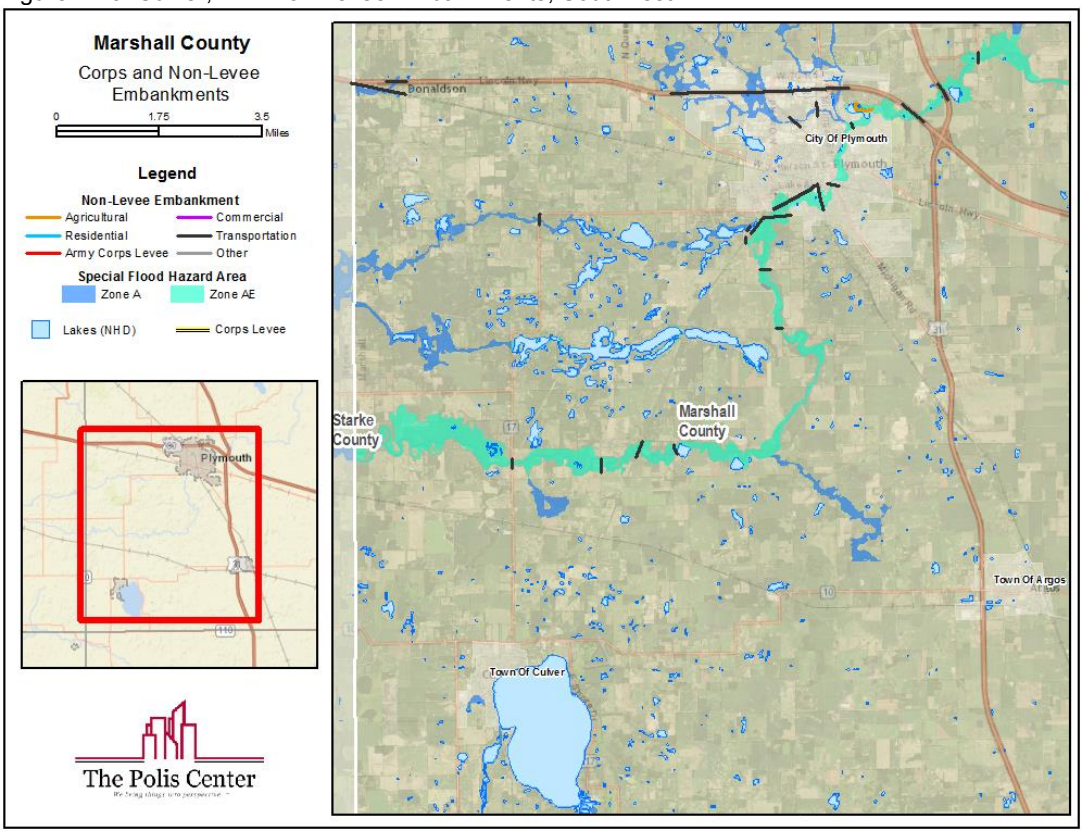


Figure 4-70: Culver, IN – Non-Levee Embankments, Southwest



Relationship to other Hazards

Flooding – Flooding is typically the leading cause to levee failure incidents. In turn, levee failure can cause further flooding and flash flooding downstream of the incident. Depending on the location of the levee, levee failure can unleash flood water onto residential homes, roads, industrial areas, and health facilities, causing millions of dollars of damages and injuries.

Plans and Programs in Place

USACE and FEMA Levee Certification- There are no currently maintained levees certified by the US Army Corps of Engineers or by FEMA under the National Levee Mapping Program. .

Floodplain Ordinance- Proposed construction in the floodway requires the prior approval of the State DNR Division of Water.

Program Gaps or Deficiencies

No program gaps or deficiencies were identified.

Chapter 5 – Goals, Objectives, Mitigation Strategies and Implementation

The goal of mitigation is to protect lives and reduce the future impacts of hazards including property damage, disruption to local and regional economies, the amount of public and private funds spent to assist with recovery, and to build disaster-resistant communities. Mitigation actions and projects should be based on a well-constructed risk assessment, provided in Section 4 of this plan. Mitigation should be an ongoing process adapting over time to accommodate a community's needs.

Community Capability Assessment

The capability assessment identifies current activities used to mitigate hazards. The capability assessment identifies the policies, regulations, procedures, programs, and projects that contribute to the lessening of disaster damages. The assessment also provides an evaluation of these capabilities to determine whether the activities man be improved in order to more effectively reduce the impact of future hazards. The planning team completed a survey and then discussed any of the discrepancies in meeting 3. The following sections highlight the existing plans and

mitigation capabilities within all of the communities and a copy of the results of the capability survey are included in Appendix G.

Planning and Regulatory

Planning and regulatory capabilities are the plans, policies, codes, and ordinances that prevent and reduce the impacts of hazards. Below the team details the NFIP program and local plans, codes, and ordinances in place, to make the community more resilient to disasters.

National Flood Insurance Program (NFIP)

The NFIP is a federal program created by Congress to mitigate future flood losses nationwide through sound, community-enforced building and zoning ordinances and to provide access to affordable, federally-backed flood insurance protection for property owners. The NFIP is designed to provide an insurance alternative to disaster assistance to meet the escalating costs of repairing damage to buildings and their contents caused by floods. Participation in the NFIP is based on an agreement between local communities and the federal government that states that if a community will adopt and enforce a floodplain management ordinance to reduce future flood risks to new construction in Special Flood Hazard Areas (SFHAs), the federal government will make flood insurance available within the community as a financial protection against flood losses.

Marshall County and the Towns of Argos, Bremen, Culver, and the City of Plymouth participate in the National Flood Insurance Program. The Towns of Bourbon and LaPaz do not participate in the NFIP, but they do not have a special flood hazard identified by the FEMA High Risk Zone.

The Indiana Department of Natural Resources (DNR) oversee the continued compliance of state floodway permitting and was empowered by the Indiana General Assembly to regulate certain development activities in the floodway, including the construction of structures, obstructions, deposits, and/or excavations. These activities any State waterway (streams less than 1 square mile in drainage area) by requiring DNR approval prior to the beginning of the project. DNR authority under the Flood Control Act is further described in 312 IAC 10: Floodplain Management.

In 1945, the Indiana Flood Control Act was passed by the state legislature, enabling the IDNR to have regulatory control over floodway areas produced by regulatory floods. The

Indiana "Flood Control Act" (IC 14-28-1) and Flood Hazard Areas Rule (310 IAC 6-1): In the Flood Control Act's preamble, the General Assembly declared that "... the loss of lives and property caused by floods and the damage resulting from floods is a matter of deep concern to Indiana

affecting the life, health, and convenience of the people and the protection of property." Furthermore, "... the channels and that part of the flood plains of rivers and streams that are the floodways should not be inhabited and should be kept free and clear of interference or obstructions that will cause any undue restriction of the capacity of the floodways."

Within the Flood Control Act, the General Assembly created a permitting program. Two of the fundamental provisions of the Act's regulatory programs consist of the following:

(1) An abode or place of residence may not be constructed or placed within a floodway.

(2) Any structure, obstruction, deposit, or excavation within a floodway must receive written approval from the Director of the Department of Natural Resources for the work before beginning construction.

The DNR is Cooperating Technical Partner (CTP) for the FEMA Floodplain Mapping program. The DNR provides floodway site determinations as requested. The DNR performs the Community Assistance Call (CAC) and Community Assistance Visit (CAV) for the NFIP program.

The CAV and CAC services as each NFIP communities assurance that the community is adequately enforcing its floodplain management regulations and prices a chance for technical assistance by the DNR on behalf of FEMA. The City of Plymouth and Town of Culver had their most recent CAV and Marshall County and the Town of Bremen had Community Assistance Call CAC completed in 2016. Neither of which required further compliance follow-up.

The NFIP's Community Rating System (CRS) recognizes and encourages community floodplain management activities that exceed the minimum NFIP standards. Depending upon the level of participation, flood insurance premium rates for policyholders can be reduced. Besides the benefit of reduced insurance rates, CRS floodplain management activities enhance public safety, reduce damages to property and public infrastructure, avoid economic disruption and losses, reduce human suffering, and protect the environment. Technical assistance on designing and implementing some activities is available at no charge. Participating in the CRS provides an incentive to maintaining and improving a community's floodplain management program over the years. Marshall County or any of its communities do not participate in the CRS program.

Plans and Ordinances

Marshall County and its incorporated communities have a number of plans and ordinances in place to ensure the safety of residents and the effective operation of communities. These include

the Marshall County, Indiana Comprehensive Plan, the Marshall County, Indiana Zoning Ordinance, the Lake of the Woods, Marshall County, Indiana Watershed Management Plan, the Soil Survey of Marshall County, Indiana, and the Storm Water Drainage and Sediment Control Ordinance. In Section 4.4 of this plan (*Hazard Profiles)* a review of the plans and programs in place as well as any identified program gaps or deficiencies was included as related to each of the natural hazards addressed in the plan. Information was collected through surveys with planning team representatives from the county, cities, towns and school districts. The review of this information was used to inform the development of mitigation strategies for the 2017 plan update.

General Mitigation Vision

In Section 4.0 of this plan, the risk assessment identified Marshall County is prone to a number of natural hazards. The planning team understands that although hazards cannot be eliminated altogether, Marshall County can work toward building disaster-resistant communities. The goals, strategies and objectives listed in the 2014 Indiana State Hazard Mitigation Plan were adopted for use in the Marshall County Plan. This framework will allow for integration of the mitigation actions that are listed by Marshall County and its jurisdictions into the state plan. The state will then be able to develop a statewide strategy that will benefit all of Indiana.

Table 4-40: Marshall County Strategies

Flooding Goal: Reduce deaths, injuries, property loss and economic disruption due to all types of flooding (riverine, flash flooding, dam/levee failure)	
Mitigation Strategy	Objectives
Prevention:	Planning, technical studies, training, adoption of ordinances and legislation, acquisition and use of equipment, establishing shelters, and encouraging participation in NFIP and CRS will be used to prevent or reduce risks to lives and property from flooding.
Property Protection:	Acquisition, repair, or retrofitting of property and acquisition and use of equipment will be used to prevent or reduce risks to property from flooding.
Public Education and Awareness:	Public education and access to information will be used to raise public awareness of risks from flooding in order to prevent or reduce those risks.
Natural Resource Protection:	Stream corridor protection projects and restoration and soil erosion control projects will be used to prevent or reduce risks and increase the protection of natural resources from flooding.
Emergency Services:	Technological improvements, warning systems, responder training, emergency response services, acquisition and use of equipment, and planning will provide emergency services to prevent or reduce the risks to lives and property from flooding.
Structural Improvements:	Construction and maintenance of drains, sewer drainage and separation projects, floodwalls, dams, culverts, levees, roads, bridges, and general flood protection projects will be used to prevent or reduce damages from flooding, loss of services to critical equipment, and the risks they pose to lives, property, and the natural environment.
Summer Storms Goal: Reduce deaths, injuries, property loss, natural resource and economic disruption due to summer storms.	
Mitigation Strategy	Objectives

Prevention:	Planning, training, technical studies, acquisition and use of equipment, adoption of ordinances and legislation, and construction of new or retrofitting safe rooms will be used to prevent or reduce risks from summer storms to lives, property, and economic activity.
Property Protection:	Constructing safe rooms and storm shelters, retrofitting, and vegetation management will be used to prevent or reduce risks to the protection of property from summer storms.
Public Education and Awareness:	Public education, warning systems, and access to information will be used to raise public awareness of risks from summer storms in order to prevent or reduce those risks.
Emergency Services:	Warning systems, responder training, emergency response services, technological improvements, and response and recovery planning will provide emergency services to prevent or reduce risks from summer storms.
Structural Improvements:	The construction of safe rooms, shelters, and underground utility lines as well as maintenance of structural projects will be used to prevent or reduce risks from summer storms
Tornado Goal: Reduce deaths, injuries, property loss, natural resource and economic disruption due to tornado.	
Mitigation Strategy	Objectives
Prevention:	Adoption of ordinances and legislation, acquisition and use of equipment, planning, conducting technical training, studies, and retrofit or construction of safe rooms will be used to prevent or reduce risks to lives, property, and economic activity from tornadoes.
Property Protection:	Constructing safe rooms and storm shelters, and retrofits will be used to prevent or reduce risks to property from tornadoes.
Public Education and Awareness:	Warning systems, IPAWS, public education, and access to information will be used to raise public awareness of risks from tornadoes in order to prevent or reduce those risks.
Emergency Services:	Warning systems, technological improvements, responder training, planning, emergency response services, and acquisition and use of equipment will provide emergency services to prevent or reduce risks from tornadoes.
Structural Improvements:	Construction of storm shelter and safe rooms and maintenance of other structural projects will be used to prevent or reduce risks from tornadoes.
Hazardous Incident: Reduce deaths, injuries, property loss, natural resource and economic disruption due to hazardous incidents.	
Mitigation Strategy	Objectives
Prevention:	Planning, training, technical studies, acquisition and use of equipment, adoption of ordinances and legislation, and construction of
Property Protection:	
Public Education and Awareness:	Public education, warning systems, and access to information will be used to raise public awareness of risks from hazardous incidents in order to prevent or reduce those risks.
Emergency Services:	Warning systems, responder training, emergency response services, technological improvements, and response and recovery planning will provide emergency services to prevent or reduce risks from summer storms.
Structural Improvements:	
Severe Winter Storms Goal: Reduce deaths, injuries, property loss, natural resource and economic disruption due to severe winter weather	
Mitigation Strategy	Objectives
Prevention:	Acquisition and use of equipment, adoption and enforcement of ordinances and legislation, planning, training, and technical studies will be used to prevent or reduce risk to the protection of lives, property, and economic activity from the risks from severe winter storms.
Property Protection:	Acquisition and use of equipment and vegetation management will be used to prevent or reduce risks to property from severe winter storms.
Public Education and Awareness:	Public education, warning systems, access to information, and outreach projects will be used to raise public awareness of the risks from severe winter storms in order to reduce those risks.

Natural Resource Protection:	Management of Logjams
Emergency Services:	Acquisition and use of equipment, emergency response services, warning systems, technological improvements, planning, and responder training will provide emergency services to prevent or reduce risks from severe winter storms.
Structural Improvements:	Structural projects for critical infrastructure will be implemented and maintained to prevent or reduce risks from severe winter storms.
Extreme Temperatures Goal: Reduce deaths, injuries, property loss, natural resource and economic disruption due to extreme temperatures.	
Mitigation Strategy	Objectives
Prevention:	Planning and the acquisition and use of equipment will be used to prevent or reduce risks from extreme heat and extreme cold.
Property Protection:	Acquisition and use of equipment will be used to prevent or reduce risks to property and economic disruption from extreme heat and extreme cold.
Public Education and Awareness:	Public education and access to information will be used to raise public awareness of the risks from extreme cold and extreme heat in order to prevent or reduce those risks.
Emergency Services:	Planning and implementing watershed plans will be used to prevent or reduce risks from drought. Structural Improvements:
Structural Improvements:	Technological improvements and acquisition of equipment for structural projects will be used to prevent or reduce risks from extreme temperatures.
Ground Failure Goal: Reduce deaths, injuries, property loss, natural resource and economic disruption due to ground failure.	
Mitigation Strategy	Objectives
Prevention:	Planning and the acquisition and use of equipment will be used to prevent or reduce risks from ground failure.
Property Protection:	Acquisition and use of equipment will be used to prevent or reduce risks to property and economic disruption from ground failure.
Public Education and Awareness:	Public education and access to information will be used to raise public awareness of the risks from ground failure in order to prevent or reduce those risks.
Emergency Services:	Planning and implementing watershed plans will be used to prevent or reduce risks from ground failures.
Structural Improvements:	Technological improvements and acquisition of equipment for structural projects will be used to prevent or reduce risks from ground failure.
Dams and Levee Goal: Reduce deaths, injuries, property loss, natural resource and economic disruption due to dam and levee.	
Mitigation Strategy	Objectives
Prevention:	Planning and the acquisition and use of equipment will be used to prevent or reduce risks from dam or levee failure.
Property Protection:	Acquisition and use of equipment will be used to prevent or reduce risks to property and economic disruption from dam or levee failure.
Public Education and Awareness:	Public education and access to information will be used to raise public awareness of the risks from dam or levee failure in order to prevent or reduce those risks.
Emergency Services:	Planning and implementing watershed plans will be used to prevent or reduce risks from dam or levee failure.
Structural Improvements:	Technological improvements and acquisition of equipment for structural projects will be used to prevent or reduce risks from dam or levee.
Drought Goal: Reduce deaths, injuries, property loss, natural resource and economic disruption due to drought.	
Mitigation Strategy	Objectives
Prevention:	Planning, acquisition and use of equipment, and technical studies will be used to prevent or reduce risks from drought.

Property Protection:	Water treatment measures will be used to prevent or reduce risks to property from drought.
Public Education and Awareness:	Public education and access to information will be used to raise public awareness of risks from drought in order to prevent or reduce those risks.
Emergency Services:	Planning and implementing watershed plans will be used to prevent or reduce risks from drought.
Structural Improvements:	Technological improvements and acquisition of equipment for structural projects will be used to prevent or reduce risks from drought.
Infectious Disease Outbreak Goal: Reduce deaths, injuries, property loss, natural resource and economic disruption due to outbreak.	
Mitigation Strategy	Objectives
Prevention:	Planning, acquisition and use of equipment, and technical studies will be used to prevent or reduce risks from outbreak.
Property Protection:	Water treatment measures will be used to prevent or reduce risks to property from outbreak.
Public Education and Awareness:	Public education and access to information will be used to raise public awareness of risks from outbreak in order to prevent or reduce those risks.
Emergency Services:	Planning and implementing watershed plans will be used to prevent or reduce risks from outbreak.
Structural Improvements:	Technological improvements and acquisition of equipment for structural projects will be used to prevent or reduce risks from outbreak.
Earthquake Goal: Reduce deaths, injuries, property loss, natural resource and economic disruption due to earthquake.	
Mitigation Strategy	Objectives
Prevention:	Planning and the acquisition and use of equipment will be used to prevent or reduce risks from extreme heat and extreme cold.
Property Protection:	Acquisition and use of equipment will be used to prevent or reduce risks to property and economic disruption from extreme heat and extreme cold.
Public Education and Awareness:	Public education and access to information will be used to raise public awareness of the risks from extreme cold in order to prevent or reduce those risks.
Emergency Services:	Planning and implementing watershed plans will be used to prevent or reduce risks from drought. Structural Improvements:
Structural Improvements:	Technological improvements and acquisition of equipment for structural projects will be used to prevent or reduce risks from drought.

Mitigation Actions and Projects

Upon completion of the risk assessment and development of the goals and objectives, the planning committee was provided a list of the six mitigation measure categories from the *FEMA State and Local Mitigation Planning How to Guides*. The types of mitigation actions are listed as follows:

- **Prevention:** Government, administrative, or regulatory actions or processes that influence the way land and buildings are developed and built. These actions also include public activities to reduce hazard losses. Examples include planning and zoning, building codes, capital improvement programs, open space preservation, and stormwater management regulations.

- **Property Protection:** Actions that involve the modification of existing buildings or structures to protect them from a hazard or removal from the hazard area. Examples include acquisition, elevation, structural retrofits, storm shutters, and shatter-resistant glass.
- **Public Education and Awareness:** Actions to inform and educate citizens, elected officials, and property owners about the hazards and potential ways to mitigate them. Such actions include outreach projects, real estate disclosure, hazard information centers, and school-age and adult education programs.
- **Natural Resource Protection:** Actions that, in addition to minimizing hazard losses, preserve or restore the functions of natural systems. These actions include sediment and erosion control, stream corridor restoration, watershed management, forest and vegetation management, and wetland restoration and preservation.
- **Emergency Services:** Actions that protect people and property during and immediately after a disaster or hazard event. Services include warning systems, emergency response services, and protection of critical facilities.
- **Structural Projects:** Actions that involve the construction of structures to reduce the impact of a hazard. Such structures include dams, levees, floodwalls, seawalls, retaining walls, and safe rooms.

Implementation of the mitigation plan is critical to the overall success of the mitigation planning process. The first step is to decide, based upon many factors, which action will be undertaken first. In order to pursue the top priority first, an analysis and prioritization of the actions is important. The plan team assessed the status and priority of the existing strategies using the FEMA mitigation evaluation criteria, using the STAPLE + E criteria. Table X lists the factors to consider in the analysis and prioritization of actions. Some actions may occur before the top priority due to financial, engineering, environmental, permitting, and site control issues. Public awareness and input of these mitigation actions can increase knowledge to capitalize on funding opportunities and monitoring the progress of an action.

Figure 5-1: STAPLE+E criteria

Criteria	Description
S – Social	Mitigation actions are acceptable to the community if they do not adversely affect a particular segment of the population, do not cause relocation of lower income people, and if they are compatible with the community's social and cultural values.
T – Technical	Mitigation actions are technically most effective if they provide a long-term reduction of losses and have minimal secondary adverse impacts.
A – Administrative	Mitigation actions are easier to implement if the jurisdiction has the necessary staffing and funding.
P – Political	Mitigation actions can truly be successful if all stakeholders have been offered an opportunity to participate in the planning process and if there is public support for the action.
L – Legal	It is critical that the jurisdiction or implementing agency have the legal authority to implement and enforce a mitigation action.
E – Economic	Budget constraints can significantly deter the implementation of mitigation actions. It is important to evaluate whether an action is cost-effective, as determined by a cost benefit review, and possible to fund.
E – Environmental	Sustainable mitigation actions that do not have an adverse effect on the environment, comply with federal, state, and local environmental regulations, and are consistent with the community's environmental goals, have mitigation benefits while being environmentally sound.

Understanding the dynamics of STAPLE + E lead to the projects success. Developing questions evolving around the evaluation criteria, similar to those outlined below, help the team prioritize the projects.

Social:

- Will the proposed action adversely affect one segment of the population?
- Will the action disrupt established neighborhoods, break up voting districts, or cause the relocation of lower income people?

Technical:

- How effective is the action in avoiding or reducing future losses?
- Will it create more problems than it solves?
- Does it solve the problem or only a symptom?
- Does the mitigation strategy address continued compliance with the NFIP?

Administrative:

- Does the jurisdiction have the capability (staff, technical experts, and/or funding) to implement the action, or can it be readily obtained?
- Can the community provide the necessary maintenance?
- Can it be accomplished in a timely manner?

Political:

- Is there political support to implement and maintain this action?
- Is there a local champion willing to help see the action to completion?
- Is there enough public support to ensure the success of the action?
- How can the mitigation objectives be accomplished at the lowest cost to the public?

Legal:

- Does the community have the authority to implement the proposed action?
- Are the proper laws, ordinances, and resolution in place to implement the action?
- Are there any potential legal consequences?
- Is there any potential community liability?
- Is the action likely to be challenged by those who may be negatively affected?
- Does the mitigation strategy address continued compliance with the NFIP?

Economic:

- Are there currently sources of funds that can be used to implement the action?
- What benefits will the action provide?
- Does the cost seem reasonable for the size of the problem and likely benefits?
- What burden will be placed on the tax base or local economy to implement this action?
- Does the action contribute to other community economic goals such as capital improvements or economic development?
- What proposed actions should be considered but be "tabled" for implementation until outside sources of funding are available?

Environmental:

- How will this action affect the environment (land, water, endangered species)?
- Will this action comply with local, state, and federal environmental laws and regulations?
- Is the action consistent with community environmental goals?

Hazard Mitigation Actions

Marshall County and its included municipalities share a common Multi-Hazard Mitigation plan and worked closely to develop it. These people work together with their city councils and the Marshall County Emergency Management Director to insure that the hazards and mitigation actions included in this plan are accurate and addressed in their jurisdictions. The jurisdictions responsible for each action are the following:

- Marshall County
- Argos
- Bremen
- Bourbon
- Culver
- La Paz
- Plymouth

Table 5-1 lists all mitigation actions for Marshall County and its jurisdictions. Appendix G contains separate mitigation action tables for each jurisdiction. Each of these mitigation action charts

detail the hazard, the mitigation action to address it, the priority ranking for implementation (1=High Priority; 2= Moderate Priority; 3= Low Priority), its current stage of implementation, the timeframe for implementation going forward, the jurisdictions who have identified they will work to implement the action, the responsible parties to carry through with implementation, and comments on how the plan will be implemented through existing planning mechanisms and funding to make implementation happen.

All of the mitigation actions identified in the 2009 Marshall County Hazard Mitigation Plan have been carried over into the 2017 plan, based on the advisement of the Marshall County Emergency Management Director and the consensus of the steering committee. None of the 2009 mitigation actions have been fully completed and are identified in the 2017 plan to reflect their ongoing implementation. *Appendix K Documentation of Marshall County MHMP Update* documents the carryover of these actions and the language revisions that they underwent for the 2017 plan to clarify or improve the wording of the mitigation action.

The status designations are:

- New – actions have not yet started
- Complete – the action is complete
- Ongoing – actions require continuing application
- In Progress – actions are currently being acted upon
- Deferred – no progress has been made
- Deleted – the action is no longer relevant

The mitigation action types are defined as follows:

- Prevention
- Property Protection
- Public Education
- Natural Resource Protection
- Emergency Services
- Structural Improvement

Mitigation Actions by Community

This is a multi-jurisdictional plan that covers Marshall County, its school districts, City of Plymouth and Towns of Argos, Bremen, Bourbon, Culver and La Paz. The Marshall County risks and mitigation activities identified in this plan also incorporate the concerns and needs of townships and other entities participating in this plan.

Table 5-1: Mitigation Actions

#	Hazards	Mitigation Action Type	Action	Priority	Status	Community	Coordinating Agency	Potential Funder	Action Source
1	Winter Storm	Emergency Services	Determine a plan for use of 4WD vehicles in the event of emergency rescue		Complete	All Communities	EMA	IDHS FEMA	Hazard Mitigation Plan
2	Flood	Property Prevention	Develop a countywide ordinance prohibiting development in floodplains		Complete	All Communities	EMA Local communities	Local Funds	Hazard Mitigation Plan
3	Flood	Property Prevention	Establish an ordinance requiring all mobile homes to have weather radios		Complete	All Communities	Local Communities	Local Funds	Hazard Mitigation Plan
4	Winter Storm	Public Education	Implement an annual winter weather emergency news release		Complete	All Communities	EMA	IDHS FEMA	Hazard Mitigation Plan
5	Flood	Natural Resource Protection	Separate sewage and storm drainage in sewer system		Complete	Bremen	Local Communities	*DNR Local funds*	Hazard Mitigation Plan
6	Hazmat	Prevention	Establish a county plan that is specific to Hazmat Emergencies		Complete	Marshall County	EMA	IDHS FEMA	Hazard Mitigation Plan
7	Multiple Hazards	Emergency Services	Establish an active LEPC to mitigate and respond to hazards		Complete	Marshall County	EMA	IDHS FEMA	Hazard Mitigation Plan
8	Multiple Hazards	Property Prevention	Establish an ordinance requiring large subdivisions to install warning systems		Complete	Marshall County	Local Communities	Local Funds	Hazard Mitigation Plan
9	Multiple Hazards	Emergency Services	Implement emergency response training and annual “event or situational” training for LEPC		Complete	Marshall County	EMA	IDHS FEMA	Hazard Mitigation Plan
10	Flood	Prevention	Implement Silt Pits program (dig out 1,000 ft by 6 ft)		Complete	Marshall County		*DNR FEMA*	Hazard Mitigation Plan
11	Winter Storm	Prevention	Implement tree trimming throughout the county		Complete	Marshall County	EMA Local utilities	Local funds	Hazard Mitigation Plan
12	Hazmat	Prevention	Conduct a commodity flow study along major roadways	Medium	In Progress	All Communities	EMA Local communities	*Department of Transportation*	Hazard Mitigation Plan
13	Multiple Hazards	Emergency Services	Create a plan to address special needs populations	High	In Progress	All Communities	EMA Local non-profits	IDHS FEMA	Hazard Mitigation Plan

14	Earthquake	Public Education	Distribute literature advising that residents, schools, healthcare facilities, and other critical facilities bolt bookshelves to walls and secure water heaters	Low	In Progress	All Communities	EMA	IDHS FEMA	Hazard Mitigation Plan
15	Multiple Hazards	Emergency Services	Establish new shelters throughout the county	Medium	Identified	All Communities	EMA	IDHS FEMA	Hazard Mitigation Plan
16	Multiple Hazards	Public Education	Implement school-wide programs to educate students on the hazards affecting the county and preparation/mitigation plans	High	Identified	All Communities	EMA	IDHS FEMA	Hazard Mitigation Plan
17	Flood	Emergency Services	Procure permanent signage to warn of flood hazards	Medium	In Progress	All Communities	EMA	IDHS FEMA	Hazard Mitigation Plan
18	Multiple Hazards	Emergency Services	Purchase generators to provide back-up power to schools and shelters	High	In Progress	All Communities	EMA	IDHS FEMA	Hazard Mitigation Plan
19	Multiple Hazards	Emergency Services	Schedule NIMS training for first responders	Medium	In Progress	All Communities	EMA	IDHS FEMA	Hazard Mitigation Plan
20	Multiple Hazards	Emergency Services	Purchase and install new warning sirens within the county	Low	In Progress	La Paz	EMA	IDHS FEMA	Hazard Mitigation Plan
21	Flood	Structural Improvement	Assess and upgrade drainage system along US 31	Medium	In Progress	La Paz	EMA Local utilities	*Local funds*	Hazard Mitigation Plan
22	Multiple Hazards	Emergency Services	Rehearse communication strategies at monthly Communication Committee meetings	Medium	Complete	Marshall County	EMA Local communities	IDHS FEMA	Hazard Mitigation Plan
23	Flood	Property Prevention	Conduct a study to determine potential buy-out properties along the Yellow River	Low	In Progress	Plymouth	EMA	IDHS FEMA	Hazard Mitigation Plan
24	Flood	Property Prevention	Flood-proof the wastewater treatment facility near Plymouth	Medium	In Progress	Plymouth	EMA Local utilities	*Local funds FEMA*	Hazard Mitigation Plan
25	Multiple Hazards	Emergency Services	Continue regular training for fire and tornado response	High	In Progress	All Communities	EMA	IDHS FEMA	Hazard Mitigation Plan
26	Multiple Hazards	Emergency Services	Install new warning sirens within the county	Low	In Progress	Culver, Bourbon, Plymouth, Bremen	EMA	IDHS FEMA	Hazard Mitigation Plan

27	Multiple Hazards	Emergency Services	Continue regular testing of sirens	High	Ongoing	All Communities	EMA	IDHS FEMA	Hazard Mitigation Plan
28	Flood	Prevention	Gage at State Road 10 and Deep Ditch	Medium	Identified	County	EMA	IDHS FEMA	Hazard Mitigation Plan
29	Multiple Hazards	Structural Improvement	Structural Improvement on South Walnut	Low	Identified	Plymouth	Local Communities	Local Funds	Hazard Mitigation Plan
30	Multiple Hazards	Structural Improvement	Structural Improvement on county bridge on Center Street over Army Ditch	Low	Identified	Bremen	Local Communities	Local Funds	Hazard Mitigation Plan
31	Flood	Property Prevention	Buyout of two mobile homes in flood hazard area	Medium	Identified	La Paz	EMA	IDHS FEMA	Hazard Mitigation Plan
32	Multiple Hazards	Structural Improvement	Structural Improvement on South Walnut	Medium	Identified	Plymouth	Local Communities	Local Funds	Hazard Mitigation Plan
33	Dam, Levee, Flood	Prevention	Continued compliance of the NFIP, for all NFIP communities	High	Identified	All NFIP Communities	EMA	IDHS FEMA	Hazard Mitigation Plan

Chapter 6 – Plan Maintenance and Implementation

Implementation and Maintenance

The Marshall County All-Hazard Mitigation Plan (AHMP) is intended to serve as a guide for dealing with the impact of both current and future hazards for all county people and institutions. As such it is not a static document but must be modified to reflect changing conditions if it is to be an effective plan. The goals, objectives and mitigation strategies will serve as the action plan. Even though individual strategies have a responsible party assigned to it to ensure implementation, overall responsibility, oversight, and general monitoring of the action plan has been assigned to the Marshall County Emergency Manager.

The corresponding community means that that community will be in charge of implementing that strategy. Goals identified by the county will be implemented by the commission and the Town and City Councils will be responsible for implementing their corresponding strategies.

It will be their responsibility to gather a Local Task Force to update the All-Hazard Mitigation Plan on a routine basis. Every year, the County Emergency Manager will call a meeting to review the plan, mitigation strategies and the estimated costs attached to each strategy. All participating parties of the original Local Task Force and cities will be invited to this meeting. Responsible parties will report on the status of their projects. It will be the responsibility of the committee to evaluate the plan to determine whether:

- Goals and objectives are relevant.
- Risks have changed.
- Resources are adequate or appropriate.
- The plan as written has implementation problems or issues.
- Strategies have happened as expected.
- Partners participating in the plan need to change (new and old).
- Strategies are effective.
- Any changes have taken place that may affect priorities.
- Any strategies should be changed.

In addition to the information generated at the Local Task Force (LEPC and CEMP) meetings, the County Emergency Manager will also annually evaluate the All-Hazard Mitigation Plan and update the plan in the event of a hazardous occurrence. Two-year updates are due on the anniversary of the plan approval date. After the second two-year update meeting, the Marshall County

Emergency Manager will finalize a new Local Task Force to begin the required five-year update process. This will be accomplished in coordination with Marshall County jurisdictions and the entire All-Hazard Mitigation Plan shall be updated and submitted to FEMA for approval (within 5 years of plan adoption). These revisions will include public participation by requiring a public hearing and published notice in addition to multiple Local Task Force meetings to make detailed updates to the plan.

Public participation for updates is as critical as in the initial plan. Public participation methods that were used in the initial writing will be duplicated for any future update processes – direct mailing list of interested parties, public meetings, press releases, surveys, questionnaires, and resolutions of participation and involvement. Additional methods of getting public input and involvement are encouraged such as placing copies of the plan in the Marshall County Emergency Manager's Office and city offices, in addition to placing the plan on the Marshall County and social media websites. Furthermore, jurisdictions will be encouraged to place a notice on their websites stating the plan is available for review at the city offices. Notifications of these methods could be placed in chamber newsletters and local newspapers. Committee responsibilities will be the same as with updates.

Chapters 5 focuses on mitigation strategies for natural hazards, jurisdiction-specific mitigation strategies for both natural and man-made/technological hazards. The All-Hazard Mitigation Plan proposes a number of strategies, some of which will require outside funding in order to implement. If outside funding is not available, the strategy will be set aside until sources of funding can be identified. In these situations, Marshall County and cities will also consider other funding options such as the county's/cities'/towns' general funds, bonding and other sources. Based on the availability of funds and the risk assessment of that hazard, the county will determine which strategies should be continued and which should be set aside. Consequently, the action plan and the risk assessment serves as a guide to spending priorities but will be adjusted annually to reflect current needs and financial resources.

The last step requires an evaluation of the strategies identified in the goals and policies framework, selecting preferred strategies based on the risk assessment, prioritizing the strategy list, identifying who is responsible for carrying out the strategy, and the timeframe and costs of strategy completion. Marshall County and its jurisdictions have incorporated the preferred

strategies including identification of the responsible party to implement, the timeframe and the cost of the activity with the goals and policies framework.

This plan will be integrated into other county plans such as County Comprehensive Plans, the County Water Plan, the County Transportation Plan and all Emergency Operations Plans. Chapter one will serve as an executive summary to be attached to those plans as necessary. The County Board and Emergency Manager will encourage jurisdictions to implement their jurisdiction-specific mitigation strategies in their comprehensive plans, land use regulations, zoning ordinances, capital improvement plans and/or building codes by including mitigation strategies in their plans as listed in Table 6-1. Further, as each land use mechanism is updated, mitigation strategies will be evaluated to determine whether they can implement or include them at that time. The Emergency Management Advisory Council (EMAC) will continue to serve as the advisory body that provides general supervision and control over the emergency management and the disaster programs for the county and its multiple jurisdictions. The quarterly meetings will continue to be available to the public and other mitigation team members through the EMAC and other mitigation projects avenues such as RiskMAP. Table 6-1 provides the year of the currently effective community capability and implementation documents or signifies if the county uses the state ordinances or codes.

Table 6-1: Marshall County and Jurisdictions Planning Mechanisims

		Implementation Documents								
		Zoning Ordinance	Comprehensive Plan	Emergency Operations Plan	Floodplain Ordinance	Storm Water Drainage	Watershed Plan	Erosion Ordinance	Burning Ordinance	Building Codes
Jurisdiction Name	Marshall County	2007	2003	Marshall County Comprehensive Emergency Management Plan 2014	11/16/11	2011	Lake of the Woods, Marshall County, IN Watershed 2005	2011	State	State
	Plymouth	2008	2013		11/16/11	-		State Erosion Control Rule 5 (327 IAC 15-5)	State	State
	Argos	2015	2018		-	-			State	State
	Bourbon	2015	2017		-	-			State	State
	Bremen	1992	-		11/16/11	-			State	State
	Culver	2017	2013		11/16/11	-			State	State
	La Paz	-	-		-	-			State	State

Many of these plans or policies can help implement the goals, objectives and strategies in Marshall County's All Hazard Mitigation Plan. The Marshall County Emergency Manager is responsible for meeting within each jurisdiction within two times throughout the next five years. During these meetings, the local Emergency Manager will review all Local Planning Mechanisms and

collaborate with the Cities and Towns to ensure the All-Hazard Mitigation Plan is becoming as integrated into local plans as possible. These Local Planning Mechanisms are meant to work cooperatively together in order to ensure the health, safety, and welfare of Marshall County and its corresponding jurisdictions. Although only one of the planning mechanisms has been updated since the initial hazard mitigation plan was adopted city, town, and county officials will integrate related plans with hazard mitigation goals, objectives, and strategies when feasible and appropriate.

Adoption, Implementation and Maintenance

County Adoption

One of the first steps in implementing the plan is to make sure that it is officially adopted in a public hearing. The task force and public provided comment on the draft plan. The task force reviewed comments, modifications were made and a final draft was sent to FEMA for review, comment and approval. After FEMA approved the plan, the county board adopted the plan. A public hearing was held to obtain any additional comments that the public or others wished to make. A copy of the county and the community jurisdictions resolutions to adopt are located in Appendix I.

City and Town Adoption

The All-Hazard Mitigation Plan for Marshall County is a multijurisdictional plan. All communities in the county – towns and cities – were involved in the various stages of the planning process and a mitigation strategies have been identified for each jurisdiction. Each of Marshall County's cities and towns passed resolutions to participate in the county plan. Following official adoption of the plan by the county each city and township was notified. Each chose whether or not to adopt the plan as well. Each were encouraged to adopt enabling them to apply for HMGP funds independently not under the umbrella of the county. Copies of the city and towns resolutions choosing to adopt the plan are in Appendix I.

Implementation and Maintenance Guidelines.

The Marshall County All-Hazard Mitigation Plan is intended to serve as a guide/reference to mitigate the impact of both current and future hazards for all county residents and institutions. As such, it is not a static document but must be modified to reflect changing conditions if it is to be an effective plan. The goals, objectives and mitigation strategies will serve as a work or action plan.

Individual strategies have a party assigned to it to help ensure implementation, oversight and general monitoring of the action plan; however, oversight has been assigned to the County Emergency Manager. The following guidelines will help implement the goals, objectives and strategies of the plan. An implementation committee will be used to assist in this process. The existing task force, the planning commission, other appropriate county committee, or any other group of stakeholders could serve as the implementation committee to review implementation opportunities identified in the plan. Implementation of strategies should be a collaborative effort of the participating jurisdictions. This committee should operate by group consensus and create recommendations for implementation to bring forward to the proper governing entity for consideration. Guidelines for the committee include:

1. Commitment to the plan and overall mitigation vision.
2. Protect sensitive information.
3. Take inventory of strategies in progress.
4. Determine strategies that no longer are needed or new strategies that have emerged.
5. Set priorities. Assign responsibilities to complete.
6. Seek funding.
7. Meet minimum bi-annually – one meeting to set the course of action and a second to monitor progress.
8. Report to all respective boards for action.
9. Advisory capacity.

Assigning strategies and implementation activities in this plan to certain entities does not guarantee completion. The strategies and activities addressed in this plan will be addressed as funding and other resources become available and approval by the responsible jurisdiction takes place.

The County Emergency Manager has the overall responsibility of tracking the progress of mitigation strategies. The County Emergency Manager will request updates from responsible agencies and cities on their mitigation actions after each disaster and at least annual to coincide with plan evaluation. Post disaster monitoring will evaluate the effectiveness of mitigation actions that have been completed and determine implementation of planned strategies. Monitoring may lead to developing a project that may be funded by FEMA's Hazard Mitigation Assistance Programs.

Annual reviews to change the plan will be led by the County Emergency Manager using the implementation committee. It will be their responsibility to review the plan and mitigation. Yearly

reviews are due on the anniversary of the plan approval. Responsible parties and the implementation committee will report on the status of their projects. Committee responsibility will be to evaluate the plan to determine whether:

- Goals, objectives and strategies are relevant.
- Risks that have changed including the nature, magnitude, and/or type of risks.
- Resources are adequate or appropriate.
- The plan as written has any implementation problems or issues.
- Deadlines are being met as expected.
- Partners participating in the plan are appropriate.
- Strategies are effective.
- New developments affecting priorities.
- Strategies that should be changed.

Updates every five years are led by the County Emergency Manager in coordination with cities and townships to complete a rewrite for submitting to FEMA. A task force, similar to the one created to complete the plan, will be formed and used in the planning process to rewrite the plan. These revisions will include public participation by requiring a public hearing and published notice. Future updates should address potential dollar losses to vulnerable structures identified. Any major changes in the plan may include additional public meetings besides just a public hearing.

Public participation for updates is as critical as in the initial plan. Public participation methods that were used in the initial writing should be duplicated for any updates – direct mailing list of interested parties, public meetings, press releases, surveys, questionnaires, and resolutions of participation and involvement. Additional methods of getting the public input and involvement are encouraged such as placing copies of the plan in public libraries for public comment or placing the plan on county and city websites. Notifications of these methods could be placed in newsletters and the local newspapers. Committee responsibilities will be the same with updates as the original plan.

The action plan proposes a number of strategies, some of which will require outside funding to implement. If outside funding is not available, the strategy may be set aside until sources of funding can be identified or modified to work within the funding restrictions. In these situations, the county and entities will also consider other funding options such as the county's general fund, bonding and other sources. Based on the availability of funds and the risk assessment of the hazard, the county will determine which strategies should they continue to work on and which should be set aside. Consequently, the action plan and the risk assessment serves as a guide to

spending priorities but will be adjusted annually to reflect current needs and financial resources. It is not a legal binding document.

Updates require an evaluation of the strategies identified in the goals and policies framework, selecting preferred strategies based on the risk assessment, prioritizing the strategy list, identifying who is responsible for carrying out the strategy, and the timeframe and costs of strategy completion. Marshall County has incorporated the preferred strategies including identification of the responsible party to implement, the timeframe and the cost of the activity in the plan framework.

This plan will be integrated into other county plans such as the County Comprehensive Plan, the County Water Plan, the County Transportation Plan and all Emergency Operations Plans. Chapter One can serve as an executive summary to be attached to those plans as necessary. The County Board encourages jurisdictions to address hazards in their comprehensive plans, land use regulations, zoning ordinances, capital improvement and/or building codes by including some of the mitigation strategies in their plans. Many of the plans or policies can include strategies from the Hazard Mitigation Plan. They are meant to blend and complement each other so that strategies are duplicated and occur in different plans as appropriate.