RESOLUITION 2013-37

A RESOLUTION OF THE TOWN COUNCIL OF THE
TOWN OF SPEEDWAY, INDIANA ADOPTING AND ACCEPTING THE
MARION COUNTY MULTI-HAZARD MITIGATION PLAN

WHEREAS, the Multi-Hazard Mitigation Plan had been prepared by Christopher B. Burke Engineering, LTD. for Marion County, the City of Beech Grove, the City of Lawrence, the City of Southport, and the Town of Speedway, Indiana; and

WHEREAS, the Multi-Hazard Mitigation Plan recommends many activities which will protect the people and property of Marion County, the City of Beech Grove, the City of Lawrence, the City of Southport, and the Town of Speedway, Indiana affected by natural hazards: and

WHEREAS, the Town of Speedway, per the 2007 CRS Coordinator's Manual criteria, the governing body must adopt the MHMP by resolution in order to be eligible for FEMA funding and keep their CRS status.

NOW THERFORE BE IT RESOLVED BY THE CITY COUNCIL OF THE CITY OF BEECH GROVE AS FOLLOWS:

1. The Multi-hazard Mitigation Plan for Marion County, Indiana, the Town of Speedway, is hereby adopted as an official plan of the Town of Speedway, Indiana.

2. This Resolution shall be in full force and effect from and after its passage by the Town Council of the Town of Speedway, Indiana.

ADOPTED this 9th day December, 2013

TOWN COUNCIL OF THE
TOWN OF SPEEDWAY, INDIANA

Eileen Fisher, President

Gary L. Raikes, Vice President

Jeff Hartman, Member

David Lindsey, Member

William Suffel, Member

ATTEST:

Monty W. Combs, Clerk-Treasurer

MULTI-HAZARD MITIGATION PLAN UPDATE

Marion County, Indiana

Prepared for

Marion County, Indiana
City of Indianapolis, Indiana
City of Beech Grove, Indiana
City of Lawrence, Indiana
Town of Speedway, Indiana
City of Southport, Indiana

September 2013

Prepared by

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CBBEL Project No. 13-0163

DISCLAIMER

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CHAPTER 1 INTRODUCTION

1.1 DISASTER LIFE CYCLE

The Federal Emergency Management Agency (FEMA) defines the disaster life cycle as the process through which emergency managers respond to disasters when they occur; help people and institutions recover from them; reduce the risk of future losses; and prepare for emergencies and disasters. The disaster life cycle, **Figure 1-1**, includes 4 phases:

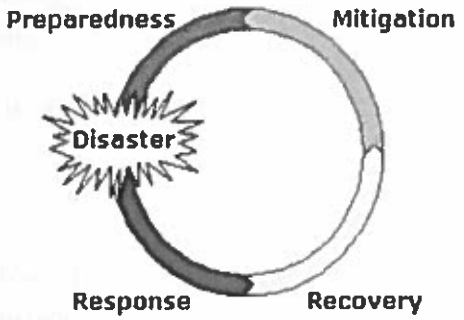


Figure 1-1 Disaster Life Cycle

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

The Marion County Multi-Hazard Mitigation Plan (MHMP) focuses on the mitigation phase of the disaster life cycle. According to FEMA, mitigation is most effective when it's based on an inclusive, comprehensive, long-term plan that is developed before a disaster occurs. The MHMP planning process identifies hazards, the extent that they affect the municipality, and formulates mitigation practices to ultimately reduce the social, physical, and economic impact of the hazards.

1.2 PROJECT SCOPE AND PURPOSE

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

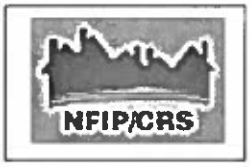
A MHMP is a requirement of the Federal Disaster Mitigation Act of 2000 (DMA 2000). According to DMA 2000, the purpose of mitigation planning is for State, local, and Indian tribal governments to identify the natural hazards that impact them, to identify actions and activities to reduce any losses from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

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

In order for National Flood Insurance Program (NFIP) communities to be eligible for future mitigation funds, they must adopt either their own MHMP or participate in the development of a multi-jurisdictional MHMP. The Indiana Department of Homeland Security (IDHS) and the United States Department of Homeland Security (US DHS)/FEMA Region V offices administer the MHMP program in Indiana. As noted above, it is required that local jurisdictions review, revise, and resubmit the MHMP every 5 years. MHMP updates must demonstrate that progress has been made in the last 5 years to fulfill the commitments outlined in the previously approved MHMP. The updated MHMP may validate the information in the previously approved Plan, or may be a major plan rewrite. The updated MHMP is not intended to be an annex to the previously approved Plan; it stands on its own as a complete and current MHMP.

The Marion County MHMP Update is a multi-jurisdictional planning effort led by the City of Indianapolis/Marion County Division of Homeland Security (DHS). This Plan was prepared in partnership with the Marion County, the City of Indianapolis, the City of Beech Grove, the City of Lawrence, the Town of Speedway, and the City of Southport. Representatives from these

communities attended the Committee meetings, provided valuable information about their community, reviewed and commented on the draft MHMP, and assisted with local adoption of the approved Plan. As each of the communities had an equal opportunity for participation and representation in the planning process, the process used to update the Marion County MHMP satisfies the requirements of DMA 2000 in which multi-jurisdictional plans may be accepted.



Throughout this Plan, activities that could count toward Community Rating System (CRS) points are identified with the NFIP/CRS logo. The CRS is a voluntary incentive program that recognizes and encourages community floodplain activities that exceed the minimum NFIP requirements. As a result, flood insurance premiums are discounted to reflect the reduced flood risk resulting from community actions that meet the 3 goals of the CRS: (1) reduce flood losses; (2) facilitate accurate insurance rating; and (3) promote education and awareness of flood insurance. Savings in flood insurance premiums are proportional to the points assigned to various activities. A minimum of 500 points are necessary to enter the CRS program and receive a 5% flood insurance premium discount. This MHMP could contribute as many as 294 points toward participation in the CRS. At the time of this planning effort, the City of Indianapolis participates in the CRS and is recognized as a Class 8. For this reason, flood insurance policyholders receive a 15% discount in the incorporated areas of Indianapolis.

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

1.3 PLANNING PROCESS

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

Preparation for the Marion County MHMP Update began in 2011 when the Indianapolis DHS submitted a PDM Grant application to IDHS. The grant request was approved by FEMA and grant funds were awarded in 2013.

Once the grant was awarded, the planning process to update the 2006 MHMP took 6 months. This included a 4 month planning process, followed by a review period by IDHS and FEMA for the draft MHMP Update, and another month for the City of Indianapolis, the City of Beech Grove, the City of Lawrence, the Town of Speedway, and the City of Southport to adopt the final MHMP Update.

1.3.1 Planning Committee and Project Team

In April 2013, the DHS compiled a list of Planning Committee and Project Team (Committee) members to guide the MHMP Update planning process. These individuals were specifically invited to serve on the Committee because they were knowledgeable of local hazards; have been involved in hazard mitigation; have the tools necessary to reduce the impact of future hazard events; and/or served as a representative on the original Planning Committee in 2006. **Table 1-1** lists the individuals that participated on the Committee and the entity they represented.

Table 1-1 MHMP Update Committee

NAME	TITLE	REPRESENTING
Tim Baughman	Chief	Department of Public Safety Communications
Shane Booker	Risk Management Coordinator	Indy Parks
Rita Burris	Public Information Officer	Indianapolis Fire Department
Robert Cheshire	Chief	Beech Grove Fire Department
Jan Crider	Hazard Mitigation Officer	Indiana Department of Homeland Security
Bettye Dobkins	Director of Safety	Indianapolis Downtown, Inc.
Randy Ellison	Chief	Southport Police Department
Peggy Frazier	Deputy Director-Operations	Indianapolis Department of Metropolitan Development
Chris Gilbert	Regional Emergency Services Director	American Red Cross of Greater Indianapolis
Greg Hall	Emergency Preparedness Coordinator	Marion County Health Department
Elia James	Senior Coordinator/CERT Manager	Indianapolis Department of Homeland Security
Jeff Larmore	Hazardous Materials Supervisor	Marion County Health Department
Stephanie Nordmeyer		Indianapolis Department of Homeland Security
Dennis Peters	Domestic Preparedness	Indianapolis Metropolitan Police Department
Donna Price	Asst Administrator - Permitting	Indianapolis Department of Code Enforcement
Steve Pruitt	DHS/DPW Liaison	Indianapolis Department of Public Works
Ray Raney	Communications Director	MECA
Nathan Self		Indianapolis Department of Public Works
TJ Shockley	Asst. EOC Manager	Indianapolis Department of Homeland Security
Dennis Slaughter	Senior Planner	Indianapolis Department of Metropolitan Development
Michael Walton	Chief	Lawrence Police Department
Mark Watson	Chief	Speedway Fire Department
Tom White		Citizen's Energy Group
Sara Woodson	Asst to Chief and Division Planner	Indianapolis Department of Homeland Security

Members of the Committee met several times during the MHMP Update, either as a Project Team, a Planning Committee, or through various group meetings such as the Local Emergency Planning Committee, and FEMA's Flood Resilience meeting. During these meetings, the Committee revisited existing (in the 2006 MHMP) and identified new critical infrastructure and local hazards; reviewed the State's mitigation goals and updated the local mitigation goals; reviewed the most recent local hazard data, vulnerability assessment, and maps; evaluated the effectiveness of existing mitigation measures and identified new mitigation projects; and reviewed materials for public participation. A sign-in sheet recorded those present at each meeting to document participation. Meeting agendas and summaries are included in **Appendix 2.** *Members of the Committee attended the public meeting in*

September 2013 and assisted with adoption of the Marion County MHMP Update.

1.3.2 Public Involvement

Drafts of the Marion County MHMP Update were posted online and paper copies were placed in main library as well as the DHS office for public review and comment. A press release announcing the placement of the draft plan in these libraries and public meetings was provided to local media and largest employers. Committee members were also provided with an informational flyer to display in their respective offices.

A public meeting was held on September 10, 2013 at the American Red Cross of Greater Indianapolis. Members of the Committee were present to describe details of the plan as well as to answer questions presented by attendees. The media release and power point presentation are located in **Appendix 3**.

1.3.3 Involvement of Other Interested Parties

Neighboring EMA Directors in Boone, Clinton, Hamilton, Hancock, Hendricks, Johnson, Morgan, and Shelby Counties as well as interested agencies, businesses, academia, and nonprofits were invited to review and comment on the draft Marion County MHMP Update (Appendix 3). Information related to the planning process, the public meeting, and the availability of the draft Marion County MHMP was directly provided to such potentially interested parties via personal conversations, informational flyer, and press releases. Successful implementation and future updates of the Marion County MHMP Update will rely on the partnership and coordination of efforts between such groups.

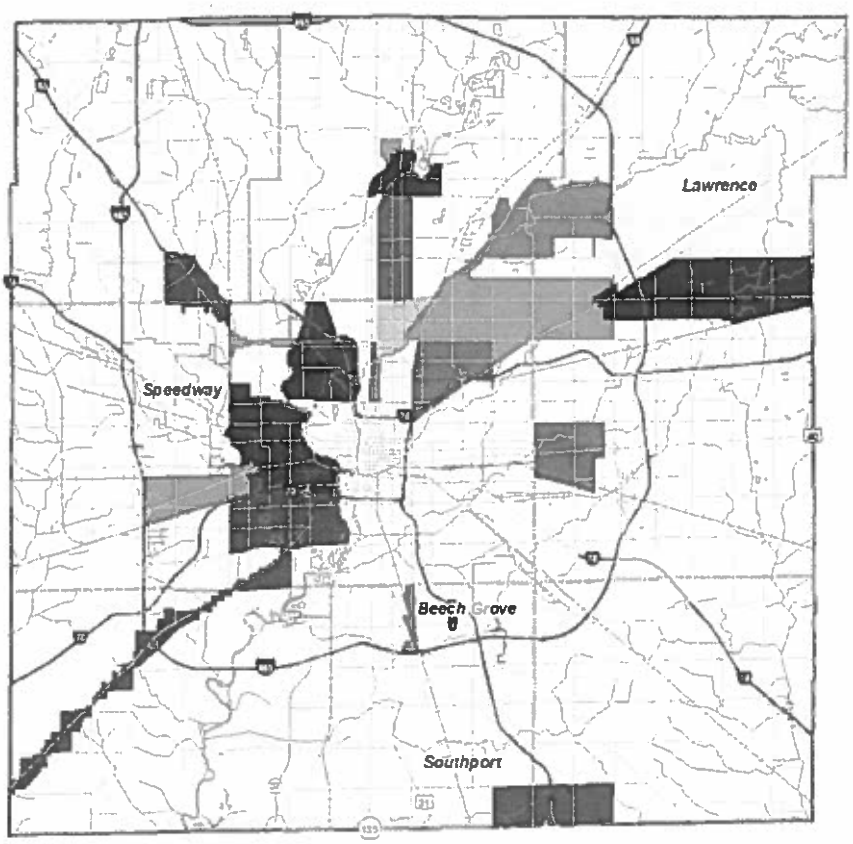
1.4 PLANS, STUDIES, REPORTS, AND TECHNICAL INFORMATION

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

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

For the purposes of this planning effort, the following materials were discussed and utilized:

- Incident and Emergency Action Plans (Eagle Creek Reservoir Dam; Morse Reservoir Dam; Pogue's Run Dam), Indiana Department of Natural Resource Dam records
- Consolidated City of Indianapolis' Comprehensive Emergency Management Plan (2012)
- The Indianapolis Star, The Noblesville Times (archived and current articles)
- Marion County Preliminary Flood Insurance Rate Maps (2011)
- Indianapolis Insight: The Comprehensive Plan for Marion County, Indiana (2002)



Within the City of Indianapolis Long-Range Planning Division, several small area or neighborhood plans have been developed. Each plan is unique to the quality and residents of that particular area, the plans are developed to drive future growth and beautification efforts, and to bring communities together in the planning process. **Figure 1-2** identifies those areas with small area plans in place.

Figure 1-2 Small Area Planning Locations

NFIP/CRS

The CRS program credits NFIP communities a maximum of 100 points for organizing a planning committee composed of staff from various departments; involving the public in the planning process; and coordinating among other agencies and departments to resolve common problems relating to flooding and other known natural hazards.

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CHAPTER 2 COMMUNITY INFORMATION

Figure 2-1 Marion County Location

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

Marion County, established in 1822 was formed from the Delaware New Purchase and is named after Francis Marion, a Brigadier General from South Carolina in the American Revolutionary War. The total area of Marion County is approximately 396.3 square miles. The location of Marion County within the State of Indiana is identified in **Figure 2-1**.

2.1 POPULATION AND DEMOGRAPHICS

In 1970, the City of Indianapolis expanded its boundaries to include all of Marion County. This consolidation was called the unified government or Uni-Gov. Many units of City and County government were consolidated into one civil government, including City Council and the County Council, which joined to become the City-County Council.

There were 16 towns in Marion County with fewer than 5,000 people that elected to retain Town status as defined by the state constitution. They are, however, included for governmental purposes in the Consolidated City of Indianapolis. The City of Beech Grove, the City of Lawrence, the Town of Speedway, and the City of Southport were not annexed into the Consolidated City of Indianapolis. These municipalities are called excluded cities and towns.

The most recent census data for Marion County estimates that the 2012 population was 918,977, which ranks 1st in the State. Of that total, the City of Indianapolis accounts for 836,633 or 90.8% of the county's population while the City of Lawrence is the second largest community with 46,408 or 5.1% of the population.

In 2011, the median age of the population in the County was 33.9 years of age. Similar to the rest of Indiana, the largest demographic age groups in the County are young adults (25-44 years) with a population of 265,222, and older adults (45-64 years) with a population of 226,516. School aged children (5-17 years) are the third largest age group with a population of 159,153 individuals living in Marion County. The approximate median household income in 2011 was reported to be $39,957 while the poverty rate in the same year was reported at 21.3% county-wide and 31.9% among children under 18. In total, 15.5% of households are married with children, and 22.4% of households are married without children.

Nearly 84.2% of the adults, older than 25, within Marion County have reportedly completed a High School education. Further, 27.1% of those same adults have also completed a Bachelor of Arts or higher degree.

2.2 EMPLOYMENT

US Census data indicates that of the Marion County work force, 25.4% are employed in unspecified private employment positions. Health Care/Social Services and Government account for 13.2% and 12.9% respectively. The total resident labor force according to estimates in 2012 is 462,847 with 40,495 unemployed and an unemployment rate of 9.2% or 47th in the State out of 92 counties. **Table 2-1** lists the major employers within Marion County as reported by Indiana Department of Workforce Development.

Table 2-1 List of Major Employers

Eli Lilly International Corp	Roche Diagnostics
Peyton Manning Children's Hospital	Indiana University School of Medicine
Indiana University Purdue University	IU Health Methodist Hospital
Indiana University Health	Indiana University Indianapolis
Eli Lilly & Co	Allison Advanced Development Co

(Indiana Department of Workforce Development, 2013)

2.3 TRANSPORTATION AND COMMUTING PATTERNS

There are several major transportation routes passing through Marion County and the municipalities within. Interstates 65, 69, 70, 74, and 465, Highway 31, 36, 40, 52, 136, and 421; and State Roads 37, 67, and 135 serve as main routes between the various municipalities. These transportation routes are identified in **Figure 2-2**.

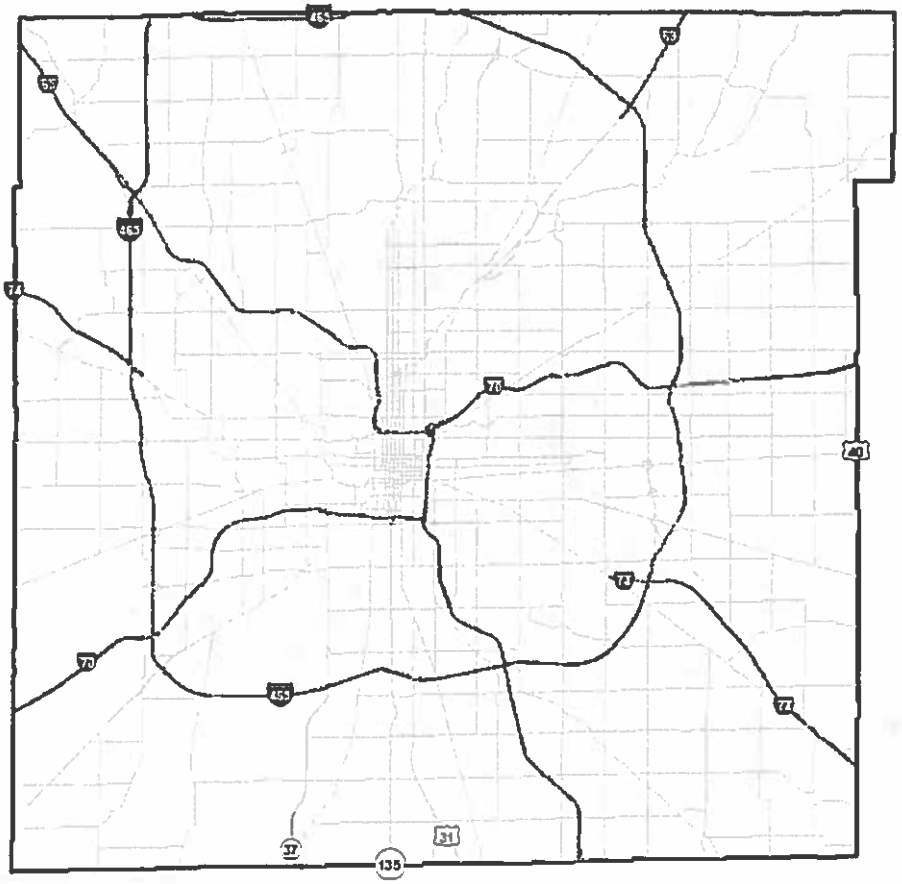

Figure 2-2 Marion County Transportation Routes

According to the Indiana Business Research Center, more than 137,000 individuals commute into Marion County on a daily basis. Approximately 38% of these commuters travel from Hamilton County. Further, approximately 30,800 Marion County residents commute to other counties with the majority traveling to Hamilton County (41%).

Figure 2-4 indicates the number of workers 16 and older who do not live within Marion County but commute into Marion County for employment purposes. Similarly, **Figure 2-3** indicates the number of Marion County residents 16 and older that commute out of the County for employment.

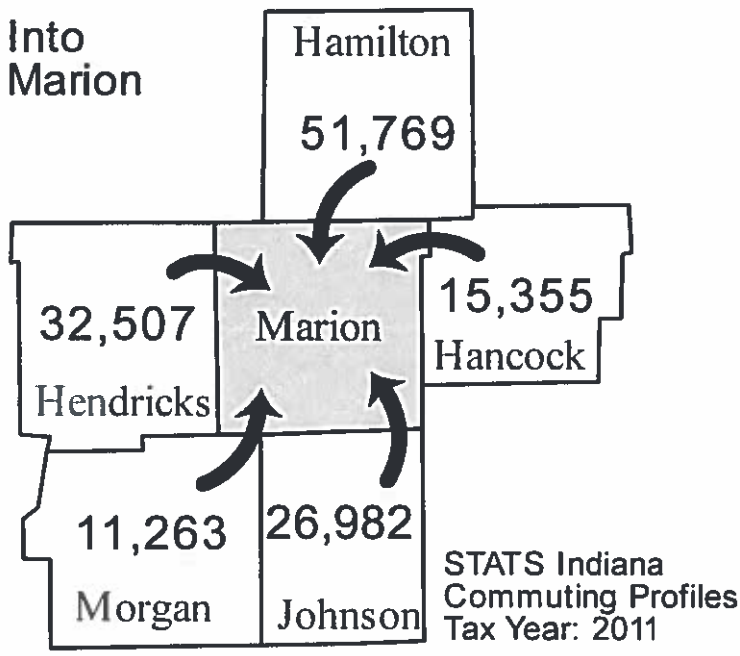

Figure 2-4 Workers Commuting into Marion County

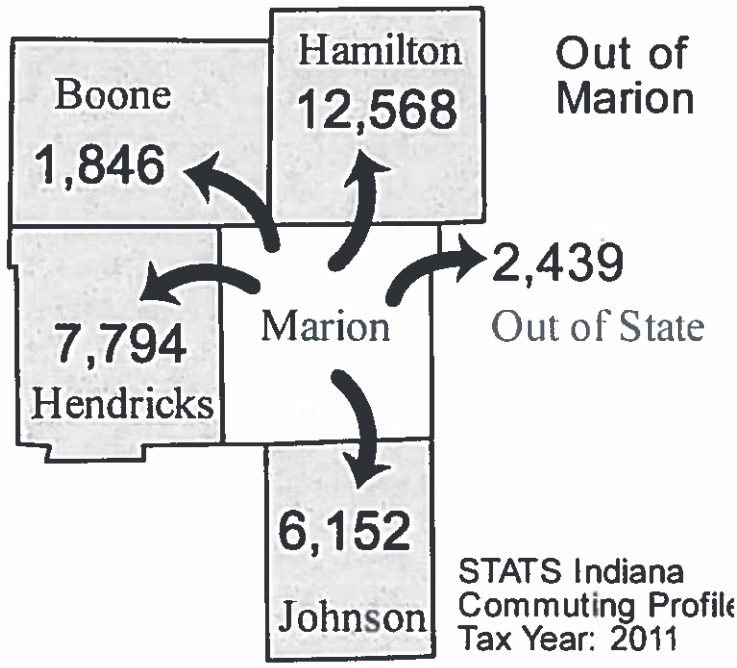

Figure 2-3 Workers Commuting out of Marion County

2.4 CRITICAL INFRASTRUCTURE AND NON-CRITICAL STRUCTURES

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

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

These are vital to the community's ability to provide essential services and protect life and property, are critical to the community's response and recovery activities, and/or are the facilities the loss of which would have a severe economic or catastrophic impact. The operation of these facilities becomes especially important following a hazard event. Homeland Security Presidential Directive 7 (HSPD-7) identified 17 critical infrastructure sectors; the Department of Homeland Security later identified Critical Manufacturing as the 18th sector.

The DHS provided the sector and location for the following 731 critical infrastructure in Marion County:

- **7 Agriculture and Food** – This sector has the ability to feed and clothe people, not only locally, but globally as well.
- **2 Banking and Finance** –includes financial firms such as insurers, banks, credit unions, investment companies, and securities brokers and dealers.
- **22 Chemical** – comprised of facilities in 5 main segments (based on the end product produced): basic chemicals, specialty chemicals, agricultural chemicals, pharmaceuticals, and consumer products.
- **17 Commercial** –Operate on the principle of open public access; that the general public can move freely throughout these facilities without the deterrent of highly visible security barriers. There are 8 subsectors: Public Assembly, Sports Leagues, Gaming, Lodging, Outdoor Events, Entertainment and Media, Real Estate, and Retail.
- **20 Communications**– This sector has evolved from predominantly a provider of voice services into a diverse, competitive, and interconnected industry using terrestrial, satellite, and wireless transmission systems.
- **3 Critical Manufacturing** –The following manufacturing industries are included within this sector: Iron and Steel Mills; Alumina and Aluminum Production and Processing; Nonferrous Metal

Production and Processing; Engine, Turbine, and Power Transmission Equipment; Electrical Equipment; Motor Vehicle; Aerospace Product and Parts; Railroad Rolling Stock; and Other Transportation Equipment.

- **2 Dams** – A vital and beneficial part of the nation's infrastructure providing a wide range of economic, environmental, and social benefits, including hydroelectric power, river navigation, water supply, wildlife habitat, waste management, flood control, and recreation.
- **1 Defense Industrial Bases** – Companies and subcontractors who perform under contracts to the Department of Defense (DoD), and companies providing incidental materials and services to the DoD, as well as government-owned and/or operated facilities are within this category.
- **81 Emergency Services** – Comprised of federal, state, local, tribal, and private partners, this sector is representative of several first-responder disciplines: emergency management, emergency medical services, fire, hazardous material, law enforcement, bomb squads, tactical operations/special weapons assault teams, and search and rescue.
- **22 Energy** – This sector is divided into three interrelated segments: electricity, petroleum, and natural gas.
- **20 Government** – These may or may not be open to the public and include general-use office buildings and special-use military installations, embassies, courthouses, national laboratories, and structures that may house critical equipment and systems, networks, and functions.
- **16 Healthcare and Public Health** - This sector plays a significant role in response and recovery across all other sectors in the event of a natural or manmade disaster.
- **387 Information Technology** – Virtual and distributed functions of this sector produce and provide hardware, software, and IT systems and services, and the Internet. This sector also includes educational facilities.
- 0 **National Monuments and Icons** – All share 3 common characteristics: they are a monument, physical structure, object, or geographic site; they are widely recognized to represent the nation's heritage, traditions, values, or have important cultural, religious, historical, or political importance; and their primary purpose is to memorialize or represent a significant national aspect.
- **0 Nuclear Reactors, Materials, and Waste** – This sector includes reactors, power plants, research facilities, testing and training facilities, and the transportation, storage, and disposal of nuclear material or waste.
- **3 Postal and Shipping** – Every other sector of the economy depends on the service providers in the Postal and Shipping Sector to deliver time-sensitive letters, packages, and other

shipments. This sector focuses on small and medium sized packages and provides service to millions of senders.

- **104 Transportation Systems** – There are 6 modes of transportation within this sector: aviation, highway, maritime, mass transit, pipeline, and rail; each moving goods and people quickly, safely, and securely through the Country.
- **41 Water** – This sector is vulnerable to a variety of attacks man-made in nature, or from harm as a result of a natural hazard event. Critical services such as firefighting or healthcare would be critically impacted if the water facilities were unable to function.

Exhibit 1 illustrates the location of critical infrastructure as maintained by DHS and Appendix 4 lists the critical infrastructure in Marion County by NFIP Community. Non-critical structures include residential, industrial, commercial, and other structures that do not meet the definition of a critical infrastructure and are not required for a community to function during a hazard event. The development of this MHMP focused on critical infrastructure; thus, non-critical structures are not mapped or listed.

2.5 MAJOR WATERWAYS AND WATERSHEDS

Figure 2-5 Waterways and 8-Digit HUCs

According to the United States Geological Survey (USGS) there are 225 waterways in Marion County; listed in **Appendix 5**. The County's main waterway is the White River and several major tributaries as they drain from the northern parts of Marion County to the southern regions. Marion County lies within 2 8-digit Hydrologic Unit Code (HUC) watersheds; the Driftwood River (05120204) and the Upper White River (05120201). These major waterways and 8-digit HUCs are identified on **Figure 2-5**.

2.6 NFIP PARTICIPATION

The NFIP is a FEMA program that enables property owners in participating communities to purchase insurance protection against losses from flooding. Since the development of the 2006 Marion County MHMP, Marion County, the City of Indianapolis, the City of Beech Grove, the City of Lawrence, the Town of Speedway, and the City of Southport continue to participate in the NFIP.

At the time of preparing this MHMP, the only NFIP entities in Marion County to participate in the CRS program is the City of Indianapolis (Class 8). The CRS program is a voluntary incentive program that recognizes and encourages community floodplain activities that exceed the minimum NFIP requirements. As a result, flood insurance premiums are discounted to reflect the reduced flood risk resulting from community actions that meet the 3 goals of the CRS: (1) reduce flood losses; (2) facilitate accurate insurance rating; and (3) promote education and awareness of flood insurance. For CRS participating communities, flood insurance premium rates are discounted in increments of 5% for each class level achieved. **Table 2-2** lists the NFIP number, effective map date, and the date each community joined the program.

Table 2-2 NFIP Participation

NFIP Communities	NFIP CID Number	Effective Map Date	Join Date
City of Indianapolis	180159	07-05-2005	05-15-1984
City of Beech Grove	*The Cities of Beech Grove, Lawrence, Southport, and the Town of Speedway participate as a part of the Unified Government of the City of Indianapolis, Marion County. Use the City CID for these communities.*		
City of Lawrence			
City of Southport			
Town of Speedway			

(FEMA, 2013)

2.7 TOPOGRAPHY

The highest elevation in Marion County, according to the 1978 Soil Survey completed by the USDA-Natural Resources Conservation Service (NRCS), is 900 feet above sea level and is located near the intersection of "Southport, Shelbyville, and Five Points Road in Franklin Township, about 4 miles east of the Town of Southport". Conversely, the lowest elevation is near Wicker Road and the White River in Perry Township and is approximately 650 feet above sea level.

Many creeks, streams, and waterways travel through the relatively flat plain make-up of Marion County. A few abrupt changes can be noted in the elevation throughout the county while along the White River, these abrupt changes are more common.

2.8 CLIMATE

The Midwestern Regional Climate Center (MRCC) provided climate data that includes information retrieved from a weather station located at the Indianapolis International Airport, identified as station 124259. The average annual precipitation is 40.95 inches per year, with the wettest month being July averaging 4.42 inches of precipitation and the driest months being February with an average of 2.41 inches of precipitation. The highest 1-day maximum precipitation was recorded in July of 1987 with 5.09 inches of rain. On average, there are 76.7 days of precipitation greater than or equal to 0.1 inches, 27.7 days with greater than or equal to 0.5 inches, and 9.6 days with greater than or equal to 1.0 inch of precipitation. Mean snowfall is 26.9 inches per year. The highest monthly amount of snowfall recorded at this station is 30.6 inches for January of 1978.

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CHAPTER 3 RISK ASSESSMENT

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

A risk assessment measures the potential loss from a hazard incident by assessing the vulnerability of buildings, infrastructure, and people in a community. It identifies the characteristics and potential consequences of hazards, how much of the community will be affected by a hazard, and the impact on community assets. The risk assessment conducted for Marion County and the NFIP communities is based on the methodology described in the Local Multi-Hazard Mitigation Planning Guidance published by FEMA in 2008 and is incorporated into the following sections:

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

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

Section 3.3: Hazard Summary provides an overview of the risk assessment process and a table summarizing the relationship of the hazards.

3.1 HAZARD IDENTIFICATION

3.1.1 Hazard Selection

The MHMP Committee reviewed the list of natural, technological, and political hazards from the 2006 Marion County MHMP, and discussed recent and the potential for future hazard events. The Team identified those hazards that affected Marion County and NFIP communities and selected the hazards to study in detail as part of this planning effort. As shown in **Table 3-1** these hazards include: drought, earthquake, extreme temperatures, flooding, hailstorm, severe winter storm, tornado, windstorm, dam & levee failure, hazardous material incident, structural fire, and civil disturbance.

All hazards studied within the 2006 Marion County MHMP are included in the update. Other hazards like those identified on the draft Hazard Identification and Risk Assessment (HIRA) tool being developed by IDHS were discussed but the Committee agreed that either these hazards are addressed in other documents or have little local impact and were therefore not studied in detail as a part of this planning effort.

Table 3-1 Hazard Identification

TYPE OF HAZARD	LIST OF HAZARDS	DETAILED STUDY	
		2006 MHMP	MHMP UPDATE
Natural	Drought	Yes	Yes
	Earthquake	Yes	Yes
	Extreme Temperatures	Yes	Yes
	Flood	Yes	Yes
	Hailstorm	Yes	Yes
	Severe Winter Storm	Yes	Yes
	Thunderstorm	Yes	Yes
	Tornado	Yes	Yes
	Windstorm	Yes	Yes
Technological	Dam & Levee Failure	Yes	Yes
	Hazardous Material Incident	Yes	Yes
	Structural Fire	Yes	Yes
Political	Civil Disturbance	Yes	Yes

3.2 HAZARD RANKING

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

3.2.1 Probability

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

- Unlikely-incident is possible, but not probable, within the next 10 years (1)
- Possible-incident is probable within the next 5 years (2)
- Likely-incident is probable within the next 3 years (3)
- Highly Likely-incident is probable within the next calendar year (4)

3.2.2 Magnitude/Severity

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

- Negligible-few injuries OR critical infrastructure shutdown for 24 hours or less OR less than 10% property damaged OR average response duration of less than 6 hours (1)
- Limited-few injuries OR critical infrastructure shut down for more than 1 week OR more than 10% property damaged OR average response duration of less than 1 day (2)
- Critical-multiple injuries OR critical infrastructure shut down of at least 2 weeks OR more than 25% property damaged OR average response duration of less than 1 week (3)
- Significant-multiple deaths OR critical infrastructure shut down for 1 month or more OR more than 50% property damaged OR average response duration of less than 1 month (4)

3.2.3 Warning Time

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

- More than 24 hours (1)
- 12-24 hours (2)
- 6-12 hours (3)
- Less than 6 hours (4)

3.2.4 Duration

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

- Less than 6 hours (1)
- Less than 1 day (2)
- Less than 1 week (3)
- Greater than 1 week (4)

3.2.5 Calculating the CPRI

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

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

The CPRI value provides a means to assess the impact of one hazard relative to other hazards within the community. A CPRI value for each hazard was determined for each NFIP community in Marion County, and then a weighted CPRI value was computed based on the population size of each community. **Table 3-2** presents each community, population, and the weight applied to individual CPRI values to arrive at a combined value for the entire County. Weight was calculated based on the percentage of each community's population in relation to the total population of the County. Thus, the results reflect the relative population influence of each community on the overall priority rank.

Table 3-2 Determination of Weighted Value for NFIP Communities

NFIP COMMUNITY	POPULATION	% OF TOTAL POPULATION	WEIGHTED VALUE
Marion County (w/o other NFIP)	9,368	1.0%	0.01
City of Indianapolis	834,852	90.8%	0.91
City of Beech Grove	14,340	1.6%	0.02
City of Lawrence	46,756	5.1%	0.05
Town of Speedway	11,930	1.3%	0.01
City of Southport	1,731	0.2%	0.00
TOTAL	**918,977**	**100%**	**1.00**

3.3 HAZARD PROFILES

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

This section describes each of the hazards that were identified by the Committee for detailed study as a part of this MHMP Update. The discussion is divided into the type of hazard: natural, man-made/technological, or political and the following subsections:

- **Hazard Overview** provides a general overview of the causes, effects, and characteristics that the hazard represents.
- **Recent Occurrences** presents the research gathered from local and national sources on the hazard extent and lists historic occurrences since 2006 and the probability of future incident occurrence.
- **Assessing Vulnerability** describes, in general terms, the current exposure, or risk, to the community regarding potential losses to critical infrastructure and the implications to future land use decisions and anticipated development trends.
- **Relationship to Other Hazards** explores the influence one hazard may have on another hazard.

NATURAL HAZARDS

3.3.1 Drought

Drought: Overview

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

There are 4 academic approaches to examining droughts; these are meteorological, hydrological, agricultural, and socio-economic. Meteorological drought is based on the degree, or measure, of dryness compared to a normal, or average amount of dryness, and the duration of the dry period. Hydrological drought is associated with the effects of periods of precipitation (including snowfall) shortfalls on surface or subsurface water supply. Agricultural drought is related to agricultural impacts; focusing on precipitation shortages, differences between actual and potential evapo-transpiration, soil water deficits, reduced ground water or reservoir levels, and crop yields. Socioeconomic drought relates the lack of moisture to community functions in the full range of societal functions, including power generation, the local economy, and food sources. **Figure 3-1** shows soil effected by drought conditions.

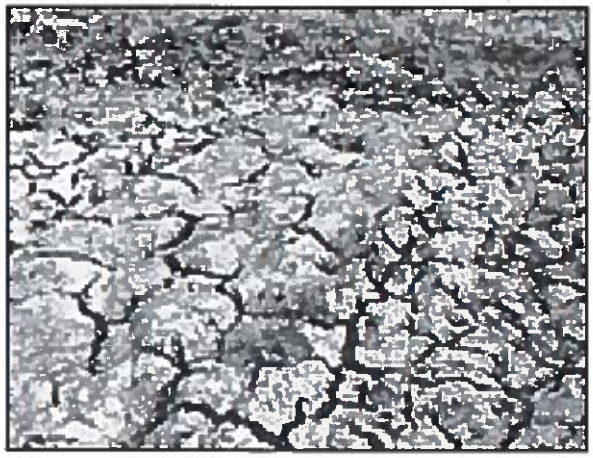

Figure 3-1 Drought Effected Soil

Drought: Recent Occurrences

Data gathered from the U.S. Drought Monitor indicated that between May 2006, and August 2013, there were 147 total drought related impacts to Marion County, 113 of which were considered statewide or regional impacts. In total, there were 82 Agricultural; 28 Business & Industry; 12 Fire; 20 Plants & Wildlife; 52 relief, Response & Restrictions; 22 Society & Public Health; 5 Tourism & Recreation; and 23 Water Supply & Quality Impacts. . In August

2012, 100% of Indiana was experiencing drought conditions ranging from "D0-Abnormally Dry" to "D4-Exceptional Drought". **Figure 3-2** identifies those areas and categories of drought throughout Indiana for August 7, 2012. Marion County is primarily located in the "D3-Extreme" with the far southwestern border located in the "D4-Exceptional" zone. D3 includes the potential impacts of major crop and pasture losses and widespread water shortages and restrictions. D4 includes exceptional and widespread crop or pasture losses are likely and shortages of water in reservoirs, streams and wells creating water emergencies. The August 21, 2012 report began to show that the northern reaches of Marion County were declassified to a "D2-Severe Drought" and by the September 4, 2012 report, the entire county was considered within the "D2" severity. It wasn't until the October 30, 2012 report that the entire county was considered out of drought condition status.

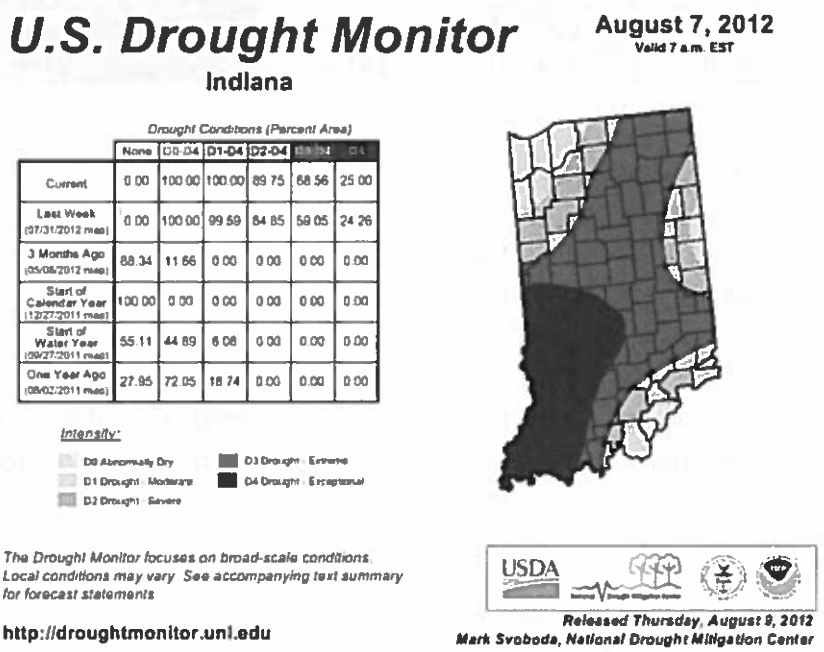

Figure 3-2 Indiana Drought Conditions

No property or crop losses have been documented in Marion County specific to the 6 events listed by the National Climate Data Center (NCDC) between April 2006 and February 2013. Four of these events were related to the 2012 drought. One narrative regarding the October 2010 event indicated that a countywide burn ban was in effect. Narratives throughout the 2012 event reported severely dry weather, burn bans, and record low rainfall amounts.

The Project Team, utilizing the CPRI, determined the overall risk of drought throughout Marion County is "Elevated". The impact of drought was determined to the same for all communities within Marion County. The Team agreed that a drought is "Possible" (to occur within the next 3 years) and the magnitude of drought is anticipated to be "Limited" (few injuries *or* critical infrastructure shut down of 1 week *or* 10% property damaged *or* response duration of less than 1 day). Further it is anticipated that with the enhanced weather forecasting abilities, the warning time for a drought is greater than 24 hours and the duration will be greater than 1 week. A summary is shown in **Table 3-3**.

Table 3-3 CPRI for Drought

	PROBABILITY	MAGNITUDE/ SEVERITY	WARNING TIME	DURATION	CPRI
City of Indianapolis	Possible	Limited	> 24 Hours	> 1 Week	Elevated
City of Beech Grove	Possible	Limited	> 24 Hours	> 1 Week	Elevated
City of Lawrence	Possible	Limited	> 24 Hours	> 1 Week	Elevated
City of Southport	Possible	Limited	> 24 Hours	> 1 Week	Elevated
Town of Speedway	Possible	Limited	> 24 Hours	> 1 Week	Elevated

According to the National Drought Mitigation Center, scientists have difficulty predicting droughts more than 1 month in advance due to the numerous variables such as precipitation, temperature, soil moisture, topography, and air-sea interactions. Further anomalies may also enter the equation and create more dramatic droughts, or lessen the severity of droughts. Based on the previous occurrences of droughts and drought related impacts felt within Marion County, the Project Team estimated that the probability of a drought occurring in the area is "Possible"; or occurrence is probable within the next 5 years.

Drought: Assessing Vulnerability

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

Direct Effects:

- Urban and developed areas may experience revenue losses from landscaping companies, golf courses, restrictions on industry cooling and processing demands, businesses dependent on crop yields; and increased potential for fires.
- Rural areas within the County may experience revenue losses from reductions in livestock and crop yields as well as increased field fires.
- Citizens served by drinking water wells may be impacted during low water periods and may require drilling of deeper wells or loss of water service for a period of time.

Indirect Effects:

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

- Increased demand on emergency responders and firefighting resources

Estimating Potential Losses

It is difficult to estimate the potential losses associated with a drought for Marion County because of the nature and complexity of this hazard and the limited data on past occurrences. However, for the purpose of this MHMP Update, a scenario was used to estimate the potential crop loss and associated revenue lost due to a drought similar to that experienced during the drought of record from 1988. In 2010, Marion County produced approximately 1.2M bushels of corn and 383K bushels of soybeans, as reported by the Natural Resources Conservation Service (NRCS) District Conservationist. Using national averages of $5.56 per bushel of corn and $12.04 per bushel of soybeans, the estimated crop receipts for 2010 would be $11.1M. Using the range of crop yield decreases reported in 1988 and 1989, just after the 1988 drought period (50%-86%) and assuming a typical year, economic losses could range between $5.5M-$9.4M; depending on the crop produced and the market demand. Effects of drought on corn crops can be seen in **Figure 3-3**.

Figure 3-3 Crops Effected by Drought

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

According to a July 5, 2012 article in *The Times* (Noblesville, IN), "The effects of drought also could touch agricultural businesses, such as handlers and processors, equipment dealers, and see, fertilizer and pesticide providers". Further, "...consumers are likely to see an increase in food prices of 2.5 percent to 3.5 percent into 2013".

Additional losses associate with a prolonged drought are more difficult to quantify. Drought has lasting impacts on urban trees: death to all or portions of a tree, reduction in the tree's ability to withstand insects and diseases, and

interruption of normal growth patterns. Such effects on trees, especially urban trees can lead to additional impacts, both environmentally and monetarily in terms of the spread of Emerald Ash Borer insect and the weakening of tree limbs and trunks which may lead to increased damages during other hazard events such as wind and ice storms.

Future Considerations

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

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

Drought: Relationship to Other Hazards

A drought will not be caused by any other hazard studied during this planning effort. However, it is anticipated that areas of the county may be more susceptible to fires during a drought and this may lead to increased losses associated with a structural fire.

3.3.2 Earthquake

Earthquake: Overview

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

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

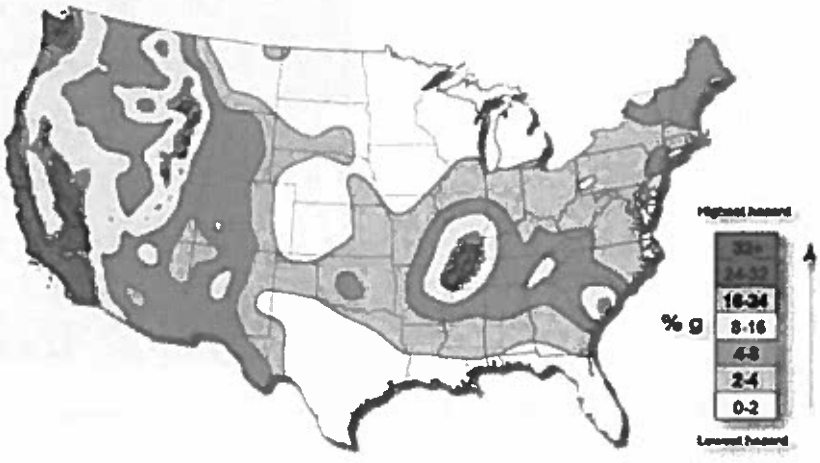

Figure 3-4 Earthquake Hazard Areas in the US

Earthquakes strike suddenly, without warning. Earthquakes can occur at any time of the year and at any time of the day or night. On a yearly basis, 70-75 damaging earthquakes occur throughout the world. Estimates of losses from a future earthquake in the United States approach $200B. Scientists are currently studying the New Madrid fault area and have predicted that the chances of an earthquake in the M8.0 range occurring within the next 50 years are approximately 7%-10%. However, the chances of an earthquake at a M6.0 or greater, are at 90% within the next 50 years.

There are 45 states and territories in the United States at moderate to very high risk from earthquakes, and they are located in every region of the country (**Figure 3-4**). California experiences the most frequent damaging earthquakes;

however, Alaska experiences the greatest number of large earthquakes-most located in uninhabited areas. The largest earthquakes felt in the United States were along the New Madrid Fault in Missouri, where a three-month long series of quakes from 1811 to 1812 occurred over the entire Eastern United States, with Missouri, Tennessee, Kentucky, Indiana, Illinois, Ohio, Alabama, Arkansas, and Mississippi experiencing the strongest ground shaking.

Earthquake: Recent Occurrences

Indiana, as well as several other Midwestern states, lies in the most seismically active region east of the Rocky Mountains. Marion County is located in close proximity to the Sharpsville Fault, which runs through southeastern Howard County and northern Tipton County.

On April 18, 2008, an M5.2 quake, reported by the Central United States Earthquake Consortium, struck southeast Illinois in Wabash County and included reports of strong shaking in southwestern Indiana, Kansas, Georgia, and the upper peninsula of Michigan. With over 25,000 reports of feeling the earthquake, there were no reports of injuries or fatalities caused by the event.

On December 30, 2010, central Indiana experienced an earthquake with a magnitude of 3.8; rare for this area in Indiana as it is only the 3rd earthquake of notable size to occur north of Indianapolis. Even rarer is the fact that scientists believe that the quake was centered in Greentown, Indiana approximately 13 miles southeast of Kokomo, Indiana. According to *The Times* (Noblesville, IN) no reports of injury or damages were provided although "Effects were felt differently throughout the county with some reporting computers sliding across desks and buildings shaking to others saying they had no idea anything took place".

Figure 3-5 Earthquake Damaged Porch

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

Based on historical earthquake data, local knowledge of previous earthquakes, and the results of the HAZUS-MH scenario conducted as a part of this planning effort, the Committee determined that the probability of an earthquake occurring in Marion County or any of the communities is "Likely". Should an earthquake occur, the impacts associated with this hazard are anticipated to be "Critical" within all areas of the County.

As with all earthquakes, it was determined that the residents of Marion County would have little to no warning time (less than 6 hours) and that the duration of the event would be expected to be less than 1 day. A summary is shown in **Table 3-4**.

Table 3-4 CPRI for Earthquake

	PROBABILITY	MAGNITUDE/ SEVERITY	WARNING TIME	DURATION	CPRI
City of Indianapolis	Likely	Critical	< 6 Hours	< 1 Day	Severe
City of Beech Grove	Likely	Critical	< 6 Hours	< 1 Day	Severe
City of Lawrence	Likely	Critical	< 6 Hours	< 1 Day	Severe
City of Southport	Likely	Critical	< 6 Hours	< 1 Day	Severe
Town of Speedway	Likely	Critical	< 6 Hours	< 1 Day	Severe

According to the Ohio Department of Natural Resources Division of Geological Survey, "...it is difficult to predict the maximum-size earthquake that could occur in the state and certainly impossible to predict when such an event would occur. In part, the size of an earthquake is a function of the area of a fault available for rupture. However, because all known earthquake-generating faults in Ohio are concealed beneath several thousand feet of Paleozoic sedimentary rock, it is difficult to directly determine the size of these faults." Further according to the Indiana Geological Survey, "...no one can say with any certainty when or if an earthquake strong enough to cause significant property damage, injury, or loss of life in Indiana will occur...we do indeed face the possibility of experiencing the potentially devastating effects of a major earthquake at some point in the future". The Committee felt that an earthquake occurring within or near to Marion County is "Likely" to occur within the next 3 years.

Earthquake: Assessing Vulnerability

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

Direct Effects:

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

Indirect Effects:

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

Figure 3-6 Minor Earthquake Damages

Types of loss caused by an earthquake could be physical, economic, or social in nature. Due to the unpredictability and broad impact regions associated with an earthquake, all critical and non-critical infrastructure are at risk of experiencing earthquake related damages. Damages to structures, infrastructure, and even business interruptions can be expected following an earthquake. Examples of varying degrees of damages are shown in **Figure 3-5** and **Figure 3-6**.

Estimating Potential Losses

In order to determine the losses associated with an earthquake, the HAZUS-MH software was utilized to determine the impact anticipated from a M5.5 earthquake with an epicenter within Marion County.

According to the HAZUS-MH scenario, total economic loss associated with this earthquake is anticipated to be near $38.7B. The HAZUS-MH model computes anticipated economic losses for the hypothetical earthquake due to direct building losses and business interruption losses. Direct building losses are the costs to repair or to replace the damage caused to the building and contents, while the interruption losses are associated with the inability to operate a business due to the damage sustained. Business interruption losses also include the temporary living expenses for those people displaced from their homes. Total building related

losses are anticipated to be $38.7B, of which 20% ($7.7B) of the estimated business losses are related to business interruption. The areas anticipated to experience significant structural losses, along with estimations of damage, are indicated on **Exhibit 2.**

The HAZUS-MH Earthquake Model allows local building data to be imported into the analysis. However, these local data are imported as "general building stock", meaning that the points are assigned to a census tract rather than a specific XY coordinate. HAZUS performs the damage analysis as a county wide analysis and reports losses by census tract. In addition to importing local building data, the Marion County model was further enhanced by adding localized parameters (i.e., shake maps, liquefaction, soils). While the results of the hypothetical scenario appear to be plausible, care should be taken when interpreting these results.

Future Considerations

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

Earthquake: Relationship to Other Hazards

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

3.3.3 Extreme Temperatures

Extreme Temperatures: Overview

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

According to the NWS, "The Heat Index or the "Apparent Temperature" is an accurate measure of how hot it really feels when the Relative Humidity is added to the actual air temperature". To find the Heat Index Temperature, refer to the Heat Index Chart in Figure 3-7. As an example, if the air temperature is 96°F and the relative humidity is 65%, the heat index – how hot it feels – is 121°F. The Weather Service will initiate alert procedures when the Heat Index is expected to exceed 105°-110°F for at least 2 consecutive days.

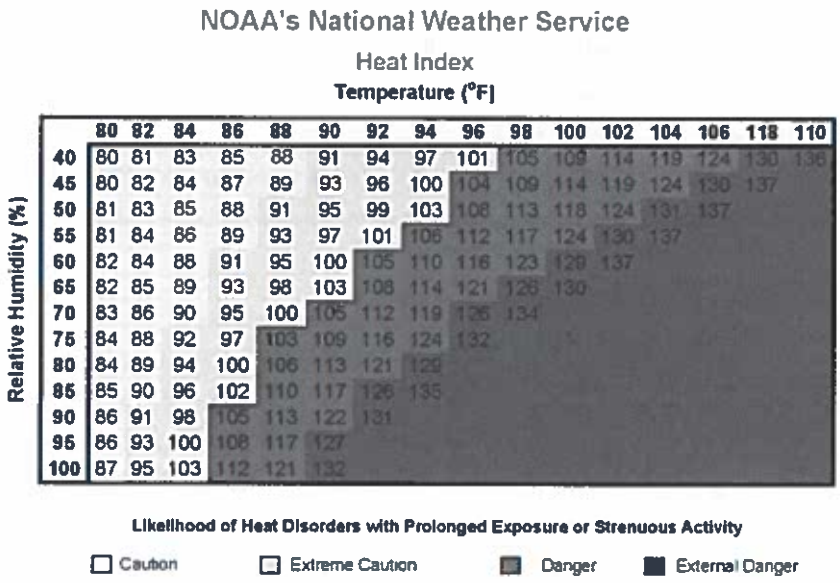

Figure 3-7 Heat Index Chart

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

As Figure 3-7 indicates, there are 4 cautionary categories associated with varying heat index temperatures.

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

Extreme cold is defined as a temporary, yet sustained, period of extremely low temperatures. Extremely low temperatures can occur in winter months when continental surface temperatures are at their lowest point and the North American Jet Stream pulls arctic air down into the continental United States. The jet stream is a current of fast moving air found in the upper levels of the atmosphere. This rapid current is typically thousands of kilometers long, a few hundred kilometers wide, and only a few kilometers thick. Jet streams are usually found somewhere between 10-15 km (6-9 miles) above the Earth's surface. The position of this upper-level jet stream denotes the location of the strongest surface temperature contrast over the continent. The jet stream winds are strongest during the winter months when continental temperature extremes are greatest. When the jet stream pulls arctic cold air masses over portions of the United States, temperatures can drop below 0° F for 1 week or more. Sustained extreme cold poses a physical danger to all individuals in a community and can affect infrastructure function as well.

Wind chill is a guide to winter danger

New wind chill chart

Frostbite occurs in 15 minutes or less

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

Figure 3-8 NWS Wind Chill Chart

In addition to strictly cold temperatures, the wind chill temperature must also be considered when planning for extreme temperatures. The wind chill temperature, according to the NWS, is how cold people and animals feel when outside and it is based on the rate of heat loss from exposed skin. **Figure 3-8** identifies the Wind Chill Chart and how the same ambient temperature may feel vastly different in varying wind speeds.

Extreme Temperature: Recent Occurrences

The effects of extreme temperatures extend across large regions, typically affecting several counties, or states, during a single event. According to the NCDC, there have been 0 reported occurrences of extreme heat or extreme cold between April 2006 and April 2013. Local media outlets have provided information related to extreme temperatures occurring since the last planning effort.

In July 2012, the RTV6 *TheIndyChannel.com* reported that "The average high temperature in Indianapolis from June 28 to July 6 was a little more than 100 degrees, and Friday's high temperature of 105 was the hottest since 1936, just

one degree shy of the all-time highest temperature in Indianapolis since records began in 1871". Further, the article highlighted the average temperature for the 10-day period was nearly 101 degrees. The record 10-day average high temperature of 103 degrees was set in 1936.

During May and June 2012, News Releases were issued by the Indianapolis Department of Public Safety warning readers of the heat advisories, noting preparations that can be made to reduce illness, and what actions can be taken if heat related illness is observed or a power outage is experienced.

January 2009 brought a string of cold weather that caused school delays, emergency response delays, and several cold weather advisories. One report indicated that approximately 96 apartment units were left without heat as a car skidded off the road and severed the gas line. In addition to those units, approximately 9,000 IPL customers were without power through the night. During this cold spell, Indianapolis set 2 winter records for power consumption on 2 consecutive days. Cold weather also slowed emergency response as firefighters in Lawrence were delayed by slick roads, frozen hydrants, and hazards caused by water used to battle the blaze.

More recently, in January 2013 several schools delayed the start of the school day as overnight and early morning temperatures with wind chill adjustments felt like -20°. Wind chill advisories were issued through Central Indiana, residents were urged to learn the warning signs of frostbite, take special precautions for pets, and dress in many warm layers.

It is difficult to predict the probability that an extreme temperature event will affect Marion County residents within any given year. However, based on historic knowledge and information provided by the NFIP representatives, an extreme temperature event is "Highly Likely" (within the calendar year) to occur and an event did occur, it would result in "Limited" magnitude. **Table 3-5** identifies the CPRI for extreme temperature events for all NFIP communities in Marion County.

Table 3-5 CPRI for Extreme Temperatures

	PROBABILITY	MAGNITUDE/ SEVERITY	WARNING TIME	DURATION	CPRI
City of Indianapolis	Highly Likely	Limited	> 24 Hours	< 1 Week	Elevated
City of Beech Grove	Highly Likely	Limited	> 24 Hours	< 1 Week	Elevated
City of Lawrence	Highly Likely	Limited	> 24 Hours	< 1 Week	Elevated
City of Southport	Highly Likely	Limited	> 24 Hours	< 1 Week	Elevated
Town of Speedway	Highly Likely	Limited	> 24 Hours	< 1 Week	Elevated

As shown in the table, index values remain identical throughout each NFIP community due to the regional extent and diffuse severity of this hazard event.

Extreme Temperatures: Assessing Vulnerability

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

By assessing the demographics of Marion County, a better understanding of the relative risk that extreme temperatures may pose to certain populations can be gained. In total, nearly 11% of the County's population is over 65 years of age, more than 7.7% of the population is below the age of 5, and approximately 21% of the population is considered to be living below the poverty line. People within these demographic categories are more susceptible to social or health related impacts associated with extreme heat.

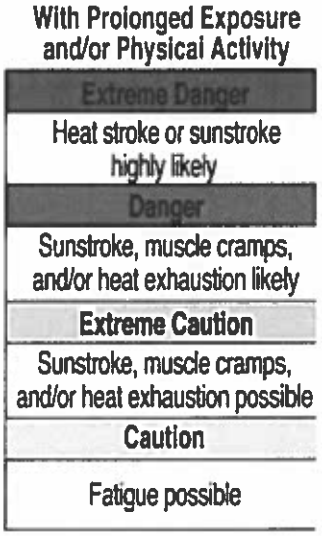

Figure 3-9 Danger Levels with Prolonged Heat Exposure

Extreme heat can affect the proper function of organ and brain systems by elevating core body temperatures above normal levels. Elevated core body temperatures, usually in excess of 104°F are often exhibited as heat stroke. For weaker individuals, an overheated core body temperature places additional stress on the body, and without proper hydration, the normal mechanisms for dealing with heat, such as sweating in order to cool down, are ineffective. Examples of danger levels associated with prolonged heat exposure are identified in **Figure 3-9**.

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

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

Direct Effects:

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

Indirect Effects:

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

Estimating Potential Losses

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

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

Future Considerations

As more and more citizens are experiencing economic difficulties, local power suppliers along with charitable organizations have implemented programs to provide cooling and heating mechanisms to residents in need. Often, these programs are donation driven and the need for such assistance must be demonstrated. As susceptible populations increase or as local economies are stressed, such programs may become more necessary to protect Marion County's at risk populations.

<u>Extreme Temperatures: Relationship to Other Hazards</u>

While extreme temperatures may be extremely burdensome on the power supplies in Marion County, the Committee concluded that this type of hazard is not expected to cause any hazards studied, with the exception of a potential civil disturbance. It is anticipated that due to prolonged extreme temperatures, primarily long periods of high temperatures, citizens may

become increasingly agitated and irritable and this may lead to a disturbance requiring emergency responder intervention.

3.3.4 Flood

Flood: Overview

Floods are the most common and widespread of all natural disasters. Most communities in the United States have experienced some kind of flooding, after spring rains, heavy thunderstorms, or winter snow melts. A flood, as defined by the NFIP, is a general and temporary condition of partial or complete inundation or 2 or more acres of normally dry land area or of 2 or more properties from overflow of inland or tidal waters and unusual and rapid accumulation or runoff of surface waters from any sources, or a mudflow. Floods can be slow or fast rising but generally develop over a period of days.

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

The traditional benchmark for riverine or coastal flooding is a 1% annual chance of flooding, or the 100-year flood. This is a benchmark used by FEMA to establish a standard of flood protection in communities throughout the country. The 1% annual chance flood is referred to as the "regulatory" or "base" flood. Another term commonly used, the "100-year flood", is often incorrectly used and can be misleading. It does not mean that only 1 flood of that size will occur every 100 years. What it actually means is that there is a 1% chance of a flood of that intensity and elevation happening in any given year. In other words, the regulatory flood elevation has a 1% chance of being equaled, or exceeded, in any given year and it could occur more than once in a relatively short time period.

Flood: Recent Occurrences

The NCDC reports that between January 2006 and April 30, 2013, there were 33 flood events (17 floods and 16 flash floods) that resulted in approximately $382.3K in property damages and an additional $11K in crop damages. While no loss estimates were provided for many of the events, reports do indicate that roads were flooded, neighborhoods were affected, and damages occurred in agricultural areas. Appendix 6 provides the NCDC information regarding flood events that have resulted in injuries, deaths, or monetary damages to property and/or crops.

Heavy rains in June of 2011 resulted in flash flooding throughout much of Central Indiana. According to a *WISHTV.com* report, "...the National Weather Service says its flash flood gauge is the highest it's been since 1971". Several emergency crews were sent out as roads were flooding, people were stranded, and a high traffic bridge was washed out. As stated in the article, "Indianapolis Fire Department said from 6 a.m. to 11:30 a.m., the department responded to 56 water rescue investigation". Further, "DPW reports a bridge was washed out on northbound Keystone Avenue near Woodfield Crossing Boulevard".

Figure 3-10 Warning Sign in Flood Prone Area

The *Insurance Journal* provides information regarding an event in May 2012 that resulted in flooding within the Broad Ripple area. "City officials found that inspectors failed to properly activate an electronic locking system on a pair of White River floodgates which a trespasser had closed weeks before the May 2012 flooding in the Broad Ripple neighborhood on the city's north side". One restaurant, Petite Chou needed to be completely gutted and rebuilt from the inside due to the high water. According to the *Journal*, "The Indianapolis Star reports the city has paid out more than $82,000 to settle damage claims but still has a nearly $650,000 claim pending from Petite Chou restaurant".

Central Indiana experienced damaging floods in April 2013. Heavy rains bringing several inches, in some areas 5-10 inches of rain, on top of saturated soils caused several local water courses to crest well above flood stage. Localized flooding was also experienced. Much of the damages to structures and property were experienced north of Marion County, in Howard and Tipton Counties.

Stream gages are utilized to monitor surface water elevations and/or discharges at key locations and time periods. Some such gages are further equipped with NWS' Advanced Hydrologic Prediction Service (AHPS) capabilities. These gages have the potential to provide valuable information regarding historical high and low water stages, hydrographs representing current and forecasted stages, and a map of the surrounding areas likely to be flooded. Within Marion County, there are 22 active USGS stream gages equipped with the AHPS capabilities; these are identified on **Exhibit 3.** In additional to stream gages, the City of Indianapolis has placed warning signs (as pictured in **Figure 3-10**) in flood prone areas.

Any property having received 2 insurance claim payments for flood damages totaling at least $1,000, paid by the NFIP within any 10-year period since 1978 is defined as a repetitive loss property. These properties are important to the NFIP because they account for approximately 1/3 of the country's flood insurance payments. According to the IDNR, Division of Water, there are 171 properties within the City of Indianapolis that are considered to be repetitive loss properties. Further, within the City of Lawrence, there is 1 additional repetitive loss property. As a part of the City of Indianapolis' mitigation efforts, the City has purchased 1 property in a repetitive loss area in the City of Lawrence.

There have been numerous claims made for damages associated with flooding in Marion County. Within the Town of Speedway, there have been 2 claims and more than $2K in payments. In addition, there have been 1,835 claims within the City of Indianapolis resulting in approximately $13.4M in payments. **Table 3-6** identifies the number of claims per NFIP community as well as payments made.

Table 3-6 Repetitive Loss Claims and Payments

NFIP COMMUNITY	# OF REPETITIVE LOSS PROPERTIES	CLAIMS SINCE 1978	$$ PAID
Indianapolis	171	1,835	$13.4M
Beech Grove	0	0	0
Lawrence	1	1	$9.5K
Southport			
Speedway	0	2	$2K
TOTAL	**172**	**1,838**	**$13.5M**

(IDNR, 2013)
(Data for the City of Southport is included within that reported for Indianapolis)

Mandatory flood insurance purchase requirements apply to structures in 1% annual chance of flooding delineated areas. Total flood insurance premiums for Marion County and the NFIP communities is approximately $5.8M. Of that total, $17K is flood insurance coverage for the City of Beech Grove. **Table 3-7** further indicates the premiums and coverage totals for individual NFIP communities.

Table 3-7 Insurance Premiums and Coverage

NFIP COMMUNITY	FLOOD INSURANCE PREMIUMS	FLOOD INSURANCE COVERAGE
Indianapolis	$5.M	$1B
Beech Grove	$17.3K	$4.4M
Lawrence	$16.9K	$6.8M
Southport		
Speedway	$37.7K	$5.4M
TOTAL	**$5.8M**	**$1.1B**

IDNR, 2013)
(Data for the City of Southport is included within that reported for Indianapolis)

As determine by the Committee, the probability of a flood occurring throughout Marion County is "Possible" to "Highly Likely" varying by community, with impacts anticipated to range from "Limited" in many communities to "Critical" within the City of Indianapolis. The Committee also determined that the warning time varied by community based on upstream notification capabilities, and that the duration of such an event is anticipated to last less than 1 day in all areas expect Indianapolis. A summary is shown in **Table 3-8**.

Table 3-8 CPRI for Flood

	PROBABILITY	MAGNITUDE/ SEVERITY	WARNING TIME	DURATION	CPRI
Indianapolis	Highly Likely	Critical	12-24 Hours	< 1 Week	Severe
Beech Grove	**Possible**	**Limited**	**> 24 Hours**	**< 1 Day**	**Low**
Lawrence	Highly Likely	**Limited**	**12-24 Hours**	**< 1 Day**	Elevated
Southport	**Possible**	**Limited**	**> 24 Hours**	**< 1 Day**	**Low**
Speedway	Likely	**Limited**	**12-24 Hours**	**< 1 Day**	Elevated

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

Flood: Assessing Vulnerability

Flood events may affect large portions of Marion County at one time as large river systems and areas with poor drainage cover much of the county and several communities. Within Marion County, direct and indirect effects of a flood event may include:

Direct Effects:

- Structural and content damages and/or loss of revenue for properties affected by increased water
- Increased costs associated with additional response personnel, evacuations, and sheltering needs

Indirect Effects:

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

Estimating Potential Losses

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

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

The Modified Building Inventory was created in ESRI ArcGIS by converting parcels to centroids, and joining Assessor Data to these centroids. Assessor data included square footage for the structure, and any structure that was listed as less than 400 ft^2 in area or was classified in the Assessor's database as a non-habitable structure was assumed to be an outbuilding. Also, buildings with a calculated replacement value of $0.00 or buildings that did not match the Assessor Data (parcel numbers did not match) were excluded from the analysis. Replacement values were included in the Assessor's database, and Content Values were calculated using:

Residential = Replacement Value x 0.5
Commercial = Replacement Value x 1.0
Industrial = Replacement Value x 1.5

Agricultural = Replacement Value x 1.0
Education = Replacement Value x 1.0
Government = Replacement Value x 1.0
Religious = Replacement Value x 1.0

The resulting Modified Building Inventory was used in the GIS analyses.

In order to estimate anticipated damages associated with each flood in Marion County and NFIP communities, it was estimated that 25% of structures in the flood zones would be destroyed, 35% of structures would be 50% damaged, and 40% of structures would be 25% damaged. **Table 3-9** identifies the estimated losses associated with structures in the floodway, the 100-year floodplain, and the 500-year floodplain areas by NFIP community within Marion County.

Table 3-9 Manual GIS Analysis Utilizing Most Recent Preliminary DFIRM Data and Marion County Building Inventory

	FLOODWAY		1%		0.2%		UNNUMBERED	
	#	$	#	$	#	$	#	$
Indianapolis	1,756	$461.2M	13,274	$2.9B	13,239	$3.1B	2,254	$325.0M
Beech Grove	81	$18.7M	92	$19.2M	198	$40.1M	0	0
Lawrence	13	$3.7M	64	$11.0M	147	$42.6M	195	$65.9M
Southport	3	$1.2M	12	$4.5M	10	$5.4M	78	$20.8M
Speedway	42	$11.1M	586	$163.5M	152	$28.6M	400	$113.3M
Total	**1,895**	**$495.90M**	**14,028**	**$3.1B**	**13,746**	**$3.2B**	**2,927**	**$525.0M**

Structures and Damages within each zone are not inclusive

Utilizing the same GIS information and process, **Table 3-10** identifies the number of critical infrastructure within each of the SFHAs in Marion County. These buildings are included in the overall number of structures and damage estimates information provided in Table 3-9.

Table 3-10 Critical Infrastructure in SFHA by NFIP Community

NFIP COMMUNITY	FLOODWAY	1%	0.2%	UNNUMBERED
Indianapolis	12 School 1 Chemical 1 Hospital 3 Emergency Response 1 Commercial 79 Bridge 3 Water 2 Dam	17 School 4 Chemical 4 Emergency Response 4 Bridge 1 Energy 3 Water 1 Communication	11 School 1 Heliport 1 Chemical 2 Hospital 1 Electric Substation 4 Emergency Response 3 Government 1 Commercial 1 Railroad 1 Manufacturing 2 Water	7 School 1 Chemical 3 Bridge 6 Water
Beech Grove	1 Emergency Response		1 School 1 Natural Gas	
Lawrence	2 Bridge 1 Water	1 Emergency Response		1 Water
Southport				
Speedway	2 Bridge 1 Water	1 Commercial	1 Chemical 1 Energy	
Total	**109**	**36**	**32**	**18**

Structures within each zone are not inclusive

Utilizing the information in Table 3-9 regarding the number of structures within each Flood Hazard Area, it is also important to note the number of flood insurance policies within each NFIP area in Marion County. **Table 3-11** provides the comparison between the number of structures in the SFHA and the number of flood insurance policies.

Table 3-11 Number of Structures in the SFHA and Number of Flood Insurance Policies

NFIP COMMUNITY	# STRUCTURES IN SFHA	# POLICIES
Indianapolis	30,523	5,899
Beech Grove	371	20
Lawrence	419	25
Southport	103	
Speedway	1,180	41
Total	**32,596**	**5,985**

IDNR, 2013)
(Data for the City of Southport is included within that reported for Indianapolis)

Future Considerations

As the municipalities within Marion County continue to grow in population, it can be anticipated that the number of critical and non-critical infrastructure

will also increase accordingly. Location of these new facilities should be carefully considered and precautions should be encouraged to ensure that school, medical facilities, community centers, municipal buildings, and other critical infrastructure are located outside the 0.2% annual chance (500-year) floodplain and/or are protected to that level along with a flood-free access to reduce the risk of damages caused by flooding and to ensure that these critical infrastructure will be able to continue functioning during major flood events.

It is also important to ensure that owners and occupants of residences and businesses within the known hazard areas, such as delineated or approximated flood zones, are well informed about the potential impacts from flooding incidents as well as proper methods to protect themselves and their property. As new FIRMS have been developed throughout Marion County, residents within these areas are being notified that they may be subject to an increased risk of damages associated with flooding. These new FIRMs are in the preliminary stages and are expected to be finalized near the end of 2013. Additionally, several individual stream studies are being completed in order to revise the Unnumbered Zone A areas, or to provide detailed delineations for the SFHA.

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

Figure 3-11 Fire Engine in Flood Waters

Indirect effects of flooding may include increased emergency response times due to flooded or redirected streets (**Figure 3-11**), the danger of dislodged and floating propane tanks causing explosions, and the need for additional personnel to carry out the necessary evacuations. Additional effects may include sheltering needs for those evacuated, and the loss of income or revenue related to business interruptions. As many communities within Marion County are closely tied to the river systems, special events occurring near to or on these rivers and waterways may be cancelled or postponed during periods of flooding or high water levels.

Flood: Relationship to Other Hazards

While flooding creates social, physical, and economic losses, it may also cause other hazards to occur. For example flooding may increase the potential for a hazardous materials incident to occur. Above ground storage facilities may be toppled or become loosened and actually migrate from the original location. In less severe situations, the materials commonly stored in homes and garages such as oils, cleaners, and de-greasers, may be mobilized by flood waters. Should access roads to hazardous materials handlers become flooded, or if bridges are damaged by flood waters, response times to more significant incidents may be increased, potentially increasing the damages associated with the release.

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

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

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

3.3.5 Hailstorms, Thunderstorms, and Windstorms

Hailstorms, Thunderstorms, and Windstorms: Overview

Hail occurs when frozen water droplets form inside a thunderstorm cloud, and then grow into ice formations held aloft by powerful thunderstorm updrafts, and when the weight of the ice formations becomes too heavy, they fall to the ground as hail. Hail size ranges from smaller than a pea to as large as a softball, and can be very destructive to buildings, vehicles (**Figure 3-12**), and crops. Even small hail can cause significant damage to young and tender plants. Residents should take cover immediately in a hailstorm, and protect pets and livestock, which are particularly vulnerable to hail, and should be under shelter as well.

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

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

Hailstorm, Thunderstorm, and Windstorm: Recent Occurrences

Figure 3-12 Damaging Hail on Vehicles

In Marion County, the NCDC has recorded 137 hailstorms and 89 thunderstorms/windstorms between April 2006 and June 2013. The largest recorded hailstone was 2.00 inches in diameter and has occurred on 3 separate hailstorm events within the previously mentioned timeframe. The average diameter hailstone occurring throughout Marion County is 0.75 inches. Significant windstorms are characterized by the top wind speeds achieved during the incident, characteristically occur in conjunction with thunderstorms, and have historically occurred year round with the greatest frequency and damage occurring in May, June, and July. Within Marion County, NCDC reports 82 instances between

April 2006 and June 2013 where top wind speeds were greater than 58 mph.

Total NCDC recorded damages for hailstorms, thunderstorms, and windstorms throughout Marion County between April 2006 and June 2013 is $3.8M. The NCDC also reports $1K in crop related damages, 43 injuries, and 7 deaths due to these types of incidents. Many event reports included in the NCDC did not provide descriptive information on the social, physical, and economic losses resulting from individual storms specific to Marion County. Appendix 6 provides the NCDC information regarding hailstorms, thunderstorms, and windstorms that have resulted in injuries, deaths, and monetary damages to property and/or crops.

In April of 2006, the Regions Bank Tower (**Figure 3-13**) suffered major damages; more than 100 windows and rooftops were blown out, contents from several law firms and business offices littered streets below, and streets surrounding the building were closed to traffic due to hanging glass and metal. While no specific damage amounts were released, reports to the NCDC estimate damages of at least $500K and no associated injuries.

Figure 3-13 Damages to Regions Bank Tower

A similar event occurred on July 25, 2009 as thunderstorms and high winds caused roof damage to the Kittle's Superstore in Castleton. According to the NCDC, "Damage to the roof and ruptured water pipes at the furniture store caused the sprinkler system to activate, dumping numerous gallons of water on the inventory. Kittle's Chairman Jim Kittle Jr. estimated the damage at several million dollars".

The most recent and nationally notable thunderstorm/high wind event occurred on August 13, 2011 when a stage structure at the Indiana State Fair collapsed. Numerous injuries and 7 deaths occurred as a 59 mph wind gust destroyed the stage rigging, which was later determined to have not been properly braced and up to code. As impending weather was noted, confusion between State Fair officials, the performers, and law enforcement exacerbated the delay in evacuations and notifications to the public. Following

the tragedy, the State Fair was closed due to clean up and investigations, several lawsuits were filed, and the event has led to stricter regulations state-wide.

According to the Institute for Business and Home Safety, central Indiana can expect to experience damaging hailstorms 3-4 times over 20 years; the average life of a residential roof. Further, thunderstorms and windstorms are considered a high frequency hazard and may occur numerous times per year.

The Committee determined the probability of a hailstorm, thunderstorm, or windstorm occurring in Marion County is "Highly Likely" and will typically affect broad portions of the county at one time resulting in potentially "Critical" damages. As advancements in technologies such as weather radar systems and broadcast alerts are continually made, the warning time for such incidents may increase. Currently, the Committee feels that the warning time is anticipated to be 12-24 hours and the duration is expected to last less than 6 hours.

Indicative of a regional hazard, the probability, magnitude, warning time, and duration of a hailstorm, thunderstorm, or windstorm are expected to be the same throughout the county. These events are highly unpredictable and the occurrences are distributed through the county. Therefore the CPRI values reflect the equally distributed risk and associated priority for a hailstorm, thunderstorm, or windstorm. A summary is provided in **Table 3-12**.

Table 3-12 CPRI for Hailstorm, Thunderstorm, and Windstorm

	PROBABILITY	MAGNITUDE/ SEVERITY	WARNING TIME	DURATION	CPRI
Indianapolis	Highly Likely	Critical	12-24 Hours	< 6 Hours	Severe
Beech Grove	Highly Likely	Critical	12-24 Hours	< 6 Hours	Severe
Lawrence	Highly Likely	Critical	12-24 Hours	< 6 Hours	Severe
Southport	Highly Likely	Critical	12-24 Hours	< 6 Hours	Severe
Speedway	Highly Likely	Critical	12-24 Hours	< 6 Hours	Severe

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

Hailstorm, Thunderstorm, and Windstorm: Assessing Vulnerability

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

Direct Effects:

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

Indirect Effects:

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

Estimating Potential Losses

Figure 3-14 Home Damaged During Windstorm

Due to the unpredictability of this hazard all critical infrastructure and non-critical structures in Marion County are at risk of damage including temporary or permanent loss of function. For hailstorms, thunderstorms, and windstorms, it is not possible to isolate specific critical infrastructure or non-critical structures that would be more or less vulnerable to damages. However, areas where utility lines are above ground and areas where dead or dying trees have not been removed may be at a higher risk of property damages or power outages during hailstorms, thunderstorms, and windstorms. Additionally, mobile homes and accessory buildings such as pole barns and sheds may also be at a higher risk of damages from hailstorms, thunderstorms, and windstorms f not properly anchored to the ground. Damages from falling limbs or uprooted trees such as shown in **Figure 3-14**, are common.

Future Considerations

As the populations of the communities in Marion County continue to grow, it can be anticipated that the number of critical and non-critical structures will also increase. In order to reduce the vulnerability for damages resulting from a hailstorm, thunderstorm, or windstorm, measures such as proper anchoring,

enforcement of the International Building Codes, and burial of power lines should be completed. While measures can be taken to remove existing structures or prevent future structures from being built in known hazard areas such as floodplains and hazardous materials facility buffers, such measures are not applicable to hailstorms, thunderstorms, and windstorms due to the diffuse nature and regional impacts of this hazard.

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

Hailstorm, Thunderstorm, and Windstorm: Relationship to Other Hazards

Hailstorms, thunderstorms, and windstorms may be the precursor for other hazards. For example, hazardous materials incidents can be the result of a hailstorm, thunderstorm, or a windstorm. Material storage containers can become damaged by high winds, debris, or even lightning, and can result in a spill or release of materials. With wind speeds greater than 58 mph, tankers and other transportation vehicles carrying hazardous materials are also at risk while on the road. High winds may also cause gaseous substances to travel farther distances at a much faster rate, increasing the evacuation area necessary to protect residents and visitors of Marion County.

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

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

3.3.6 Tornado

Tornadoes: Overview

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

A tornado is generated when conditions in a strong cell are produced that exhibit a mall of cool air that overrides a layer of warm air. The underlying layer of warm air rapidly rises, while the layer of cool air drops – sparking the swirling action. The damage from a tornado is a result of the high wind velocity and wind-clown debris. Tornado season is generally April through June in Indiana, although tornadoes can occur at any time of year. Tornadoes tend to occur in the afternoons and evenings; over 80 percent of all tornados strike between 3:00 pm and 9:00 pm, but can occur at any time of day or night as shown in **Figure 3-15**. Tornadoes occur most frequently in the United States east of the Rocky Mountains. Tornadoes in Indiana generally come from the south through the east. In Marion County, the predominant tornado path seems to be from the southwest to the northeast.

Figure 3-15 Funnel Cloud During a Lightning Storm at Night

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

Tornado: Recent Occurrences

The classification of tornadoes utilizes the Fujita Scale of tornado intensity, described in **Table 3-13**. Tornado intensity ranges from low intensity (F0) tornadoes with effective wind speeds of 40-70 mph to high intensity (F5+) tornadoes with effective wind speeds of 261-318+ mph. According to the NCDC, Marion County has experienced 3 tornadoes between 2006 and 2013. Tornadoes recorded for Marion County include 1 – F0, 1 – F1, and 1-F2. Exhibit 4 illustrates these tornado touchdowns and paths through Marion County.

Table 3-13 Fujita Scale of Tornado Intensity

F-Scale	Winds	Character of Damage	Relative Frequency
F0 (weak)	40-72 mph	Light damage	29%
F1 (weak)	73-112 mph	Moderate damage	40%
F2 (strong)	113-157 mph	Considerable damage	24%
F3 (strong)	158-206 mph	Severe damage	6%
F4 (violent)	207-260 mph	Devastating damage	2%
F5 (violent)	261-318 mph	Incredible damage	<1%

The NCDC reports 2 tornadoes, both in 2008, which resulted in significant property damages and injuries. The first, occurring on January 29, 2008 near the Waterfront Pointe Apartments, was classified as an F1 with winds near 105 mph. Approximately $100K in property damages to the apartments was noted. The second, occurring on May 30, 2008 damaged the northeastern portion of Marion County and traveled into Hancock County. Approximately $29M in property damages and 18 injuries were noted. Wind speeds were estimated to be near 125 mph and the entire path was just over 7 miles in length. Within Marion County, according to NCDC, the area receiving the most damages was an apartment complex near 38th Street and Mitthoefer Road. More specific information regarding the injuries was not provided.

The Committee estimated the probability of a tornado occurring in Marion County would be "Highly Likely" and the magnitude and severity of such an event to be "Critical". As with many hazardous events, the Committee anticipated a short warning time, less than 6 hours, and a short duration, also less than 6 hours. The summary is shown in **Table 3-14**.

Table 3-14 CPRI for Tornado

	PROBABILITY	MAGNITUDE/ SEVERITY	WARNING TIME	DURATION	CPRI
Indianapolis	Highly Likely	Critical	< 6 Hours	< 6 Hours	Severe
Beech Grove	Highly Likely	Critical	< 6 Hours	< 6 Hours	Severe
Lawrence	Highly Likely	Critical	< 6 Hours	< 6 Hours	Severe
Southport	Highly Likely	Critical	< 6 Hours	< 6 Hours	Severe
Speedway	Highly Likely	Critical	< 6 Hours	< 6 Hours	Severe

The Indiana State Climate Office estimates that throughout Indiana, there is an average of 20 tornado touchdowns per year. Based on the number of tornado touchdowns previously reported through the NCDC and local weather agencies, the Committee determined the probability of a future tornado occurring in Marion County is highly likely (within the calendar year).

Tornado: Assess Vulnerability

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

Direct Effects:

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

Indirect Effects:

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

Estimating Potential Losses

Due to the unpredictability of this hazard, all critical and non-critical structures within the County are at risk of future damage or loss of function. Estimates of potential physical losses were determined through a hypothetical exercise where F2 intensity tornadoes traveled through portions of the County. This is intended to present a "what-if" scenario of a tornado incident and associated damages. Damage estimates were derived by assuming that 25% of all structures in the path of the tornado would be completely destroyed, 35% would be 50% damaged, and 40% would have only 25% damage. These estimations were also determined utilizing 3 wind speed zones based on distance from the tornado path. **Table 3-15** provides summary data for the hypothetical tornadoes, which are identified on **Exhibit 4**.

Table 3-15 Summary of Hypothetical Tornado Damages

	Number of Structures Damaged	Estimated Damage ($)
North Tornado	**1,752**	**$321.0M**
Indianapolis	1,553	$285.9M
Speedway	199	$35.1M
South Tornado	**2,516**	**$482.5M**
Beech Grove	286	$68.7M
Indianapolis	1,527	$295.7M
Lawrence	576	$97.5M
Southport	127	$20.6M

Future Considerations

Within Marion County, there are numerous events each year that draw many thousands of Indiana residents as well as international guests. Due to this, it is imperative that the DHS place continued importance on the need to maintain and, as necessary, upgrade the outdoor warning siren coverage. Currently, approximately 97% of Marion County is covered by an outdoor warning siren. The existing siren locations are located on Exhibit 4 and the coverage area for outdoor warning sirens is provided in **Figure 3-16**.

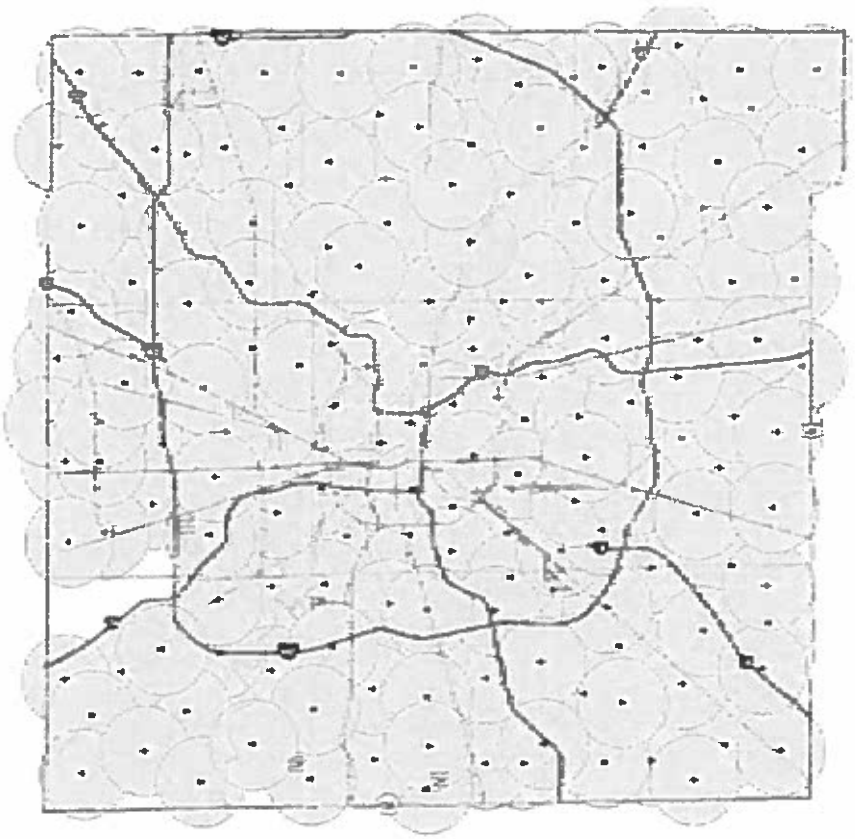

Figure 3-16 Outdoor Warning Siren Coverage

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

<u>Tornado: Relationship to Other Hazards</u>

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

Tornadoes may also result in a dam or levee failure as described within the hailstorm, thunderstorm, and windstorm section. The increased wind speeds, and debris caused by the tornado, may directly impact the dam or levee, or cause indirect damages through large debris or downed trees. In addition,

tornadoes may lead to structural fires as the destruction path is sometimes long and broad, leading to an increased number of potentially damaged homes, exposed power lines, and large amounts of debris.

3.3.7 Winter Storm and Ice

Winter Storm and Ice: Overview

A winter storm can range from moderate snow over a few hours to blizzard conditions with high winds, ice storms, freezing rain or sleet, heavy snowfall with blinding wind-driven snow, and extremely cold temperatures that can last for several days. Some winter storms may be large enough to affect several states while others may affect only a single community. All winter storms are accompanied by cold temperatures and blowing snow, which can severely reduce visibility. A winter storm is one that drops 4 or more inches of snow during a 12-hour period, or 6 or more inches during a 24-hour span. An ice storm occurs when freezing rain falls from clouds and freezes immediately on impact. All winter storms make driving and walking extremely hazardous. The aftermath of a winter storm can affect a community or region for days, weeks, and even months.

Figure 3-17 Ice Covered Power Lines

Storm effects such as extreme cold, flooding, and snow and ice accumulation (**Figure 3-17**) can cause hazardous conditions and hidden problems for people in the affected area. People can become stranded on the road or trapped at home, without utilities or other services, including food, water, and fuel supplies. The conditions may overwhelm the capabilities of a local jurisdiction. Winter storms are considered deceptive killers as they may indirectly cause transportation accidents, and injury and death resulting from exhaustion/overexertion, hypothermia and frostbite from wind chill, and asphyxiation; and house fires occur more frequently in the winter due to lack of proper safety precautions.

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

A winter storm watch indicates that severe winter weather may affect your area. A winter storm warning indicates that severe winter weather conditions

are definitely on the way. A blizzard warning means that large amounts of falling or blowing snow and sustained winds of at least 35 mph are expected for several hours. Winter storms are common in Marion County. Such conditions can result in substantial personal and property damage, even death.

Winter Storm and Ice: Recent Occurrence

Since the completion of the 2006 Marion County MHMP, the NCDC has recorded 14 winter storms, 1 blizzard, and 1 ice storm in Marion County between April 2006 and February 2013. Damage estimates were not provided for any events during this time period. However, some events did include a narrative description. In March 2008, a winter snow storm affected much of central Indiana with a mixture of rain, freezing rain, sleet, and snow. In many areas, according to the NCDC, nearly 0.5 inches of rain accumulated on electrical power lines and nearly 6 inches of snow fell in many areas, including Marion County.

According to the narrative provided by the NCDC, the January 2009 winter storm event "...was one of the greatest snow storms of all time to strike the Indianapolis, Indiana area". Snow totals ranged from 5-16 inches throughout central and southern Indiana, with more than 12 inches in the Indianapolis area. Snowfall records kept since 1884 indicate that this event resulted in the 8th deepest snowfall of record.

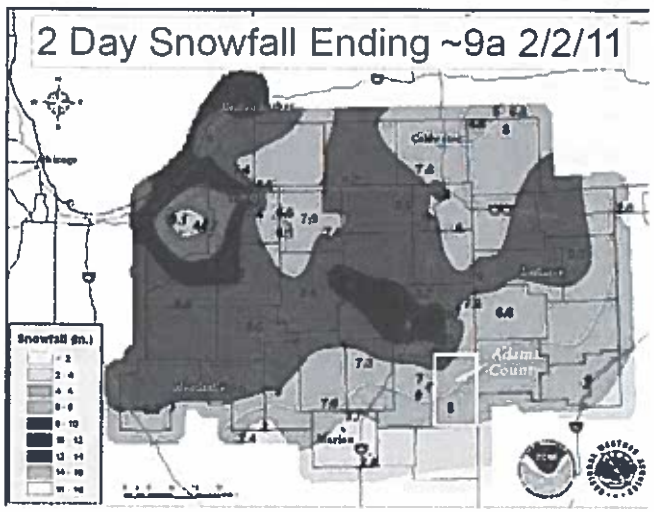

Figure 3-18 Snowfall Accumulation

In February 2011, Indiana was hit hard by multiple snow storms. The month started with a 2 day blizzard that dropped between 2 and 6 inches of snow in Marion County (**Figure 3-18**). In many areas, the Indiana State Police issued a "Level 1 Emergency" which restricts travel to emergency personnel only due to impassable road conditions. Three days later on February 5th, another 4 to 6 inches of heavy snow fell resulting in snow accumulations of 12 to 18 inches of snow. Another snowstorm hit the area on February 23rd adding another 5 inches.

Appendix 6 provides the NCDC information regarding winter storms, and ice storms that have resulted in injuries, deaths, or monetary damages to property and/or crops.

The probability, magnitude, warning time, and duration of a winter storm or ice storm causing disruption to residents and businesses in Marion County, as

determined by the Committee, is expected to be consistent throughout the NFIP communities. It is "Highly Likely" that this type of hazard will occur in this area and will typically affect the entire County, and possibly several surrounding counties, at one time, resulting in "Critical" severity. The warning time for severe temperatures or several inches of snow associated with a winter storm is usually greater than 24 hours while the duration of the incident is anticipated to last less than 1 week. A summary of the Committee's determinations is provided in **Table 3-16**.

Table 3-16 CPRI for Winter Storm and Ice

	PROBABILITY	MAGNITUDE/ SEVERITY	WARNING TIME	DURATION	CPRI
Indianapolis	Highly Likely	Critical	> 24 Hours	< 1 Week	Severe
Beech Grove	Highly Likely	Critical	> 24 Hours	< 1 Week	Severe
Lawrence	Highly Likely	Critical	> 24 Hours	< 1 Week	Severe
Southport	Highly Likely	Critical	> 24 Hours	< 1 Week	Severe
Speedway	Highly Likely	Critical	> 24 Hours	< 1 Week	Severe

The Committee determined that the probability for a winter storm or ice storm to occur in Marion County or any of the communities within is "Highly Likely", or will occur within the calendar year. Based on historical data and the experience of the Committee, winter storms and ice storms are common within Marion County and will continue to be an annual occurrence.

Winter Storm and Ice: Assessing Vulnerability

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

Direct Effects:

- Employers may experience loss of production as employees may not be able to get to work
- Roads may impassable
- Expenses related to snow removal or brine/sand applications

Indirect Effects:

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

Estimating Potential Losses

Given the nature and complexity of a regional hazard such as a winter storm, it is difficult to quantify potential losses to property and infrastructure. As a

result, all critical infrastructure and non-critical structures are at risk from winter storm and ice incidents.

Figure 3-19 Travel Impacted During Snow Storm

For planning purposes, information collected on winter storms impacting other communities around the nation is also useful in assessing the potential social, physical, and economic impact that a winter storm could have on the Marion County communities. For example, a March 2003 snowstorm in Denver, Colorado dropped approximately 31 inches of snow and caused an estimated $34M in total damages. In addition, a February 2003 winter storm dropped an estimated 15 - 20 inches of snow in parts of Ohio. The Federal and Ohio Emergency Management Agencies and U.S. Small Business Administration surveyed damaged areas and issued a preliminary assessment of $17M in disaster related costs. These costs included snow and debris removal, emergency loss prevention measures, and public utilities repair. The agencies found over 300 homes and businesses either damaged or destroyed in 6 counties. Snow storms and blizzards also make road travel difficult and dangerous, as in **Figure 3-19**.

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

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

Future Considerations

As populations increase and communities continue to grow in size, the need to respond to winter storms or ice storms will remain an important municipal effort. As new construction or re-development occurs, especially new or existing critical infrastructure, it is important to ensure that these new structures are equipped to deal with the potential risks associated with this hazard. Those may include lengthy power outages and potentially impassable transportation routes, making it difficult to obtain supplies or for passage of response vehicles.

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

Winter Storm and Ice: Relationship to Other Hazards

Figure 3-20 Flooding Caused by Snow Melt

Winter storms and ice storms can lead to flooding as the precipitation melts and enters local receiving water bodies. This increased volume of water on already saturated, or still frozen ground can quickly result in flooding related damages to structures and properties (**Figure 3-20**), as well as within the stream or river channel. The increased flooding may then lead to a dam or levee failure within the same area, further exacerbating the damages.

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

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

TECHNOLOGICAL HAZARDS

3.3.8 Dam and Levee Failure

Dam and Levee Failure: Overview

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

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

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

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

A levee is a flood control structure designed to hold water away from a building. Levees protect buildings from flooding as well as from the force of water, from scour at the foundation, and from impacts of floating debris. The principle causes of levee failure are similar to those associated with dam

failure and include overtopping, surface erosion, internal erosion, and slides within the levee embankment or the foundation walls. Levees are designed to protect against a particular flood level and they may be overtopped in a more severe event. When a levee system fails or is overtopped, the result can be catastrophic and often times more damaging that if the levee were not there, due to increased elevation differences and water velocity. The water flowing through the breach continues to erode the levee and increase the size of the breach until it is repaired or water levels on the two side of the levee have equalized.

Dam and Levee Failure: Recent Occurrences

Figure 3-21 Eagle Creek Reservoir Dam

Within Marion County, there are 20 DNR regulated dams: 5 high hazard dams, 2 significant hazard dams, and 13 low hazard dams as shown on Exhibit 3. High Hazard dams include: Castlebrook Dam, College Park Dam, Eagle Creek Reservoir Dam, Geist Reservoir Dam, and Pogue's Run Dam. Eagle Creek Reservoir Dam in northwestern Marion County is pictured in **Figure 3-21**. There have been no recorded dam failures in Marion County.

There are 9 levees considered to be consequential in terms of buildings identified as in or out of the 100-year floodplain. While there are numerous other levees constructed within Marion County, an additional 35 levees, they are not providing protection for the 100-year flood and as such, not included within this planning effort.

Based on the information provided to them, the Committee determined the probability of a dam failure is "Possible" in Indianapolis and Speedway (these communities are immediately downstream of a dam) and "Unlikely" in communities without dams (Beech Grove, Lawrence, and Southport). The effects of such an incident are anticipated to range from "Negligible" (areas without dams) to "Significant" (based on the number of structures or populations downstream of the dam). Indianapolis and Speedway are expected to have the least amount of warning time (less than 6 hours) and in all, the duration of this event, in areas where dams are located, is anticipated to last less than 1 week. **Table 3-17** indicates the CPRI as determined by the Committee.

Table 3-17 CPRI for Dam and Levee Failure

	PROBABILITY	MAGNITUDE/ SEVERITY	WARNING TIME	DURATION	CPRI
Indianapolis	**Possible**	Significant	> 6 Hours	< 1 Week	Elevated
Beech Grove	**Unlikely**	**Negligible**	**> 24 Hours**	**< 6 Hours**	**Low**
Lawrence	**Unlikely**	**Negligible**	**> 24 Hours**	**< 6 Hours**	**Low**
Southport	**Unlikely**	**Negligible**	**> 24 Hours**	**< 6 Hours**	**Low**
Speedway	**Possible**	Significant	> 6 Hours	< 1 Week	Elevated

Dam & Levee Failure: Assessing Vulnerability

Within Marion County, direct and indirect effects from a dam failure or a levee failure may include:

Direct Effects:

- Loss of life and serious damage to downstream homes, industrial and commercial buildings, public utilities, major highways, or railroads

Indirect Effects:

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

Due to the conditions beyond the control of the dam owner or engineer, there may be unforeseen structural problems, natural forces, mistakes in operation, negligence, or vandalism that may cause a dam to fail. Fortunately, two of the high hazard dams in Marion County, Eagle Creek Reservoir Dam and Pogue's Run Dam have an Incident and Emergency Action Plan (IEAP), both updated in 2012 by CBBEL, with a detailed dam failure inundation area identified. An IEAP for Geist Reservoir Dam is anticipated to be completed in the spring of 2014.

Estimating Potential Losses

The potential dam failure inundation areas for the Eagle Creek Reservoir Dam and the Morse Reservoir Dam were overlaid onto recent aerial photography to estimate the number of critical and non-critical structures that may be affected by a dam failure. The Eagle Creek Reservoir Dam was selected as a worst case scenario with a very large potential impact area, including downtown Indianapolis. The Morse Reservoir Dam, while located within Hamilton County, was selected to indicate that impacts to Marion County may originate in areas outside of the County.

The actual magnitude and extent of damage depend on the type of dam break, volume of water that is released, and the width of the floodplain valley to accommodate the dame break flood wave. The anticipated damages to the structures and contents located within Marion County are identified in **Table 3-18**.

Table 3-18 Estimated Damages for Dam Failure

	EAGLE CREEK RESERVOIR	MORSE RESERVOIR
Structures (>400 sq. ft.)	31,916	9,642
Outbuildings (<400 sq. ft.)	8,315	1,973
TOTAL Structures	**40,231**	**11,615**
TOTAL Damages ($)	**$7.1B**	**$2.1B**

There are several critical infrastructure located within the delineated dam failure inundation area for the Eagle Creek Reservoir Dam and the Morse Reservoir Dam. **Table 3-19** identifies the number and type of critical facility within each potential inundation area. These buildings are included in the overall number of structures and damage estimates information provided in Table 3-18.

Table 3-19 Critical Structures in the Potential Dam Inundation Area

	EAGLE CREEK RESERVOIR	MORSE RESERVOIR
Indianapolis	1 Ag/Food 49 Bridge 5 Chemical 2 Commercial 1 Communication 1 Dam 1 Emergency Response 2 energy 1 Government 3 Hospital 1 Manufacturing 1 Petroleum 28 School 2 Transportation 8 Water	50 Bridge 1 Chemical 1 Communication 4 Emergency Response 1 Energy 12 School 4 Water
Speedway	2 Bridge 1 Chemical 1 Commercial 1 Energy 1 Government 1 Manufacturing 1 School 1 Water	
TOTAL Structures	**122**	**73**

Figure 3-22 WR-20(a) Levee Upstream of the Confluence of the White River and Fall Creek

There are 2 accredited levees in Marion County: HD-C1 and WR-C1; 5 levees in the accreditation process: EC09(b), EC12(c), WR16(a), WR20(a)/FC02(a), and WR17/WR18; and 2 levees where deficiencies must be corrected prior to the accreditation process is begun: LEC01 and LEC04. These levees are identified on Exhibit 3 and a portion of the WR20(a) levee is shown in **Figure 3-22**.

In 2008, CBBEL was retained by the City of Indianapolis to assist the City with researching the inventory, status, and general conditions of all the levees in Indianapolis. CBBEL was also tasked to develop a list of recommended levees that may be eligible for recertification through FEMA and determine the extent and cost of generating data needed as technical evidence. Table **3-20** indicates the number and type of structures located behind each of the consequential levee segments reviewed in 2008.

Table 3-20 Structures Located Behind Consequential Levees in Marion County

LEVEE SEGMENT	NUMBER/TYPE OF STRUCTURE
WR-16	**614**: 493 Residential; 63 Commercial; 39 Industrial; 19 Exempt/Utilities
WR-20(a)/FC-02(a)	**12**: 3 University; 9 Commercial
LEC-01	**105** Mobile homes
EC-09(b)	**11** Multifamily Residential
EC-12(c)	**150:** 14 Multifamily, 11 Duplex, 125 Single Family Residential
WR-20(b)	**2:** 1 Park Building; 1 Golf Course
HD-C1/WR-C1	**455:** 1 School; 16 Commercial; 46 Multifamily, 287 Single Family Condominiums, 105 Residential
LEC-04	**27:** 26 Residential, 1 Commercial
WR-17/WR-18	0

(CBBEL, 2008)

Future Considerations

As areas near existing dams or levees continue to grow in population, it can be anticipated that the number of critical and non-critical structures will also increase accordingly. Location of these new facilities should be carefully considered and precautions should be taken to ensure that schools, medical facilities, municipal buildings, and other critical infrastructure are located outside of the delineated or estimated dam failure inundation areas and

outside the levee-protected areas. Also, flood-free access should be provided for these facilities.

It is also very important to all downstream communities and property owners that all IEAPs are kept up-to-date as well as routinely exercised to ensure the greatest safety to those within the hazard area. It is also important to note that, due to their relatively low design standard, the levees are vulnerable to overtopping and failure. Detailed flood response and evacuation plans should be prepared for these areas and exercised routinely. There should also be a significant targeted level of public education for these areas.

Dam & Levee Failure: Relationship to Other Hazards

With the potentially large volumes and velocities of water released during a dam breach, it can be expected that a dam failure would lead to flooding and within the inundation areas downstream of the dam. Similarly, if levee systems are located within the dam failure inundation area, increased stress may be applied to these systems leading to a potential levee failure as well.

Downstream bridges and roads are also in danger of being destroyed or damaged due to a dam failure. Bridges may become unstable and portions of road surfaces may be washed away or the entire road may be undermined. Other infrastructure such as utility poles and lines may be damaged as the water flows along the surface or pipes may become exposed due to scouring; all of which may lead to utility failures within the area downstream of the dam failure.

Several other independent hazards may also lead to a dam failure. Hazards such as flooding, the melting of snow or ice, or rapid precipitation associated with thunderstorms, may all lead to increased pressure on the dam structures or overtopping of the structures, leading to failure. Additionally, earthquakes or tornadoes may cause damage to the structures or earthen components of the dam resulting in irreparable damages or failure.

3.3.9 Hazardous Materials Incident

Hazardous Material Incident: Overview

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

Figure 3-23 Drums of Potentially Hazardous Waste

As materials are mobilized for treatment, disposal, or transport to another facility, all infrastructure, facilities, and residences in close proximity to the transportation routes are at an elevated risk of being affected by a hazardous materials release. Often these releases can cause serious harm to Marion County and its residents if proper and immediate actions are not taken. Most releases are the result of human error or improper storage (**Figure 3-23**), and corrective actions to stabilize these incidents may not always be feasible or practical in nature.

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

Hazardous Materials Incident: Recent Occurrences

During conversations with Committee members and through information provided by local news outlets, it was noted that several incidents involving manufacturing facilities and transportation routes occur each year in Marion County. The number of facilities utilizing, storing, and/or manufacturing chemicals and the number of high volume transportation routes increase the likelihood of an incident.

In November 2012, Indianapolis hazmat responders were called to a Rolls-Royce facility in reaction to a potentially dangerous mixture of acids as a result of a valve failure. According to a Channel 13, wthr.com report, "a valve failed,

causing three types of acid to mix in an aluminum drum, and eat through the drum. That's when employees called 911". A possible explosion was a concern, but responders quickly neutralized the mixture and ultimately no injuries were reported.

Garfield Park Aquatic Center was the location of a chemical incident in June 2012. A pump failure resulted in a large dosing of a water purification chemical as visitors were using the pool facilities. At least 71 people were sent to local hospitals with reactions similar to smoke inhalation including coughing and vomiting.

According to the Committee, the probability of a hazardous materials release or incident is "Highly Likely" throughout all of Marion County with all areas expected to have "Limited" damages as a result. This is in part due to the nature of the transportation routes as well as the number of chemical related facilities in the county. The warning time for such an event is anticipated to be less than 6 hours and the duration will be less than 1 day. A summary is shown in **Table 3-21**.

Table 3-21 CPRI for Hazardous Materials Incident

	PROBABILITY	MAGNITUDE/ SEVERITY	WARNING TIME	DURATION	CPRI
Indianapolis	Highly Likely	**Limited**	< 6 Hours	**< 1 Day**	Severe
Beech Grove	Highly Likely	**Limited**	< 6 Hours	**< 1 Day**	Severe
Lawrence	Highly Likely	**Limited**	< 6 Hours	**< 1 Day**	Severe
Southport	Highly Likely	**Limited**	< 6 Hours	**< 1 Day**	Severe
Speedway	Highly Likely	**Limited**	< 6 Hours	**< 1 Day**	Severe

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

Hazardous Materials Incident: Assessing Vulnerability

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

Direct Effects:

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

Indirect Effects:

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

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

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

In Marion County, 582 facilities are subject to SARA Title III provisions due to the presence of listed hazardous materials in quantities at or above the minimum threshold established by the Act. These facilities are also required to create and distribute emergency plans and facility maps to local emergency responders such as the LEPC, fire departments, and police departments. With this knowledge on hand, emergency responders and other local government officials can be better prepared to plan for an emergency, the response it would require, and prevent serious affects to the community involved.

Estimating Potential Losses

In addition, the very nature of these events makes predicting the extent of their damage very difficult. A small-scale spill or release might have a minor impact and would likely require only minimal response efforts. Another slightly larger incident might result in the disruption of business or traffic patterns, and in this situation might require active control response measures to contain a spill or release. On the other hand, even small or moderate events could potentially grow large enough that mass evacuations or shelter in place techniques are needed, multiple levels of response are utilized, and additional hazards such as structural fires and/or additional hazardous materials releases (or explosions) may occur. Given the unpredictable nature

of hazardous materials incident, an estimate of potential losses was not estimated.

Future Considerations

Figure 3-24 Fuel Tanker Fire

Additional facilities, both critical and non-critical in nature may be affected if a hazardous materials release were to occur along a transportation route (**Figure 3-24**). Several routes including railways, Interstate 65, 69, 70, 74, and 465; and numerous segments of US Highways and State Routes are traveled by carriers of hazardous materials.

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

<u>Hazardous Materials Incident: Relationship to Other Hazards</u>

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

3.3.10 Structural Fire

Structural Fire: Overview

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

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

Figure 3-25 Structural Collapse Following a Fire at the Former Link Belt Factory

Structural Fire: Recent Occurrences

"At one point nearly 200 emergency responders from seven fire departments were at the scene battling the Indianapolis southwest side fire" according to a report posted to Channel 13, wthr.com on June 16, 2013. This event began as a fire at a recycling center and included several propane tank explosions, at least 4 inured firefighters, and evacuations of neighborhoods within a 5 block radius of the facility. An additional concern during this incident was the falling ash and drifting embers that ignited dumpsters approximately 1/8 of a mile away. **Figure 3-25** indicates some of the damage

at this location, a recycling center within the former Link Belt Factory on Belmont Avenue.

The November 2012 "Richmond Hill Explosion" will be in the memories of emergency responders and Indianapolis area residents for a long time. Two people were killed and dozens of homes were severely damaged following a gas leak explosion. This event was later determined to be the result of tampering with gas lines and equipment at one residence. Estimates of damages exceeded $4.4M as approximately 30 residences were deemed unsafe, 5 were completely destroyed and 10 with major damage. Indianapolis' Department of Code Enforcement found 86 homes affected by the blast and subsequent fires. **Figure 3-26** identifies some of the immediate damages caused by the explosion in the Richmond Hills subdivision.

Figure 3-26 Richmond Hill Subdivision Explosion

The Committee, the probability of a hazardous materials release or incident is "Highly Likely" throughout all of Marion County with all areas expected to have "Limited" damages as a result. This is in part due to the nature of the transportation routes as well as the number of chemical related facilities in the county. The warning time for such an event is anticipated to be less than 6 hours and the duration will be less than 1 day. A summary is shown in **Table 3-22**.

Table 3-22 CPRI for Structural Fire

	PROBABILITY	MAGNITUDE/ SEVERITY	WARNING TIME	DURATION	CPRI
Indianapolis	Highly Likely	Limited	< 6 Hours	< 1 Day	Severe
Beech Grove	Highly Likely	Limited	< 6 Hours	< 1 Day	Severe
Lawrence	Highly Likely	Limited	< 6 Hours	< 1 Day	Severe
Southport	Highly Likely	Limited	< 6 Hours	< 1 Day	Severe
Speedway	Highly Likely	Limited	< 6 Hours	< 1 Day	Severe

Structural Fire: Assessing Vulnerability

Given the unpredictable nature of structural fire hazards, an estimate of potential losses associated with this hazard is difficult to predict. Vulnerable structures may be found in all land use classes throughout Marion County and will include all critical infrastructure and non-critical structures.

Direct Effects:

- Loss of structure and contents
- Emergency response dependent on nature and magnitude of the fire
- Potential for loss of life
- Damages to adjacent properties or structures, potentially increasing the magnitude of the fire as well as increasing the response needed

Indirect Effects:

- Loss of revenue for affected businesses or properties involved
- Potential need for temporary housing/shelter for residents involved
- Expenditures related to debris removal and/or demolition of structures involved

Estimating Potential Losses

Relatively speaking, high-rise fires are likely to have the greatest social and economic losses of all fire hazards. A significant high-rise fire involving a commercial structure would likely displace several businesses and their employees, and losses would include both structural damages and business interruptions. In the event of a significant high-rise fire involving a residential complex, shelters and safe havens would be needed for resident displacement, and in the long-run housing replacements would be needed.

According to the National Fire Protection Association (NFPA), there were 1.4M fires reported throughout the United States in 2011. Of that total, nearly 485K fires were structural fires resulting in 2,600 deaths, 15,600 injuries, and $9.7B

in property damages. Further, a structure fire is reported every 65 seconds within the United States.

Future Considerations

It is difficult to remove the potential for a structural fire occurrence. As the number of structures within the county increase through development or change in use and nature through re-development, the risk of a structure fire will also likely increase. Within Marion County, high-rise commercial structures are numerous within Indianapolis, and all communities have large multi-family, multi-structure apartment complexes that would result in a great number of displaced residents as well as a great impact on the business present.

Structural Fire: Relationship to Other Hazards

Structural fires can be very destructive in nature and while causing significant damages, may not result in creating additional hazards, such as those studied in this planning effort. Fires routinely lead to hazardous materials concerns, and even to releases and spills when the fires are located in storage or manufacturing areas. However, it is not anticipated that a structural fire will lead to other hazards such as weather related hazards, or other technological hazards in this effort.

POLITICAL HAZARDS

3.3.11 Civil Disturbance

Civil Disturbance: Overview

Civil disturbances typically occur when highly visible and large-scale public events result in rioting, looting, arson, disruption of essential services and functions, or other unlawful behavior. These disturbances typically occur in association with event and activities with strong public interest and attention. Historically within the United States, civil disturbances have occurred frequently and have had a wide range of physical, social, and economic impacts.

Civil Disturbance: Recent Occurrences

There are numerous events conducted in Marion County that could potentially result in civil disturbances. **Table 3-23** lists facilities and events that frequently attract high public scrutiny and media attention within Marion County.

Table 3-23 Facilities and Events with Potential for Civil Disturbance

Event/Facility	Description
Indiana Convention Center	The Center hosts several hundred small and large events each year. Attendance at such events may range from 30 people in a small conference room, to over 50,000 for one event. The Convention Center is also connected to Lucas Oil Stadium via tunnel under South Street.
Indianapolis Motor Speedway	Several national and international racing events are held at the speedway each year. The Indianapolis 500, the Brickyard 400, the MotoGP are a just a few of those events drawing several hundred thousand spectators.
Bankers Life Fieldhouse	Home to the Indiana Pacers and the Indiana Fever this facility also host a number of events, concerts, and activities throughout the year.
Indiana State Fairgrounds	The State Fair typically draws nearly 1M visitors each year and the grounds are host to many events such as hockey games, trade shows, and other gatherings.
Black Expo	At nearly 100,000 attendees, this event provides concerts, health fairs, and other entertainment throughout downtown

	Indianapolis.
Mini Marathon	The "Mini" typically draws nearly 50,000 people from around the world as competitors, volunteers, and spectators. The path of this race goes through Indianapolis as well as Speedway.
Lucas Oil Stadium	Home to the Indianapolis Colts, this facility also hosts several concerts, events, and other sports events throughout the year.
Government Buildings	Each year, in every community, potentially polarizing decisions are made in these facilities. With State Government Office for several agencies and Congressmen located in Indianapolis, these facilities are also high profile locations for protests and gatherings.

While certainly possible, civil disturbance does not seem to be a common occurrence within Marion County. This is in large part due to the successful partnerships between event and facility planners and the local law enforcement agencies that patrol or observe these large events and facilities. Reports of civil disturbances were not located through local media searches and the Committee discussed the fact that while the possibility does exist, the law enforcement and their quick reactions typically prevent disturbances from reaching a riotous level.

The Committee determined that based on their experiences and understanding of this type of hazard, it would be "Likely" that a civil disturbance would happen in each of the communities and that would this type of disturbance occur, the magnitude would be "Limited". Further, there would be less than 6 hours warning time prior to the actual disturbance and that due to the amount of planning and communications involved, the actual duration would also be less than 6 hours. A summary of the determinations is provided in **Table 3-24**.

Table 3-24 CPRI for Civil Disturbance

	PROBABILITY	MAGNITUDE/ SEVERITY	WARNING TIME	DURATION	CPRI
Indianapolis	Likely	**Limited**	< 6 Hours	**< 6 Hours**	Elevated
Beech Grove	Likely	**Limited**	< 6 Hours	**< 6 Hours**	Elevated
Lawrence	Likely	**Limited**	< 6 Hours	**< 6 Hours**	Elevated
Southport	Likely	**Limited**	< 6 Hours	**< 6 Hours**	Elevated
Speedway	Likely	**Limited**	< 6 Hours	**< 6 Hours**	Elevated

Given the large size, strong public interest, and regular frequency associated with numerous events within the County, it was determined that these types of disturbances may occur within any of the individual communities. This is in part due to the interconnectedness of the events, lodging, and other accommodations during such large events.

Civil Disturbance: Vulnerability Assessment

Civil disturbances can have a variety of physical, social, and economic impacts to a community, and while certain facilities and events are more likely than others to be the site of a civil disturbance, these incidents can occur in nearly any location.

Direct Effects:

- Increased number of emergency responders ready to activate if needed
- Increased security efforts for buildings and grounds crews during events
- Increased potential for escalating chaos or criminal activity

Indirect Effects:

- Damages from participants, either to structures, property, or people
- Increased expenditures related to observation and enforcement needs by emergency response agencies.
- Increased perceptions of heightened risk based on historical disturbances

Estimating Potential Losses

In addition, the very nature of these events makes predicting the extent of their damage very difficult. A small-scale disturbance such as a local labor strike might have a minor community impact and would likely require only minimal police oversight or management. Another slightly larger disturbance might be associated with a protest growing large enough to begin disrupting businesses or traffic patterns, in this situations police intervention might require active control, but not likely requires the use of chemical agents or riot gear. On the other hand, civil disturbances could potentially grow large enough and violent enough that rioting, looting, arson, and other violent acts might occur. These larger disturbances usually require the use of chemicals, riot gear, and large-scale arrests in order to restore order. Given the unpredictable nature of civil disturbances, an estimate of potential losses associated with a disturbance was not estimated.

Future Considerations

Social, physical, and economic losses associated with a civil disturbance will likely increase as more people choose to live, work, and visit Marion County. Ensuring that residents and visitors are well informed about the potential impacts and threats associated with civil disturbances and the proper methods to protect themselves and their property will help reduce future damages and losses.

Civil Disturbance: Relationship to Other Hazards

Civil disturbances are not expected to result in any of the hazards studied in this planning effort except a structural fire. Numerous examples exist of civil disturbances escalating into a potentially riotous situation with ignitions and associated damages. Similarly, it is not expected that any other hazards would directly lead to a civil disturbance. The Committee did determine that an extreme heat event may lead to a situation on the brink of a civil disturbance.

3.4 HAZARD SUMMARY

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

Table 3-25 summarizes the CPRI values for the various hazards studied within this MHMP. The hazards that ranked as "Severe" risk were flooding; earthquake; extreme temperatures; hailstorm, thunderstorm and windstorm; hazardous materials incident; structural fire; tornado; winter storm and ice storm. Hazards with "Elevated" risk include: civil disturbance; dam and levee failure; drought; and tornado.

Table 3-25 Combined CPRI

TYPE OF HAZARD	LIST OF HAZARDS	WEIGHTED AVERAGE CPRI
Natural	Drought	
	Earthquake	
	Extreme Temperature	
	Flood	
	Hail/Thunder/Wind	
	Tornado	
	Winter Storm/Ice	
Technological	Dam/Levee Failure	
	Hazardous Materials Incident	
	Structural Fire	
Political	Civil Disturbance	

It can be important to understand the cause and effect relationship between the hazards selected by the Committee. **Table 3-26** can be utilized to identify those relationships. For example, a winter storm (along the side of the table) can result in a flood (along the top of the table). In a similar fashion, a hazardous materials incident (along the top of the table) can be caused by an earthquake; flood; hailstorm, thunderstorm, or windstorm; tornado; or a winter storm or ice storm (along the side of the table).

Table 3-26 Relationship of Hazards

EFFECT → / CAUSE ↓	Drought	Earthquake	Extreme Temperatures	Flooding	Hailstorm, Thunderstorm, Windstorm	Tornado	Snow and Ice Storm	Dam & Levee Failure	Hazardous Materials	Structural Fire	Civil Disturbance
Drought										X	
Earthquake								X	X	X	
Extreme Temperatures											X
Flooding								X	X	X	
Hailstorm, Thunderstorm, Windstorm				X				X	X	X	
Tornado								X	X	X	
Snow and Ice Storm				X				X	X		
Dam & Levee Failure				X					X		
Hazardous Materials										X	
Structural Fire									X		
Civil Disturbance										X	

As a method of better identifying the potential relationships between hazards, Exhibit 3 can be referenced to indicate the proximity of one or more known hazard areas such as the delineated floodplains and the locations of EHS facilities. For this reason, the City of Indianapolis or any other community may be impacted by more than 1 hazard at a time, depending on certain conditions. It can be anticipated that if a flood were to occur within these areas, there would be a potentially increased risk of this facility experiencing a hazardous materials incident.

Future development in areas where multiple known hazard areas (dam failure inundations areas, floodplains and surrounding hazardous materials facilities) overlap should undergo careful design, review, and construction protocol to reduce the risk of social, physical, and economic losses due to a hazard incident. While it may certainly be difficult, critical infrastructure should be constructed within these regions.

CHAPTER 4 MITIGATION GOALS AND PRACTICES

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

4.1 MITIGATION GOAL

REQUIREMENT §201.6(c)(3)(i):
[The hazard mitigation strategy shall include a] description of mitigation goals to reduce or avoid long-term vulnerabilities to the identified hazards.

The Committee reviewed the mitigation goals as outlined within the 2006 Marion County MHMP and determined that each of these remain valid and effective. In summary, the overall goal of the Marion County MHMP is to reduce the social, physical, and economic losses associated with hazard incidents through emergency services, natural resource protection, prevention, property protection, public information, and structural control mitigation practices.

4.2 MITIGAITON PRACTICES

REQUIREMENT §201.6(c)(3)(ii):
[The mitigation strategy shall include a] section that identifies and analyzed a comprehensive range of specific mitigation actions and projects being considered to reduce the effects of each hazard, with particular emphasis on new and existing buildings and infrastructure.

REQUIREMENT §201.6(c)(3)(iii):
[The mitigation strategy section shall include] an action plan describing how the actions identified in section (c)(3)(ii) will be prioritized, implemented, and administered by the local jurisdiction. Prioritization shall include a special emphasis on the extent to which benefits are maximized according to a cost benefit review of the proposed projects and their associated costs.

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

found that FEMA mitigation grants are cost-effective since they often lead to additional non-federally funded mitigation activities, and have the greatest benefits in communities that have institutionalized hazard mitigation programs. Six primary mitigation practices defined by FEMA are:

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

4.2.1 Existing Mitigation Practices

As part of this planning effort, the Committee discussed the strengths and weaknesses of existing mitigation practices and made recommendations for improvements, as well as suggested new practices. The following is a summary of existing hazard mitigation practices within Marion County. Mitigation measures that were included in the 2006 Marion County MHMP are noted as such.

<u>Emergency Services</u>

- The Indianapolis DHS maintains nearly 170 outdoor warning sirens which provide 97% coverage for Marion County. If a siren fails, an alert will be sent to DHS staff. *(2006 Measure)*
- NOAA weather radios, purchased through a UASI grant have been distributed to critical infrastructure and the public through weather-related events. *(2006 Measure)*
- Additional storm centers (5) were added along the western border of Marion County at aid in detection of severe weather.
- A Marion County Community Emergency Response Team (CERT) effort has resulted in the training of over 500 participants including major employers, critical infrastructure, and varying demographic constituents. *(2006 Measure)*

- The Indianapolis DHS maintains a working relationship with large event planners as well as facility liaisons to ensure coordination in the event of a hazardous incident. *(2006 Measure)*
- The Indianapolis DHS maintains and utilizes more than 60 cameras to monitor critical infrastructure and neighborhoods with recorded data stored for a period of time. *(2006 Measure)*
- The Indianapolis DHS maintains a dedicated EOC for utilization during various hazardous events, large planned events, or during exercises.
- The Indianapolis DHS utilizes a reporting and tracking system to document resources needed and expenditures related to hazardous events within the County.
- Several real-time stream gages equipped with the AHPS capabilities provide data regarding stream gage height and action levels. *(2006 Measure)*
- Trained weather spotters, amateur radio operators, and other volunteers are utilized to provide timely severe weather warnings.
- The American Red Cross continuously works within the County to provide assistance as needed in response to a disaster, including the set-up of temporary shelters. *(2006 Measure)*
- The Marion County LEPC and Indiana DHS District 5 utilize realistic hazardous materials related training exercises that simulate response conditions and scenarios for emergency responders, decision makers, and the public. This group also ensures that up-to-date facility maps and hazardous materials information are available for all Tier II facilities.

Natural Resource Protection

- The City of Indianapolis (along with the Cities of Beech Grove, Lawrence, Southport, and the Town of Speedway participate as a part of the Unified Government of the City of Indianapolis, Marion County) is in good standing with the NFIP Program and have flood protection ordinances that meet minimum requirements.
- The City of Indianapolis, which provides drainage oversight and planning to all areas of Marion County, employs staff certified as a CFM and that participate in the Indiana Association of Floodplain and Stormwater Managers.
- The communities within Marion County utilize Indiana Water Conservation guidelines during time of drought. *(2006 Measure)*
- The communities within Marion County have established procedures for issuing and enforcing burn bans during times of drought.

- Current Wellfield Protection and Flood Control regulations have been evaluated and recommendations have been made to better protect natural resources through the "Indy Rezone" process.

Prevention

- The City of Indianapolis participates in the CRS program at a Class 8 which provides a 10% reduction in flood insurance premiums throughout Marion County. *(2006 Measure)*
- The City of Indianapolis completed an Abandoned Properties Action Plan which inventories unsafe structures to be demolished which reduces the likelihood of structural fires and/or arson. *(2006 Measures)*
- The City of Indianapolis and the DHS have an active GIS department with a well-developed GIS inventory of essential facilities and localized building information that can be utilized to aid in land use planning and decision making efforts.
- Utility providers in Marion County routinely complete tree maintenance as needed to prevent dead and dying tree limbs from falling and damaging property and power lines, or injuring people during severe weather incidents.
- Many local developers are choosing to bury power lines in new developments and in large areas of re-development, although there are no requirements to do so.
- The City of Indianapolis completed a web-based Flood Response Plan (FRP) that uses real-time stream gages to improve flood response efforts and reduce flood-related losses in repetitive loss areas and low-lying areas throughout the County.
- Staff members from various planning departments and local agency partners have attended advanced HAZUS-MH classes. *(2006 Measure)*

Property Protection

- All communities are following the International Building Code which includes requirements to minimize damages from natural hazards.
- DHS acquired a floodprone property in Lawrence using FEMA grant funds
- Indianapolis updated their Stormwater Standards to incorporate green infrastructure practices and created an incentive program for developers to incorporate these practices

Public Information

- Outreach materials are routinely provided within office and agencies throughout Marion County, large public events, speaking opportunities with schools, etc. *(2006 Measure)*
- Multi-media campaigns (electronic, television, print, etc.) have been conducted related to emergency preparedness at the household level, what to do in case of an emergency, and where the public can turn for help should a hazardous event occur.

Structural Control

- The City of Indianapolis has completed an IEAP and an Emergency Response Plan (ERP) for Eagle Creek Reservoir Dam and Pogue's Run *(2006 Measure)*
- The City of Indianapolis conducts routine inspections of consequential levees throughout the County *(2006 Measure)*
- The City of Indianapolis FRP includes regular inspections of all levee segments as part of the flood preparedness activities *(2006 Measure)*
- Indianapolis is in the process of certifying levees along the White River, Fall Creek and Eagle Creek to protect adjacent buildings and infrastructure from the 100-year flood and is implementing a maintenance schedule on non-certified levees
- Indianapolis continues to work with the USACE to construct a floodwall along the White River to protect the Broad Ripple, Warfleigh, and Butler neighborhoods

4.2.2 Proposed Mitigation Practices

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

- **Social** – the proposed mitigation projects will have community acceptance, they are compatible with present and future community values, and do not adversely affect one segment of the population.
- **Technical** – the proposed mitigation project will be technically feasible, reduce losses in the long-term, and will not create more problems than they solve.
- **Administrative** – the proposed mitigation projects may require additional staff time, alternative sources of funding, and have some maintenance requirements.

- **Political** – the proposed mitigation projects will have political and public support.
- **Legal** – the proposed mitigation projects will be implemented through the laws, ordinances, and resolutions that are in place.
- **Economic** – the proposed mitigation projects can be funded in current or upcoming budget cycles.
- **Environmental** – the proposed mitigation projects may have negative consequences on environmental assets such as wetlands, threatened or endangered species, or other protected natural resources.

Table 4-1 lists a summary of all proposed mitigation practices identified for all hazards, as well as information on the local status, local priority, benefit-cost ratio, project location, responsible entity, and potential funding source, associated with each proposed practice. The proposed mitigation practices are listed in order of importance to Marion County for implementation. Projects identified by the Committee to be of "high" local priority may be implemented within 5 years from final Plan adoption. Projects identified to be of "moderate" local priority may be implemented within 5-10 years from final Plan adoption, and projects identified by the Committee to be of "low" local priority may be implemented within 10+ years from final Plan adoptions. However, depending on availability of funding, some proposed mitigation projects may take longer to implement.

The benefit derived from each mitigation practice along with the estimated cost of that practice was utilized to identify the mitigation practices having a high, moderate, or low benefit cost ratio. Preparing detailed benefit cost ratios was beyond the scope of this planning effort and the intent of the MHMP.

The update of this MHMP is a necessary step of a multi-step process to implement programs, policies, and projects to mitigate the effect of hazards in Marion County. The intent of this planning effort was to identify the hazards and the extent to which they affect Marion County and to determine what type of mitigation strategies or practices may be undertaken to mitigate for these hazards. A FEMA-approved MHMP is required in order to apply for and/or receive project grants under the Hazard Mitigation Grant Program (HMGP), Pre-Disaster Mitigation (PDM), Flood Mitigation Assistance (FMA), and Severe Repetitive Loss (SRL). FEMA may require a MHMP under the Repetitive Flood Claims (RFC) program. Although this MHMP meets the requirements of DMA 2000 and eligibility requirements of these grant programs additional detailed studies may need to be completed prior to applying for these grants. **Section 5.0** of this plan includes an implementation plan for all high priority mitigation practices identified by the Committee.

The CRS program credits NFIP communities a maximum of 72 points for setting goals to reduce the impact of flooding and other known natural hazards; identifying mitigation projects that include activities for prevention, property protection, natural resource protection, emergency services, structural control projects, and public information.

Table 4-1 Proposed Mitigation Practices

MITIGATION PRACTICE	MITIGATION STRATEGY	HAZARD ADDRESSED	
Community Rating System 1. Reduce flood insurance premiums through increased participation or advancement in the NFIP's CRS Program. *(2006 Measure)* *(Will assist with NFIP compliance)*	☒ Emergency Services ☒ Nat. Res. Protection ☒ Prevention ☒ Property Protection ☒ Public Information ☒ Structural Control	☐ Drought ☐ Earthquake ☐ Extreme Temperature ☒ Flood ☐ Hail/Thunder/Wind ☐ Tornado ☐ Winter Storm/Ice ☐ Dam/Levee Failure ☐ HazMat Incident ☐ Structural Fire ☐ Civil Disturbance	**Ongoing** 1. City c **Propose** 1. Prep Class
Public Education & Outreach 1. Provide hazard preparedness (warning sirens, radio stations, insurance protection, etc.) literature at public facilities and on agency websites as appropriate. *(2006 Measure)* 2. Post information/warning signage in local parks and other public gathering places explaining outdoor warning sirens and local radio stations that carry emergency information	☒ Emergency Services ☒ Nat. Res. Protection ☒ Prevention ☒ Property Protection ☒ Public Information ☒ Structural Control	☒ Drought ☒ Earthquake ☒ Extreme Temperature ☒ Flood ☒ Hail/Thunder/Wind ☒ Tornado ☒ Winter Storm/Ice ☒ Dam/Levee Failure ☒ HazMat Incident ☒ Structural Fire ☒ Civil Disturbance	**Ongoing** 1. Liter offic throu speci requ webs **Propose** 1. Enc enh grou with prot to d volu insu cam fam resi prot 2. Dev incl on F etc. ever

MITIGATION PRACTICE	MITIGATION STRATEGY	HAZARD ADDRESSED	
Emergency Response & Recovery 1. Purchase and utilize permanent and mobile video monitoring systems to help improve post-disturbance prosecution and enhance civil disturbance and crowd control training. 2. Designate and enforce snow removal routes with no street parking. 3. Improve planning and coordination among event coordinators, facility owners, and emergency response teams in preparation for large gatherings and crowd control.	☒ Emergency Services ☒ Nat. Res. Protection ☒ Prevention ☒ Property Protection ☒ Public Information ☐ Structural Control	☐ Drought ☐ Earthquake ☐ Extreme Temperature ☒ Flood ☒ Hail/Thunder/Wind ☒ Tornado ☒ Winter Storm/Ice ☒ Dam/Levee Failure ☒ HazMat Incident ☒ Structural Fire ☒ Civil Disturbance	**Ongo** 1. V 2. D 3. C o **Propo** 1. P p sy 2. D d 3. Ir
Floodplain Management 1. Conduct detailed hydraulic analyses of unstudied, understudied, and unnumbered Zone A streams to determine exact floodplain boundaries. *(2006 Measure)* 2. Adopt preliminary FIRMs and FIS 3. Support FEMA approved flood depth mapping (RiskMAP) to better understand the flood risk potential. 4. Update floodplain ordinance to include "No Adverse Impact" and/or compensatory storage language for future development in the floodplain 5. Re-establish multi-department watershed teams to improve water resource and floodplain planning and project coordination 6. Evaluate and implement recommendations from completed flood protection studies. 7. Complete fluvial erosion hazard mapping to identify and protect critical infrastructure that may be impacted by natural stream movement. 8. Increase freeboard requirement from 2 feet above the BFE to 3 feet or higher 9. Encourage the restoration of the natural stream corridor in new and redevelopment projects *(Will assist with NFIP compliance)*	☐ Emergency Services ☒ Nat. Res. Protection ☒ Prevention ☒ Property Protection ☒ Public Information ☐ Structural Control	☐ Drought ☐ Earthquake ☐ Extreme Temperature ☒ Flood ☐ Hail/Thunder/Wind ☐ Tornado ☐ Winter Storm/Ice ☐ Dam/Levee Failure ☐ HazMat Incident ☐ Structural Fire ☐ Civil Disturbance	**Ongoi** 1. Fl a **Propo** 1. C e m al 2. A 3. D p 4. Ir fl 5. R 6. Ir re 7. C p 8. U 9. E

MITIGATION PRACTICE	MITIGATION STRATEGY	HAZARD ADDRESSED	
Building Protection 1. Minimize impacts of flooding by diverting or retaining stormwater on site using green infrastructure practices 2. Protect existing critical infrastructure in 1% & 0.2% annual chance flood hazard. *(2006 Measure)* 3. Discourage development of new critical infrastructure in 1% & 0.2% annual chance flood hazard. *(2006 Measure)* 4. Encourage new or retrofitted critical infrastructure to incorporate structural bracing, shutters, laminated/impact-resistant glass and interlocking roof coverings to minimize damage. 5. Encourage the installation of lightning rods and grounding as well as surge protectors for critical infrastructure 6. Relocate, buyout, or floodproof (non-residential) existing non-critical structures that are subject to repetitive flooding. *(2006 Measure)*	☐ Emergency Services ☒ Nat. Res. Protection ☒ Prevention ☒ Property Protection ☒ Public Information ☒ Structural Control	☐ Drought ☐ Earthquake ☐ Extreme Temperature ☒ Flood ☒ Hail/Thunder/Wind ☒ Tornado ☐ Winter Storm/Ice ☒ Dam/Levee Failure ☒ HazMat Incident ☒ Structural Fire ☒ Civil Disturbance	**Ongoing** 2. The with **Propose** 1. Enc pro 2. Con or p 3. Con floo 4. Incc retr 5. Enc 6. Prio kno to r to a free
Emergency Preparedness & Warning 1. Purchase additional mobile electronic messaging boards to utilize during hazard events 2. Promote utilization of weather radios in all critical infrastructure, as well as residents and businesses 3. Establish procedures to alert and evacuate the populations in known hazard areas. 4. Improve disaster preparedness and emergency response through elements of the StormReady Community Program. 5. Coordinate with local business owners to include electronic alerts on private message boards	☒ Emergency Services ☐ Nat. Res. Protection ☒ Prevention ☒ Property Protection ☒ Public Information ☐ Structural Control	☒ Drought ☒ Earthquake ☒ Extreme Temperature ☒ Flood ☒ Hail/Thunder/Wind ☒ Tornado ☒ Winter Storm/Ice ☒ Dam/Levee Failure ☒ HazMat Incident ☒ Structural Fire ☒ Civil Disturbance	**Ongoing** 1. DPV mes 2. Mar outr 3. Indi noti affe 4. Loc "Stc **Propose** 1. Pur boa 2. Con and 3. Det noti 4. Bec Con

MITIGATION PRACTICE	MITIGATION STRATEGY	HAZARD ADDRESSED	
Management of High Hazard Dams and Levees 1. Encourage Dam owners to restrict unauthorized access to dams and levees 2. Improve condition of levees in poor or fair condition 3. Discourage development of new critical infrastructure in the dam break inundation areas and behind levees. 4. Protect existing critical infrastructure located behind levees 5. Review regular inspection and maintenance of high hazard dams and private levees regardless of ownership.	☐ Emergency Services ☐ Nat. Res. Protection ☒ Prevention ☒ Property Protection ☐ Public Information ☒ Structural Control	☐ Drought ☐ Earthquake ☐ Extreme Temperature ☐ Flood ☐ Hail/Thunder/Wind ☐ Tornado ☐ Winter Storm/Ice ☒ Dam/Levee Failure ☐ HazMat Incident ☐ Structural Fire ☐ Civil Disturbance	**Ongoi** 1. E **Propc** 1. C e t a 3. B a in 4. In in 5. E in m
Land Use Planning & Zoning 1. Incorporate hazard information, risk assessment, and hazard mitigation practices into the Comprehensive Land Use Plan and Development Review to better guide future growth and development. 2. Conduct a "Safe Growth Audit" of development plans and codes 3. Encourage plantings to shade buildings, parking lots, etc. to reduce urban heat island effect and to reflect heat away from buildings	☐ Emergency Services ☒ Nat. Res. Protection ☒ Prevention ☒ Property Protection ☒ Public Information ☐ Structural Control	☒ Drought ☒ Earthquake ☒ Extreme Temperature ☒ Flood ☒ Hail/Thunder/Wind ☒ Tornado ☒ Winter Storm/Ice ☒ Dam/Levee Failure ☒ HazMat Incident ☒ Structural Fire ☒ Civil Disturbance	**Ongoi** 1. Se pr th 2. Tr flc 3. IU tre **Propo** 1. Co 20 2. Ad We
Geographic Information Systems 1. Train GIS staff in HAZUS-MH to quantitatively estimate losses in "what if scenarios" and continue to use the most recent GIS data in land use planning efforts. *(2006 Measure)* 2. Map at risk public and commercial structures (earthquake, unsafe buildings, etc.)	☒ Emergency Services ☒ Nat. Res. Protection ☒ Prevention ☒ Property Protection ☒ Public Information ☒ Structural Control	☒ Drought ☒ Earthquake ☒ Extreme Temperature ☒ Flood ☒ Hail/Thunder/Wind ☒ Tornado ☒ Winter Storm/Ice ☒ Dam/Levee Failure ☒ HazMat Incident ☒ Structural Fire ☒ Civil Disturbance	**Ongoi** 1. GIS inf inf 2. Th stu **Propo** 1. Inc MH 2. Th inc

MITIGATION PRACTICE	MITIGATION STRATEGY	HAZARD ADDRESSED	
Power Back-Up Generators 1. Promote power back-up generators in all critical infrastructures. *(2006 Measure)* 2. Obtain funding to retrofit public facilities and/or all critical infrastructures with appropriate wiring and electrical capabilities for utilizing a large generator for power back-up. 3. Investigate the potential to utilize alternative energy generators.	☒ Emergency Services ☒ Nat. Res. Protection ☒ Prevention ☒ Property Protection ☒ Public Information ☐ Structural Control	☒ Drought ☒ Earthquake ☒ Extreme Temperature ☒ Flood ☒ Hail/Thunder/Wind ☒ Tornado ☒ Winter Storm/Ice ☒ Dam/Levee Failure ☒ HazMat Incident ☒ Structural Fire ☒ Civil Disturbance	**Ongoing** 1. Mar **Propose** 2. Retr capa 3. Inve
Water Conservation Ordinance 1. Establish the legal authority to fine or penalize Marion County residents disregarding the open burning ban. 2. Incorporate drought tolerant or xeriscaping practices into landscape ordinance requirements	☒ Emergency Services ☒ Nat. Res. Protection ☒ Prevention ☒ Property Protection ☒ Public Information ☒ Structural Control	☒ Drought ☐ Earthquake ☐ Extreme Temperature ☐ Flood ☐ Hail/Thunder/Wind ☐ Tornado ☐ Winter Storm/Ice ☐ Dam/Levee Failure ☐ HazMat Incident ☐ Structural Fire ☐ Civil Disturbance	**Ongoing** 1. Ope area **Propose** 1. Esta burn 2. Enh

CHAPTER 5 IMPLEMENTATION PLAN

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

5.1 BUILDING PROTECTION

Minimize impacts of flooding by diverting or retaining stormwater on site by utilizing green infrastructure practices.

- Investigate and prioritize areas prone to flooding.
- Determine the feasibility of incorporating green infrastructure practices on an individual site or regional scale.
- Encourage landowners to install the practices or to allow a demonstration project on their property.

5.2 COMMUNITY RATING SYSTEM

Reduce flood insurance premiums through increased participation and advancement in the NFIP's CRS Program.

- Review application and guidance materials and begin gathering supporting documentation.
- Complete application and calculate credits.
- Consult with ISO representative to review application prior to submission.
- Submit application for advancement within the CRS program.
- Maintain and record information as necessary for annual recertification.

5.3 EMERGENCY PREPAREDNESS & WARNING

Purchase additional mobile electronic message boards to utilize during hazard events.

- Determine number of message boards needed to adequately convey messages for typical hazard events.
- Secure funding or include in budget as appropriate.
- Obtain message boards.

Promote utilization of weather radios in all critical infrastructure as well as in all residences and businesses.

- Continue to stress the importance of weather radios in all literature, public events, and presentations provided.
- As available, secure funding to purchase weather radios.
- Provide weather radios to facilities in need.

Establish procedures to alert and evacuate the populations in known hazard areas.

- Investigate mass notification alert systems and determine which is most appropriate and compatible with components utilized at the Indianapolis DHS EOC.
- Secure funding and obtain the mass notification alert system.
- Train appropriate partnering agencies and personnel on the system, notifications, and procedures.
- Complete an education and outreach campaign informing the public, and especially those in a hazard area, about the mass notification alert system.

5.4 EMERGENCY RESPONSE & RECOVERY

Purchase and utilize permanent and mobile video monitoring systems to help improve post-disturbance prosecution and enhance civil disturbance and crowd control.

- Inventory areas and structures in need of permanent video monitoring systems as well as determine the number of mobile or temporary systems needed based on large events in the past.
- Secure funding, purchase, and install video monitoring systems as feasible.
- Utilize footage as needed to better plan and prepare for large events and crowds and in prosecution situations as needed.

5.5 FLOODPLAIN MANAGEMENT

Conduct detailed hydraulic analyses of unstudied, understudied, and unnumbered Zone A streams to determine exact floodplain boundaries.

- Review listing of unstudied streams and floodprone areas.
- Secure funding, municipal bond, or funds from existing budgets to complete floodplain studies.

- Update the Floodplain Prioritization Study to direct future analyses.

Adopt Preliminary FIRMs and FIS

- Review Preliminary FIRMs and FIS documentation.
- When finalized, adoption to be completed by the Indianapolis City-County Council

Support FEMA approved flood depth mapping (RiskMAP) to better understand the flood risk potential.

- Prioritize areas of greatest potential impact from flooding.
- Review effective floodplain boundaries.
- Secure funding and prepare a depth map to indicate the flood risk potential as a depth of water in affected areas.
- Inform land and property owners of the potential risk to their property and structures.

Update floodplain ordinance to include "No Adverse Impact" and/or compensatory storage language for future development in the floodplain.

- Review the City of Indianapolis' current floodplain ordinance.
- Determine areas where improvements or adjustments can be made to include compensatory storage requirements.
- Review ASFPM's NAI language and incorporate into existing floodplain ordinance.
- Adopt updated and revised floodplain ordinances as appropriate.

Re-establish multi-department watershed teams to improve water resource and floodplain planning and project coordination.

- Review previous agencies represented on the multi-department watershed teams.
- Update roster of personnel and contact information.
- Review roles and responsibilities of the team.
- Integrate the team into planning and project coordination.

5.6 LAND USE PLANNING & ZONING

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

- Draft language and prepare exhibits to incorporate into the appropriate sections of the Indianapolis Comprehensive Land Use

Plan, individual excluded cities' plans, neighborhood redevelopment plans, etc.
- Adopt amendments as appropriate

Conduct a "Safe Growth Audit" of development plans and codes.

- Obtain the American Planning Association materials related to conducting a "Safe Growth Audit"
- Create a Steering Committee to review and discuss long-range plans, ordinances, and other municipal planning documents.
- Utilize the MHMP hazard information and known hazard areas to develop areas where growth should be limited or restricted.
- Utilize audit findings to review long-range plans, ordinances, and other municipal planning documents.

5.7 MANAGEMENT OF HIGH HAZARD DAMS & LEVEES

Encourage dam owners to restrict unauthorized access to dams and levees.

- Inventory High and Significant dam owners and operators.
- Determine if access restrictions are currently in place at each dam or if further restrictions need to be added.
- Secure funding and install access restrictions as appropriate.

Improve conditions of levees in poor or fair condition.

- As levee inspections are completed (either routine or emergency), track observations for needed improvements or reconstruction.
- Secure funding and complete improvements and/or necessary repairs to enhance the levees to a "good" condition.

Discourage development of new critical infrastructure in the dam break inundation areas and behind levees.

- Utilize GIS layers of the dam break inundation areas developed through the preparation of an IEAP to highlight areas where development should be restricted or limited.
- As new development, or re-development, is proposed, inform the landowner of the risk.
- Provide the landowner and developer of actions that may be taken to reduce the risk of loss or damages in these hazard areas.

5.8 PUBLIC EDUCATION & OUTREACH

Provide hazard preparedness (warning sirens, radio stations, insurance protection, etc.) literature at public facilities and on agency websites as appropriate.

- Distribute literature at large public events throughout Marion County.
- Provide literature at all municipal offices as appropriate.
- Evaluate additional media outlets and utilize as appropriate (social media, print, billing inserts, etc.)

Post information and/or warning signage in local parks and other public gathering locations explaining outdoor warning sirens and local radio stations that carry emergency information.

CHAPTER 6 PLAN MAINTENANCE PROCESS

6.1 MONITORING, EVALUATING, AND UPDATING THE PLAN

REQUIREMENT §201.6(c)(4)(i):
[The plan maintenance process shall include a] section describing the method and schedule of monitoring, evaluating, and updating the mitigation plan within a five-year cycle.

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

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

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

During the annual meetings the Implementation Checklist provided in **Appendix 9** will be helpful to track any progress, successes, and problems experienced.

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

DMA 2000 requires local jurisdictions to update and resubmit their MHMP within 5 years (from the date of FEMA approval) to continue to be eligible for mitigation project grant funding. In early 2018, the DHS Director will once again reconvene the MHMP Committee for a series of meetings designed to replicate the original planning process. Information gathered following individual hazard incidents and annual meetings will be utilized along with updated vulnerability assessments to assess the risks associated with each hazard common in Marion County. These hazards, and associated mitigation goals and practices will be prioritized and detailed as in Section 3.0 this MHMP. Sections 4.0 and 5.0 will be updated to reflect any practices implemented within the interim as well as any additional practices discussed by the Committee during the update process.

Prior to submission of the updated MHMP, a public meeting will be held to present the information to residents of Marion County and to provide them an opportunity for review and comment of the draft MHMP. A media release will be issued providing information related to the update, the planning process, and details of the public meeting.

6.2 INCORPORATION INTO EXISTING PLANNING MECHANISMS

REQUIREMENT §201.6(c)(4)(ii):
[The plan shall include a] process by which local governments incorporate the requirements of the mitigation plan into other planning mechanisms such as the comprehensive or capital improvements, when appropriate.

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

Based on added language within each of the Comprehensive Plan updates the appropriate Zoning Ordinances and Floodplain Management Ordinances within each community would also need to be amended.

6.3 CONTINUED PUBLIC INOLVEMENT

REQUIREMENT §201.6(c)(4)(iii):
[The plan maintenance process shall include a] discussion on how the community will continue public participation in the plan maintenance

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

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

NFIP/CRS

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

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