Multi-Hazard Mitigation Plan
St. Joseph County, Indiana

2017

Contact:

John Antonucci, Director
Emergency Management Agency
South Bend Central Fire Station
1222 South Michigan Street
South Bend, IN 46601
(574) 235-9378
johnsjcema@gmail.com
www.stjosephcountyindiana.com/307/Emergency-Management

Prepared By:

The Polis Center
School of Liberal Arts
Indiana University–Purdue University Indianapolis
1200 Waterway Blvd.
Indianapolis, IN 46202
polis@iupui.edu
www.polis.iupui.edu
(317) 274-2455

Table of Contents

List of Figures

List of Tables

Chapter 1 - Overview

Introduction

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

The St. Joseph County Multiple Hazard Mitigation Plan Update is developed to the "Multiple 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 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 changes in priorities. This update will remain effective for 5 years from the community adoption.

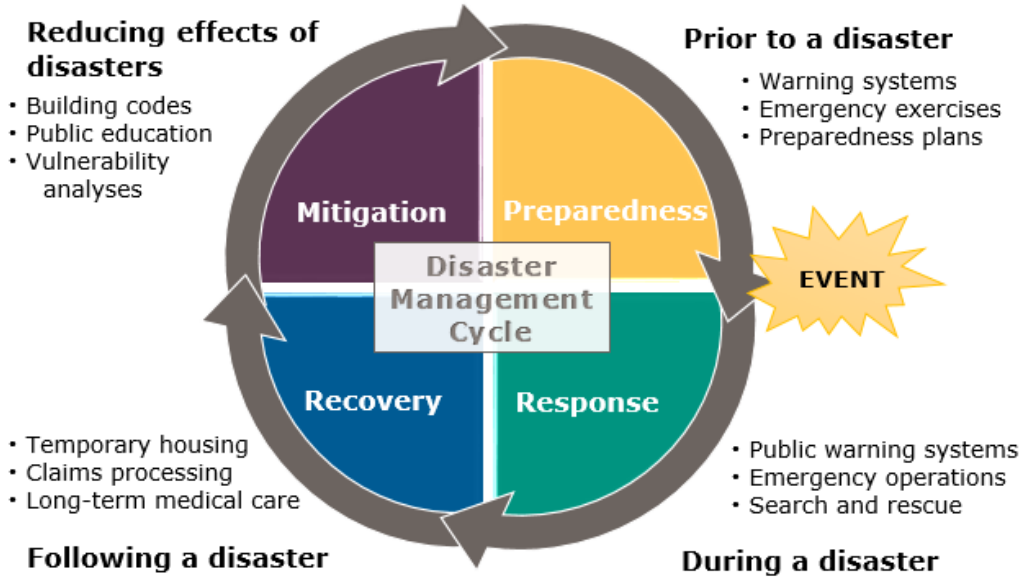
The procedures outlined in the plan are based upon guidance provided by the Federal Emergency Management Agency and is consistent with the requirements and procedures defined in the Disaster Mitigation Act of 2000. The analysis includes three components: 1) profile and analysis of

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 St. Joseph County, its school jurisdictions, and the incorporated communities within the county, which consist of the cities of Mishawaka and South Bend and the towns of Lakeville, New Carlisle, and North Liberty. The communities of Indian Village, Osceola, Roseland and Walkerton were invited to participate but did not take part in the planning process. The St. Joseph 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	South Bend	City	Yes	Yes
2	Indian Village	Town	Yes	No
3	Lakeville	Town	Yes	Yes
4	Mishawaka	Town	Yes	Yes
5	New Carlisle	Town	Yes	Yes
6	North Liberty	Town	Yes	Yes
7	Osceola	Town	Yes	No
8	Roseland	Town	Yes	No
9	Walkerton	Town	Yes	No

Planning Team

The St. Joseph County Emergency Management Agency Director 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 2-2: Hazard Mitigation Planning Team

Name	Title	Organization	Jurisdiction
John Antonucci	EMA Director	County Emergency Management Agency	St. Joseph County
Kalee Ziots	EMA Deputy Director	County Emergency Management Agency	St. Joseph County
Elaine Horvath	Office Manager	County Emergency Management Agency	St. Joseph County
Jim Lopez	Special Projects Coordinator	County Emergency Management Agency	St. Joseph County
Bryon Woodward	Fire Chief	Mishawaka Fire Department	Mishawaka
Greg Hunt	Fire Chief	Mishawaka Fire Department	Mishawaka
Chip Porter		County Highway Department	St. Joseph County
Julie Kroger	911 Dispatch Assistant Supervisor	911 Dispatch	St. Joseph County
Vicki Kitchen *	Clerk-Treasurer	North Liberty	North Liberty
Paul Burrows		St. Joseph County	St. Joseph County
Chuck Bulot *	Building Commissioner	St. Joseph County Building Department	St. Joseph County
Patrick Howard	Marshal	Lakeville Police Department	Lakeville
Andy Myer	EMS	South Bend Fire Department	South Bend
Ted Bombagetti	District Coordinator	Indiana Department of Homeland Security	District 2
Timm Schabbel	Fire Chief	Clay Fire Department	St. Joseph County
Dan Casad *	Director of Operations	Town of Lakeville	Lakeville
Jaren Kilian	Assistant Chief	Clay Township Fire Department	St. Joseph County
Jeff Roseboom	Police	New Carlisle Police	New Carlisle
Kara Boyles	City of South Bend Engineering	City of South Bend	South Bend
Jessica Clark	County Engineer	St. Joseph County	St. Joseph County
Beverly Kingston	County GIS	St. Joseph County	St. Joseph County
John Carlson	County GIS	St. Joseph County	St. Joseph County
Mark Walsh	Police	South Bend Police Department	South Bend
Josh Schweizer	Fire Chief	New Carlisle Fire Department	New Carlisle
Corey Noland	Councilman	County Council	St. Joseph County
Jim Luccki	Fire Chief	South Bend Fire Department	South Bend
Charlie Feirrell	Highway Engineer	Highway Engineer Department	St. Joseph County
Ray Schultz	Assistant Chief	Mishawaka Fire	Mishawaka
Johnnie McCarey	Supervisor	St. Joseph County Highway	St. Joseph County
Troy Villa	Engineer	City of South Bend	South Bend
Sue Ellen Douelrick	Engineer	City of South Bend	South Bend
Rebecca Matthys	Engineer Intern	City of South Bend	South Bend
John Karris		Department of Natural Resources	St. Joseph County
Ashlee Jackson	Sergeant-DNR-LE	Department of Natural Resources	St. Joseph County

Review of Existing Plans

St. Joseph County and the local communities utilize land use plans, emergency response plans, municipal ordinances, and building codes in order to direct community development. The

planning process also incorporated the existing natural hazard mitigation elements from these previous planning efforts. Table 2-2 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
Town of North Liberty	1975	Zoning Ordinance for the Town of North Liberty	Ordinance for planning development and area land use	Section 4,5,6
City of South Bend	2004	City of South Bend Zoning Ordinance	Ordinance for development and growth and the promotion the public health, safety, and welfare.	Section 4,5,6
St. Joseph County	2005	St. Joseph County Zoning Ordinance	Current and future development is subject to the provisions for buildings, structures and uses.	Section 4,5,6
Town of New Carlisle	2010	Town of New Carlisle Zoning Ordinance	Ordinance guiding the future development of the town and promoting public health and	Section 4,5,6
Indiana Department of Homeland Security	2014	State of Indiana Multi-Hazard Mitigation Plan	Statewide hazard mitigation plan	Section 5
Federal Emergency Management Agency	2015	Flood Insurance Study: St Joseph County, Indiana	Study that establishes flood insurance rates and promotes floodplain management	Section 3,4,5
St. Joseph County Board of Commissioners	2016	St. Joseph County Commodity Flow Study	Commodity flow study for the LEPC of St Joseph County	Section 3,4
Town of Lakeville	2017	Town of Lakeville Zoning Ordinance	Ensuring that growth be commensurate with and promote best land use practices.	Section 4,5,6

Planning Process Timeline and Steps

The St. Joseph County planning team met on May 17, 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 May 14, 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 August 2, 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 media resources including Facebook and Twitter. In addition, a final copy of the plan will be available online through the county's website. Copies of the outreach methods and contacts for this update are in outlines Appendix E.

Chapter 3 – Community Profile

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

General County Description

St. Joseph County is located in northern Indiana and is situated approximately 150 miles north of the state capital, City of Indianapolis. According to the US Census, the county covers 457.9 square miles of land and 3.54 square miles of water and has an estimated population of 269,141. South Bend is the county seat and is the largest city in the county and the fourth largest city in Indiana.

South Bend forms an urban sprawl in the northcentral part of the county while the rest of the county is primarily composed of rolling farmland with heavily-wooded areas adjacent to the major streams. The northern and central parts of the county contain the bulk of the population, living in incorporated communities centralized in the cities of South Bend and Mishawaka. The southern and western sections of the county are comparatively more rural.

The nine incorporated cities and towns within St. Joseph County consist of the cities of Mishawaka and South Bend and the towns of Indian Village, Lakeville, New Carlisle, North Liberty, Osceola, Roseland and Walkerton. Within St. Joseph County, there are also twenty-four unincorporated towns. The county contains townships: Centre, Clay, German, Greene, Harris, Liberty, Lincoln, Madison, Olive, Penn, Portage, and Union.

St Joseph County has had several new development projects in recent years and is forming plans for more. In 2016, St. Joseph County Redevelopment Commission partnered with the South Bend Regional Chamber to begin studying rail development opportunities within various parts of the

county. The St. Joseph County Rail Opportunity Plan is intended to serve as building block for further projects that pave the way for economic development opportunities with in the county.

Recently, the St. Joseph County Chamber of Commerce launched the details of its four-year, $3.75 million economic development strategic initiative, growSJC—Invest in Your Future. If the campaign is successful, the initiative will result in the creation of 2,000 new jobs and $250 million in new capital investment. Beginning in May 2017, the community of New Carlisle made strides in developing a new industrial park. About 2.5 miles of water and sewer lines were installed for the new business hub as part of the $4.35 million infrastructure project.

St. Joseph County has long been one of the main centers for industry, manufacturing, and business in northern Indiana. Currently, manufacturing, retail trade, and educational and social services represent the largest industrial sectors. The majority of St. Joseph County residents live in the city with 37.8% of the population living in South Bend and 18.1% living in Mishawaka. The county has a population density of 587.8 per square mile. In the past three decades (1980 through 2010), St. Joseph County's population grew by 9.5%.

Historical Setting

Organized in 1830, the county was named after the St. Joseph River that runs through the county. Alexis Coquillard, from Detroit, established the first home in St. Joseph County. The first court was held in Alexis Coquillard's home, where the county commissioners met to establish a location for a county seat. He later established a fur trade along the river, and also Ft. Wayne, which were the trading posts with the Native Americans of northwestern Indiana and southwestern Michigan.

Prior to the European settlement in the area, Miami and Potawatomi Native Americans hunted on the land that now consists of St. Joseph County. The first known European to come the area was Father James Marquette, who traveled up the Kankakee River and across the portage to St. Joseph River in May 1675. Drawn by the easy proximity to the Kankakee River, the rich natural resources, and bountiful wildlife that attributed to the fur trade, European settlers migrated into the area and established a portage and trade routes. The first permanent European residents of South Bend were fur traders attracted to the possibility of wealth through trade. The rivers permitted the creation of facilities for mills and machinery and helped with the transportation of goods to southern markets.

In addition to being a center for trade and industry, St. Joseph County also became the regional center for higher education. In November 1842, a French priest named Edward Sorin and seven compatriots set out to establish a school on 524 acres. This school encompassed religious novitiates, preparatory and grade schools, a manual labor school, and a classical collegiate curriculum that included four years of humanities, poetry, rhetoric, philosophy, language classes in French, German, Spanish and Italian, music, and drawing. Eventually, Edward Sorin's school became the University of Notre Dame.

St. Joseph County developed into a lively center for industrial and manufacturing businesses in northern Indiana. It also saw the creation of new technological development. St Joseph County was the birthplace of the Studebaker Automobile Company, and county resident James Oliver invented the Chilled Plow, perhaps the most popular plow in the world. As time passed, the county settled into a balanced region that offered urban amenities to the surrounding rural area.

Physical Characteristics

Climate and Precipitation

St. Joseph County climate is typical 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 the National Climatic Data Center (NCDC) normal temperatures from 1971 to 2000, the lowest average winter temperature is 16.1º F and the average high is 30.4º F. During the summer, the average July temperature is 72.9º F. On June 25, 1988, the highest recorded temperature peaked at 104º. Average annual precipitation is 40 inches throughout the year and snowfall averages 70 inches from October through April.

The prevailing wind is from the south-southwest at an average speed of 10 miles per hour. 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 70% during the summer and 40% 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

St. Joseph County's topography is characterized by gentle terrain with few slopes. A ridge runs from the southwest to the county's center, then parallel to the St. Joseph River to the east, creating a boundary for a gentle plateau that covers the southeastern portion of the county. The general direction of drainage is to the northwest. The highest point in the county is about 1,030 feet above sea level. The lowest point of the county is about 709 feet about sea level, which ranks St. Joseph County 76th in terms of lowest elevations when compared to the 92 counties in Indiana.

Another plateau enters from the north, just west of the St. Joseph River, and ends near U.S. 20 while a third plateau enters from the northeast. Winding its way through these three plateaus, the St. Joseph River enters the county from the central north and exits the county from the east. A fourth plateau briefly enters the county on its west side. The area between this plateau and the other three is low and flat and constitutes the largest single area of floodplain within the county.

Soils

The St. Joseph County Indiana Soil and Water Conservation District (SWCD) identifies and prioritizes local soil and water resource concerns, provides information on soil, water, and related natural resource conservation, and connects land users to sources of education and technical and financial assistance necessary for the implementation of conservation practices and technologies. The mission of the St. Joseph County Soil and Water Conservation District is to provide a means for all interested people in St. Joseph County to work together to administer programs to preserve, protect and improve soil, water, air, plant, and animal resources for future generations.

The St. Joseph County Indiana Soil and Water Conservation District (SWCD) provides resources that help the community engage with educational opportunities, address environmental concerns, and to develop further knowledge of conservation. The St. Joseph County Indiana Soil and Water Conservation District (SWCD) has an ongoing conservation and environmental education workshop for K-12 educators, their students, and other members of the community. Over a third of St. Joseph County's soil is well drained, roughly a quarter of the soil is poorly drained. The remainder of the soil drainage types vary from very poorly drained to excessively well drained. The division of these soil characteristics is found in Appendix A.

Land Use and Ownership

The mostly densely urban area is the north central-northeast portion of the county, where South Bend, Mishawaka, and Osceola are located. The county's primary developed land use is residential, with most industrial and commercial uses located in South Bend.

The Area Plan Commission, established in 1965, serves the City of South Bend, Towns of Lakeville, New Carlisle, North Liberty, Osceola, Roseland, and the remaining unincorporated portions of the county. The commission does not serve the City of Mishawaka or the Towns of Indian Village and Walkerton. In addition to comprehensive planning, the primary responsibility of the administration of the zoning and subdivision process.

The St. Joseph County Comprehensive Plan recognizes urban sprawl as a concern of many residents in the county and the effects on their quality of life. The county plan recognizes the initiatives towards smart growth development and sees the concepts being a helpful resource to address existing planning concepts with a more unified vocabulary.

Rule 5 applies to all construction activities (includes clearing, grading, and excavating) that results in the disturbance of one (1) acre or more of land area. Projects that are smaller than one acre may also be regulated by this Rule if it is determined that the project is part of a "larger common plan of development or sale means a plan, undertaken by a single project site owner or a group of project site owners acting in concert, to offer lots for sale or lease/ where such land is contiguous, or is known, designated, purchased or advertised as a common unit or by a common name, such land shall be presumed as being offered for sale or lease as part of a larger common plan. The term also includes phased or other construction activity by a single entity for its own use.

Agriculture

The 2012 U.S. Census of Agriculture reports that there are 691 farms in the county, covering over 150,000 acres. Of this farming land, 89.7% is cropland and 10.3% is classified as "other uses." In contrast, 71.5% of Indiana is harvested cropland and 45.3% of the state is woodland, meaning St. Joseph County has a higher percentage of harvested cropland than the state as a whole. Approximately, 150,000 acres of St. Joseph County were actively farmed in 2012 compared to nearly 180,000 acres in 2007, which represents a 15% decrease in the number of acres.

As illustrated in the map of St Joseph County Agricultural Areas in the appendix, the densely cultivated areas, which are more than 75% cultivated, are located in the southeast corner and between the cities and LaPorte County. Areas located around South Bend and Mishawaka and to the east are primarily agri-urban, with less than 100 homes per square miles. The majority of farm businesses are located to the south and west and the southeast is highly concentrated with confined feeding operations.

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 114 acres of managed property, of which nearly 100 acres managed by local entities, their classification and locations are available in the appendix.

St Joseph County is home to several parks and nature reserves. Anderson Road Property, Bendix Woods County Park, Chamberlain Nature Preserve, Ferrettie- Baugo Creek County Park, LaSalle Trail, Spicer Lake County Park, St. Patrick's County Park are committed to restoring and conserving biodiversity for the benefit and present and future generations and encouraging citizens to learn about the natural history and resources of Indiana.

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 table in the appendix identifies the endangered or threatened species within the county and identifies the habitat characteristics where the species are found within the county.

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.

Land 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 the 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. A map these features is located in the appendix.

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.

The Indiana Department of Natural Resources has issued an advisory about blue-green algae found in the lake at Potato Creek State Park in St. Joseph County in the summer of 2017. Blue-Green algae can be toxic in high levels and can pose a threat to water quality and the flora and fauna that are dependent on the lake's ecosystem. Although boating and swimming are still permitted, DNR recommend avoiding direct contact with blue-algae. Indiana Department of Emergency Management attributes blue algae exposure symptoms include rashes, skin, eye irritation, nausea, stomachaches, and tingling in fingers and toes. DNR officials encourage individuals to avoid exposure to the algae and encourage those that are exposed to it, to avoid consumption of the water and shower immediately afterwards.

Watersheds

St. Joseph County is located primarily in the St. Joseph and Kankakee Watershed with a small portion within the Little Calumet-Galien, as shown in the water resources map. The county is split

in terms of the basin divide, with portions of the Kankakee will flow west and St. Joseph flows from the east to the north into Michigan.

Spanning the Michigan-Indiana border and emptying into Lake Michigan at St. Joseph, Michigan, the St. Joseph River Watershed stretches for the southwest portion of the Lower Peninsula of Michigan to northwestern portion of Indiana. It drains nearly 5,000 square miles from the following counties: Berrien, Branch, Calhoun, Cass, Hillsdale, Kalamazoo, St. Joseph and Van Buren in Michigan and De Kalb, Elkhart, Kosciusko, Lagrange, Noble, St. Joseph and Steuben in Indiana. It incorporates 3,742 total river miles flowing through and near Kalamazoo-Portage, Elkhart-Goshen, St. Joseph/Benton Harbor, and the South Bend metropolitan areas.

With funding from the Indiana Department of Environmental Management, the St. Joseph County River Watershed Management Plan was prepared by the St. Joseph River Watershed Initiative and is dedicated to efforts to protect, restore and enjoy the river and its resources. The initiative has taken on the role of coordinator to safe guard the watershed's resources and to gather data, identify critical areas in need of conservation or action, and lead management planning in the sub-watershed areas.

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, it 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. The St. Joseph

County NHD contains 568.3 miles of streams and rivers. The St. Joseph River flows through the center of South Bend and Mishawaka.

The Indiana Natural Resources Commission has declared three rivers in St. Joseph County as navigable, Baugo Creek (formerly Banbango Creek), Kankakee River and the St. Joseph River.

Lakes

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.

The DNR Department of Fish and Wildlife maintains a list of the lakes in Indiana and the general assembly has established the listing of PFL, which are both identified in the appendix. The DNR Division of Water regulate these lakes using the Lake Preservation Act (I.C. 14-26-2) and/or Lowering of 10 Acre Lakes Act or "Ditch Act" (I.C. 14-26-5). Public Freshwater lakes maintain the following criteria:

- 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

The DNR public access site program began in 1953 and today consists of more than 400 public access sites and strives to provide free access at rivers and lakes. 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, which may include 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. For a list of PFL and maps their location, visit Appendix A.

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 Environmental 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 and the county is the responsible agency for the administration of the North American Wetlands Conservation Act (NAWCA). Tables and Maps of wetland resources are located in Appendix A, although they are considered for informational purposes only.

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.

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.

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. Impaired waters in the county are identified in a map located in the appendix.

People

Populations

In 1980, St. Joseph County had a population of 241,617 and a population density of 527.7 people per square mile. The population had decreased 1.3 percent between 1970 and 1980. As of 2016, an estimated 269,141 people reside in St. Joseph County, Indiana with a density of 587.8 people per square mile. A region's economy thrives or dwindles because of the people who choose to live there. That choice may occur from being born in the area and desiring to stay or may be the result of a more deliberate decision involving relocating from somewhere else. Monitoring change in the size and movement of population is an important barometer of well-being.

Comparing and contrasting the data from the beginning of the century and 2016 reveals the largest percent increases in population occurring in the towns of Lakeville (38.9%) and North Liberty (36.9%). The sprawl of South Bend has inevitably affected the more than 60% reduction in population in the Town of Roseland. 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. Maps of the migration and population trends are found in appendix A.

Age and Sex Characteristics

Some populations may require special attention during 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 significant groups, which include low-income citizens, older adults, people who don't speak English as their primary language, people with disabilities, and people without high school diplomas.

St. Joseph County compare 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), St. Joseph County ranks sixth, meaning it has a relatively high special needs population in terms of the assessed area. The county has a relatively high poverty rate with approximately 17.8% of the population living below the poverty level. People in poverty may experience difficulty in accessing resources to respond to a hazard. The remaining factors were on average with the other county data. After poverty, the second largest special needs group identified in the county consists of those aged 65 and older.

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
- 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 St. Joseph County population reveals an aging population. The percent of the population aged 65 and older is slightly greater in 2015 than in 2010; however, the median age in St. Joseph County is 36.6 which is slightly below the Indiana median age of 37.5.

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 to 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 2.63 people and average family household size of 4.12. 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 41% increase in wage growth. St. Joseph County's median family income of $58,116 is slightly less than, but comparable to, the Indiana median family income of $61,119.

Housing

The percent of vacant properties in the county are just over 11%, which is just below the US percentage average of 12.3%. Of the 115,351 total housing units in the county, approximately 88% of these are occupied, and nearly 61% are owner occupied. Approximately 30% of the county lives along, and only .8% are housing units for seasonal or recreational use. Tables that provide the details of the housing are located in the Appendix A.

Workforce

In recent years, St. Joseph County has incurred the most growth in the number of larger business establishments with 50-99 employees while smaller business corporations with 1-9 employees have experienced the greatest negative percent change.

Employment

The Average Annual Earning by Sector table reveals that, from 2011-2015, St. Joseph County has experienced the largest positive percent increase in the management of companies sector with 63% growth. Construction and accommodation and food service also encountered significant development over the past five years. In contrast, the utilities and finance and insurance sectors diminished by -18% and 15.5% respectively. 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 St. Joseph County is $24,395 compared to an Indiana average of $25,346. The median household income is $45,471, 18.9% lower than the state median household income of 49,255. The financial crisis has had a similar impact in St. Joseph County as it did in Indiana and the US although the county's unemployment rate has been consistently greater than both the state and the nation from 2009-2015.

Nearly 90% of the workforce in St. Joseph County is employed in the private sector. Of the industry types operating in the county, health care and other social assistance employ the largest percentage of people, followed closely behind are manufacturing and retail trade with government services and education with over 10,000 employed county citizens. The top major employers in terms of number of employees are listed by manufacturing and non-manufacturing along with other employment statistics on sectors are provided in Appendix A.

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 tables in Appendix A provide some more detail on the education attainment within the county over time and provide a comparison to the state averages

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). 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. St. Joseph County has 80 historic places, which appear on the National Register of Historic Places, but only one nationally recognized historic structure identified within the county. There are twenty-three established historic districts within the county: two in Mishawaka, fourteen in South Bend, four in St. Joseph County, one in New Carlisle, and two in North Liberty.

As part of their cultural resources, St. Joseph County hosts dozens of religious centers that act as valuable community resources and enrich the counties sense of history and heritage. Dotted throughout the county, St. Joseph County has at least 53 cemetery sites that serve as in memoriam to those that have passed. The communities' museums, religious centers and cemeteries are shown on the cultural resources map in Appendix A.

The city of South Bend possesses 63 historic places and fourteen recognized historic districts. A sampling of these districts includes, but is not limited to, Chapin Park, East Washington, Howard Park, Muessel-Drewery Brewery, Saint Casimir Parish, South Michigan Street, and West Washington. The city of Mishawaka contains two historic districts and at least nine nationally recognized historic places.

Endowed with historic transportation structures, St. Joseph County contains 25 historic bridges consisting of unique architectural examples along with ornate bridges, railroad bridges, and an unusual truss bridge noted for its multi-span length.

Community Services & Infrastructure

The following section provides an overview on community services and infrastructure within St. Joseph 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 are 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.

St. Joseph County is comprised of the John Glenn School Corporation, Penn-Harris-Madison School Corporation, School City of Mishawaka, New Prairie United School Corporation, South Bend Community School Corporation, and the Union-North United School Corporation. The county is also home to multiple private and alternative schools. The communities of Walkerton, New Carlisle, Mishawaka, South Bend, and Lakeville all have public schools located within their community. Additionally, the Logan Center offers support services to children with mental and physical special needs.

For higher education, St. Joseph County contains Bethel College, Holy Cross College, Ivy Tech North Central, Indiana University- South Bend, St. Mary's College, and the University of Notre Dame.

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. North Chain (Bass) Lake, Pleasant Lake, Worster Lake, and multiple locations along the St. Joseph River are all listed as DNR recommended fishing spots.

St. Joseph County is home to Potato Creek State Park. Potato Creek is located approximately 12 miles southwest of South Bend and offers a wide variety of activities and facilities for public

recreation. Surrounding the 327 acre Worster Lake, Potato creek preserves natural habitats, old prairies, mature woodlands, and diverse wetlands. The park contains 287 electric campsites, 70 horsemen's electric sites, a youth tent camping area, a camp store and a dumping station. In order to provide opportunities for appreciation of nature and conservation opportunities, St. Joseph County has several county parks like Anderson Road, Bendix Woods, Beverly D. Crone Restoration Area, Chamberlain Lake, Ferrettie/Baugo Creek, Spicer Lake, and St. Patrick's Park. Throughout St. Joseph County, there are many campground facilities, including Maple Ridge, Mini Mountain Campground, Potato Creek State Park, South Bend East KOA, and Sunny Haven Recreational Park. In addition, there are several rental cabins and RV campgrounds scattered around the county. In addition to hiking and fishing opportunities, St. Joseph County offers recreational sports and cultural forms of arts and entertainment.

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. Aiding communication and outreach, twelve post offices service St. Joseph County.

Supporting public literacy and community engagement, Boone County has numerous social service and welfare organizations that supplement public aid. The county has several senior citizen service organizations and youth centers that help create opportunities for residents to connect with their community.

St. Joseph County possesses ten libraries: St. Joseph County Main Library, Centre, Roger B. Frances Branch Library, German Township Branch, Lakeville Branch Public Library, Lasalle Branch Public Library, North Liberty Branch Public Library, River Park Branch Public Library, Virginia M. Tutt Branch Public Library, and Western Branch Public Library. In addition to making expansive book collections accessible to the public, these libraries offer disability services, public computers, homebound services, youth and adult education opportunities, and spaces for community outreach. For a more extensive list of public facilities, see Appendix B.

Public Utilities

As part of an initiative to increase sustainability, the University of Notre Dame, American Electric Power (AEP), and Northern Indiana Public Service (NIPSCO) in South Bend has started to construct more ground-mounted solar photovoltaic systems for solar energy. In 2015, the university announced that it would stop burning coal within five years and promised to cut its carbon output by more than half by 2030. The University of Notre Dame is investing $113 million in renewable energy, so more sustainable utility projects are being proposed for the future.

Among its other utilities and public facilities, the community of South Bend has an electric company, and a natural gas utility. St. Joseph County has Hazmat facilities seeking 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. The St. Joseph County Solid Waste Management District maintains designated places for proper disposal of hazardous waste.

Health Care Providers

An emergency disaster can impact an entire community and can involve numerous medical and public health entities, including its 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 Memorial Hospital in South Bend is a key healthcare resource and one of St. Joseph County's largest non-manufacturing employers. Other hospitals include Kindred Hospital, Memorial Children's Hospital, A Rosie Place, Rivercrest Specialty Hospital, St. Joseph Regional Medical Center, and Unity medical & Surgical Hospital.

There are numerous nursing facilities like Regency Place Healthcare, Fountainview Place, Holy Cross House, Morningcrest Nursing & Memory, North Woods Village, and Portage Place Elderly Group Home. More health care and social assistance providers are listed in Appendix B.

In order to promote community health, the St. Joseph County Health Department has sought to combat childhood obesity through programs like the Reducing Obesity Coalition (ROC) of St. Joseph County and the Let's Move! Initiative. St. Joseph County has taken steps to increase community health partnerships by creating the St. Joseph County Health Improvement Alliance.

Other 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.

St. Joseph County is equipped with outdoor tornado warning sirens. The primary warning system is operated by the St. Joseph County Emergency Management Agency (EMA). The EMA reminds residents and officials that outdoor warning sirens are not intended to be heard indoors and that the sirens should not be relied upon as the single source of notification in the event of an emergency. The EMA operates the sirens during regular business hours only; dispatch operates them after hours.

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.

Twin Branch Power Plant, University of Notre Dame, and Prairie View I & Ii L F G T E. The creation of solar Michiana power plants are progressing. At the end of 2016, there were a total of four newly constructed solar power plants. Two of these new power plants, Twin Branch and Olive, are located in St. Joseph County. In 2016, construction began on a proposed energy center in New Carlisle,

Indiana. The St. Joseph Energy Center will be a 1,400MW Greenfield natural gas-fired, combined-cycle power plant. Trillium provides the county with natural gas, and American Electric Power Inc. serves the communities' electric needs.

The University of Notre Dame has started using solar energy to power Kenmore Warehouse in South Bend. While there are other solar panels on campus this is the largest at the University of Notre Dame. The ground-mounted solar photovoltaic system has 432 modules and is expected to generate nearly a third of the electricity that the facility uses.

St. Joseph County is a StormReady community. StormReady 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 highlighted in the appendix include bridges and roads that INDOT submits to the federal highway department to allocate future transportation funds. The county bridges are the responsibility of the County Highway Department where bridges are inspected on a rotating basis depending upon the type of structure. Interstates 80 and 90 extend into the county, and the county has approximately 60 miles of interstate highway. The state, cities, towns and county manage more than 200 miles of road and 200 bridges. Most of the county roads

are paved, but a few are graveled. Refer to the road and railroad features map which further detail the transportation features and facilities located in Appendix A.

Rail

Northwest Indiana is a dense concertation of rail, which is, believed to carry approximately 16% of the freight in the region. According to the Northwestern Indiana NRPC Regional Planning Commission, the region carries over 700 miles of active rail crosses through the region, 557 of which are active mainline. CSX Garrett railroad subdivision, which runs from Willow Creek to the La Porte–St. Joseph county line, has some of the heaviest freight rail activity. The CN South Bend subdivision runs from the Lake-Porter county line to the La Porte-St. Joseph county line. The South Shore & South Bend Railroad (South Shore Freight) performs short haul, switching and terminal operations. Along with freight trains, both interstate and commuter passenger trains operate throughout Northwest Indiana. The Northern Indiana Commuter Transportation District operates on an electrified commuter rail line between Chicago's Millennium Station and the City of South Bend providing a readily accessible commuter service.

Air

The largest commercial airport in the county is the South Bend International Airport. It is the state's third busiest airport in terms of passenger traffic. The South Bend Regional Airport offers domestic flights and even allows the rental of private jets. Additionally, St. Joseph County has over a dozen small and private airports.

Commuting

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. There are over 130,000 commuters in the county and of these, approximately 26.9% (170,260) work inside the county. The state of Michigan has more than 8,000 residents who commute into the county and only a small percentage of St. Joseph county residents travel into Michigan.

Roads between South Bend/Mishawka are heavily traveled to Elkhart county and the communities of Elkhart, Goshen, and Bristol. The routes of I-90, US 20 and US 33 are the main avenues for nearly 5,000 Elkhart county residents and nearly 11,000 St. Joseph county residents commute into Elkhart County

The average travel time to work in St. Joseph County is 20.7 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 listed in the quick reference guide.

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 (THIRA), 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 examples 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. 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 level which is where the comprehensive list of the 31 care five preparedness mission areas (preventions, protection, mitigation, response, recovery) and 31 core capabilities are listed. The county EMA coordinates the communication of the hazard rank in this portal.

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 by or affect the city, town, county, and their respective communities. The following sections define the natural and technological hazards 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; when 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 reviewed in this plan:

Table 4-1: Natural Hazards Idenified in Plan

Geologic	Atmospheric	Other
Flooding	Droughts	Infectious Disease Outbreak
Flash Flooding	Extreme Temperatures	Wildfires
Ground Failure • Fluvial erosion • Karst areas • Mine failure	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. 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 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 caused by another hazard (e.g., flood, storm). The following table provides a summary of the technological hazards covered in depth in this plan.

Table 4-2: 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. The team reviewed previous plans hazard priority as shown in the following table.

Table 4-3: Hazards rank in previous Hazard Mitigation Plan

Hazard
Winter Storm
Tornado
Thunderstorm
Hazmat
Flooding
Earthquake
Dam/Levee Failure

Through the completion of a hazard risk and probability survey and subsequent 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 to countywide natural and technological hazards and is outlined in the following table.

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

Natural Hazards	Probability	Consequence	Warning Time	Duration	Risk Factor
Tornadoes	4 - Highly Likely	3 - Critical	4 - < 6 Hours	1 - < 6 Hours	3.4
Winter Storms	4 - Highly Likely	2 - Limited	3 - 6-12 Hours	3 - < 1 Week	3.15
Summer Storms	4 - Highly Likely	2 - Limited	4 - < 6 Hours	1 - < 6 Hours	3.1
Hazardous Incident	3 - Likely	3 - Critical	4 - < 6 Hours	2 - < 24 hours	3.05
Flooding	3 - Likely	2 - Limited	1 - 24+ Hours	4 - > 1 Week	2.5
Extreme Temperatures	3 - Likely	2 - Limited	1 - 24+ Hours	4 - > 1 Week	2.5
Infectious Outbreak	2 - Possible	2 - Limited	4 - < 6 Hours	2 - < 24 hours	2.3
Dam Failure	2 - Possible	2 - Limited	4 - < 6 Hours	2 - < 24 hours	2.3
Levee Failure	2 - Possible	2 - Limited	4 - < 6 Hours	2 - < 24 hours	2.3
Flash Flooding	2 - Possible	2 - Limited	3 - 6-12 Hours	3 - < 1 Week	2.25
Drought	2 - Possible	2 - Limited	1 - 24+ Hours	4 - > 1 Week	2.05
Ground Failure	2 - Possible	1 - Negligible	4 - < 6 Hours	2 - < 24 hours	2
Earthquake	1 - Unlikely	1 - Negligible	4 - < 6 Hours	2 - < 24 hours	1.55
Wild Fires	1 - Unlikely	1 - Negligible	4 - < 6 Hours	2 - < 24 hours	1.55

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 4-5: 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, etc. The table identifies each incorporated community's risk to flooding, flash flooding, dam/levee failure, hazardous materials incidents, and ground failure.

Table 4-6: Localized Hazards for Incorporated Jurisdictions

Jurisdiction	Hazard Probability					
	Flooding	Flash Flooding	Levee Failure	Dam Failure	Hazardous Incident	Ground Failure
Indian Village	Unlikely	Possible	Unlikely	Unlikely	Possible	Possible
Lakeville	Possible	Possible	Unlikely	Unlikely	Possible	Possible
Mishawaka	Possible	Possible	Possible	Possible	Possible	Possible
New Carlisle	Possible	Possible	Unlikely	Unlikely	Possible	Possible
North Liberty	Possible	Possible	Unlikely	Unlikely	Possible	Possible
Osceola	Possible	Possible	Unlikely	Unlikely	Possible	Possible
Roseland	Unlikely	Possible	Unlikely	Unlikely	Possible	Possible
South Bend	Possible	Possible	Possible	Possible	Possible	Possible
Walkerton	Possible	Possible	Unlikely	Unlikely	Possible	Possible

NCDC Historical Storm Events

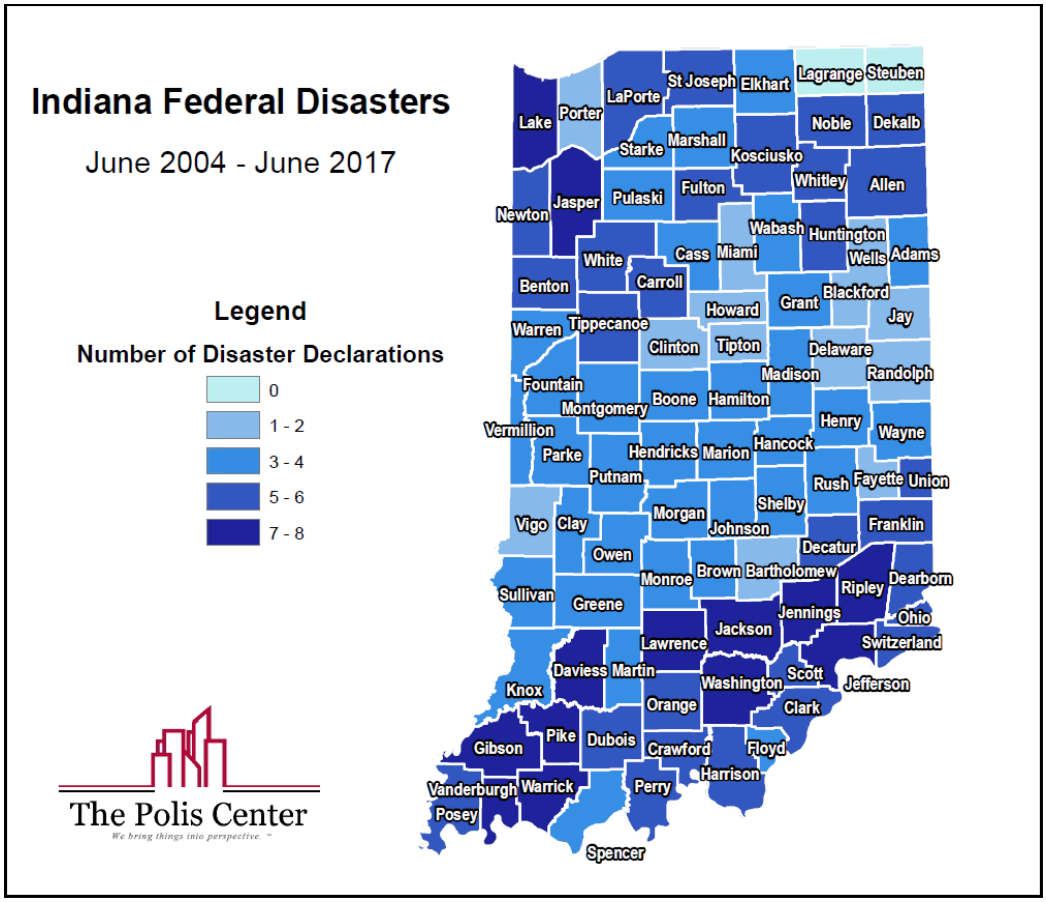
Historical storm event data was compiled from the National Climatic Data Center (NCDC). NCDC records are estimates of damage reported to the National Weather Service (NWS) from various local, state, and federal sources. Typically, the submissions are from law enforcement and emergency managers and other community members that may participate in storm spotter training.

The NCDC data included 570 reported events in St. Joseph County between 1965 and December 31, 2016. Including; 439 summer storms, 22 tornado events, 15 flood events, 89 winter storms, 5 extreme temperature events. A table listing all events, including; injury, death, and property loss statistics are included in Appendix B. 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.

FEMA Declared Disasters

Between 2004-2017, FEMA has declared seventeen emergencies and disasters for the state of Indiana. The following map shows the number disasters by county in the state since June 2004.

Figure 4-1: Disaster Declarations for Indiana



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

Table 4-7: FEMA-Declared Disasters and Emergencies for St. Joseph County (2000- 2017)

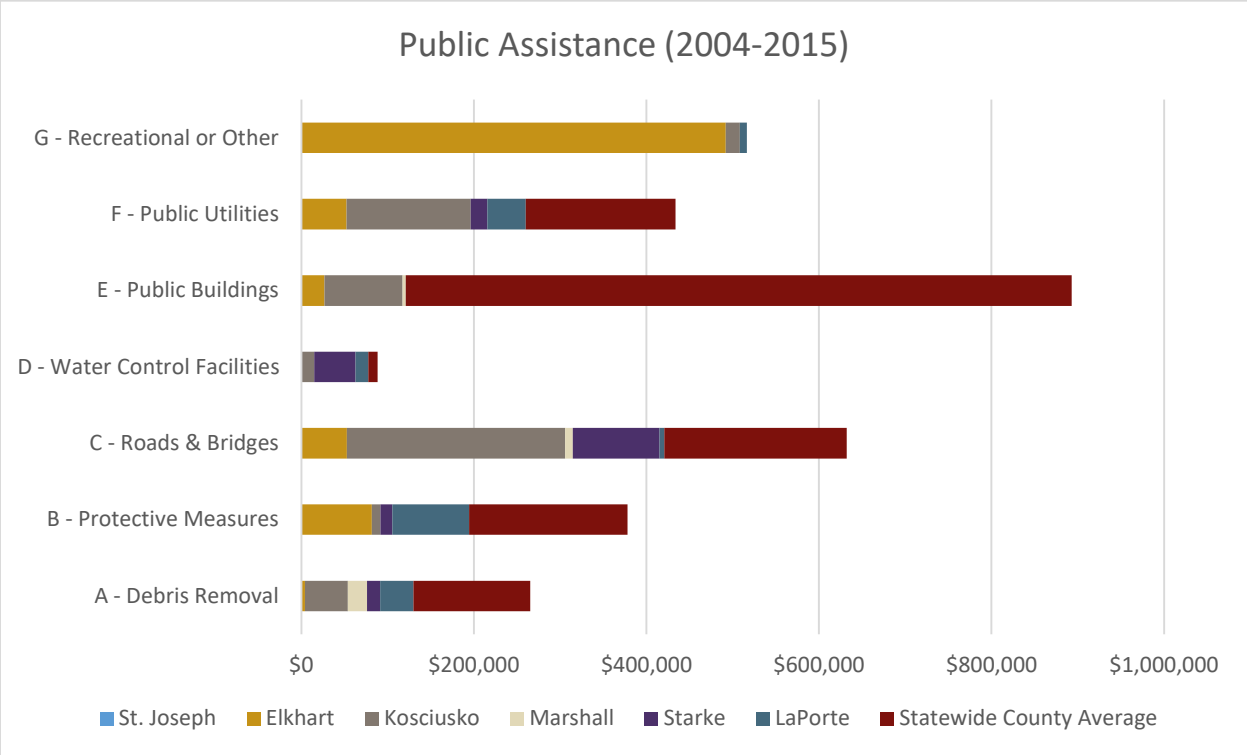
Disaster Number	Date of Incident	Date of Declaration	Disaster Description	Type of Assistance
DR-1832	3/8/2009-3/14/2009	4/22/2009	Severe Storm(s) - Severe Storms, Tornadoes, And Flooding	IA, HMGP
DR-1795	9/12/2008-10/6/2008	9/23/2008	Severe Storm(s) - Severe Storms And Flooding	IA, PA, HMGP
DR-1740	1/7/2008- 3/14/2008	1/30/2008	Severe Storm(s) - Severe Storms And Flooding	IA, PA, HMGP
EM-3274	2/12/2007-2/14/2007	3/12/2007	Snow - Snow	PA
EM-3238	8/29/2005-10/1/2005	9/10/2005	Hurricane - Hurricane Katrina Evacuation	PA
DR-1573	1/1/2005-2/11/2005	1/21/2005	Severe Storm(s) - Severe Winter Storms And Flooding	IA, HMGP
EM-3162	12/11/2000-12/31/2000	1/24/2001	Snow - Snow	PA

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.
- **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 2 provides a breakdown of the PA in comparison to surrounding counties and the statewide averages.

Figure 4-2: Disaster Assistance for St. Joseph 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 US 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 4-8 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

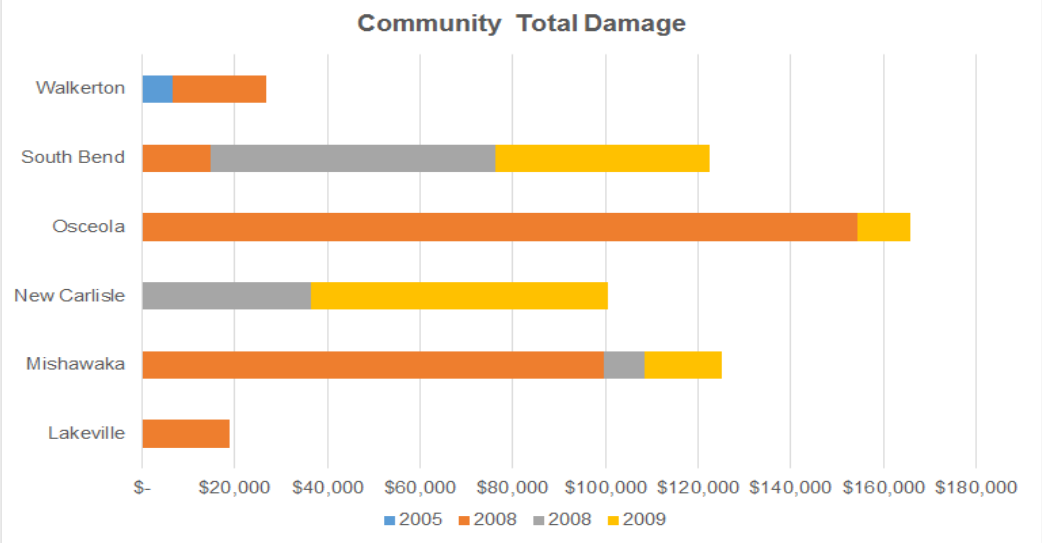


Table 4-8: SBA declaration reference (2004-2016)

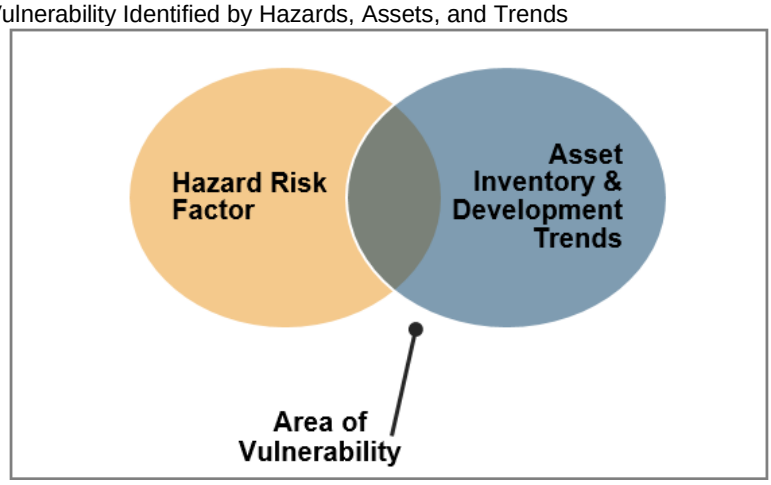
Year	FEMA Declaration	SBA Declaration	Community	Total
2008	1740	11160	Lakeville	1
2008	1740	11160	Mishawaka	1
2008	1740	11160	Osceola	1
2008	1740	11160	South Bend	1
2008	1740	11160	Walkerton	1
2008	1795	11449	Mishawaka	1
2008	1795	11449	New Carlisle	1
2008	1795	11449	South Bend	5
2009	1832	11720	Mishawaka	1
2009	1832	11720	New Carlisle	1
2009	1832	11720	Osceola	1
2009	1832	11720	South Bend	2

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. 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.

Future Development

Since St. Joseph 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. St. Joseph 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 St. Joseph 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 as listed in Chapter 6. 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

The following hazard profiles outlined the hazard risk exposure for the county. The hazard is first described, and then reviewed in the historical context of the county. In many cases, an analysis subsequently follows which analyzes the facility and building inventory risk. When appropriate, the analysis is presents the mapping and in some cases, if the results are helpful but not critical, they are included in Appendix B.

4.1 Riverine Flood and Flash 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 St. Joseph County can be classified as one of two types: Flash floods or riverine floods, which are both 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.

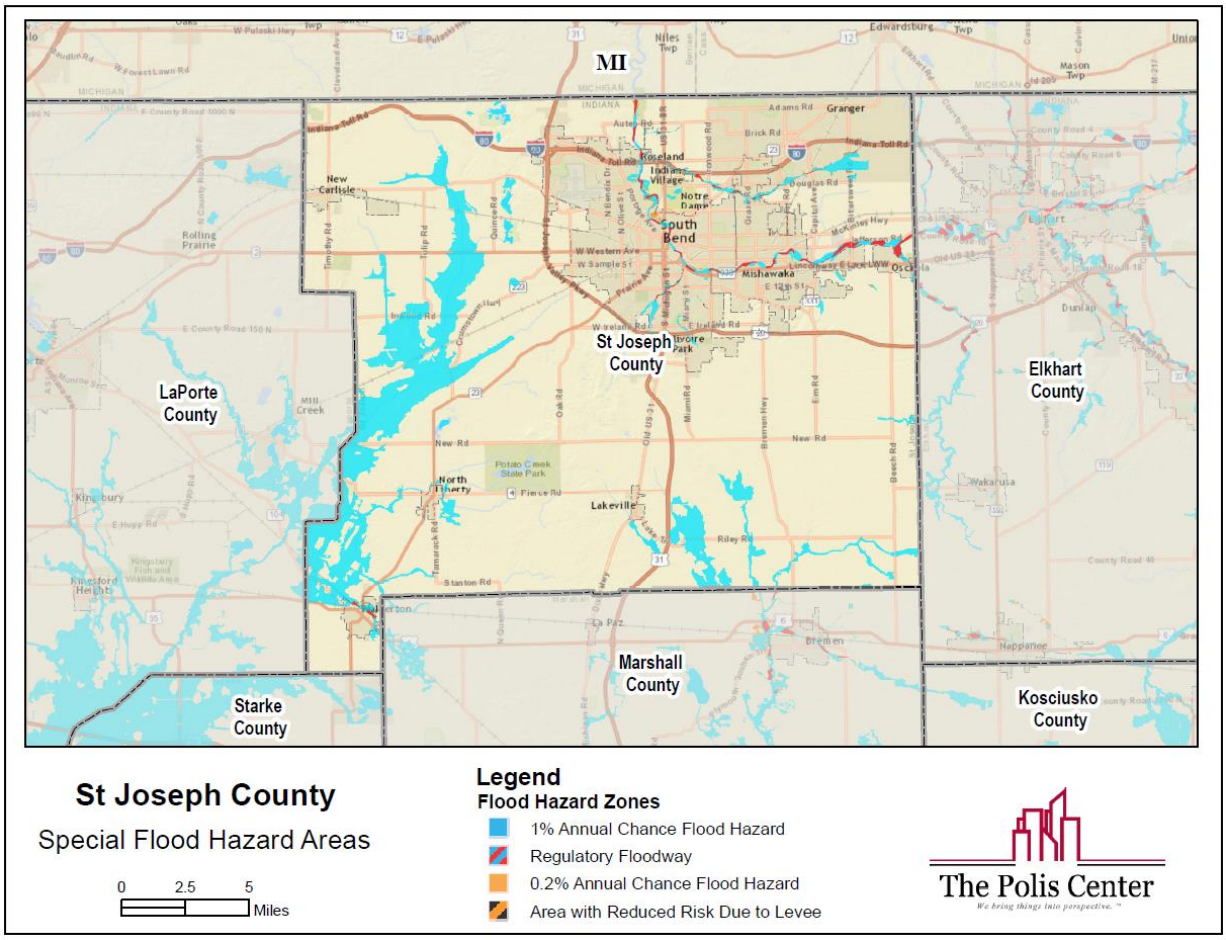
Riverine floods refer to floods on large rivers at locations with large upstream catchments. Riverine floods are typically associated with precipitation events that are of relatively long duration and occur over large areas. Flooding on small tributary streams may be limited, but the contribution of 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 4-5: Special Flood Hazard Areas



Best Available Data

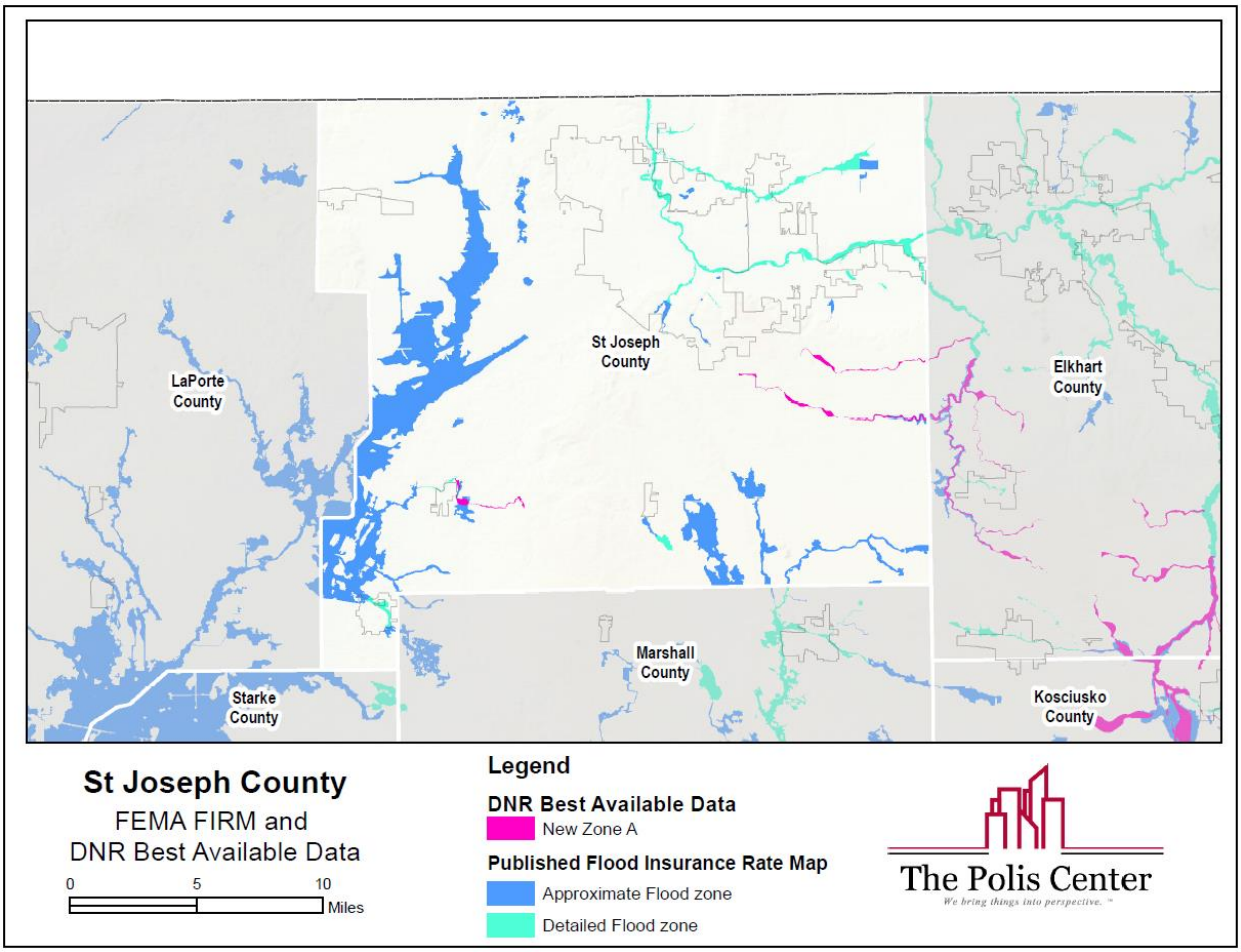
The Indiana Floodplain Information Portal (INFIP) is a mapping application hosted by the IDNR. The website provides floodplain information to citizens and local officials, including floodplain data and flood elevation data for select streams. The portal displays the following floodplain layers: FEMA 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 4-6 identifies the stream reaches that have Best Available SFHA data on the INFIP.

Figure 4-6: Best Available Special Flood Hazard Areas



Flood History in St. Joseph County

Most river flooding occurs in early spring and is the result of excessive rainfall and/or the combination of rainfall and snowmelt. Severe thunderstorms may cause flooding during the

summer or fall, but tend to be localized. According to the St. Joseph County Flood Insurance Study, the worst flood in recent history took place on February 27, 1985. A flow of 18,000 cubic feet per second was recorded at the City of Elkhart gage. Most of the flooding problems in St. Joseph County occur as a result of poor drainage in the Kankakee and Yellow River drainage basins. 2008 flooding in the county caused portions of US 331 South of Wyatt to be closed as a result of flood waters over the road.

July of 2012 Walkerton experienced flash flooding when more ranges of than 1.5 to 3 inches fell within a few hour period. Near Gilmer Park in July of 2015, US 20 was closed from flooding.

On August 15, 2016 the North Liberty, South Bend, Mishawaka, and Gilmer Park sustained approximately one million dollars' worth of flash flood damages. The University of Notre Dame $1.2 million in damages during the flood. Local news agencies reported the county sustained around 9 inches of rain during the August 2016 flooding; however, the City of South Bend actually reported 9.65 inches of rain according to the EMA office. During the 2016 flooding, a woman drowned when she was electrocuted due to flood waters that had entered her basement.

Figure 4-7: Historic Rainfall Figure from Tribune on August 15-16, 2016

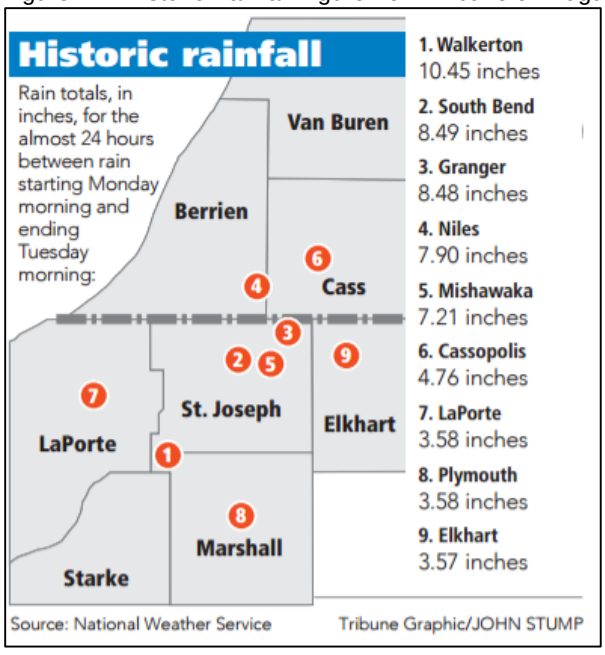
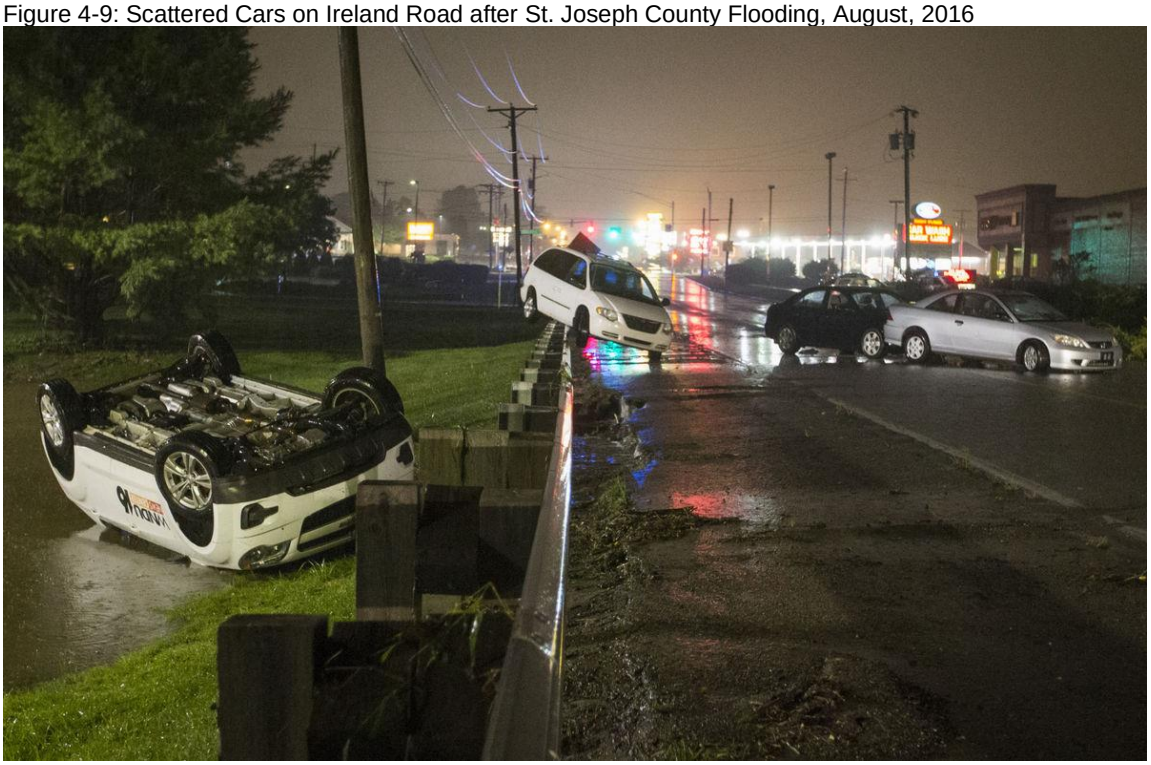


Figure 4-8: St. Joseph County Flooding, August, 2016

Figure 4-9: Scattered Cars on Ireland Road after St. Joseph County Flooding, August, 2016



Tribune Photo/Robert Franklin

Figure 4-10: Flooding on Miain Street

Tribune Photo/Santiagi Flores

Figure 4-11: Flood Waters on Walter St.- August 16, 2016

Tribune Photo/Robert Franklin

Figure 4-12: South Bend Police Cruiser during August 2016 Flood

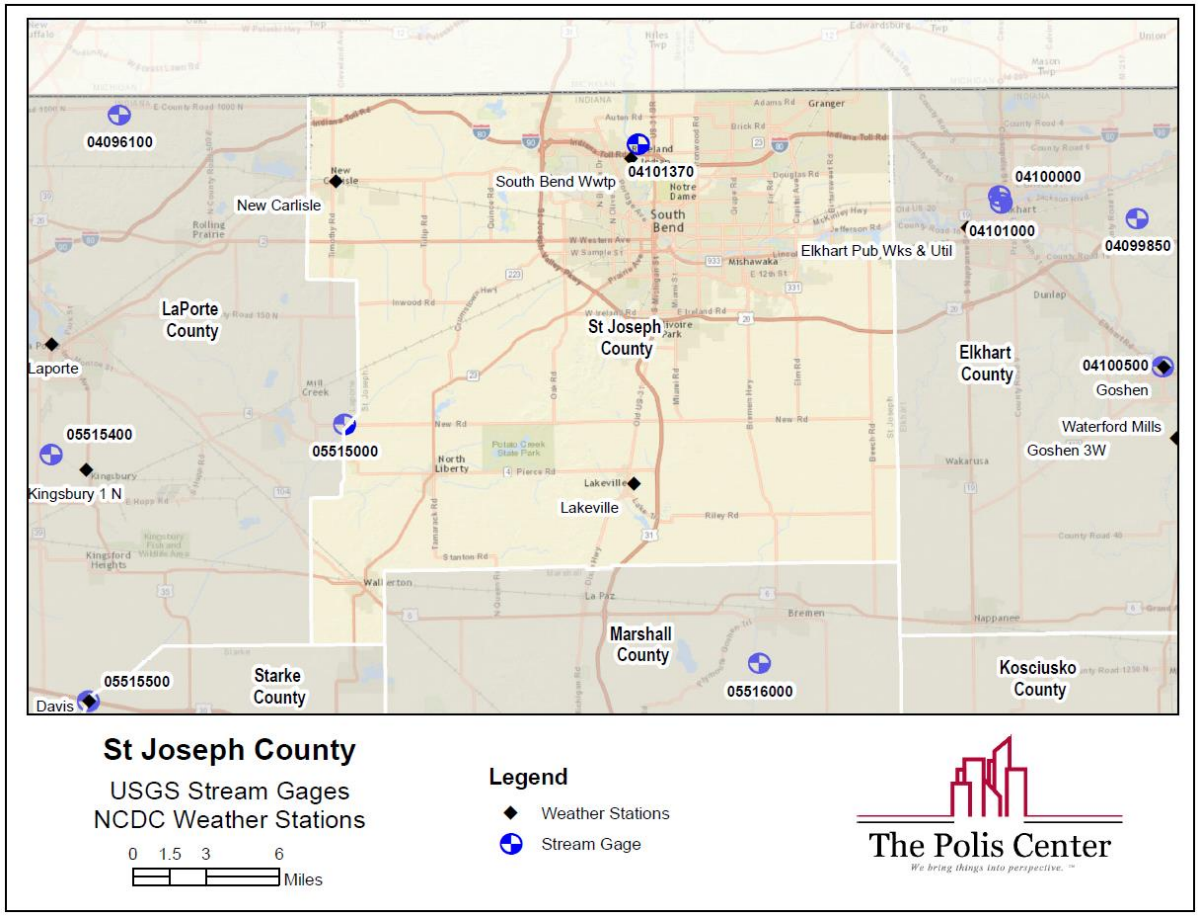
Photo/Santiago Flores

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 is one gage in the county near South Bend along the St. Joseph River. The figure below shows the locations of these gages and the available NCDC Weather Stations.

Figure 4-13: USGS Stream Gages and NCDC Weather Stations



Vulnerability and Future Development

Currently, the St. Joseph County planning commission reviews new development for compliance with the local zoning ordinance. Development in the floodway and floodplain are reviewed by local permitting officials. If there is a difficult time determining this, a surveyor will visit the property to make an official determination. If a property is deemed to be built within the floodplain, then an Elevation Certificate must be provided by the builder to prove that they have built on fill above the require areas.

For all new development, St. Joseph 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.

For more information on the local permitting requirements, please contact:

St. Joseph County Building Department
125 S Lafayette Blvd # 100
South Bend, IN 46601
(574) 235-9554

In South Bend, Kara Boyles, City of South Bend Director of Engineering, oversees the city's public works and storm water management services and initiatives and reviews streets for problem areas.

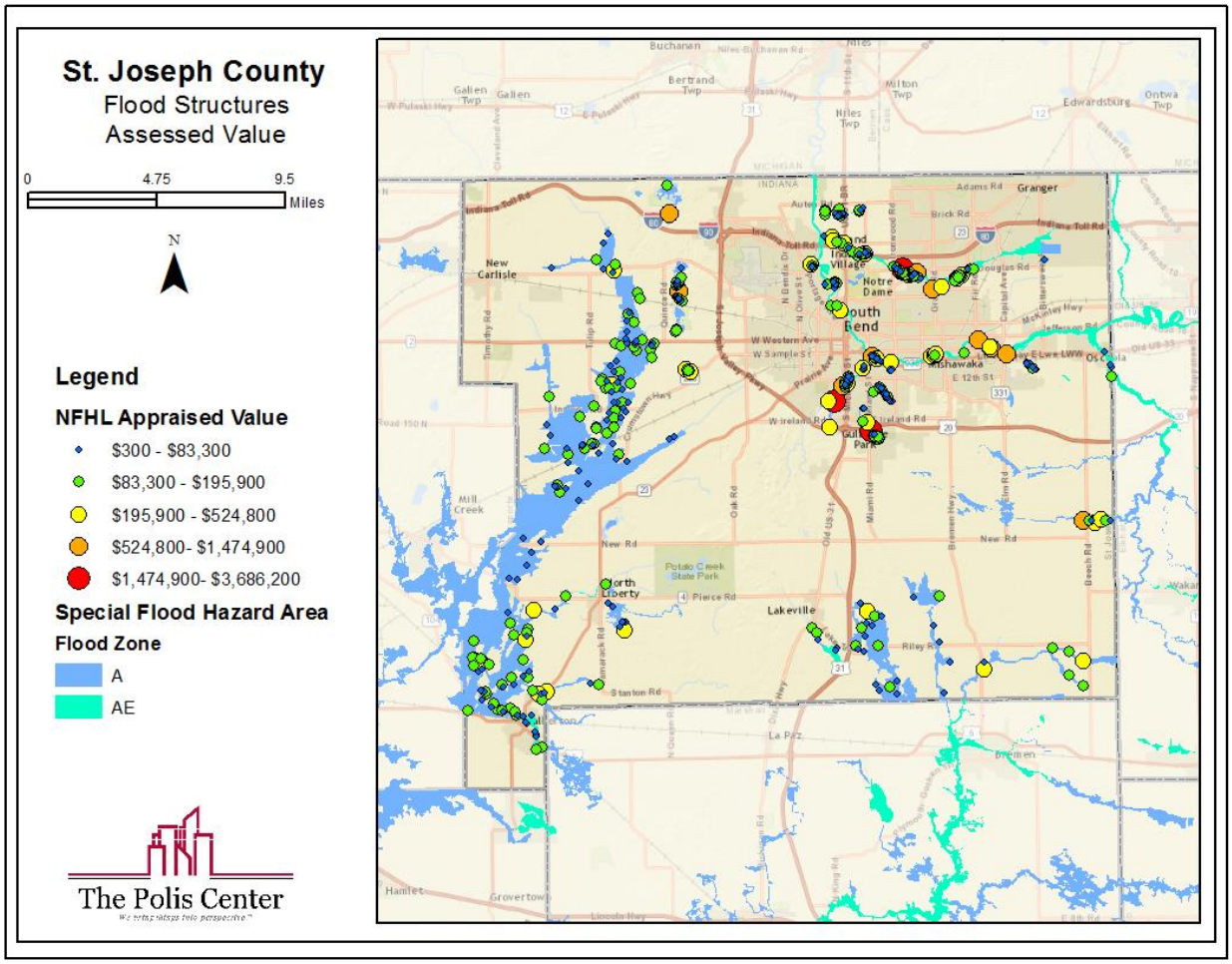
Risk Analysis

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 1% annual chance flood zone, which considered a high-risk area, and presented the appraised values for the structures in the impacted areas.

Figure 4-14: 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. The communities that did not have any reported structures in the Zone A or AE floodways have a dash in the table.

Table 4-9: Structures in Zone A or AE Appraised Value

	Zone A		Zone AE	
	Total Structures	Appraised Value	Total Structures	Appraised Value
St. Joseph County	250	$24,715,280	153	$18,840,000
City Of Mishawaka	-	-	28	$8,752,260
City of South Bend	63	$12,113,500	134	$11,498,070
Town of Indian Village	-	-	-	-
Town Of Lakeville	1	$102,100	-	-
Town Of New Carlisle	-	-	-	-
Town Of North Liberty	1	$63,000	2	$286,400
Town Of Osceola	-	-	3	$146,000
Town Of Roseland	-	-	2	$167,400
Town Of Walkerton	-	-	8	$423,700
Total	**315**	**$36,993,880**	**330**	**$40,113,830**

Source: St. Joseph County 2016 secured roll assessor and parcel date; St. Joseph County DFIRM

Table 4-10: 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
St. Joseph County	43	$4,877,100	403	$43.555.280
City Of Mishawaka	3	$2,020,600	28	$8,752,260
City of South Bend	51	$4,474,100	197	$23,611,570
Town of Indian Village	-	-	-	-
Town Of Lakeville	-	-	1	$102,100
Town Of New Carlisle	-	-	-	-
Town Of North Liberty	-	-	3	$349,400
Town Of Osceola	-	-	3	$146,000
Town Of Roseland	2	$167,400	2	$167,400
Town Of Walkerton	2	$154,700	8	$423,700
Total	**101**	**$11,693,900**	**645**	**$77,107,710**

Source: St. Joseph County 2016 secured roll assessor and parcel date; St. Joseph County DFIRM

The total structures in the Special Flood Hazard Area are based on approximate building locations and, therefore, should not be used as an absolute comparison. This information may be used to target further mitigation through further engagement with the NFIP. In addition, this may be a tool to help understand if there would be an interest in becoming involved in a discount program with the Community Rating System (CRS).

Table 4-11: Community Structure Count and Number of Policies

	Structures in Zone A/AE	Number of Policies
St. Joseph County	403	172
City Of Mishawaka	28	39
City of South Bend	297	105
Town of Indian Village	-	-
Town Of Lakeville	1	-
Town Of New Carlisle	-	-
Town Of North Liberty	3	-
Town Of Osceola	3	1
Town Of Roseland	2	3
Town Of Walkerton	8	3
Total	**645**	**323**

Source: St. Joseph County DFIRM; FEMA Indiana NFIP report, June 2017.

The analysis detected several areas of interest for St. Joseph County which contain a larger than average amount of buildings exposed to flood hazard and as such should be mentioned. Buildings located in the flood zone are symbolized based on their occupancy code. These areas are depicted in the images below and addition areas that could pose threats are located in Appendix A.

Figure 4-15: Flood Zone Buildings South Bend

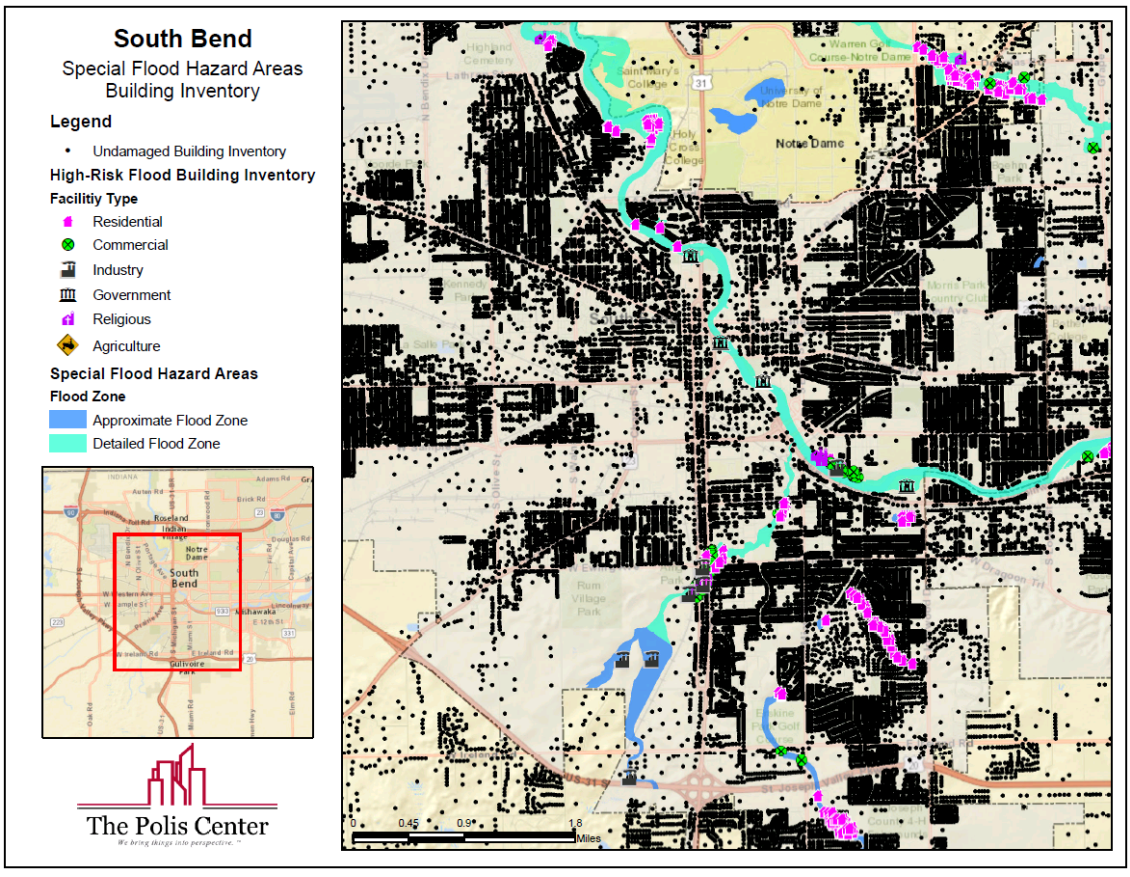


Figure 4-16: Special Flood Hazard Buildings in the Southwest of County

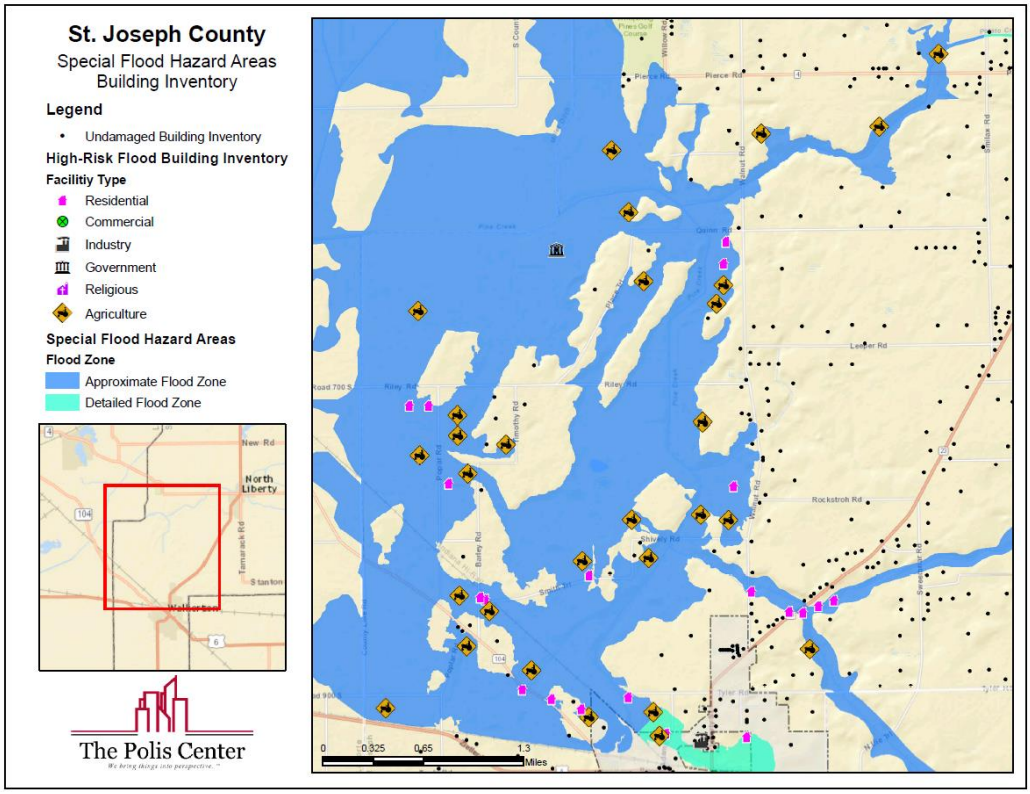
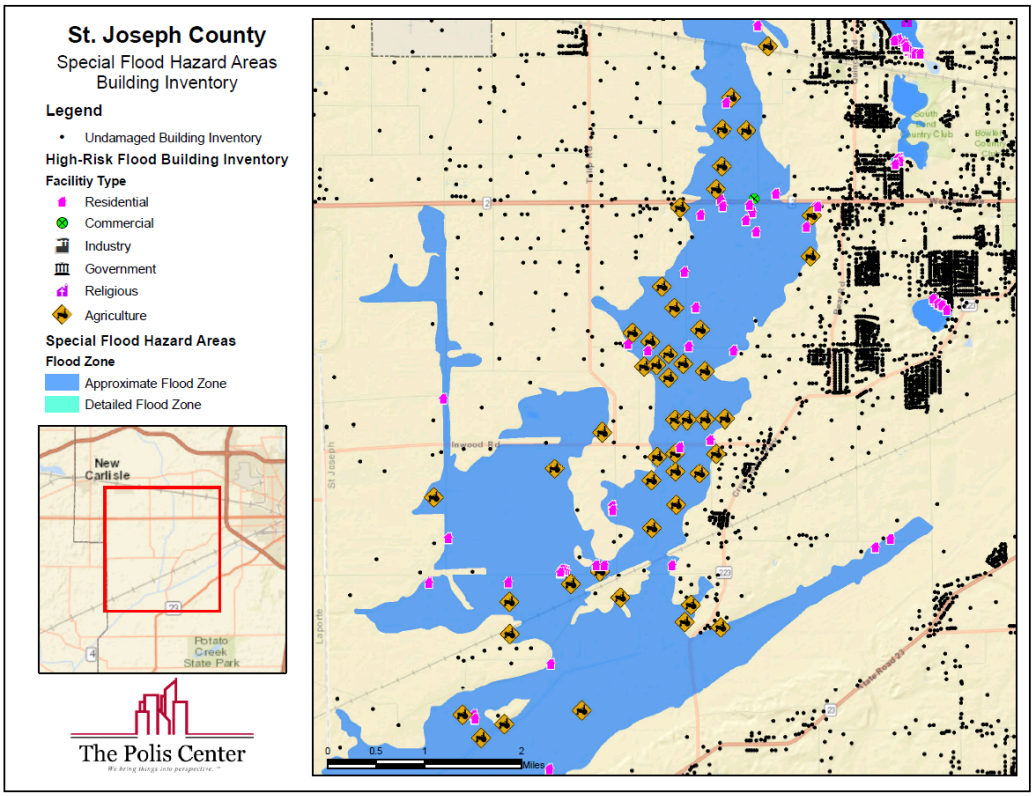


Figure 4-17: Special Flood Hazard Buildings in the Easter portion of County



Historical Analysis

Since the NFIP plays such a vital role in mitigating flood risk, understanding the status of hazard maps and reported losses occurring can provide insight on new strategies to mitigate the impacts and losses of future events. A historical analysis of the NFIP and flood history can be a tool to determine mitigation strategies.

The following table provide the status of the NFIP and their associated maps: Initial Flood Hazard Boundary Map (FHBM) date, Initial Flood Insurance Rate Map date, Current Effective date, and the regular entry date are provided below. The maps used in the execution of the local floodplain ordinance used the Current Effective Map Date. The following table then identifies the NFIP community reported losses, payments, and total claims that were closed without a payment.

Table 4-12: NFIP Participation and Mapping Dates

Community ID	Community	FHBM Identified	Init FIRM Identified	Curr Eff Map Date	Reg-Emer Date
180225#	Town of Indian Village	10/18/74	04/15/81	01/06/11	06/11/81
180226#	Town of Lakeville	11/23/73	09/30/76	01/06/11	09/30/76
180228#	Town of North Liberty	11/30/73	08/19/85	01/06/11	08/19/85
185179#	Town of Roseland	-	05/04/73	01/06/11	05/04/73
180231#	City of South Bend	08/16/74	02/01/78	01/06/11	02/01/78
180232#	Town of Walkerton	11/23/73	04/15/81	01/06/11	04/15/81
180227B	City of Mishawaka	12/28/73	08/17/81	12/16/15	08/17/81
180229B	Town of Osceola	12/17/73	01/06/11	12/16/15	12/14/92
180224B	St. Joseph County (unincorporated)	12/27/74	08/15/78	12/16/15	08/15/78
Not in the Program					**Sanction Date**
180312#	Town of New Carlisle	-	01/06/11	01/06/11	01/06/12

Table 4-13: Community Loss and Payments Totals

NFIP Community	Total Losses	Closed without Payment	Total Payments
St. Joseph County	68	21	$93,874
City of Mishawaka	29	9	$3,747
Town of North Liberty	1	0	$3,184
Town of Osceola	2	1	$19,889
Town of Roseland	2	0	$176,721
City of South Bend	56	20	$603,819
Total	**158**	**51**	**$901,234**

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 Mishawaka and City of South Bend both have 3 single-family properties repetitive loss properties. The County has 6 totaling 20 total losses of over $350,000. There is 1 single family home structure that has received total payments of nearly $200,000.

Combining Available Data and Methods

Hazus-MH was used to estimate the damages incurred for a 1% annual chance flood event in St. Joseph 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 St. Joseph 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.

St. Joseph 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 649 buildings county-wide at a cost of $193.1 million. In the modeled scenario South Bend sustained the most damage with 189 buildings damaged at a cost of $120.8 million. The total estimated numbers and cost of damaged

buildings by community are given in Tables 4-14 and 4-15. Figure 4-18 depicts the St. Joseph County buildings that fall within the SFHA.

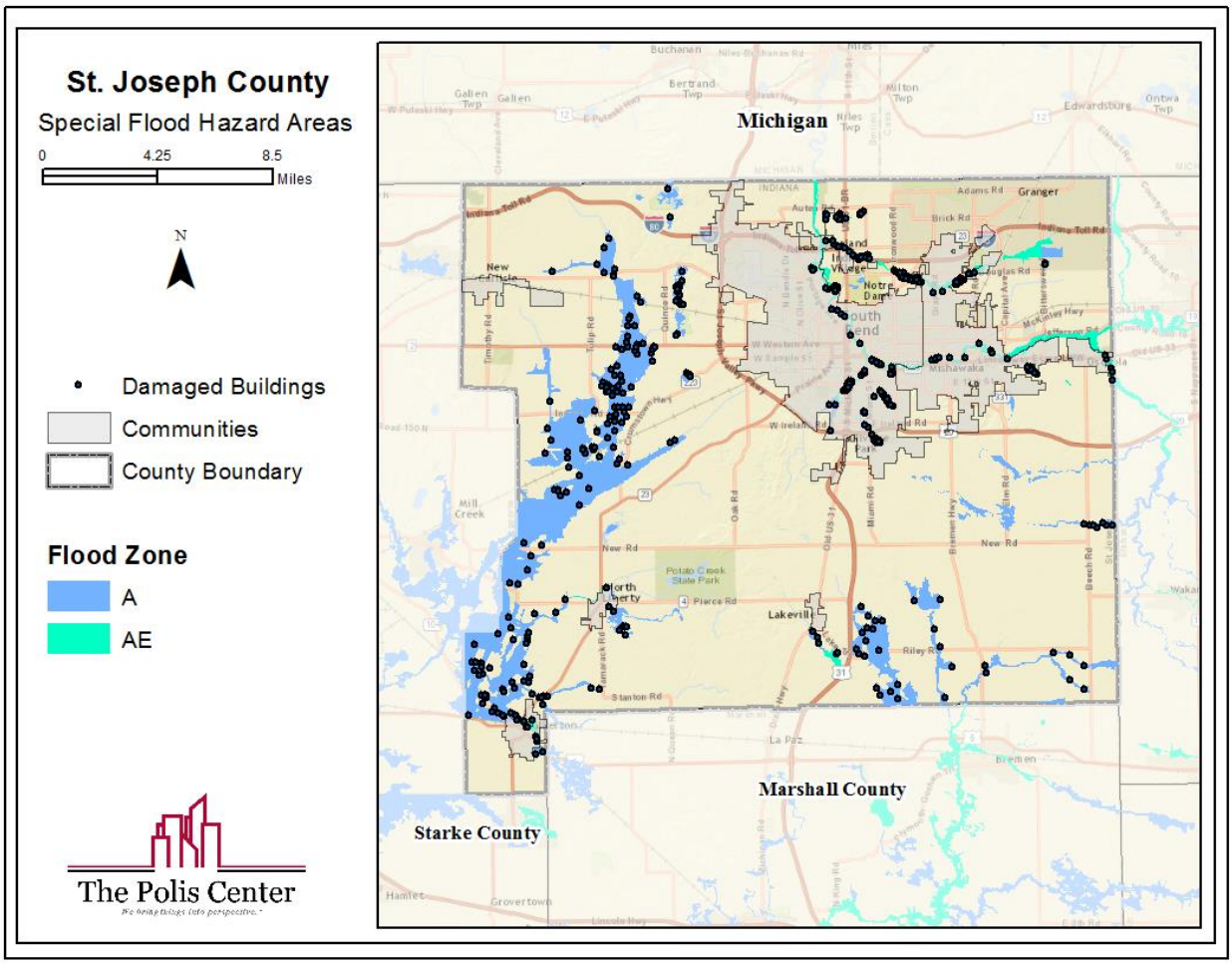
Table 4-14: Number of Buildings Damaged by Community and Occupancy Class

Community	Total Buildings Damaged	Building Occupancy Class						
		Agriculture	Commercial	Educ.	Govt.	Industrial	Religious	Residential
St. Joseph Co. (unincorporated)	419	132	3	0	3	0	3	273
Roseland	2	0	0	0	0	0	0	2
North Liberty	2	0	2	0	0	0	0	2
Osceola	3	2	0	0	0	0	0	1
Walkerton	7	1	1	0	0	1	0	4
South Bend	189	0	31	1	4	10	9	135
Mishawaka	27	0	4	0	4	0	0	19
Total	**649**	**133**	**41**	**1**	**11**	**11**	**12**	**440**

Table 4-15: Cost of Buildings Damaged by Community and Occupancy Class

Community	Cost Buildings Damaged	Building Occupancy Class						
		Agriculture	Commercial	Educ.	Agriculture	Industrial	Religious	Agriculture
St. Joseph Co. (unincorporated)	$53,324,953	$13.315,064	$5,686,168	$0	$263,342	$0	$8,623,022	$25,437,356
Roseland	$209,509	$0	$0	$0	$0	$0	$0	$209,509
North Liberty	$272,253	$0	$0	$0	$0	$0	$0	$272,253
Osceola	$271,841	$206,741	$0	$0	$0	$0	$0	$65,100
Walkerton	$1,512,546	$163,959	$645,068	$0	$0	$323,003	$0	$380,515
South Bend	$120,788,258	$0	$22,069,588	$93,659	$387,623	$68,542,569	$**9,215,723**	$20,479,093
Mishawaka	$16,818,385	$0	$11,920,700	$0	$1,198,227	$0	$0	$3,699,458
Total	**$193,064,554**	**$13,685,764**	**$40,321,525**	**$93,659**	**$1,849,192**	**$68,865,573**	**$17,838,746**	**$50,410,093**

Figure 4-18: 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 no essential facilities in St. Joseph County are within 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 St. Joseph County including one cell tower, one waste water treatment plant, and two Hazmat facilities.

Table 4-16: Impacted Critical Facilities

Facility Type	Facility Name
Communication	56491 Rice Road
Waste Water Treatment	South Bend Municipal STP
HAZMAT	Rossborough

Short Term Shelter and Debris

Figure 4-19: Short Term Shelter Needs

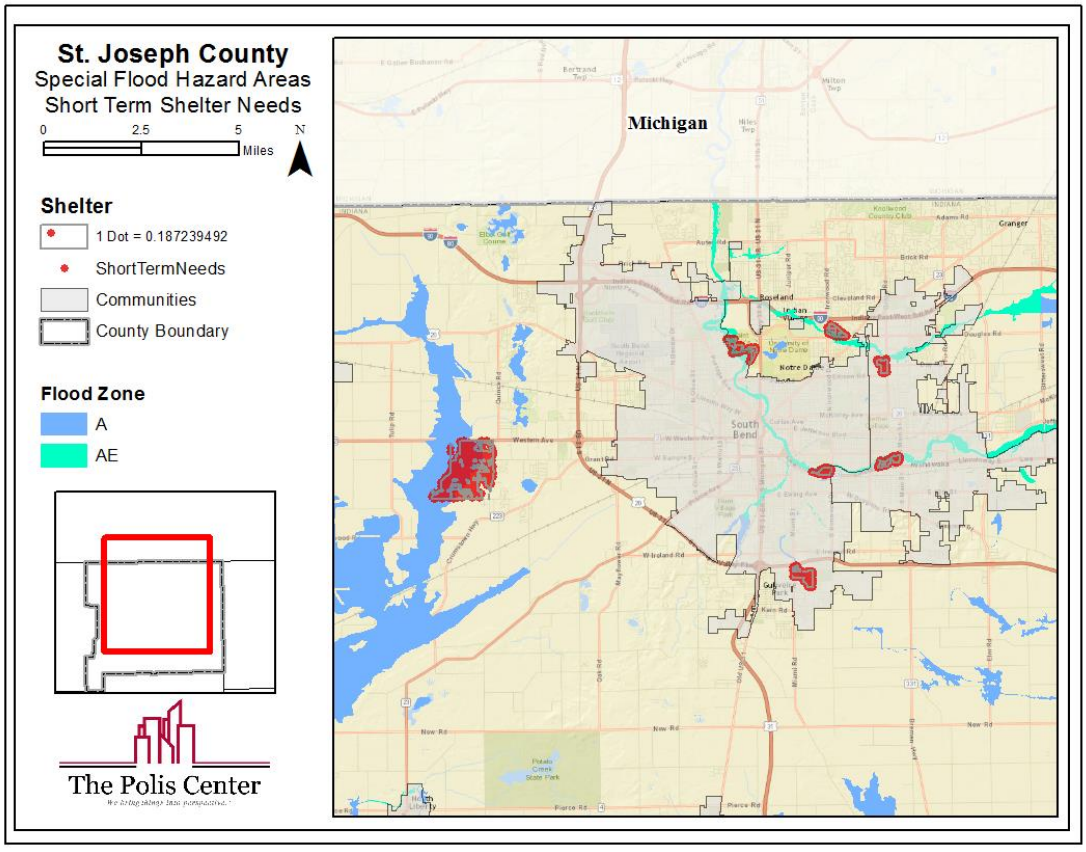
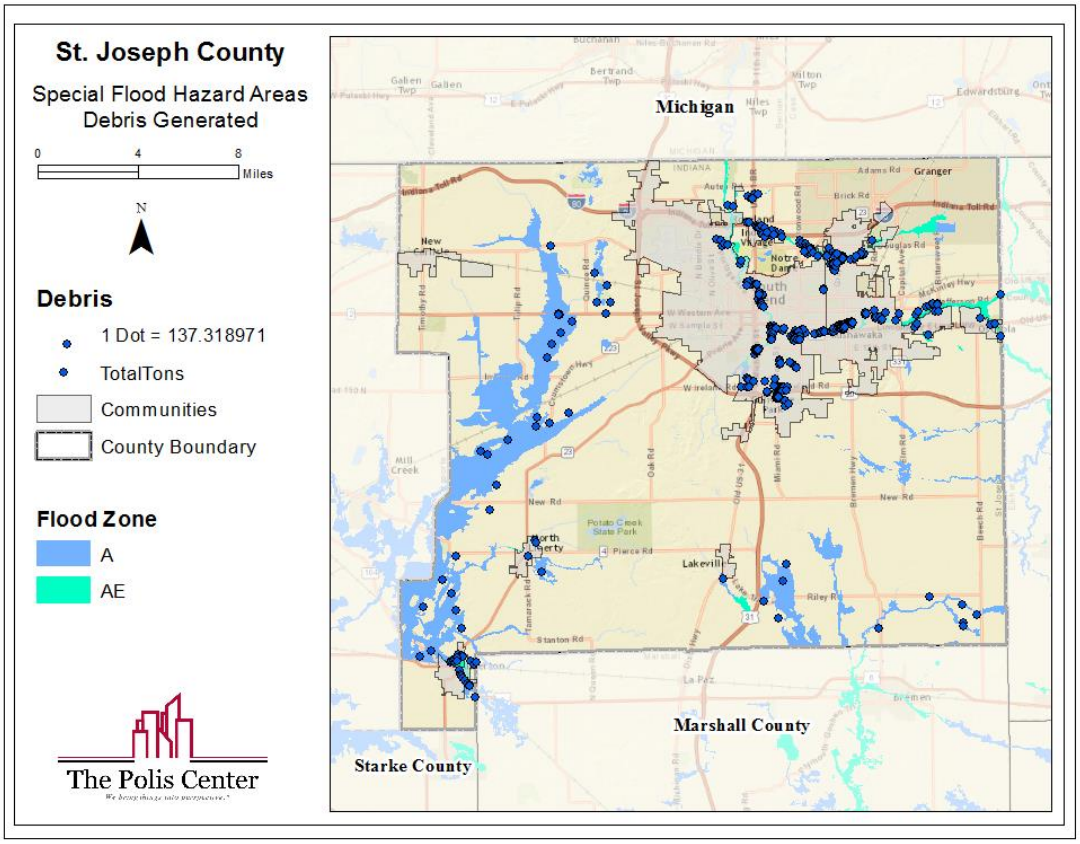


Figure 4-20: Tons of Debris Generated



Relationship to other Hazards

Severe storms and blizzards - Summer storms can potentially lead to log jams. Melting snow can contribute to flooding, and, in some 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 – St. Joseph 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. The St. Joseph River at South Bend gage data can be accessed online and used to inform the public of areas expected to be flooded as the river level rises.

Repetitive Loss Structures - St. Joseph County and its NFIP communities have been active in pursuing project which 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, St. Joseph County utilizes the 911 Mass Notification System and the St. Joseph County Police Department's Facebook page, as well as local news media. St. Joseph 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 - St. Joseph 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 4-21 depicts Indiana's historical earthquake epicenters. Tables 4-17 and 4-18 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 4-21: Indiana Historical Earthquake Epicenters

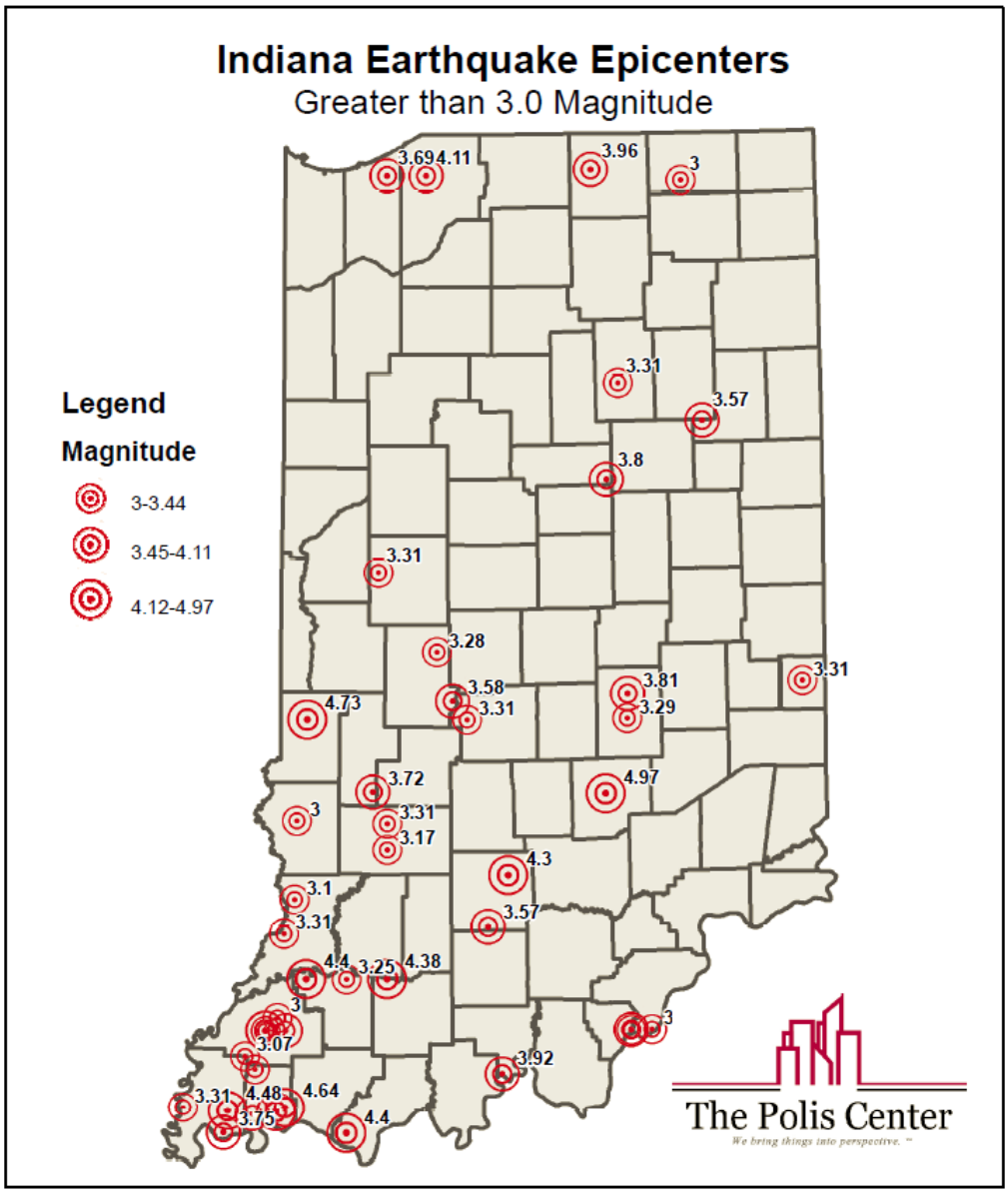


Table 4-17: Abbreviated Modified Mercalli Intensity Scale

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 4-18: 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 St. Joseph 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 St. Joseph 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. Because an extensive inventory of the infrastructure is not available to this plan, it is important to emphasize that any number of these structures could become damaged in the event of an earthquake. 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 St. Joseph 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 St. Joseph County based on this event.

The second deterministic scenario was a Moment Magnitude of 5.5 with the epicenter located in St. Joseph 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 St. Joseph 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 4-19, Table 4-20, and Figure 4-22. HAZUS-MH estimates that approximately 36 buildings will be at least moderately damaged. It is estimated no buildings will be damaged beyond repair.

The total building related losses totaled $8.48 million; 8% 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 38% of the total loss.

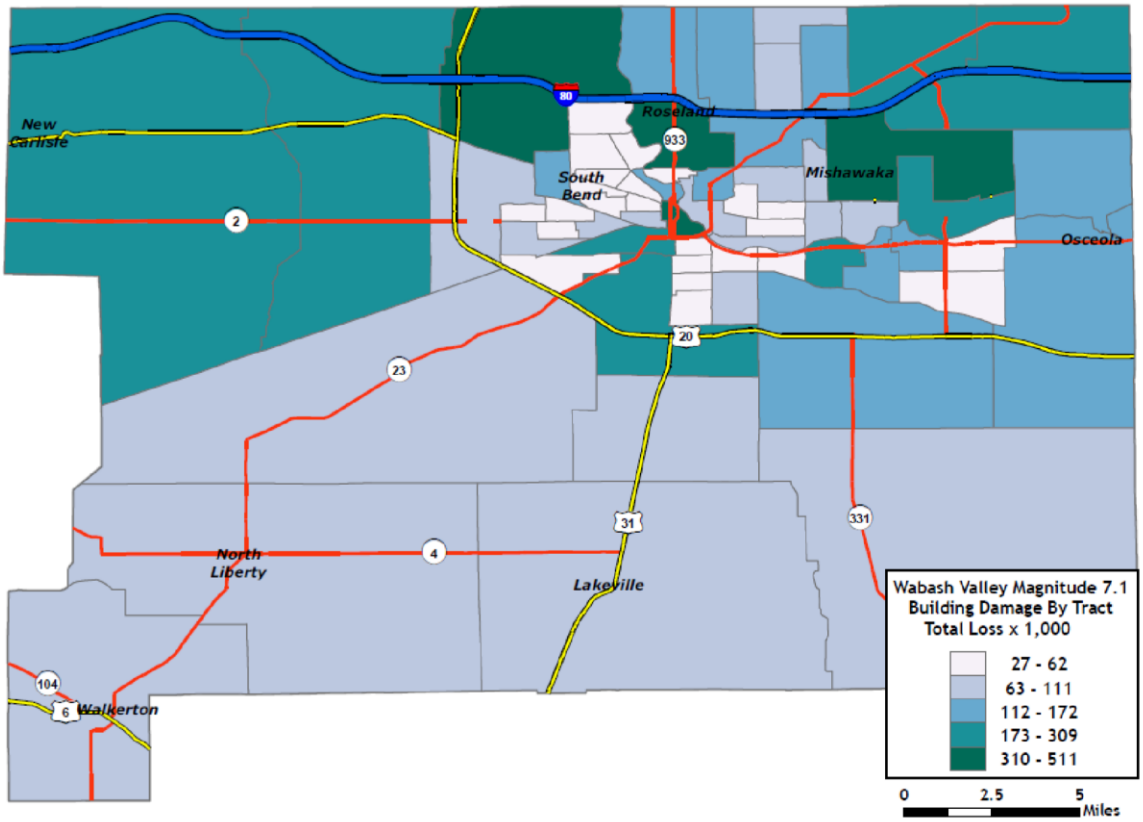
Table 4-19: Wabash Valley Scenario- Damage Counts by Building Occupancy

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	3,068	3.23	33	6.23	3	7.69	0	0.00	0	0.00
Commercial	4,580	4.82	40	7.66	3	9.04	0	0.00	0	0.00
Education	60	0.06	1	0.13	0	0.13	0	0.00	0	0.00
Government	198	0.21	2	0.38	0	0.42	0	0.00	0	0.00
Industrial	1,137	1.20	11	2.16	1	2.68	0	0.00	0	0.00
Other Residential	2,509	2.64	20	3.75	1	4.15	0	0.00	0	0.00
Religion	748	0.79	9	1.66	1	1.87	0	0.00	0	0.00
Single Family	82,628	87.04	409	78.03	27	74.01	0	0.00	0	0.00
Total	94,927		524		36		0		0	

Table 4-20: Wabash Valley Scenario-Building Economic Losses in Millions of Dollars

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Losses							
	Wage	0.00	0.00	0.14	0.01	0.11	0.26
	Capital-Related	0.00	0.00	0.11	0.01	0.03	0.15
	Rental	0.00	0.02	0.15	0.02	0.03	0.22
	Relocation	0.00	0.00	0.00	0.00	0.00	0.01
	Subtotal	**0.00**	**0.02**	**0.41**	**0.04**	**0.18**	**0.64**
Capital Stock Loses							
	Structural	0.32	0.02	0.13	0.06	0.17	0.70
	Non_Structural	1.62	0.25	0.73	0.69	0.96	4.26
	Content	0.90	0.10	0.54	0.36	0.74	2.63
	Inventory	0.00	0.00	0.04	0.20	0.00	0.24
	Subtotal	**2.83**	**0.37**	**1.44**	**1.30**	**1.89**	**7.83**
	Total	**2.83**	**0.39**	**1.84**	**1.34**	**2.07**	**8.48**

Figure 4-22: Wabash Valley Scanario- Building Econmic Losses in Thousands of Dollars



Wabash Valley Scenario—Essential Facility Losses

Before the earthquake, the region had 4,074 care beds available for use. On the day of the earthquake, the model estimates that only 2,037 care beds (50%) 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 St. Joseph County

The results of the initial analysis, the 5.5 magnitude earthquake with an epicenter in the center of St. Joseph County, are depicted in Tables 4-21 and 4-22 and Figure 4-23. HAZUS-MH estimates that approximately 18,886 buildings will be at least moderately damaged. This is more than 20% of the total number of buildings in the region. It is estimated that 797 buildings will be damaged beyond repair.

The total building related losses totaled $1.8 billion; 12% 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 48% of the total loss.

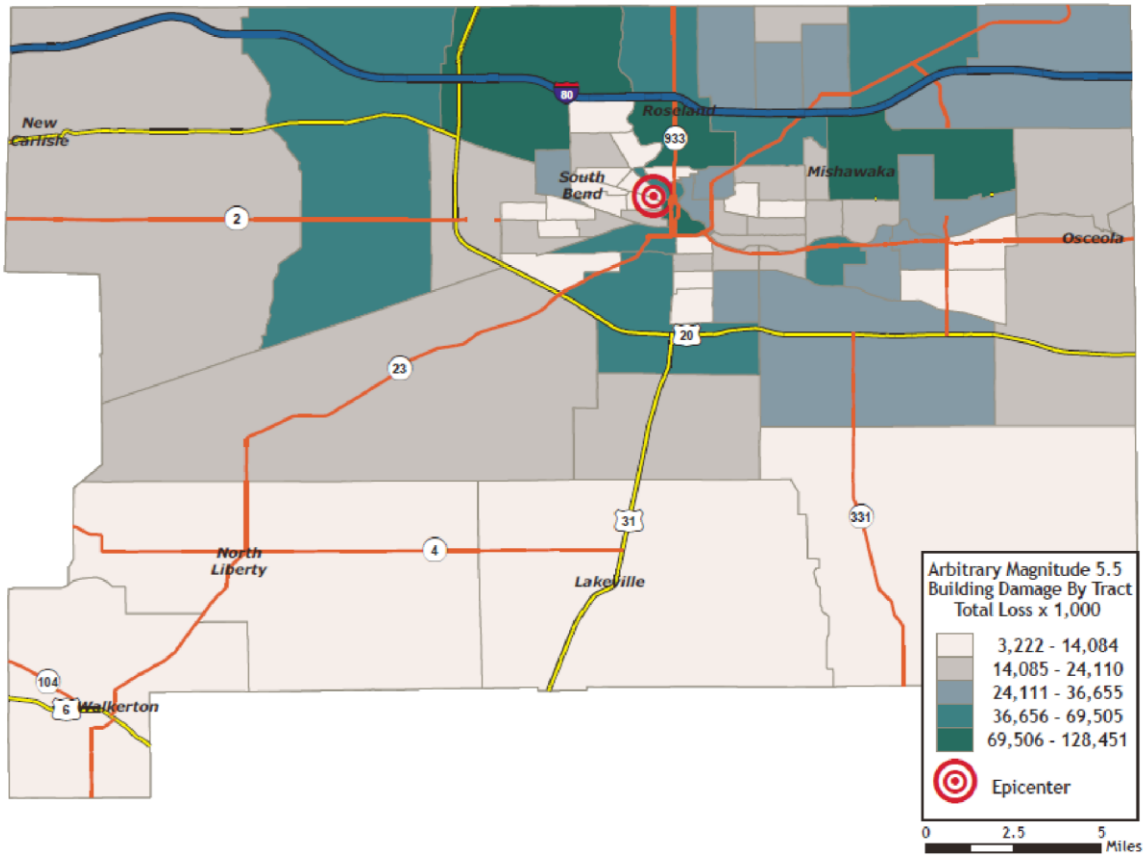
Table 4-21: 5.5M Scenario- Damage Counts by Building Occupancy

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	1,955	3.89	546	2.07	440	3.06	142	3.85	19	2.43
Commercial	2,199	4.38	1,022	3.87	963	6.69	372	10.07	67	8.41
Education	32	0.06	13	0.05	12	0.08	4	0.10	1	0.12
Government	108	0.21	41	0.16	37	0.26	11	0.31	3	0.38
Industrial	546	1.09	237	0.90	247	1.72	101	2.75	17	2.18
Other Residential	1,241	2.47	684	2.59	440	3.06	135	3.64	30	3.74
Religion	348	0.69	180	0.68	153	1.06	61	1.65	15	1.92
Single Family	43,779	87.20	23,669	89.68	12,103	84.08	2,868	77.63	644	80.82
Total	50,208		26,392		14,395		3,694		797	

Table 4-22: 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	2.12	66.96	7.38	18.84	95.31
	Capital-Related	0.00	0.87	53.76	4.55	5.53	64.72
	Rental	0.30	10.50	36.93	4.71	13.11	65.56
	Relocation	0.04	0.27	2.08	0.50	3.51	6.39
	Subtotal	0.34	13.76	159.73	17.15	40.99	231.98
Capital Stock Loses							
	Structural	102.59	7.76	38.96	17.90	45.71	212.92
	Non_Structural	470.83	66.05	116.57	84.19	166.04	905.68
	Content	207.54	23.57	83.07	48.60	114.64	477.42
	Inventory	0.00	0.00	6.04	27.45	0.03	33.51
	Subtotal	780.96	97.38	246.65	178.14	326.41	1,629.54
	Total	781.30	111.14	406.38	195.29	367.41	1,861.52

Figure 4-23: 5.5M Scenario- Building Economic Losses in Thousands of Dollars



St. Joseph County 5.5M Scenario—Essential Facility Losses

Before the earthquake, the region had 4,074 care beds available for use. On the day of the earthquake, the model estimates that only 95 care beds (2%) are available for use by patients already in medical care facilities and those injured by the earthquake. After one week, 41% of the beds will be back in service. By day 30, 71% will be operational.

Results 5.0 Magnitude 500-Year Probabilistic Scenario

The results of the 500-year probabilistic analysis are depicted in Tables 4-23 and 4-24. HAZUSMH estimates that approximately 588 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 six buildings will be damaged beyond repair. The total building-related losses totaled $25.25 million; 29% 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 39% of the total loss.

Table 4-23: 500-Year Probabilistic Scenario-Damage Counts by Building Occupancy

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	2,936	3.15	116	6.31	45	8.73	6	9.61	0	5.42
Commercial	4,430	4.76	139	7.55	48	9.24	6	9.74	0	5.83
Education	58	0.06	2	0.10	1	0.12	0	0.12	0	0.12
Government	192	0.21	6	0.31	2	0.38	0	0.37	0	0.35
Industrial	1,093	1.17	39	2.11	15	2.86	2	3.07	0	1.63
Other Residential	2,449	2.63	59	3.22	19	3.76	2	3.75	0	3.19
Religion	722	0.78	25	1.34	9	1.75	1	1.92	0	1.72
Single Family	81,184	87.23	1,450	79.06	377	73.15	47	71.41	5	81.74
Total	93,064		1,835		516		66		6	

Table 4-24: 500-Year Probabilistic Scenario-Building Economic Losses in Millions of Dollars

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Losses							
	Wage	0.00	0.03	2.01	0.25	0.70	2.99
	Capital-Related	0.00	0.01	1.58	0.15	0.21	1.95
	Rental	0.01	0.24	1.31	0.19	0.38	2.14
	Relocation	0.00	0.01	0.06	0.02	0.09	0.18
	Subtotal	0.01	0.29	4.97	0.61	1.38	7.25
Capital Stock Loses							
	Structural	2.72	0.20	1.17	0.66	1.72	6.47
	Non_Structural	5.16	0.57	1.18	0.66	1.85	9.43
	Content	0.73	0.08	0.36	0.24	0.53	1.94
	Inventory	0.00	0.00	0.03	0.14	0.00	0.16
	Subtotal	8.61	0.85	2.73	1.70	4.10	18.00
	Total	8.62	1.14	7.70	2.31	5.48	25.25

500-Year Probabilistic Scenario—Essential Facility Losses

Before the earthquake, the region had 4,074 care beds available for use. On the day of the earthquake, the model estimates that only 2,437 care beds (60%) are available for use by patients already in medical care facilities and those injured by the earthquake. After one week, 98% of the beds will be back in service. By day 30, 100% will be operational.

Results Annualized Risk Scenario

HAZUS-MH estimates that approximately 289 buildings will be at least moderately damaged. It is estimated that no building 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.

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. Structures built above a karst formation could potentially be subject to land subsidence and collapse into a resulting sinkhole.

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 St. Joseph County

There are no records or knowledge of any significant ground failure events in the county.

Vulnerability and Future Development

The extent of the ground failure hazard is closely related to development near the regions that are at risk. The extent will vary within these areas depending on the potential of elevation change, as well as the size of the underground structure. The hazard extent of ground failure is spread throughout the county in various concentrated areas.

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, St. Joseph County predominantly lies in the low incidence zone.

Figure 4-24: USGS Landslide Overview Map

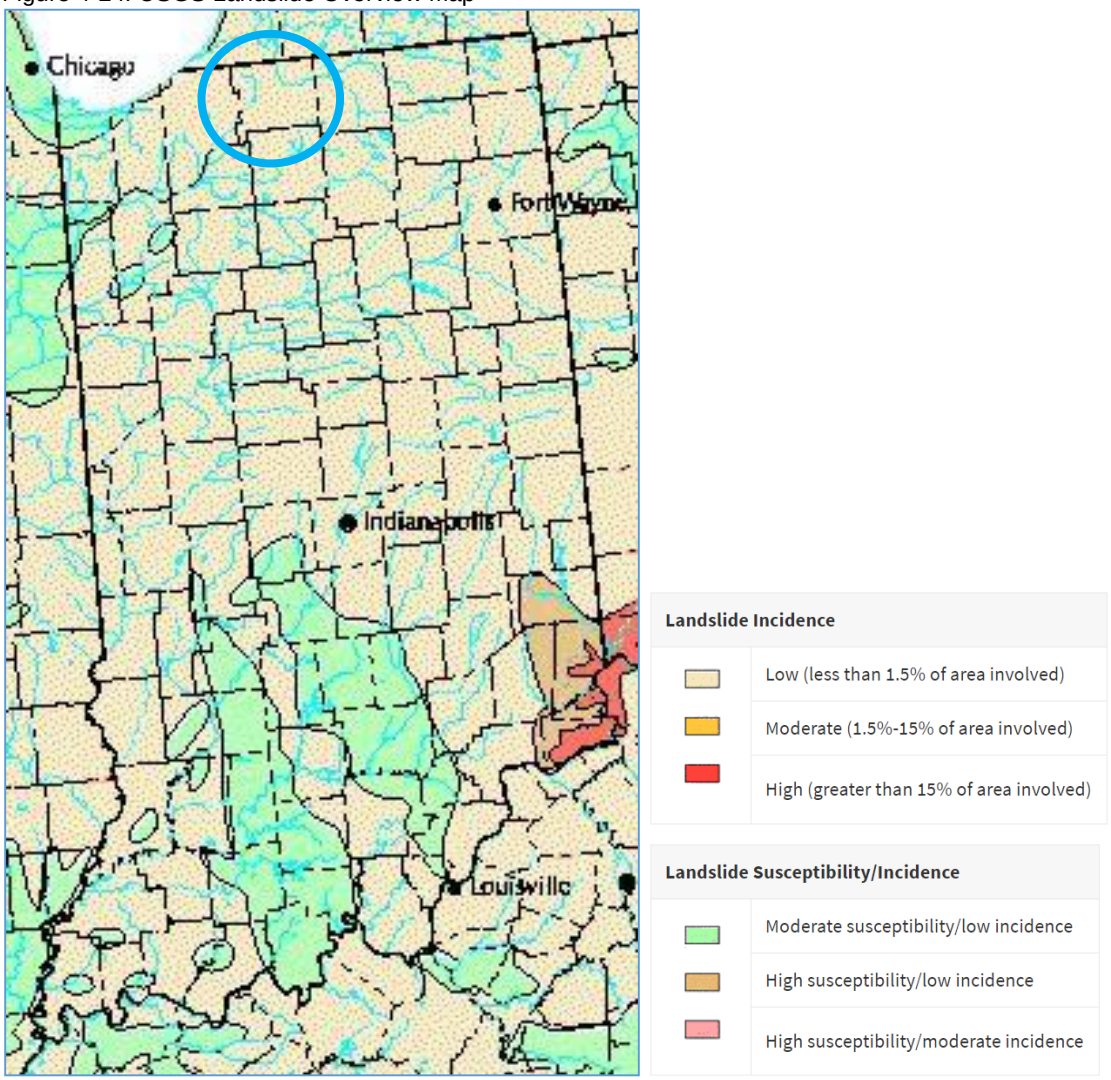
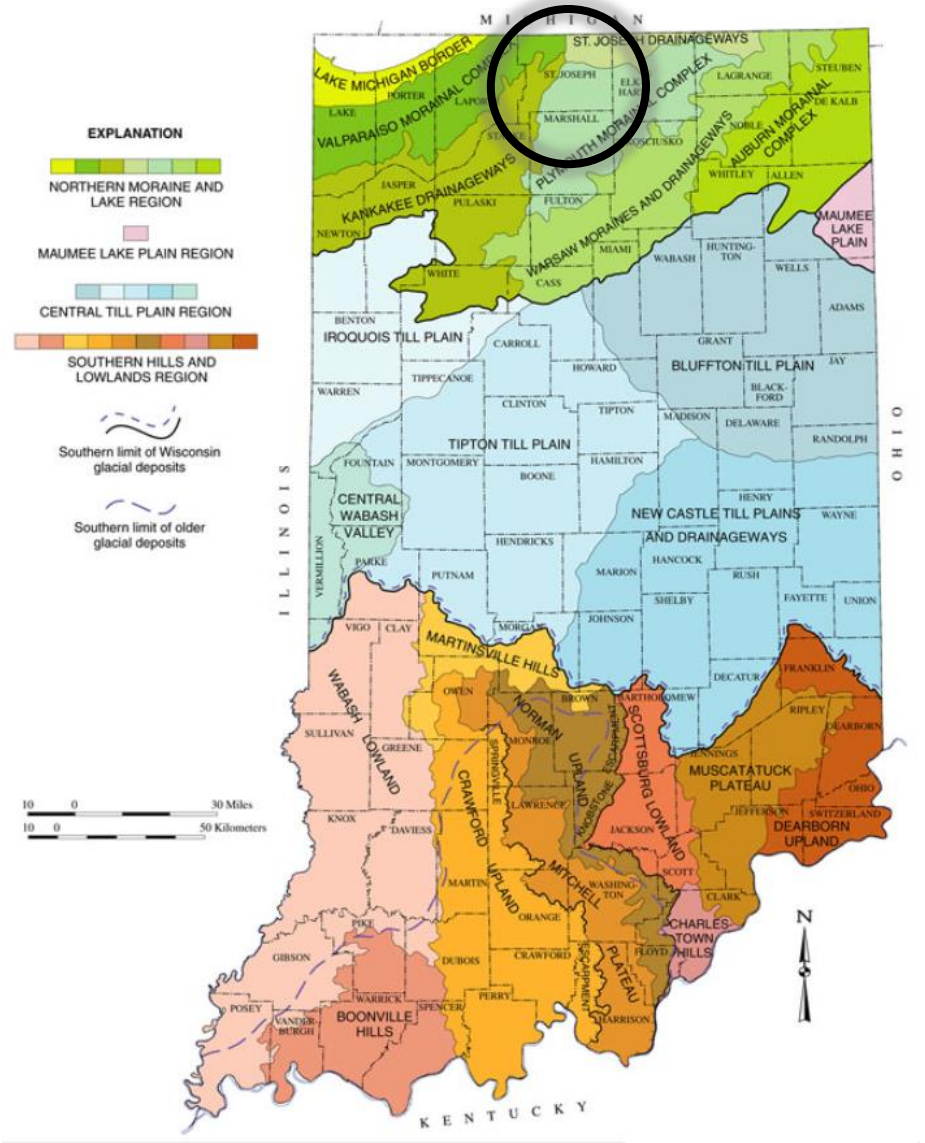


Figure 4-25 shows the physiographic divisions in Indiana. The county was north of both glacial periods and is located in the northern moraine and lake region. The county is located within the Valparaiso & Plymouth Morainal Complex and the Kankakee & St. Joseph Drainageways.

Figure 4-25: Physiographic Divisions of Indiana



Risk Analysis

Exposure Analysis

Structures and infrastructure located along high slopes or unstable slopes are more vulnerable for landslides or ground failure events. The existing buildings and infrastructure of St. Joseph County are discussed in types and number below.

As seen in Figure 4-26, the terrain of St. Joseph 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 throughout the county. In particular, the most variance appears to be along the St. Joseph River as it cuts across the central portion of the county just north of the US 20 bypass. Areas of steeper slope are represented in red while the green areas are representative of flatter terrain. There are no karst environments to report in this county.

Figure 4-26: Slope Map – St. Joseph County

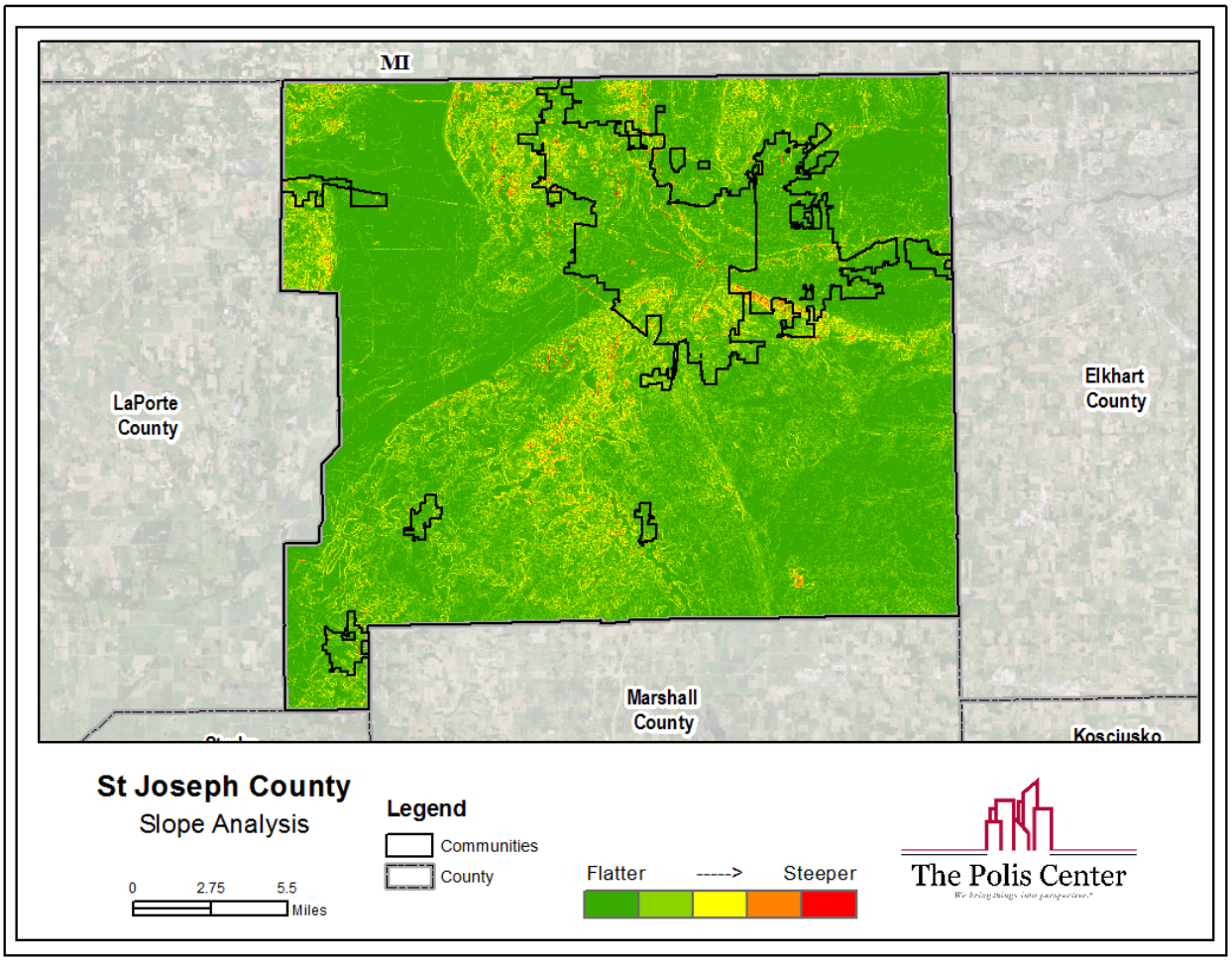
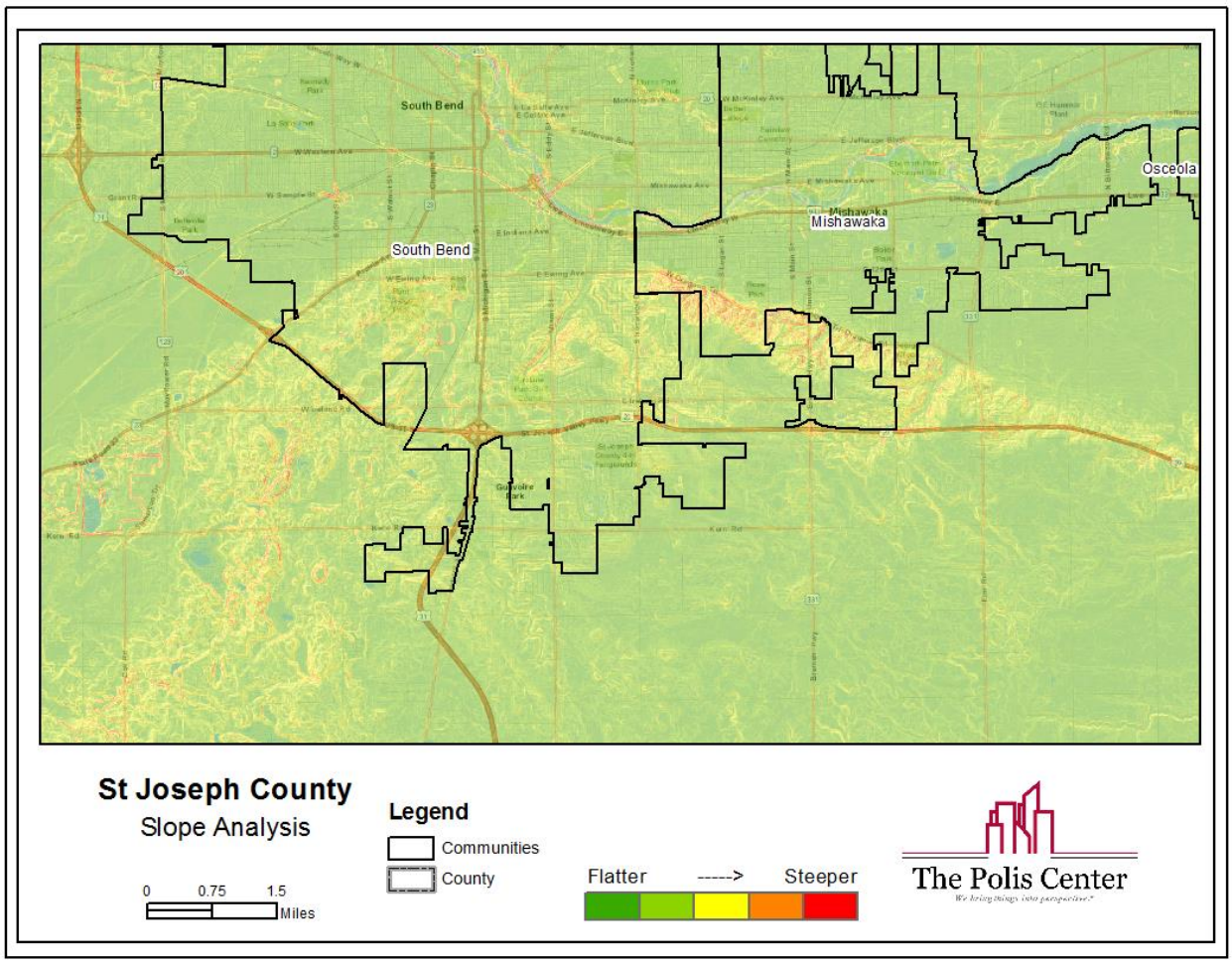


Figure 4-27 shows portions of South Bend and Mishawaka which display some of the more diverse terrain in the area. The south western portion of the map below displays more areas of varied terrain which lead towards Potato Creek State park.

Figure 4-27: Slope Map – South Bend and Mishawaka, St. Joseph 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

St. Joseph County Erosion and Sediment Control Ordinance: - Ordinance intended to control soil erosion and sedimentation caused by land disturbing activities within St. Joseph County.

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. 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 St. Joseph County are shown in map and in tables in the Appendix.

Summer storms, including thunderstorms, hailstorms, and windstorms affect St. Joseph 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.

Summer Storm History in St. Joseph County

Historically, several severe tornadoes have impacted St. Joseph County. In April 1965, a particularly severe tornado swept through St. Joseph County killing three people, injuring twenty-eight, and inflicting over 25 million in property damages throughout the region. The county

sustained damages of approximately 2.5 million from a tornado on September 9, 1985. The St. Joseph County Historical Tornado Tracks figure shows tornado touchdown points and tracks in St. Joseph County since 1950 shown in the appendix. The county has experienced tornadoes in 22 tornadoes on record. Two brief tornadoes developed in October of 2016 when a narrow axis of moisture lifted ahead of a strong shear.

There have been 439 thunderstorm events reported to the NOAA in St. Joseph County since 1965 itemized by impact in the appendix. Numerous storms in March and June of 2016 impacted down powerlines from tree limbs. In July of 2014 on two back to back days, hail events were reported in Soouth Bend/Nutwood and Granger. In July 2014, a woman suffered injuries form a thunderstorm wind event, when a tree was blown onto her vehicle In August 2014 a 51 year old man, was injured when he was struck by lightning while working outside as the storm rolled in..

Vulnerability and Future Development

A storm water ordinance 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 St. Joseph 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.

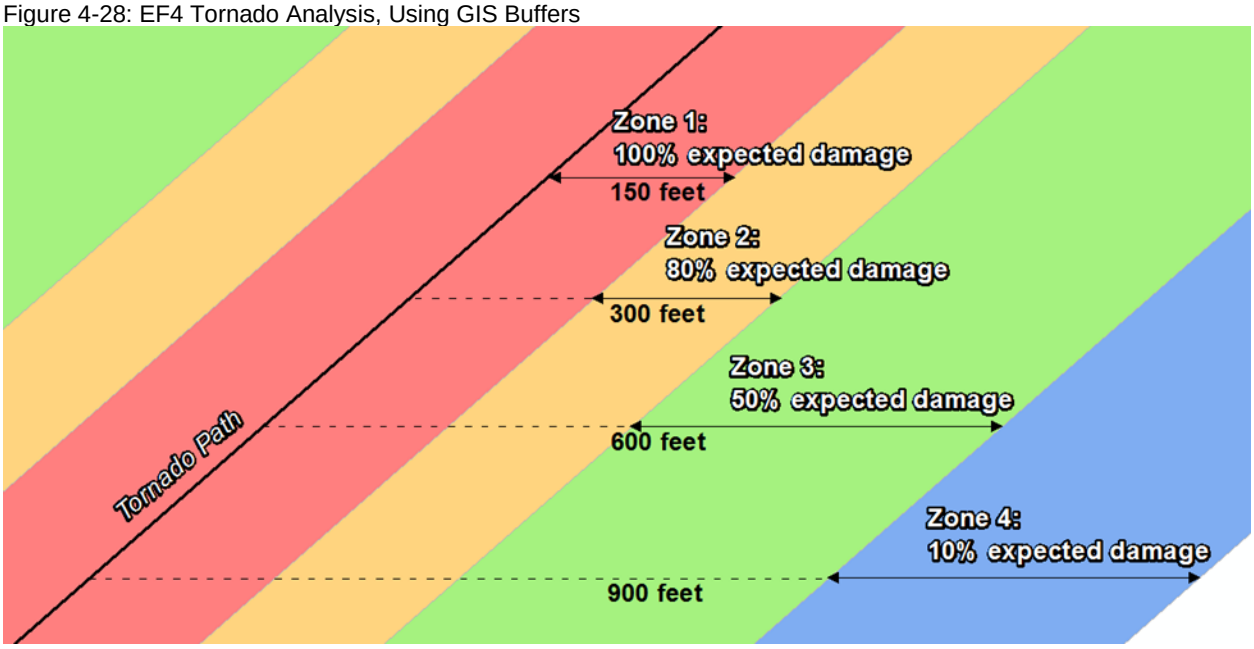
An example scenario is described as follows to gauge the anticipated impacts of tornadoes, in terms of numbers and types of buildings and infrastructure, in the county. GIS overlay modeling was used to determine the potential impacts of an EF4 tornado. The analysis used a hypothetical path based upon an F3 tornado event that would run from Walkerton, North Liberty, and then South Bend. 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 4-25 depicts tornado damage curves as well as path widths.

Table 4-25: 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. The figure and table below describe the zone analysis.

Figure 4-28: 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.

An EF3 tornado has three damage zones, as shown in Table 4-26. 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 4-26: 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 decided to create a hypothetical EF4 tornado path that crossed the majority of the state. The hypothetical path starts out of the county in the northeast portion of Starke County, stretches up through the towns of Walkerton and North Liberty then turning slightly to cross parts of South Bend and Mishawaka finally coming to an end in the northeast corner of the county. The damage curve buffers for this hypothetical tornado path are shown in Figure 4-29.

Figure 4-29: Modeled F4 Tornado Hypothetical Path

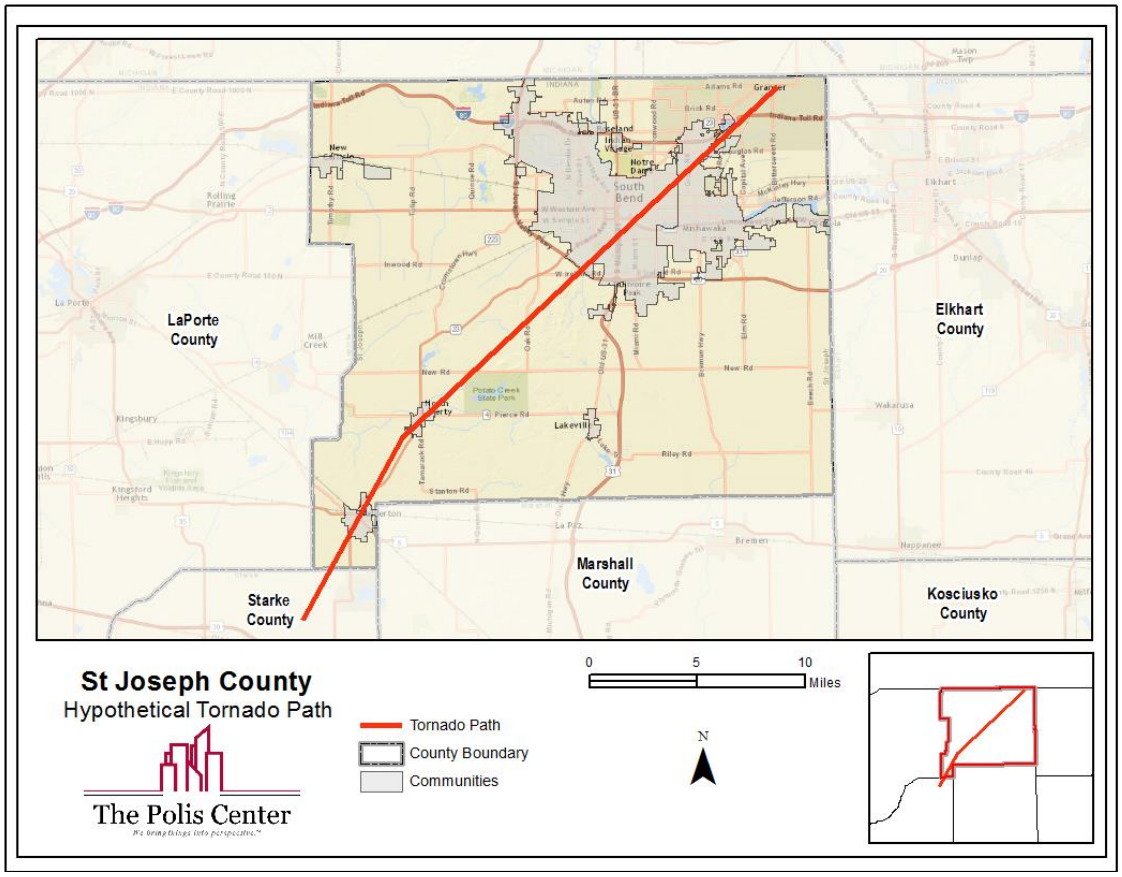


Figure 4-30: Tornado Buffer and Building Inventory through Communities

The building losses are an estimate of building replacement costs multiplied by the percentages of damage. The overlay was performed against parcels provided by St. Joseph 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.

Results

The results of the analysis are depicted in Tables 4-27 and 4-28. The GIS analysis estimates that 3,275 buildings will be damaged. The estimated building losses from the hypothetical tornado would be $1.2 billion.

Table 4-27: Estimated Building Losses by Occupancy Type

Occupancy	Zone 1	Zone 2	Zone 3	Zone 4
Residential	467	469	959	927
Commercial	55	41	78	78
Industrial	18	17	24	20
Agriculture	6	11	21	19
Religious	4	4	13	10
Government	6	8	5	4
Education	1	1	0	0
Total	**557**	**551**	**1,109**	**1,058**

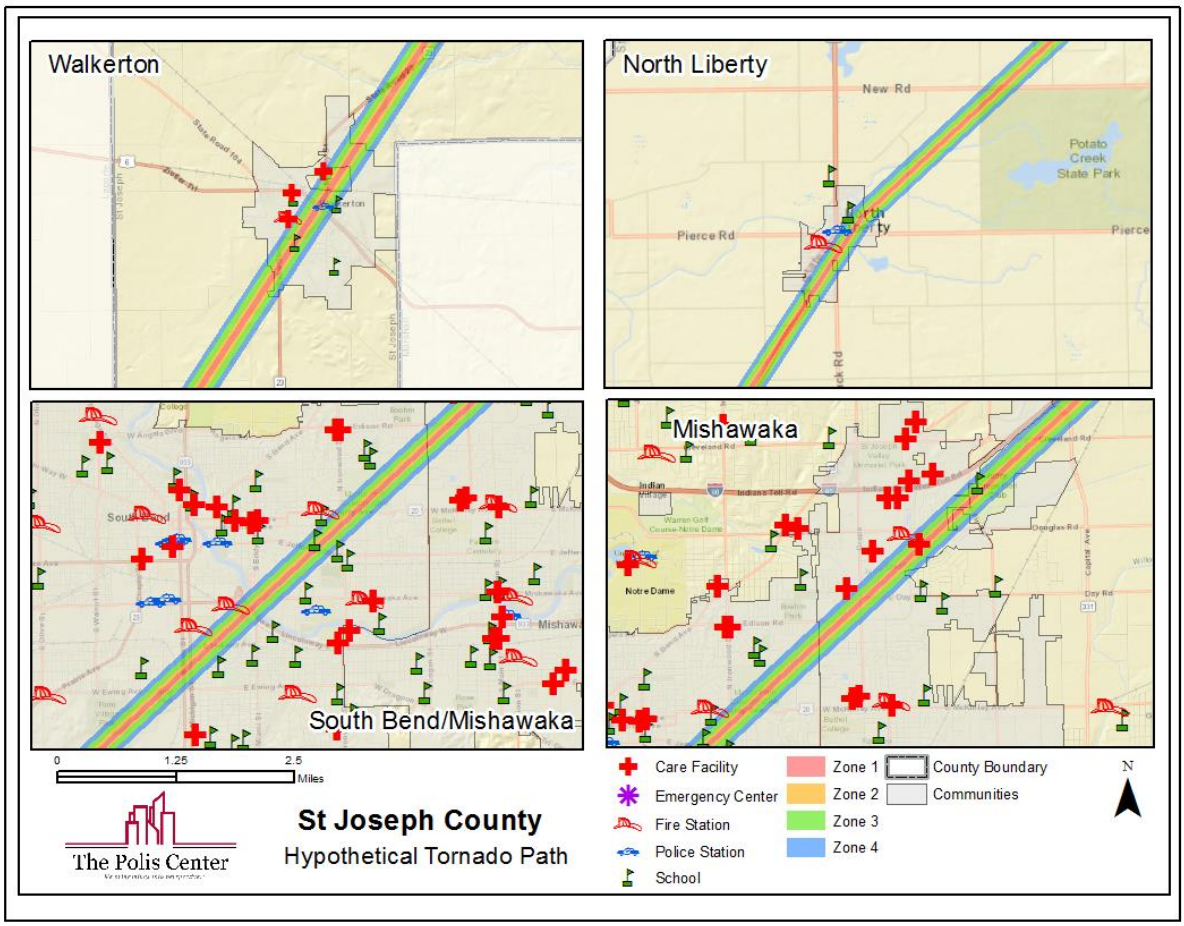
Table 4-28: Estimated Losses by Zone

Occupancy	Zone 1	Zone 2	Zone 3	Zone 4
Residential	$293,504,529	$60,263,814	$97,964,802	$35,283,999
Commercial	$218,732,169	$61,554,309	$151,064,626	$52,116,678
Industrial	$43,252,366	$46,300,347	$51,645,008	$5,194,630
Agriculture	$1,816,834	$2,764,679	$1,817,220	$530,076
Religious	$1,870,371	$17,356,264	$21,374,022	$2,464,089
Government	$8,912,540	$12,414,308	$12,867,530	$583,471
Education	$16,707,300	$192,122	$0	$0
Total	**$584,796,110**	**$200,845,845**	**$336,733,210**	**$96,172,945**

Essential Facility Damage

There were a total of 8 essential facilities located within the threat zones of the hypothetical tornado paths. The analysis found that that the hypothetical tornado path would also disrupt 2 medical care facilities, 1 police station, and 5 schools.

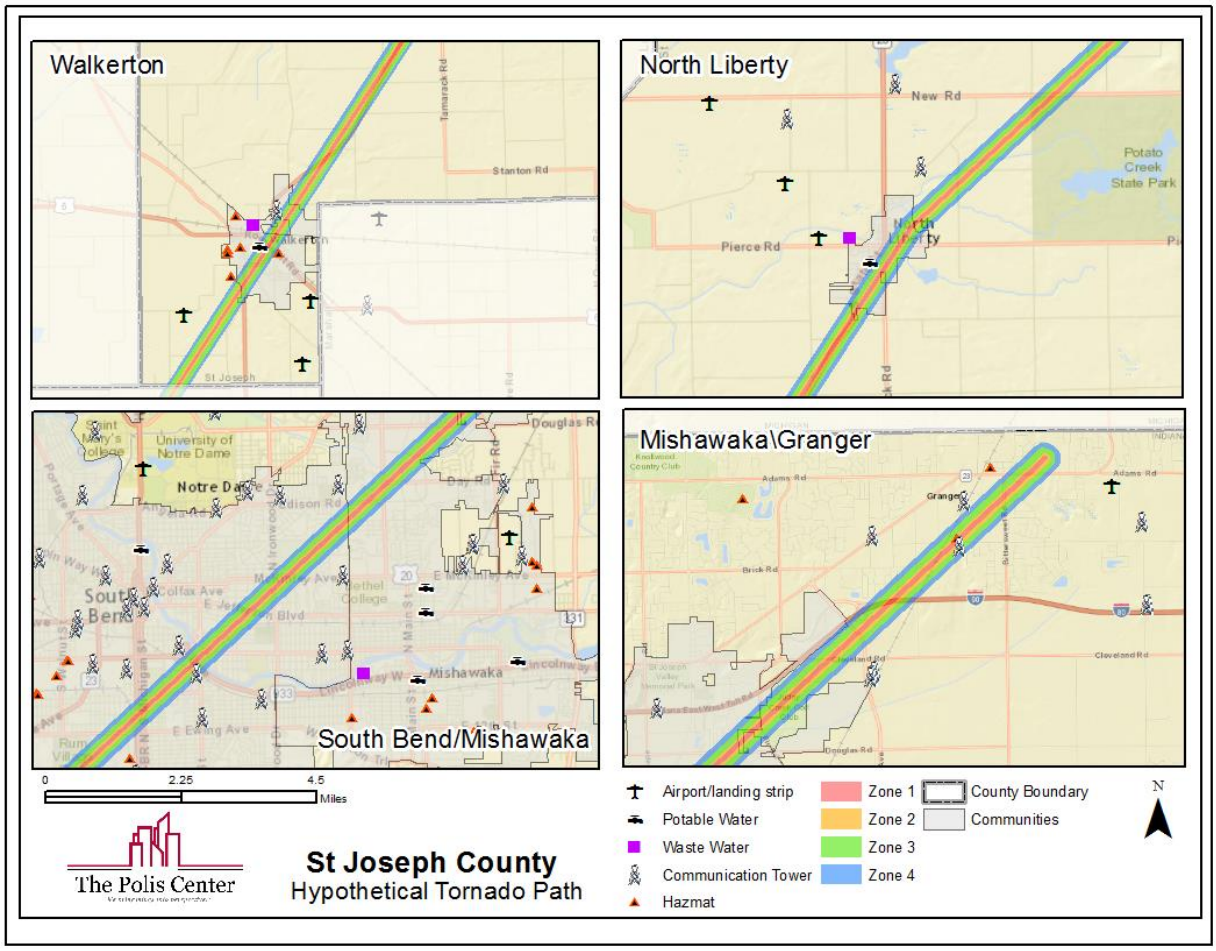
Figure 4-31: Essential Facility Damage



Critical Facility Damage

There were a total of 4 critical facilities located within the threat zones of the hypothetical tornado paths: 1 potable water facility, 2 communication towers, and 1 hazmat facility.

Figure 4-32: Critical Facility Damage



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 St. Joseph County. There is a network of trained

SKYWARN spotters in St. Joseph 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. St. Joseph County held the 2017 Skywarn Spotter Training in March of 2017.

Storm Shelters –The St. Joseph County Emergency Management Agency supports residential applicants in their pursuit of storm shelter federal funding.

Outdoor Warning Sirens– St. Joseph 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. 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 – Not all critical facilities have backup power.

Burying Power Lines - Burying power lines helps 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 St. Joseph County Highway 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. Many of the utility companies also assist in the management of tree maintenance along utility corridors.

School Closings - All school districts within St. Joseph 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 St. Joseph County is covered by the National Weather Service transmitters in South Bend and North Webster.

Public Warning and Notification - In the event of emergencies or hazardous conditions that require timely and targeted communication to the public, St. Joseph County utilizes the local news media. St. Joseph 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 - St. Joseph 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 – Gaps in the warning sirens are listed as a needed mitigation strategy.

Storm Shelters - Not all St. Joseph 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).

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 1. USDM Index

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.

Drought History in St. Joseph County

Since the last MHMP, the Indiana Drought Monitor and National Drought Mitigation Center have recorded instances of drought conditions occurring throughout St. Joseph County. St. Joseph County experienced a period of drought from the end of August 2010 to the end of March 2011., and over 85% of land area in St. Joseph County was at category D1 for four weeks in November 2011. The periods of drought negatively impacted crop growth, and between August and December 2010, the county was eligible for business assistance.

From August 2011 to October 2011, St. Joseph County experienced a drought event that resulted in the county experiencing category D0 drought for eleven weeks. Although no major impacts from

these time periods were recorded, decelerated planting of crops and diminished growth of crops or pastures can be expected at category D0.

Like the rest of Indiana, St. Joseph County was affected by the 2012 central US drought. At the peak of the drought, .01% of the county was at category D3 for six weeks. Saint Joseph County's corn crop struggled, ears of corn were smaller than usual, and the National Drought Mitigation Center reported numerous fires occurring in rural areas and fields. Nearly half of Indiana, including St. Joseph County, had open burn bans. During the summer of 2012, drought limited trout production at an Indiana state fishery and led to canceled trout stockings in northern Indiana. Along with more than half of Indiana, St Joseph County was declared eligible for small-business administration(SBA) loans, and some business were eligible for assistance.

After the 2012 drought, St. Joseph County experienced category D0 events from early September through December 2013, August 12-26, 2014, and April through May 2015. The National Drought Mitigation Center did not record any impacts for these time frames in St. Joseph County, but crops, and pastures are commonly affected during D0 drought.

From October 27, 2015 through December 29, 2015, 12% of St. Joseph County underwent ten weeks of level D1 drought, affecting soybeans, winter wheat, pastures with dryness. In the summer of 2016, St. Joseph 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 St Joseph County. The dry weather also stressed late planted corn in both June and August 2016.

Geographic Location for Drought

Droughts are regional in nature. All areas of the county are vulnerable to the risk of drought.

Hazard Extent for Drought

Droughts can be widespread or localized events. The extent of the droughts varies both in terms of the extent of the heat and the range of precipitation.

Risk Identification for Drought

In Meeting #2, the planning team determined that the probability of a drought is possible with limited consequences. The warning time for a drought is more than 24 hours with a duration of more than 1 week. The calculated CPRI for drought is 2.05.

Vulnerability Analysis for Drought

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 varying impacts within the affected area. Future development will remain vulnerable to drought events. Typically, some urban and rural areas are more susceptible than others. Excessive demands for water in populated urban areas place a limit on water resources. In rural areas, crops and livestock may suffer from extended periods of drought.

Community Development Trends and Future Vulnerability

Because droughts and extreme heat are regional in nature, future development will be impacted across the county. 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.

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 St. Joseph County SWCD routinely monitors the wells throughout the county for water levels for groundwater levels.

EMS Training – The St. Joseph County Emergency Medical Service (EMS) provides full emergency services the county and is dedicated to the preservation of life and quality of life and the education of the public in areas of life preservation.

Program Gaps or Deficiencies

No program gaps or deficiencies were identified.

4.6 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

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 St. Joseph 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. There have been 92 total winter events, including 18 winter storms and 10 heavy snow events. There have been on average 4-6winter related hazards on record for the county for the past ten years.

The winter of 2000 brought three heavy snow events and three ice storms in 2007. On December 21, 2008, Icy roads due to lake-effect snow showers and blowing snow led to a fatal car crash of four people. Another crash on the week prior was also the result of lake effect snow and resulted in 2 casualties and 2 injuries was the result of lake effect snow.

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.

Plans and Programs in Place

Snow Removal - The St. Joseph County Highway 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 St. Joseph County receive priority for snow plowing. INDOT handles snow removal on highways within St. Joseph County. All other city and town jurisdictions either have their own equipment for snow removal or contract for services to do so.

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

Burying Power Lines - Burying power lines helps eliminate loss of power due to snow and ice storms.

NOAA Weather Radio Transmitter Towers - The National Weather Service delivers storm warnings and key information during severe winter weather events over its radio towers.

School Closings - All school districts within St. Joseph 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, St. Joseph County utilizes the local news media. St. Joseph 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 - St. Joseph 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.

4.7 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.

While wildfire's may begin from natural causes such as drought and lightning, the majority are human induced. State properties are at a greater increase of wildfire threat and pose as a natural location to promote fire management safety.

Wildfire History in St. Joseph 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

Flooding and Erosion-Wildfires can completely eliminate vegetation and pose an increased risk to flooding and erosion effects.

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

Hazardous Material Release – Storage tanks carrying chemicals including chlorine, anhydrous ammonia, and fuel tanks located at farm pose an increased risk to wildfire ignition.

Infectious Disease Outbreak- Pests such as the Emerald Ash Borer, pose a threat to increased wildfire risk, as they provide liter for fire ignition.

Plans and Programs in Place

Fire Departments- Fire departments respond to structure fires and will also help when needed in other jurisdictions. Community arrangements are highlighted in detail within the community profile.

Zoning- County and community enforced zoning promote healthy fire safety from all avenues of construction and enforcement.

State Land Management- DNR manages all state properties and executes vegetation management plans which reduce the risk of wildfire incidents.

4.8 Extreme Temperatures

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.

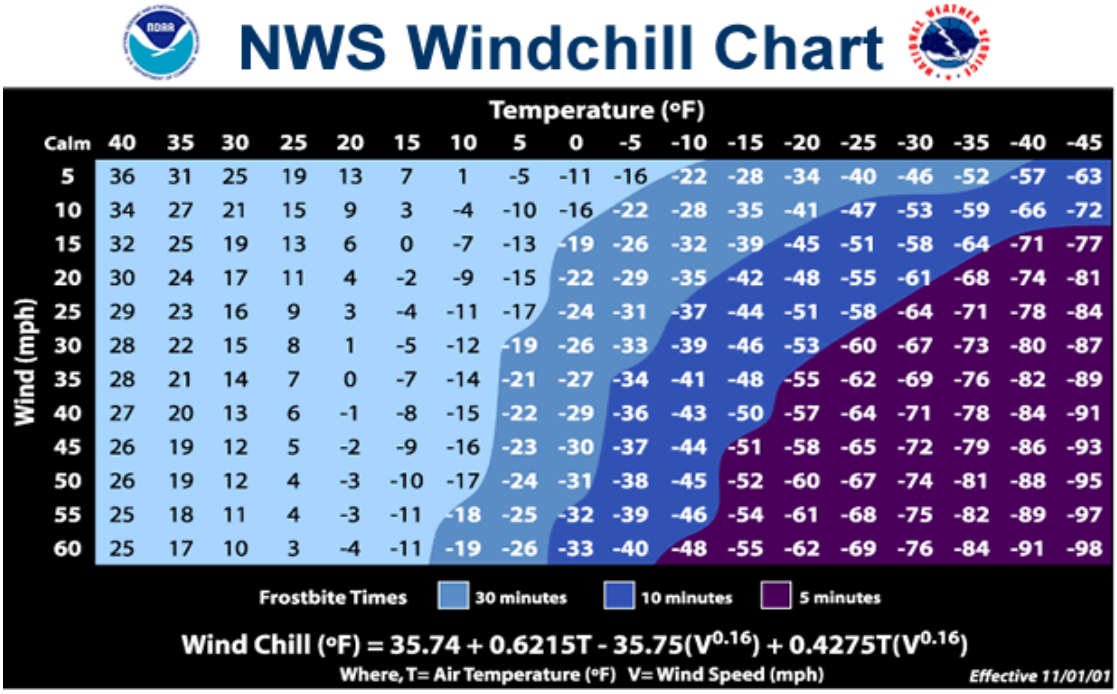
Extremely cold temperatures often accompany a winter storm, so individuals may also have to cope with power failures and icy roads. Although staying indoors can help reduce the risk of vehicle accidents and falls on the ice, individuals are susceptible to indoor hazards. Homes may become too cold due 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 4-34, includes a frostbite indicator, showing points where temperature, wind speed, and exposure time will produce frostbite in humans.

Figure 4-34: 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 24º 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 15º F to 24º F below zero.
- Wind Chill Warning: Issued when wind chill readings are life threatening. Wind chill readings of 25º F below zero or lower are expected.

Extreme Heat

Heat is the leading weather-related killer in the United States, even though most heat-related deaths are preventable through outreach and intervention 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. The NWS issues a heat advisory when, during a 24-hour period, the temperature ranges from 105ºF to 114ºF during the day, and remains at or above 80ºF at night.

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.

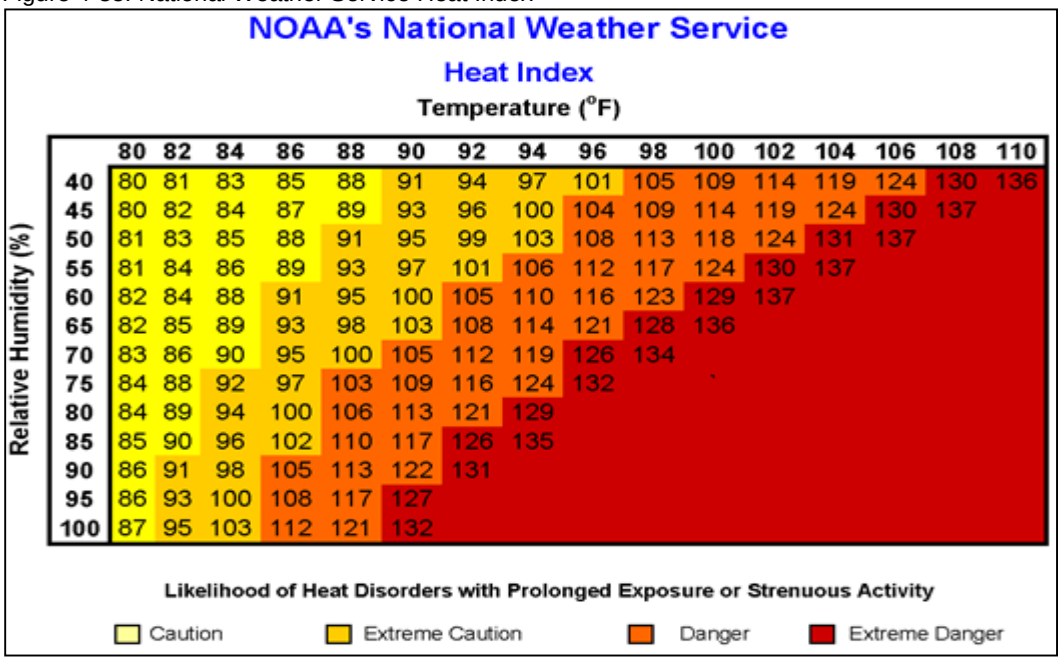
Depending on severity, duration, and location, EHEs can also trigger secondary hazards, including dust storms, droughts, wildfires, water shortages, and power outages.

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 4-35.

Figure 4-35: 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 St. Joseph County

Based on NCDC records in January of 2014 and 2015, the county experienced an extreme cold/wind chill event. In July 2011, an excessive heat event caused an indirect death when it was discovered after a man passed away that he had an underlying heart condition.

Relationship to other Hazards

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

Plans and Programs in Place

School Closings - All school districts in St. Joseph 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, St. Joseph County utilizes the CodeRED Mass Notification System and the St. Joseph County Sheriff's Office Facebook page, as well as local news media. St. Joseph 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.

4.9 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 Emerald Ash Borer was found in St. Joseph County in 2006. 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 St. Joseph County

Emerald Ash Borer

The Indiana Department of Natural Resources announced that Emerald Ash Borers (EAB) were found in St. Joseph County in 2006. In 2012, more than one hundred Ash trees were removed from the downtown area in South Bend due to the infestation of Emerald Ash Borers.

Vector-Borne Illness

There have been no reported outbreaks of vector-borne diseases outbreaks in the county.

Vulnerability and Future Development

Future development will remain vulnerable to these events. Emerald ash borers 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.

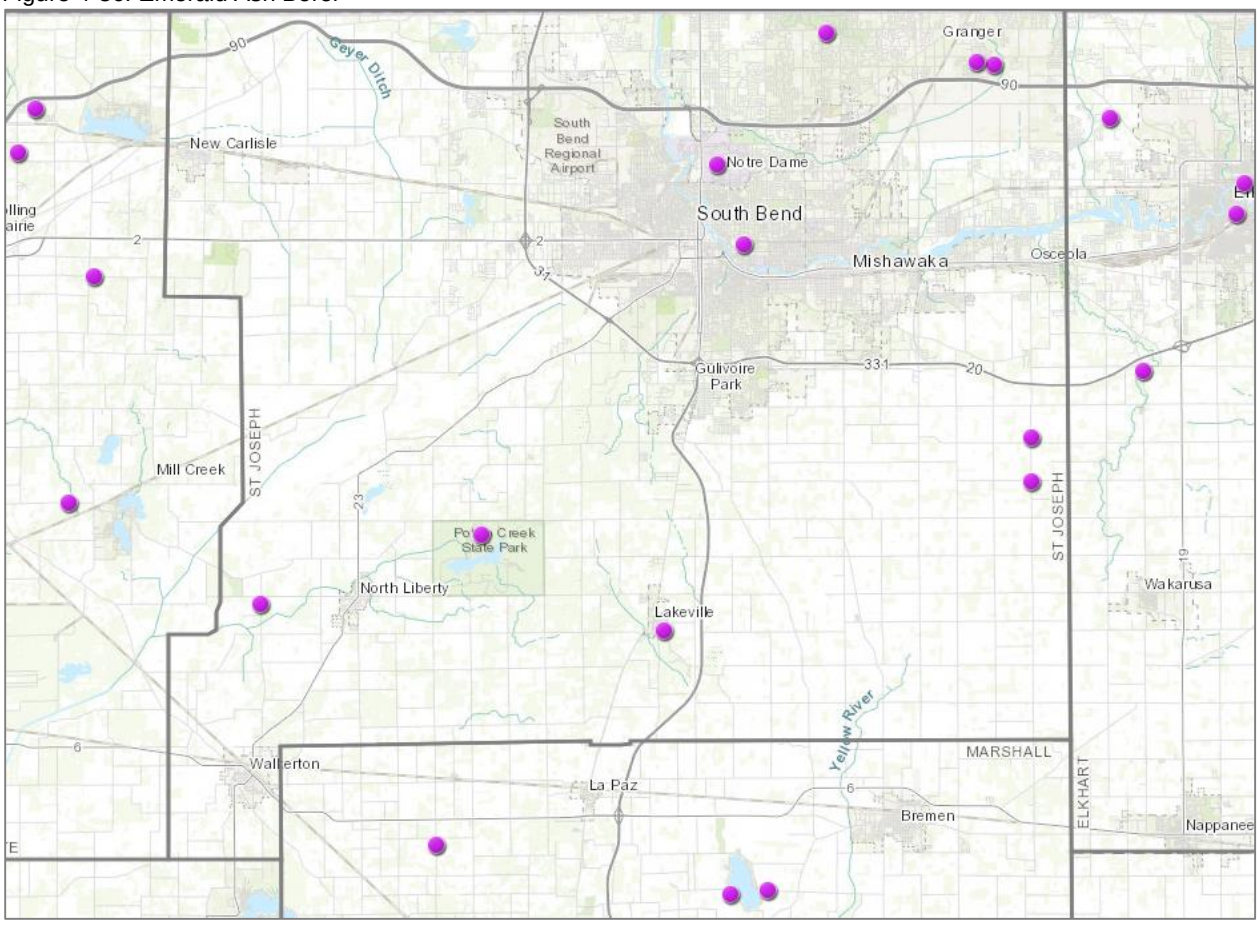
All communities can be potentially at risk for an epidemic and experience increased risk during hazards the cause displacement, contaminate the water supply, deprive people of essential utilities, or when residents are not exposed to educational resources outlining preventive steps.

Risk Analysis

Exposure Analysis

An exposure analysis identifies the existing and future assets located in identified hazard areas. The reported identification of the Emerald Ash Borer in St. Joseph County is identified in Figure 4-36 and reveals that Emerald Ash Borers have been spotted throughout the county and surrounding areas.

Figure 4-36: Emerald Ash Borer



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 county implements all relevant health codes for septic, storage, and infectious disease management.

The department has multiple divisions, including: Emergency Preparedness/Epidemiology, Health Education, Environmental, Food Service, Nursing, and Vital Records and has approximately 50 employees within the department. St. Joseph County Board of Health contact:

St. Joseph County Health Department
227 West Jefferson Boulevard, South Bend, IN 46601
http://www.sjchd.org/ (574) 235-9750

Program Gaps or Deficiencies

No program gaps or deficiencies were identified at this time.

4.10 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.

IDHS works with county Emergency Management Agency offices to coordinate their local Comprehensive Emergency Management Plan (CEMP) and Local Emergency Planning Committee (LEPC) programs. An LEPC 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. A CEMP incorporates lists of Hazmat preparedness tasks for Emergency Support Function (ESF) personnel.

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 St. Joseph 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. The Indiana State Police maintains the

listing of contaminated residences, outbuilding, vehicles & properties. Although the county has a fairly low average rate of contaminated structures, the City of Elkhart to the east appear to have heavier metropolitan concentrations of locations, with over 124 in and around the city.

Hazardous Incident History in St. Joseph County

St. Joseph 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 St. Joseph 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. The Indiana Toll Road runs through the northern portion of St. Joseph County and intersects with several major highways, state roads, and interstates along the way. The Indiana Toll Road operates as a major route for travel to and from Chicago. In addition to the toll road, US 31 runs through the county crossing over the Indiana Toll Road just north west of South Bend and then proceeding into Michigan. US 31 is a major transportation corridor connecting the northern portions of the state with Indianapolis. The US 20 bypass is the third major transportation route through the county running east and west until it merges with US 31 and proceeds north out of the county.

There are two major rail lines running through the county: Norfolk Southern and the Canadian National Railroad/Grand Trunk Railroad. Both railroad lines cross through several St. Joseph County communities including New Carlisle, South Bend, and Mishawaka.

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 4-30: St. Joseph Buildings Contaminated by Meth per Year

Year	Total	Year	Total
2007	19	**2012**	22
2008	9	**2013**	33
2009	9	**2014**	23
2010	20	**2015**	28
2011	21	**2016**	12

Combining Available Data and Methods

The EPA and the 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), exposure guidelines have been 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

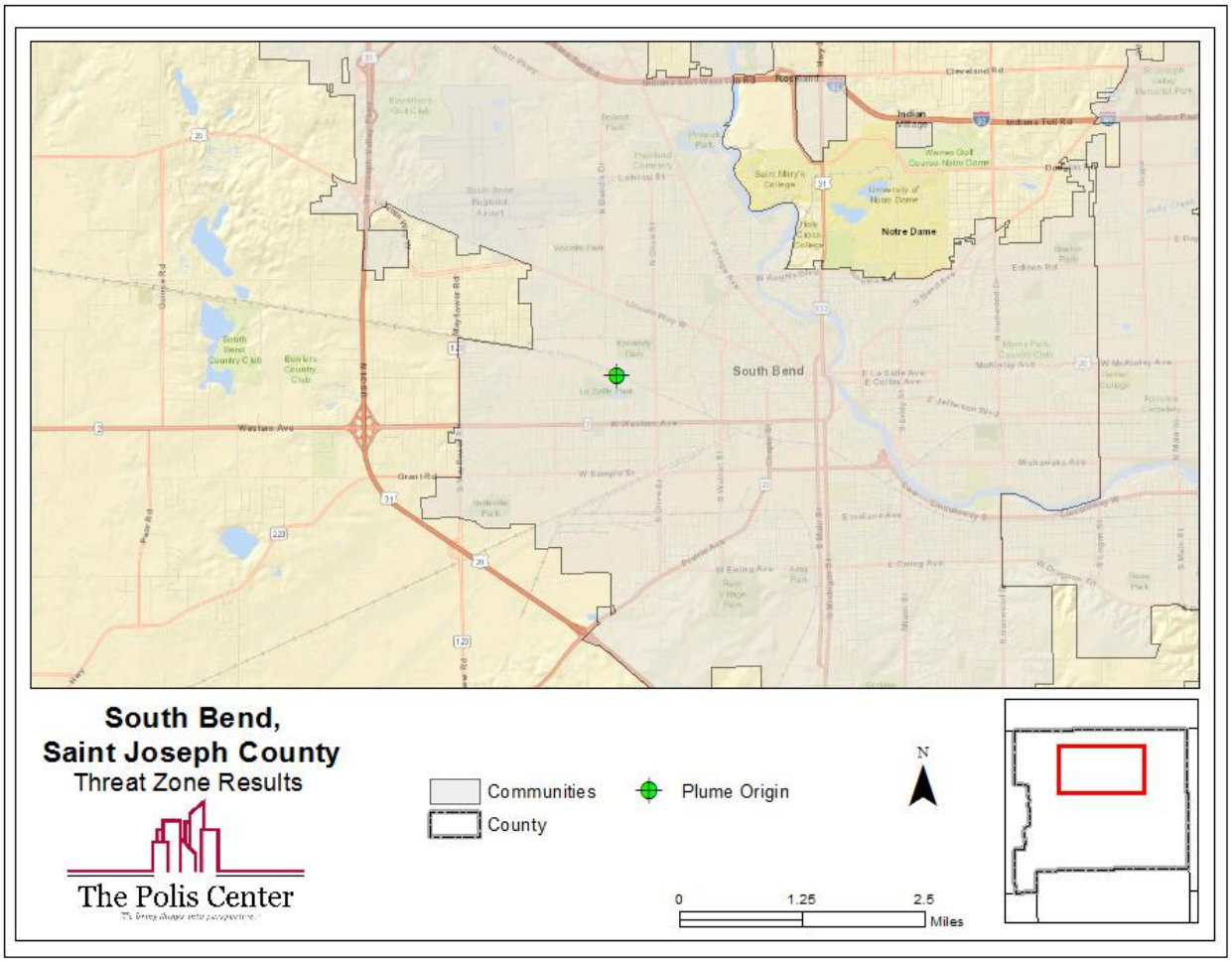
- Zone 3 (AEGL 3): Above this airborne concentration of a substance, it is predicted that the general population, including susceptible individuals, could experience life-threatening health effects or death.

Scenario

The ALOHA model was utilized to assess the area of impact for a chlorine release along the Norfolk Southern rail line near the South Bend Station just west of the city. This area was selected as a recreation of the 2009 Hazardous Materials Spill section of the Multi-Hazard Mitigation Plan of St. Joseph County.

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.

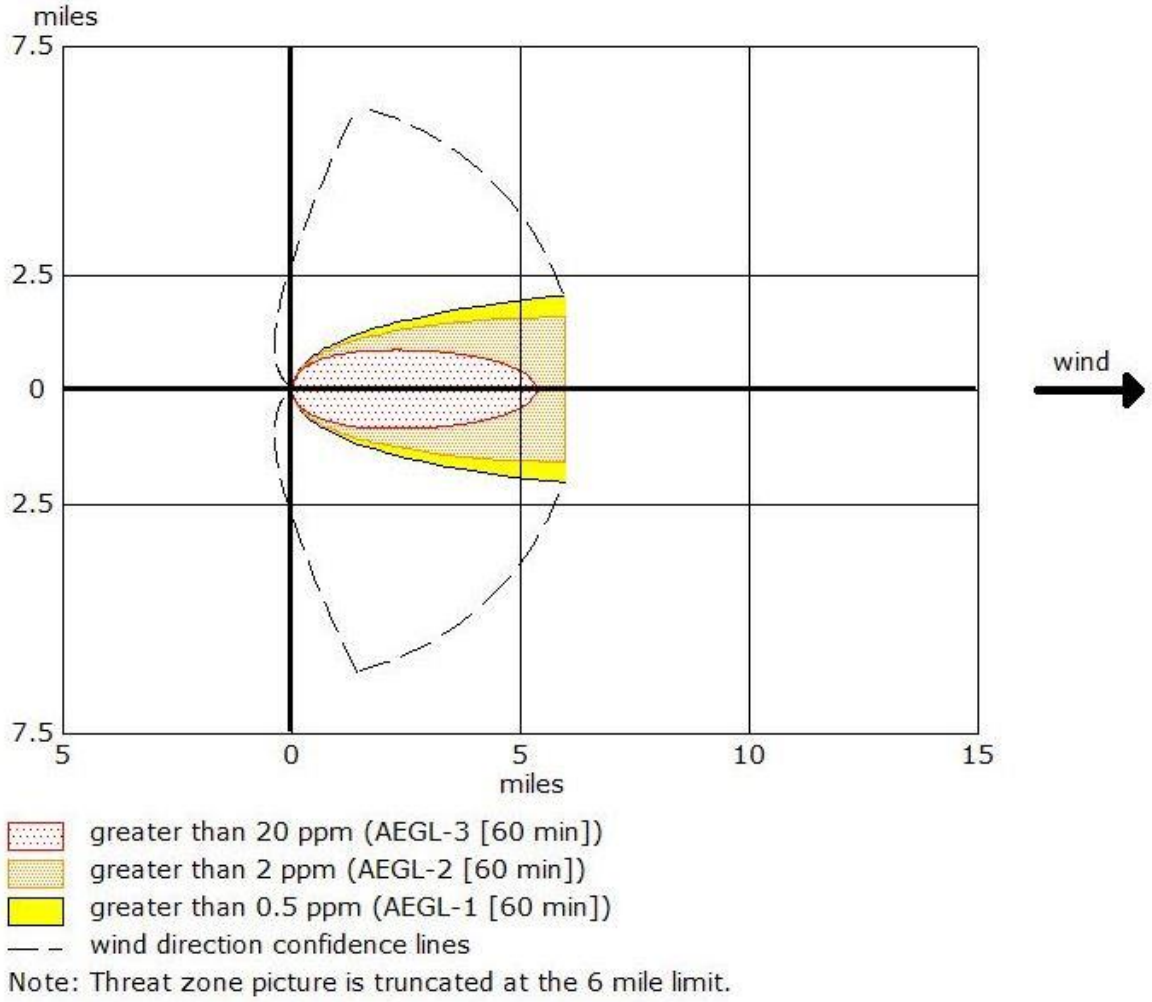
Figure 4-37: Location of Chemical Release



Results

According to the ALOHA parameters, approximately 10,500 pounds of material would be released per minute. The image in Figure 4-38 depicts an example of a plume footprint generated by ALOHA.

Figure 4-38: 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.

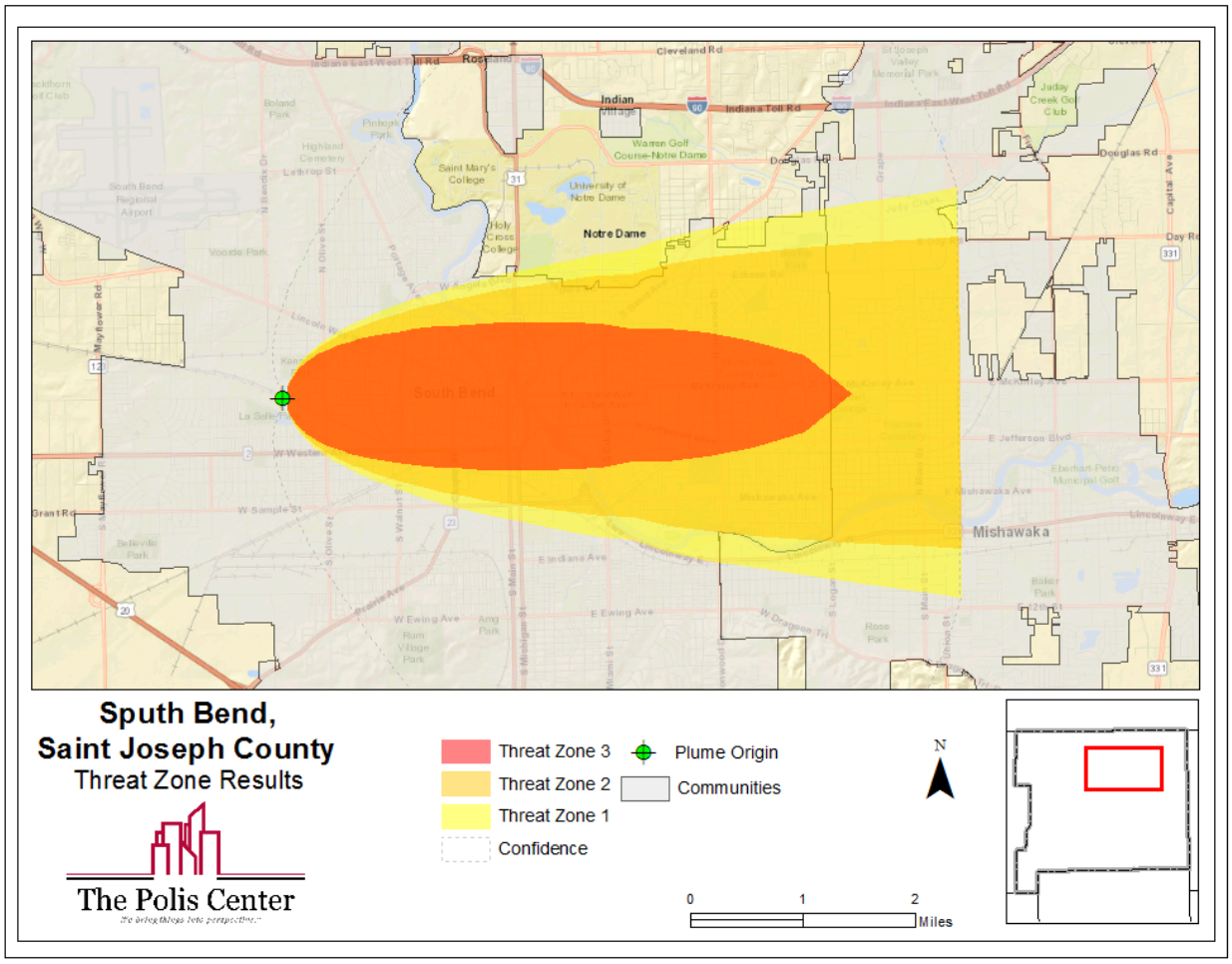
The ALOHA atmospheric modeling parameters, depicted in Figure 4-39, were based upon the conditions used in the previous mitigation plan. The air temperature was 68ºF with 75% humidity and clear skies. The wind speed was set for 5 mph blowing to the east. The modeled source of the chemical spill was a tanker with a diameter of 10.4 feet and a length of 53 feet (12,408 gallons). The model incorporated a tank that was 90% full with the chlorine in its liquid state at the time of its release.

Figure 4-39: ALOHA Modeling Parameters

```
SITE DATA:
  Location: SOUTH BEND, INDIANA
  Building Air Exchanges Per Hour: 0.35 (sheltered single storied)
  Time: June 30, 2017  1233 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: -30.2° 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 W at 3 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: 10.4 feet               Tank Length: 53 feet
  Tank Volume: 33500 gallons
  Tank contains liquid                   Internal Temperature: 68° F
  Chemical Mass in Tank: 178 tons        Tank is 90% full
  Circular Opening Diameter: 2.5 inches
  Opening is 12.5 inches from tank bottom
  Release Duration: ALOHA limited the duration to 1 hour
  Max Average Sustained Release Rate: 10,500 pounds/min
     (averaged over a minute or more)
  Total Amount Released: 340,988 pounds
  Note: The chemical escaped as a mixture of gas and aerosol (two phase flow).

THREAT ZONE:
  Model Run: Heavy Gas
  Red    : 5.0 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 4-40 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

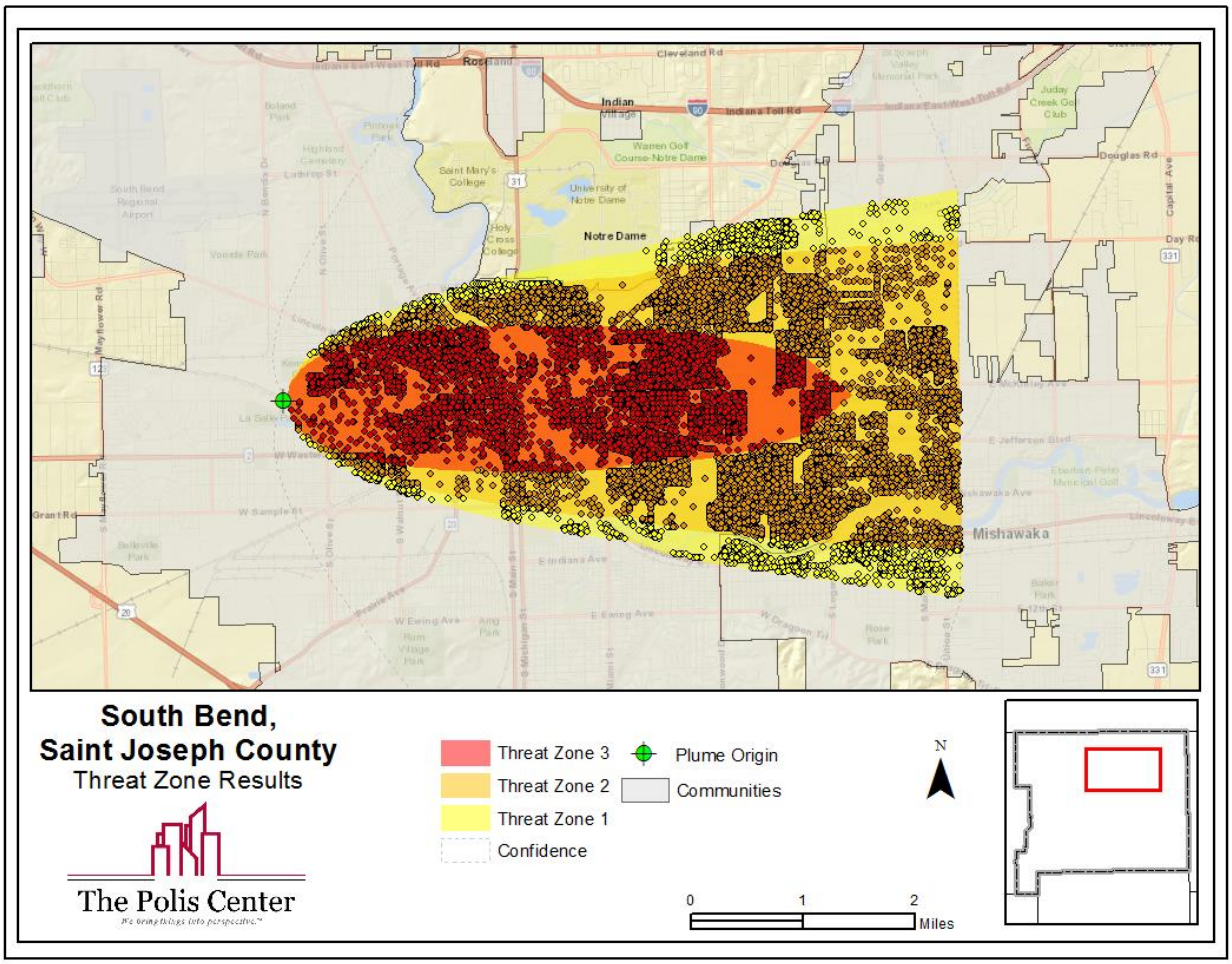
Figure 4-40: Threat Zone Results



Building Inventory Exposure

The St. Joseph 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 4-41 depicts the St. Joseph County Building Inventory after the intersect process.

Figure 4-41: Building Inventory by Threat Zone



By summing the building inventory within the three threat zones; the GIS overlay analysis predicts that as many as 13,940 buildings and 29,715 people could be exposed. The population is estimated based on 2.5 people per residence within St. Joseph County. The threat zone begins on the west side of South Bend and extends to the east across the majority of the city.

The results of the analysis against the Building Inventory counts are depicted in Table 4-31. Table 4-32 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.

The maps of impacts facilities and infrastructure are then displayed in a map. Of the Critical essential facilities, impacts would be with 22 care facilities, 8 fire stations, 7 police stations, and 25 schools. The analysis displayed an impact to critical facilities that are not considered essential would total 31 communication facilities, 14 Hazmat facilities, 4 potable water facilities, and 1 waste water facility. These facilities are labeled in Figure 4-42.

Table 4-31: Estimated Exposure for all Threat Zones

Occupancy	Building Counts	Building Exposure
Agriculture	0	$0
Commercial	1,318	$5,043,948,086
Education	33	$356,546,229
Government	284	$612,982,495
Industrial	154	$741,424,436
Religious	265	$1,613,303,131
Residential	11,886	$3,379,118,500
Total	**13,940**	**$11,747,322,878**

Table 4-32: 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	0	$0	0	0	$0	0	0	$0
Commercial	0	249	$1,276,051,139	0	583	$1,983,694,476	0	486	$1,784,202,470
Education	0	3	$28,016,463	0	26	$272,052,121	0	4	$56,477,643
Government	0	26	$94,503,786	0	109	$160,316,657	0	149	$358,162,052
Industrial	0	26	$217,916,802	0	74	$321,442,298	0	54	$202,065,336
Religious	0	37	$319,329,674	0	62	$305,932,208	0	166	$988,041,428
Residential	3,300	1,320	$340,174,365	16,683	6,673	$1,791,609,803	9,733	3,893	$1,247,334,333
Total	**3,300**	**1,661**	**$2,275,992,230**	**16,683**	**7,527**	**$4,835,047,563**	**9,733**	**4,752**	**$4,636,283,085**

Figure 4-42: Essential Facilities Located in Threat Zone

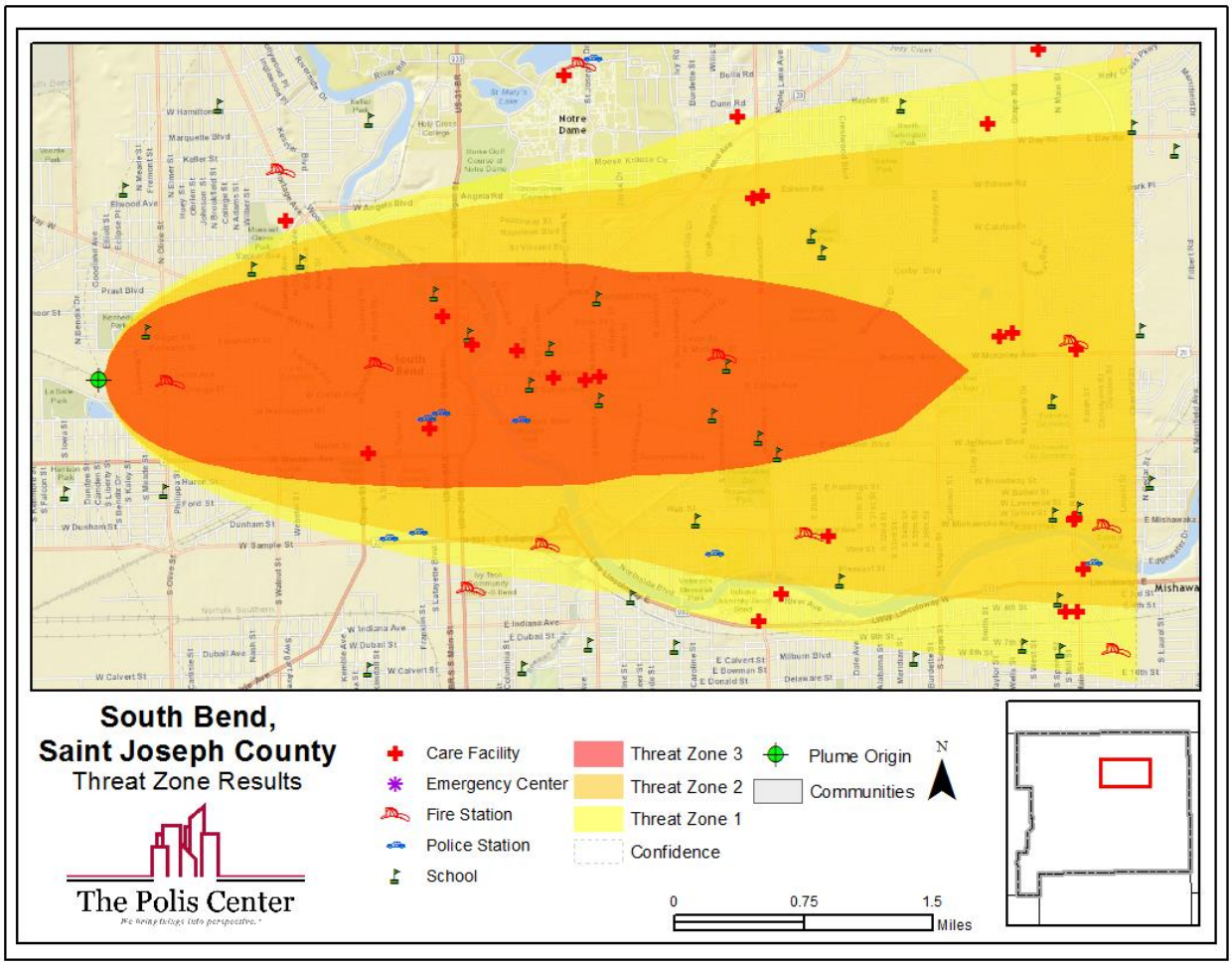
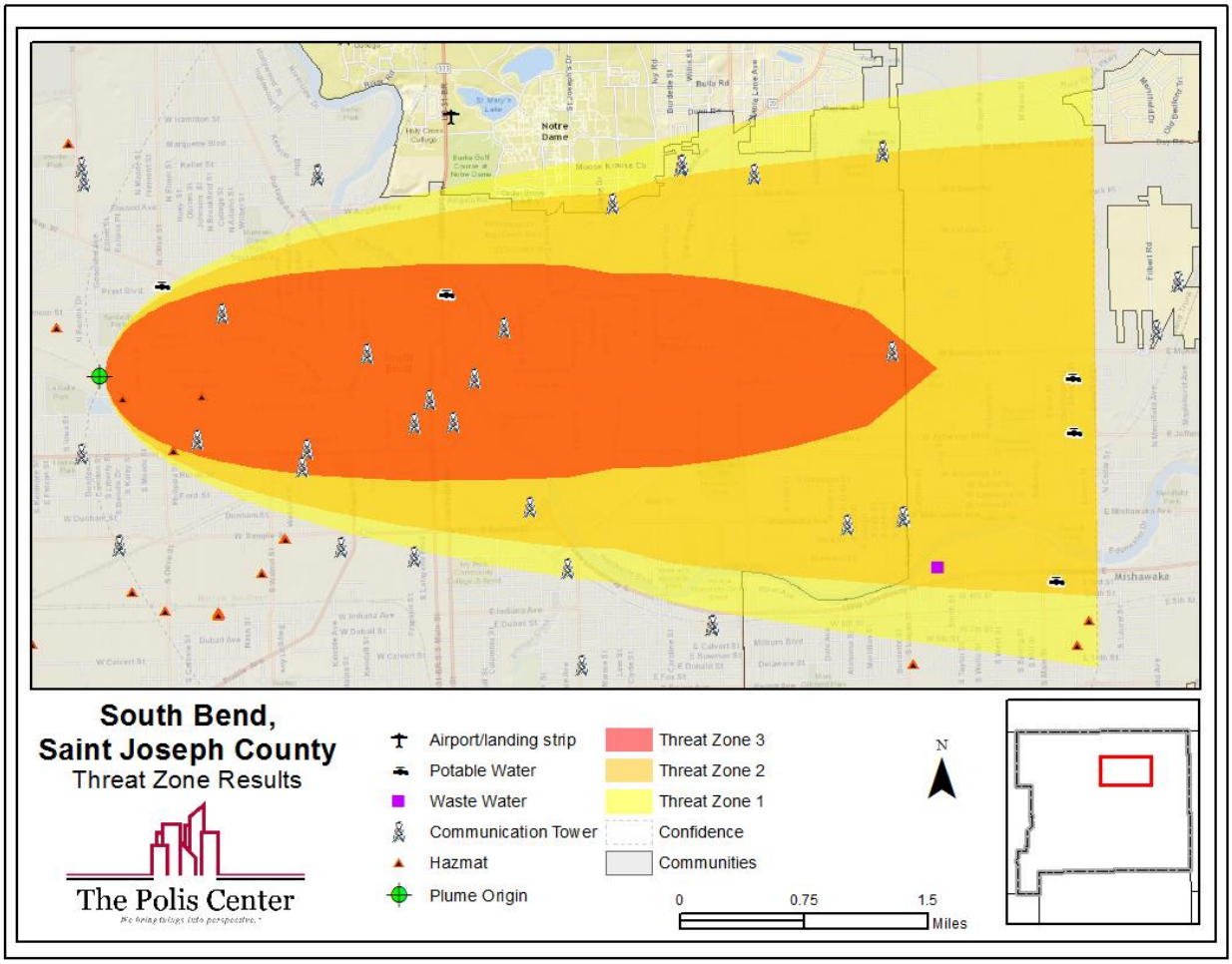


Figure 4-43: Critical Facilities in Threat Zones



Relationship to other Hazards

Flood- Hazmat incidents are likely when flood incidents occur.

Plans and Programs in Place

CEMP- The county coordinates local hazardous response through the CEMP.

LEPC- The county coordinates local planning committee through the LEPC.

Commodity Flow Study- The St. Joseph County plan is completed.

Program Gaps or Deficiencies

No gaps or deficiencies were identified at this time.

4.11 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. Dams are usually constructed to provide a ready supply of water for drinking, irrigation, recreation and other purposes. They can be made of rock, earth, masonry, or concrete or of combinations of these materials.

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.

With research led by Manchester University (Indiana), and support from National Fish Habitat Program and the Ohio River Basin Fish Habitat Partnership, two low-head dams were removed on the Eel River of the Wabash River watershed in north central Indiana in October 2012.39 The removal of these dams resulted in the reconnection of over 190 stream miles. Data from this study demonstrates the ecological benefits of removing these dams. This project has been thought to bring tremendous awareness about the Eel River (located in northeast Indiana) and fish passage, and the benefits of low head removal both locally and regionally.

Dam History in St. Joseph County

There are no records or local knowledge of any dam failures in the county. There are 7 registered dams within the Indiana Department of Natural Resources 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, one dam is classified as high hazard, and it 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.

Figure 4-44: St. Joseph County Dams

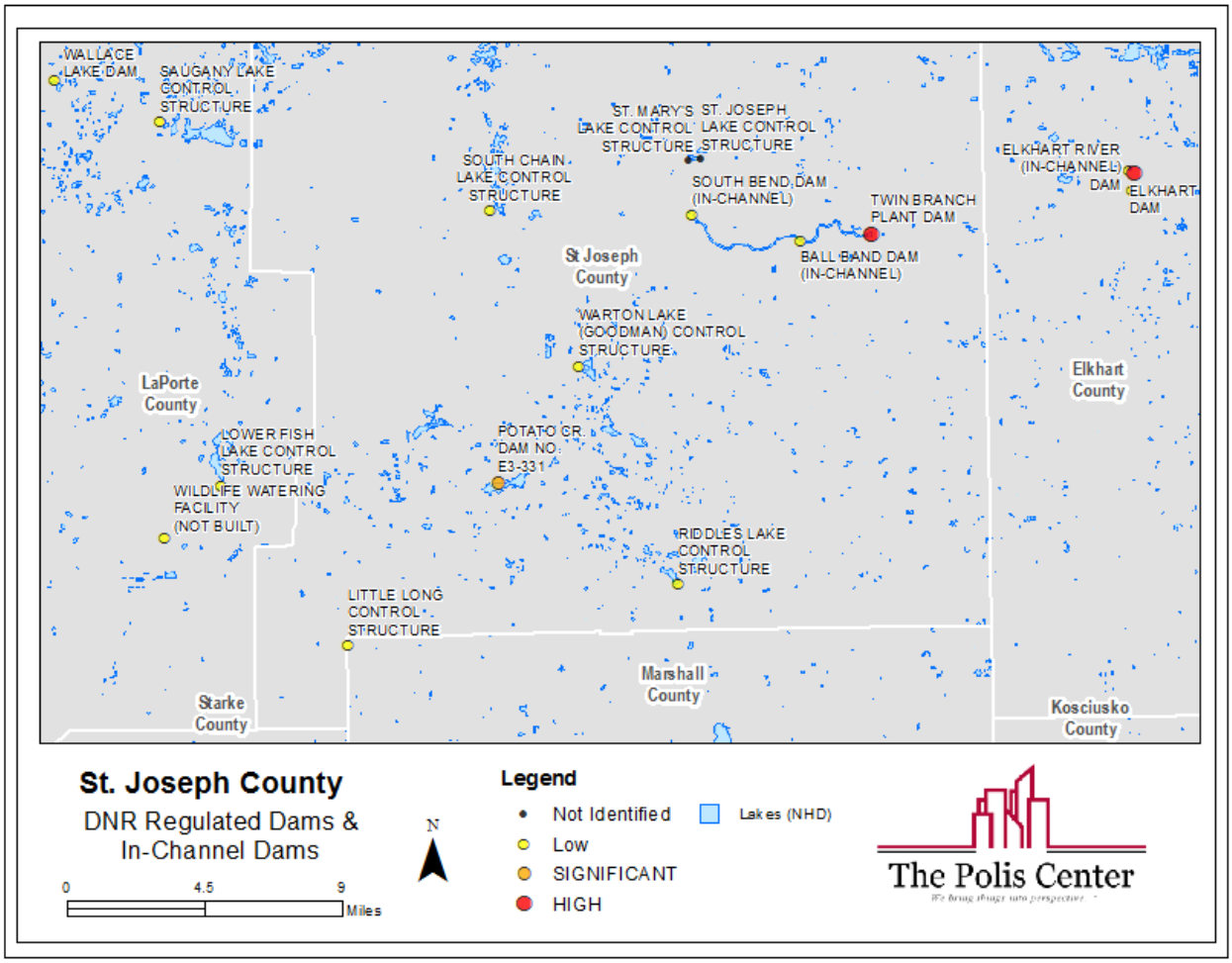


Table 4-33: DNR Hazard Classification and In-Channel Dams

Name	Hazard Level	In Channel	EAP
Twin Branch Dam*	High	No	Yes
Potato Creek Dam #E3-331	Significant	Yes	Yes
South Bend Dam	Low	Yes	No
Ball Band Dam	Low	Yes	No
Warton Lake Control Structure	Low	No	No
South Chain Lake Control Structure	Low	No	No
Riddles Lake Control Structure	Low	No	No

**According to DNR records, this is not a State regulated dam but is Federally regulated.*

Risk Analysis

Exposure Analysis

The Twin Branch Dam is the only high hazard dam and does have an Emergency Action Plan (EAP). The detailed dam failure inundation area was 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 4-45: Twin Branch Dam

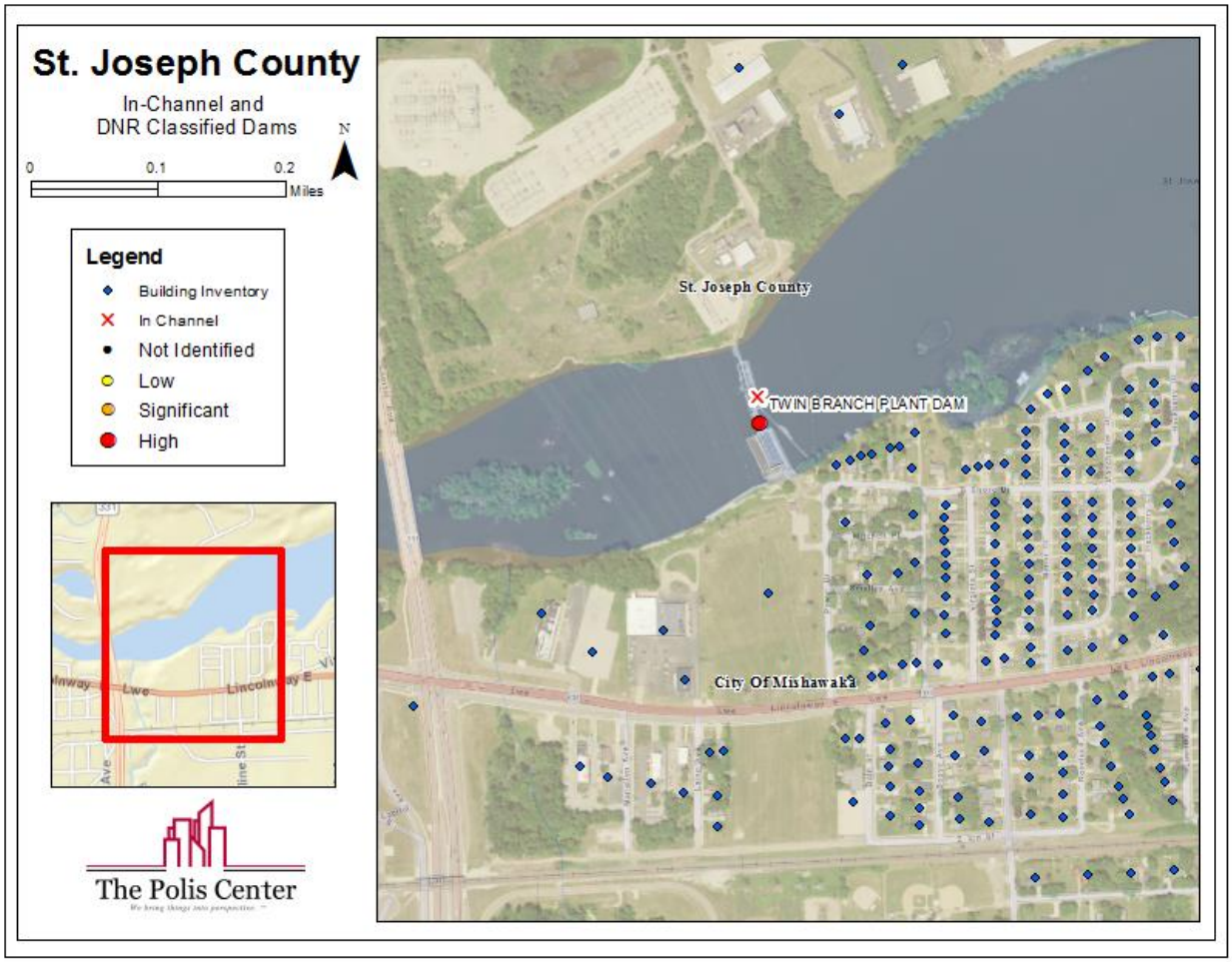


Figure 4-46: Ball Band Dam

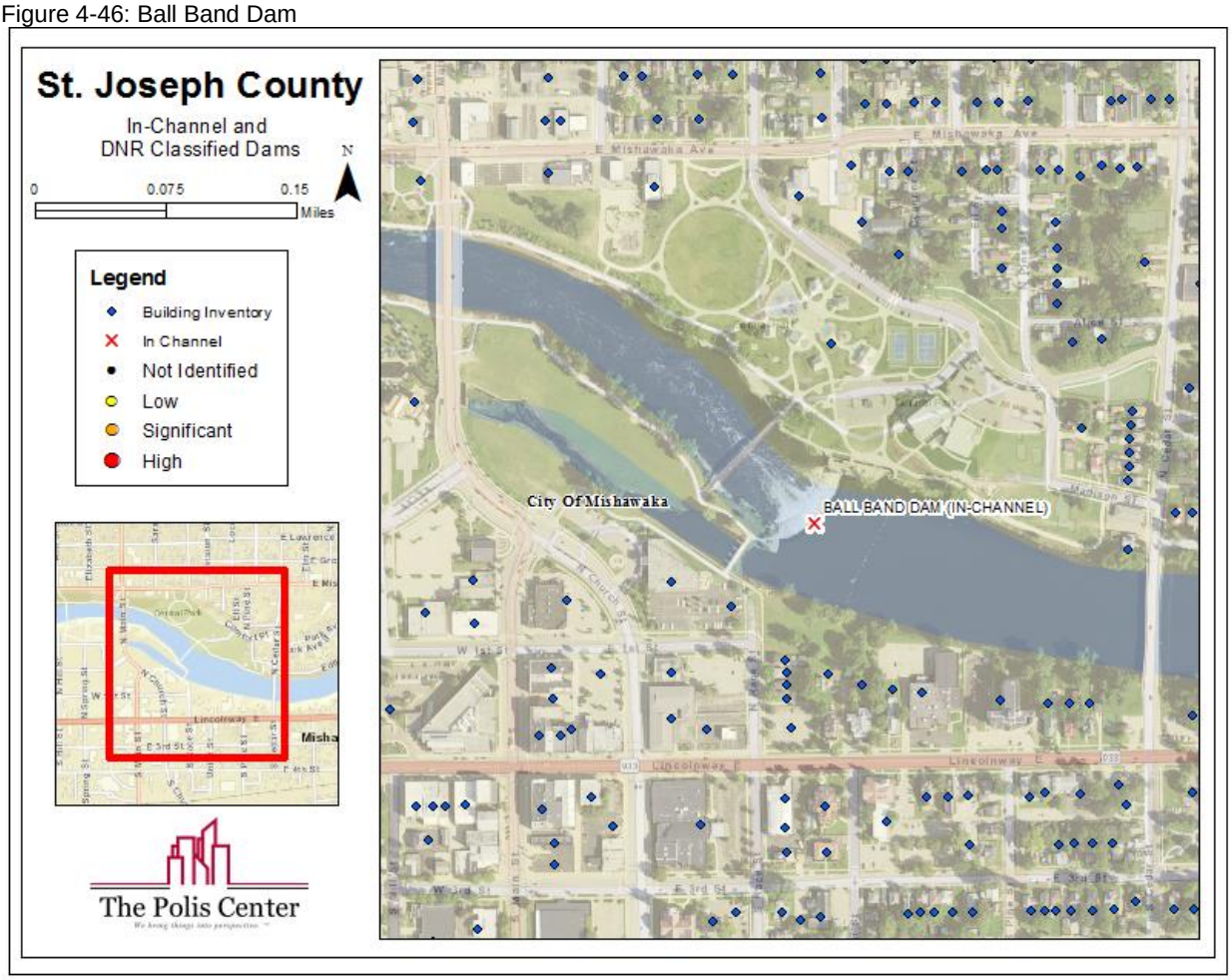


Figure 4-47: South Bend Dam

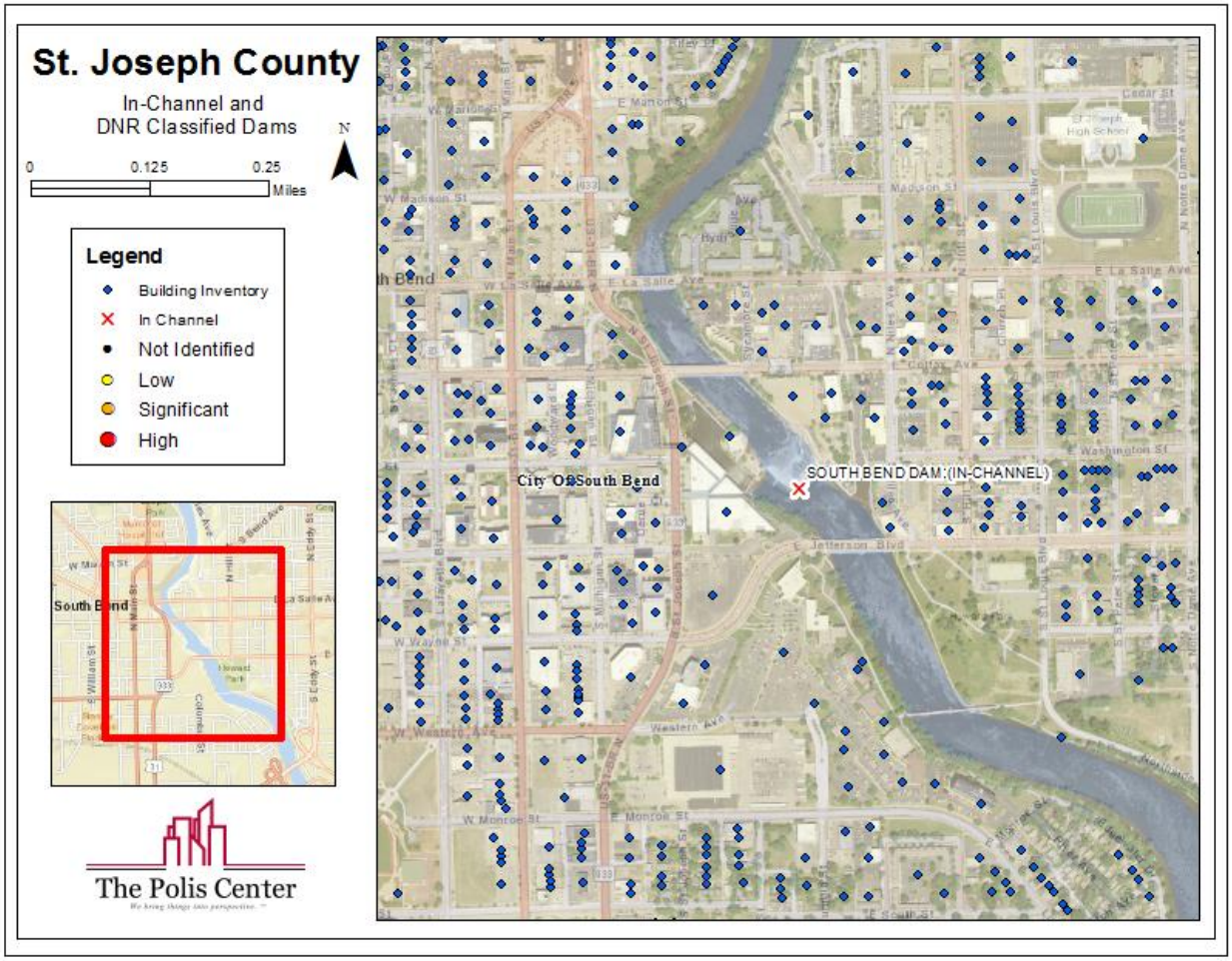
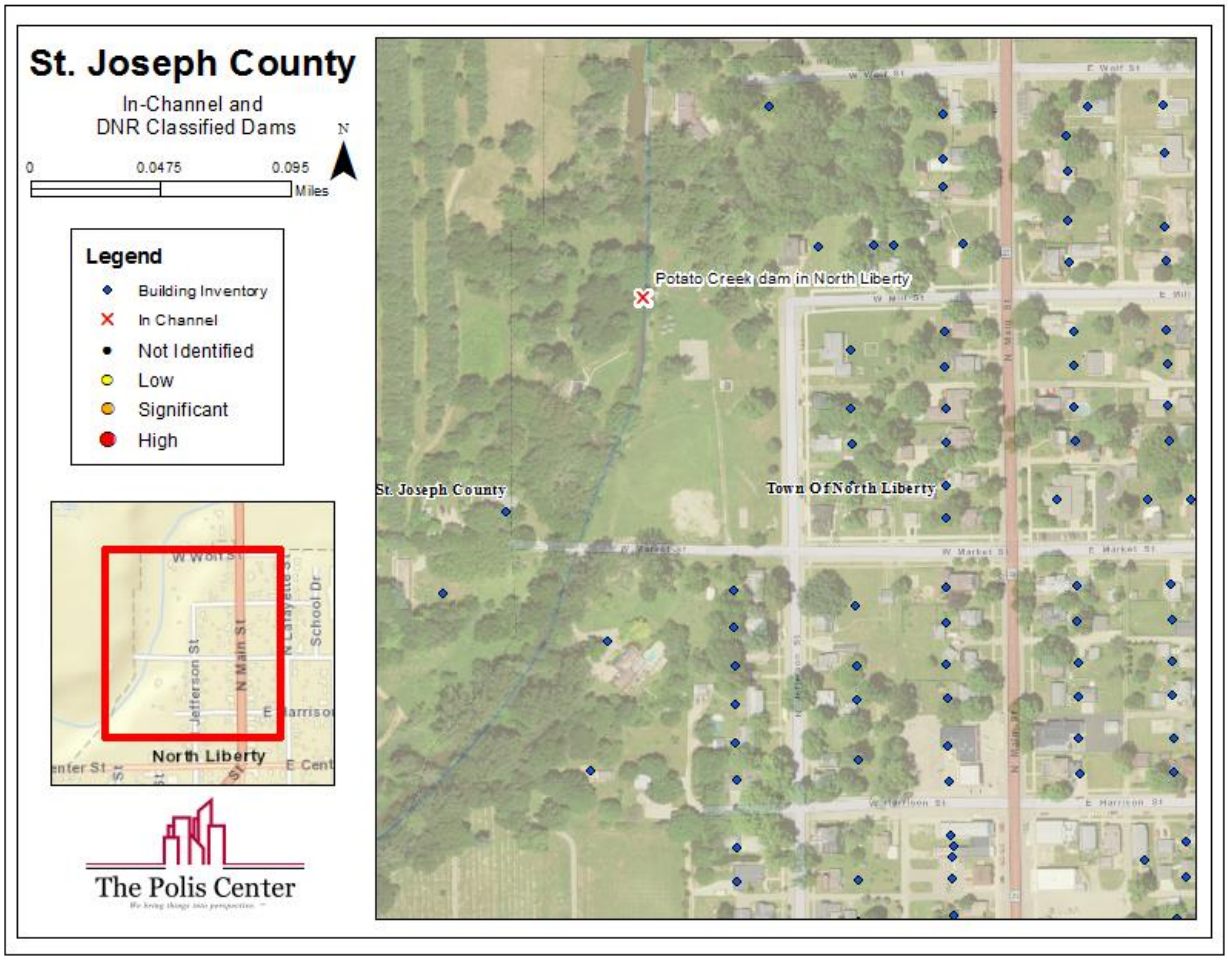


Figure 4-48: Potato Creek Dam in North Liberty



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.

4.12 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.

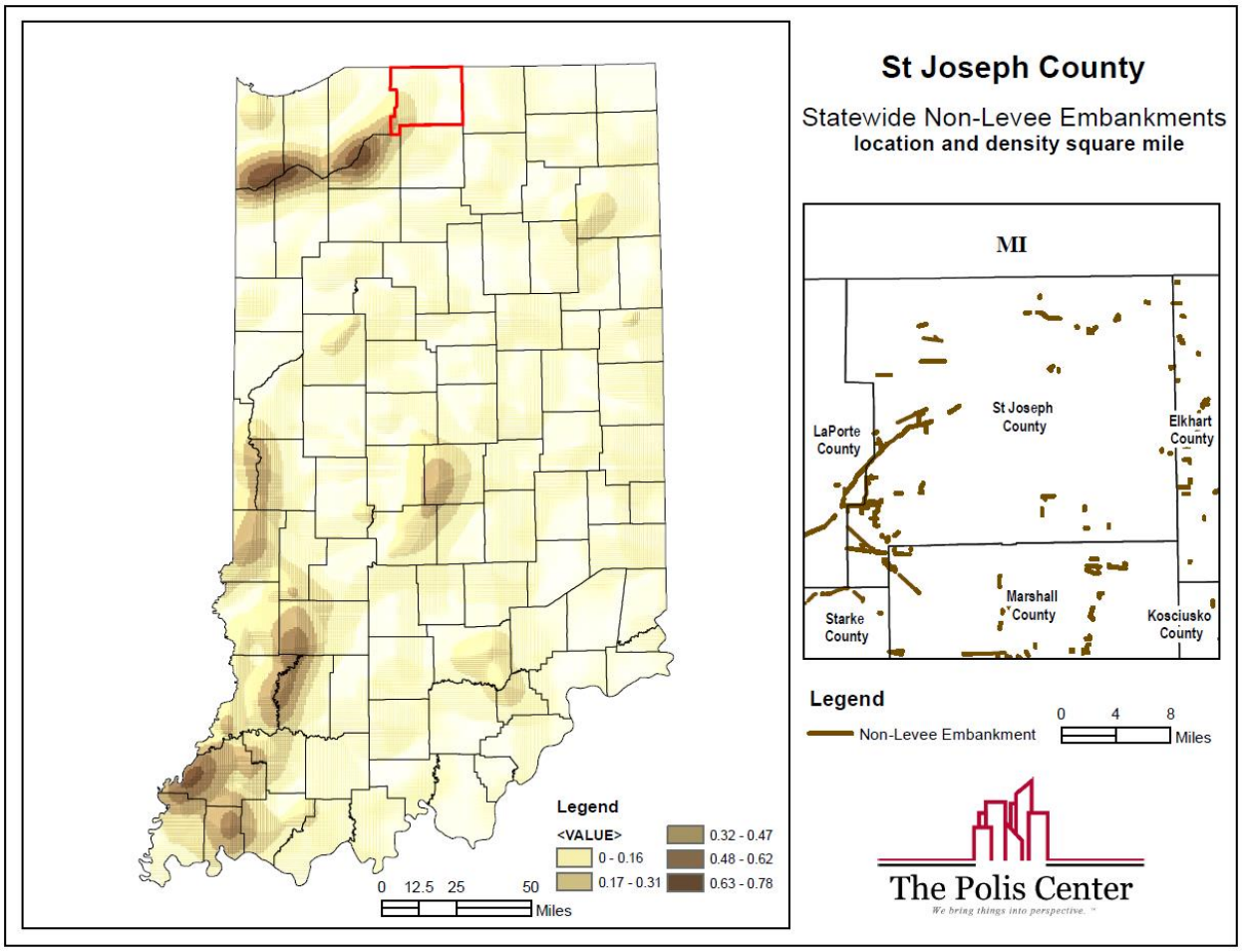
Non-Levee Embankments

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.

The following figure identifies the geographic location density (using a hill shade) of levees in the state of Indiana and an overview of the levees in St. Joseph County. Just downstream of St. Joseph County, there are numerous levees along the Kankakee River.

Figure 4-49: Non-Levee Embankment Concentration 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 History in St. Joseph County

There are no records or local knowledge of any significant levee or non-levee embankment failures in the county. There is no certified or accredited levee in the county and numerous NLEs that are later assessed in the analysis for their potential impact to health and safety.

Vulnerability and Future Development

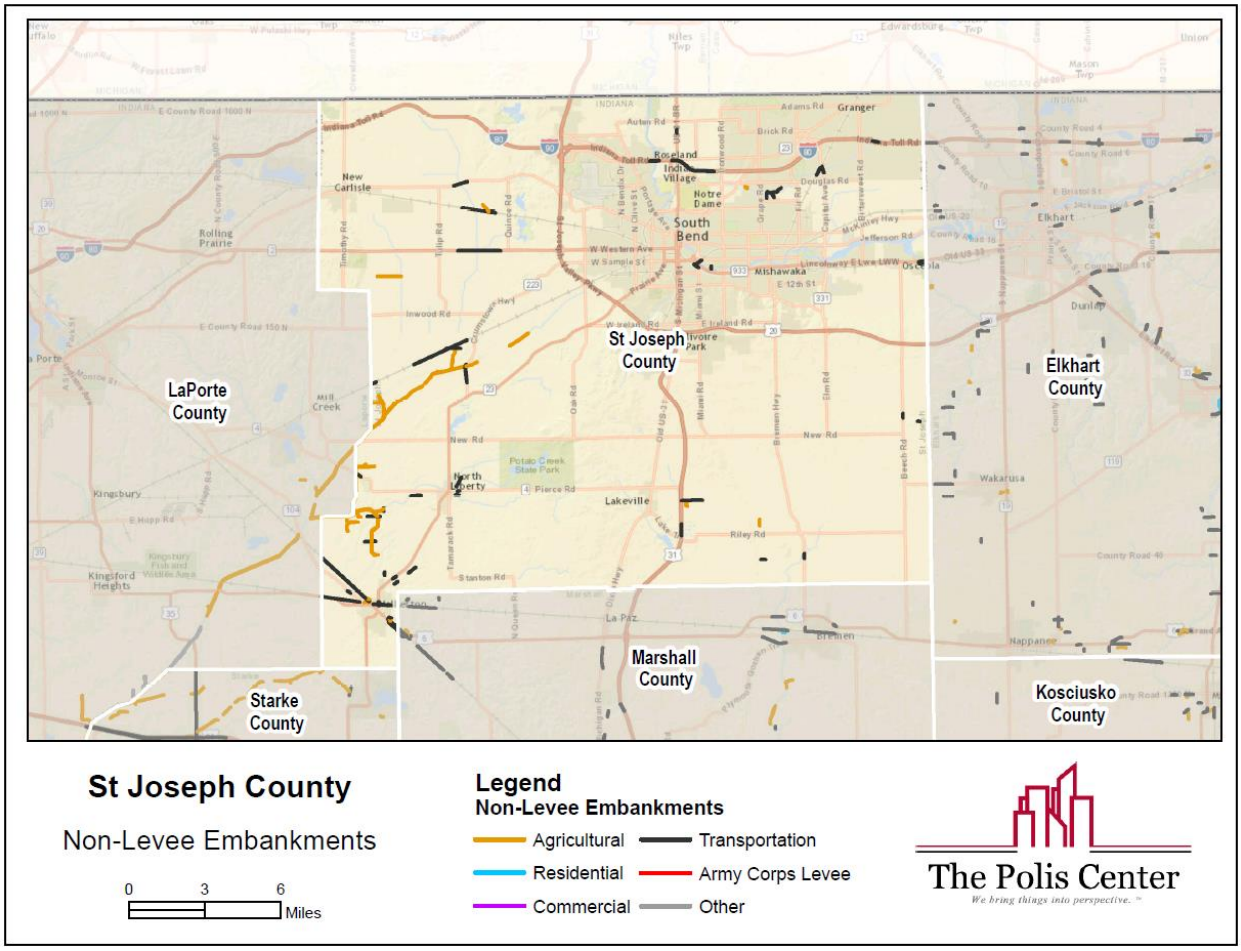
The extent of potential levee failure varies across the county. In order to be considered creditable flood protection structures on FEMA's flood maps, levee owners must provide documentation to prove the levee meets design, operation, and maintenance standards for protection against the "one-percent-annual 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 St. Joseph 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 4-50 shows the extents of the NLE in the county.

Figure 4-50: Non-Levee Embankments: St. Joseph County



Risk Analysis

Analysis

St. Joseph County is predominately made of transportation-related NLEs evenly dispersed across the county but with a concentration in the southwest corner. In addition to transportation NLEs agricultural NLEs are prevalent in the county as well. The towns of Walkerton, North Liberty, Roseland, Indian Village, South Bend, Mishawaka, and Osceola all contain NLEs. The following maps provide a closer look at the areas around these NLE structures. Community boundaries are shown below in grey. Flood zone areas are illustrated on the maps in turquoise and blue. Turquoise flood zone areas represent the detailed flood zone, and blue Special Flood Hazard Areas indicate approximate flood zones.

Figure 4-51: Non-Levee Embankments, Northcental

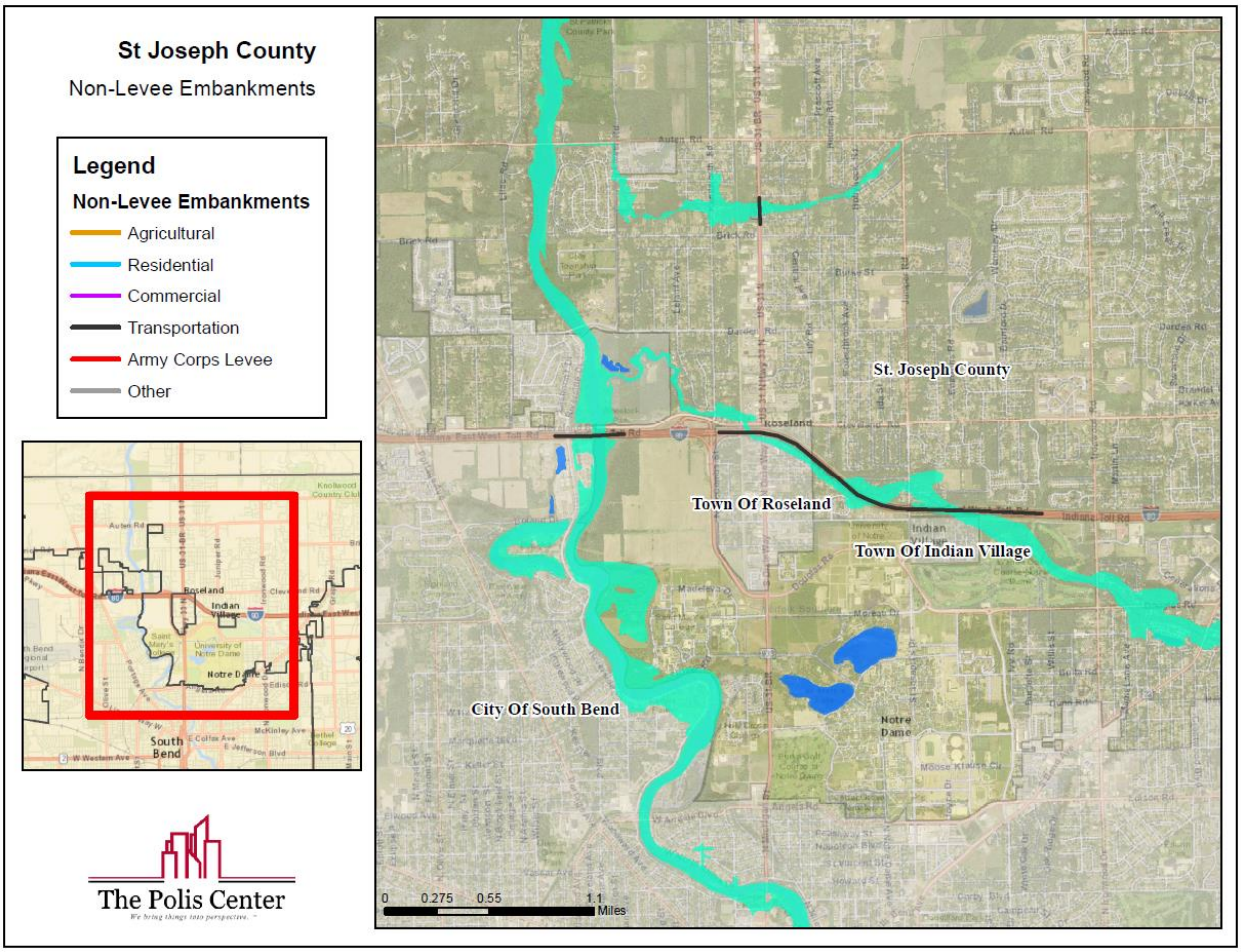


Figure 4-52: Mishawaka, IN – Non-Levee Embankments, Northeast

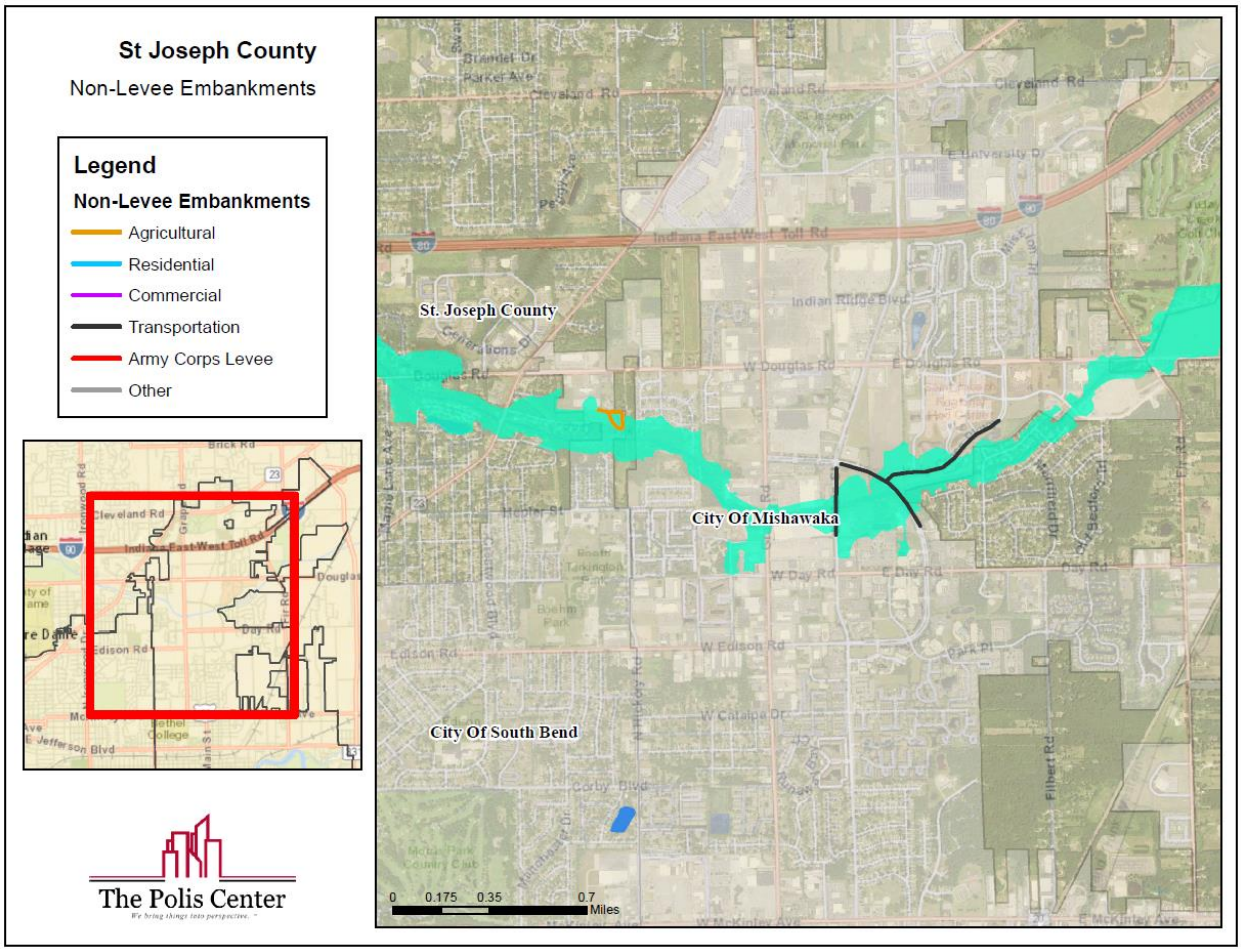
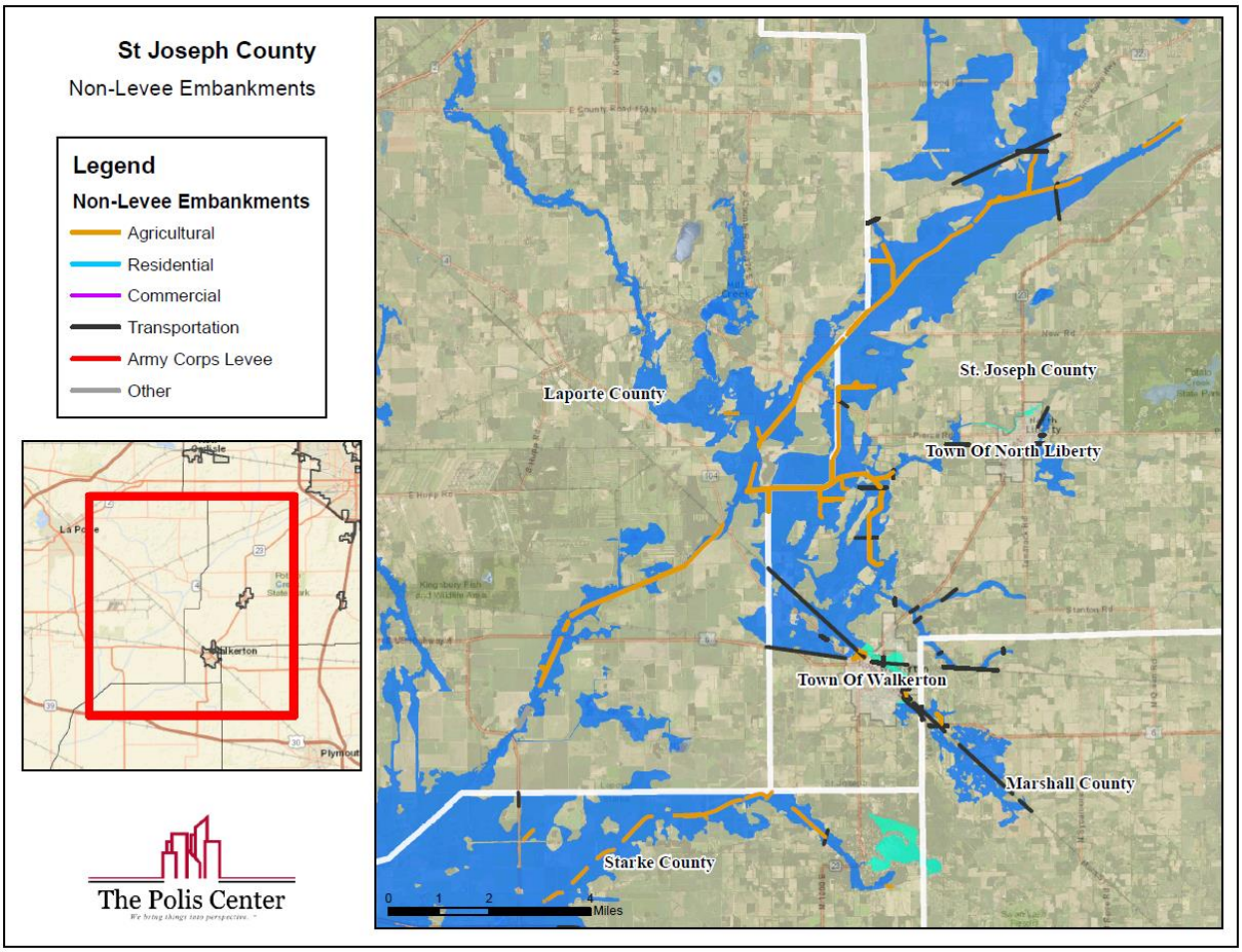


Figure 4-53: Walkerton, IN & Surrounding Counties – Non-Levee Embankments, Southwest



Relationship to other Hazards

Flooding– Flooding is typically the leading cause to levee failure incidents.

Plans and Programs in Place

USACE and FEMA Levee Certification- There are no currently maintained levees certified or accredited in the county.

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.

The unincorporated portions of the county, the Towns of Indian Village, Lakeville, North Liberty, Osceola, Roseland, and Walkerton and the Cities of Mishawaka and South Bend participate in the National Flood Insurance Program.

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.

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 county and the cities of South Bend and Mishawaka's most recent CAV was in July 2014, which did not require further compliance follow-up.

St. Joseph County, the communities of South Bend and Mishawaka, Osceola, Roseland, Indian Village, Lakeville, North Liberty, and Walkerton participate in the NFIP. The Town of New Carlisle is not currently part of the NFIP. The total number of policies, written premiums in-force, and coverage of insurance in-force are identified below.

Table 5-1: NFIP policies and coverage

Community	Total Number of Policies	Insurance In-force whole	Written Premium In-force
St. Joseph County	172	39,053,100	132,707
Indian Village	n/a	n/a	n/a
Lakeville	n/a	n/a	n/a
Mishawaka	35	15,430,000	52,713
New Carlisle	n/a	n/a	n/a
North Liberty	n/a	n/a	n/a
Osceola	1	350,000	415
Roseland	3	251,200	2,701
South Bend	102	22,895,000	120,244
Walkerton	3	320,500	1,847

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. St. Joseph County and its communities do not participate in the CRS program.

The NFIP participating communities of South Bend, Mishawaka, Osceola, Roseland, Indian Village, Lakeville, North Liberty, Walkerton, and St. Joseph County will continue their NFIP compliance through mitigation measures that may include protecting existing critical facilities in floodplains, enforcing floodplain ordinances the prohibit development of new facilities in 100-year floodplains, collaborating with residential owners to buyout and mitigate properties subject to flooding, and instituting steps to relocate, buyout, or flood proof existing non-residential facilities subject to

repetitive flooding. The NFIP communities may also introduce or continue floodplain management activities such as conducting detailed flood protection studies for areas with repetitive flooding issues, and completing more detailed fluvial erosion hazard mapping to identify and protect critical infrastructure that may be impacted by mobile stream movement.

Plans and Ordinances

St. Joseph 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 St. Joseph County, Indiana Comprehensive Plan, the St. Joseph County, Indiana Zoning Ordinance, the Lake of the Woods, St. Joseph County, Indiana Watershed Management Plan, the Soil Survey of St. Joseph 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 plan team representatives of the county, cities, towns and school districts. The results of the community capability were then used to inform the development of mitigation strategies for the 2017 plan update.

General Mitigation Vision

The planning team understands that although hazards cannot be eliminated altogether, St. Joseph 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 St. Joseph County Plan. This framework will allow for integration of the mitigation actions that are listed by St. Joseph 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 5-2: Mitigation Strategy Framework

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 5-3 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. Understanding the

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

Table 5-3: 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.

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

St. Joseph 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 St. Joseph 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:

- St. Joseph County
- Indian Village
- Lakeville
- Mishawaka
- New Carlisle
- North Liberty
- Osceola
- Roseland
- South Bend
- Walkerton

Table 5-4 lists all mitigation actions for St. Joseph County and its jurisdictions. Each of these mitigation action charts detail the hazard, the mitigation action to address the identified hazard, 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. Additionally, the St. Joseph County planning team assigned the mitigation actions priority rankings for implementation (1=High Priority; 2= Moderate Priority; 3= Low Priority). Mitigation actions given a "high" priority ranking will ideally be implemented within 5 years of the MHMP plan adoption date. Mitigation actions ranked as a "medium" priority may be addressed within 5-10 years from the MHMP plan adoption date, and "low" priority mitigation actions may take over 10 years before action completion. Although higher ranking priorities may constitute a greater county concern than lower ranking priorities, the availability of funds may cause some mitigation actions to take longer to implement.

All of the mitigation actions identified in the 2009 St. Joseph County Hazard Mitigation Plan have been carried over into the 2017 plan, based on the advisement of the St. Joseph 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 H Documentation of mitigation actions for 2017 HMP* 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 St. County, its school districts, Cities of Mishawaka and South Bend and Towns of Indian Village, Lakeville, New Carlisle , North Liberty, Osceola, Roseland and Walkerton. The St. Joseph 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 5-3: Mitigation Actions

#	Hazards	Mitigation Action Type	Action	Priority	Status	Community	Coordinating Agency	Potential Funder	Action Source
1	Multiple Hazards	Emergency Services	Create smaller circuits for electrical service and have multiple tie-ins for substations		Complete	AEP and NIPSCO-served areas			Hazard Mitigation Plan
2	Winter Storm	Emergency Services	Implement Prioritized Plowing (i.e. ambulances, bus routes)		Complete	AEP and NIPSCO-served areas			Hazard Mitigation Plan
3	Summer Storm	Prevention	Implement tree trimming throughout the county		Complete	AEP and NIPSCO-served areas			Hazard Mitigation Plan
4	Flood	Property Prevention	Develop a countywide ordinance prohibiting development in floodplains		Complete	All Communities			Hazard Mitigation Plan
5	Winter Storm	Emergency Services	Implement an annual winter weather emergency news release		Complete	All Communities			Hazard Mitigation Plan
6	Multiple Hazards	Emergency Services	Install new warning sirens within the county		Complete	New Carlisle			Hazard Mitigation Plan
7	Multiple Hazards	Emergency Services	Determine a plan for use of snowmobiles in the event of emergency rescue		Complete	North Liberty			Hazard Mitigation Plan
8	Winter Storm	Emergency Services	Cross train departments (i.e. Parks, Streets) and make vehicles ready for winter weather plowing		Complete	South Bend			Hazard Mitigation Plan
9	Flood	Natural Resource Protection	Establish park lands along floodway		Complete	South Bend			Hazard Mitigation Plan
10	Multiple Hazards	Prevention	Install backup battery packs for vital signalized intersections		Complete	South Bend			Hazard Mitigation Plan
11	Flood	Structural Improvement	Install real time controls or smart valves for storm water management		Complete	South Bend			Hazard Mitigation Plan

12	Multiple Hazards	Emergency Services	Determine a plan for use of 4WD vehicles in the event of emergency rescue		Complete	St. Joseph County			Hazard Mitigation Plan
13	Multiple Hazards	Emergency Services	Establish an active LEPC to mitigate and respond to hazards		Complete	St. Joseph County			Hazard Mitigation Plan
14	Multiple Hazards	Emergency Services	Implement emergency response training and/or annual “event or situational” training for LEPC		Complete	St. Joseph County			Hazard Mitigation Plan
15	Multiple Hazards	Emergency Services	Establish a Cooling and Warming Policy		Complete	St. Joseph County, South Bend			Hazard Mitigation Plan
16	Earthquake	Public Education	Distribute literature advising that residents, schools, healthcare facilities, and other critical facilities use tie-downs to secure water heaters	Low	Identified	All Communities	EMA	IDHS FEMA	Hazard Mitigation Plan
17	Earthquake	Prevention	Conduct Indirect impact study or assessment	High	Identified	St. Joseph County	EMA	IDHS FEMA	Hazard Mitigation Plan
18	Earthquake	Prevention	Retrofit shelving in hospitals and emergency services	Low	Identified	All Communities	EMA	IDHS FEMA	Hazard Mitigation Plan
19	Winter Storm	Prevention	Review and Update the Cooling and Warming Policy	Medium	Identified	St. Joseph County	EMA	IDHS FEMA	Hazard Mitigation Plan
20	Winter Storm	Emergency Services	Establish plan for warming centers for special needs populations	Medium	Identified	St. Joseph County, South Bend, Mishawaka	EMA local non-profits	IDHS FEMA	Hazard Mitigation Plan
21	Winter Storm	Prevention	Increase coordination between Street Departments and Emergency Responders	High	Identified	St. Joseph County, South Bend, Mishawaka	EMA local utilities	*IDHS FEMA*	Hazard Mitigation Plan
22	Multiple Hazards	Emergency Services	During switch to LED signals, install backup battery packs for vital signalized intersections	High	Identified	All Communities	EMA	IDHS FEMA	Hazard Mitigation Plan
23	Multiple Hazards	Emergency Services	Establish siren maintenance and replacement program	High	Identified	All Communities	EMA Local communities	IDHS FEMA	Hazard Mitigation Plan

24	Multiple Hazards	Emergency Services	Conduct Search and Rescue assessments	High	Identified	St. Joseph County	EMA	IDHS FEMA	Hazard Mitigation Plan
25	Multiple Hazards	Emergency Services	Implement All Weather Radio Program to help with affordability and programming	High	Identified	St. Joseph County	EMA	IDHS FEMA	Hazard Mitigation Plan
26	Multiple Hazards	Natural Resource Protection	Implement Debris Management Planning and Training	High	Identified	All Communities	EMA	IDHS FEMA	Hazard Mitigation Plan
27	Multiple Hazards	Emergency Services	Training on Reverse 911 and additional modern mass communication systems (i.e. Nixle, Text Messaging, Twitter, Facebook)	High	Identified	St. Joseph County	EMA	IDHS FEMA	Hazard Mitigation Plan
28	Multiple Hazards	Prevention	Establish training for weather spotters	Medium	Identified	All Communities	EMA	IDHS FEMA	Hazard Mitigation Plan
29	Multiple Hazards	Prevention	Assess storm shelters throughout the county	Medium	Identified	St. Joseph County	EMA *local communities*	IDHS FEMA	Hazard Mitigation Plan
30	Multiple Hazards	Public Education	Implement school-wide programs to educate students on the hazards affecting the county and preparation/mitigation plans	Low	Identified	All Communities	EMA	IDHS FEMA	Hazard Mitigation Plan
31	Multiple Hazards	Public Education	Public reminders to “exercise”/maintain backup generators (i.e. circuit policing)	Low	Identified	All Communities	EMA	IDHS FEMA	Hazard Mitigation Plan
32	Hazmat	Prevention	Perform assessment of ordinances for Hazmat locations	Low	Identified	All Communities	EMA	IDHS FEMA	Hazard Mitigation Plan
33	Hazmat	Prevention	Switch from ton cylinders of chlorine gas disinfectants	High	Identified	South Bend	EMA	IDHS FEMA	Hazard Mitigation Plan
34	Hazmat	Prevention	Conduct studies along major transportation corridors (80/90, US 20, railroads)	High	Identified	St. Joseph County	EMA	IDHS FEMA	Hazard Mitigation Plan

35	Dam Failure	Natural Resource Protection	Improvements to local dams (Twin Branch and Century Center)	High	Identified	St. Joseph County, South Bend, Mishawaka	EMA	*DNR*	Hazard Mitigation Plan
36	Erosion	Natural Resource Protection	Stabilize St. Joseph River to reduce the risk of erosion	Medium	Identified	South Bend	Planning	*DNR*	RiskMAP Process
37	Flood	Emergency Services	Acquire SWIFT water response equipment and launch training	High	Identified	St. Joseph County	EMA	IDHS FEMA	Hazard Mitigation Plan
38	Flood	Structural Improvement	Install emergency culvert pipes	High	Identified	All Communities	EMA Local Utilities	*IDHS FEMA*	Hazard Mitigation Plan
39	Flood	Structural Improvement	Assess and upgrade drainage systems in various location (i.e. US 20, 56000 Block of Oak Road, East portion of County near Heather Lake)	High	Identified	St. Joseph County, New Carlisle, South Bend	Local Utilities	Local funds	Hazard Mitigation Plan
40	Flood	Emergency Services	Procure permanent signage to warn of flood hazards	Medium	Identified	All Communities	EMA	IDHS FEMA	Hazard Mitigation Plan
41	Flood	Prevention	Conduct a Drainage Study for Charles St.	Medium	Identified	St. Joseph County, Mishawaka	EMA	IDHS FEMA	Hazard Mitigation Plan
42	Flood	Emergency Services	Install real time river gauges	Medium	Identified	St. Joseph County, Mishawaka, South Bend	EMA	IDHS FEMA	Hazard Mitigation Plan
43	Flood	Property Prevention	Conduct a study to determine potential buy-out properties (i.e. Kline St., Bowman Creek, 56000 Block of Oak Road)	Medium	Identified	St. Joseph County, South Bend, Mishawaka	EMA	IDHS FEMA	Hazard Mitigation Plan
44	Flood	Prevention	Reduce risk of basement flooding from an elevated water table by implementing a permanent mitigation solution.	Low	Identified	St. Joseph County	Planning	Other	RiskMAP Process
45	Flood	Property Prevention	Acquire at-risk structures along Bowman Creek through B/C Analyses and Damage Assessments		Ongoing	South Bend	Emergency Management	IDHS FEMA	RiskMAP Process

46	Ground Failure	Natural Resource Protection	Carry out sediment/erosion projects (i.e. North Shore Dr. Juday Creek)	Medium	In Progress	St. Joseph County	EMA	DNR	Hazard Mitigation Plan
47	Multiple Hazards	Emergency Services	Schedule NIMS training for first responders	High	In Progress	St. Joseph County	EMA	IDHS FEMA	Hazard Mitigation Plan
48	Multiple Hazards	Emergency Services	Continue regular testing of sirens		Ongoing	All Communities	EMA local communities	IDHS FEMA	Hazard Mitigation Plan
49	Dam Failure	Prevention	Develop Emergency Action Plan (EAP) for South Bend Dam		Ongoing	South Bend	EMA local communities	Other	RiskMAP Process
50	Dam, Levee, Flood	Prevention	Continued compliance of the NFIP for all NFIP communities. Participating communities will continue compliance by considering further mitigation measures including the following: 1) protecting existing critical facilities in floodplains, 2) enforcing floodplain ordinances that prohibit development of new facilities in 100-year floodplains, 3) collaborating with residential owners to buyout and mitigate properties subject to flooding, and 4) instituting steps to relocate, buyout, or flood proof existing non-residential facilities subject to repetitive flood loss.	High	Identified	All NFIP Communities	EMA	IDHS FEMA	Hazard Mitigation Plan

Chapter 6 – Plan Maintenance and Implementation

Implementation and Maintenance

The St. Joseph County Multi -Hazard Mitigation Plan (MHMP) 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 St. Joseph 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 Multi-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 Multi-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 St. Joseph

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 St. Joseph County jurisdictions and the entire Multi-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 St. Joseph County Emergency Manager's Office and city offices, in addition to placing the plan on the St. Joseph 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 Multi-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, St. Joseph 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. St. Joseph 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 adoption year of the community capabilities and jurisdiction planning documents or designates if the jurisdiction defers to a state or county plan.

Table 6-1: St. Joseph County and Jurisdictions Planning Mechanisms

		Implementation Documents								
		Zoning Ordinance	Comprehensive Plan	Emergency Operations Plan	Floodplain Ordinance	Storm Water Drainage	Watershed Plan	Erosion Ordinance	Burning Ordinance	Building Codes
Jurisdiction Name	St. Joseph County	2005	2000	St. Joseph County Comprehensive Emergency Management Plan 2003	2015	2006	Baugo Creek Watershed 2004	2006	State	2005
	South Bend	2018	2006		1/06/11	2018		2018	2018	2018
	Mishawaka	2017	2017		2017	2017		2017	2017	2017
	Indian Village	2016	-		1/06/11	-		State	State	County
	Lakeville	2017	-		1/06/11	-		State	State	County
	New Carlisle	2010	-		1/06/11	-		State	State	County
	North Liberty	1975	-		1/06/11	-		State	State	County
	Osceola	2015	1992		12/16/15	-		State	State	County
	Roseland	1990	-		1/06/11	-		State	State	County
	Walkerton	2016	-		1/06/11	-		State	State	County

Many of these plans or policies can help implement the goals, objectives and strategies in St. Joseph County's Multi Hazard Mitigation Plan. The St. Joseph 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 Multi-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 St. Joseph 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 Multi-Hazard Mitigation Plan for St. Joseph 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 St. Joseph 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 St. Joseph County Multi-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. St. Joseph 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.