

Marquette County, Wisconsin

Multi Hazard Mitigation Plan



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Madison · Milwaukee

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Executive Summary

What is Hazard Mitigation Planning?

It is safe to say that “hazard mitigation” is not a term used by most people as they go about their lives. Still, hazard mitigation could be critical to people’s basic health, safety, and welfare.

Simply put, hazard mitigation is defined as any action taken to reduce the chance of a natural hazard from happening, or to reduce a natural hazard’s impact on people or property when it does happen. Marquette County can be affected by any number of natural and human-made hazards. These include major storms, flooding, dam breaks, extreme temperatures, and disease outbreaks.

Hazard mitigation planning helps communities to develop consensus around actions to reduce or eliminate the long-term risk to human life, health, safety, and property from hazards. **This Multi-Hazard Mitigation Plan is a collection of the various actions that Marquette County and other communities in the County may take to mitigate hazards.** The actions fall into various categories and priority levels, cover different geographic areas, and address different types of hazards. The organization, contents, and data in the Plan are driven in part by the planning requirements of the Federal Emergency Management Agency (FEMA).

Marquette County’s Planning Process

Marquette County Emergency Management Agency (MCEM) took the first steps towards preparing this Plan in 2007. Having successfully completed a County-wide comprehensive plan in 2005, the County was poised to identify and mitigate local hazards. The initial impetus for developing this Plan was the County’s desire to attain federal funding to mitigate against future natural hazards to become compliant with the Disaster Mitigation Act of 2000. **Completion of the County-wide Multi-Hazard Mitigation Plan will make the County, its towns, and participating cities and villages eligible for grant funding for mitigation projects through FEMA.**

The County’s standing Public Safety Committee guided the development of this Plan over the course of about nine months, serving as the Hazard Mitigation Planning Committee. The Committee included five County Board members appointed by the Chair. The Committee, its staff, and consultants also pursued public, local government, and other stakeholder and expert input throughout the planning process. This included reaching out to local governments, state and federal agencies, property and business owners, and the general public. Chapter 1: Planning Process, of the Multi-Hazard Mitigation Plan further describes the public process.

Hazard Identification and Risk Assessment

Chapter 2: Planning Context of the Multi-Hazard Mitigation Plan begins by painting a picture of how natural and other hazards have affected the County and its communities today and in the past. Key information regarding the County’s geography, geology, climate, demographics, housing, employment, political jurisdictions, infrastructure, and emergency services are laid out. For instance, much of the County’s population and tourism historically grew around rivers, streams, and lakes—and their floodplains. This has had a profound impact on hazard risk in the County.

Based on historical research and reports from residents and agencies, the hazards that people and property are at risk of in Marquette County generally include:

- **Flooding**, particularly resulting from seasonal and sometimes unpredictable overflow of the Fox River and its tributaries—most notably the Montello River.
- **Potential dam failures**, which may result from flooding, severe weather, or lack of proper maintenance.
- **Severe storms**, including hail, lightning, tornadoes, and severe winds.
- **Severe winter storms**, including snow storms, ice storms, and blizzards.
- **Extreme temperatures**, including periods of extreme heat and extreme cold associated with Marquette County’s position in the nation’s interior.

- **Drought**, which can significantly affect the County’s strong farm economy and peoples’ water supply.
- **Earthquakes**, which can sometimes affect the County.
- **Human-caused and disease-outbreak hazards**, like animal-borne diseases and possibly spill-over from incidents in nearby areas. Other human-caused hazards, such as poor access or preparedness in areas vulnerable to natural hazards, are addressed at length in the Plan.

The Plan includes a “risk assessment” for each of these identified hazards within Chapter 3: Hazard Identification and Risk Assessment. This assessment helps determine how severe each hazard is, and how important hazard mitigation actions would be to address it. The risk assessment includes a history of hazard occurrences, a projection of the future probability of occurrences of each hazard, an assessment of the County’s vulnerability to each hazard (e.g., how many people would be affected), and a projection of potential damages from future occurrences of each hazard.

Hazard Mitigation Goals

Armed with knowledge of the hazards that most affect Marquette County, the Hazard Mitigation Planning Committee developed the following seven hazard mitigation goals, with input and review from the public:

- **Protect human lives, both today and for future generations**
- **Protect critical facilities, like schools and other places of assembly**
- **Protect public and environmental health**
- **Protect sensitive populations (elderly, children, low-income families, tourists)**
- **Prevent future risks of hazards in highly vulnerable areas**
- **Help people to protect themselves**
- **Promote the use of partnerships in hazard mitigation**

These goals were used to prioritize hazard mitigation actions and strategies to address each hazard. Other factors were also critical in identifying and prioritizing strategies. These included community support, whether the strategy was technically feasible, where it would be cost-effective, and what groups would be available to carry it out. Chapter 4: Mitigation Goals and Strategies, further describes the goal-setting process and then outlines all proposed hazard mitigation strategies.

The rest of this summary covers some of the highest priority mitigation strategies that are identified in this Plan. Readers are encouraged to review the entire Plan for a more complete review of these and other strategies.

Priority Mitigation Strategies for Multiple Hazards

In the course of preparing the Plan, it became apparent that certain strategies could be carried out following Plan adoption to address nearly all of the hazards listed above. These strategies include:

- **Pursuing Regular Community Outreach and Education.** Educational efforts should focus on simple changes in behavior that can minimize risks. Education also needs to be constantly reinforced to be effective. County and local governments can provide communities with information about the effect of disasters, methods for preventing damages, and the actions to take when disasters threaten a locality.
- **Improving Coordination and Communication among Emergency Responders.** Disasters cross jurisdictional boundaries and affect numerous aspects of a community—from physical safety, to economic stability, to environmental conditions. The County intends to continue to work to improve communication and coordination among the various emergency responders at all levels of government through various approaches.
- **Countywide Emergency Access Plan:** Natural hazards can result in road closures limiting the transportation of people, goods, and critical services. Marquette County will be prepared to reroute traffic and ensure that critical infrastructure can adequately accommodate traffic during natural hazards. Marquette County will work with government officials to adequately communicate road closure to the public to minimize transportation issues, such as through the use of a county info-line and Web page.

- **Promoting and Implementing Modern Hazard Warning Systems.** The County intends to continue outreach efforts to encourage all institutions, businesses, and residents to have a National Oceanic and Atmospheric Administration (NOAA) weather radio for up to date warnings and directions on pending hazards. Additionally, the County will explore expanding its system of warning the public and local governments about impending hazards, such as through automatic e-mails, a dedicated county hazard info-line, voice or text messages via phones, and/or an updated Web page.
- **Providing Adequate Emergency and Power Sources.** County emergency responders must be prepared to operate during natural hazards. The County will explore providing backup power and communication services for the County Emergency Operations Center.

Flood Hazard Mitigation: Address Critical Areas

Rivers in Marquette County exceed their banks during spring thaws and periods of very heavy rain on a fairly regular basis. In rural areas, this mainly leads to temporary road closures, erosion, and crop damage. In places of greater population density and economic activity, flooding can threaten homes, lives, health, economic activity, infrastructure, and the environment. In fact, during the writing of this Plan, Marquette County a sustained period of extremely heavy rain, within which several inches of rain fell causing sandbagging and evacuations in Montello. This recent event emphasizes that severe weather and flooding are a common natural hazard that the County must be prepared to mitigate. The highest priority strategies for mitigating future flooding in the County include the following:

- **Pursue Regular Community Outreach and Education,** including information on floodplain regulations, floodproofing, and flood insurance. Outreach should include procedures for homeowners, residents, and tourists during flood events, but should focus particularly on the coordination of emergency providers and on providing good information to local governments.
- **Update Official Floodplain Maps,** using modern hydrologic (water) models that reflect current conditions in and around waterways, particularly to map accurate floodway boundaries.
- **Enhance Stormwater Management and Erosion Control,** such as through better storm drainage and infiltration systems and removal of obstructions along waterways, to minimize the effect of flooding on private property and business activities.
- **Protect Critical Facilities and Infrastructure,** such as police and fire stations and schools. It is critical to both ensure that these facilities are not themselves flooded, and that they remain accessible to serve the population (e.g., access roads not flooded) in the event a natural hazard takes place.
- **Implement appropriate strategies to address areas that are subject to regular and problematic flooding, such as the central parts of the City of Montello and areas along the Fox River in the Town of Moundville.** For Montello, such a strategy may include ensuring access to and from critical facilities like the police and fire stations and County offices and pursuing effective floodproofing of the historic commercial buildings of downtown Montello. In addition, pursuing voluntary acquisition of homes located south of the historic downtown in Montello and those along the Fox River in the Town of Moundville that have experienced several floods in the past few years, along with a mutually agreeable plan for the relocation of the people who live there.

Dam Break Mitigation: Upgrade Aging Infrastructure

Over 50 dams in the County hold back water for recreational use, for protection of life and property, and for hydropower. Dams are most susceptible to failure during flash floods or prolonged precipitation events. Dam owners and operators must be attentive to weather conditions to ensure that all aspects of the dams are functioning properly, including the strength and integrity of the embankments around the dam. Many dams in Wisconsin were erected in the late 1800s and early 1900s. The fact that this infrastructure is aging is a growing concern across the state, as evidenced by the outcomes of the June 2008 storms. The highest priority strategies for dam failure mitigation include the following:

- **Develop Dam Emergency Action Plans.** An Emergency Action Plan is a formal document that identifies potential emergency conditions at a dam and prescribes procedures to be followed to eliminate the loss of life and minimize property damage. All dams that meet the Wisconsin Department of Natural Resources' large dam criteria or pose a threat to life or property are required by Wisconsin law to have an Emergency Action Plan. Based on the Wisconsin Department of Natural Resources' public database, 14 dams in Marquette meet "large dam" criteria, but only five are reported to have Emergency Action Plans. Efforts should be made to complete Emergency Action Plans for the remaining 9 dams.
- **Implement an Effective Program of Dam Monitoring and Maintenance.** Flood control structures should be monitored continuously during flood events, after flood events, and annually by a trained operator (e.g. Mason Lake). Tree and shrub maintenance also can reduce the impacts of debris damaging dam infrastructure.
- **Improve Planning and Regulatory Practices.** Modern erosion control, stormwater management, preservation of open space, wetlands, and other natural areas are all methods to manage runoff into area streams and lakes, which in turn reduces water levels during storms and stress on dams. Therefore, effective zoning and planning will properly minimize impacts to area dam infrastructure, as well as flooding in general.
- **Pursue Regular Community Outreach and Education.** Local residents and communities should be better informed of the potential loss to property and life that neighboring dams present. Upon the completion of the Emergency Action Plan the Wisconsin Department of Natural Resources should provide the County with dam break maps and associated planning documents. The County should then share with local governments and emergency providers this information that can be used for land use planning and other decisions.

Severe Storms Mitigation: Protect Vulnerable and Seasonal Populations

Marquette County has had its fair share of severe weather in the form of thunderstorms, straight line winds, tornadoes, and winter storms. This obviously affects the year-round population, which is getting older and possibly more vulnerable to hazards. In addition, the natural setting of the County and proximity to larger population centers draws thousands of visitors during warmer months—in fact, the County's population during a busy summer weekend can triple. This seasonal and tourist population congregates near waterways, creating a large, vulnerable, and potentially under-informed population to the threats posed by severe storms. The large increase in population creates a challenge for County safety and health officials, particularly in response to severe weather events. The comprehensive initiative recommended for severe storm mitigation includes the following strategies:

- **Pursue Regular Community Outreach and Education,** particularly towards owners of vulnerable properties such as campgrounds, vulnerable populations such as the elderly and tourists, and during the most vulnerable times of the year, mainly summer.
- **Promote and Implement Modern Hazard Warning Systems,** such as NOAA weather radios and tools like the internet and cell phones.
- **Advance the Construction of Shelters and Saferooms,** in locations that are central to existing vulnerable populations. For example, zoning ordinances should include provisions for the inclusion of saferooms/shelters for new developments like campgrounds, mobile home parks, and housing for the elderly or disabled, and grant funding should potentially be made available for their construction in existing developments.
- **Develop Reliable and Multiple Evacuation Routes from Key Places of Assembly,** such as recreation areas and the fairgrounds, through roadway improvements, signage, and coordination with the County and local emergency and protective service providers and with owners/operators of these places of assembly.

Wildfire Mitigation: Advancing Good Land Use Practices

Marquette County is largely rural. In the northern half of the County, over 40 percent of the landscape is forested. In April 2003, there was a large fire that affected about 570 acres in the northern part of the County, along with parts of neighboring counties. Forest fires are largely preventable or controllable with proper management approaches. The following strategies briefly describe recommended wildfire mitigation measures:

- **Support Active Forest Management to Minimize the Potential for Catastrophic Fires.** This includes promoting the preparation and implementation of forest management plans for large property owners, such as is required by the Managed Forest Law program through the Wisconsin Department of Natural Resources. A greater forest ranger presence in the County would also help.
- **Engage in Good Land Use Planning, Proper Home Siting, and Adequate Access to Homes in Fire Prone Areas.** In general, the number of homes in forested areas should be minimized through good local planning. Where they are located in forested areas, techniques such as creating a cleared space around the homes and providing safe and accessible driveway access are critical.
- **Pursue Regular Community Outreach and Education,** utilizing the Wisconsin Department of Natural Resources informational documents and the Marquette County Emergency Management’s local knowledge to devise an outreach plan.
- **Improve Coordination and Communication among Emergency Responders,** to more effectively manage local resources and timely response in the event of a large fire.

Implementing the Plan: Partnerships and Perseverance

Adoption of this Plan provides the County and local communities with a coordinated approach for prioritizing hazard mitigation activities over the next several years. Additional work, analysis, and participation will be necessary before many of these strategies can be carried out through action. Chapter 5: Plan Adoption and Implementation details the County’s implementation approach.

Also, local communities and other stakeholders will need technical support to implement many of local mitigation strategies. MCEM will prioritize its mitigation efforts by focusing assistance on areas most vulnerable to the most significant hazards, and where there is visible and consistent community support for hazard mitigation. Communities demonstrated their commitment to hazard mitigation through participation in this planning process, and can continue to do so by partnering with MCEM to implement this Plan.

Finally, many of the strategies recommended in the Plan can occur only if outside financial support through FEMA and other sources is garnered. The Plan has been written to position the County and its communities for this support, with full recognition and respect for the funding criteria of these agencies. The County and its communities will pursue funding for priority strategies identified in the Plan as opportunities present themselves.

This has been merely a summary of the Marquette County Hazard Mitigation Plan. Interested persons are encouraged to review the entire Plan document—or focus on key sections of interest—for more information.

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Chapter 1: Planning Process

Chapter 1 of the Marquette County Multi-Hazard Mitigation Plan documents the process followed to develop the Plan, including how it was prepared and who was involved in the planning process.

PLAN DEVELOPMENT

The development of this Plan was initiated by Marquette County Emergency Management (MCEM) Agency in 2007. The initial impetus for developing this Plan was the County's desire to attain federal funding to mitigate against future natural hazards and to become compliant with the Disaster Mitigation Act of 2000 (described further below). Completion of the County-wide Multi-Hazard Mitigation Plan would then make the County and participating local communities eligible for grant funding for future mitigation projects. Having successfully completed a Countywide comprehensive plan in 2005, the County was poised to efficiently and effectively identify and mitigate local hazards.

In October 2007, Marquette County was awarded funding by FEMA to create a Countywide Multi-Hazard Mitigation Plan. The County used this grant to hire Vandewalle & Associates to help MCEM staff develop the Plan. (Together, Vandewalle & Associates and MCEM staff are referred to as the "project team" throughout this document.) Work on the Plan began in December 2007, and the Plan was submitted to the Wisconsin Emergency Management Agency (WEM) for review and approval on July 1, 2008. A final Plan was approved by the Marquette County Board of Supervisors on August 19, 2008.

Benefits of Hazard Mitigation Planning

Hazard mitigation planning serves as a very useful tool for the County and individual communities to develop consensus around a plan of action to reduce or eliminate the long-term risk to human life and property from hazards. Specifically, the development of this Plan is intended to:

- Increase public awareness of risks of hazards in the County
- Establish hazard mitigation goals and priority mitigation strategies
- Establish priorities for the use of public resources to mitigate hazards
- Identify strategic partners to help implement the mitigation strategies
- Enable the County and participating municipalities to become eligible to apply for grant from FEMA for both pre-disaster and post-disaster mitigation projects

Additionally, implementation of this Plan will:

- Reduce the cost of recovering from natural hazards by decreasing damage
- Prevent injury and death to people exposed to hazards
- Speed emergency response to, and recovery from, disasters

Disaster Mitigation Act of 2000

The development of the Marquette County Multi-Hazard Mitigation Plan is a response to the passage of the Disaster Mitigation Act of 2000 (DMA), which was signed into law by the U.S. Congress on October 30, 2000, with the goal of reducing losses and future public and private expenditures, and improving response and recovery from disasters. This act, Public Law 106-390, amended the Robert T. Stafford Relief and Emergency Assistance Act.

The Act establishes that by November 1, 2004, local governments and tribal organizations must prepare a multi-hazard mitigation plan in order to be eligible for funding from the FEMA Pre-Disaster Mitigation Assistance Program and Hazard Mitigation Program. If a plan was not prepared by November 1, 2004, and a major disaster is declared, a local government or tribal organization must agree to prepare a multi-hazard mitigation plan within one year to be eligible for funding from the Hazard Mitigation Grant Program.

The Act requirement that natural hazards, such as flooding or severe weather, be addressed in the risk assessment and vulnerability analysis sections of the multi-hazard mitigation plan. Assessment of human caused hazards, such as hazardous waste spills, is encouraged but not required.

PLANNING PROCESS

Process Overview

The first step in the planning process was to organize the resources available through local, state, and federal organizations, and to organize a Hazard Mitigation Planning Committee to bring together people in the County with interest and/or expertise in disaster response, disaster history, and hazard mitigation.

The local outreach effort was then expanded to include representatives of municipalities in the County as well as residents and other stakeholders to collect a thorough understanding of hazard vulnerability and history of disasters in each community. After the hazards were identified, the project team determined the potential damage and impact of each hazard.

Armed with an understanding of the risks posed by natural hazards and knowledge of vulnerable areas as identified by municipalities, local residents and business owners, and/or Marquette County Emergency Management, the project team identified possible ways to avoid or minimize the damage to these areas through new as well as existing planning, education, and regulatory measures.

The project team then identified ways that the County and participating municipalities could bring the hazard mitigation plan to life. To ensure a successful long-term plan, a process for future reviews and updates to the plan and ways to measure the communities' progress in decreasing damage caused by hazards is identified in the Plan.

Hazard Mitigation Planning Committee

The Plan was prepared under the guidance of staff of the Marquette County Emergency Management Agency (MCEM) and the County's Public Safety Committee, which was designated as the County's Hazard Mitigation Planning Committee for purposes of this process. The Committee held four meetings during major junctures of the planning process. The Committee assisted in identifying areas and populations vulnerable to hazards, setting mitigation goals, evaluating mitigation strategies, and developing the implementation approach. The Committee also reviewed and approved a draft Plan prior to submittal to WEM. The Committee included five County Supervisors, and was staffed by staff from MCEM, the Marquette County Sheriff's Office, Marquette County Emergency Medical Service (EMS) staff, and the Coroner.

GOVERNMENT, PUBLIC, AND STAKEHOLDER INVOLVEMENT

Involvement of Local Governments and the Public

Project Kick-off / Risk Assessment Public Meetings

The project team organized three kickoff meetings in January and February 2008 to provide local government representatives and community members with information about the purpose and benefits of the Plan and an overview of the planning process. Additionally, participants were asked at these meetings to provide information on historical occurrences of disasters and areas of disaster vulnerability. Participants were also asked to provide their goals for the hazard mitigation plan and to identify strategies that they wanted to be evaluated as part of the planning process.

The first meeting on January 15, 2008, held in conjunction with the Marquette County Fire Association Meeting, was aimed at gaining knowledge from the local firefighters and police officers of essential facilities and hazards. The

second and third meetings were held on February 7, 2008 and February 12, 2008 at the County Public Safety Room and were targeted to the officials and residents of the towns, villages, and city in the County. The meetings were advertised in public meeting notices through the County, press releases to local media, flyers posted in public places, and invitations sent directly to each town, village, and city clerk and president, all Marquette County Departments, fire chiefs, local law enforcement, neighboring County Emergency Management Agencies, Public Safety partnering agencies, and interested individuals.

Fire and police representatives from towns, villages, and the city within the County were present at the Fire Association Meeting. Officials from the several towns, the city, the Marquette County Salvation Army, and Waushara County Emergency Management attended the February public meetings.

Mitigation Strategies Public Meetings

In April 2008, two public meetings were held to present the initial results of the hazard risk assessment and to seek input from local government representatives and County residents on potential mitigation strategies to be evaluated in the Plan.

The first Countywide public meeting was held on April 17, 2008 at the County Public Safety Room. The second meeting was held on April 28, 2008 in conjunction with the Marquette County Towns' Association Meeting in the Town of Neshkoro.

The meetings were advertised in public meeting notices through the County and City, press releases to local media, flyers posted in public places, and invitations sent directly to each town, village, and city clerk and president, all Marquette County Departments, fire chiefs, local law enforcement, neighboring County Emergency Management Agencies, Public Safety partnering agencies, and interested individuals.

Hazard Mitigation Committee Meetings

Representatives of the County and all municipalities in the County were able attend Hazard Mitigation Planning Committee (Public Safety Committee) meetings. The following jurisdictions were represented at these meetings:

December 2, 2007: Marquette County and the City of Montello

April 7, 2008: Marquette County and the City of Montello

June 23, 2008: Marquette County and the City of Montello

County Department Heads Meeting

On January 4, 2008, the project team met with County department heads in Montello. The goal of this meeting was to hear each department's role in hazard mitigation, their goals for the Plan, and what strategies should be utilized to address their major concerns.

Involvement of Adjacent Jurisdictions and Government Agencies

The project team extended an invitation for a meeting on February 7, 2008 to representatives of the U.S. Department of Agriculture (USDA), Department of Natural Resources (WDNR), Red Cross, Salvation Army, Wisconsin Emergency Management (WEMC), local Police Departments, School Districts, Wisconsin State Assembly, wastewater treatment plant (WWTP) operators, and the emergency management staff from all counties adjacent to Marquette County. Actual meeting attendees included representatives from the USDA, Red Cross, Salvation Army, Columbia County Emergency Management, Montello Police Department, Marquette Sheriff's Department, Westfield Police Department, WDNR, Wisconsin State Assembly, MCEM, and Vandewalle & Associates.

The purpose of this meeting was to discuss the goals of the Marquette County Multi-Hazard Mitigation Plan, to discuss issues of hazard vulnerability in the region, and to discuss opportunities for cross-jurisdictional and intergovernmental mitigation efforts.

In Summer 2008, the draft Multi-Hazard Mitigation Plan was then e-mailed to this same group, seeking their input prior to the Plan undergoing the adoption process.

Public Review Process

Opportunities for public comment and Plan review were provided during the drafting stages and prior to adoption. The project team presented the Draft Plan to the Hazard Mitigation Planning Committee on June 23, 2008. WEM received a copy of the Draft Plan on July 1, 2008 and completed an expedited review of the Draft Plan. The Draft Plan was then made available on the Marquette County web site and at the Montello Public Library. Comments and questions about the Plan were directed to the MCEM staff. Marquette County then began the process of attaining approval from the city, villages, and county boards in August, 2008.

INCORPORATED PLANS, STUDIES, REPORTS, & TECHNICAL DATA

The following is a list of some of the primary references and data sources used for preparation of this Plan. Many other sources were used and are cited throughout the Plan.

- Marquette County Hazardous Materials Survey (1998)
- Hazard Analysis for the State of Wisconsin (2002)
- Flood Insurance Study for Marquette County (Unincorporated Areas) (1991)
- Flood Insurance Study for the City of Montello, Wisconsin (1990)
- Flood Insurance Study for the Village of Endeavor, Wisconsin (1990)
- Flood Insurance Study for the Village of Oxford, Wisconsin (1988)
- Flood Insurance Study for the Village of Westfield, Wisconsin (1998)
- Marquette County Comprehensive Plan, and local community comprehensive plans (2005)
- County and local zoning and subdivision regulations
- National Oceanic and Atmospheric Administration (NOAA) National Database of U.S. Storm Events

Chapter 2: Planning Context

Chapter 2 of the Marquette County Multi-Hazard Mitigation Plan provides geographic, demographic, and political context for the County. The information provided in this chapter provides a context for hazard mitigation strategies.

PHYSICAL GEOGRAPHY

Marquette County is located in south-central Wisconsin and covers 464 square miles. Marquette County is bordered on the west by Adams County and on the east by Green County. To the south, Marquette shares a border with Columbia County. The northern border is shared with Waushara County.

Marquette County is a rural county, with farmland covering about 43% and woodlands encompassing another 30%.¹ Marquette County lies in an ecological region known as the “Central Sand Hills.” This region is located at the eastern edge of the old Glacial Lake Wisconsin and contains a series of glacial moraines and partially covered glacial outwash. Pre-settlement vegetation consisted of oak forests, oak savanna, and a variety of prairie types.

The most prominent natural feature in Marquette County is the Fox River. The Fox River enters the County from Columbia County and flows into Buffalo Lake where it continues on and enters Lake Puckaway. Marquette County is subject to frequent flooding along the Fox, Mekan, Neenah, and Montello Rivers. Many waterways in the County are controlled by dams.



Adequately assessing flood hazards requires acknowledging that floods occur over geographical areas defined by a watershed which is not solely within the bounds of political jurisdictions. A watershed is an area that drains to a common waterway, such as a river, wetland, lake, or ocean. Marquette County is divided into seven major watersheds, all of which lie within the Upper Fox River Basin and drain into Lake Michigan. The Montello River Watershed drains the northwest part of the County, and is the largest in the County, covering 126 square miles of agriculture, forestland, and the developed areas of Westfield, Harrisville and parts of the City of Montello. The Little Roche A Cri Creek drains a small part of the northwestern part of the County and drains to the Wisconsin River. The northeastern part of the County is drained by the Mekan River, White River and Fox River watershed

areas. Several groundwater fed “glacial pothole” lakes are located in this watershed. The County’s southern portion is drained by the Neenah Creek, Buffalo-Puckaway and Lower Grand River Watersheds.

The County has over 90 lakes and several streams and rivers. Covering 2,210 acres, Buffalo Lake is the largest lake in the County. Other prominent lakes in the County include Montello Lake, Lawrence Lake, Tuttle Lake, Crystal Lake, White Lake and Mason Lake.² Nearly 25% of Marquette County is covered by wetlands which play an important role in regulating flooding impacts throughout the County.³ The hierarchy of watersheds demands that jurisdictions within watersheds work together to effectively manage flood risk and minimize potential damage. Within a watershed, development upstream also directly affects communities downstream.

Marquette County’s landforms and topography are characterized by several glacial advances and retreats that took place over northeastern and central Wisconsin some 15,000 to 25,000 years ago. As a result of this activity, numerous

¹ Marquette County Comprehensive Plan, 2005

² Ibid.

³ Ibid.

unique geologic and topographic features emerged such as escarpments, outwash plains, lake plains, terminal moraines, ground moraines, and drumlins. The County's western portion is covered by a thick mantle of glacial till referred to as the terminal moraine. Within the moraine, old glacial lake beds exist, now reflected in marshland and scattered areas of red clay. The remainder of the County has a shallower mantle of drift, referred to as ground moraine, associated with large tracts of marsh deposits.⁴

The average slope in Marquette County is 2.9% with a total relief range of about 560 feet.⁵ Within the County about 8% of soils are highly erodible and are largely located in the western third of the County.⁶ Most of the County is comprised of sandy soils but clay soils in the southwestern portion of the County are more susceptible to erosion and represent a potential hazard. Between 30 and 35% of farmers are part of a conservation plan that includes measures to reduce soil degradation and erosion.⁷

⁴ Ibid.

⁵ USGS, National Elevation Dataset, 2001

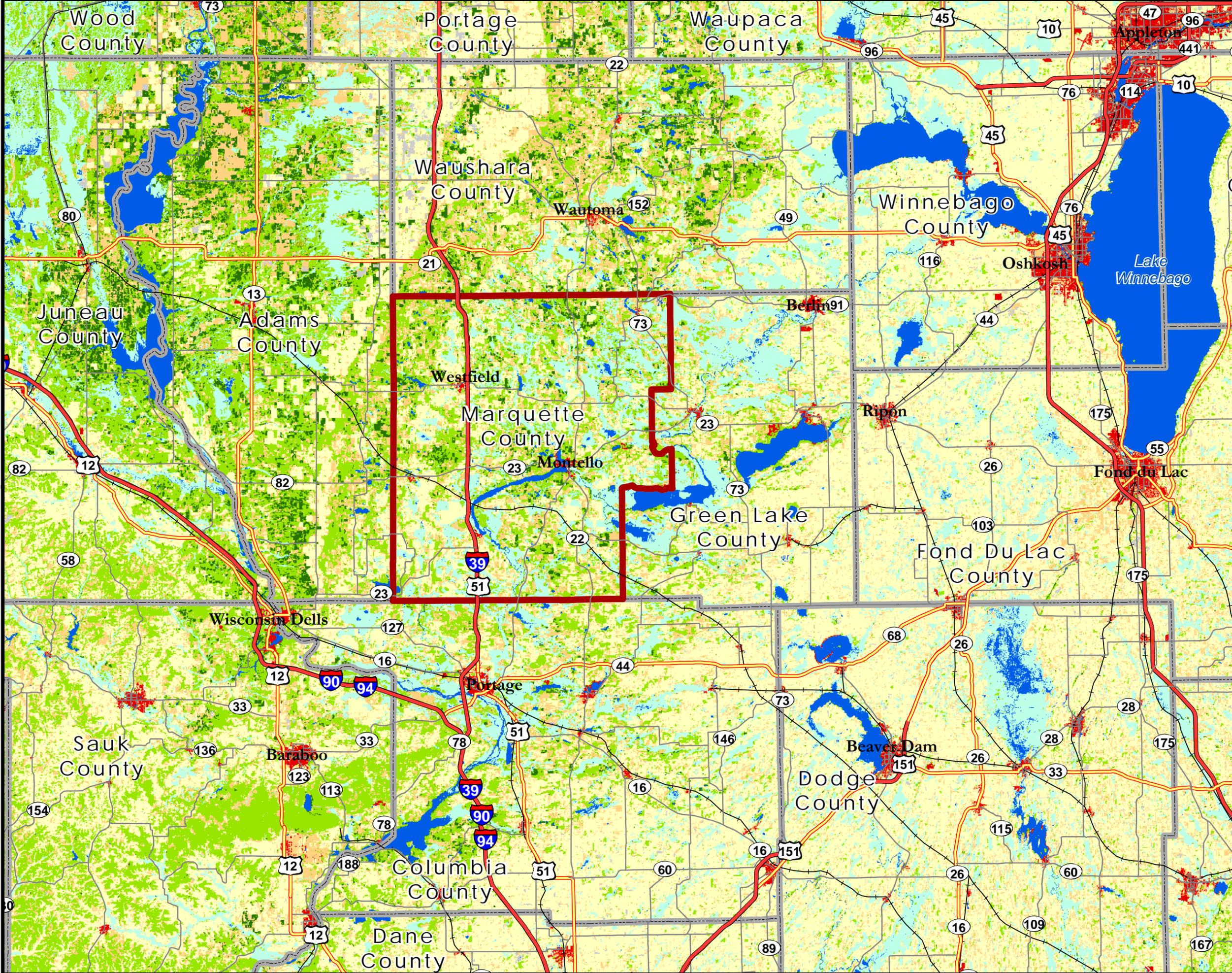
⁶ USDA-NRCS Digital Soil Survey, 2005

⁷ Pat Kilbey. Marquette County Land Conservationist. Personal Communication, 3/25/08.

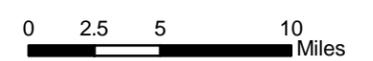
Marquette County Multi-Hazard Mitigation Plan

Map 1 *Regional Context*

-  Marquette County
 -  County Boundary
 -  Surface Water
 -  Railroads
 -  Limited Access
 -  Highways
 -  Secondary Roads
 -  Highway Ramp
- Existing Land Cover
-  Agriculture
 -  Barren
 -  Deciduous Forest
 -  Coniferous Forest
 -  Wetlands
 -  Grassland
 -  Shrubland
 -  Urban/Developed



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DEMOGRAPHICS

Marquette County has experienced moderate population growth over the past 50 years. Most of the newest people moving into the County are seeking recreational or retirement homes along lakeshores or woodlots. Marquette County, with its abundant natural resources and proximity to Chicago, Milwaukee, Madison, the Fox Valley, and other nearby urban areas, attracts individuals looking for a more rural landscape.⁸ During this same time period, the unincorporated areas of the County grew faster than the cities and villages. Figure 2.1 compares Marquette County's population trends over the past 30 years to trends in neighboring counties and the state.

Figure 2.1: Population Trends, 1970 - 2000⁹

	1970	1980	1990	2000	Pop. Change*	Percent Change*
Marquette County	8,865	11,672	12,321	14,555	+2,234	18.1
Green Lake County	16,878	18,370	18,651	19,105	+454	2.4
Waushara County	14,795	18,526	19,385	23,154	+3,769	19.4
Adams County	9,234	13,457	15,682	18,643	+2,961	18.9
Columbia County	40,150	43,222	45,088	52,468	+7,380	16.4
East Central Region**	475,090	511,033	542,712	609,438	+66,726	12.3
Wisconsin	4,417,731	4,705,767	4,891,769	5,363,675	+471,906	9.6

Sources: U.S. Census of Population and Housing, 1970 – 2000; East Central Wisconsin Regional Planning Commission, 2003

** 1990 to 2000 population change*

*** East Central Region includes Calumet, Fond du Lac, Green Lake, Marquette, Menomonee, Outagamie, Shawano, Waupaca, Waushara, and Winnebago Counties*

Since the 2000 Census, Marquette County has continued to grow, with an estimated population of 15,227 residents in 2006.

Marquette County's population is aging as is indicated in Figure 2.2. In 2000, the County's median age of 41 years was comparable to surrounding counties, but slightly older than the state average. For an historical perspective, the County's median age in 1970 was 37.5, in 1980 it was 36.1, and in 1990 it was 39.1.¹⁰ With prolonged life expectancy and a trend toward declining birth rates, the County's median age will likely continue to get older.

⁸ Marquette County Comprehensive Plan, 2005

⁹ Ibid.

¹⁰ Ibid.

Figure 2.2: Age and Gender Distribution, 2000¹¹

	Median Age	% under 18	% over 65	% Female
Marquette County	40.9	21.1	18.3	45.7
Green Lake County	40.9	24.2	18.8	50.8
Waushara County	42.1	23.5	19.2	49.6
Adams County	44.5	20.8	20.9	49.3
Columbia County	38.0	25.2	14.4	49.6
Wisconsin	36.0	25.5	13.1	50.6

Source: U.S. Census of Population and Housing, 2000

As a proportion of the total population, most neighboring counties and the state had a larger proportion of younger people (age 18 and younger) than Marquette County. The percentage of the County's senior population (aged 65 and older) was higher than the state, but comparable to other counties in the region. According to state projections, the County's "baby boom" and elderly age cohort will continue to increase, while the younger age groups (5 to 19) will decrease.¹² By 2030, nearly 30% of the County's population will be aged 65 or older (compared to 20% of the population in 2000).¹³

Of the County's population age 25 and older, 79% attained a high school level education in 2000. For comparison, the high school graduation rate for the East Central Region and the state was about 85%. Approximately 10% of this same age group in the County had attained a college level education (bachelor's degree or higher).¹⁴

According to 2000 Census data, the County's median household income was \$35,746 in 1999. For comparison, the median household income reported statewide in 1999 was \$43,791. Reported median household incomes in Marquette County increased by about 60% from 1989 to 1999.

What is not generally included in this Census data is the County's large seasonal and summer tourist population, occupying summer homes and visiting campgrounds. Anecdotal data suggests that, on a busy summer weekend, the County's population actually swells to perhaps triple the year-round population total.

HOUSING

According to 2000 Census data, there were 8,664 housing units in Marquette County. The County's housing stock is predominately single-family homes (79%), which is comparable to the East Central Region's housing stock (75%), but higher than the statewide figure (69%).¹⁵ When compared to other counties in the East Central Region, the County has the smallest share of multi-family units (3%) and largest share of mobile homes, trailers and other units (16%). About a quarter of the County's housing stock is classified as "seasonal" by the U.S. Census. Figure 2.3 summarizes the housing stock characteristics from the 2000 Census.

Current housing statistics from Marquette County estimate about 22% of homes are mobile homes with 33% of residences classified as temporary—again attesting to the County's large seasonal (summer) population. Additionally, the median home value is a little over \$83,000.¹⁶

¹¹ Ibid.

¹² Wisconsin Department of Administration, 2004

¹³ Ibid.

¹⁴ Marquette County Comprehensive Plan, 2005

¹⁵ Marquette County Comprehensive Plan, 2005

¹⁶ Marquette County GIS Department, January 2008

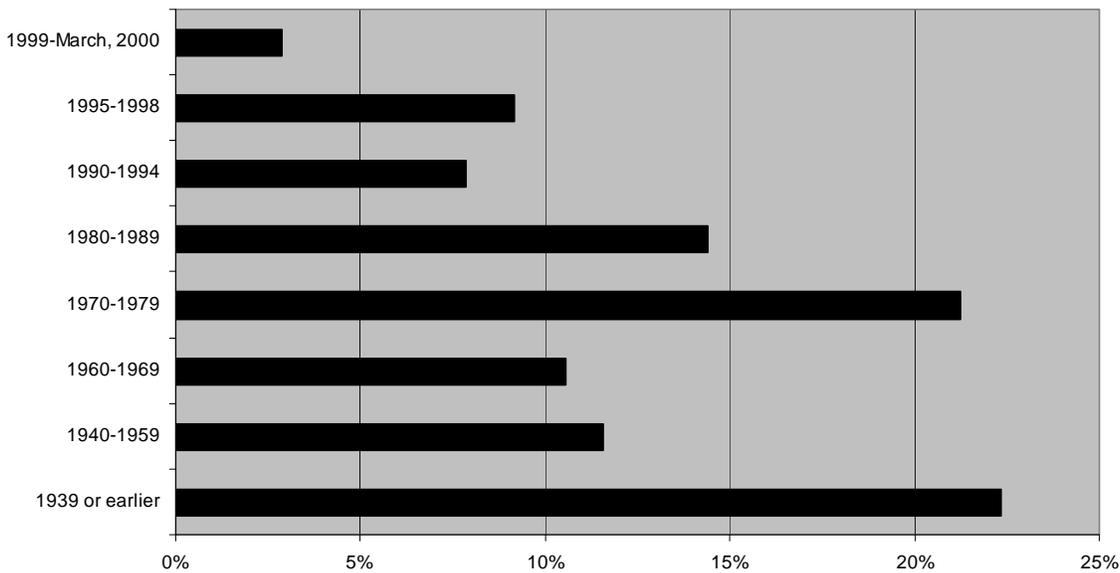
Figure 2.3: Comparison of Housing Stock Characteristics - 2000

	Marquette County	East Central	Wisconsin
Total Housing Units	8,664	257,449	2,321,144
Occupancy Rate	69%	90%	89%
% Vacant (Homeowner)	2.1%	1.3%	1.2%
% Vacant (Rental)	6.2%	6.7%	5.8%
% Seasonal	26%	5%	6%
% Owner Occupied	82%	73%	68%
Median Value of Owner Occupied Housing	\$87,000	\$92,220	\$112,200

Source: U.S. Census of Population and Housing, 2000

The County experienced its highest building rate during the 1970s—which parallels the County’s biggest growth spurt in population. The pace of housing development in the County also increased in the early 2000s. According to State Department of Administration estimates, the County had 9,031 housing units in 2003, which means that it added about 120 new units a year from 2000 to 2003. However, the housing market since 2003 has been in a state of relative stagnation—this is a national trend.

Figure 2.4: Marquette County Distribution of Housing Stock by Age



The County’s average household size has steadily dropped over the past thirty years, from 2.90 in 1970, to 2.65 in 1980, to 2.52 in 1990, to 2.41 in 2000.¹⁷ The County’s average household size is expected to drop to 2.17 by 2030 according to the Wisconsin Department of Administration.

¹⁷ U.S. Census of Population and Housing, 2000

EMPLOYMENT

The labor force in Marquette County has remained relatively steady since 1990, increasing by about 2% between 1990 and 2000. However, the number of employed persons working in agriculture decreased by 83% during that decade. As of 2002, manufacturing, retail trade, administrative support, and waste management and remediation service were the industries employing the largest number of people in Marquette County (U.S. Decennial Census).

The County's primary economic activity is reflected in manufacturing and education employment., with the largest manufacturing employers being Brakebush Brothers, Inc. (poultry processing), located south of the Village of Westfield. According to 2000 Census data, the largest proportion of the 6,621 employed persons living in Marquette County were employed in the manufacturing sector (26%), followed by the education, health and social services sector (14%). Jobs related to the tourism industry (arts, entertainment, recreation, accommodation and food services, and retail trade) made up a combined total of 19% of the County's labor force. About half of the working residents of the County commute to other counties for work, making an effective and reliable transportation network critical.

POLITICAL JURISDICTIONS

Marquette County is bordered on the west by Adams County and on the east by Green Lake County. To the south, Marquette shares a border with Columbia County. The northern border is shared with Waushara County.

Local governmental units within the County include one city, 4 villages (Westfield, Endeavor, Oxford, and Neshkoro), and 14 towns (Springfield, Newton, Crystal Lake, Neshkoro, Westfield, Harris, Shields, Mecan, Montello, Packwaukee, Oxford, Douglas, Moundville, Buffalo). The City of Montello is the County seat and contains approximately 10% of the County's population, with about 1,500 people. In 2000, 28% of County residents lived in the city and villages and the other 72% resided in unincorporated areas (towns) of the County.

UTILITIES

"Lifeline" systems, including communication, transportation, power, water, and sewer, should be designed to be as hazard-resistant as economically possible. Damage to any one of these infrastructure components can cripple a community at any time, and can make disaster recovery much more difficult.

The County is served by three electric power utilities: Pioneer Power and Light (Westfield Electric), Alliant-Wisconsin Power and Light, and the Adams-Columbia Electric Cooperative. There are three hydropower electrical generating facilities in Marquette County, in the City of Montello, Town of Harris, and Village of Neshkoro.

There are three electric transmission lines running north-south through the County, all operated by the American Transmission Company (ATC). These lines carry electric energy from power plants to local communities. The rights-of-way for the three lines in the County vary from a width of 40 feet to 100 feet. To meet the state's growing electricity use, many existing transmission lines will need upgrading and many new lines and substations will need to be constructed.

Natural gas is transported from north to south through Neshkoro and Montello by ANR Pipeline Co.

Enbridge Energy Partnership operates the Lakehead Pipeline which transports over 1.4 million barrels of crude oil each day to major oil refineries in the Midwest and Canadian Province of Ontario. The oil line enters the County in the Town of Westfield and exits in the Town of Moundville (See Map 2). Upgrades are being made to add additional capacity via a new 20 inch diameter pipe.¹⁸

Currently, there 11 cell towers located in Marquette County, most are sited along major highways. The County's zoning ordinance includes regulations for the siting of new wireless communication facilities. On some of these cell towers, the County's EMS added antennas to improve Countywide emergency dispatch communication. Antennas

¹⁸ Enbridge Energy Partnership. <http://www.enbridge-expansion.com/expansion/>

were placed near the Westfield High School, near the Village of Neshkoro, and in the Town of Endeavor near Interstate 39.¹⁹

Fiber optic lines for broadband internet access are provided in the City of Montello and the villages of Endeavor, Oxford, and Westfield.²⁰

The City of Montello has the only public water system in the County, serving about 630 households. The municipal system includes one water tower and two active wells that pump, on average, 162 million gallons per day. Residents in the County's 14 towns and four villages all obtain their water supply from individual private wells.

The City of Montello and the four villages (Endeavor, Neshkoro, Oxford and Westfield) all have municipal wastewater treatment facilities. In addition, residents located within Sanitary District No. 1 in the central part of the Town of Packwaukee, on the north side of Buffalo Lake, are also served by public sanitary sewer service.

TRANSPORTATION INFRASTRUCTURE

There are about 880 miles of road in Marquette County. Of that total, about 525 miles are town roads, 240 miles are County roads, and the remaining 115 miles are State/Interstate Highways.²¹

Interstate 39, with its connections to major urban centers including Madison and Chicago (and Milwaukee and Minneapolis/Saint Paul via Interstate 94), provides excellent access to and from Marquette County.

State Highways (STHs) 22 and 23 provide access to and from adjacent communities and regional markets such as the Fox Valley area, the Lake Puckaway/Green Lake area, and the Wisconsin Dells/Baraboo area. STH 23 is the main east-west route through the County, while STH 22 runs generally north-south through the area. Both converge in Montello, where they cross a flood hazard area. STH 22, in particular, provides the only north-south crossing in the central part of the County. STH 73 serves the far northeastern portion of the County and the Village of Neshkoro. STH 82 runs west from the Interstate through the Village of Oxford.

There are no airports in Marquette County, but there are several small private airstrips.

The Union Pacific Railroad runs through the southern part of Marquette County, beginning in the town of Buffalo and running through the towns of Packwaukee, Montello and Oxford. This rail line connects Chicago, Milwaukee and Minneapolis and traverses Wisconsin in a roughly diagonal route. This is a freight rail route; there is no passenger rail service serving the County and none is anticipated.

EMERGENCY SERVICES

The Marquette County Sheriff's Department serves as the primary law enforcement agency for town residents. The department has 35 full-time officers. The City of Montello and the Villages of Oxford and Westfield also operate their own municipal police departments.

There are ten fire departments/districts in Marquette County. The Montello Fire Department is the largest department, serving residents in the city and town of Montello, and the towns of Buffalo, Packwaukee, and Shields.

As of 2005, Marquette County's Emergency Medical Service was staffed with 5 full-time employees.²² The



¹⁹ Marquette County Comprehensive Plan, 2005

²⁰ Ibid.

²¹ Marquette Countywide/Strategic Plan, 2007

director of EMS and his secretary work at the Services Center building in Montello. Fulltime Crew Chiefs are assigned to each ambulance area of Oxford, Montello and Westfield. A core of 70 paid-on-call volunteer Emergency Medical Technicians (EMTs) staff the four ambulances at the EMT Intermediate level.²³

The EMS service provides a vital service to the County's rural population, providing emergency care from the rural areas to regional hospitals. Call volume has increased 62% over the past 10 years and, with a growing aging population, the demand for these services will likely continue to increase.²⁴

About two-thirds of Marquette County's EMS annual operating budget of \$600,000 comes from user fees (which are typically covered by Medicare, Medicaid, private insurance, private pay and special service contracts), and the other third comes from property tax levies. This budget covers the five full time employees, the small compensations for on-duty volunteer EMTs, equipment, and operating costs. The County's EMS department has been developing options for consideration to improve its services, including additional staff and increased volunteer compensation.

In 2007, First Responder groups began operating in Briggsville, Endeavor and Town of Springfield. These fire based "first-responders" improved the priority response in areas without nearby ambulances.²⁵

In terms of availability of health care services, there are no major hospitals located in the County, with the nearest hospital located in Portage. According the East Central Wisconsin Regional Planning Commission, there were 4 licensed medical doctors in Marquette County (which equates to about 3,600 persons per doctor). There are several day care and child care facilities located in the County's urban areas.

²² Tim Houslet, Marquette County EMS Director. Personal Communication, 3/25/08

²³ Ibid.

²⁴ Marquette County Comprehensive Plan, 2005

²⁵ Ibid.

Chapter 3: Hazard Identification and Risk Assessment

Analyzing the hazards in the County is an important and necessary step to help identify potential risks and to prioritize mitigation projects that will minimize those risks. This chapter includes an assessment of the hazards that can affect Marquette County as well as an assessment of the risk of loss of life and property from hazards based on the future probability of and vulnerability to hazards.

HAZARD IDENTIFICATION

Marquette County is at some risk for the following natural hazards:

- | | |
|---|-------------------------|
| 1. Flooding | 5. Extreme Temperatures |
| 2. Dam Failures | 6. Drought |
| 3. Severe Storms (including hail, lightning, tornadoes, and severe winds) | 7. Earthquakes |
| 4. Severe Winter Storms | 8. Forest/Wild Fires |

Additionally, the County is more or less vulnerable to the following hazards that are either caused by humans or are disease outbreaks, as identified in the Marquette County Disaster Plan:

- | | |
|--|---|
| 1. Civil Disturbances | 6. Terrorism, including bomb threats and agroterrorism, occurring either in Marquette County or nearby metropolitan areas |
| 2. Explosions | 7. Transportation Accidents: Aircraft, Bus, Rail, Trucking |
| 3. Hazardous Materials | 8. Energy shortages and blackouts |
| 4. Nuclear Energy/Nuclear Power Plants | 9. War (nuclear or non-nuclear) |
| 5. Mass Casualties | |

The sources that were used to identify the hazards that are addressed in this Plan include the following:

- Marquette County Emergency Management (MCEM) records
- Marquette Countywide Strategic Plan
- National Oceanic and Atmospheric Administration (NOAA) National Climatic Data Center
- Marquette County Hazard Analysis
- Hazard Analysis for the State of Wisconsin (2002)
- Hazard Mitigation Planning Committee members, local government representatives, and members of the public

This Plan covers each of the possible natural hazards in Marquette County, but will place an emphasis the most critical natural hazards identified by local officials and community members. From information gathered from the Marquette County Public Safety Committee in December, 2007, the Marquette County Fire Association meeting in January, 2008, and two community kick-off meetings in February, 2008, the most critical natural hazards for the County were identified as flooding, severe Storms (including hail, lightning, tornadoes, and severe winds), potential dam failures, and forest/wild fires. Also, human-made hazards are addressed extensively in the Marquette County Disaster Plan, so these are not covered at length in this Multi-Hazard Mitigation Plan.

Marquette County has been the subject of four Presidential Disaster Declarations due to flooding—one each in 1973, 1993, 2004, and 2008. One Presidential Emergency Declaration is also on record as a result of drought in 1976.

Although the history of Presidential Disaster Declarations in Marquette County highlights the most severe disasters, it does not wholly capture the hazards that Marquette County has experienced and to which it is vulnerable. The NOAA National Database of U.S. Storm Events identifies 282 severe weather events from 1955 to 2007. In storm events specific to Marquette County, no deaths and two injuries have resulted from the severe weather events listed by NOAA. Figure 3.1 attempts to define losses specific to Marquette County, but in some instances it is difficult to discern because the database lacks full information on both the historical occurrences and impacts of disasters in the County. Consequently, this Plan supplements NOAA data with information from additional organizations and local residents to more fully understand the risk of disasters in Marquette County.

Figure 3.1: Presidential Disaster and Emergency Declarations

Date	Type of Declaration	Disaster Event	Total Damages
April, 27 1973	Disaster Declaration	Flood	Unknown
June 17, 1976	Emergency Declaration	Drought	Unknown
July 2, 1993	Disaster Declaration	Flood	\$740,000,000 (State)
June 18, 2004	Disaster Declaration	Severe Storm/Flood	Unknown
June 19, 2008	Disaster Declaration	Flood	\$20,000,000*
<i>Sources: FEMA, Wisconsin Natural Hazard Mitigation Plan, Marquette County</i>			
<i>* FEMA Estimates, June 2008.</i>			

Figure 3.2: Severe Weather in Marquette County 1950-2008*

Hazard	# of Events	Reported Deaths	Reported Injuries	Property Damage	Crop Damage
Flood/Flash Flood **	7	0	0	\$21,325,000*	\$10,200,000
Severe Thunderstorms & Winds	96	0	0	\$336,000	\$55,000
Tornadoes	14	0	0	\$1,428,000	\$501,000
Hail	47	0	2	\$1,002,000	\$N/A
Winter Storms	55	0	0	\$10,000	\$N/A
Extreme Temperatures	27	0	0	\$21,000	N/A
Fog	33	0	0	\$0	\$0
Drought	4	0	0	\$0	\$4,480,000 (state)
Totals	282	0	2	\$24,122,00*	\$10,756,000
<i>Source: National Climatic Data Center: U.S. Storm Events Database & Vandewalle & Associates</i>					
<i>*As of 1/1/2008</i>					
<i>** The FEMA estimated damage totals from the June 2008 flood area included (\$20 million)</i>					

RISK ASSESSMENT

The following section provides an assessment of risk associated with each of the hazards that have historically affected Marquette County. The risk assessment incorporates the following for each hazard:

- A description of the hazard
- An overview of historical occurrences of the hazard in the County
- An assessment of vulnerability to the hazard throughout the County
- A projection of the future probability of occurrences of the hazard in the County
- A projection of potential damages from future occurrences of the hazard in the County

Areas of hazard vulnerability are illustrated in the maps at the end of this chapter. Additionally, additional detail on historical occurrences of hazards in the County is provided in Appendix A.

Flooding

Flooding Hazard Overview

Flooding is defined as a partial or total inundation of normally dry land from the overflow of inland waters or rapid accumulation or run-off of surface waters from any source. Flooding severity is impacted by amount of rainfall (or other source of water such as melted snow), duration of rainfall, topography, land cover, frozen soil, soil saturation, reservoir/mill pond capacity, river or stream levels, and frozen rivers or streams.²⁶



Major floods in Wisconsin have primarily been confined to specific streams and rivers or to locations that receive intense rainfall in a short time. Such riverine floods tend to occur in the early spring when melting snow adds to normal runoff when the ground is often still frozen, or in the summer and early fall after intense rainfall. Spring flooding is characterized by a slow buildup of flow and velocity in rivers over a period of days. This buildup continues until the river or stream overflows its banks, for weeks to months, and then slowly recedes. Generally, the timing and location of this type of flooding is predictable and allows substantial time for evacuation of people and most personal property.

Another form of riverine flooding is ice jam flooding which occurs when ice jams form in a waterway, constricting downstream water flow. At these locations, water rises rapidly, extending upstream.

When the jam is cleared, flooding occurs downstream. Tree blockage can also exacerbate flooding.

The primary form of flooding in Marquette County is riverine flooding. Rivers in Marquette County—particularly the Montello River—exceed their banks during spring thaws and periods of very heavy rain on a fairly regular basis. In rural areas, this mainly leads to temporary road closures, erosion, and crop damage. In places of greater population density and economic activity, flooding can threaten lives, health, economic activity, infrastructure, and the environment.

Flash flooding occurs in the event of intense rainfall within a short period of time, causing a rapid rise and fall of water levels. Three flash floods are on record with the National Weather Service between 2002 – 2007.

Flood events constitute 90% of federal disaster declarations; their occurrence is frequent and response and recovery costs can be extremely high. Historical flooding events prove that Marquette County is no exception to this rule.

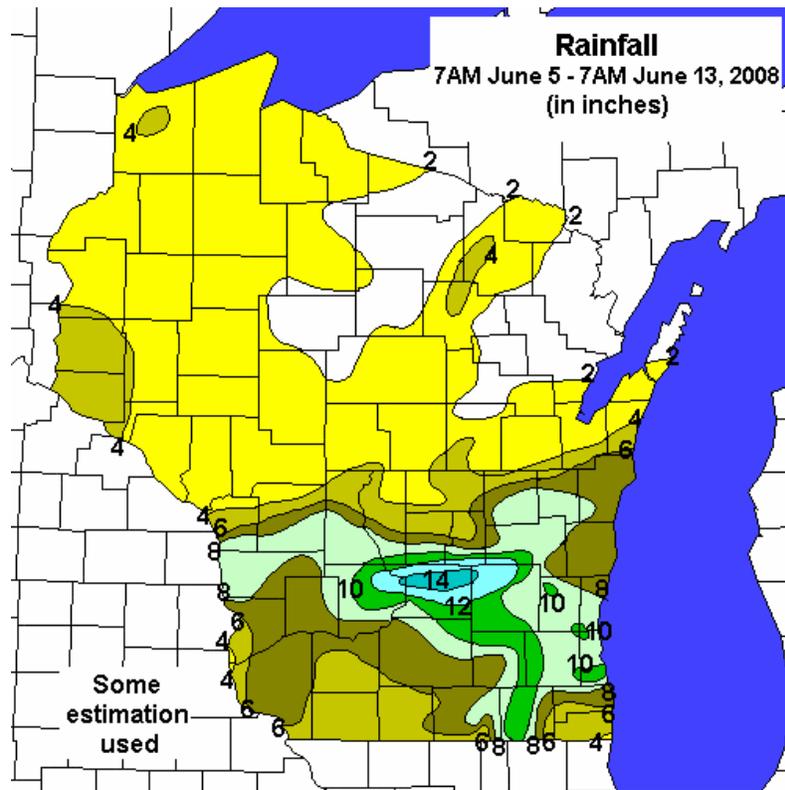
Historical Occurrences of Flooding

Flooding is the most costly natural disaster that affects Marquette County resulting in millions of dollars of damage to property and crops in the past century.

After record snowfalls over much of Wisconsin, Marquette County soils remained saturated in the Spring of 2008. During the week of June 5, 2008 through June 13, 2008 Marquette County received anywhere between 6 and 12 inches of rain (see Figure 3.3).

²⁶ Wisconsin Emergency Management. *Hazard Analysis for the State of Wisconsin*.

Figure 3.3: Rainfall Totals from June 5 – June 13, 2008



Source: NOAA's National Weather Service, June 2008. <http://www.crh.noaa.gov/Image/mkx/Rain5Jun13Jun2008.gif>

The intense rains quickly raised water levels on area streams and lakes causing severe flooding damage to over 100 homes in the City of Montello, Town of Moundville, Village of Endeavor, Town of Packwaukee, and the Town of Montello. The severe flooding also caused road washouts, crop damage, and numerous road closures on key north/south routes in the southern half of the County. FEMA estimates approximately \$20 million in damages (statistics throughout the plan that include this estimated total will include an asterisk indicating these are estimated damage totals).

Additional notable floods with considerable damage occurred in Marquette County in 1993 and 2004. The 1993 flood caused over \$740,000,000 in losses over much of Wisconsin. The severity of flooding increased towards the south and west portions of the state. The 2004 flood caused minor basement damage to 354 homes, and major basement damage to 17 homes, private property damage of \$1,000,000, and \$205,000 damage to public infrastructure. Over 28,000 acres of crop land was ruined for a crop loss of about \$10,000,000.

In addition to the estimated losses associated with the 1993 and 2004 floods, public and private entities received disaster recovery grant from federal and state sources. Figure 3.4 summaries grant funding and sources.

Figure 3.4: History of Disaster Recovery Grants in Marquette County

1993 Flood				
Community	# Grants	Federal Grant Share	State Grant Share	Total Payments
Marquette County*	11	\$165,143	\$9,681	\$174,825
2004 Flood				
Community	# Grants	Federal Grant Share	State Grant Share	Total Payments
Town of Harris	1	\$3,480	\$580	\$4,060
Marquette County	5	\$112,714	\$18,786	\$131,500
City of Montello	5	\$22,241	\$3,706	\$25,974
Town of Oxford	1	\$1,630	\$272	\$1,901
Village of Oxford	1	\$1,928	\$321	\$2,250
Harris Fire Dept.	1	\$15,999	\$889	\$16,888
Packwaukeee	2	\$4,199	\$700	\$4,899
Total	16	\$162,190	\$25,254	\$187,445
<i>Source: Wisconsin Emergency Management, 2008</i>				
*Individual communities aren't defined in the 1993 data				

The three recorded flash floods in Marquette County in 2002, 2004, and 2007 resulted in \$110,000 in property damage and \$200,000 in crop damage. Damage from these events resulted in flooded basements, road washouts, and road closures.

Overall, six flooding events have been documented in the County since 1955, not including the June 2008 flooding. These events have resulted in \$1,325,000 in known damages to property and \$10,200,000 in known damages to agricultural land—and that is only for events beginning in 1993 (quantifiable data on damages prior to 1993 is not available). Details on each of these events are provided in Table A1 in Appendix A.

In addition to the account of specific flooding events described in Table A1, Figure 3.5 below summarizes the history of claims and number of flood insurance policies held in Marquette County under the National Flood Insurance Program. As flooding damage to agricultural land is covered under crop insurance policies, this table only relates to non-agricultural properties. As compared to the over \$1.3 million in property damages that have been experienced in the County from flooding since 1993, this table illustrates that flood insurance has historically only addressed a fraction of the damages experienced.

Figure 3.5: History of National Flood Insurance Program Losses

Community	Total Losses	Closed Losses	Open Losses	CWOP Losses	Total Pay-ments	Policies In-force	Insurance In-force	Written Premium In-force
Montello	4	1	0	3	\$4,160	23	\$2,360,700	\$15,967
Endeavor	2	1	0	1	\$1,000	1	\$90,000	\$850
Neshkoro	No statistics available					1	\$50,000	\$490
Westfield	No statistics available					1	\$120,000	\$1,074
Unincorporated Marquette County	4	2	0	2	\$17,037	48	\$6,025,000	\$21,831

Source: NFIP Loss Statistics, 2/1/2008

Definitions

- Total losses - All losses submitted regardless of the status.
- Closed losses - Losses that have been paid.
- Open losses - Losses that have not been paid in full.
- CWOP losses - Losses that have been closed without payment.
- Total Payments - Total amount paid on losses.
- Policies In Force - Policies in force on the "as of" date of the report.
- Insurance In Force - The coverage amount for policies in force.
- Written Premium In Force - The premium paid for policies in force.

Flooding Hazard Vulnerability

Areas and populations vulnerable to flooding hazards were determined based on the following:

- Marquette County Floodplain Maps
- Marquette County building structure type and location
- Records of historical occurrences and impacts of flooding
- Input from the Hazard Mitigation Planning Committee, stakeholders, local officials, and County residents
- Aerial photographs
- Wisconsin National Flood Insurance Program Loss Statistics

The areas and populations most vulnerable to damage to life and/or property from flooding hazards in the County include the following, which are illustrated in the maps at the end of this chapter:

- Areas with residents and/or businesses within a mapped 100-year floodplain
- Flood-prone areas with residents and/or businesses outside of a mapped floodplain
- Populations that are particularly vulnerable to injury or death from flooding include the elderly and residents of mobile home parks or campgrounds
- Agricultural land in the County which can result in significant damages/reduction of crop yields from significant flooding

Given the frequency of flooding events and the significant economic and social impact of these flood events, it is economically logical to employ mitigation techniques that lessen the damage. Recovery assistance has only been provided for 67% of floods. Of recent flooding events, the County received Presidential Disaster Declarations in 1993 and 2004.

The following Figure 3.6 summarizes the value of land and structures within the County by municipality. This information was the basis for determining the potential structural loss that is identified in Figure 3.7. The approach of averaging data by municipality was utilized because Marquette County has yet to complete a digital database of parcels that can be linked to tax assessment data.

Figure 3.6: Properties Values within the County

Location	Property Values			Acreage	
	Land Value	Improvement Value	Total Value	Total Acres	Total # Parcels
Incorporated Areas (Cities and Villages)					
City of Montello	\$18,135,600	\$50,694,700	\$68,830,300	1,385	1,070
Village of Endeavor	\$2,868,000	\$18,621,300	\$21,489,300	449	280
Village of Neshkoro	\$5,091,400	\$16,697,700	\$21,789,100	1,345	336
Village of Oxford	\$3,676,300	\$19,106,400	\$22,782,700	591	398
Village of Westfield	\$6,399,500	\$41,064,600	\$47,464,100	1,025	659
Unincorporated Areas (Towns)					
Buffalo	\$32,210,500	\$56,588,500	\$88,799,000	31,508	1,494
Crystal Lake	\$46,801,627	\$44,767,420	\$91,569,047	22,952	1,403
Douglas	\$13,706,000	\$37,926,100	\$51,632,100	18,672	1,039
Harris	\$21,125,600	\$33,487,300	\$54,612,900	19,745	1,175
Mecan	\$29,115,100	\$55,477,000	\$84,592,100	17,611	1,494
Montello	\$41,968,900	\$88,988,900	\$130,957,800	21,753	1,893
Moundville	\$10,231,800	\$19,214,100	\$29,445,900	14,846	724
Neshkoro	\$40,423,900	\$54,560,700	\$94,984,600	13,798	998
Newton	\$17,716,900	\$30,218,600	\$47,935,500	22,787	1,112
Oxford	\$25,929,420	\$61,416,880	\$87,346,300	21,507	1,472
Packwaukee	\$46,744,800	\$117,327,400	\$164,072,200	26,183	2,226
Shields	\$16,496,500	\$24,521,300	\$41,017,800	20,118	1,005
Springfield	\$34,862,350	\$66,338,700	\$101,201,050	22,290	1,570
Westfield	\$26,001,600	\$50,437,700	\$76,439,300	18,435	1,238
TOTAL	\$439,505,797	\$887,455,300	\$1,326,961,097	297,000	21,586
<i>Source: Marquette County GIS, 2008</i>					

Figure 3.7: Properties Values within in the 100 year Floodplain

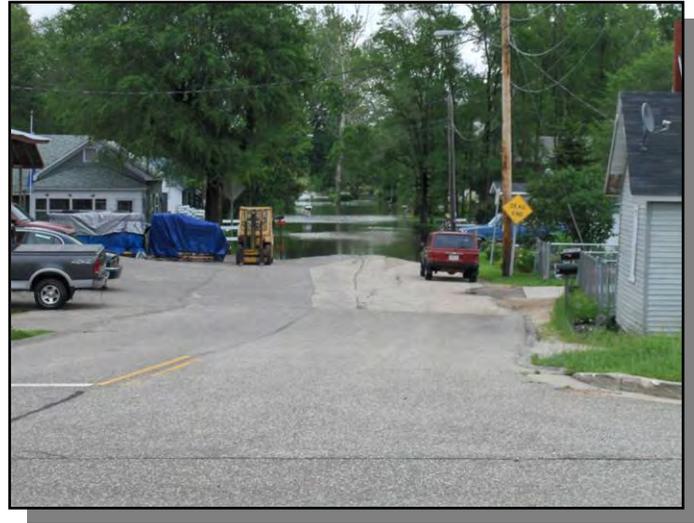
Location	Property Values			Acreage			Total Sum
	Average Improvement Value	Total # Structure	Total Structure Value	Land Value Per Acre	Floodplain Acres	Total Land Value	Total Property Value
Incorporated Areas (Cities and Villages)							
Montello	\$67,774	99	\$6,709,626	\$13,094	330	\$4,321,119	\$11,030,745
Endeavor	\$90,836	2	\$181,672	\$6,388	95	\$606,815	\$788,487
Neshkoro	\$71,054	1	\$71,054	\$3,785	118	\$446,681	\$517,735
Oxford	\$64,988	2	\$129,976	\$6,220	95	\$590,945	\$720,921
Westfield	\$81,802	3	\$245,406	\$6,243	67	\$418,308	\$663,714
Unincorporated Areas (Towns)							
Buffalo	\$106,170	5	\$530,850	\$1,022	3,287	\$3,360,300	\$3,891,150
Crystal	\$72,322	24	\$1,735,728	\$2,039	2,757	\$5,621,826	\$7,357,554
Douglas	\$84,656	7	\$592,592	\$734	2,906	\$2,133,120	\$2,725,712
Harris	\$69,332	12	\$831,984	\$1,070	1,725	\$1,845,612	\$2,677,596
Mecan	\$79,938	44	\$3,517,272	\$1,653	4,185	\$6,918,768	\$10,436,040
Montello	\$104,202	20	\$2,084,040	\$1,929	5,931	\$11,442,916	\$13,526,956
Moundville	\$73,336	44	\$3,226,784	\$689	3,021	\$2,082,073	\$5,308,857
Neshkoro	\$97,430	13	\$1,266,590	\$2,930	1,543	\$4,520,512	\$5,787,102
Newton	\$71,103	4	\$284,412	\$778	1,460	\$1,135,150	\$1,419,562
Oxford	\$106,074	2	\$212,148	\$1,206	2,351	\$2,834,436	\$3,046,584
Packwaukee	\$101,847	19	\$1,935,093	\$1,785	4,055	\$7,239,432	\$9,174,525
Shields	\$65,043	9	\$585,387	\$820	539	\$441,975	\$1,027,362
Springfield	\$89,285	1	\$89,285	\$1,564	369	\$577,131	\$666,416
Westfield	\$88,955	20	\$1,779,100	\$1,410	728	\$1,026,808	\$2,805,908
TOTAL	\$83,481	331	\$26,008,999	\$2,914	35,625	\$57,563,926	\$83,572,925
<i>Source: Marquette County GIS, 2008</i>							

With about \$26 million in structural value and \$57 million of land value in the 100-year floodplain, Marquette County demonstrates significant vulnerability to property damage from flooding events. The Montello River and Fox River converge in the City of Montello, and are controlled by dams. Despite these manmade alterations, 99 structures and 330 acres of land are susceptible to a 100-year flood, totaling almost \$18 million dollars in property value. The Towns of Moundville and Mecan both have 44 structures within the 100-year floodplain, totaling over \$3 million dollars in structural value in each of these towns. The Towns of Montello, Mecan, and Packwaukee each have over 4,000 acres of land within the 100-year floodplain, accounting for a combined \$33 million in land value.

The following sections describe specific issues contributing to flooding hazard vulnerability within individual communities in the County. Maps that represent flood hazards for the most affected communities are included at the end of this chapter.

City of Montello

Upstream from the convergence of the Montello River and Fox River in Montello, both rivers are hydrologically altered to form large lakes upstream of the City. The dam that controls the Montello River serves to generate hydropower and creates an impoundment of 286 acres (Montello Lake). The dam controlling the Fox River creates a large lake of 2,210 acres (Buffalo Lake). Both the Montello and Fox River are known to exceed their banks during spring thaws and periods of very heavy rain. In rural areas, this mainly leads to temporary road closures, erosion, and crop damage. In places of greater population density and economic activity—like the City Montello—the flooding of these rivers can have more serious effects, not to mention what could happen in the event of dam failure.



In the City of Montello, mainly residential areas along Highway 22, Island Drive, E. Water Street, E. Main Street and portions of the downtown lie within the FEMA designated 100-year floodplain. During the June 2008 flood, many residents were forced to sandbag, sometimes several feet high, around their homes. The 100-year floodplain designation signals areas of potential flooding and provides fairly strict regulations intended to limit significant additional investment in the floodplain areas. Flood events include road and bridge closures and washouts and street, yard, and basement flooding. These “nuisance” events negatively affect economic activity, the structural integrity of housing and other structures, the desire and legality for investments in those properties (leading to decline), and the quality of life in an area with a relatively vulnerable population. This area includes a concentration of low-income and elderly residents.

The following are key issues contributing to current and future flooding vulnerability in the City of Montello floodplain:

- *Recurrent flooding of residential properties along Highway 22.* The residential areas lining Highway 22 south of the downtown, between the two dams, now experience fairly regular flooding, which negatively affects these properties. Protecting these areas from recurrent flooding is costly, and may result in flooding being exacerbated in other places.
- *Flooding outside of mapped 100-year floodplain.* In the recent floods of June 2008, areas outside of the 100 year floodplain experience flood damage as well signaling the importance of updated floodplain maps. Additionally, some areas within the floodplain do not appear to actually be susceptible to flooding.
- *Dam maintenance.* Both the Montello Lake and Buffalo Lake dams hold a large volume of water. The WDNR has rated the Montello Lake Dam as a “high” hazard dam, which suggests that a dam failure would result in a loss of life. Regular maintenance and monitoring will help ensure protection of downstream property. This includes special attention to the integrity of the embankment along Buffalo Lake that was temporarily used as an alternate route while Highway 22 was closed during the 2008 flood.

Village of Endeavor

The dam in Montello on the Fox River creates Buffalo Lake, which diminishes in width near the Village of Endeavor. Much of the Village is built on a hillside above the Fox River. The Village’s highest point is about 110 feet above the river. Only a few homes along the river are subject to flooding.

The following are key issues contributing to current and future flooding vulnerability in Endeavor:

- *Potential future development.* The County’s and Village’s comprehensive plans indicate potential residential development along County Highway T and Lakeview Avenue, which may be impacted by future flooding.

- *Stormwater management.* New residential development in the southern portion of the Village, outside of the floodplain, is susceptible to flooding and may benefit from new stormwater infrastructure.

Village of Neshkoro

The White River flows through the heart of Neshkoro and has been altered by a dam just east of State Highway 73. The Neshkoro Millpond is 184 acres in size and utilized for the generation of hydropower. Only a handful of homes lie within the 100 year floodplain in the Village. The Neshkoro Dam controls the seasonal variation on the White River.

The following are issues contributing to future flooding vulnerability in Neshkoro:

- *Flooding outside of mapped 100-year floodplain.* The City has experienced some flooding outside of a mapped 100-year floodplain, and may benefit from improved stormwater management and updated floodplain maps there. Areas along W. Pearl Street, W. Park Street, and W. Bluff Street have regular flooding issues.
- *Potential future development.* Most the large undeveloped sections of the Village have been mapped for future residential development. New development should be placed outside of mapped 100-year floodplains or those areas susceptible to flooding, and proper stormwater management strategies should be incorporated when land does develop.
- *Dam maintenance.* The Neshkoro Dam holds a large volume of water. The WDNR has rated this dam as a “significant” hazard, which suggests that a dam failure would result in significant property damage and possible loss of life. Regular maintenance and monitoring will help ensure protection of downstream property.

Village of Oxford

The flow of Neenah Creek on the west side of the Village is controlled by a dam that forms a 61 acre impoundment north of State Highway 82. Downstream of the dam, the Neenah Springs/Great Glacier water company is one of 24 bottled water companies in Wisconsin producing about 2.4 million gallon of water in 2005. East of downtown Oxford, a drainageway drains a wet area from north to south through the Village. Several homes within the Village lie in the 100 year floodplain.

The following are key issues contributing to current and future flooding vulnerability in Oxford:

- *Flooding outside of mapped 100-year floodplain.* The City has experienced some flooding outside of a mapped 100-year floodplain and may benefit from updated floodplain maps, particularly east of the downtown area.
- *Potential future development.* The County land use plan has identified areas within the 100 year floodplain for future residential development. All new development should be placed outside of the mapped 100 year floodplains or those areas susceptible to flooding, and proper stormwater management strategies should be incorporated when land does develop.
- *Dam maintenance.* The Neenah Creek Dam holds a large volume of water. However, the WDNR has rated this dam as a “low” hazard, which suggests that a dam failure would only result in property damage. Regular maintenance and monitoring will help ensure protection of downstream property.

Village of Westfield

Westfield Creek is the primary waterway that flows through the Village. There is a dam near Main Street in downtown Westfield. The dam created Westfield Pond, a 32 acre impoundment. Most land along Westfield Creek downstream from the dam is undeveloped. A small tributary that flows from the northwest corner of the Village flows through many residential lots before reaching Westfield Creek east of Main Street. FEMA floodplain boundaries through this area encompass currently developed residential properties.

The following are key issues contributing to current and future flooding vulnerability in Westfield:

- *Dam maintenance.* The Westfield Creek Dam holds a large volume of water. The WDNR has rated this dam as a “significant” hazard, which suggests that a dam failure would result in significant property damage and the possible loss of life. Regular maintenance and monitoring will help ensure protection of downstream property.

- *Residential properties along tributary.* A small tributary that flows from the northwest corner of the Village flows through many residential lots before reaching Westfield Creek east of Main Street. FEMA floodplain boundaries through this area encompass currently developed residential properties.

Briggsville (Town of Douglas)

Briggsville is an unincorporated settlement in the southwest corner of Marquette County, along State Highway 23 in the Town of Douglas. A large dam on the South Branch of Neenah Creek forms Mason Lake. Mason Lake is only partially in Marquette County, but extends westward into Adams County and is about 856 acres in size. The WDNR has rated the Lake Mason Dam as a “high” hazard, which suggests that a dam failure would result in a loss of life. Regular maintenance and monitoring will help ensure protection of downstream property. Additionally, local officials have indicated that increased security was necessary at the structure controlling the dam operation. Downstream of Briggsville are several agricultural fields which lie within the 100-year floodplain. During the June 2008 floods, residents of Briggsville were forced to sandbag around their homes.

Harrisville (Town of Harris)

Harrisville is an unincorporated settlement in central Marquette County at the intersection of County Highways J and B. Montello Creek flows through the community towards the City of Montello. In July 2007, flash flooding near Harrisville caused water depths of 2 to 3 feet on roadways and caused water to enter basements and cause approximately \$50,000 in damage.

A large hydroelectric dam along Water Street creates Harris Pond, which has a surface area of 245 acres. Downstream of the dam several homes are within the 100 year floodplain and are directly downstream of the dam. The WDNR has rated the Harrisville Dam as a “high” hazard, which suggests that a dam failure would result in a loss of life. Regular maintenance and monitoring will help ensure protection of downstream property.

Germania (Town of Shields)

Along the Mekan River lies the unincorporated settlement of Germania, where Eagle Road and County Highway N intersect. A large dam just upstream of Germania creates an impoundment of 595 acres. The dam is managed by the WDNR as part of the Germania Wildlife Area. Several homes along County Highway N near Mekan Creek are in the 100-year floodplain. The WDNR has rated the Germania Dam as a “significant” hazard, which suggests that a dam failure would result in significant property damage and possible loss of life. Regular maintenance and monitoring will help ensure protection of downstream property.

Town of Moundville (11th Ct.)

The Fox River has flooded homes several times in the past several years. In June 2008, 25 homes off of 11th Court were severely damaged by flood waters. All of these homes lie entirely within the 100 year floodplain. Future development should not occur within the 100 year floodplain or areas outside of the floodplain that are susceptible to flooding.



Packwaukee Hamlet (Town of Packwaukee)

Packwaukee is an unincorporated community along the banks of Buffalo Lake. Most homes along Buffalo Lake are several feet above the lake. Areas north of the community along County Highway C are wet and inappropriate for future development. In May 2004, areas around Packwaukee experienced road washouts, crop damage, and basement damage totaling \$50,000 in property damage and \$200,000 in crop damage.

The following are key issues contributing to current and future flooding vulnerability in Packwaukee:

- *Road washout.* County Highway C, just north of Pauckwaukee has washout issues during high water events. Attention should be given to the size of the culvert as well as other possible obstructions in the area.
- *Livestock runoff.* An 800 head bison farm on the south side of Buffalo Lake could be negatively impacting both surface and groundwater quality. Special care should be taken during heavy rain events to minimize runoff potential.
- *Potential future development.* There are lots along Highway C north of the Packwaukee community that appear to be marketed for development, but also appear to be highly susceptible to flooding.
- *Highway D causeway.* Local officials indicated that the causeway across Buffalo Lake has been eroding at high rates in recent years. This is the only north-south connection across Buffalo Lake in the area. The June 2008 flood caused severe damage to the causeway forcing its closure.

Agricultural Land

Agricultural land within the County is vulnerable to crop damage, injured livestock, and soil erosion in the event of flooding. This vulnerability can significantly affect the economic stability of municipalities, farms, and agri-businesses, particularly since 43% of the County is in farmland.

Two flooding events since 1993 have had a substantial economic impact on farmland. In July 1993, the County experienced a three-week flood event that affected 86,000 acres. In May of 2004, areas around Packwaukee experienced a flash flood that caused \$200,000 in crop damage. Later that year in June, Marquette County experienced a very large crop loss of approximately \$10 million dollars impacting over 28,000 acres.

Agricultural practices also contribute to the County's vulnerability to flooding. Crops that are grown all the way up to a stream contribute to erosion as well as threaten water quality from fertilizers and pesticides.

Major Roadways

Road washouts and blocked access pose an additional vulnerability in Marquette County. In 2002 flash flooding caused gravel shoulder washouts and road closures. In 2004, another flash flooding event caused road washouts as well. In June 2008, the county sustained a great deal of damage to road infrastructure including the closure of all north/south routes across Buffalo Lake and the Fox River. When major County or State roadways or one-way-in-and-out roadways experience washouts, it limits emergency responders' ability to reach a flooded area, results in costs to improve damaged roadways, and impacts economic activity.

Projected Future Probability of Flooding Hazards

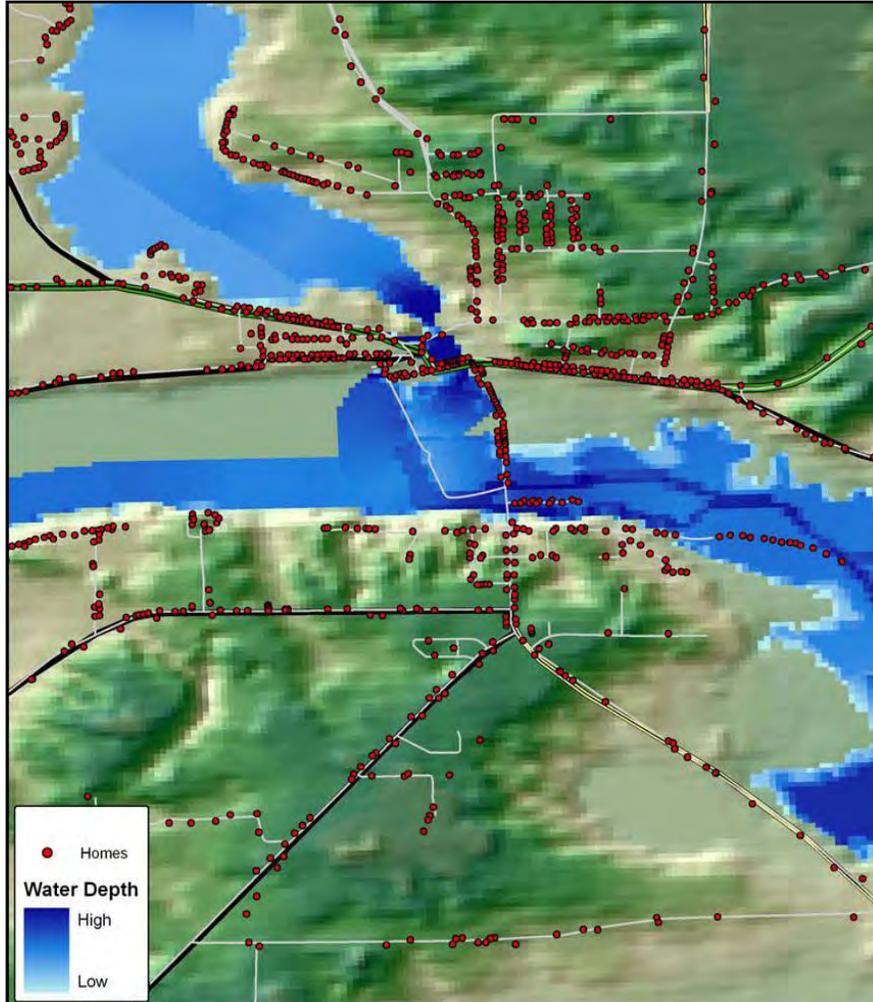
Flooding is not the most common and costliest disaster that affects Marquette County, resulting in millions of dollars of damage to property and crops in the past several decades. Historical records indicate that large floods in the County occur infrequently. Since 1993, NOAA recorded two large flooding events, which equates to one large flood every seven to eight year, not including the recent June 2008 flooding.

Additionally, three flash floods have been documented in the County between 2002 and 2007, equating to a probability of flash flooding once every 2 years, or a 50% chance of a flash flood each year.

Projected Future Damages from Flooding Hazards

In order to better quantify projected loss to property and cropland, a computer model was used to estimate loss during a 100-year flooding event. The HAZUS computer model was created by FEMA for the purpose of helping communities better understand the potential loss from natural disasters. The two major inputs to this model were 2000 statistics from the U.S. Census Bureau and elevation data from the USGS. Additional local information was used to estimate crop values and yields and the location of critical facilities. FEMA included regional values for construction materials and type. As an example, figure 3.8 below illustrates the generated floodplain and water depth based on elevation data and displays home locations in Montello.

Figure 3.8: 100 Year Flood Depth in the City of Montello



Based on actual flood levels from June 2008, most areas of the above figure in blue were flooded, indicating that portions of Marquette County experienced a near 100 year flood event. Marquette County should be prepared for continued damage from future flooding in these low lying areas.

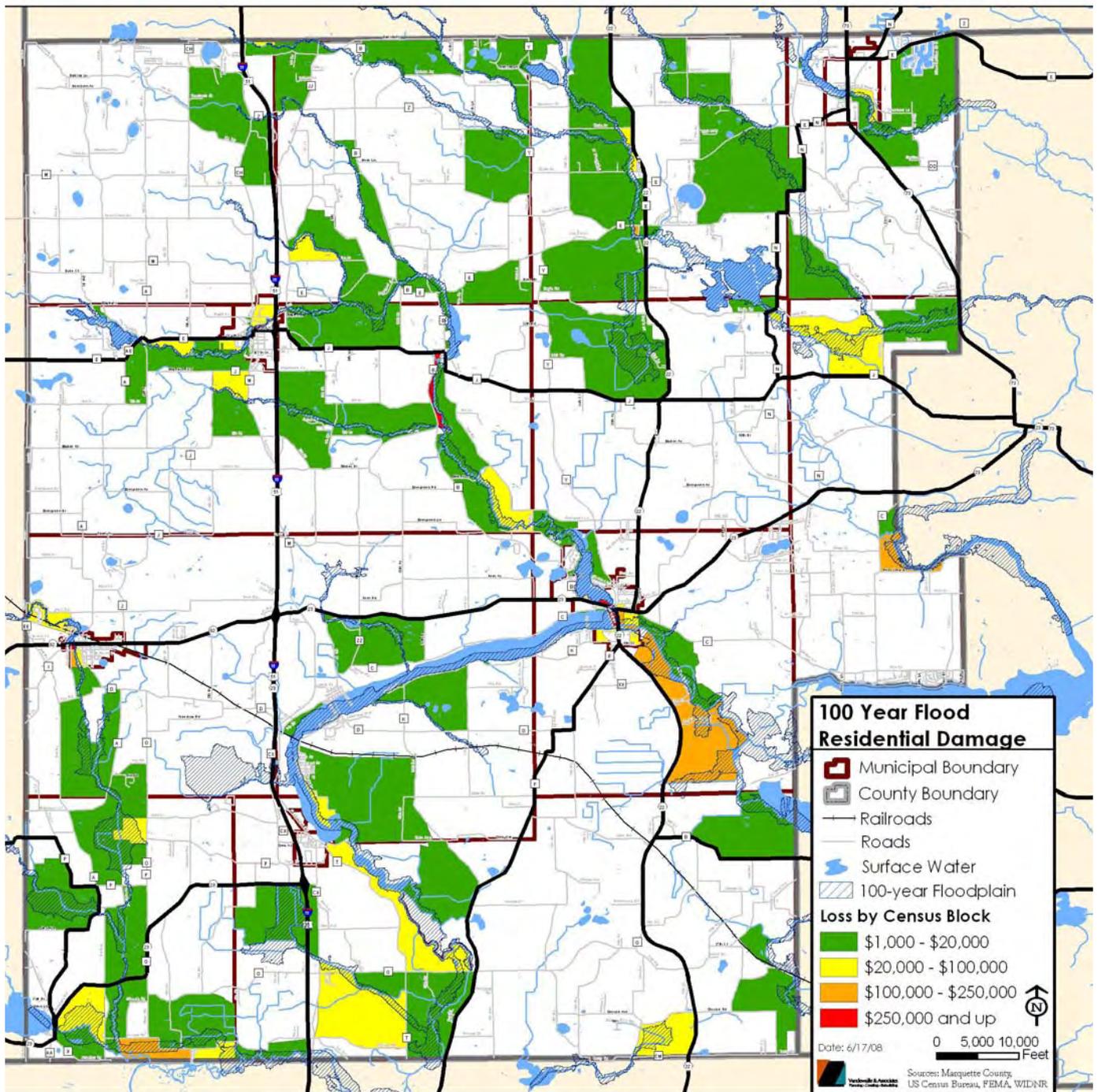
The HAZUS model estimated loss and damage based on a 100 year flood in Marquette County. The model estimates that a 100-year flood would displace 721 individuals and require short term shelter for 180 people. The HAZUS model allows the user to define the date of the flood which is important in calculating agricultural loss. Based on historical flooding in Marquette County, a flood date of June 1 was selected. The following figure summarizes the possible agricultural loss from a 100 year flood.

Figure 3.9: Possible Agricultural Loss from a 100-Year Summer Flood

Crop	3 Day Loss	7 Day Loss	14 Day Loss	Total Loss
Corn	\$1,726,695	\$2,302,260	\$2,302,260	\$6,331,216
Soybeans	\$914,430	\$1,219,240	\$2,302,260	\$7,125,833
Oats	\$588,120	\$784,160	\$784,160	\$2,156,440
Corn Silage	\$1,943,409	\$2,591,212	\$2,591,212	\$3,352,911
Totals	\$5,172,654	\$6,896,873	\$6,896,873	\$18,966,400
<i>Source: FEMA HAZUS Model – 2007. Marquette County, FSA</i>				

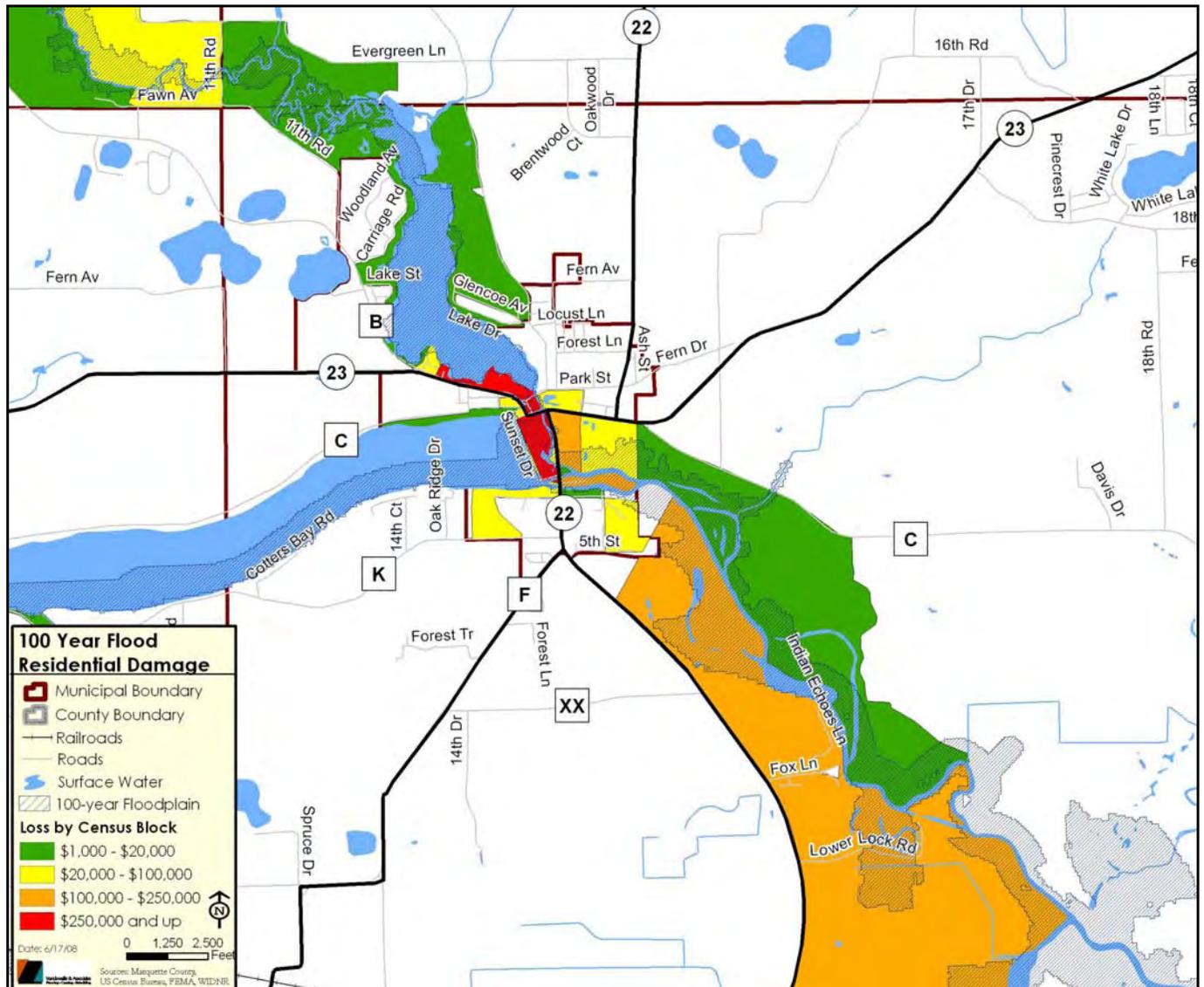
Marquette County would experience significant agricultural and property loss in all parts of the County in a 100 year flood event, assuming a summer event. The projected crop loss of \$19 million for a 100-year flood that would cover the entire County is possible when one considers the fact that in the summer 2004, Marquette County experienced a large flood that caused about \$10 million in agricultural damage. The model also estimates over \$11 million in residential loss, which includes building, contents, relocation, income, and rental loss (See figure 3.10 for areas with largest potential loss). The current property value in Marquette County, as documented in Figure 3.7, is estimated to be around \$26 million. The HAZUS model also estimated that the flood would create 622 tons of debris.

Figure 3.10: Residential Infrastructure Damage Totals by Census Block as Modeled for a 100 Year Flood



Of the estimated \$11 million in residential infrastructure damage from a 100 year flood, \$4.1 million is expected to occur in the City of Montello. Approximately \$1.4 million of damage is predicted in the historic downtown and \$900,000 in damage along Highway 22 south of downtown. Figure 3.11 illustrates the potential loss by census block for the City of Montello.

Figure 3.11: Residential Infrastructure Damage Totals in the City of Montello as Modeled for a 100 Year Flood



In addition to these quantitative damage estimates, the following potential damages from a 100-year flood are anticipated in the County, based on data from the National Weather Service and input from MCEM, the Hazard Mitigation Planning Committee, stakeholders, and residents:

- *Transportation Network:* washed out roads and bridges, undermined riverbanks, embankment failures, and debris cleanup. The strong current of water across roads can cause serious injuries and death when individuals attempt to drive or cross these flooded areas.²⁷ Also, blockages to major roads can interrupt economic activity.
- *Drainage Systems:* damaged and destroyed culverts and tubes and debris cleanup.
- *Public Property:* flooded public facilities such as schools and parks and damaged recreational amenities, lands, and historic sites.
- *Access to Critical Facilities:* For example, the HAZUS model predicted that the Police Station in Montello could suffer major building damage in the event of a 100-year flood.

²⁷ Wisconsin Emergency Management. *Hazard Analysis for the State of Wisconsin.*

- *Utilities*: downed transmission lines and poles, damaged transformers and telecommunication networks, damaged water treatment systems, diminished water quality from overflow and backup of sanitary sewer.
- *Residential Structures*: flooded basements, collapsed foundations, damaged septic systems, collapsed wells, and destroyed/severely damaged homes.
- *Agricultural Lands*: inundated cropland, injured livestock, soil erosion, delayed planting/growing season, washout of seed and agricultural chemicals into drainage systems, root and plant rotting, stunted crop growth and decreased nutritional value.
- *Businesses*: inventory and revenue loss and permanent closure. According to FEMA, approximately 30% of flood-impacted businesses do not reopen following a disaster. These closures result in restricted access to goods and services, as well as lost tax revenue that can lead to decreased services provided by local governments.
- *Local Economy*: additional public expenditures for response and recovery personnel, repair materials, and equipment; and lost revenue from closed business and destroyed cropland and livestock.

Dam Failures

Dam Failures Hazard Overview

A dam failure or a levee breach results in an uncontrolled release of water rapidly flooding downstream property. A dam can fail due to excessive rainfall, rapid snowmelt, poor construction, earthquake activity, surface erosion, and vandalism.²⁸ Many Wisconsin dams were built in the late 1800s and early 1900s and with weathering, increasing hydrologic pressure, and neglect are increasingly subject to failure.²⁹

Currently, the WNDNR maintains a database that documents 51 dams in Marquette County. The WNDNR rated 14 dams as “large,” or measuring more than six feet high with 50 acre feet or more of max storage OR 25 feet and greater high with more than 15 acre feet of storage. Of the remaining dams, 21 are defined as small dams, 13 are within the Fox River National Wildlife Area, and two are undefined. In Marquette County, three dams located in the City of Montello, Town of Harris, and the Village of Neshkoro are utilized for electrical generation.

Historical Occurrences of Dam Failures

In association with the widespread flooding of 1993, the Briggsville Dam failed and washed out the embankment in March. No severe property damage was sustained but a recreational lake was totally drained. Later that same year, the embankment of Packers Bay Dam was overtopped in June.³⁰ In the late 1980s, local residents documented the failure of a dam near the Village of Westfield, which affected properties as far east as Mecan. In June 2008, the Lake Mason Dam, just upstream of Briggsville had to be opened up to 86% to reduce pressure from several days of intense rainfall.

Dam Failure Hazard Vulnerability

Marquette County has 51 dams, but the majority of these dams are small in size and not stringently regulated for safety purposes. The WNDNR assigns hazard ratings to large dams within the state based on the existing land use and zoning downstream of the dam. The dams are classified into three categories that identify the potential hazard to property and life downstream in case of a dam failure. A high hazard indicates that a failure would most probably result in the loss of life. A significant hazard indicates a failure would result in appreciable property damage. A low hazard exists where failure would result in only minimal property damage and the loss of life is unlikely. The following figure 3.12 includes data on the dams in Marquette County that have a hazard rating.

²⁸ Wisconsin Emergency Management. *Hazard Analysis for the State of Wisconsin*.

²⁹ WNDNR, Dam Safety. <http://dnr.wi.gov/org/water/wm/dsfm/dams/faq.html>

³⁰ Wisconsin Emergency Management. *Hazard Analysis for the State of Wisconsin*.

Figure 3.12: Large Dams that Pose a Potential Hazard to Downstream Property and Life

Owner	River or Stream	Dam Size	Downstream Community	Hazard Rating*	Impoundment Size (Ac)	Name of Impoundment	Max Storage (ac ft)
WNDR	Grand River	Large	None	High	2,500		22,000
Lake of the Woods Campground	Little Pine Creek	Large	Budsin	High	20	Little Pine Pond	100
Town of Douglas *	South Branch Neenah Creek	Large	Briggsville	High	856	Mason Lake	7,500
Lake Emery Rehab. District	Ox Creek	Large	None	High	35	Lake Emery	220
City of Montello *	Montello River	Large	Montello	High	286	Lake Montello	2,300
Town of Harris *	Montello Creek	Large	Harrisville	High	245	Harris Pond	1,600
Village of Neshkoro	White River	Large	Neshkoro	Significant	184	Neshkoro Millpond	945
Village of Westfield	Westfield Creek	Large	Westfield	Significant	32	Westfield Pond	225
Lake Lawrence Rehab Dist. *	Lawrence Creek	Large	Lawrence	Significant	221	Lawrence Lake	2,350
WNDR	Mecan River	Large	Germania	Significant	595	Germania Marsh	3,000
WNDR	Fox River	Large	Montello	Low	2,210	Buffalo Lake	19,000
Village of Oxford *	Neenah Creek	Large	Oxford	Low	61	Neenah Lake	600
Duffy Marsh Property Owners	Unnamed Trib to Grand River	Large	None	Low	1,302	Duffy's Marsh	5,750
NRCS	Trib to Montello River	Large	None	Low	0		300

* Indicates a site in which an Emergency Action Plan has been created by the WDNR

Source: WDNR Department of Dam and Public Safety, 2006

During the June 2008 flood, the embankment along the Buffalo Lake Dam was utilized as an alternate road when Highway 22 was closed. Local officials raised concerns about stability of this embankment following the heavy traffic volumes that were transported across a structure not intended for heavy and sustained traffic. Special attention should be given to this embankment during future high water events to ensure its integrity.

Projected Future Probability of Dam Failures

Based on historical dam failures, the cause has been associated with large precipitation events. Regular monitoring and maintenance of dams in the County is critical in eliminating the serious hazard that a dam failure can present to downstream residents as the dam infrastructure continues to age. The six high hazard large dams represent a larger risk than those in other portions of the County and should receive special attention. All dams upstream of concentrated populations in the above list should be regularly monitored to ensure functionality and protection of property and human life.

Many Wisconsin dams were built over 100 years ago. As dams continue to age, the likelihood for failure increases as undesirable woody vegetation on the embankment, deteriorated concrete, inoperable gates, and corroded outlet pipes become problems. Since dam failures are often exacerbated by flooding, the probability of dam failures can be associated with projected flood frequencies (see Flooding Hazard section above).

Projected Future Damages from Dam Failures

The WDNR's classification of six high-hazard, large dams in the County indicates that in the case of a failure, there would be a likely loss of life and significant property damage. A large dam failure would likely cause major property damage to nearby structures and communities, but the exact impacts are difficult to quantify without access to dam break maps. WDNR has completed a dam break analysis for the Westfield, Grand River Marsh, Montello, Briggsville, Oxford, Montello Granite, Harrisville, and Lawrence Lake dams, but the project team was unable to obtain those maps during this process. The dam break analysis describes and maps potential damage from a dam failure and is used as the basis for the creation of an Emergency Action Plan. An EAP is required by Wisconsin Administrative Code NR 335.07 for dams that meet the large criteria or pose a threat to life or property. Where available, the Emergency Action Plan for each high-hazard dam includes provisions for notifying emergency authorities and downstream residents in the case of a dam failure.

Severe Thunderstorms and Windstorms

Severe Thunderstorms and Windstorms Hazard Overview

The National Weather Service defines a severe thunderstorm as a storm event that produces any of the following: downbursts with winds of 58 miles per hour (50.4 knots) or greater, hail of $\frac{3}{4}$ of an inch or greater, or a tornado. Any given county in Wisconsin may experience 10 or more thunderstorms per year.³¹ A thunderstorm cell travels approximately 30 to 50 miles per hour and generally runs its course of creation and dissipation within 30 minutes. In Wisconsin, heavy rain, lightning, hail, tornadoes, and severe winds occur separately and in combination during severe storm events.³² Thunderstorms can occur throughout the year, with the highest frequency between May and September between noon and midnight.

The following is a description of the characteristics and risks associated with thunderstorms.

Lightning

Lightning travels between and among the ground, clouds, and tall structures. Lightning can cause death and injury to humans and animals, set fire to buildings, cause damaging surges within the power and communications grids. Lightning is responsible for the death of more people in the U.S. each year than tornadoes or hurricanes. People are at greatest risk of fatality and injury from lightning when at outdoor recreation events or near trees.³³

Hail

Hail is developed when there are sufficiently strong and persistent up-draft wind speeds and water has accumulated in a super-cool state in the upper parts of the storm. Although injury and loss of life is rarely associated with hailstorms, property damages can be extensive. Hail ranges in size from barely visible to the size of softballs and larger, and tend to fall in swaths of 20 to 100 miles. The hail season peaks between April and June, and occurs primarily between noon and midnight.

Severe Windstorms

In Wisconsin, thunderstorm winds actually cause more damage year-to-year than tornadoes, and this is no exception in Marquette County. Severe winds (58 mph or greater) are most common between April and September, peaking in June.

³¹ Ibid

³² Ibid.

³³ Ibid.

The following terms are used to describe causes and types of severe winds:³⁴

- *Straight-line wind*: A straight-line wind includes any thunderstorm wind that is not associated with rotation, differentiating them from tornadic winds. Straight-line winds can be difficult to detect on radar. Most straight-line winds are a result of outflow generated by a thunderstorm downdraft. Straight-line winds can produce damage equivalent to an F0 or F1 tornado.
- *Downdraft*: A downdraft is a small-scale column of air that rapidly sinks toward the ground.
- *Downburst*: A downburst occurs when a strong downdraft wider than 4 km (2.5 miles) results in an outward burst of damaging winds on or near the ground. Downburst winds sometimes begin as a microburst and spread out over a wider area, sometimes producing damage similar to a strong tornado.
- *Microburst*: A microburst is a small concentrated downburst, less than 4 km (2.5 miles) that produces an outward burst of damaging winds at the surface. Microbursts generally last 5-10 minutes, with maximum windspeeds up to 168 mph.

Tornadoes

A tornado is a violently rotating, funnel shaped column of air that may or may not touch the ground. Average winds in a tornado are 175 to 250 miles per hour and may produce winds in excess of 300 miles per hour. Most Wisconsin tornadoes travel southwest to northeast or west to east, travel speeds average around 20 to 40 mph, and persist for less than 10 minutes with a path length of less than 5 miles.³⁵ The destructive power of a tornado lies primarily in its high wind velocities and sudden changes in pressure, which are thought to account for over 90% of resulting damages. Tornadoes are associated with storm systems and therefore usually are accompanied by hail, torrential rain, and intense lightning. Tornadoes can strike anywhere and cause extensive damage.

Tornadoes can occur in any month but are most common from March through August, between 3:00 – 7:00 p.m.³⁶ Wisconsin lies along the northern edge of "tornado alley," which spans from Texas to Michigan.

In the U.S., tornadoes were historically classified using the Fujita Scale into six intensity categories, F0 to F5. These categories are based on the estimated maximum wind speed occurring within the funnel. Since February 2007, the Enhanced Fujita scale has been used, ranging from EF0 to EF5. The new EF-Scale improves upon the F-Scale by estimating the strongest 3-second wind gust based on the degree of damage to one or more of 28 classes of trees or structures.



F1 Tornado Damage, Town of Newton (MCEM, 2005)

Figure 3.13 illustrates the damage experienced for each EF class as well as the average percentage of each class of tornado from the National Weather Service. This national average was calculated based on a four-year period beginning in 1998 when Doppler radar greatly improved the ability to detect lower-intensity tornadoes. In Wisconsin about 80%

³⁴ National Oceanic and Atmospheric Administration. *National Severe Storms Laboratory Website*. http://www.nssl.noaa.gov/primer/wind/wind_basics.html

³⁵ National Weather Service, Milwaukee/Sullivan, WI. <http://www.crh.noaa.gov/mkx/flyers/flyertor.php>

³⁶ Wisconsin Emergency Management. *Hazard Analysis for the State of Wisconsin*.

of tornadoes are between 50 and 110 mph, 19% are rated as strong with speeds of 110 to 205 mph and only 1% are violent with winds speeds in excess of 205 mph.³⁷

Figure 3.13: Tornado Wind & Damage Scale

Enhanced Fujita Scale	3-second Gust Wind Speed (mph)	Damages	Average % of Tornadoes NWS Quad Cities Region (Year – Year)
EF0	65–85	(Light Damage) Some damage to trees and TV antennas; Shallow rooted trees pushed over.	29%
EF1	86–109	(Moderate Damage) Peels surface off roofs; windows broken; light mobile homes overturned; some trees uprooted or snapped; moving automobiles pushed off road.	40%
EF2	110–137	(Considerable Damage) Roofs torn off frame homes; weak buildings and mobile homes destroyed; large trees snapped or uprooted; railroad boxcars pushed over; cars blown off highway.	24%
EF3	138–167	(Severe Damage) Roofs and some walls torn off frame homes; some rural buildings demolished; trains overturned; steel-framed hangars and warehouses torn; most trees uprooted or snapped.	6%
EF4	168–199	(Devastating Damage) Well-constructed frame homes leveled, leaving piles of debris; steel structures badly damaged; trees debarked by fling debris; cars and trains thrown or rolled considerable distances; missiles generated.	2%
EF5	200–234	(Incredible Damage) Strong frame houses lifted off foundations and disintegrated; steel-reinforced concrete structures badly damaged; vehicle-sized missiles generated; incredible phenomena can occur.	Less than 1%

Source: NOAA, NWS Storm Prediction Center

Historical Occurrences of Severe Thunderstorms and Windstorms

Lightning

In recent history, Marquette County has no documented occurrences of lightning that has caused damages.

Hail

Between 1963 and 2007, Marquette County experienced 47 occurrences of severe hail causing \$1,002,000 in property damages and no recorded crop damage. On May 12, 2000, a very destructive hailstorm struck the northern portion of

³⁷ National Weather Service, Milwaukee/Sullivan, WI. <http://www.crh.noaa.gov/mkx/flyers/flyertor>

Marquette County. With around \$1 million dollars in damage, it is believed that this storm is the most costly hailstorm to have occurred in southern Wisconsin in the past 100 years. Hailstones the size of baseballs (3 inches in diameter) resulted in damage to hundreds of homes and vehicles. Two people in Marquette County were injured by the large hailstones and needed medical treatment. In the Town of Crystal Lake, it was reported that hailstones left impact marks on walkways. With twelve events, 2006 saw the greatest number of events reported in a single year. Refer to Table A3 in Appendix A for a full list of these historical events.

Severe Windstorms and Tornadoes

There have been 90 reported occurrences of severe thunderstorm winds in Marquette County between 1955 and 2007. These events have caused a reported \$327,000 in property damages and \$55,000 in crop damages. The greatest number of events was reported in 2005—10 instances of severe winds. Refer to Table A2 in Appendix A for a full list of these historical events.

Tornadoes most frequently occur between April and September, in late afternoon and early evening hours. This is true in Marquette County, as all recorded tornadoes occurred between May and September. Since 1955, 14 tornadoes have been recorded in Marquette County by the National Weather Service—seven F0 (light damage), four F1 (moderate damage), and three F2 (considerable damage) on the Fujita Scale. Additionally, four funnel clouds were spotted during this time period. Total known damages from these events are \$1,929,000 – with the bulk of this from an F2 tornado in 2004. This tornado spun up about a ½ mile east of I-39 near the intersection of Fawn Court and County Highway M. Many trees were uprooted, four homes destroyed, 25 sustained major damage, and 142 had minor damage. Additionally, nine agricultural buildings were damaged before the tornado ended one mile short of the County line, four miles southeast of Montello. The County sustained \$1 million in property damage and another \$500,000 in crop loss. Refer to Table A4 in Appendix A for a full list of these historical events.

Severe Thunderstorms and Windstorms Hazard Vulnerability

Based on review of the historic patterns of thunderstorms and associated hail, lightning, wind, and tornado events, the entire County is vulnerable to damages from severe storms and tornadoes. In Wisconsin hail events represent 20% of all severe weather events, straight-line winds make up 72%, and tornadoes add about 8%.³⁸ In Wisconsin there is approximately 30 thunderstorm days a year and the southern half of the state is more susceptible to thunderstorms than the northern half.

The County's recreational appeal, numerous wetlands, lakes, wooded areas, trout streams, and other natural features are some of the County's greatest assets, but result in isolated concentrations of people that are particularly vulnerable to severe storms. Of all County residential units, 33% are occupied part-time. The County's population doubles and sometimes triples in the summer months, when severe thunderstorms and windstorms are most likely to occur. A rural county designed for 15,000 people is soon faced with the challenge of managing and protecting upwards of 45,000 people. Community members identified 13 campgrounds that are mainly spread through the eastern half of the County that could contain over 1,000 people on a summer weekend (see Map 2). These campgrounds are often not equipped with shelters in the case of an emergency and usually lack severe weather warning systems.

The City of Montello is the largest concentration of people in the County, but still only accounts for 10% of the County's year-round population. The four villages absorb an additional 18% of the County's population. The remaining 72% of people are concentrated in unincorporated communities surrounding lakes and other natural features. The County estimates that 22% of residential units are mobile homes. Research by the NWS indicates that 40% of all tornado-related deaths between 1985 and 1998 occurred in mobile homes, 27% were in permanent homes, 11% were in vehicles, and 8% were out in the open (other locations, each accounting for less than 5% of deaths, included businesses, schools, and long-span roofs).³⁹ Although many mobile homes are scattered throughout the County, the majority are concentrated within mobile home parks. Locations of mobile home parks are identified as vulnerable populations on Map 2.

³⁸ National Weather Service, Milwaukee/Sullivan, WI. <http://www.crh.noaa.gov/mkx/flyers/flyerhail.php>

³⁹ Tornado Fatalities by Circumstance, 1985-1998, Storm Prediction Center.

<http://www1.ncdc.noaa.gov/pub/data/techrpts/tr9902/tr9902.pdf>

As documented in the Marquette County Comprehensive Plan (2005), the County’s median age has been increasing over the past several decades and the percentage of individuals over the age 65 is about 7% higher than the state’s average. Given the County’s rural, natural, and recreational appeal one can expect the number of retired citizens to continue to grow. Both elderly and individuals with special needs require specialized assistance and care in case of an emergency. These groups of people are most at risk for injury or death from severe storms, tornadoes, or other severe windstorms.

Lightning

People are at greatest risk of fatality and injury from lightning when at an outdoor recreation event or near objects such as tall trees or water towers.⁴⁰ Between 1959 and 1999 lightning killed 49 people giving Wisconsin a rank of 29th in the nation and lightning injured another 230 people ranking Wisconsin 19th.⁴¹

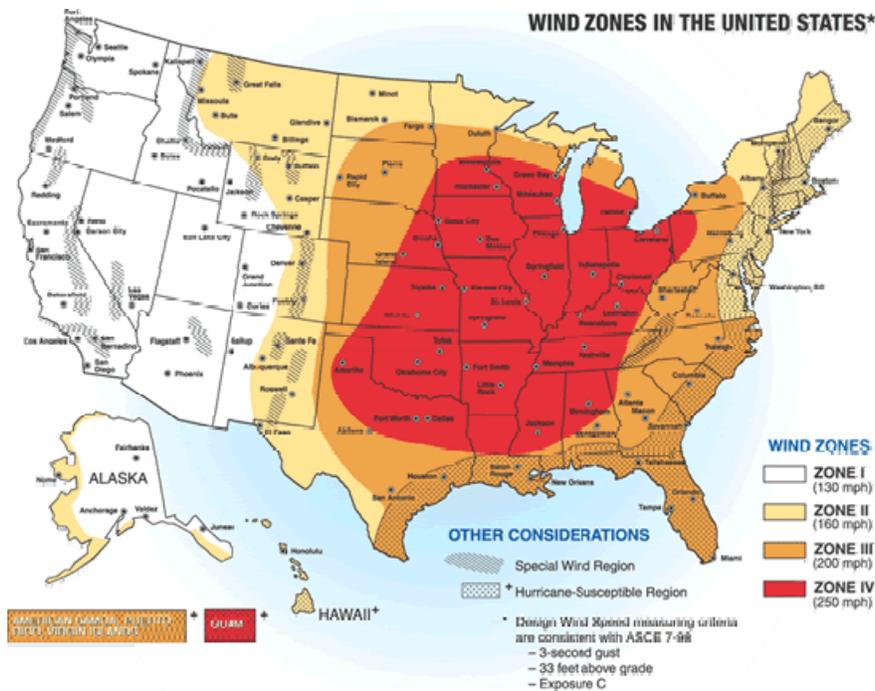
Hail

Building roofs, vehicles, and other outdoor objects of value are most vulnerable to hail damage. Livestock is also vulnerable to damage.

Tornadoes and Severe Winds

Overall, Marquette County is vulnerable to severe winds and tornadoes and is located in the most severe wind zone in the U.S., as illustrated in Figure 3.14

Figure 3.14: Wind Zones in the United States



Generally, concentrated populations and individuals with special needs are most vulnerable to severe winds. In addition to mobile home parks, campgrounds and industrial parks are also vulnerable to damage from tornadoes and severe winds. Like mobile home parks, campers and pole-shed style industrial buildings do not provide protection against the wind velocities of a tornado, and often there is no shelter provided in the building or area. The risk assessment maps at the end of this chapter illustrate historical paths of severe winds and tornadoes.

⁴⁰ Wisconsin Emergency Management. *Hazard Analysis for the State of Wisconsin*.

⁴¹ National Weather Service, Milwaukee/Sullivan, WI. <http://www.crh.noaa.gov/mkx/flyers/flyertstm.php>

Projected Future Probability of Severe Thunderstorms and Windstorms

Probability is described below for each of the hazards associated with severe storms.

Lightning

Between 1956 and 2007, Marquette County experienced no recorded occurrences of lightning that caused damage. These events do not appear to be likely in the County.

Hail

Between 1963 and 2007, Marquette County experienced 47 occurrences of severe hail. Based on this historic frequency, the County can expect a severe hailstorm (3/4 of an inch or greater) once a year.

Tornadoes and Severe Winds

There have been 90 reported occurrences of severe thunderstorm winds in Marquette County between 1955 and 2007. Based on this, there is a likelihood of severe winds, not including tornadoes, occurring one to two times in any given year in the County.

Between 1955 and 2007, 14 tornadoes have been recorded in Marquette County by the National Weather Service. Based on this, there is a 27% probability of a tornado in Marquette County in any given year. Figure 3.15 illustrates the probability of a tornado by magnitude based on past occurrences.

Figure 3.15: Probability of Tornadoes by Magnitude

	F0	F1	F2	F3	F4	F5
Number of Tornadoes Reported since 1955	7	4	3	0	0	0
Probability of each magnitude of tornado, when a tornado occurs – Marquette County	50%	28.6%	21.4%	< 1%	< 1%	< 1%
Probability of each magnitude of tornado, when a tornado occurs – State of Wisconsin	80%		19%		1%	
<i>Source:</i> National Weather Service, Milwaukee/Sullivan, WI. http://www.crh.noaa.gov/mkx/flyers/flyertor						

Combination of two means “high risk” – storm shelter is preferred method of protection from high winds

While no tornadoes over an F2 magnitude have been recorded by the National Weather Service in Marquette County, tornadoes up to F5, the most severe, have occurred in Wisconsin. According to the Wisconsin Natural Hazard Plan, “every county in Wisconsin has had tornadoes and is susceptible to a tornado disaster.”

Projected Future Damages from Severe Thunderstorms and Windstorms

In the past, severe thunderstorm events caused substantial property and infrastructure damage and it is logical to assume they will continue to do so. Potential damages from severe storms include the following:

- *Utilities:* downed and damaged electrical lines, poles, and antennae; damaged transformers, telephone lines, and interrupted radio communications
- *Transportation Network:* debris cleanup and road damage
- *Drainage Network:* debris cleanup, damaged and destroyed culverts and tubes
- *Residences:* damaged or destroyed houses, mobile homes, garages, trees, siding, roofs, and windows
- *Businesses:* closures, and building and inventory damages
- *Agricultural Lands:* damage or destroyed buildings, crops, and livestock, and soil erosion
- *Personal Property:* damaged cars, trucks, and recreational vehicles
- *Death and injury to people and animals*

Also based on historical data, there are two levels of damages due to severe thunderstorms. Marquette County incurred 36 moderate storms with damages ranging from \$1,000 to \$40,000 for a total of \$212,000 and an average of \$5,889. However, six much more severe storms constituted \$3,101,000 in damages with an average of \$516,833 for

those storms. Based on damages in the last ten years, the County has averaged nearly \$300,000 a year in damages from hail, tornadoes, and severe winds. Additionally, severe storms in the County have resulted in two reported injuries.

Lightning

There have been no reported fatalities or injuries due to lightning. However, lightning is responsible for the death of more people in the U.S. each year than tornadoes or hurricanes. Wisconsin is ranked 29th in the nation for lightning deaths and 19th for injuries.⁴² Consequently people in Marquette County are still at risk of injury and death from lightning.

Hail

NOAA data reports that there have been 47 occurrences of severe hail in Marquette County, causing \$1,002,000 in property damages and no recorded crop damages. On May 12, 2000 a very destructive hailstorm caused \$1 million in damage and injured two people.

Tornadoes and Severe Windstorms

There have been 90 reported occurrences of severe thunderstorm winds in Marquette County between 1955 and 2007. These events have caused a reported \$327,000 in property damages and \$55,000 in crop damages.

NOAA data indicates that tornadoes have caused \$1,929,000 of damage in Marquette County from 1955 to 2007. Past impacts from tornado events have included downed utility lines, uprooted trees, destroyed and damaged homes, and damaged agricultural building. A tornado in 2004 that cut through the central part of the County uprooted trees, destroyed 4 homes, and damaged 167 homes and nine agricultural buildings.

With the exception of the \$1.5 million dollars in damages from the 2004 tornado, on average, damages per tornado were \$33,000.

Damages from future tornadoes are projected to predominantly impact a 1-2 mile long area, 100 yards wide, as most tornadoes will be weak. However, it is possible that a strong tornado will occur, resulting in a path $\frac{1}{4}$ to $\frac{1}{2}$ mile wide and 20 miles long. It is also possible that a violent tornado will occur, resulting in a 1-mile wide path and extending greater than 20 miles.

Severe Winter Storms

Severe Winter Storms Hazard Overview

Winter storms include heavy snowstorms, blizzards, and ice storms. Winter storms cover broad geographical areas and one storm can impact entire regions of the state. The winter storm season in Wisconsin generally runs from October to March. However, severe winter weather has occurred as early as September and as late as April and the early part of May in some locations of the state. Historical events have resulted in problems of drifting snow and hazardous roadway conditions. According to the Wisconsin Natural Hazard Mitigation Plan, there are five categories of winter storms:

- *Blizzard*: The most dangerous of all winter storms, a blizzard combines low temperatures, heavy snowfall and winds of at least 35 miles per hour, reducing visibility to only a few yards.
- *Heavy Snowfall*: A heavy snow storm produces six inches or more of snow in a 12-hours period or eight inches or more in a 24-hour period
- *Ice Storm*: An ice storm occurs when moisture falls and freezes immediately upon impact.
- *Freezing Drizzle/freezing rain* – rain that falls upon surfaces that are 32 degrees Fahrenheit or below, freezing on impact.
- *Sleet* – Solid pellets or grains of ice that forms from rain freezing before hitting the ground or the refreezing of largely melted snowflakes.

⁴² National Weather Service, Milwaukee/Sullivan, WI. <http://www.crh.noaa.gov/mkx/flyers/flyertstm.php>

Wisconsin experiences three to five days of freezing rain per year and a major ice storm occurs about once every other year.⁴³ Much of the snowfall in Wisconsin occurs in small increments between one and three inches per storm. Heavy snowfalls occur on average of 5 times per year throughout the state.⁴⁴ In addition to individual storm events, a severe winter storm occurs when an extremely cold period extends for over a month or when severe ice storms or heavy snowfall occur repeatedly for six weeks or more.

Historical Occurrences of Severe Winter Storms

NOAA reported 53 severe winter storms events in Marquette County between 1993 and 2007. Refer to Table A5 in Appendix A for a full list of these historical events. These storms included heavy snow, ice storms, and blizzards.

Severe Winter Storms Hazard Vulnerability

Winter storms present a serious threat to the health and safety of residents and can result in significant damages to property. Heavy snow and accumulated ice can cause structural collapse of buildings, down power lines, and isolate people from assistance and services, particularly in rural areas such as Marquette County. Research suggests that 70% of fatalities related to ice and snow occur in automobiles and 25% are people caught outside in the cold.⁴⁵

Historic data indicate no specific pattern of incidents; therefore, all jurisdictions, structures, and critical facilities are equally vulnerable to damages due to severe winter storms. Potential impacts could include damaged roofs due to ice or snow-loading, frozen pipes, and downed electrical lines. A severe winter storm event could damage critical facilities, interrupt provision of water and electricity, and temporarily suspend public services.

The rural, aging, and often seasonal population increases Marquette County's vulnerability to winter storm hazards. About 72% of people live outside of cities and villages. Access to rural populations is often delayed or impossible during severe winter storms. Further, with approximately 1/3 of the County's residential units only occupied part-time, winter maintenance can be minimal and increase potential property damage. Finally, 22% of residential units are mobile homes which are typically subject to increased property damage during severe storms.

Some of the most vulnerable populations to winter storms are the elderly and those with special needs. Both elderly and individuals with special needs require specialized assistance and care in case of an emergency, which can be delayed or temporarily suspended in winter weather. These groups of people are most at risk for injury or death from winter storms. As documented in the Marquette County Comprehensive Plan (2005), the County's median age has been increasing over the past several decades and the percentage of individuals over the age 65 is about 7% higher than the state's average. Given continuing demographic movements and the County's rural, natural, and recreational appeal, the number of retired and elderly citizens in the County will certainly grow, probably significantly.

The combination of the above factors creates the need for increased communication, education, and preparedness in the case of a severe winter storm.

Projected Future Probability of Severe Winter Storms

Based on historical frequency of 53 events over the 15 year period from 1993 to 2007, Marquette County can expect three to four severe winter storm events per year.

Projected Future Damages from Severe Winter Storms

Damages and losses due to winter storms are generally minor and widespread. Increased automobile accidents and additional municipal expenditures for emergency response and snow removal are common, and such claims are not tracked. Potentially extreme impacts of winter storms usually involve ice storms. For Marquette County, damages were only reported for one storm in late season snow storm in April of 2007 of \$10,000.

Possible damages that could occur from winter storms include the following:

- *Infrastructure:* temporarily closed/blocked roadways, additional hours and equipment for emergency services, and diminished operation of public facilities and schools.

⁴³ Wisconsin Emergency Management. *Hazard Analysis for the State of Wisconsin*.

⁴⁴ Wisconsin Emergency Management. *Hazard Analysis for the State of Wisconsin*.

⁴⁵ National Weather Service, Milwaukee/Sullivan, WI. <http://www.nws.noaa.gov/om/winter/winter1.htm>

- *Utilities:* downed power lines and frozen pipes. Most of Marquette County's power lines are above ground and power outages could severely impact County residents during a severe winter storm. The cost of burying power lines is often times cost prohibitive.
- *Private Property:* damaged or collapsed roofs; ice damming; and damaged vehicles.
- *Businesses:* diminished profits due to closure or destroyed inventory.
- *Agriculture:* injured or killed livestock.
- *Injury and Death:* people are at risk of injury or death in particular when driving conditions are hazardous due to slick road, winds, and decreased visibility from snow. Extremely cold temperatures accompanied by strong winds can result in temperatures that can cause frostbite, hypothermia, and death.

Forest Fires

Forest Fires Hazard Overview

A forest fire is an uncontrolled fire that occurs in a forest or woodland, usually outside of the limits of incorporated villages or cities. A wild fire is any instance of uncontrolled burning in brush, marshes, grasslands, or field lands. For the purposes of this analysis, forest and wild fires are evaluated together. The causes of these fires includes lightning, human carelessness, and arson.

The forest fire season in Marquette County begins in March and continues through November; however, fires can occur during any month of the year, particularly whenever vegetation is dry because of a dry winter or a summer with little precipitation. Specifically, lack of precipitation, high wind, and low humidity are conditions that can contribute to the intensity of the fire season. Fires can occur naturally; however though they are often initiated and enhanced by human activities. The length and peak months of the forest fire season can vary from year to year. The main determinants of vulnerability and risk are land use, forest cover, amount of combustible material present, and weather conditions. Although preventing or controlling forest fires is preferable, many mitigation efforts prevent or alleviate damage to homes and communities when fires inevitably occur.



Fire in Red Pine Plantation, WDNR

Marquette County has a forest protection network that includes agencies and organizations at the state, County, and local levels. This network includes a public information program that reaches all sectors of the public and conveys how to use the forest and recreational areas responsibly. State programs include the DNR's fire suppression plan, the Wisconsin Fire Control Program, and Rural Community Fire Protection Program. In Marquette County there are ten fire departments. The Montello Fire Department is the largest department, serving residents in the city and town of Montello, and the towns of Buffalo, Packwaukee, and Shields. Although the state will help cover the costs of fire suppression on state-owned lands, local fire districts frequently fund the local cost unless a responsible party is identified, who would then be accountable for the costs incurred.

The entire County is included in the state's extensive forest fire control area. However, as of June 2008, the Montello ranger station is vacant because of a state hiring freeze, according to the MCEM. The Wautoma station is currently covering Marquette County.

Historical Occurrences

According to the DNR approximately 1,500 fires burn more than 5,000 acres annually in the State of Wisconsin. Over 90% of the fires are human-caused. The figures 3.16 and 3.17, summarize historical fires and their causes in Marquette County.

Figure 3.16: Historical Fire Occurrences

Year	# of Fires	# Acres	Year	# of Fires	# Acres
1982	22	70.1	1994	65	156.7
1983	28	42.2	1995	69	159.8
1984	45	177.2	1996	75	194.9
1985	37	107.6	1997	64	47.0
1986	40	37.3	1998	55	97.9
1987	44	81.0	1999	78	154.0
1988	87	189.8	2000	61	158.2
1989	94	119.7	2001	52	40.5
1990	54	171.3	2002	65	63.3
1991	24	26.7	2003	61	670.8
1992	64	103.6	2005	46	69.6
1993	30	21.7	2006	35	57.0

Source: Wisconsin DNR Forestry Division, March 2007

Figure 3.17: Historical Fire Types

Cause of Fire	# of Fires	# Acres
Debris Burning: Brush Piles	170	939.0
Debris: Burning: Household Trash (not in container)	121	345.9
Equipment: Farm Equipment	78	45.7
Misc: Power Lines	66	27.4
Misc: Electric Fence	56	32.2
Misc: Fireworks	42	10.9
Debris Burning: Leaf/Needle Piles	41	23.7
Debris Burning: Broadcast – ½ acre or less	41	87.6
Misc: Improper Ash Disposal	40	80.3
Debris Burning: Incinerator/Burning Barrel	39	65.7

Source: Wisconsin DNR Forestry Division, March 2007

Fire occurrences vary considerably from year to year largely based on the weather and condition of forested areas. The DNR has documented 1,317 fires over the past 25 years in Marquette County. Over 37% of all fires were a result of debris burning and another 17% were started from equipment usage.

The largest fire in the past 25 years impacted 572 acres in the northern part of Marquette County in the Town of Crystal Lake. The fire began near Lake of the Woods Campground on April 14, 2003, and threatened 100 camper trailers and 24 homes. The intensity and proximity of the fire forced all fire department resources to protect private property. Fire crews from 17 local municipalities, Marquette and Waushara Counties, the Red Cross, and crews from Wood County, Clark County, Necedah, Wildcat Mountain, UW-Stevens Point, and the U.S. Fish and Wildlife assisted

in putting out the fire.⁴⁶ One cottage, three outbuildings, three camper-trailers, and various boats, canoes, and other equipment were destroyed. The loss of the buildings was in part due to a lack of access (long, narrow driveways with minimal vertical clearance) and lack of defensible space (minimal space between the buildings and highly flammable vegetation).⁴⁷

Vulnerability Assessment

Approximately 30% of Marquette County is forested, with over 40% of land being wooded in the northern tier of towns. Based on the spatial distribution of fire occurrences from 1982 to 2006, the north half of the County is more vulnerable to fires. This vulnerability is likely due to the larger percentage of forested lands and campground activity. As the number of vacation homes and recreational facilities increase, more people and more property are vulnerable to injury and damages due to fires. Therefore while the number of projected forest fires has decreased over the years, the potential danger to lives and property has not.

Future Probability

With 1,317 fire occurrences and 3,018 acres burned in the past 25 years, the County can expect around 50 fires burning about 60 acres a year. With the Montello ranger station currently vacant, it is possible that response time could be increased as the County's fire needs are served by the Wautoma ranger station. If housing development trends continue to expand into forested areas of the County, there is an increasing forest fire risk due to human factors. The increased human presence in the forested areas presents a major challenge in protecting life, property, and the forest resources from destructive forest fires.

In April 2004, the community of Crystal Lake became the first "firewise" community in the state, which included the purchase of water backpacks, installation of four fire sirens, and easily seen emergency fire numbers. The homeowners in Crystal Lake are hopeful that their efforts will enhance property values, minimize future risk, and lower fire insurance rates.⁴⁸

Future Potential Loss

Forested areas in Marquette County are mainly valued for their recreational and natural value. As was evident in the 2003 fire in Crystal Lake, there is a large potential for private property loss, with over 100 trailers and 24 homes threatened in that event. Areas with concentrated populations in forested areas are most vulnerable to loss. Campgrounds and mobile home parks in these areas should take special care when burning debris or dealing with fire.

Drought

Drought Hazard Overview

Drought can be both agricultural or hydrologic. Agricultural drought is a dry period of sufficient length and intensity that markedly reduces crop yields. Hydrologic drought is a dry period of sufficient length and intensity to affect lake and stream levels and the height of the groundwater table. Agricultural and hydrologic droughts may, but do not necessarily, occur at the same time.

Drought conditions may vary from below normal precipitation for a few weeks to severe lack of normal precipitation for a couple of months to years. Additionally, the onset and end of a drought can be difficult to detect. Weather conditions, soil moisture, runoff, water table conditions, water quality and streamflow affect drought conditions. Specifically, high temperature, high wind and low relative humidity can all contribute to drought severity.⁴⁹

In Marquette County, agricultural land is the most vulnerable to drought, as the amount and timing of precipitation has a significant impact on crop production. Therefore, the severity of a drought must be measured in terms of crop yield as well as precipitation. Drought mitigation measures focus on conservation and preparation management.

⁴⁶ Ibid.

⁴⁷ Wisconsin DNR, Forestry Division. <http://dnr.wi.gov/forestry/fire/prevention/wui/crystal.htm>

⁴⁸ Wisconsin Natural Resources Magazine. April, 2005. <http://www.wnrmag.com/supps/2005/apr05/partners.htm>

⁴⁹ Wisconsin Emergency Management. *Hazard Analysis for the State of Wisconsin*.

Historical Occurrences of Drought

Wisconsin Emergency Management documented several regional droughts that impacted Marquette County. The most significant was from 1929 to 1934, following that was a drought from 1976 to 1977, which caused approximately \$624 million dollars in agricultural loss. The drought of 1987 to 1988 was believed to be the most severe, causing between 30% and 60% crop loss, with agricultural losses set at \$1.3 billion for the region. In recent history, NOAA documented droughts in 2002, 2003, 2005, and 2007. The 2002 drought resulted in over \$4.4 million in agricultural loss statewide.

Drought Hazard Vulnerability

Agricultural areas of the County are most vulnerable to the impacts of drought. Municipal water systems have the potential to be impacted by drought. Substantial events can ruin cropland and result in great loss, hurting the local economy. Droughts also increase the risk of forest fires because of the extreme dryness. The loss of vegetation from a drought can result in flooding, even from an average rainfall.⁵⁰

Projected Future Probability of Drought

The Wisconsin Emergency Management has documented five significant droughts in the state since 1930. Therefore, the future probability of a significant drought is about 10% in any given year. It appears that the frequency of droughts—significant and relatively minor—has increased over the past several years. For example, according to NOAA, four droughts between 2002 and 2007 have occurred. This suggests that the chance that a dry period classified as a drought has up to a 50% chance of happening in any given year.

Projected Future Damages from Drought

The specifics of past financial loss from drought for Marquette County is limited; therefore, it is difficult to quantify future damages from drought.

Extreme Temperatures

Extreme Temperatures Hazard Overview

Extreme heat is defined as temperatures that hover 10 degrees or more above the average high temperature for several weeks. Additionally, high humidity contributes to extreme heat by retarding the body's ability to cool from evaporation of perspiration, causing the body to work much harder to cool down. Sunburn also slows the skin's ability to release heat. Stagnant atmospheric (humid and muggy) conditions and poor air quality can also induce heat-related illnesses. Another result of extreme heat is greater electricity demands for air conditioning systems, which can lead to power outages.

Extremely cold temperatures accompanied by strong winds can result in temperatures that can cause frostbite, hypothermia, and death.

Historical Occurrences of Extreme Temperatures

NOAA data for temperature extremes in Marquette County are only recorded as far back as 1994 and are listed in detail in Table A6 in Appendix A. There have been 12 instances of extreme cold and 15 instances of extreme heat since 1994. In recent history, NOAA did not record any injuries, deaths, or financial loss from extreme temperatures in Marquette County.

The most severe instance of extreme temperature in the region were related to cold weather and harsh windchills in December 9, 1994 and February 1, 1996, in which 6 people died and 39 people were injured in the more densely populated areas around Milwaukee. The summer of 1995 produced two periods of prolonged heat in June and July. Between July 12th and 15th, the extreme heat produced the greatest number of weather-related deaths in Wisconsin history. During this heat wave, 141 Wisconsinites died directly or indirectly from the heat.⁵¹ At the end of July 1999,

⁵⁰ Ibid.

⁵¹ Ibid.

high humidity and temperatures in the 90s and 100s produced heat index values of 110 and 125. This heat wave alone accounted for 12 direct and 8 indirect deaths statewide, according to the National Weather Service.

Extreme Temperatures Hazard Vulnerability

Populations that are particularly susceptible to illness, injury, and death from extreme temperatures include the elderly, low-income persons (particularly if they cannot afford sufficient heating or cooling), people in urban areas, young children, sick persons, overweight persons, persons with alcohol problems, and men in general (because they sweat more and become more quickly dehydrated). Usually the victims have been overexposed to heat or have over-exercised for their age and physical condition. Excessive heat also puts strain on a person's respiratory and cardiovascular system, particularly impacting toddlers and the elderly.

Heat waves kill more people in the U.S. on average than all other natural disasters combined.⁵² Risk is particularly high in the most urbanized areas, such as the Milwaukee area, which experiences exacerbated heat due to the urban heat island effect, and also has a higher concentration of poor and elderly persons.

Marquette County has an aging population and consequently its residents are becoming more vulnerable to extreme temperatures over time. Based on data from the U.S. Census, Marquette County's population of persons over 65 grew by 4% from 1990 to 2000, now totaling 7,586 individuals in this age cohort—15% of the total County total population. The percentage of the County's senior population (aged 65 and older) was 18.3%, which was considerably higher than the state average of 13.1%, but comparable to other counties in the region. According to state projections, the County's "baby boom" and elderly age cohort will continue to increase, while the younger age groups (5 to 19) will decrease.⁵³ By 2030, nearly 30% of the County's population will be aged 65 or older (compared to 18% of the population in 2000).⁵⁴

Projected Future Probability of Extreme Temperatures

Based on NOAA accounts of extreme temperatures from 1994 to 2007, there is a 63% probability of an extreme cold event and 79% probability of an extreme heat event in any given year.

Projected Future Damages from Extreme Temperatures

Extremely high or extremely low temperatures pose significant threat to the health of people and animals. Although such extremes cannot be avoided, planning for their occurrence will minimize their impact.

There is no record of quantified damages to property due to severe temperatures in Marquette County. However, damages are possible, as described in the list of potential damages from extreme temperatures below:

- Human illness or death including heatstroke, respiratory problems, frostbite, and hypothermia
- Livestock and pet illness or death due to extended exposure to extreme temperatures
- Electricity outages due to high usage, causing interruptions in communications infrastructure and business productivity
- Buckling pavement
- Loss of water pressure when fire hydrants opened in urban areas
- Broken plumbing pipes resulting from freezing water

Earthquakes

Earthquake Hazard Overview

An earthquake is caused by slipping plates that make up the earth's crust. Earthquakes result in a sometimes violent shaking or trembling of the ground. An earthquake does not need to be of large magnitude to cause extensive damage. Areas that are less prone to this hazard event are usually less prepared, which can result in significant

⁵² New York Times. *Most Deadly of the Natural Disasters: The Heat Wave*. August 13, 2002.

⁵³ Wisconsin Department of Administration, 2004

⁵⁴ *Ibid.*

damage. In the U.S., earthquake intensity is monitored using the Modified Mercalli Scale on a scale of I, meaning relatively low intensity, to XII meaning very high intensity. Earthquake magnitude is measured by the Richter Scale of 1 – 8, with 8 being the most severe. The Richter Scale measures an entire earthquake event whereas the Modified Mercalli Scale measures the effects of an earthquake at different sites.

Earthquakes in the Midwest originate at depths of 1 to 20 km below the earth's surface. Bedrock in the central U.S. is flat-lying, old, intact, and strong and consequently earthquake vibrations travel very far through this bedrock in comparison to the young, broken, weak bedrock of the west coast. Consequently, earthquakes in the central U.S. are felt and cause damage in an area 15 to 20 times greater than west coast earthquakes of similar magnitudes.⁵⁵

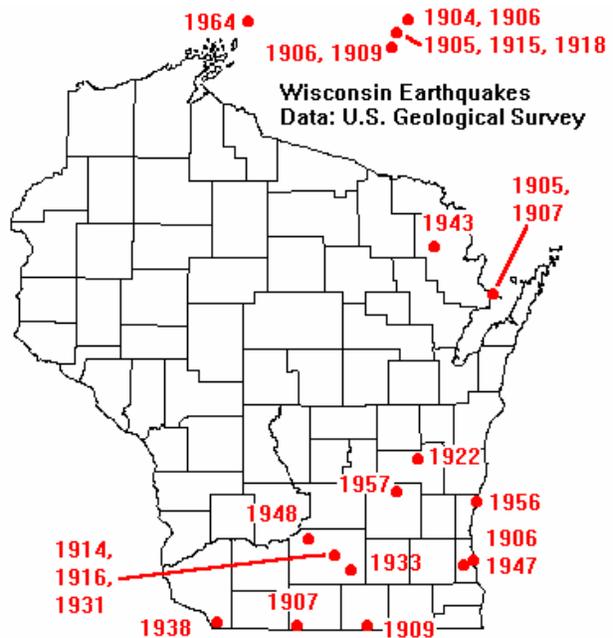
Historic Occurrences of Earthquakes

The historical occurrence of earthquakes in Wisconsin varies depending on whether the earthquake was felt or whether it originated in state. The USGS lists 19 events and 11 more near the Upper Peninsula of Michigan which are illustrated in Figure 3.18 below. Additionally, Wisconsin Emergency Management lists 24 historic quakes in the past century.

Significant earthquakes that have been felt or that originated in Wisconsin include the following:^{56, 57}

- December 1811 – February 1812: Strongest historic earthquakes in North America (estimated 8.3 to 8.7 on Richter Scale) occurred in the New Madrid Fault Zone near New Madrid, Missouri.
- May 26, 1909: 5.1 magnitude earthquake believed to originate in Aurora, Illinois reached over 500,000 square miles and caused moderate damage to areas in southern Wisconsin
- May 6, 1947: Center just south of Milwaukee near the shore of Lake Michigan caused minor damage and rattled windows in communities in a 4,000 square mile radius.
- November 9, 1968: The strongest earthquake in recent history occurred in south central Illinois and the shock was felt in portions of 23 states including cities of Baraboo, La Crosse, Portage, Sheboygan, Beloit, and Milwaukee in Wisconsin.
- April 3, 1974: This magnitude 4.75 earthquake originated near the 1968 earthquake in southern Illinois and was felt in most southern Wisconsin.
- April 18, 2008: A 5.2 magnitude earthquake originated in West Salem, Illinois and was felt in Chicago, Milwaukee, Madison, Cincinnati, and Des Moines. Around 15 aftershocks followed this quake in the next several days with the strongest measuring 4.6.⁵⁸

Figure 3.18: Historical Earthquakes



Earthquake Hazard Vulnerability

The threat to Wisconsin from earthquakes is considered to be low with damage ranging from rattling windows to plaster cracking.⁵⁹ The quakes that have been felt are centered in Wisconsin and adjacent states. The cause of these earthquakes is not fully understood but it believed to be a result of the continuing rebound of the earth's crust after

⁵⁵ Illinois Emergency Management Agency. *Illinois Natural Hazard Mitigation Plan*.

⁵⁶ USGS. Earthquake Hazards Program. <http://earthquake.usgs.gov/regional/states/wisconsin/history.php>

⁵⁷ Wisconsin Emergency Management. *Hazard Analysis for the State of Wisconsin*.

⁵⁸ MSNBC. *Earthquake Felt in Wisconsin*. <http://www.msnbc.msn.com/id/24195355/>

⁵⁹ Wisconsin Emergency Management. *Hazard Analysis for the State of Wisconsin*.

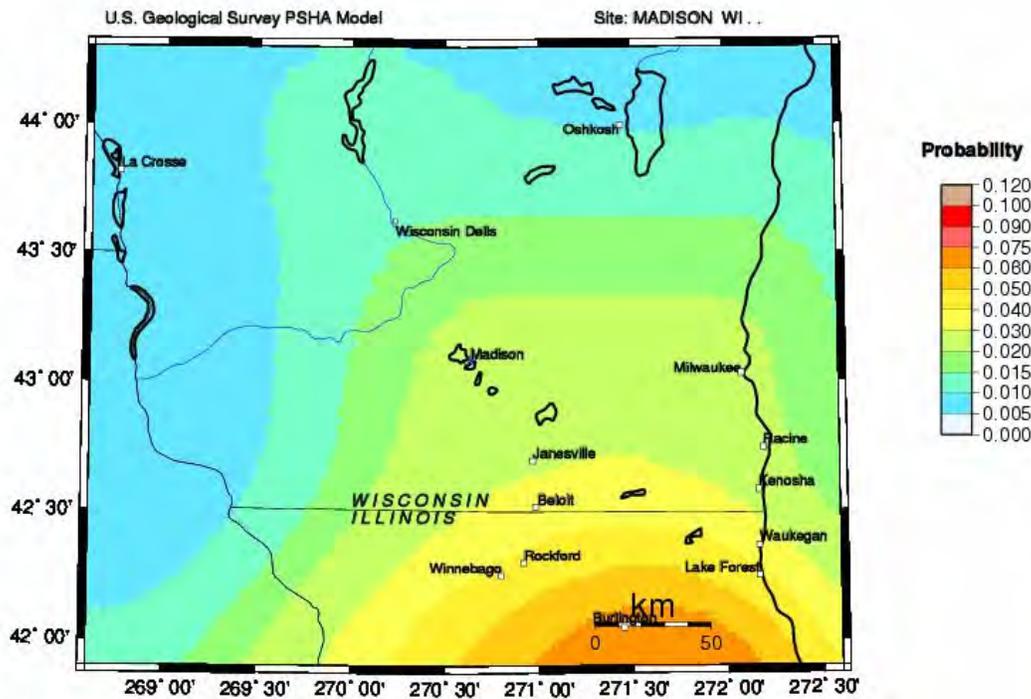
the retreat of the last glacial ice.⁶⁰ In the event of an earthquake from the New Madrid Fault zone along the Mississippi River Valley in Missouri, southern portions of Wisconsin would experience very light to moderate damage. Another potential impact of a major New Madrid Fault earthquake could be damage to petroleum and natural gas pipelines that traverse regions near the fault zone.

Projected Future Probability of Earthquakes

Most earthquakes that occur in Wisconsin are very low in intensity and occur once every few years.⁶¹ According Wisconsin Emergency Management, even an earthquake in the New Madrid Fault zone equivalent to the 1811 quake would only cause minor damage to counties in southeastern Wisconsin.

Within the past century there have been no earthquakes that have originated in Wisconsin over a magnitude of 4.5.⁶² Figure 3.19 illustrates the probability of an earthquake with a magnitude greater than 4.75 in a 100 year period. Marquette County has only a one to two percent chance for an earthquake greater than 4.75 on the Richter Scale in 100 years.

Figure 3.19: Probability of an earthquake with a magnitude greater than 4.75 in 100 years



Source: USGS. Earthquake Hazard Program. <http://eqint.cr.usgs.gov/eqprob/2002/out/image.15748.jpg>

Projected Future Damages from Earthquakes

There is not a record of damages from past earthquakes experienced in Marquette County. Given the past history of earthquakes in Wisconsin, there is little risk, except to structures that are poorly constructed.⁶³ A more likely concern is indirect effects such as the disruption of oil, gas, and electric transmission as well as other goods and services.

⁶⁰ Ibid.

⁶¹ Ibid.

⁶² Ibid.

⁶³ Ibid.

Human-Caused and Disease Outbreak Hazards

Hazard Overview

The County is vulnerable to the following hazards that are either caused by humans or are disease outbreaks, as identified in the Marquette County Disaster Plan:

1. Civil Disturbances
2. Explosions
3. Hazardous Materials
4. Nuclear Energy/Nuclear Power Plants
5. Mass Casualties
6. Terrorism, including bomb threats and agroterrorism, occurring either in Marquette County or nearby metropolitan areas
7. Transportation Accidents: Aircraft, Bus, Rail, Trucking
8. Energy shortages and blackouts
9. War (nuclear or non-nuclear)

A thorough assessment of the risk in Marquette County for each of these hazards, and detailed strategies for addressing them, is beyond the scope of this Plan. The Marquette County Disaster Plan should be referenced for more detailed information on how the County intends to respond to these types of potential hazards and disasters. However, the following Hazard Vulnerability section provides an overview of the primary factors contributing to vulnerability to hazards caused by humans or disease outbreaks.

Hazard Vulnerability

Generally speaking, hazards caused by humans or due to disease outbreaks cannot always be as easily predicted, and therefore mitigated, as naturally-occurring hazards. However, there are several factors that can put a community at greater risk of experiencing loss of life and property when these types of hazards become apparent or incidents occur as a result of them. The factors that contribute to the County's vulnerability to human-created or disease-based hazards include the following:

- *Hazard Detection and Response Preparedness:* Communication systems within the County and between the County and regional and national agencies greatly impact the County's ability to detect a hazard when it occurs or is expected to occur and then to respond quickly and effectively to the disaster. Marquette County recognizes that hazard detection and communication is an area that can use continual improvement and therefore the County continually updates and improves its communications systems. These efforts are overseen by the County Public Safety Committee.
- *Land Use, Economy, and Population Density:* The land use, population, and economic makeup of the County plays a role in the County's vulnerability to certain manmade and disease outbreak hazards. In Marquette County, agriculture and wooded lands are primary land uses and consequently play a role in the local economy. This, therefore, makes the County more susceptible to loss of life and property from foreign animal disease outbreaks such as Foot and Mouth disease and insect infestations.

Conversely, the rural nature of the County reduces its risk of terrorism disasters as compared to more densely populated areas. That said, acts of terrorism can threaten a broader regional area, making it still a real risk. Marquette County is about an hour from Madison and two hours from Milwaukee. Both Madison and Milwaukee are slightly greater threats to terrorism due their positions as major economic, political, and educational centers.

- *Standing Water:* Vulnerability of exposure to mosquitoes carrying West Nile Virus is greatly exacerbated by presence of standing water rich in organic content, such as water impounded at the bottom of catch basins/storm drains. Flood waters remaining stagnant for periods of time could also lead to greater mosquito populations.
- *Building Code, Fire and Hazardous Materials Safety Regulations and Enforcement:* Vulnerability to explosions, fires, and hazardous materials incidents is greatly dependent on the strength and enforcement of ordinances regulating building construction, use of fire, and use/storage of hazardous materials. Knowing the locations of sites that

manage hazardous materials—and contingency plans if there is a problem with containment—is also a key factor affecting vulnerability. The Risk Assessment maps attempt to present the most recent record of these sites.

- *Infrastructure Maintenance:* Vulnerability to road, rail, and air accidents is related both to weather conditions and the quality of transportation infrastructure. Consequently, improved transportation systems maintenance reduces vulnerability to this hazard.

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Marquette County Multi-Hazard Mitigation Plan

Map 2 Risk Assessment - Countywide

Jurisdictional Boundaries

- Municipal Boundary
- County Boundary

Infrastructure

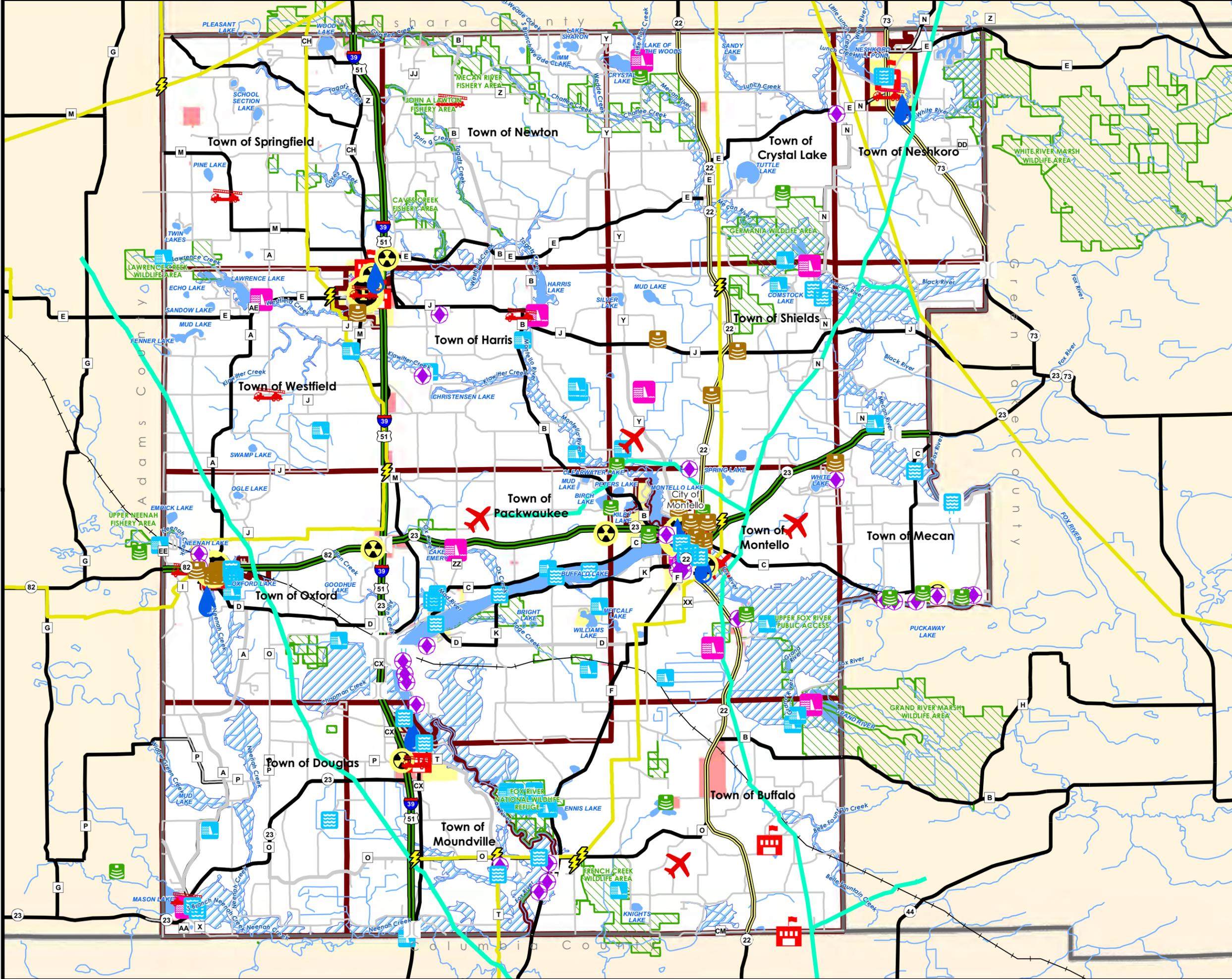
- Railroad
- Natural Gas Pipeline
- Electric Transmission Lines
- Constrained Waterway
- Vulnerable Population
- Flood
- Place of Assembly
- Campground
- School
- Hazardous Material
- Municipal Building
- County Courthouse
- Airport/Air Strip
- Power Facility
- Natural Gas Facility
- Fire Station
- Police Station
- Wastewater Treatment Plant
- Small Dam
- Large Dam
- Bridge
- Surface Water
- 100-year Floodplain
- Conservation Lands

Future Growth Areas

- Residential
- Non-Residential

More detailed maps are provided for villages, cities, and areas with concentrated natural hazards

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Marquette County Multi-Hazard Mitigation Plan

Map 3 Risk Assessment - Montello

Jurisdictional Boundaries

- Municipal Boundary
- County Boundary

Infrastructure

- Railroad
- Natural Gas Pipeline
- Electric Transmission Lines
- Constrained Waterway
- Vulnerable Population
- Flood
- Place of Assembly
- Campground
- School
- Hazardous Material
- Municipal Building
- County Courthouse
- Airport/Air Strip
- Power Facility
- Natural Gas Facility
- Fire Station
- Police Station
- Wastewater Treatment Plant
- Small Dam
- Large Dam
- Bridge
- Surface Water
- 100-year Floodplain
- Conservation Lands

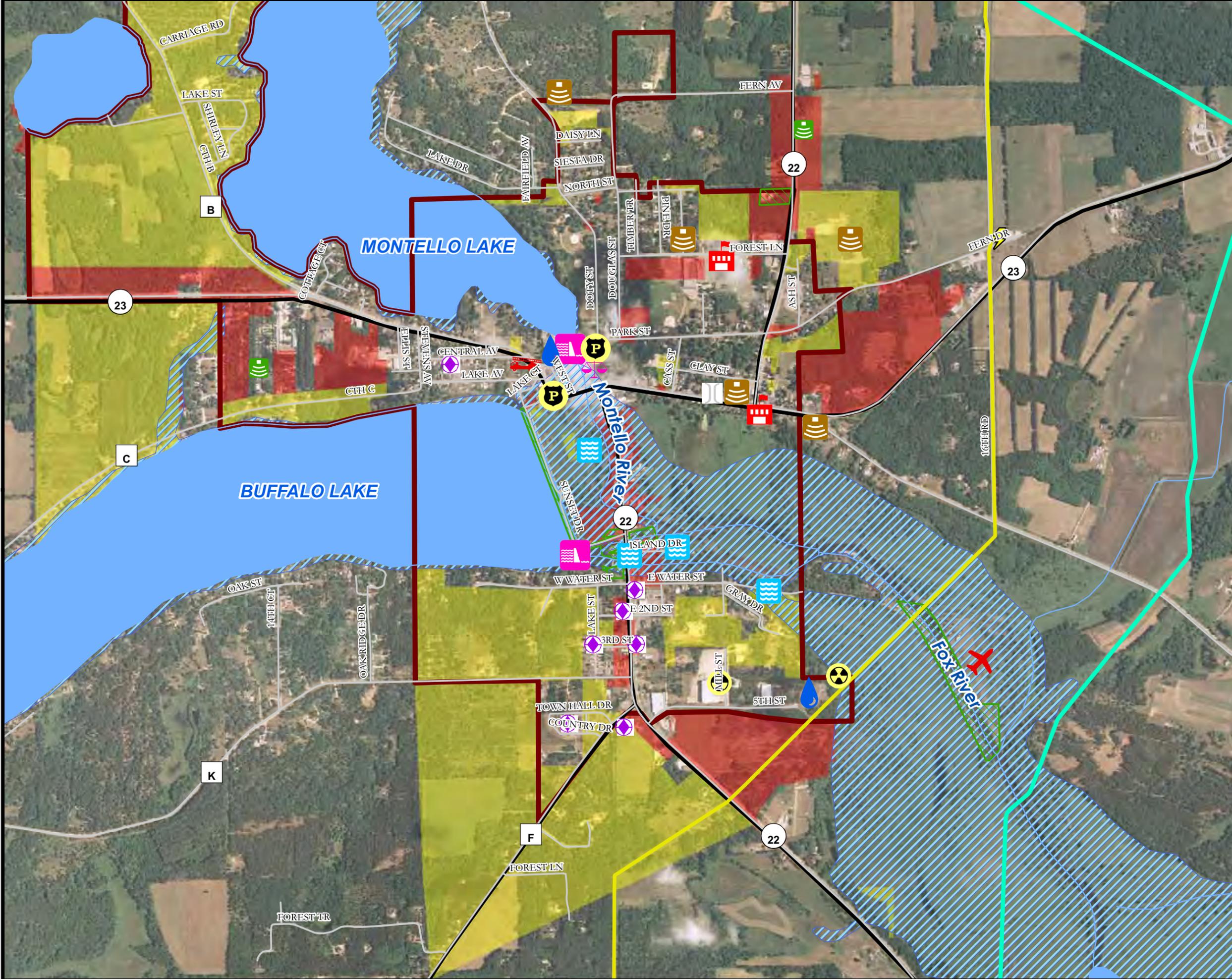
Future Growth Areas

- Residential
- Non-Residential

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Date: 6/30/08
Sources: Marquette County, US Census Bureau, FEMA, WIDNR



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Marquette County Multi-Hazard Mitigation Plan

Map 4
Risk Assessment - Endeavor

Jurisdictional Boundaries

- Municipal Boundary
- County Boundary

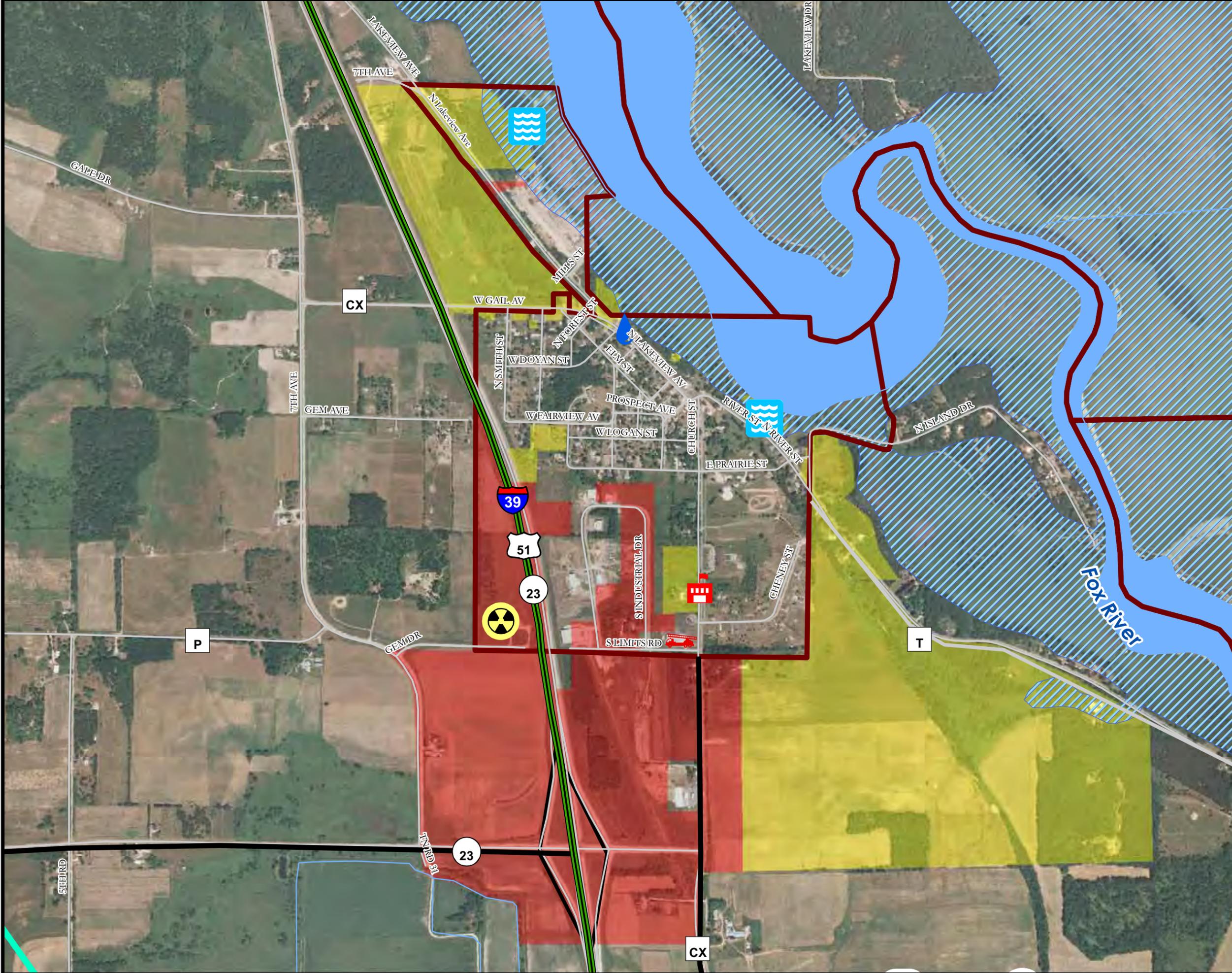
Infrastructure

- Railroad
- Natural Gas Pipeline
- Electric Transmission Lines
- Constrained Waterway
- Vulnerable Population
- Flood
- Place of Assembly
- Campground
- School
- Hazardous Material
- Municipal Building
- County Courthouse
- Airport/Air Strip
- Power Facility
- Natural Gas Facility
- Fire Station
- Police Station
- Wastewater Treatment Plant
- Small Dam
- Large Dam
- Bridge
- Surface Water
- 100-year Floodplain
- Conservation Lands

Future Growth Areas

- Residential
- Non-Residential

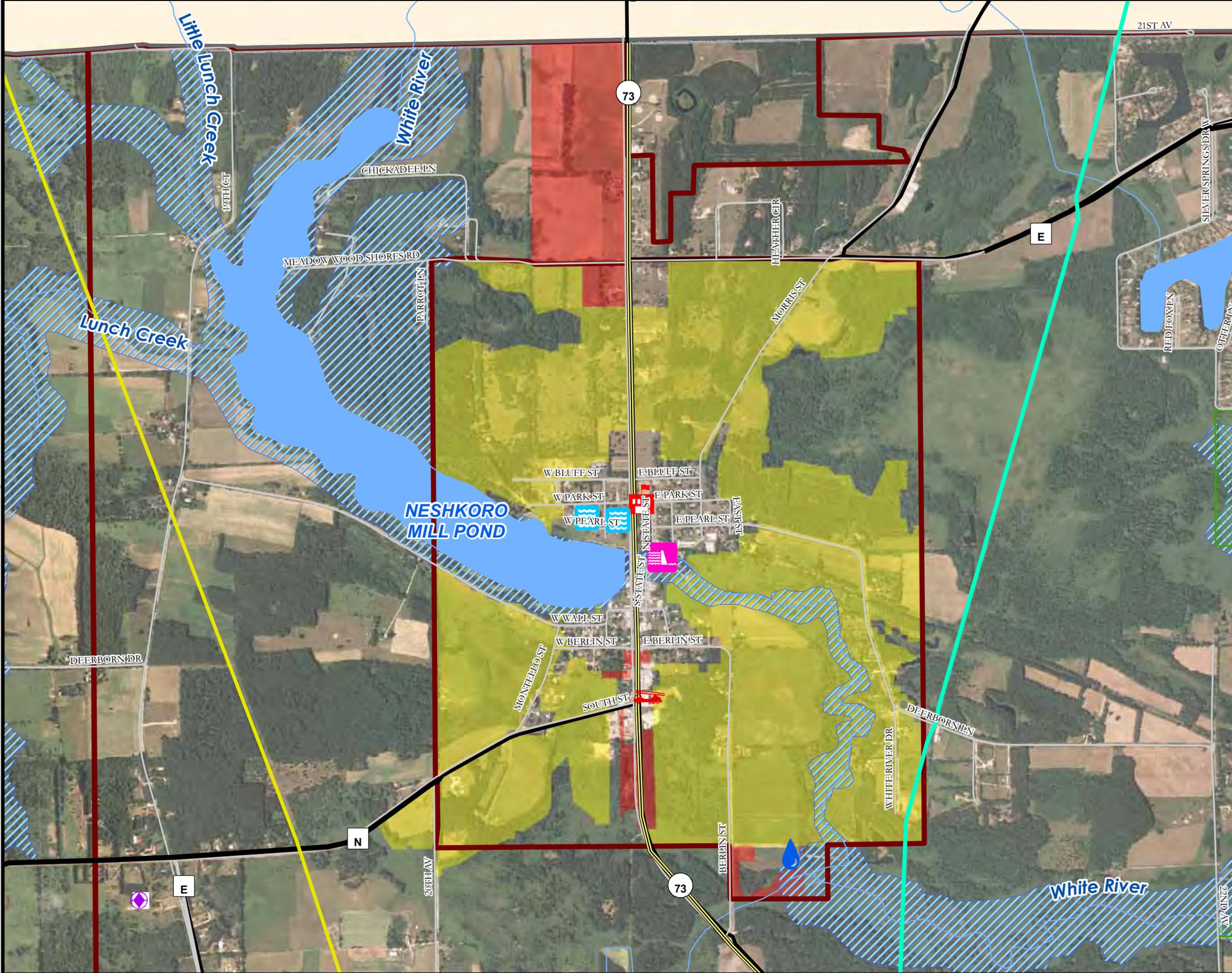
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Marquette County Multi-Hazard Mitigation Plan

Map 5 Risk Assessment - Neshkoro



- Jurisdictional Boundaries**
- Municipal Boundary
 - County Boundary
- Infrastructure**
- Railroad
 - Natural Gas Pipeline
 - Electric Transmission Lines
 - Constrained Waterway
 - Vulnerable Population
 - Flood
 - Place of Assembly
 - Campground
 - School
 - Hazardous Material
 - Municipal Building
 - County Courthouse
 - Airport/Air Strip
 - Power Facility
 - Natural Gas Facility
 - Fire Station
 - Police Station
 - Wastewater Treatment Plant
 - Small Dam
 - Large Dam
 - Bridge
 - Surface Water
 - 100-year Floodplain
 - Conservation Lands

- Future Growth Areas**
- Residential
 - Non-Residential

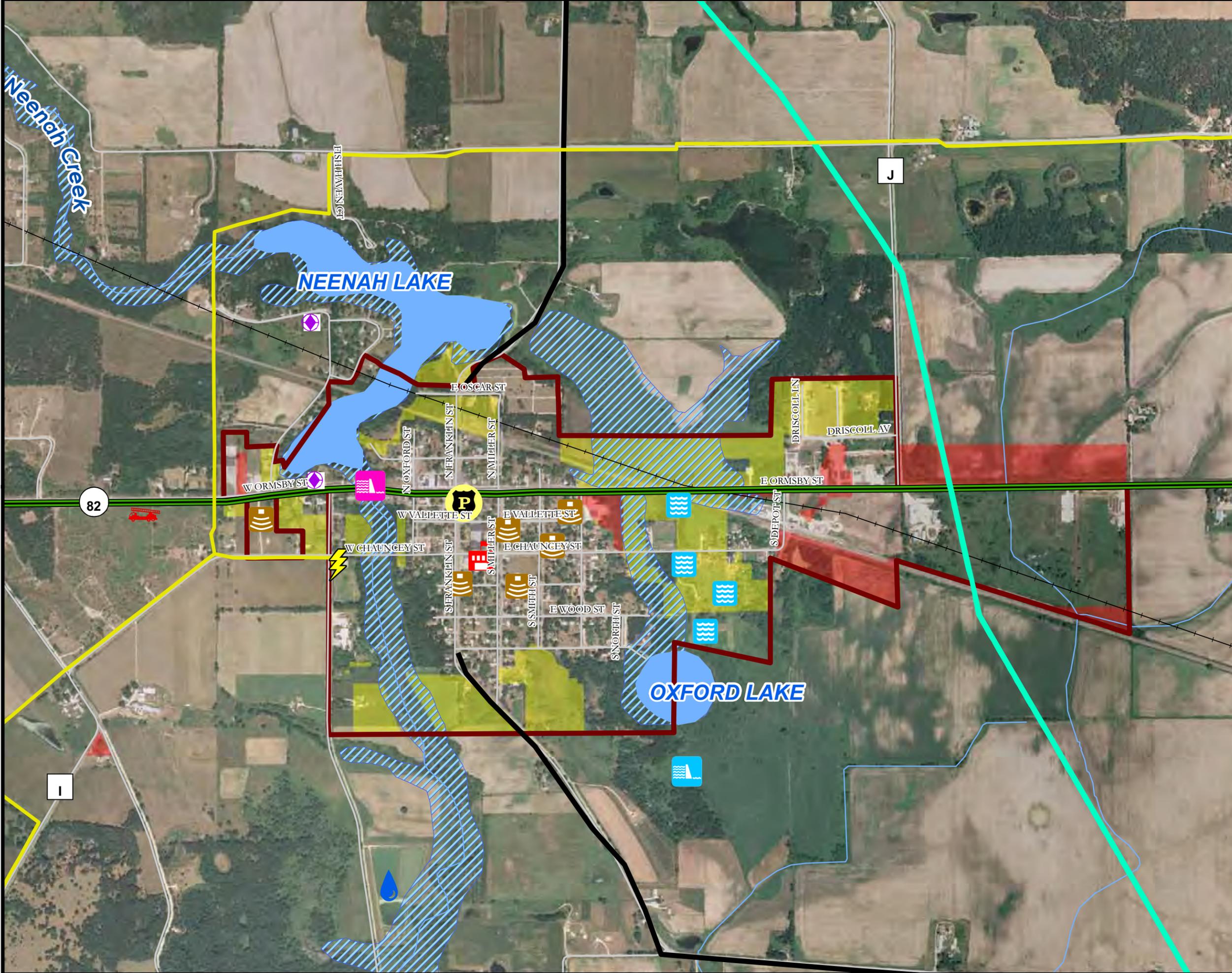
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Marquette County Multi-Hazard Mitigation Plan

Map 6 Risk Assessment - Oxford



- Jurisdictional Boundaries**
- Municipal Boundary
 - County Boundary
- Infrastructure**
- Railroad
 - Natural Gas Pipeline
 - Electric Transmission Lines
 - Constrained Waterway
 - Vulnerable Population
 - Flood
 - Place of Assembly
 - Campground
 - School
 - Hazardous Material
 - Municipal Building
 - County Courthouse
 - Airport/Air Strip
 - Power Facility
 - Natural Gas Facility
 - Fire Station
 - Police Station
 - Wastewater Treatment Plant
 - Small Dam
 - Large Dam
 - Bridge
 - Surface Water
 - 100-year Floodplain
 - Conservation Lands
- Future Growth Areas**
- Residential
 - Non-Residential

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0 500 1,000 2,000 Feet

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Marquette County Multi-Hazard Mitigation Plan

Map
7

Risk Assessment - Westfield

Jurisdictional Boundaries

- Municipal Boundary
- County Boundary

Infrastructure

- Railroad
- Natural Gas Pipeline
- Electric Transmission Lines
- Constrained Waterway
- Vulnerable Population
- Flood
- Place of Assembly
- Campground
- School
- Hazardous Material
- Municipal Building
- County Courthouse
- Airport/Air Strip
- Power Facility
- Fire Station
- Police Station
- Wastewater Treatment Plant
- Small Dam
- Large Dam
- Bridge
- Surface Water
- 100-year Floodplain
- Conservation Lands

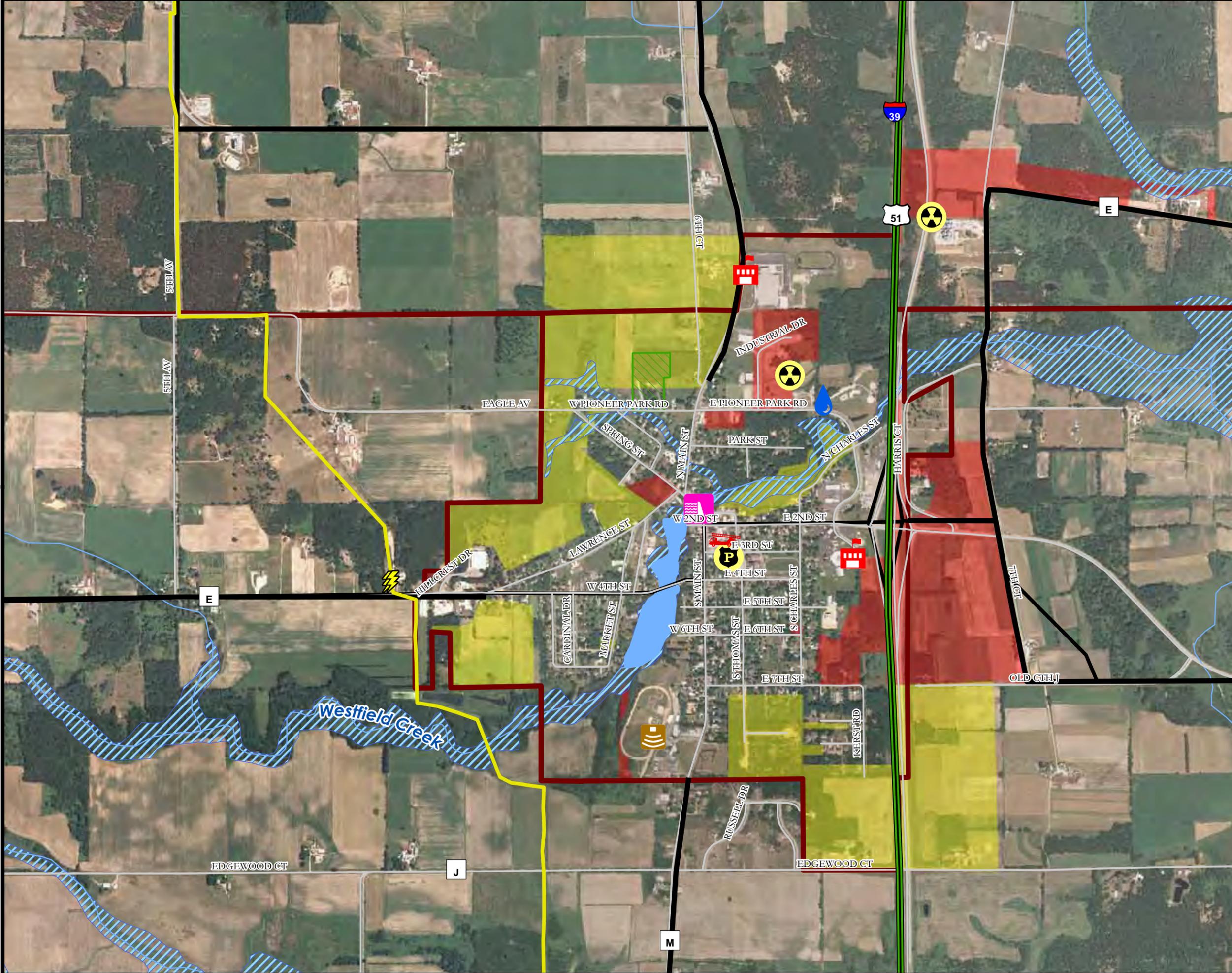
Future Growth Areas

- Residential
- Non-Residential

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Date: 6/30/08
Sources: Marquette County, US Census Bureau, FEMA, WIDNR



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Marquette County Multi-Hazard Mitigation Plan

Map
8

Risk Assessment - Briggsville

Jurisdictional Boundaries

-  Municipal Boundary
-  County Boundary

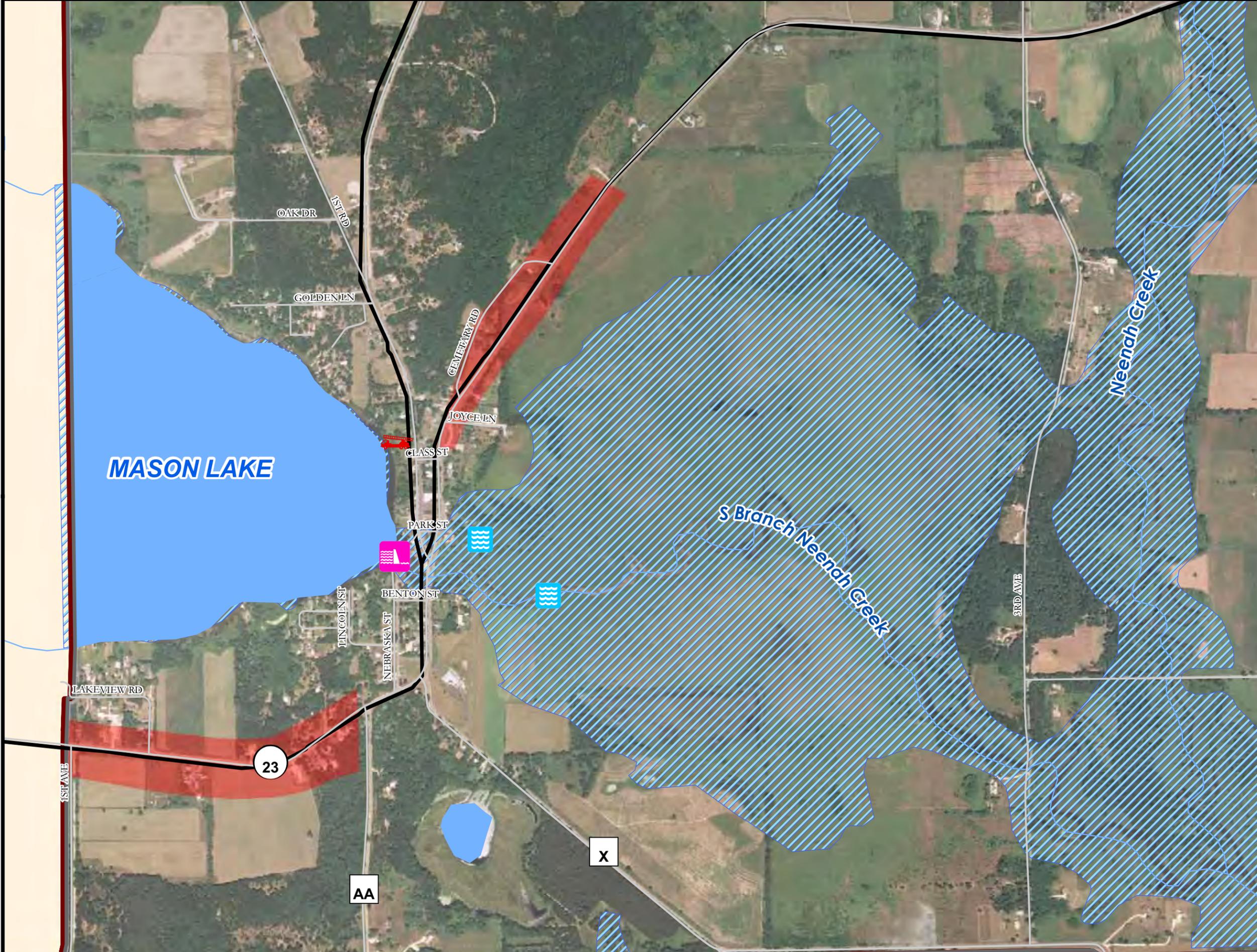
Infrastructure

-  Railroad
-  Natural Gas Pipeline
-  Electric Transmission Lines
-  Constrained Waterway
-  Vulnerable Population
-  Flood
-  Place of Assembly
-  Campground
-  School
-  Hazardous Material
-  Municipal Building
-  County Courthouse
-  Airport/Air Strip
-  Power Facility
-  Natural Gas Facility
-  Fire Station
-  Police Station
-  Wastewater Treatment Plant
-  Small Dam
-  Large Dam
-  Bridge
-  Surface Water
-  100-year Floodplain
-  Conservation Lands

Future Growth Areas

-  Residential
-  Non-Residential

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Marquette County Multi-Hazard Mitigation Plan

Map 9 Risk Assessment - Harrisville

Jurisdictional Boundaries

-  Municipal Boundary
-  County Boundary

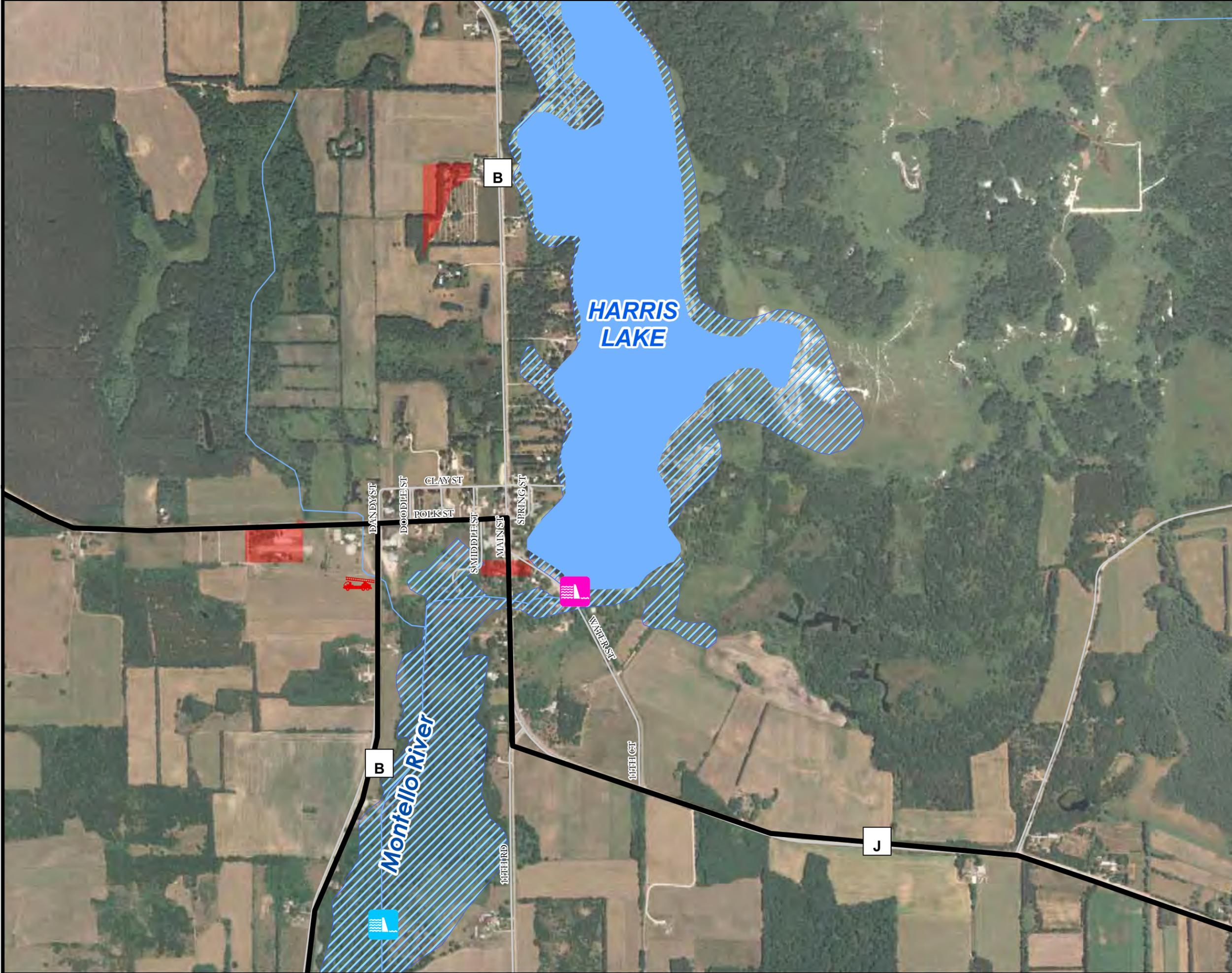
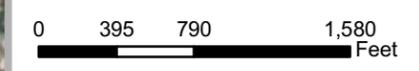
Infrastructure

-  Railroad
-  Natural Gas Pipeline
-  Electric Transmission Lines
-  Constrained Waterway
-  Vulnerable Population
-  Flood
-  Place of Assembly
-  Campground
-  School
-  Hazardous Material
-  Municipal Building
-  County Courthouse
-  Airport/Air Strip
-  Power Facility
-  Natural Gas Facility
-  Fire Station
-  Police Station
-  Wastewater Treatment Plant
-  Small Dam
-  Large Dam
-  Bridge
-  Surface Water
-  100-year Floodplain
-  Conservation Lands

Future Growth Areas

-  Residential
-  Non-Residential

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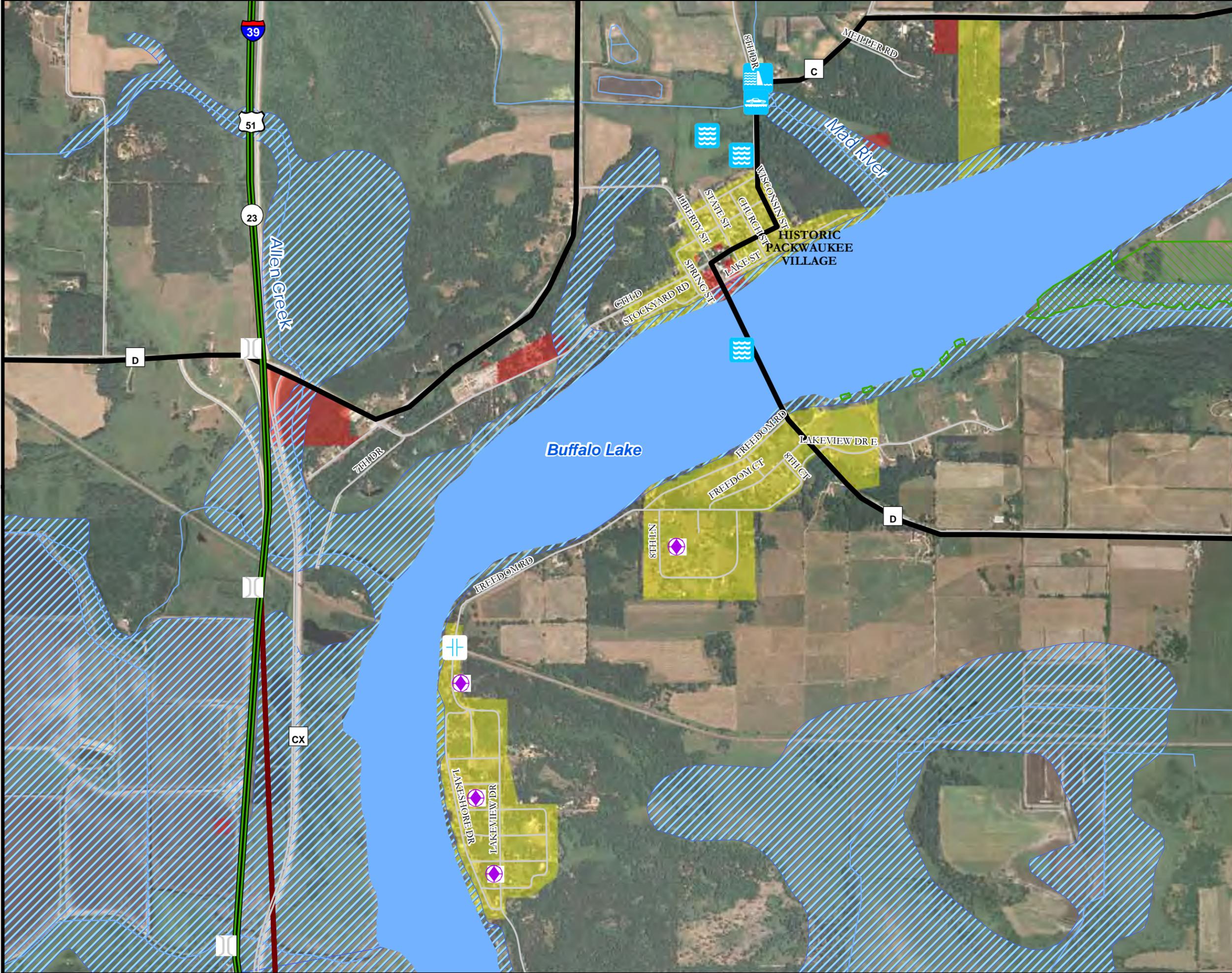


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Marquette County Multi-Hazard Mitigation Plan

Map 10 Risk Assessment - Packwaukee

- Jurisdictional Boundaries**
- Municipal Boundary
 - County Boundary
- Infrastructure**
- Railroad
 - Natural Gas Pipeline
 - Electric Transmission Lines
 - Constrained Waterway
 - Vulnerable Population
 - Flood
 - Place of Assembly
 - Campground
 - School
 - Hazardous Material
 - Municipal Building
 - County Courthouse
 - Airport/Air Strip
 - Power Facility
 - Natural Gas Facility
 - Fire Station
 - Police Station
 - Wastewater Treatment Plant
 - Small Dam
 - Large Dam
 - Bridge
 - Surface Water
 - 100-year Floodplain
 - Conservation Lands
- Future Growth Areas**
- Residential
 - Non-Residential



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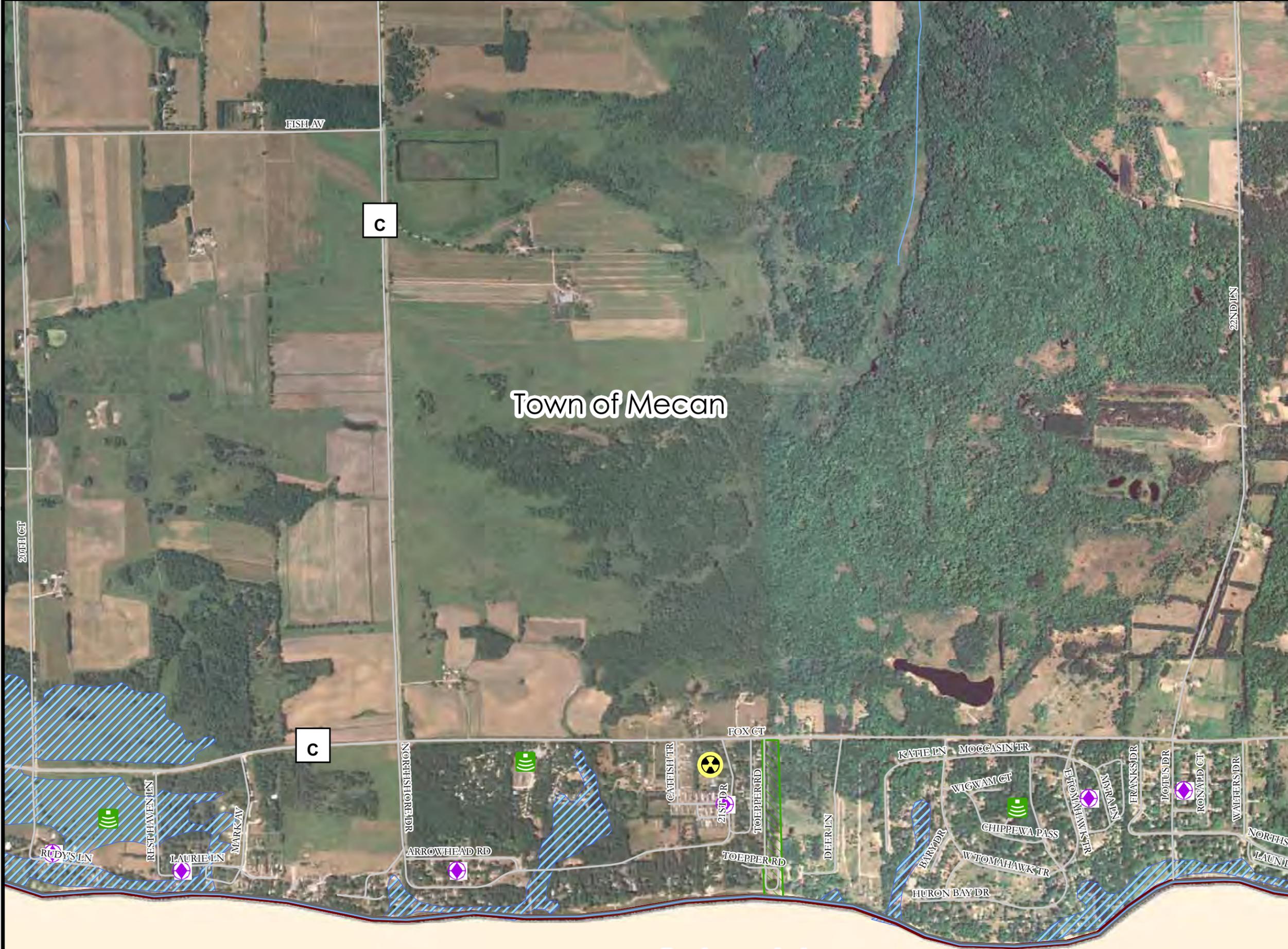


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Marquette County Multi-Hazard Mitigation Plan

Map
11

Risk Assessment - Puckaway Lake



Jurisdictional Boundaries

- Municipal Boundary
- County Boundary

Infrastructure

- Railroad
- Natural Gas Pipeline
- Electric Transmission Lines
- Constrained Waterway
- Vulnerable Population
- Flood
- Place of Assembly
- Campground
- School
- Hazardous Material
- Municipal Building
- County Courthouse
- Airport/Air Strip
- Power Facility
- Fire Station
- Police Station
- Wastewater Treatment Plant
- Small Dam
- Large Dam
- Bridge
- Surface Water
- 100-year Floodplain
- Conservation Lands

Future Growth Areas

- Residential
- Non-Residential

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Chapter 4: Mitigation Goals and Strategies

Chapter 4 discusses mitigation strategies for the hazards that have occurred and are probable in Marquette County, as indicated in Chapter 3. This chapter also identifies parties that would be responsible for implementation of the strategies and potential partners that could provide assistance. At the core of these mitigation strategies is education and cooperation. Community members are more likely to embrace mitigation measures if they understand how those actions can limit the economic, social, and environmental impact of hazards. Further, governmental agencies and jurisdictions are more likely to develop information networks when there is a clearly understood common goal of decreasing the impact of disasters. Mitigation strategies that are applicable to all hazards are discussed, followed by disaster specific mitigation strategies, presented county-wide and for the communities that are most affected.

HAZARD MITIGATION GOALS

At an early Public Safety Committee meeting held as part of this process, the Committee participated in an exercise to identify the highest priority goals for this Multi-Hazard Mitigation Plan. These are the goal statements upon which this Plan is based:

1. **Protect human lives, both today and for future generations**
2. **Protect critical facilities, like schools and other places of assembly**
3. **Protect public and environmental health**
4. **Protect sensitive populations (elderly, children, low-income families, tourists)**
5. **Prevent future risks of hazards in highly vulnerable areas**
6. **Help people to protect themselves**
7. **Promote the use of partnerships in hazard mitigation**

These goals were presented at the community meetings held on April 17 and April 28 and input on the goals was sought from meeting attendees. Feedback from attendees reinforced these seven priority goals.

HAZARD MITIGATION STRATEGY PRIORITIZATION PROCESS

The project team identified potential hazard mitigation strategies for each hazard, in part from a FEMA State and Local Mitigation Planning How-To Guide.⁶⁴ Additionally, Committee members and members of the public were asked to identify any additional strategies that may not have been on the list developed by project team.

A five-stage process was undertaken to identify priority mitigation strategies in this Plan.

Stage One: Hazard Mitigation Planning Committee Initial Priority Strategies

At the April 7, 2009 Committee meeting, members were asked to help prioritize a list of potential mitigation strategies for each hazard, described in Chapter 3. Committee members were given a list of potential strategies and asked to circle the five strategies they believed should be the highest priorities. Committee members could also write in any strategies not included on the list. After this exercise, a discussion was facilitated with the group during which each Committee member identified and explained his or her top strategy, so that the group had an opportunity to further examine the strategies through a dialogue.

Stage Two: Community / Jurisdiction Meetings

With an understanding of hazard risks in the County, the Committee's initial input on mitigation strategy priorities, and initial community and jurisdictional input on mitigation strategies voiced in the February community meetings,

⁶⁴ Federal Emergency Management Agency. *State and Local Mitigation Planning How-To Guide: Developing the Mitigation Plan*. April 2003.

the project team presented a list of potential strategies for each hazard and presented these strategies at two community meetings on April 17 and April 28, 2008. After each of the strategies was presented, the project team facilitated a dialogue with participants to elicit input, questions, and concerns for each strategy. Participants were asked to identify their highest priority strategies for the community they were representing.

Stage Three: Draft Strategy Prioritization

Armed with a more thorough understanding of benefits, drawbacks, and perceptions of each strategy based on input from the Committee, local governments, and the public, the project team then evaluated the benefits and drawbacks/costs of each strategy to develop a preliminary prioritization. This analysis is summarized in Tables B1 – B8 in Appendix B

The following ten criteria were considered when identifying the benefits and drawbacks of each strategy. Criteria 3 through 10 are a part of a prioritization system developed by FEMA called STAPLEE (based on the first letter of each strategy, as highlighted below). In part of their hazard mitigation planning, some communities/counties have used a purely quantitative process to score each strategy for each of the STAPLEE criteria. In the case of Marquette County, it was determined that a qualitative, holistic evaluation process would produce the most meaningful prioritization.

1. Ability to achieve one or more of the Marquette County Hazard Mitigation Goals
2. Community support
3. Ability to be implemented (potential funding available)
4. **S**ocial impacts
5. **T**echnical feasibility
6. **A**ministrative requirements
7. **P**olitical support
8. **L**egality
9. **E**nvironmental impacts
10. **E**conomic impacts / costs of implementing

Stage Four: Draft Multi-Hazard Mitigation Plan

Based on the input provided at the April 2008 meetings and the above criteria, the project team then refined the list of priority mitigation strategies and also identified responsible parties, potential partners, and implementation timelines. These were incorporated into the first Draft Multi-Hazard Mitigation Plan in June 2008.

PRIORITY HAZARD MITIGATION STRATEGY SUMMARY TABLES

The following figures summarize the mitigation strategies, responsible parties, potential partners, and implementation timelines for each potential natural hazard in the County. These strategies are then discussed in further detail following these figures.

Table B1 – B8 in Appendix B lists all of the potential mitigation strategies that were evaluated for each hazard and describes the benefits and drawbacks/costs of each strategy. The highest priority strategies are divided into two categories; First Priority and Second Priority for each hazard. Following the detailed description of the highest priority strategies “other” strategies are listed as a possible larger menu of potential strategies that the County may employ as it advances implementation of this Plan.

A summary table lists all strategies in Figure 4.1, their priority, and the location the strategy addresses. This table provides an overview of strategies that are discussed later in this chapter.

Figure 4.1: Summary of Mitigation Strategies

Mitigation Strategy	Tier One	Where	Tier Two	Where
All Hazards	Pursue Regular Community Outreach and Education	Countywide*	Protect Critical Facilities and Infrastructure	Countywide*
	Improve Coordination and Communication Among Emergency Responders		Improve Planning and Regulatory Practices	
	Countywide Emergency Access Plan			
	Promote and Implement Modern Hazard Warning Systems			
	Providing Adequate Emergency and Power Sources			
Flooding	Increase Community Outreach and Education	Countywide*	Improved Planning and Regulatory Practices	Countywide*
			Establish River Gages	Buffalo Lake, Fox River, Montello River
	Update Official Floodplain Maps, collect information on flood prone areas	Cities and Villages	Promote Floodproofing of Buildings Where Appropriate and Cost-effective	Montello
	Enhance Stormwater Management and Erosion Control	Countywide*	Protect Water Quality	Countywide*
	Advance an Initiative of Voluntary Acquisition of Structures and Relocation of People	Montello, Town of Montello, Town of Moundville	Promote and Implement Modern Hazard Warning Systems	Countywide*
	Countywide*	Increase Access to Flood Insurance	Countywide*	
Dam Failure	Pursue Regular Community Outreach and Education	Locations around dams	Improve Planning and Regulatory Practices	Countywide*
	Develop or Maintain Emergency Action Plans through WDNR	14 Large/Potentially hazardous Dams		
	Implement an Effective Program of Dam Maintenance and Monitoring (including clearing and removal of obstructions from drainage ways and securing of dam houses)	14 Large/Potentially hazardous Dams		
Severe Storms	Pursue Regular Community Outreach and Education	Countywide*	Improve Coordination and Communication Among Emergency Responders	Countywide*
	Promote and Implement Modern Hazard Warning Systems	Countywide*	Recruit additional Storm Spotters and Train Them	Countywide*
	Advance the Construction of Shelters and Saferooms	Vulnerable populations		
	Develop Reliable and Multiple Evacuation Routes from Key Places of Assembly	Campgrounds, Fairgrounds, other places of assembly		
	Promote Active Tree Management	Countywide*		
	Protect Critical Facilities and Infrastructure	Countywide*		
Drought	Pursue Regular Community Outreach and Education	Countywide*	Improve Planning and Regulatory Practices	Countywide*
	Promote Use of Best Management Practices for Yards and Agriculture	Countywide*		
Extreme Temperatures	Pursue Regular Community Outreach and Education	Countywide*	Promote And Improve Use Of Cooling Centers (Possibly Similar Spaces As Saferooms)	Countywide*
Earthquakes	Promote and Implement Modern Hazard Warning Systems	Countywide*	Pursue Regular Community Outreach and Education	Countywide*
			Protect Critical Facilities And Infrastructure	Countywide*
Wildfires	Support Active Forest Management to Minimize the Potential for Catastrophic Fires	Forested areas of the County	Pursue Regular Community Outreach and Education	Forested areas of the County
	Engage in Good Land Use Planning, Proper Home Siting, and Provide Adequate Access to Homes in Fire Prone Areas	Forested areas of the County	Improve Coordination and Communication Among Emergency Responders	Countywide*

* City of Montello, Villages of Westfield, Endeavor, Oxford, and Neshkoro, and the Towns of Springfield, Newton, Crystal Lake, Neshkoro, Westfield, Harris, Shields, Mecan, Montello, Packwaukee, Oxford, Douglas, Moundville, Buffalo

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Mitigation strategies are separated into priorities. Priorities One and Two are described in detail in this chapter. Additionally, future strategies for consideration for each hazard are included as “other” strategies.

- *First Priority:* Includes highest priority strategies; begin implementation in as soon as possible following adoption of Plan, and ideally complete within five years.
- *Second Priority:* Includes second-highest priority strategies; begin implementation following completion or at least initiation of Priority One strategies, or as unique opportunities may present themselves.
- *Other Potential Strategies:* Includes strategies that are not currently identified as priorities, but are included for future consideration as the County moves forward with implementation of this Plan.

The following acronyms are used in the identification of responsible parties and potential partners:

- ACE Army Corps of Engineers
- FEMA Federal Emergency Management Agency
- WDOT Wisconsin Department of Transportation
- WEM Wisconsin Emergency Management
- WDNR Wisconsin Department of Natural Resources
- NRCS Natural Resources Conservation Service
- MCEM Marquette County Emergency Management
- MCSWCD Marquette County Soil & Water Conservation District
- UWEX University of Wisconsin-Extension
- USGS United States Geological Survey

PRIORITY MITIGATION STRATEGIES FOR ALL HAZARDS

The following five mitigation strategies are applicable to all types of hazards. These strategies should be considered and implemented in a comprehensive approach addressing multiple hazards.

Strategy 1: Pursue Regular Community Outreach & Education

County and local governments are best equipped to provide communities with information about the effect of disasters, methods for preventing damages, and the actions to take when disasters threaten a locality. Ideally, such information would be distributed annually or at the beginning of each hazard season. Traditional points of contact between governmental agencies and the community are effective means to provide information and resources. Such points of contact include municipal and County meetings; building, zoning, and burning permitting processes; parks and recreation permitting processes; and school classrooms. Web sites, e-mail list-serves, local closed-circuit cable and radio stations, newspaper articles, and informational fliers (that could, for example, be included with utility or tax bill mailings) can also reach a large audience at little to no cost.

Often there are misconceptions about the costs, benefits, and implementation of hazard mitigation strategies. Governmental jurisdictions, agencies, and organizational partners should lead by example to educate the public about good practices and disaster resistance. Visual and economic proof that mitigation strategies reduce the economic and social impact of disasters is one of the most effective educational tools available. Elected officials and department heads should be educated on the financial and social impacts of disasters, mitigation strategies, and the need to work together in order implement this Multi-Hazard Mitigation Plan most effectively.

Educational efforts should focus on the simple changes in behavior that can minimize risks. Self instigated mitigation strategies can be accomplished at the household level; for example, clearing dead and down timber and other debris from drainage areas or storm sewer inlets, observing construction site and farmland soil conservation practices, and using construction methods that reduce damage from hazards. Insurance agencies and lenders can help disseminate information on household mitigation strategies, as damages due to hazards have a direct impact on a property owner’s investment and possible insurance payouts.

Other specific examples of education and outreach tools include the following:

- *Web*: MCEM should develop a simple website that each municipality could link to providing information on disaster preparedness and hazard mitigation. The website would target both government agencies within the County as well as the public. Government agencies could be provided with e-mail notices when content is updated.
- *Elementary and Secondary Curriculum*: Curriculum may be enhanced by programs such as Red Cross' "Master of Disaster" Program or the Project WET program on the water cycle.
- *Public Access Television*: Where available, local public or government access cable stations can be used to play mitigation videos developed by state and national organizations and agencies.
- *Construction Education*: Instructors of building trades vocations should be provided up-to-date information on hazard resistant construction techniques.
- *Severe Weather Awareness Week*: This week occurs in March as a tool to promote awareness of hazard preparedness and mitigation. This week is an opportunity for schools, businesses, individuals, and organizations to review their severe weather action plans.
- *Education Targeting Vulnerable Populations*: Education and outreach efforts should be balanced between efforts to communicate to people County-wide and focusing particular attention on high risk groups, such as people residing in the floodplain, the elderly, low-income persons, and people residing in mobile homes.
- *Real Estate Deed Disclosure*: Informational fliers that identify rights and requirements of buyers, sellers, and lenders, as well as and provide resources to conduct additional research on properties could prevent investing in problematic properties. Such prevention will benefit everyone, as tax dollars fund disaster assistance and subsidize floodplain insurance payments, and high-risk properties inflate insurance premiums.

Priority: First Priority

Location: City of Montello, Villages of Westfield, Endeavor, Oxford, and Neshkoro, and the Towns of Springfield, Newton, Crystal Lake, Neshkoro, Westfield, Harris, Shields, Mecan, Montello, Packwaukee, Oxford, Douglas, Moundville, Buffalo

Responsible Parties: MCEM, Red Cross, local governments

Potential Partners: WEM, Utilities, Local media, schools districts, real estate community

Funding Source: Marquette County Emergency Management budget, with potential assistance from FEMA mitigation grant, other public grant funds, and/or private sponsorship.

Strategy 2: Improve Coordination and Communication among Emergency Responders and Regional Groups

Disasters cross jurisdictional boundaries and affect numerous aspects of a community, from physical safety, to economic stability and environmental condition. Therefore, effective mitigation requires that mitigation strategies also cross jurisdictional boundaries to include neighboring towns, villages, cities, and counties, as well as across department and agency lines.

County officials were particularly interested in improving coordination between with state and federal agencies during emergency response in relation to road closures and dam operation. Effective communication in regards to these critical infrastructure will allow the County to provide a unified message to local citizens and minimize confusion.

Through the planning process, the project team observed opportunities for improved intergovernmental/inter-agency coordination in Marquette County. Improved intergovernmental/inter-agency coordination does not require signed agreements or contracts. Being aware of neighboring communities' plans for growth and development or infrastructure improvements and expansions can lead to better decision making regarding land use and hazard mitigation. One model to help achieve increased coordination might be of Stephenson County, IL, in which the county created the Unified Command Committee, an organization that included participation from all emergency responders in the County.

Coordinated regional approaches—between Marquette County and other adjacent counties—would improve rapid and cost-effective delivery of emergency services, given that the majority of disasters cause physical, economic, and

environmental impacts at the regional scale. More regular meetings, or at least teleconferences, among emergency management personnel may be in order.

Priority: First Priority

Location: City of Montello, Villages of Westfield, Endeavor, Oxford, and Neshkoro, and the Towns of Springfield, Newton, Crystal Lake, Neshkoro, Westfield, Harris, Shields, Mecan, Montello, Packwaukee, Oxford, Douglas, Moundville, Buffalo

Responsible Parties: MCEM, Fire Departments, Police Departments, Sheriff's Department, Red Cross, Local Governments, EMS

Potential Partners: WEM, other County emergency management agencies, regional watershed groups, local governments

Funding Source: Marquette County Emergency Management budget, with potential assistance from public grant funds and/or private sponsorship.

Strategy 3: Countywide Emergency Access Plan

Natural hazards often result in damage to the transportation infrastructure. Marquette County should be prepared to handle the complexities that result from road closures and other negative impacts to the effective movement of people, goods, and services.

Only three routes exist across Buffalo Lake and the Fox River in the County. The June 2008 flood resulted in the closure of all three roads greatly limiting transportation options, impacting local business and inconveniencing regional and local populations. The County should develop alternate transportation routes during hazards. Each of the three road crossings (Highway 22, County Highway D, and County Highway O) across Buffalo Lake and the Fox River should be examined to determine how to enhance their structural integrity to ensure their operation during hazards. Engineering studies should explore how to raise Highway 22 through Montello, restructure County Highway D (the causeway) to accommodate larger flood events, and either raise or improve the structural integrity of County Highway O across the Fox River.

The County should not only be prepared to re-route traffic in the event of major road closures but must effectively communicate this information to people. The County should explore a dedicated telephone info-line that would provide information on road closures and current hazard conditions. Additionally, web-based technologies should be considered to display updated road closures and local hazard information.

Priority: First Priority

Location: Countywide in response to road closures, engineering studies of County Highway D, County Highway O, and Highway 22 near Buffalo Lake and the Fox River

Responsible Parties: MCEM, WDOT, Highway Department, Sheriff Department, Fire Department

Potential Partners: Local governments

Funding Source: FEMA Mitigation Grant Program, Marquette County, Wisconsin Department of Transportation, City of Montello

Strategy 4: Promote and Implement Modern Hazard Warning Systems

NOAA weather radio continuously broadcasts National Weather Service (NWS) forecasts, warnings and other crucial weather information as well as provides direct warnings to the public for natural, man-made, or technological hazards 24-hours a day. This network of radio stations is the primary trigger for activating the national Emergency Alert System (EAS) on commercial radio, television, and cable networks. NWS broadcasts also include post-event information for natural and human caused hazards.

The County will continue education and outreach efforts to encourage residents to have a National Oceanic and Atmospheric Administration (NOAA) weather radio on hand (and use it) to provide up to date warnings and directions regarding pending hazard events. Going further, the County will pursue obtaining grant funding to obtain NOAA weather radio for all interested county residents, at little or no cost to the resident.

In addition to NOAA radios, the County may update and expand its system of warning the public and local governments about impending hazards. For example, a modern system of automatic e-mails, phone messages, or cell phone text messages to warn of a hazard event should be explored—particularly given the large seasonal and tourist population. An automated phone message system may be particularly effective in much of Marquette County because smaller, more isolated communities may not have sirens.

Priority: First Priority

Location: City of Montello, Villages of Westfield, Endeavor, Oxford, and Neshkoro, and the Towns of Springfield, Newton, Crystal Lake, Neshkoro, Westfield, Harris, Shields, Mecan, Montello, Packwaukee, Oxford, Douglas, Moundville, Buffalo

Responsible Parties: MCEM, local governments

Potential Partners: WEM, school districts, owners/managers of facilities with vulnerable populations

Funding Source: FEMA Mitigation Grant program, Marquette County Emergency Management, with potential assistance from public grant funds and/or private sponsorship

Strategy 5: Provide Adequate Emergency and Power Sources

Currently the Marquette County Emergency Management Department does not have adequate equipment to operate the Emergency Operation Center during the event of a natural hazard. Marquette County should work to equip the Public Safety Room in the County Building in Montello with an additional phone line, backup power, and other communication tools including the internet and mobile devices. In addition, towns and villages should work to ensure adequate backup power and critical communication is maintained during hazards.

Priority: First Priority

Location: Critical Facilities, County Emergency Operations Center in the County Building

Responsible Parties: Utilities, MCEM, county government, local governments

Potential Partners: Sheriff Department, Fire Department

Funding Source: FEMA Mitigation Grant program, Marquette County, Local utility companies, with potential assistance from public grant funds and/or private sponsorship

Strategy 6: Protect Critical Facilities and Infrastructure

Protection of critical facilities is a vital hazard mitigation measure to ensure that emergency responders and their facilities are protected from disasters, so that they are able to respond quickly during hazard events. Critical facilities include emergency operations centers, police and fire stations, courthouses, rescue/ambulance services, medical facilities (hospitals, nursing homes, and clinics), utilities (water, sewer, electric, gas, and communications), and transportation facilities (critical roads, bridges, and airports). These critical facilities are illustrated on the Risk Assessment maps at the end of Chapter 3.

In addition to these critical facilities, major places of assembly should also be particularly prioritized in the event of disaster to protect these concentrations of people. Major places of assembly include schools, major employers, large multi-family housing complexes, auditoriums, and other large facilities. Protection of safe routes and communications to and from these places should be prioritized, as well as evacuation plans. Many places of assembly are also illustrated in the Risk Assessment maps in Chapter 3.

Lastly, protection of critical infrastructure, including major roads and utilities, is critical to ensuring access to/from communities, neighborhoods, and places of assembly (e.g., campgrounds) during disasters as well as providing needed services including water, communications, and power, to residents and businesses in the County.

Priority: Second Priority

Location: Countywide and in key locations, such as Montello, Mecan, and Packwaukee

Responsible Parties: MCEM, local governments, utilities, fire departments, police departments, sheriff's department, County highway department

Potential Partners: schools, owners/managers of places of assembly

Funding Source: Marquette County, local units of government, with potential assistance from public grant funds and/or private sponsorship

Strategy 7: Improve Planning and Regulatory Practices

This Multi-Hazard Mitigation Plan should be considered an integral part of the local and County-wide planning and land use management efforts since land use is a major factor in hazard vulnerability. A number of specific examples of planning and regulatory practices are identified below that should be a part of the County's multi-hazard mitigation strategy:

Incorporate Hazard Mitigation into Comprehensive Planning

Comprehensive planning efforts, both local and County-wide, provide opportunities to integrate hazard mitigation strategies into daily planning and land use policy decisions. Land use planning establishes guidelines for the use and development of land, and is generally used to guide decisions on zoning changes and subdivisions. Land use planning also helps communities organize the use of lands and their resources according to the land's capabilities to best meet people's needs over time. Land that is prone to natural disaster, due to location, topography, soils, geology, or plant cover should be identified as hazard-prone within the land use element of the comprehensive plan.

While hazard mitigation was generally considered when preparing the 2005 Marquette County Comprehensive Plan and local comprehensive plans, the Risk Assessment maps from this Plan should be used when updating County and local comprehensive plans. Under Wisconsin law, this will have to occur by 2015. Overall, a good land use element and associated future land use map within a comprehensive plan has the capability of:

- Guiding development towards areas that are not subject to hazards
- Reducing population and building density in the hazardous areas
- Encouraging limitations on new development in hazardous areas
- Encouraging use of best agricultural, soil erosion, and stormwater management practices

Zoning Code Amendments and Enforcement

When enforced, zoning is a powerful mitigation tool. A zoning ordinance is the set of rules that a local or County government adopts to regulate the future use of land, particularly when new development is proposed. Zoning ordinances may also include rules for certain qualities of new development such as site planning, landscaping, and signage. The County Zoning Administrator is charged with enforcing the zoning ordinance in unincorporated areas that have zoning, and is responsible for issuing zoning permits for these same unincorporated areas. The County also administers floodplain regulations in all parts of unincorporated Marquette County. Cities and villages with adopted local zoning ordinances are responsible for enforcement and permit issuance within their jurisdictions.

In small communities, there is often hesitancy to "regulate one's neighbor" by enacting or enforcing permit and code requirements. However, a favor to one person can be damaging to the downstream neighbor or the community as a whole when disaster damages result in additional local and County expenditures for overtime of emergency response and recovery assistance. Permitting officials are the frontline defense against substandard, unsafe construction methods and risky development investments that result in additional, unplanned public expenses.

County and local zoning ordinances should be updated, as necessary, to include the following provisions:

- Require site plan review for larger projects and projects in flood-prone areas. A site plan is a map of a proposed development usually submitted as part of an application for zoning change, variance, or conditional/special use permit, and indicates site topography, drainage, vegetation, building location, parking, access, and utility locations..
- Require that mobile homes include anchored tie downs to protect these homes from severe storms.

- Require new or expanded mobile home parks, campgrounds, RV parks, and other similar facilities to provide a storm shelter.
- Include the latest wetland and floodplain zoning models and standards to insure that hazard-prone areas are considered in the process of obtaining a zoning or building permit.
- Require that new utility lines be installed underground wherever possible.

Subdivision Ordinance Amendments and Enforcement

When enforced, subdivision ordinances are effective hazard mitigation tools. A subdivision ordinance is the set of rules that a government adopts to regulate the division of larger parcels of land into smaller lots for sale and development. A subdivision ordinance typically defines requirements that the subdivider must meet before lots may be sold. These may include requirements for lot sizes, roads, utilities, grading, and stormwater management. Land in a city or village is only subject to that city or village's ordinance, and land outside of cities and villages are subject to the County's subdivision ordinance and possibly that of a nearby city or village.

The County and local subdivision ordinances should include the following, as needed:

- A requirement that the developer of each new subdivision plat provide, with preliminary submittals, a detailed "site assessment checklist" that would identify natural features (and potential hazards) in and around a site before land is divided.
- For each land division, submittal of detailed preliminary plats or certified survey maps with floodplain and wetland boundaries clearly identified. At times, this will require a detailed survey of the property, and its environmental features.
- Quantified stormwater management requirements that are based on the area of impervious surfaces, such as pavement and roofs, and Best Management Practices for stormwater management. BMPs are policies, practices, procedures, or structures that are recognized to be the most effective and practical means of managing a system, such as stormwater management or erosion control
- Requirements that all new buildable lots should be kept out of the floodplain.
- A requirement that developers of mobile home parks, industrial parks, and campgrounds should provide a storm shelter.

Comprehensive Outdoor Recreation Planning

The purpose of a comprehensive outdoor recreation plan, more commonly referred to as a park and open space plan, is to guide the acquisition, preservation, and development of land for park, recreation, and related open space uses in an entire community or County. This plan is required by the DNR if a community wants to apply to the State Stewardship or federal Land and Water Conservation (LAWCON) programs to fund land acquisition for conservation and passive recreational purposes. Open space designation of disaster-prone areas can eliminate the opportunity for development that will continue to incur repetitive damages. If prepared and updated once every five years, these plans enable communities to obtain grants for park and open space land acquisition, which may serve multiple recreation and hazard mitigation objectives. If the County chooses to undertake a comprehensive outdoor recreation plan, the recommendations regarding sensitive lands in this Multi Hazard Mitigation Plan should be included.



Capital Improvement Planning

Decisions to extend roads, waste water treatment facilities, or utilities into hazard-prone areas will increase the risk that additional public funds will be necessary at some point to repair damage. Additionally, public investment in, and expansion of, public infrastructure in an area implies that the area is “safe” for development and private investment and may inadvertently promote private developments in hazard prone areas. Expansion of existing capital improvements, or investment in new capital improvements should be evaluated for “disaster sustainability”--location and investment should be directed by risk assessment and best management land use practices, in addition to existing capital improvement criterion. This evaluation is extremely important in rapidly developing areas.

Purchase of Conservation Easements and Development Rights

By purchasing an easement, a local government, utility or non-profit land conservation agency compensates an owner for partial rights to use a property. A common example is a utility easement: a property owner will provide the right to lay public utilities across their land and then agrees not to build in the area. As a hazard mitigation strategy, easements can prevent a property from being developed if to do so would not be in accordance with a community’s land use plan. The County may consider purchasing development rights (easements) of vacant, hazard-prone properties where fee simple acquisition is not practical or desired.

Priority: Second Priority

Location: City of Montello, Villages of Westfield, Endeavor, Oxford, and Neshkoro, and the Towns of Springfield, Newton, Crystal Lake, Neshkoro, Westfield, Harris, Shields, Mecan, Montello, Packwaukee, Oxford, Douglas, Moundville, Buffalo

Responsible Parties: Marquette County and local government zoning departments

Potential Partners: MCEM, park and recreation departments, land and water conservation departments

Funding Source: Marquette County Zoning Department budget, possible “Smart Growth” comprehensive planning grant funds

PRIORITY FLOOD MITIGATION STRATEGIES

Flood mitigation strategies addressed in this section can apply to riverine or flash flooding, and most may be applied throughout the County in areas susceptible to flooding. Specific flood mitigation strategies for particular small areas or particular communities may be found at the end of this section.

Strategy 1: Pursue Regular Community Outreach and Education

Strategy 1 under the “Priority Mitigation Strategies for All Hazards” section above provides an overview of the Community Outreach and Education strategy.

As it relates to flooding specifically, continual outreach with the community is critical to ensure that the objectives of the flood mitigation program are understood and that residents, businesses, and property owners have several mechanisms for getting accurate information, voicing opinions, and shaping the actions. Specifically, the flood mitigation outreach and education should focus on communications in the following areas:

- *Flood Mitigation Strategy:* As the County, local jurisdictions, and other partners work to implement this Multi-Hazard Mitigation Plan, it will be critical to keep the community continually up-to-date and treat community members as implementation partners on the objectives, details, and progress of the flood mitigation actions being proposed and carried out. Updates should be made through information shared with community organizations, community-wide meetings and direct project update mailings to residents, property owners, and business owners in areas vulnerable to flooding.
- *Procedures During Flood Events:* Coordination of appropriate procedures for emergency providers as well as instructions for homeowners, residents, and tourists will help prevent and reduce loss to life and property during flood events. The County should work to develop a dedicated phone info-line to communicate appropriate information. A more formalized emergency management team, including all providers that touch on emergency response, may be an appropriate step.

- *Floodplain Regulations:* Frequently, County residents do not understand the limitations to improvements that can be made to structures in the floodplain and floodway due to local, state, and federal floodplain regulations. The County can help allay these frustrations by providing published materials that explain the regulations in lay terms and also give clear definitions and examples of what does and does not constitute a “substantial improvement” to property; this threshold initiates stricter regulations.
- *Floodproofing:* The County, local governments, and the Red Cross could distribute materials to residents and business owners in floodprone areas that clearly explain and provide examples of floodproofing actions that residents can take themselves to protect properties from flood damage, such as elevating utilities and appliances in basements.
- *Flood Insurance:* To improve access to flood insurance, residents need accurate, up-to-date information. To help in this regard, the County could connect property owners with flood insurance carriers through periodic flood insurance open houses and printed materials.
- *Continued compliance with the NFIP:* The County and local governments should work with the community to ensure current individuals enrolled in the program remain in good standing.

Priority: First Priority

Location: Countywide, particularly in flood prone areas identified on the Risk Assessment maps

Responsible Parties: MCEM, Marquette County government, Red Cross, local governments

Potential Partners: Utilities, WEM, local media, local organizations and community groups, lenders, contractors

Funding Source: Marquette County Emergency Management, Red Cross, with potential assistance from public grant funds and/or private sponsorship

Strategy 2: Update Official Floodplain Maps

There has been some concern over how accurate and current floodplain maps are in the County, particularly in Montello, as they are based on County data and computer models completed in the early 1980s. Given that these maps dictate decisions that have community, legal, and financial ramifications, they should be accurate. FEMA floodplain maps are based on historical flood data, hydrologic and hydraulic rainfall and river-flow data, topography, wind velocity, existing flood control measures, and existing and planned development. This information is fed through a computer model and then adjusted based on the number of National Floodplain Insurance Program policyholders, flood damage claims, and the prevalence of repetitive loss properties. Funding limitations allow the agency to update maps only every 15-20 years.

The County should seek resources to update floodplain maps based on modern hydrologic models that reflect current conditions in the watershed. This updated information would prove to be an invaluable tool for future decision-making. This strategy is suggested for specific communities in the County where specific issues with floodplain maps have been identified; however, the most efficient, effective strategy may be to gather new data on a County-wide level in order to update the maps County-wide.

One particular funding source that should be explored is the Army Corps of Engineers Planning Assistance to States. Another possible source for assistance is the FEMA Cooperative Technical Partners (CTP) Program. The program provides the opportunity to pool local and national resources. CTP works with communities to use local analysis, permitting, and planning data as the basis for the NFIP map. This cooperative process provides an opportunity to interject a tailored, local focus into the national floodplain program. Therefore, where unique conditions exist, the community can take special approaches to flood hazard identification, resulting in more efficient floodplain management. For participating in the CTP Program, community partners will receive Community Rating System credits, which may lead to discounted flood insurance premiums for property owners. Eligibility requirements and benefits can be found at http://www.fema.gov/fhm/ctp_qa1.shtm.

Following completion of a floodplain map update, amendments and revisions should be made to Flood Insurance Rate Maps. This updated information will help provide more accurate warning to residents in the floodplain and better identify the risk of flooding in the community, and provide a more defensible regulatory tool.

MCEM should initiate contact with the FEMA Cooperating Technical Partners Program to determine the specific requirements and timeframe for a formal update. The County Zoning Department and MCEM should direct the

FIRM update, with assistance from FEMA and Army Corps of Engineers (ACE) and cooperation from local governments. In the meantime, MCEM and the County and local planning and zoning departments should collectively annotate the existing floodplain map.

A cost-effective alternative to a full NFIP update or the CTP—or a shorter-term record building approach—is to supplement the official floodplain delineations with additional areas known to flood. This could be done using information compiled and mapped during this hazard mitigation planning process. Although these areas will not be held to the regulations of properties that are within the FEMA designated floodplain, County Zoning and Emergency Management staff will have record of areas of concern and will be better able to educate and warn property owners and developers of potential risk.

Priority: First Priority, to begin collecting additional data on flood prone areas and identifying a potential funding source. The actual update of floodplain maps may be second priority.

Location: City of Montello, Village of Neshkoro, Village of Oxford, Harrisville, Packwaukee, and other county areas susceptible to flooding.

Responsible Parties: MCEM, county and local governments

Potential Partners: WEM, FEMA, Army Corps

Funding Source: FEMA Mitigation Grant Program, Marquette County, US Army Corps, local jurisdictions

Strategy 3: Enhance Stormwater Management and Erosion Control

Erosion control and stormwater management programs and ordinances attempt to reduce stormwater run-off from construction sites and new development projects. The overall goals of these efforts are to encourage erosion control practices during private development site construction and ongoing stormwater management after construction for subdivisions and other larger projects to prevent flooding and protect water quality. Improved stormwater management and erosion control practices have the potential to minimize the effect of flooding on private property and business activities.

In addition to enacting stormwater management plans and ordinances, the range of approaches that the County, local governments, and other partners may pursue include:

- Adopting community-wide stormwater management plans to identify potential upgrades to existing stormwater management systems, and the best locations and configurations for stormwater basins and conveyance routes in new development areas.
- Adopting modern erosion control and stormwater management regulations to assure that new development projects do not exacerbate flooding and soil erosion through use of Best Management Practices. Stormwater management and erosion control ordinances could be either stand-alone regulations, or could be integrated into subdivision and zoning ordinances. Such ordinances can identify construction site erosion control requirements that include bank stabilization such as sloping or grading techniques, planting vegetation on slopes, or terracing hillsides. At a minimum, the County and local jurisdictions should update subdivision and zoning ordinances to quantify stormwater management requirements. The County and local governments in the County could share the same or similar ordinance language, which may also enable the County and local governments to share enforcement responsibilities through a contracted staff person.
- Regular inspections of culverts, ditches, and stormwater inlets to assure that they are free from blockage. Clearing blockages and improving the function of existing systems (e.g., ditch dredging) will be pursued where problems are identified.



- Promoting erosion control techniques, such as vegetative swales, over key properties to minimize soil erosion onto public roads and nearby properties.
- Regular inspection of the river and streams to identify problematic obstructions. Marquette County, the Soil and Water Conservation Service, and the University of Wisconsin-Extension may also help educate property owners on stream management techniques.
- Directing development away from wetlands and ensuring wetland protection regulations are enforced. Wetlands serve as natural collection basins for floodwaters as their unique soils and hydrology function as sponges by collecting water, filtering it, and slowly releasing it into rivers, streams, and the water table.
- Promoting Best Management Practices for agriculture to reduce stormwater runoff erosion. Examples of such practices include: contour farming, planting hydrophyte crops that have a high water absorption rate, conserving crop residues after harvesting, limiting tillage depth and speed, extending crop rotations to reduce incidence of summer fallow, strip cropping, and fertilization with animal manure.
- Promoting installation of inlet control valves in basements. Basement flooding caused by the back up of combined storm water/sewer systems is a common problem associated with flooding. Inlet control valves slow the flow of the water into the system to prevent the system from exceeding capacity. The City of Chicago secured a FEMA mitigation project grant to install these valves in its sewer system, reducing damages by 90%.
- Promoting site and building designs that go beyond minimum stormwater management requirements to reduce impervious surface coverage such as through use of pervious pavement, installation of “green” roofs (roofs that incorporate planting beds to absorb stormwater), or installation of “rain gardens.” This strategy should be considered in particular for the Buffalo Lake, Montello River, and Puckaway Lake corridors as new development is proposed.
- Exploring other more comprehensive stormwater management solutions, such as additional storm sewer and/or storm/floodwater detention and storage basins. As part of this, considerations should include the benefits to flood mitigation of such initiatives, potential negative side effects (e.g., disturbing contaminated soils), and cost-effectiveness before implementing any solution.



Priority: First Priority

Location: Countywide, and in locations where population is most dense and flooding is a significant concern

Responsible Parties: Marquette County government, local governments, Marquette County Soil & Water Conservation District, Marquette County Natural Resources Conservation Service, property owners

Potential Partners: MCEM, University of Wisconsin-Extension

Funding Source: FEMA Mitigation Grant Program, Marquette County Zoning Department budget, WDNR stormwater planning grants

Strategy 4: Advance Voluntary Acquisition of Structures and Relocation of People in Limited Areas

Voluntary acquisition of properties and relocation of people out of a floodplain is a mitigation strategy that offers the potential to *eliminate* vulnerability to flood hazards in heavily and repeatedly affected areas. Further detail is provided at the end of this section under “Area Specific Flood Mitigation Strategies,” particularly for the City of Montello and the Town of Moundville which have both received repeated flooding over the past five years in areas along Highway 22 (see Figure 4.2) and homes along 11th Court (see Figure 4.3). Relocation can offer several potential benefits, including the following:

- *Getting people out of harm’s way*, preventing damage to property, and more importantly eliminating the risk of injury and death in the event of a major flood event. Additionally, reducing the number of people living the floodplain in turn reduces the risk to emergency responders who are responsible for repeatedly helping to protect or evacuate these residents.
- *Opening the door to new housing alternatives*, as often times homes in floodprone areas have become subject to irreversible damage and disinvestment, and even homeowners seeking to make improvements are limited in doing so due to floodplain regulations. Relocation offers an opportunity for residents to move into homes that are not subject to limitations on improvements and will not be damaged due to flooding.
- *Opportunities to create new public open space amenities*, such as riverfront pathways, recreation areas, gardens, and other uses.



Figure 4.2 Areas Subject to Repeated Flooding Hazards in the City and Town of Montello

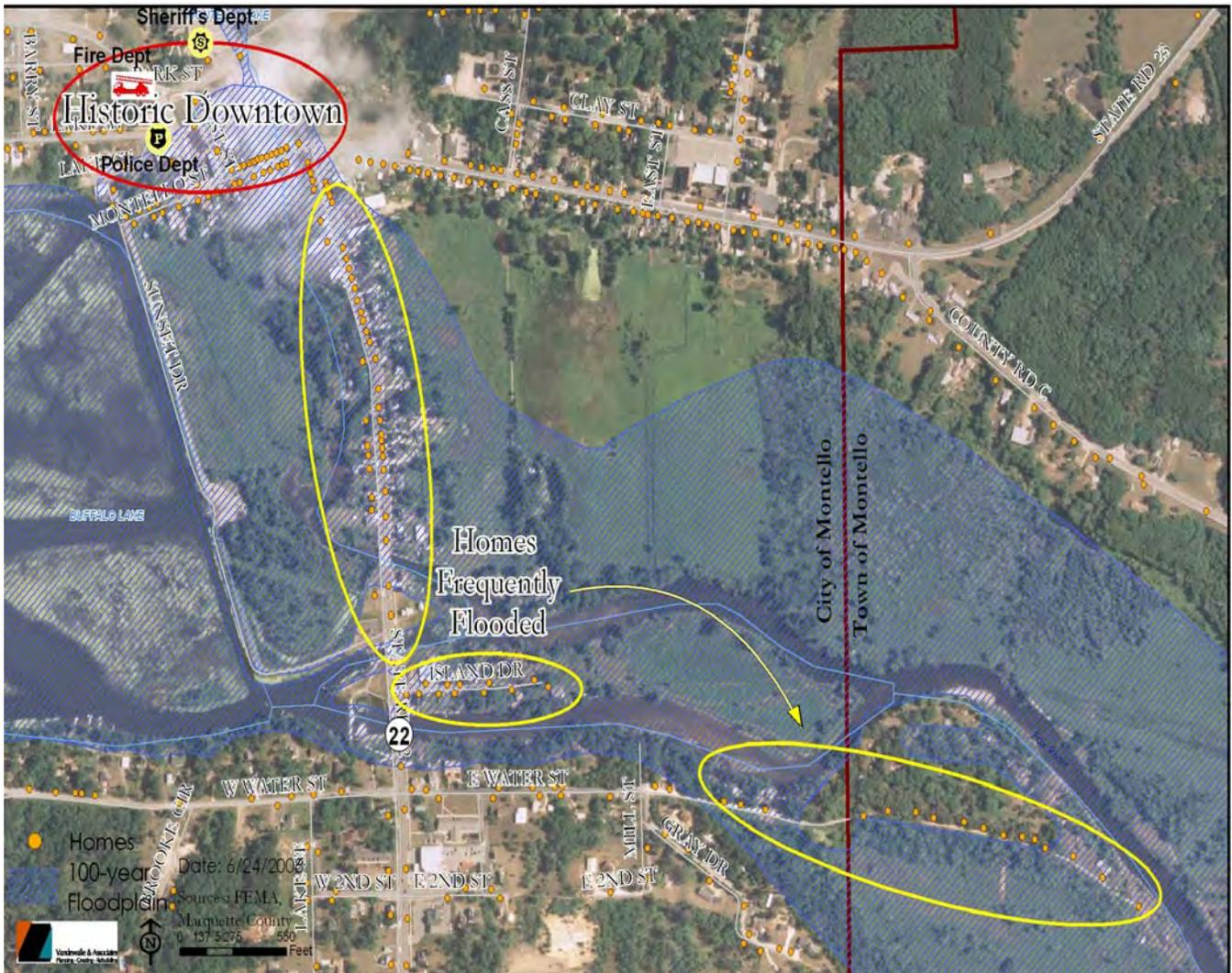
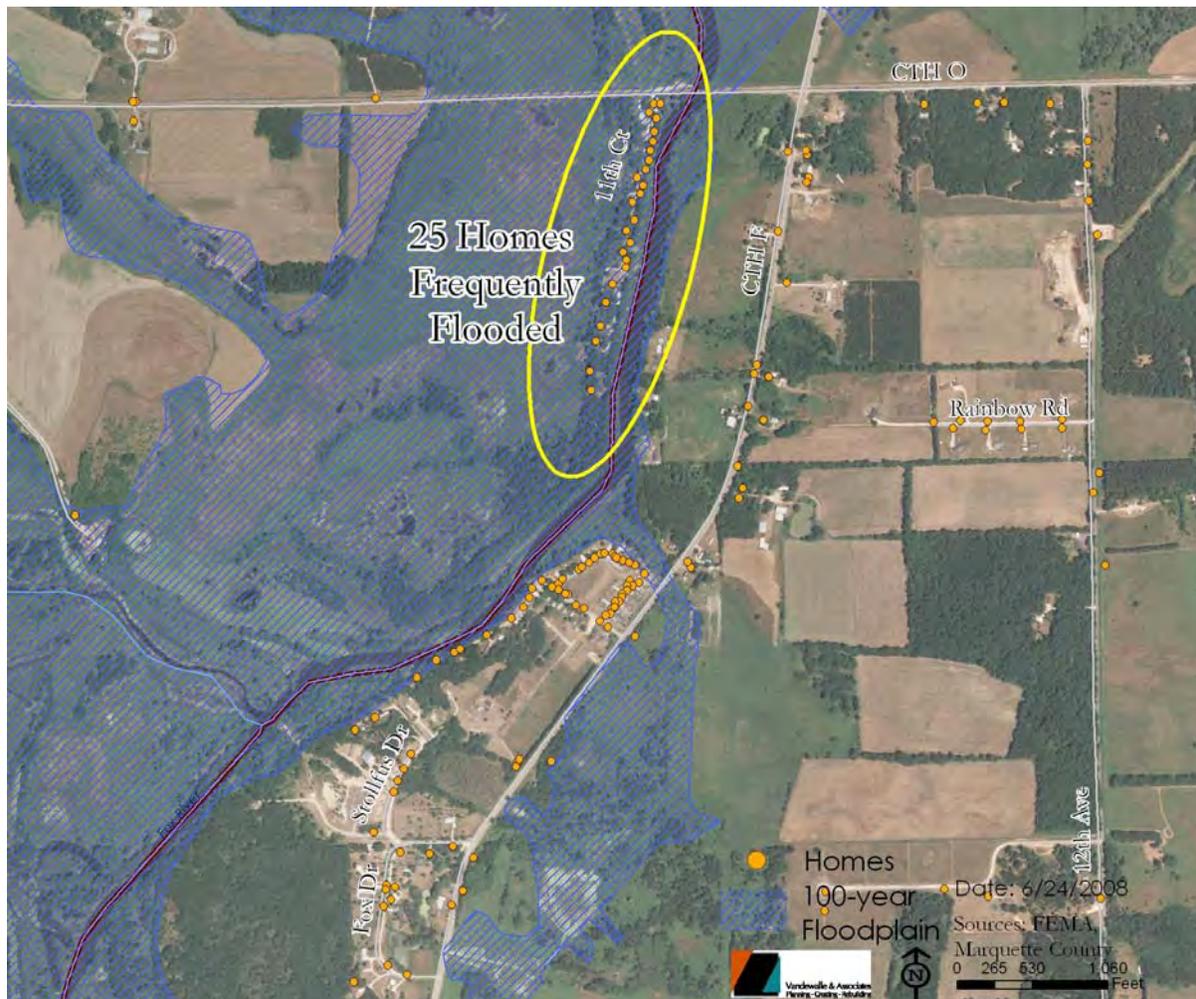


Figure 4.3 Areas Subject to Repeated Flooding Hazards in the Town of Moundville



Priority: First Priority

Location: City of Montello for residential areas south of the historic downtown and north of the Fox River, the Town of Moundville along 11th Court; perhaps some scattered building sites in other locations in the County

Responsible Parties: MCEM, affected local governments

Potential Partners: WEM, Local institutions, community leaders

Funding Source: FEMA, Marquette County Emergency Management and Zoning Department budgets, local jurisdictions, State Stewardship or Federal LAWCON programs

Strategy 5: Protect Critical Facilities and Infrastructure

Protection of critical facilities from flooding is a vital hazard mitigation measure to ensure that emergency responders and their facilities are protected from disasters so that they are able to respond quickly during hazard events. This strategy applies to all hazards and consequently is discussed in detail under the “Priority All Hazards Mitigation Strategies” section above.

As it applies specifically to flooding, protection of critical infrastructure, like emergency and protective services buildings and road access, is also an important strategy. For residents, it can be a matter of making sure people have a route to dry land and safety. For businesses, it is critical to have reliable property access to maintain cost-effective operations. Without such reliable access, businesses that rely on local roads for shipping and receiving, as well as customer and employee access, will suffer. Floodplains in the County, including in the City of Montello, affect several

businesses and employers that contribute significantly to the local economic base. Consequently, when these businesses are affected by flooding, this has considerable economic impact on these businesses and ultimately the economy as a whole.

Mitigation actions to either floodproof roadways accessing critical facilities and businesses (e.g., by raising them), constructing new or improved roads, or floodproofing or relocating businesses or critical facilities like police and fire stations, should be evaluated and implemented as appropriate. This approach should not be construed as advocating the relocation of commercial buildings or activities in the Historic Downtown area of Montello, as depicted in Figure 4.2. However, steps to ensure the continued access to and functionality of emergency and protective services facilities in this vicinity should be carefully studied as pursued as appropriate.

A particular focus should be placed on the three road crossings across Buffalo Lake and the Fox River as these corridors offer the only north/south transportation routes across these dominate water features in the County. All three crossings were closed during the 2008 flooding. An engineering study should be conducted at each site to determine the necessary upgrades to maintain the functionality of these critical transportation routes.



In the Town of Douglas, it was the opinion of participants that the culvert under 5th Road should be upgraded to a larger size, the road should be raised in this area, or other appropriate measures should be explored.

Priority: First Priority

Location: City of Montello, the three crossings of Buffalo Lake and the Fox River, perhaps other locations where flooding may affect local road access

Responsible Parties: MCEM, County government (highway department), local government, utilities, fire departments, police departments, sheriff's department

Potential Partners: Schools, WDOT

Funding Source: FEMA Mitigation Grant Program Marquette County, local city, village, and town budgets, with potential assistance from public grant funds or other resources

Strategy 6: Establish River Gages

Currently no water bodies in Marquette County have a government (USGS, NWS) operated river gage. The Montello Dam Operate generates flow estimates for the Montello River. Typically the USGS operates gages on large streams and waterways across the country. Due to funding constraints not all large waterways have an active river gage. The county should convey the importance of establishing a gage to the USGS and NWS along the Fox River, Buffalo Lake, and Montello River. Water levels rise at different rates on all three water bodies. Alternately the County can work with local governments and the WDNR to establish locally maintained river gages to help predict flood waters levels.

Priority: Second Priority

Location: Buffalo Lake, Fox River, and Montello River

Responsible Parties: MCEM, County governments

Potential Partners: Dam Operators, WDNR, USGS, NWS

Funding Source: Marquette County, possibly public and private utilities, dam operators, USGS, local jurisdictions

Strategy 7 Improve Planning and Regulatory Practices

Strategy 5 under the “Priority Mitigation Strategies for All Hazards” section above provides an overview of this strategy, including tools for planning for and regulating flood hazard areas.

As it relates to flooding, a specific emphasis should be place on amending County and municipal subdivision and zoning ordinances, where requirements are not already in place, to require developers to conduct a detailed evaluation of floodplain boundaries and include them on site plans, certified survey maps, and subdivision plats for any proposed development near the floodplain or other known flood-prone areas. This certified data could also ultimately help hone a formally updated floodplain maps, described above.

Priority: Second Priority

Location: Countywide

Responsible Parties: Marquette County government, local governments

Potential Partners: MCEM

Funding Source: Marquette County Zoning Department budget and cities and villages

Strategy 8 Promote Floodproofing of Buildings Where Appropriate and Cost-effective

Where relocation of buildings out of the floodplain is not feasible, there are a multitude of floodproofing measures that can help reduce the risk of damage to structures—the most appropriate floodproofing tool depends on the type and structural integrity of a building as well as the long-term benefit of floodproofing versus the cost. The following are potential floodproofing techniques available to property owners.

- *Installation of Backflow Valves and Sump Pumps:* To minimize potential damages to foundations and household utilities, property owners can install sump-pumps in basements to remove floodwater and backflow valves to deter sewage backups.
- *Wet Floodproofing:* Using water resistant paints or other materials can allow for easy cleanup after floodwater exposure in accessory structures or in a garage area below an elevated residential structure. Wet floodproofing also entails elevating items such as electric circuit breakers or appliances high enough to prevent damage from most instances of flooding. In a basement, wet floodproofing may be preferable to attempting to keep water out completely, because it allows for the pressure of exterior and interior water forces to balance, thereby discouraging structural collapse. Wet floodproofing may only be used for basements in cases of new construction, substantial improvement, or substantial damage. Information about such building practices should be made available through a hazard mitigation link on a potential future MCEM website and issued at the time of building and zoning permits for properties within a flood-prone area.
- *Dry Floodproofing:* Strengthening walls, sealing openings, or using waterproof compounds or plastic sheeting on walls can help keep building interiors dry; however, retrofitting a structure is cost prohibitive unless a substantial improvement or repair is underway. When allowed, new construction in areas prone to foundation collapse should not employ dry floodproofing. Information about such building practices should be made available through a hazard mitigation link on a potential future MCEM website and on the Red Cross website and issued at the time of building and zoning permits for properties within a flood-prone area.
- *Elevation:* A fourth floodproofing technique includes elevating a structure so that the lowest habitable floor is raised above the base flood elevation. Such lifting should include elevation of utilities or other mechanical devices above expected flood levels. This strategy, however, should be reserved for buildings with particular historic or cultural value, as the cost of elevation is usually prohibitive unless supported by outside funding, and the State of Wisconsin supports relocation over elevation for the use of hazard mitigation grant funds.

Priority: Second Priority

Location: Countywide, City of Montello Historic Downtown (see Figure 4.2)

Responsible Parties: property owners

Potential Partners: MCEM, local governments, property owners, contractors

Funding Source: FEMA Mitigation Grant Program, Marquette County Emergency Management, Marquette County Zoning Department, Individual landowners, real estate/realty community

Strategy 9: Protect Water Quality

Containers of hazardous materials such as petroleum or chemicals should not be located in a flood-prone area, and local and county zoning regulations should be amended as needed to implement this recommendation. If such a location is necessary, containers need to be anchored and sealed to limit the potential for water contamination and damaging effects of flooding by causing fires or explosions, or by otherwise making structures unusable due to contamination. Emergency response to a hazardous materials spill is delineated in the Marquette County Disaster Plan. Locations of hazardous materials are illustrated on the risk assessment maps included in Chapter 3.

Many Marquette County residents live on or near bodies of water. Proper erosion control and stormwater management should be encouraged to minimize the impacts of sediment and nutrient runoff into area surface and groundwater.

Livestock operations near streams, lakes, and wetlands should be aware of their proximity to water and take extra care in their manure management. Local residents identified a large livestock operation near Packwaukee, which was partially within the 100 year floodplain.

Improper management of local wastewater treatment plants can negatively impact local surface water, particularly during flooding events when wastewater treatment plants are forced to handle large volumes of stormwater. Additionally, the City and villages should address threats to water quality through the maintenance of sanitary sewers to prevent leaching that may occur during flooding events.

Priority: Second Priority

Location: City of Montello, Villages of Westfield, Endeavor, Oxford, and Neshkoro, and the Towns of Springfield, Newton, Crystal Lake, Neshkoro, Westfield, Harris, Shields, Mecan, Montello, Packwaukee, Oxford, Douglas, Moundville, Buffalo

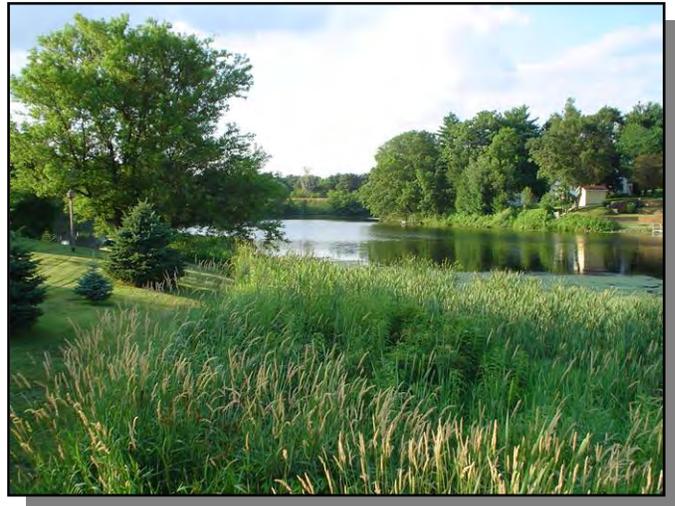
Responsible Parties: County and local government property owners, businesses

Potential Partners: WDNR, Marquette County Soil and Water, MCEM

Funding Source: Marquette County Land Conservation budget, USDA, individual landowners

Strategy 10: Promote and Implement Modern Hazard Warning Systems

Refer to Strategy 3 in the “Priority All Hazards Mitigation Strategies” section above.



Strategy 11: Increase Access to Flood Insurance

Insurance against property damage due to flooding can help to prevent financial devastation when damaging flooding occurs. Although flood insurance does not prevent flood damage from occurring, it may help mitigate a property owner's financial exposure to flood damage. Property owners should be educated about the limitations of policies provided by private insurance providers as well as the National Flood Insurance Program (NFIP), as often coverage is inadequate to enable full recovery from a flood event. In addition to awareness of limitations, consumers should be aware of the documentation required in their private insurance policies in order to be reimbursed for personal property and property improvements; without requisite documentation, insurance agencies can refuse payouts. The National Flood Insurance Program also has significant limitations; often the FEMA damage assessment process is inconsistent and underestimates damage reimbursements. To remedy the inconsistencies, an audit team should follow the FEMA assessment teams to survey the quality of residents' experience and evaluate the accuracy and consistency of the agency's damage estimates.

National Flood Insurance Program policies are available to all property owners and renters in communities that participate in the program. Communities that choose to participate in the NFIP must adopt ordinances that at a minimum meet base-level federal and state requirements. Communities may pass more stringent ordinances that further reduce risk.

Properties do not have to be located in a floodplain to be eligible for flood insurance, and consequently, owners of properties in flood-prone areas outside of mapped 100-year floodplains should consider purchasing NFIP insurance.

The County and local governments can help increase flood insurance program participation rates through the outreach and education efforts on the National Flood Insurance Program (NFIP), such as through printed materials and workshops. According to FEMA, often insurance agents are either uneducated about the benefits and applicability of the NFIP, or simply do not inform customers of its availability because its processing costs are high, profit to the agent is low, and it requires significant paperwork. MCEM should work with local insurance agents as well as WEM, FEMA, and the NFIP to create and undertake an outreach and educational effort to enroll municipalities that currently do not participate in the program, and inform property owners of flood-prone property of the availability of flood insurance and provide a guide to enrollment.

Additionally, increased access to flood insurance could be improved by reducing the cost of flood insurance. The best way to accomplish this may be for jurisdictions that participate in the NFIP to enroll in the Community Rating System (CRS). The CRS is a FEMA-sponsored program that rewards communities for taking flood mitigation actions above NFIP minimal requirements by reducing flood insurance premiums in the community. Conducting this hazard mitigation process earns the municipality points in the CRS, as will conducting on-going outreach with residents, among other initiatives. Specific actions that can be taken to reduce premiums include:

- Updated topographic mapping
- Adopting floodplain zoning ordinances above and beyond state and federal minimums
- Implementing of educational outreach programs
- Requiring open space dedication of floodplain areas
- Participating in the National Weather Service Storm Ready Program. This is a program that recognizes those communities that are prepared for natural disasters; to participate, the NWS inspects a community to verify that it has resources to receive weather information and warnings, the means to disseminate warnings to critical facilities, and that community preparedness activities have been accomplished and are ongoing.

At the time of writing, the following areas of the County participate in the NFIP:

- Unincorporated Marquette County
- City of Montello
- Village of Endeavor
- Village of Oxford
- Village of Westfield

Priority: Second Priority

Location: Village of Neshkoro should enter into NFIP, City of Montello, Villages of Westfield, Endeavor, Oxford, and the Towns of Springfield, Newton, Crystal Lake, Neshkoro, Westfield, Harris, Shields, Mecan, Montello, Packwaukee, Oxford, Douglas, Moundville, Buffalo

Responsible Parties: MCEM, property owners, local governments

Potential Partners: Insurance providers, WEM

Funding Source: FEMA Mitigation Grant Program, Marquette County Emergency Management, real estate interests

Area Specific Mitigation Strategies for Flooding

The following flood mitigation strategies are either First or Second Priority strategies that are particularly applicable to particular communities in Shawano County.

City of Montello

Montello has experienced flooding on several occasions in the past few years which should be addressed by city and county officials. Approximately 50 homes lie within the 100 year floodplain or have been subject to flooding over the past decade as illustrated in figure 4.2. The following mitigation strategies are advised to specifically address the flood hazards within the City of Montello.

- *State of Wisconsin Tourism Flood Grant:* Communities which suffered a major loss in the June, 2008 floods are eligible for a one-time grant of up to \$12,500. Entities eligible for the grant include non-profit marketing organizations such as convention bureaus, economic development groups, and chambers of commerce that are located in counties designated as a FEMA disaster area. This grant could be used to restore the tourism associated with Buffalo Lake and surrounding natural areas.
- *Update Floodplain Map:* Updated floodplain mapping in the City of Montello would reveal areas most threatened by future flooding, focus future development out of floodplains, and help focus a potential program for the voluntary acquisition of properties for conversion to green space to minimize flooding impacts. The most recent large flood in June 2008 resulted in areas flooding that were not mapped but several areas that were within the FEMA defined 100 year floodplain were not impacted by flood waters.
- *Advance an Initiative of Voluntary Acquisition of Structures and Relocation of People:* Homes along Highway 22 south of the Historic Downtown, along Island Dr., and along E. Water Street have experienced flooding on several occasions during the past several years. The voluntary acquisition and relocation of these homes to areas less susceptible to flooding may be more cost effective than continued efforts to protect, clean-up, and repair. It may also help upgrade this part of the City and advance green space, recreation, and economic growth/tourism.
- *Promote Floodproofing of Buildings Where Appropriate and Cost Effective:* Focus should be placed on historic commercial buildings of downtown Montello
- *Protect Critical Facilities and Infrastructure:* Important County health and safety facilities are in the City of Montello as well as two large dams. According to FEMA Floodplain modeling, the Police Station can be impacted by a 100 year flood. Measures should be explored to properly maintain dams, floodproof critical buildings, or investigate the possible relocation of critical community facilities. This concern is particularly evident when one reviews the Risk Assessment map for the City in Chapter 3—all of the critical facilities are north of or in the Montello and Fox River floodplains, and there are areas of fairly significant residential development south of the Fox River.

Town of Moundville

The Town of Moundville has experienced flooding on several occasions in the past few years which should be addressed by town and county officials. An area of particular concern is the 25 homes along 11th Court which lie within the 100 year floodplain as illustrated in figure 4.3. The following mitigation strategies are advised to specifically address the flood hazards within the Town of Moundville.

- *Advance an Initiative of Voluntary Acquisition of Structures and Relocation of People:* Homes along 11th Court have experienced flooding on several occasions during the past several years. The voluntary acquisition and relocation

of these homes to areas less susceptible to flooding may be more cost effective than continued efforts to protect, clean-up, and repair.

Town of Montello

On E. Water Street, just beyond the City of Montello lie 13 homes that have experienced flooding on several occasions in the past few years as illustrated in figure 4.2. Only a few of these homes lie within the current 100 year floodplain boundaries but during the most recent 2008 flood all 13 homes were subject to flood waters. The following mitigation strategies are advised to specifically address the flood hazards within the Town of Montello.

- *Update Floodplain Map:* Updated floodplain mapping in the City of Montello should be extended to include this area in the Town of Montello as well. This mapping would reveal areas most threatened by future flooding, focus future development out of floodplains, and help focus a potential program for the voluntary acquisition of properties for conversion to green space to minimize flooding impacts. The most recent large flood in June 2008 resulted in areas flooding that were not mapped.
- *Advance an Initiative of Voluntary Acquisition of Structures and Relocation of People:* Homes along E. Water Street have experienced flooding on several occasions during the past several years. The voluntary acquisition and relocation of these homes to areas less susceptible to flooding may be more cost effective than continued efforts to protect, clean-up, and repair.

Village of Endeavor

The Village has planned for potential residential development along CTH T and Lakeview Avenue (see Risk Assessment map in Chapter 3), which may be impacted by future flooding. Specific mitigation strategies advised to specifically address the flood hazards within Endeavor are as follows:

- *Enhance Stormwater Management and Erosion Control:* New development should incorporate modern stormwater and erosion control measures
- *Improve Planning and Regulatory Practices:* New development should occur outside of the floodplain to minimize future flood damage

Village of Neshkoro

Neshkoro has experienced flooding outside of the 100 year floodplain, and is not currently enrolled in the National Flood Insurance Program. In addition, it is possible that future development could increase flooding concerns if not properly planned. Homes within the village experience regular flooding. Specific mitigation strategies advised to specifically address the flood hazards within the Village of Neshkoro are as follows:

- *Increase Access to Flood Insurance:* The Village is not currently enrolled in the National Flood Insurance Program (NFIP). This means that local property owners may not be eligible for federal assistance in the event of a damaging flood. The Village should take the necessary steps to enroll in NFIP; Marquette County Emergency Management can assist in these efforts.
- *Enhance Stormwater Management and Erosion Control:* Homes along W. Park St. and W. Pearl Street experience regular flooding, although they are not in the floodplain. Approaches such as the creation of a stormwater detention basin in the area, a better conveyance route to the Mill Pond, and/or another responsible approach should be pursued to reduce the flooding risk in this area.
- *Update Floodplain Map:* In light of the situations that have advised the first two strategies above, the Village may wish to participate in the updating of the official floodplain map, as described more fully earlier in this section.
- *Improve Planning and Regulatory Practices:* According to the Village's comprehensive plan, future residential development is anticipated in areas near the White River. New development should occur outside of the floodplain to minimize future flood damage, and proper stormwater management and erosion control approaches should be exercised. This may require zoning and subdivision ordinance amendments.

Village of Oxford

The Village has experienced flooding outside of the 100 year floodplain, northeast of Oxford Lake. There appears to be some new residential development planned over these areas that have experienced some flooding. Additionally, critical facilities, such as the Police Station and new Fire Station in particular, are located towards the west edge of the Village and be isolated from the remainder of the Village and surrounding area in the event of a flood or other incident affecting the Highway 82 bridge over the Neenah Creek. Specific mitigation strategies advised to specifically address the flood hazards within the Village of Oxford are as follows:

- *Protect Critical Infrastructure:* The Village and Fire District should take steps in the planning for the new fire station to ensure access to the east side of the Village in the event the Highway 82 bridge over Neenah Creek becomes flooded or otherwise not available.
- *Improve Planning and Regulatory Practices:* All new development should be placed outside of the mapped 100 year floodplains or those areas susceptible to flooding, and proper stormwater management strategies should be incorporated when land does develop. The Village should revisit its comprehensive plan to reconsider allowing or encouraging additional development in flood prone areas northeast of Oxford Lake (see Risk Assessment map in Chapter 3 for area in question).
- *Update Floodplain Map:* The Village may wish to participate in the updating of the official floodplain map, as described more fully earlier in this section.

Packwaukee Village and Nearby Areas

In the Packwaukee area, attention should be directed towards maintaining adequate transportation access in the event of a flood or other major event. The County Highway D causeway and Freedom Road, which is the only access under a rail bridge to a southern residential area, appear to create particular vulnerabilities for neighboring populations situated along Buffalo Lake. Specific mitigation strategies advised to specifically address the flood hazards within the Packwaukee area are as follows:

- *Enhance Stormwater Management and Erosion Control:* A culvert under CTH C north of Packwaukee has been identified as inadequate during heavy rain events. (This culvert is beyond the area covered by the Risk Assessment map in Chapter 3.) The culvert over this waterway should be upgraded to a larger size, the road should be raised in this area, or other appropriate measures should be explored.
- *Protect Critical Facilities and Infrastructure:* Freedom Road, on the southeast side of Buffalo Lake, is the only access to a large residential area in this vicinity. It runs beneath a railroad trestle to access this area, and becomes a one-lane road in the area of the crossing. Measures should be explored to widen this bottleneck or create an alternate route around this potential hazard, in the event of flooding or other natural or human-induced hazard. Local officials also indicate that the causeway across Buffalo Lake (County Highway D) has been eroding at high rates in recent years. This is the only north-south connection across Buffalo Lake in the area. An engineering analysis should be conducted to explore the problems and solutions related to the causeway. Measures should be taken to make improvements as directed by the analysis.
- *Protect Water Quality:* Local residents documented a large buffalo farm south of Packwaukee. Marquette County Soil and Water Conservation District and NRCS should work with this farm to develop or update a nutrient management plan to ensure that manure is properly handled.

Other Possible Flood Mitigation Strategies

The following additional strategies may be considered for future implementation, but were not awarded either First or Second Priority.

- Improve Coordination and Communication Among Emergency Responders
- Develop Emergency Water and Power Sources
- Monitor Vulnerable Populations
- Construct Structural Flood Control Projects

PRIORITY DAM FAILURE MITIGATION STRATEGIES

Marquette County is home to approximately 50 dams with the purpose of recreation, protection of life and property, and hydropower. Many dams in Wisconsin were originally constructed in the late 1800s and early 1900s. With weathering, increasing hydrologic pressure, and neglect, dams are increasingly subject to failure. For example, during the flooding of 1993, the Briggsville Dam failed and washed out.

The WDNR maintains a database of dams throughout the state and has documented 14 dams in Marquette County as having the potential to cause loss of property or life in the event of a dam failure. Of these 14 dams, six have been given a “high” hazard risk rating, which signifies that a failure would likely result in the loss of life.

Strategy 1: Pursue Regular Community Outreach and Education

Permanent and seasonal residents should be informed or made aware of the potential loss that a dam failure may pose to life and property. Dam failures, though rare, cause swift and significant damage to downstream property. The WDNR has identified 14 out of the 51 dams in Marquette County as “large” and posing a potential hazard to life and property. Special attention should be given to residents within the immediate downstream area of these dams.

Marquette County Emergency Management should work with WDNR to develop dam hazard information specific to each local community. Hazard information should include the location of the dam, contact information for the owner/operator, impact area, saferoom or shelter locations, and other necessary information. If an Emergency Action Plan has been created for a dam, the local community should be provided with the dam break map that documents areas most threatened by a dam failure so appropriate land use planning decisions can be enacted.

Priority: First Priority

Location: Landowners downstream from the 14 large or potentially hazardous dams in the County

Responsible Parties: MCEM, Farm Bureau, MCSWCD, UWEX, county and local governments

Potential Partners: WEM, local media.

Funding Source: Marquette County Emergency Management, dam operators, with potential assistance from public grant funds or other resources

Strategy 2: Develop and Maintain Dam Emergency Action Plans

The WDNR defines an Emergency Action Plan as a formal document that identifies potential emergency conditions at a dam and prescribes procedures to be followed to eliminate the loss of life and minimize property damage.

Emergency Action Plans are site specific but generally address an unexpected condition that endangers the structural integrity of the dam that might result in downstream flooding. The Emergency Action Plan is required by state law for dams that are defined as “large” and pose a threat to life and property (see Figure 3.11 for a list of dams.)

The Emergency Action Plan coordinates the necessary actions by the dam owner and the responsible local, state, and federal emergency organizations in the event of an emergency at the dam. The Plan assists dam owners and operators in the identification of appropriate design, construction, operation, and maintenance measures to minimize the consequences of a dam failure to life and property.

Of the 14 dams in the County that require an Emergency Action Plan, as defined by WDNR, only five have completed a plan (see Figure 3.11). For the five dams that have completed an Emergency Action Plan, dam owners and operators should work to ensure that their plans remain compliant, current, and comprehensive of local conditions. For the other nine dams, dam owners and operators should coordinate with the WDNR to establish a timeline to complete the Emergency Action Plan to ensure downstream life and property are protected.

Priority: First Priority

Location: Dams without an Emergency Action Plan: Grand River Dam, Lake of the Woods Campground Dam, Lake Emery/Ox Creek Dam, Neshkoro Dam, Westfield Dam, Mecan River Dam, Fox River Dam (Montello), Duffy Marsh Dam

Dams with an Emergency Action Plan: Mason Lake Dam, Montello Dam, Harrisville Dam, Lawrence Lake Dam, Oxford Dam

Responsible Parties: MCEM, Dam operators, Property Owners, WDNR

Potential Partners: WEM

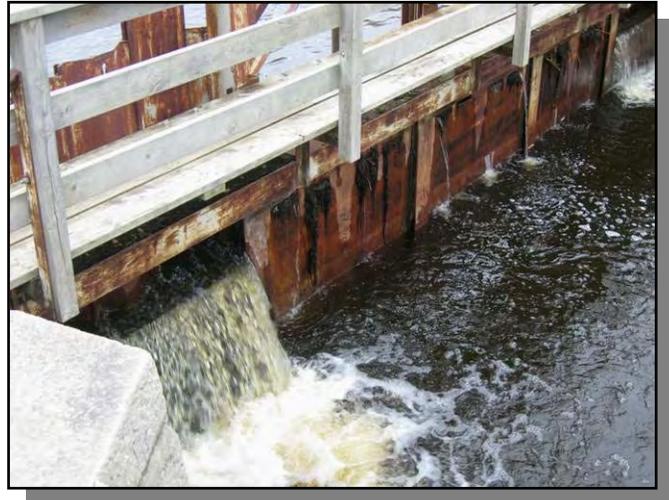
Funding Source: Dam operators, WDNR, Marquette County Emergency Management, possibly public and private utilities, local jurisdictions

Strategy 3: Implement an Effective Program of Dam Maintenance and Monitoring

Most dams in Wisconsin were erected in the late 1800s and early part of the 20th century. Dam maintenance is critical in maintaining the safe and proper functioning of the infrastructure. Special attention should be given to the 14 large and potentially hazardous dams in the County. Dam failures are categorized as either rainy or sunny day failures. Dam failures occur because of large flooding events but are also subject to failure because of poor maintenance, damage/obstruction of outlet systems, or vandalism.

In June of 2008, the Lake Mason Dam in Briggsville had to be opened to 86% to release pressure that had built up from a series of large rain events. Concerns exist in regards to the safety of the dam house. Security at the dam house should be upgraded to protect downstream property.

An additional result of the 2008 flooding was the re-routing of thousands of cars and trucks off of Highway 22 onto a small service round on top of the Buffalo Lake embankment. Questions now exist in regards to the integrity of this critical embankment.



Flood control structures should be monitored continuously during flood events, after flood events, and annually by a trained operator. Tree or shrub pruning can reduce the potential for trees or other debris from falling into area streams or lakes and causing damage to the infrastructure or blocking the outlet. MCEM and the Marquette County Highway Department could work with local utilities to educate property owners on the benefits of proper tree management to only protect dam infrastructure but to eliminate damage to other public infrastructure such as power lines.

Priority: First Priority

Location: All 14 large/potential hazardous dams in Marquette County, particularly the Lake Mason Dam and the Buffalo Lake Dam

Responsible Parties: MCEM, Property Owners, WDNR, Marquette County Highway Department

Potential Partners: WEM

Funding Source: FEMA Mitigation Grant Program, WDNR, dam operators, public and private utilities, local jurisdictions

Strategy 4: Improve Planning and Regulatory Practices

Modern erosion control; stormwater management; and preservation of open space, wetlands, and other natural areas are all methods to minimize increased runoff into area streams and lakes, which in turn reduces water levels during storms and stress on dams. Therefore, effective zoning, planning, subdivision controls, and environmental regulations should be deployed to properly minimize impacts to area dam infrastructure, as well as flooding in general.

Priority: Second Priority

Location: City of Montello, Villages of Westfield, Endeavor, Oxford, and Neshkoro, and the Towns of Springfield, Newton, Crystal Lake, Neshkoro, Westfield, Harris, Shields, Mecan, Montello, Packwaukee, Oxford, Douglas, Moundville, Buffalo

Responsible Parties: County and local government zoning departments

Potential Partners: MCEM

Funding Source: Marquette County Zoning Department budget, Marquette County Land Conservation budget

PRIORITY SEVERE STORMS MITIGATION STRATEGIES

Marquette County is vulnerable to thunderstorms, severe wind (including tornadoes), and winter storms. Although the frequency, severity, and other characteristics of these different storms vary, the mitigation strategies associated with them are similar enough that they are grouped under this overall “Severe Storms” category.

Strategy 1: Pursue Regular Community Outreach and Education

Strategy 1 under the “Priority All Hazards Mitigation Strategies” section above provides an overview of the Community Outreach and Education strategy.

As it relates to storms specifically, continual outreach with the community is critical to ensure that residents, businesses, and property owners are sufficiently prepared to protect themselves and their property from damages due to storm events. Specifically, severe storm preparedness should focus on:

- *Vulnerable properties:* Mobile homes, campgrounds, certain industrial buildings (e.g. pole sheds), and camping trailers are most vulnerable to damage from severe storms. Additionally, certain elements of a building are most vulnerable to storm damage, including windows, doors, garage doors, and roofs, and consequently the County can educate property owners on structural retrofitting techniques.
- *Vulnerable populations:* The following populations are most vulnerable to injury or death due to severe storms: people in automobiles; people that occupy vulnerable properties including mobile homes, campgrounds, seasonal residents, industrial buildings, and camping trailers; the elderly, the very young; the physically or mentally impaired; people who may not understand a severe storm warning due to language barriers; and livestock. In order to best reach these groups, educational efforts can be directed to places such as campgrounds and driver’s education courses.
- *Vulnerable times of year:* Educational efforts should be most concentrated at the beginning of the severe storm and winter storm seasons each year, and during the summer tourist season. Wisconsin has established a Lightning Safety Awareness Week in June and a Winter Weather Awareness Week in November.



Marquette County Emergency Management, the Health Department, and Highway Department could team with local utilities and insurance agencies to provide household, tourist, and traveling preparedness information annually or with new accounts. Additionally, MCEM could communicate with the County Highway Department and local public works departments to ensure these departments are apprised of severe weather developments that may require response.

Efforts should be particularly focused on educating seasonal residents and visitors to the risks associated with severe storms. Often, these populations are not as familiar with their surroundings or common safety measures. Through the assistance of the MCEM, campground owners could prepare and distribute procedural information in case of a storm. Modern communication systems, storm shelters, and safe and redundant access routes to campgrounds and other places of assembly, such as the fairgrounds, are also critical.

Priority: First Priority

Location: City of Montello, Villages of Westfield, Endeavor, Oxford, and Neshkoro, and the Towns of Springfield, Newton, Crystal Lake, Neshkoro, Westfield, Harris, Shields, Mecan, Montello, Packwaukee, Oxford, Douglas, Moundville, Buffalo

Responsible Parties: MCEM, County and local governments, County health department, County highway department, Red Cross, Mobile home park and campground owners

Potential Partners: Utilities, WEM, local media, local organizations, WDOT, insurance agencies

Funding Source: Marquette County Emergency Management budget, Red Cross, Tourism funding sources (room tax), with potential assistance from public grant funds or other resources

Strategy 2: Promote and Implement Modern Hazard Warning Systems

Refer to Strategy 3 in the “Priority All Hazards Mitigation Strategies” section above. As it relates to severe storms, specifically, a vulnerable population that should be particularly targeted are people in campgrounds and people at the County Fair in Westfield. One strategy for reaching campers would be for campground managers to maintain a list of campers’ cell phone numbers, updated on a daily basis, so that they could be sent messages through MCEM (if MCEM sets up an automated phone alert system) to warn of the onset of a severe storm.

Priority: First Priority

Location: Focus on campgrounds and fairgrounds in the City of Montello, Villages of Westfield, Endeavor, Oxford, and Neshkoro, and the Towns of Springfield, Newton, Crystal Lake, Neshkoro, Westfield, Harris, Shields, Mecan, Montello, Packwaukee, Oxford, Douglas, Moundville, Buffalo

Responsible Parties: MCEM, local governments, Campground owners

Potential Partners: WEM

Funding Source: Marquette County Emergency Management, with potential assistance from public grant funds or other resources

Strategy 3: Advance the Construction of Shelters and Saferooms

Marquette County Emergency Management should continue its work with property owners to ensure that people in the County are aware of the safest place to congregate in severe storm events. MCEM should continue to offer assistance in identifying safe areas in structures. The availability of this service could be advertised or noticed at the start of the severe wind/tornado season through local newspapers, radio stations, and a future MCEM website, and throughout the summer months to target tourists.

MCEM should also coordinate with campground owners and managers of concentrated seasonal homes to identify opportunities for shelters in the case of a severe storm. The Risk Assessment maps in Chapter 3—as well as land use maps prepared as part of Marquette County’s Comprehensive Plan—could be utilized to determine opportunities for regional shelters that can serve multiple campgrounds or concentrations of homes.

MCEM could also work with communities to develop a survey procedure and guidance document to inventory structural and non-structural hazards in and near designated shelter sites. Survey results can be used to determine mitigation priorities that can be incorporated into local and county capital improvement plans.

Overall, this strategy should be targeted to places where people are most at risk as well as where large numbers of people congregate, including:

- Mobile home parks
- Campgrounds
- Park and recreation areas
- County Fairgrounds
- Major employers
- Multi-family housing
- Schools
- Health care centers
- Other places of assembly
- Industrial buildings
- Prefabricated slab-on-grade construction buildings

Additionally, the County and local subdivision and zoning ordinances should be amended to require that developers of new or expanding mobile home, industrial parks, and campgrounds or recreational areas provide saferooms or shelters.

Priority: First Priority

Location: City of Montello, Villages of Westfield, Endeavor, Oxford, and Neshkoro, and the Towns of Springfield, Newton, Crystal Lake, Neshkoro, Westfield, Harris, Shields, Mecan, Montello, Packwaukee, Oxford, Douglas, Moundville, Buffalo

Responsible Parties: MCEM, Red Cross, owners/managers of at-risk properties identified above

Potential Partners: local governments, county zoning department

Funding Source: FEMA Mitigation Grant Program, Marquette County Emergency Management, campground other private facility operators, with potential assistance from public grant funds or other resources

Strategy 4: Develop Reliable and Multiple Evacuation Routes from Key Places of Assembly

The efficient and appropriate evacuation of people during a storm is crucial in maximizing safety. Schools, large employers, campgrounds, the County fairground, and other concentrated populations are documented on the Risk Assessment maps in Chapter 3. The County Highway Department, sheriff, police, fire, and utilities should coordinate with the MCEM to determine appropriate safe routes, ideally through an initiative of the recommended emergency management team. The identification of routes should occur in coordination with the construction of saferooms and shelters.

Focus should be placed on populated concentrations that lack appropriate shelter in severe storms such as campgrounds, mobile home parks, or fairgrounds. Managers of these properties, through the assistance of the MCEM and County Highway and Sheriff's Department, should identify the most appropriate evacuation routes and distribute these to all campers, residents, and attendees.

Priority: First Priority

Location: City of Montello, Villages of Westfield, Endeavor, Oxford, and Neshkoro, and the Towns of Springfield, Newton, Crystal Lake, Neshkoro, Westfield, Harris, Shields, Mecan, Montello, Packwaukee, Oxford, Douglas, Moundville, Buffalo

Responsible Parties: County Highway and Sheriff's Departments, MCEM, local government, facility owners/managers

Potential Partners: WDOT, utilities, fire departments, police departments

Funding Source: Marquette County Highway Department budget, WDOT, with potential assistance from public grant funds or other resources

Strategy 5: Promote Active Tree Management

Tree pruning can reduce the potential for trees falling on and breaking power lines or damaging buildings. MCEM and the Marquette County Highway Department could work with local utilities to educate property owners on the benefits of proper tree management. The Highway Department could develop a community outreach method to provide subject property owners with educational materials regarding the benefits of tree management, and provide a contact that can help with questions and concerns well before trimming activities take place. Annually, local utilities could distribute educational information regarding the benefits of tree management with customer bills, or when establishing a new account.



Priority: Second Priority

Location: City of Montello, Villages of Westfield, Endeavor, Oxford, and Neshkoro, and the Towns of Springfield, Newton, Crystal Lake, Neshkoro, Westfield, Harris, Shields, Mecan, Montello, Packwaukee, Oxford, Douglas, Moundville, Buffalo

Responsible Parties: County Highway Department, utilities, property owners

Potential Partners: MCEM, river/creek volunteer organizations

Funding Source: Marquette County Emergency Management or Highway Department budget, private utility companies, with potential assistance from public grant funds or other resources

Strategy 6: Protect Critical Facilities and Infrastructure

This strategy, as it relates to storms, focuses on protecting critical facilities (e.g. police and fire stations, emergency operations centers, and hospitals) and major roadways and utility lines from storm damage to ensure that emergency responders are able to respond quickly during hazard events. This can be accomplished in the following ways:

- *Active Tree Management:* Owners and operators of critical facilities should ensure that trees on or near critical facilities are well managed, therefore not posing a significant risk of damage during a major windstorm. Additionally, MCEM should work with local utilities to ensure active tree management along above-ground utility transmission and distribution lines.
- *Undergrounding Utilities:* When serving new development in the County, utilities in Marquette County should be required to underground new electric and communications infrastructure. Additionally, opportunities to underground existing infrastructure should be explored as infrastructure improvements are made.
- *Structural Retrofitting:* Existing critical facilities that exhibit vulnerability to severe storms should undergo structural retrofitting, such as bracing roofs, doors, and windows.
- *Maintenance of Winter Storm Equipment:* Communities should prepare for severe winter weather by ensuring that plowing and sanding equipment is operational and prepared to handle potential emergencies.
- *Snow Fences:* Using snow fences or "living snow fences" (rows of trees or other vegetation) can limit blowing and drifting snow over critical segments of roads. Living snow fences are longer lasting than standard snow fences and are permanent so they do not require the time of municipal staff to seasonally install and dismantle them. MCEM should work with the County Highway Department to prioritize areas for snow fences. The Highway Department and Wisconsin Department of Transportation could develop a community outreach method to provide adjacent property owners with educational materials regarding the property specific and community benefits of snow fences, provide a contact that can help with questions and concerns, and clarify that such fences

are a component of the rights-of-way privileges for maintenance of County roads to help garner support and/or acceptance for installation of snow fences.

Priority: Second Priority

Location: City of Montello, Villages of Westfield, Endeavor, Oxford, and Neshkoro, and the Towns of Springfield, Newton, Crystal Lake, Neshkoro, Westfield, Harris, Shields, Mekan, Montello, Packwaukee, Oxford, Douglas, Moundville, Buffalo

Responsible Parties: MCEM, local government,

Potential Partners: WDOT, schools County Highway Department, utilities, fire departments, police departments, Sheriff's Department

Funding Source: FEMA Mitigation Grant Program, Marquette County Emergency Management or Highway Department budget, WDOT, private utility companies, with potential assistance from public grant funds or other resources

Strategy 7: Improve Coordination and Communication Among Emergency Responders

Refer to Strategy 2 in the “Priority All Hazards Mitigation Strategies” section.

Priority: Second Priority

Location: City of Montello, Villages of Westfield, Endeavor, Oxford, and Neshkoro, and the Towns of Springfield, Newton, Crystal Lake, Neshkoro, Westfield, Harris, Shields, Mekan, Montello, Packwaukee, Oxford, Douglas, Moundville, Buffalo

Responsible Parties: MCEM

Potential Partners: Fire, Police, and Sheriff's departments, local governments, Red Cross, EMS

Funding Source: Marquette County Emergency Management budget, with potential assistance from public grant funds or other resources

Strategy 8: Recruit Additional Storm Spotters and Train Them

In rural areas, local storm spotters are critical in identifying severe storms and providing the proper warning to area residents. Marquette County Emergency Management coordinates with the National Weather Service to hold one training session each year during the first week of March in Montello.

MCEM and the National Weather Service should consider holding two meetings during the same week, or consecutive weeks, to accommodate different residents' schedules. Additionally, the MCEM should work with local media outlets to better advertise the training sessions offered.

Priority: Second Priority

Location: City of Montello, Villages of Westfield, Endeavor, Oxford, and Neshkoro, and the Towns of Springfield, Newton, Crystal Lake, Neshkoro, Westfield, Harris, Shields, Mekan, Montello, Packwaukee, Oxford, Douglas, Moundville, Buffalo

Responsible Parties: MCEM, National Weather Service

Potential Partners: WEM

Funding Source: Marquette County Emergency Management, National Weather Service, with potential assistance from public grant funds or other resources

Other Possible Severe Storm Mitigation Strategies

The following additional strategies may be considered for future implementation, but were not awarded either Priority 1 or Priority 2 status:

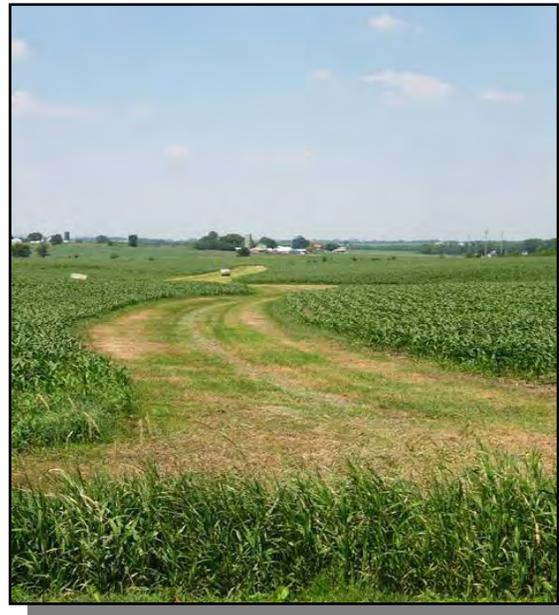
- Conduct Structural Retrofitting of Non-Critical Facilities
- Monitor Vulnerable Populations
- Increase Use of Crop Insurance
- Develop Emergency Water and Power Sources
- Advance an Initiative of Voluntary Acquisition of Structures and Relocation of People

PRIORITY DROUGHT MITIGATION STRATEGIES

Strategy 1: Pursue Regular Community Outreach and Education

Drought is a long-term condition and therefore is best mitigated through improved water use and conservation practices that take time to understand and implement. Consequently, a priority drought mitigation strategy is community outreach and education to property owners, particularly agricultural land owners, to encourage implementation of the following strategies:

- *Agriculture and Irrigation Best Management Practices:* Area organizations that support agriculture should coordinate to provide educational materials and programs to farmers on Best Management Practices for agriculture and irrigation including erosion control techniques, use of drought-resistant crops, and irrigation practices to ensure that irrigation systems are used most efficiently and soil retains water most efficiently. These agencies include the Marquette County Soil and Water Conservation District, Natural Resources Conservation Service, University of Wisconsin-Extension, Marquette County Farm Bureau, and the USDA Farm Service Agency.
- *Yard Irrigation Best Management Practices:* Area organizations that educate property owners on lawn and garden maintenance, such as University of Wisconsin Extension, should focus educational materials on Best Management Practices for yard irrigation. These practices include using native plants, capturing rainwater through cisterns or rain barrels, promoting stormwater infiltration through rain gardens, mowing at proper frequency, and watering in the evening.
- *Water Saving, Storage and Use Restrictions:* When the County experiences a drought, techniques to conserve water should be employed, including prohibiting use of water for certain non-essential activities such as washing vehicles, prescribing certain days of the week that lawns can be watered, etc.
- *Drought-Proofing Wells:* MCEM can educate residents of unincorporated areas of the County that rely on well water about drought-proofing wells. Drought-proofing entails either improving the pumping system within the well or digging a deeper well.
- *Emergency Assistance Programs:* Agricultural droughts typically trigger the availability of several USDA emergency assistance programs; MCEM should work with the organizations responsible for these programs to ensure that information is clear and readily available to farmers. These programs include Farmers Home Administration



loans, Agricultural Stabilization and Conservation Service disaster assistance payments, Natural Resource Conservation Service technical assistance, and Federal Crop Insurance Corporation loss claims.

Priority: First Priority

Location: City of Montello, Villages of Westfield, Endeavor, Oxford, and Neshkoro, and the Towns of Springfield, Newton, Crystal Lake, Neshkoro, Westfield, Harris, Shields, Mecan, Montello, Packwaukee, Oxford, Douglas, Moundville, Buffalo

Responsible Parties: MCEM, Farm Bureau, MCSWCD, UWEX, county and local governments

Potential Partners: local media

Funding Source: Marquette County Emergency Management and Land Conservation budgets, Farm Bureau, with potential assistance from public grant funds or other resources, CRP and related programs

Strategy 2: Promote Use of Best Management Practices for Yards and Agriculture

In addition to educating farmers and property owners on Best Management Practices for yards and agriculture (BMPs are described in Priority Strategy 1 above), the County and local governments can help to ensure the use of these practices by:

- *Passing Water Conservation Ordinances:* Such an ordinance can reduce water consumption, thereby using community water systems more efficiently, through provisions such as limiting lawn watering to early morning and evenings and on alternate days of the week and requiring that hoses for washing vehicles have automatic shut-off nozzles.
- *Using BMPs on Publicly-owned Land:* County and local governments can set an example by using BMPs for lawns (drought resistant plants, rain gardens, etc.) on publicly-owned lands.
- *Providing Incentives for Use of BMPs on Privately-owned Land:* Incentives can be provided to encourage more efficient water use. For example, water utilities can provide a rebate on the purchase of rain barrels and high efficiency washing machines and the Marquette County Soil and Water Conservation district provides incentives to farmers who plant grass strips along water bodies to reduce erosion.

Priority: Second Priority

Location: City of Montello, Villages of Westfield, Endeavor, Oxford, and Neshkoro, and the Towns of Springfield, Newton, Crystal Lake, Neshkoro, Westfield, Harris, Shields, Mecan, Montello, Packwaukee, Oxford, Douglas, Moundville, Buffalo

Responsible Parties: MCEM, County and local governments,

Potential Partners: Farm Bureau, MCSWCD, NRCS, UWEX

Funding Source: Marquette County Emergency Management or Land Conservation budgets, with potential assistance from public grant funds or other resources, CRP and related programs

Strategy 3: Improve Planning and Regulatory Practices

Marquette County should work with local agricultural-related agencies to develop a drought contingency plan to provide detailed steps to be taken during a drought to preserve local water resources. As part of this effort, areas in the County that are identified as having potentially problematic groundwater levels should be monitored for decreasing levels.

Additionally, comprehensive/land use plans for the County should continue to call for the preservation of wetland areas and stormwater management ordinances should be updated to promote maximum erosion control (stormwater management ordinances are described in more detail in Strategy 5 in the “Priority Flood Mitigation Strategies—County-wide” Section above).

Priority: Second Priority

Location: City of Montello, Villages of Westfield, Endeavor, Oxford, and Neshkoro, and the Towns of Springfield, Newton, Crystal Lake, Neshkoro, Westfield, Harris, Shields, Mecan, Montello, Packwaukee, Oxford, Douglas, Moundville, Buffalo

Responsible Parties: MCEM, County and local governments

Potential Partners: UWEX

Funding Source: Marquette County Zoning Department budget, with potential assistance from public grant funds or other resources, potential “Smart Growth” planning funds

Other Possible Drought Mitigation Strategies

The following additional strategies may be considered for future implementation, but were not awarded either Priority 1 or Priority 2 status:

- Increase Use of Crop Insurance
- Promote and Implement Modern Hazard Warning Systems
- Improve Hazard Threat Recognition
- Develop Emergency Water Sources

PRIORITY EXTREME TEMPERATURES MITIGATION STRATEGIES

Strategy 1: Pursue Regular Community Outreach and Education

Exposure to extreme temperatures poses a considerable risk of illness, injury, and even death, particularly for vulnerable populations. Armed with good information about the risks of exposure to severe temperatures and ways to avoid exposure, this risk can be avoided. Consequently, education and outreach is a key strategy for mitigating extreme temperature disasters.

As described in the Risk Assessment chapter of this Plan, the following are populations most vulnerable to illness or injury from extreme temperatures and should be targeted in educational programs and materials:

- Elderly persons
- Low-income persons (at risk of not being able to afford sufficient heating or cooling)
- Young children
- Sick persons
- Overweight persons
- Persons with alcohol problems
- Men (due to higher rate of sweating and increased dehydration)
- People in urban areas (higher urban temperatures due to urban heat island effect)

Educational materials should provide information about:

- *Avoiding and Recognizing Illness/Injury from Extreme Temperatures:* These materials should focus on steps to avoid overexposure to extreme heat or cold as well as warning signs for recognizing the onset of heat stroke, hypothermia, and other temperature-related illnesses.
- *Cooling Centers:* Locations and hours of centers, transportation to/from centers, and rules (e.g. parents/guardians must accompany children, alcohol is not allowed, etc.)

Priority: First Priority

Location: City of Montello, Villages of Westfield, Endeavor, Oxford, and Neshkoro, and the Towns of Springfield, Newton, Crystal Lake, Neshkoro, Westfield, Harris, Shields, Mecan, Montello, Packwaukee, Oxford, Douglas, Moundville, Buffalo

Responsible Parties: MCEM, County and local governments, Red Cross

Potential Partners: Utilities, WEM

Funding Source: Marquette County Emergency Management, with potential assistance from public grant funds or other resources, Red Cross, AARP

Strategy 2: Promote and Improve Use of Cooling Centers

Currently, the County has agreements with the school districts to use the schools as cooling centers during periods of extreme temperatures. While the number of these centers is adequate, the use of them could be improved. Improved education and outreach about the availability and rules associated with these centers would improve their efficacy. Additionally, focusing outreach on vulnerable populations will improve the use of these facilities.

Priority: Second Priority

Location: City of Montello, Villages of Westfield, Endeavor, Oxford, and Neshkoro, and the Towns of Springfield, Newton, Crystal Lake, Neshkoro, Westfield, Harris, Shields, Mecan, Montello, Packwaukee, Oxford, Douglas, Moundville, Buffalo

Responsible Parties: MCEM, County and local governments, Red Cross

Potential Partners: Utilities, WEM

Funding Source: Marquette County Emergency Management, with potential assistance from public grant funds or other resources, Red Cross

Other Possible Extreme Temperature Mitigation Strategies

The following additional strategies may be considered for future implementation, but were not awarded either Priority 1 or Priority 2 status:

- Monitor Locations of Vulnerable Populations and Improve Access to Adequate Heating/Cooling
- Promote Home Weatherization
- Promote and Implement Modern Hazard Warning Systems
- Improve Coordination and Communication Among Emergency Responders
- Increase Use of Crop Insurance

PRIORITY EARTHQUAKE MITIGATION STRATEGIES

Although progress is being made in our ability to predict earthquakes, the most effective mitigation tools are community education and managing the built environment.

Strategy 1: Promote and Implement Modern Hazard Warning Systems

Refer to Strategy 3 in the “Priority All Hazards Mitigation Strategies” Section above. In particular, since earthquakes cannot always be easily detected, hazard warning systems can be used to warn people of potential aftershocks.

Strategy 2: Pursue Regular Community Outreach and Education

Because earthquakes are so infrequent in the Midwest, the population tends to neither be aware of, nor prepared for, the potential impacts. And, as described in the Risk Assessment section of this Plan, Marquette County is at low risk of experiencing significant impacts of earthquakes due to its distance from the New Madrid fault.

That said, Marquette County has felt several earthquakes originating from different parts of the region. Consequently, MCEM, the Red Cross, and their partners should include earthquake preparedness as part of a comprehensive hazard mitigation educational program. Specifically, education should focus on:

- *Having a home disaster kit and plan:* including a few days supply of food and water, a fire extinguisher, smoke alarms, a properly equipped first aid kit complete with any necessary prescription medication in sufficient quantities to last a few days to a few weeks; organizing and testing a family emergency plan which would help ensure each family member’s survival; having residents know how to turn off gas supply to building.
- *Eliminating/reducing earthquake hazards in properties:* such as free standing water heaters, stoves, and other gas or electric appliances which could move or fall during an earthquake; bookshelves or filing cabinets which are free

standing or bookshelves with objects stored above head level; water or gas pipes which are not fastened well to walls or ceiling and large panes of glass which could fracture and fly apart.

- *Steps to take in the event of an earthquake:* These steps include staying inside a building (if already inside), and ducking, covering, and holding. Find protection next to or under heavy furniture. Avoid running outside as falling building parts can fall. Avoid rooms with a lot of ceiling fixtures. Avoid large spans of windows. Avoid large rooms with open-span ceilings or roofs.

Priority: Second Priority

Location: City of Montello, Villages of Westfield, Endeavor, Oxford, and Neshkoro, and the Towns of Springfield, Newton, Crystal Lake, Neshkoro, Westfield, Harris, Shields, Mecan, Montello, Packwaukee, Oxford, Douglas, Moundville, Buffalo

Implementation Timeline: Ongoing; identify opportunities to improve within 5 years

Responsible Parties: MCEM, Red Cross

Potential Partners: schools, local governments

Funding Source: Marquette County Emergency Management budget, with potential assistance from public grant funds or other resources

Strategy 3: Protect Critical Facilities and Infrastructure

Public buildings, such as schools and community halls, are critical facilities not only because of the large, and often-vulnerable population they accommodate, but also because they are often identified as shelter sites for a community. Therefore, it is essential that these buildings are safe and can function after a seismic event. MCEM could work with communities to develop a survey procedure and guidance document to inventory structural and non-structural hazards in and near designated shelter sites. Survey results can be used to determine mitigation priorities that can be incorporated into capital improvement plans. Such surveys should take into account that existing shelter sites are often constructed of brick and mortar, which is intolerant of earth shaking movements.

Additionally, MCEM should evaluate access to communications and power utilities to each Village. This infrastructure should be “looped”; that is, utility distribution lines should enter a community from at least two points so that if damaged on one end, the community is still served from the lines entering from the other location.

Priority: Second Priority

Location: City of Montello, Villages of Westfield, Endeavor, Oxford, and Neshkoro, and the Towns of Springfield, Newton, Crystal Lake, Neshkoro, Westfield, Harris, Shields, Mecan, Montello, Packwaukee, Oxford, Douglas, Moundville, Buffalo

Implementation Timeline: initiate within 5 years

Responsible Parties: MCEM, county and local governments, utilities, fire, police, and sheriff’s department

Potential Partners: schools

Funding Source: Marquette County Emergency Management budget; city, village, and fire district budgets; with potential assistance from public grant funds or other resources

Other Possible Earthquake Mitigation Strategies

The following additional strategies may be considered for future implementation, but were not awarded either Priority 1 or Priority 2 status:

- Promote Structural Retrofitting and Property Protection of Non-Critical Facilities
- Improve Planning and Regulatory Practices
- Improve Coordination and Communication among Emergency Responders
- Improve Hazard Threat Recognition
- Monitor Vulnerable Populations
- Develop Emergency Water and Power Sources

PRIORITY WILDFIRE MITIGATION STRATEGIES

Strategy 1: Support Active Forest Management to Minimize the Potential for Catastrophic Fires

In order to promote forest preservation for timber harvesting, habitat preservation, and recreational uses, the State of Wisconsin encourages private landowners to participate in the State's Managed Forest Law (MFL) Program. Enrollment is open to all private landowners owning ten or more acres of contiguous forestland. The emphasis of the program is production and harvesting of timber in a responsible manner, but the program also provides an incentive to open lands for public uses such as hunting, fishing, cross-country skiing, hiking, and sightseeing. The program thereby is intended to promote a variety of potentially compatible forest uses. Preparing and adhering to a forest management plan is a requirement of each property enrolled in the program. In exchange, the property owner pays lower property tax and receives a tax deferment on harvested timber.

The forest Ranger Post in Marquette County is currently vacant. Promoting a greater ranger presence could increase active forest management.

SOURCES OF ASSISTANCE FOR FOREST LAND MANAGEMENT AND PLANNING

The following programs provide assistance – funding and/or technical – for forest management plans, tree planting, timber stand improvement, fencing, erosion control, and other management issues.

- Wisconsin Forest Landowner Grant Program (WFLGP), state program administered by WDNR
- Stewardship Incentives Program (SIP), federal program administered by WDNR and Farm Service Agency (FSA)
- Conservation Reserve Program (CRP), federal program administered by FSA and Natural Resource and Conservation Services (NRCS)
- Forestry Incentives Program (FIP), federal program administered by NRCS with WDNR input
- Managed Forest Law (MFL), state program administered by WDNR
- Environmental Quality Incentives Program (EQIP), federal program administered by NRCS with WDNR input

Priority: First Priority

Location: Focus on the northern half of the County which is 40% wooded, but also countywide

Responsible Parties: MCEM, Fire, Police, and Sheriff's department, private landowners, WNDR

Potential Partners: county and local governments

Funding Source: WDNR, FSA, NRCS (see the above box)

Strategy 2: Engage in Good Land Use Planning, Proper Home Siting, and Adequate Access to Homes in Fire Prone Areas

Homeowners or new home construction should ensure that emergency responders can access homes. Roads and driveways should be kept accessible to emergency vehicles and fire equipment. Driveways should be kept relatively straight and flat, bridges should be strong and wide enough to support two-way emergency vehicle traffic, and addresses should be visible from the road.

The most obvious way of managing these risks is to direct development away from forested areas. For those forested areas where residential development has already occurred or will be allowed to occur, the WDNR provides information for private homeowners and local communities on preventative measures and strategies to mitigate wildfire damage in residential areas within or adjacent to forestland.



Narrow Road Access, WDNR

The MCEM should coordinate with the WDNR to determine the appropriate building standards for new homes as well as appropriate modifications to existing homes to increase access to homes in wooded portions of the County.

Priority: First Priority

Location: Focus on the northern half of the County which is 40% wooded, but also countywide

Responsible Parties: MCEM, Fire, Police, and Sheriff's department, local governments, property owners

Potential Partners: Utilities, WDNR

Funding Source: WDNR, Marquette County Zoning Department budget

Strategy 3: Pursue Regular Community Outreach and Education

The WDNR provides information for private homeowners and local communities on preventative measures and strategies to mitigate wildfire damage in residential areas within, or adjacent to, forestland. Strategies to prevent or minimize any major wildfire damage include efforts to protect private homes through thoughtful home siting and grounds maintenance.

MCEM, county and local governments should work with insurance agencies to educate private developers and property owners on the risk of wildfires and take measures to ensure that emergency responders can safely and adequately fight fires. In 2004, Crystal Lake in northern Marquette County was the first "firewise" community in Wisconsin. The County should continue to encourage other communities to adopt "firewise" principles. This model involves appointing a board of area residents interested in fire issues, conducting a wildlife hazard assessment, removing trees to promote access along roads and driveways, and scheduling a spring cleaning day to remove flammable woody debris. Area Fire Departments and the DNR can assist with these efforts.

Information provided to residents should also focus on educating landowners about proper forest management. Municipalities should encourage private landowners to participate in the State's Managed Forest Land (MFL) Program. MCEM and UWEX should work with WDNR to provide MFL program information to property owners in fire prone areas.

Priority: Second Priority

Location: City of Montello, Villages of Westfield, Endeavor, Oxford, and Neshkoro, and the Towns of Springfield, Newton, Crystal Lake, Neshkoro, Westfield, Harris, Shields, Mecan, Montello, Packwaukee, Oxford, Douglas, Moundville, Buffalo

Responsible Parties: MCEM, MCSWCD, UWEX, WDNR, County and local governments

Potential Partners: local media

Funding Source: WDNR, Marquette County Zoning Department budget, Marquette County Emergency Management budget, local real estate interests, local media (in kind)

Strategy 4: Improve Coordination and Communication among Emergency Responders

This Strategy is discussed in further detail as Strategy 2 in the “Priority Strategies for All Hazards” section of this Plan.

To respond effectively to the changing risk of wild and forest fires, local, state, and federal fire protection agencies and organizations should continually identify changes in development trends, land uses, and vegetative cover to evaluate protection priorities. Given the rural nature of Marquette County, coordination among fire response units is imperative. Barn fires often require mutual aid response, and fires on isolated properties may require assistance from adjacent departments based on proximity. In addition to the currently held cooperative aid programs among Fire Departments, ongoing training in fire control and fire-fighting tactics are necessary for any response unit. Given that nearly all local fire personnel are volunteers, the importance of training sessions and drills is increased.

Priority: Second Priority

Location: City of Montello, Villages of Westfield, Endeavor, Oxford, and Neshkoro, and the Towns of Springfield, Newton, Crystal Lake, Neshkoro, Westfield, Harris, Shields, Mecan, Montello, Packwaukee, Oxford, Douglas, Moundville, Buffalo

Responsible Parties: MCEM, Fire, Police, and Sheriff’s department

Potential Partners: Red Cross, WDNR

Funding Source: Marquette County, with potential assistance from public grant funds or other resources

PRIORITY HUMAN-CAUSED HAZARD AND DISEASE OUTBREAK MITIGATION STRATEGIES

Based on the primary vulnerability factors identified in Marquette County for human-caused hazards and disease outbreaks, the priority mitigation strategies will be pursued.

Strategy 1: Improve Coordination and Communication among Emergency Responders

One of the County’s most critical hazard mitigation tools is an efficient communication and coordination system among emergency responders in the County as well as with agencies in the region and State. The County should continue to work with neighboring counties in the distribution of resources and response. Methods to strengthen existing relationships should continue while exploring future measures to create regional and local communication and coordination. This Strategy is discussed in further detail as Strategy 2 in the “Priorities Strategies for All Hazards” section of this Plan.

Priority: First Priority

Location: City of Montello, Villages of Westfield, Endeavor, Oxford, and Neshkoro, and the Towns of Springfield, Newton, Crystal Lake, Neshkoro, Westfield, Harris, Shields, Mecan, Montello, Packwaukee, Oxford, Douglas, Moundville, Buffalo

Implementation Timeline: ongoing efforts to improve coordination

Responsible Parties: Marquette County Emergency Management, Fire Departments, Police Departments, Sheriff’s Department, Red Cross, Local Governments, EMS

Potential Partners: WEM

Funding Source: Marquette County, with potential assistance from public grant funds or other resources

Strategy 2: Pursue Regular Community Outreach and Education

Another key hazard mitigation tool for human-caused hazards and disease outbreaks is education and outreach. This strategy is discussed in further detail as Strategy 1 in the “Priorities Strategies for All Hazards” section of this Plan. Specifically, for human-caused hazards and disease outbreaks, education and outreach can play a role in educating people on:

- Developing family emergency plans and home emergency kits
- Safety guidelines and regulations, such as for handling hazardous materials, traffic safety, and fire safety
- Signs for recognizing foreign animal disease outbreaks in livestock
- Ways to prevent vulnerability to disease outbreaks, such as by identifying and removing standing water to reduce vulnerability to West Nile Virus
- Energy conservation strategies

Priority: First Priority

Location: City of Montello, Villages of Westfield, Endeavor, Oxford, and Neshkoro, and the Towns of Springfield, Newton, Crystal Lake, Neshkoro, Westfield, Harris, Shields, Mecan, Montello, Packwaukee, Oxford, Douglas, Moundville, Buffalo

Implementation Timeline: ongoing; identify opportunities to improve within 3 years

Responsible Parties: MCEM, Red Cross, local governments

Potential Partners: WEM, utilities, local media

Funding Source: Marquette County Emergency Management budget, with potential assistance from public grant funds or other resources

Strategy 3: Promote and Implement Modern Hazard Warning Systems

The County should continue efforts to encourage residents to have a National Oceanic and Atmospheric Administration (NOAA) weather radio on hand to provide up to date warnings and directions regarding hazard events. NOAA weather radios provide information on all hazards. Additionally, the County should continue to update and expand its system of warning the public and local governments about impending hazards. This strategy is discussed in further detail as Strategy 3 in the “Priorities Strategies for All Hazards” section.

Priority: First Priority

Location: City of Montello, Villages of Westfield, Endeavor, Oxford, and Neshkoro, and the Towns of Springfield, Newton, Crystal Lake, Neshkoro, Westfield, Harris, Shields, Mecan, Montello, Packwaukee, Oxford, Douglas, Moundville, Buffalo

Responsible Parties: MCEM, local governments

Potential Partners: WEM

Funding Source: Marquette County Emergency Management budget, with potential assistance from public grant funds or other resources

Strategy 4: Identify and Address Infrastructure Hazard Vulnerability

Transportation, communications, and energy infrastructure are all critical tools for emergency response during disasters and, if not well maintained, can also increase the County’s vulnerability to loss of life and property from disasters. Additionally, stormwater catch basins have the potential to create areas of standing water that increase the County’s vulnerability to West Nile Virus.

To reduce vulnerability to hazards from infrastructure, MCEM should work with County and local government public works staff and utilities to undergo periodic evaluations of infrastructure for identify areas of hazard vulnerability so that improvements can be incorporated in County, municipal, state, and utility upgrade plans.

Priority: Second Priority

Location: City of Montello, Villages of Westfield, Endeavor, Oxford, and Neshkoro, and the Towns of Springfield, Newton, Crystal Lake, Neshkoro, Westfield, Harris, Shields, Mekan, Montello, Packwaukee, Oxford, Douglas, Moundville, Buffalo

Implementation Timeline: Initiate evaluation within 5 years; ongoing evaluation and maintenance

Responsible Parties: MCEM, county and local governments, public works staff

Potential Partners: Railroads, airports, utilities, WDOT

Funding Source: Marquette County Emergency Management budget, with potential assistance from public grant funds or other resources

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Chapter 5: Plan Adoption and Implementation

PLAN ADOPTION

This plan should be adopted by the County Board and by the governing bodies of all of the municipalities in the County. Adoption of the Marquette County Multi-Hazard Mitigation Plan accomplishes the following:

- Confirms the commitment of community leaders and citizens to mitigate the effects of disasters.
- Provides a definitive guide for community leaders and officials of the County and local jurisdictions to initiate changes that will decrease damages incurred from disasters.
- Ensures the long-term continuity of mitigation policies and programs through changes in political leadership, County and municipal staff, and community decision makers.
- Provides confirmation to Wisconsin Emergency Management and FEMA that the Plan's recommendations were assessed and approved by the governing authority of Marquette County.

Before the County, city, and villages adopt the Plan, it is first reviewed by the Wisconsin Emergency Management (WEM) to insure compliance with the Disaster Mitigation Act of 2000 and any additional state requirements. A Wisconsin State Hazard Mitigation Officer from WEM oversee the review process. Upon WEM's approval, the Plan is sent to the County for review and County Board approval. WEM then sends the plan to FEMA Region V for review and approval.

Cities and villages that do not adopt the Plan cannot apply for mitigation grant funds unless they prepare, adopt, and submit a mitigation Plan of their own. Adoption of the Plan gives the jurisdiction legal authority to implement mitigation strategies and to enact ordinances, policies, and programs with the goal of reducing disaster related losses. Unincorporated areas (townships) do not have to formally adopt the Plan.

PLAN IMPLEMENTATION

MCEM Role

Upon approval of the Plan, the County should inform all participating jurisdictions and stakeholders, and the Director of County Emergency Management should distribute copies of the Plan to these parties. Additionally, the County should make the Plan available to the public by placing it on the County's Emergency Management website, which incidentally should continue to be expanded and enhanced.

Marquette County Emergency Management should take the lead on Plan implementation, which would include making sure that the Plan is referenced by future planning efforts and is used to provide guidance on political decisions, public expenditures, and policy directives. With assistance from the Public Safety Committee, MCEM should monitor implementation progress and effects of mitigation strategies. Monitoring the Plan will help implement the recommendations put forth in the Plan.

In addition to overseeing implementation and plan monitoring, MCEM and the Hazard Mitigation Planning Committee (Public Safety Committee) should prioritize mitigation projects and spearhead fund procurement to finance mitigation projects. Such efforts could include preparation of grant proposals as well as provision of assistance to local jurisdictions in preparation of grant proposals to state, federal, and non-profit funding opportunities.

As discussed in Chapter 4, education about self-initiated mitigation strategies that can be employed to reduce potential disaster-related damages can be a cost effective method of building local support for mitigation. MCEM should undertake creative outreach programs to community members, business owners, and non-profit personnel to encourage involvement, in and understanding of, local mitigation efforts.

County and local jurisdiction staff and elected officials should insure that the recommended mitigation strategies in Chapter 4 are considered in budgets. In addition to the grant opportunities discussed in this Plan, as political will dictates, administrators and elected officials should contemplate the use of volunteer efforts, bonds, loans, fees, and taxes to finance high priority mitigation projects.

Focus on Highest Priority Items

This Plan presents mitigation strategies priorities. MCEM should keep its focus on highest priority strategies that exhibit the greatest ability to reduce hazard vulnerability. Specifically, the following are some of the key initial areas of focus:

- *Improve Modern Hazard Warning Systems:* The rural and dispersed population of Marquette County requires innovative means to warn people of impending hazards or inform residents post-hazard. One method would be to provide weather radios to county residents at no cost through a FEMA grant. Additionally email, text messaging, and other electronic means should be explored.
- *Improve Communication Among Emergency Providers through Comprehensive Emergency Response Team:* A coordinated regional approach between Marquette County and adjacent counties would improve efficiency and response. More regular meetings, or at least teleconferences, among emergency management personnel may be in order.
- *Protect Vulnerable Seasonal Populations through a Variety of Approaches:* Marquette County should work to better ensure the safety of tourists and seasonal populations through the development of shelters and saferooms at campgrounds, mobile home parks, and the county fairgrounds. The County should also work to develop reliable and multiple evacuation routes from these places of assembly through road improvements and signage.
- *Focus on Permanent Solutions for Repeated and Vulnerable Flood Hazard Areas:* The County should initiate a study to determine areas that have been repeatedly flooded in the past several years. In these areas and those within close proximity to the 100 year floodplain should explore floodproofing techniques and possible relocation to areas not threatened by flooding.

PLAN EVALUATION & MAINTENANCE

Planning is an ongoing process, and for this Multi-Hazard Mitigation Plan to remain current and applicable, periodic updates will be necessary. The Disaster Mitigation Act of 2000 requires that local mitigation plans are evaluated and updated at least every five years. To expedite this process, MCEM should begin to maintain a record of disaster related damages that will help to further hone the vulnerability and risk assessments, and should track mitigation projects to determine implementation progress and results. Additionally, vulnerability, risk, and mitigation recommendations should be reviewed following a disaster to determine if any changes are warranted based on degrees of damage and patterns of the event. The County Board must approve all additions and updates to the Plan, and all updates should include public involvement and stakeholder outreach.

Appendices

APPENDIX A: DISASTER HISTORY TABLES

The tables on the following pages provide a detailed record of the history of disasters in the County. Note that these tables only include reported events and therefore should not be considered fully exhaustive.

Table A1: Historical Occurrences of Flooding: 1998 – 2008

Date	Location	Reported Property Damage	Reported Crop Damage	Notes
6.27.1998	Westfield			Early morning thunderstorms, some of them severe, rolled east across south central and southeast Wisconsin. Straight-line downburst winds of 60 to 70 mph associated with the severe storms pushed over large trees and toppled some power lines. Heavy rains of 1.08 inches in 28 minutes ending at 0142CST resulted in urban /small stream flooding southwest of Westfield in Marquette County. The powerful winds, blinding rain, and high waters forced a rescue of 61 campers on a Wisconsin River sandbar east of Portage on the Sauk County side of the river. In West Bend (Washington Co.), about 1500 customers lost electricity due to toppled powerlines.
6.1.2000	Briggsville	6 homes damaged		Marquette Co: 6 homes were damaged and trees uprooted by powerful winds estimated at 70 knots (80 mph) in Briggsville. Urban flooding in Briggsville was also noted with water 6 inches deep.
6.22.2002	Neshkoro			At least 3 lines of thunderstorms with heavy rains sagged south into the northern parts of Marquette and Green Lake counties during the overnight hours. Individual thunderstorm cells trained west to east, ultimately resulting in flash flooding which caused gravel shoulder washouts on some roads as well as road closures.
5.23.2004	Packwaukeee	Basement damage		Flash flooding in Marquette, Sauk, western Dane, and Iron counties consisted of gravel washouts, mudslides, and basement damage.

Date	Location	Reported Property Damage	Reported Crop Damage	Notes
6.1.2004	Countywide	Basement damage. Estimated private property damage: \$1M. Public infrastructure damage: \$205,000.	28K acres of farm crop ruined for a crop loss of about \$10M	Marquette Co: Minor basement damage to 354 homes, and major basement damage to 17 homes.
7.3.2007	Harrisville	Basement damage		Slow moving thunderstorm cells trained over the same area northeast of Harrisville near and along CTH E (3 NE Harrisville or about 2.7 miles west-southwest of Budsin), resulting in a flash flood. Water depths on road surfaces reached 2 to 3 feet, and water entered basements of several homes. Damage occurred to personal property in the basements.
6.5.08	Marquette County	\$20,000,000		Between 6 and 12 inches of rain fell on the County over one week in early June. Over 100 homes were severely damaged. Road closures, road washouts, and sandbagging were common across the southern half of the county where the rainfall was most intense. One injury and no deaths were reported.
TOTAL		\$21,205,000	\$10,000,000	

Table A2: Historical Occurrences of Severe Storms: 1955 – 2007

Date	Time	Location	Wind Speed (knots)	Reported Injuries	Property Damage	Notes
5.6.1955	1900	Countywide				
8.24.1975	2350	Countywide				
8.9.1979	1655	Countywide	65 kts.			
7.20.1980	130	Countywide				
7.20.1981	1240	Countywide				
8.1.1982	2200	Countywide	52 kts.			
7.3.1983	1921	Countywide	52 kts.			
7.3.1983	1934	Countywide				
7.19.1983	1853	Countywide				
7.19.1983	1855	Countywide				
6.23.1986	1602	Countywide	52 kts.			
9.26.1986		Countywide				
5.8.1988	1655	Countywide				
6.13.1990		Countywide				
6.13.1990	1410	Countywide	56 kts.			
9.14.1991	1805	Countywide				
8.25.1992	1536	Countywide				
7.11.1994	1715	Endeavor			5K	
9.13.1994	1840	Oxford				
4.3.1995	1430	Countywide				
8.14.1995		Westfield				
8.14.1995	0125	Glen Oak				
8.28.1995	0720	Westfield				
6.29.1996	1810	Westfield			6K	Strong thunderstorm winds toppled large trees west of Westfield.
6.29.1996	1821	Brooks			5K	Powerful thunderstorm winds knocked down large trees... some up to 12 inch in diameter.
8.7.1996	1510	Briggsville	52 kts.			
4.5.1997	1815	Montello			5K	Intense thunderstorm winds toppled large trees in and near the city of Montello.
6.15.1997	1610	Oxford			1K	
6.15.1997	1615	Glenoak			1K	
6.24.1997	1502	Oxford			1K	
7.16.1997	1735	Neshkoro				
7.16.1997	1835	Westfield			1K	
9.16.1997	1905	Westfield			2K	
5.6.1995		Countywide				
8.24.1975		Countywide				
8.9.1979		Countywide	65 kts.			
7.20.1980		Countywide				
7.20.1982		Countywide				

Date	Time	Location	Wind Speed (knots)	Reported Injuries	Property Damage	Notes
8.1.1982		Countywide	52 kts.			
7.3.1983		Countywide	52 kts.			
7.3.1983		Countywide				
7.19.1983		Countywide				
7.19.1983		Countywide				
6.23.1986		Countywide	52 kts.			
9.26.1986		Countywide				
5.8.1988		Countywide				
6.13.1990		Countywide				
6.13.1990		Countywide	56 kts.			
9.14.1991		Countywide				
8.25.1992		Countywide				
7.11.1994		Endeavor			5K	
9.13.1994		Oxford				
8.14.1995		Westfield				
8.14.1995		Glen Oak				
8.28.1995		Westfield				
6.29.1996	1810	Westfield			6K	Strong thunderstorm winds toppled large trees west of Westfield.
6.29.1996	1821	Brooks			5K	Powerful thunderstorm winds knocked down large trees... some up to 12 inch in diameter.
8.7.1996	1510	Briggsville	52 kts.			
4.5.1997	1815	Montello			5K	Intense thunderstorm winds toppled large trees in and near the city of Montello.
6.15.1997	1610	Oxford			1K	
6.15.1997	1615	Glenoak			1K	
6.24.1997	1502	Oxford			1K	
7.16.1997	1735	Neshkoro				
7.16.1997	1835	Westfield			1K	
9.16.1997	1905	Westfield			2K	
5.28.1998	2005	Westfield			1K	
5.31.1998	1240	Countywide	59 kts.		150K	Marquette County: mostly tree and power line damage scattered across all parts of county. This county got off relatively easy. Measured peak wind gust of 68 mph in Briggsville. Gusts over remainder of county estimated in 60 to 70 range.
6.18.1998	1250	Oxford			2K	

Date	Time	Location	Wind Speed (knots)	Reported Injuries	Property Damage	Notes
6.27.1998	1318	Oxford	52 kts.			Early morning thunderstorms, some of them severe, rolled east across south central and southeast Wisconsin. Straight-line downburst winds of 60 to 70 mph associated with the severe storms pushed over large trees and toppled some power lines. Heavy rains of 1.08 inches in 28 minutes ending at 0142CST resulted in urban /small stream flooding southwest of Westfield in Marquette County.
6.27.1998	2130	Montello			5K	
6.28.1999	1510	Packwaukee	52 kts.		2K	The 2nd round consisted of primarily large hail and heavy rains, although a wet microburst did generate powerful winds which leveled some large trees in Packwaukee (Marquette Co.)
6.1.2000	1547	Briggsville	70 kts.		40K	Marquette Co: 6 homes were damaged and trees uprooted by powerful winds estimated at 70 knots (80 mph) in Briggsville. Urban flooding in Briggsville was also noted with water 6 inches deep.
9.1.2000	1500	Endeavor			1K	Damaging straight-line winds downed large trees near Endeavor (Marquette Co.)
9.11.2000	1915	Westfield			2K	The 3rd round of severe storms affect the counties of Marquette and Green Lake. Isolated, damaging straight-line winds and some large hail were produced by a solid line of thunderstorms which diminished in strength and broke up

Date	Time	Location	Wind Speed (knots)	Reported Injuries	Property Damage	Notes
4.23.2001	1120	Montello	50 kts.			
6.11.2001	1950	Westfield	55 kts.		15K	Marquette County: A tree fell on and damaged a home in Packwaukee. Near Westfield, ten (10) calf pens were destroyed.
6.14.2001	1350	Montello	52 kts.			
6.16.2001	1815	Montello	56 kts.			
6.16.2001	1820	Westfield	52 kts.			
9.7.2001	1825	Endeavor	52 kts.			
9.7.2001	1150	Montello	50 kts.			
4.18.2002	1937	Briggsville	52 kts.			
7.30.2002	2030	Budsin	56 kts.			
8.21.2002	1705	Briggsville	56 kts.			
9.2.2002	2000	Montello	56 kts.			
8.20.2003	1949	Endeavor	52 kts.			
5.12.2004	1653	Packwaukee	52 kts.			
5.12.2004	1720	Montello	52 kts.			
6.16.2004	1747	Endeavor	52 kts.			
6.23.2004	1855	Oxford	57 kts.			
7.16.2004	1315	Endeavor	61 kts.		1K	
6.30.2005	1320	Harrisville	56 kts.			
7.23.2005	1326	Westfield	52 kts.		1K	
7.23.2005	1330	Montello	56 kts.		3K	
7.25.2005	2118	Harrisville	56 kts.		2K	
9.7.2005	1410	Montello	52 kts.			
9.13.2005	1555	Westfield	52 kts.			
9.13.2005	1608	Montello	52 kts.			
9.13.2005	1612	Neshkoro	52 kts.			
9.13.2005	1617	Endeavor	56 kts.			
7.1.2006	1905	Glenoak	56 kts.		2K	
7.30.2006	1815	Countywide	56 kts.		5K	
7.30.2006	1906	Briggsville	52 kts.			
5.24.2007	1415	Endeavor			2K	
5.24.2007	1415	Westfield			2K	Large trees were uprooted. A pre-frontal squall line evolved into two separate north-south lines of thunderstorms that moved east to west across parts of south-central Wisconsin. Within the lines there were short bowing-segments. Afternoon instability was limited due to a large amount of clouds ahead of the thunderstorms.

Date	Time	Location	Wind Speed (knots)	Reported Injuries	Property Damage	Notes
8.11.2007	2305	Oxford			100K	Powerful thunderstorm wind gusts to around 56 knots (65 mph) toppled many trees and power-poles/power-lines in a swath from Oxford to Montello. Pre-frontal clusters of thunderstorms became severe with powerful straight-line winds as they moved east-southeast at anywhere from 35 to 45 knots (40 to 52 mph) to the east-southeast.
TOTALS					\$382,000	

Source: National Climatic Data Center: U.S. Storm Event Database

Table A3: Historical Occurrences of Hail Damage: 1963 – 2007

Date	Time	Location	Magnitude (in)	Property Damage	Crop Damage	Injured
7.21.1963		Countywide	1.0			
6.14.1974		Countywide	1.0			
7.3.1975		Countywide	1.75			
8.13.1976		Countywide	1.75			
8.29.1984		Countywide	1.75			
7.8.1989		Countywide	.75			
3.27.1991		Countywide	1.0			
4.24.1994		Lawrence	1.0			
7.24.1994		Westfield	.88			
7.16.1997	1720	Neshkoro	.75			
7.16.1997	1912	Westfield	.75			
9.1.1998	1743	Westfield	1.0			
2.11.1999	1345	Montello	.75			
6.8.1999	1650	Briggsville	.75			
6.28.1999	1520	Montello	.75			
3.8.2000	1735	Glenoak	1.0			
3.8.2000	1800	Montello	.75			
5.12.2000	0930	Westfield	3.0	1 Million		2
9.2.2000	0250	Germania	.75			
5.14.2001	0950	Westfield	.75			
4.18.2002	1553	Endeavor	.75			
4.18.2002	1254	Oxford	.75			
5.30.2002	1806	Briggsville	1.0			
6.21.2002	1615	Endeavor	.75			
5.10.2003	1923	Montello	1.0			
7.31.2003	1150	Oxford	.75			

Date	Time	Location	Magnitude (in)	Property Damage	Crop Damage	Injured
8.28.2003	1915	Briggsville	.75			
5.12.2004	1720	Montello	.75			
6.16.2004	1747	Endeavor	.75			
6.23.2004	1905	Montello	1.75	2K		
6.28.2006	1620	Endeavor	.75			
7.1.2006	1905	Glenoak	1.0			
7.17.2006	1617	Budsin	.75			
7.17.2006	1617	Westfield	.75			
7.17.2006	1635	Neshkoro	.88			
8.23.2006	2050	Montello	.75			
8.23.2006	2348	Oxford	1.75			
8.24.2006	0030	Packwaukee	1.0			
10.2.2006	1513	Westfield	1.0			
10.2.2006	1539	Westfield	.75			
10.2.2006	1542	Westfield	.88			
10.2.2006	1545	Westfield	.88			
10.2.2006	1635	Montello	.75			
4.30.2007	1805	Endeavor	.75			
7.3.2007	1710	Packwaukee	.75			
TOTALS				\$1,002,000		2

Source: National Climatic Data Center: U.S. Storm Event Database

Table A4: Historical Occurrences of Tornadoes: 1958 – 2007

Date	Time	F-Scale	Location	Length (miles)	Width (yds)	Reported Damages	Notes
7.31.1955		F2	Countywide			250K	
7.8.1959		F2	Countywide			25K	
6.20.1965		F1	Countywide			25K	
8.9.1979		F0	Countywide				
7.3.1983		F0	Countywide				
7.3.1983		F1	Countywide			25K	
5.8.1988		F1	Countywide			3K	
9.7.1992		F0	Countywide				
9.26.1992		F0	Countywide				
7.7.1994			Endeavor				
8.11.1995			Montello				
6.2.1996	1735		Montello				
6.1.2000	1600		Packwaukee				
6.23.2004	1900	F2	Packwaukee			1.5M	
8.18.2005	1708	F1	Westfield			101K	
TOTALS						\$1,929,000	

Source: National Climatic Data Center: U.S. Storm Event Database

Table A5: Historical Occurrences of Severe Winter Storms: 1993 - 2007

Date	Time (CST)	Type	Estimated Damage	Notes
1.13.1993		Heavy snow		
1.5.1994		Heavy snow		
1.16.1994		Heavy snow		
1.26.1994		Heavy snow/ice storm		
2.22.1994		Heavy snow		
2.25.1994		Heavy snow		
1.19.1995		Heavy snow		
3.6.1995		Heavy snow		
3.27.1995		Heavy snow		
4.9.1995		Heavy snow		
11.26.1995		Heavy snow		
12.8.1995		Blowing snow		
12.13.1995		Ice storm		
1.25.1996		Heavy snow		
1.26.1996		Heavy snow		
1.29.1996	1700	Blizzard		
12.23.1996	1100	Heavy snow		
2.27.1997	0200	Heavy snow		
3.12.1997	2100	Heavy snow		
3.13.1997	2100	Heavy snow		
1.4.1998	1500	Ice storm		
3.8.1998	0400	Winter storm		
4.7.2000	0600	Winter storm		
12.18.2000	1400	Heavy snow		
3.2.2002		Heavy snow		
2.3.2003		Winter weather/mix		
4.4.2003		Ice storm		
12.10.2003	1500	Heavy snow		
1.4.2004		Winter weather/mix		
1.16.2004		Winter weather/mix		
2.5.2004	0200	Heavy snow		
2.8.2004	2100	Winter weather/mix		
3.7.2004	0300	Winter weather/mix		
12.20.2004	0400	Winter weather/mix		
1.6.2005	0500	Winter storm		
1.22.2005	0200	Winter storm		
2.20.2005		Winter storm		
3.19.2005	0400	Winter storm		
11.15.2005	1800	Winter weather/mix		
2.16.2006	0900	Winter storm		
11.10.2006	1500	Winter weather		
1.12.2007	1100	Winter weather		
1.14.2007	1900	Winter weather		
1.21.2007	0400	Winter weather		
2.23.2007	1800	Winter storm		
2.24.2007	1800	Blizzard		

2.25.2007	0351	Winter storm		
3.1.2007		Winter weather		
3.2.2007	0900	Winter weather		
4.11.2007	0200	Winter storm	10K	
11.21.2007	1500	Winter weather		
TOTAL			\$10,000	
<i>Source: National Climatic Data Center: U.S. Storm Event Database</i>				

Table A6: Historical Occurrences of Extreme Temperatures: 1994 – 2007

Date	Time (CST)	Type	Reported Deaths	Reported Injuries	Notes
1.13.1994		Cold			
6.14.1994		Heat wave			
2.10.1995		Cold			
10.12.1995	1400	Record warmth			
12.9.1995		Cold			
1.30.1996	0200	Extreme windchill			
1.31.1996		Extreme cold			
2.1.1996		Extreme cold			
1.17.1997		Extreme cold			
11.23.1998		Excessive heat			
12.1.1998		Excessive heat			
1.5.1999		Extreme cold			
7.4.1999		Excessive heat			
7.29.1999	0800	Excessive heat			
11.8.1999		Record warmth			
11.13.1999	1300	Record warmth			
7.31.2001	1100	Excessive heat			
8.6.2001	1100	Excessive heat			
4.15.2002	1300	Excessive heat			
6.30.2002		Excessive heat			
7.1.2002	0600	Excessive heat			
7.8.2002	1100	Excessive heat			
7.21.2002		Excessive heat			
12.18.2005		Cold/wind chill			
2.17.2006	1800	Cold/wind chill			
2.18.2006	1800	Cold/wind chill			
2.3.2007	0900	Cold/wind chill			
<i>Source: National Climatic Data Center: U.S. Storm Event Database</i>					

APPENDIX B: MITIGATION STRATEGIES PRIORITIZATION

Armed with a thorough understanding of benefits, drawbacks, and perceptions of each strategy based on input from the Committee, local governments, and the public, the project team evaluated the benefits and drawbacks/costs of each strategy to develop a preliminary prioritization.

The following ten elements were considered when identifying the benefits and drawbacks of each strategy. Elements 3 through 10 are a part of a prioritization system developed by FEMA called STAPLEE (based on the first letter of each strategy, as highlighted below). Some communities have used a quantitative process to score each strategy for each of the STAPLEE criteria. In the case of Marquette County, it was determined that a qualitative, holistic evaluation process would produce the most meaningful prioritization.

1. Ability to achieve one or more of the Marquette County Hazard Mitigation Goals
2. Community support
3. Ability to be implemented (potential funding available)
4. **S**ocial impacts
5. **T**echnical feasibility
6. **A**ministrative requirements
7. **P**olitical support
8. **L**egality
9. **E**nvironmental impacts
10. **E**conomic impacts / costs of implementing

The following tables summarize the resulting prioritization of mitigation strategies based on benefits and costs/drawbacks. Mitigation strategies are separated into the following priorities:

- *First Priority*: Includes highest priority strategies; begin implementation in Years 1 through 3, following adoption of this Plan.
- *Second Priority*: Includes second-highest priority strategies; begin implementation in Years 1 through 5, generally after Priority One priorities are underway.
- *Other Potential Strategies*: Includes strategies that are not currently identified as priorities, but are included for future consideration as the County moves forward with implementation of this Plan.

Table B1: Flood Mitigation Strategies Prioritization Matrix

Mitigation Strategy	Benefits	Drawbacks/Costs
1 st Priority		
Increase Community Outreach and Education	<ul style="list-style-type: none"> ▪ Can be used to help achieve all mitigation goals, particularly 1) protect human lives, 6) help people protect themselves, and 7) promote partnerships in mitigation ▪ Community-supported strategy ▪ Cost and time required to implement can be minimal ▪ Opportunities to partner with several organizations 	<ul style="list-style-type: none"> ▪ Cost of materials, programs, and staff time ▪ Large seasonal and tourists populations can be hard to reach
Update Official Floodplain Maps	<ul style="list-style-type: none"> ▪ Can be used to help achieve multiple mitigation goals, particularly 5) Prevent future risks of hazards in highly vulnerable areas ▪ Better knowledge of areas vulnerable to flooding ▪ Helps communities regulate building in floodplain ▪ Makes floodplain insurance an available option for new properties in floodplain ▪ Potential to remove properties from floodplain (and associated regulations) that may be in floodplain due to old maps ▪ ACE “Silver Jackets” program a potential funding source 	<ul style="list-style-type: none"> ▪ May meet resistance from property owners who do not want to be subject to floodplain regulations ▪ Cost of updating maps ▪ Due to severity of June 2008 storms, some homes that were flooded may end up part of the revised 100 year floodplain.
Enhance Stormwater Management and Erosion Control	<ul style="list-style-type: none"> ▪ Can be used to help achieve mitigation goals, particularly 1) protect human lives and 3) protect human and environmental health ▪ Improve stream’s and storm sewer’s capacity to carry water flow when obstructions removed ▪ Reduced threat to roadway damage and incidents from soil erosion ▪ Reduce erosion and threats to water quality from runoff ▪ Potential funding sources: HMGP, NRCS ▪ Improved ag. land erosion control can be implemented through SWCD incentive program 	<ul style="list-style-type: none"> ▪ Cost of any new infrastructure needed ▪ Environmental cost, if any, of new stormwater projects ▪ Cost of maintaining existing infrastructure ▪ May be environmental regulations associated with removal of vegetation from waterways
Advance an Initiative of Voluntary Acquisition of Structures and Relocation of People	<ul style="list-style-type: none"> ▪ Can be used to help achieve multiple mitigation goals, particularly 1) protect human lives ▪ Gets residents permanently out of harm’s way ▪ Eliminates risk to emergency responders who would otherwise evacuate people ▪ Many affected properties also have poor, one-way access issues ▪ Focused in a few areas of the County ▪ Opens the door to new housing alternatives ▪ Creates an opportunity to create open space amenities in the floodplain ▪ HMGP is a potential funding source 	<ul style="list-style-type: none"> ▪ Cost of acquisitions ▪ Potential to involve implementation hurdles: overcoming public misperceptions of intent of the program; getting political and public buy-in ▪ Approach can be difficult for small communities to act on May be a challenge in identifying new housing that some residents can afford

Mitigation Strategy	Benefits	Drawbacks/Costs
Protect Critical Facilities and Infrastructure	<ul style="list-style-type: none"> ▪ Can be used to help achieve multiple mitigation goals, particularly 2) protect critical facilities ▪ Can reduce/eliminate loss of productivity and sales at businesses that lose access to the highway/populations when roadways/bridges are flooded or compromised by flooding ▪ Protect community's ability to respond to disasters by protecting critical facilities used in disasters ▪ Reduce economic impacts from damages to critical facilities 	<ul style="list-style-type: none"> ▪ Cost of floodproofing or relocating facilities / infrastructure ▪ Often involves coordination among different levels of government (e.g. WDOT) and among different local districts (e.g. fire districts)
2 nd Priority		
Improved Planning and Regulatory Practices	<ul style="list-style-type: none"> ▪ Can be used to help achieve multiple mitigation goals, particularly 5) Prevent future risks of hazards in highly vulnerable areas and ▪ Funding sources available for planning activities, particularly for open space preservation ▪ Can be used as a tool to prevent future development or activities that increase flood vulnerability 	<ul style="list-style-type: none"> ▪ Can sometimes meet resistance to planning and regulation by the public ▪ Costs to develop plans or improve regulations ▪ Time and political commitment to regulation enforcement, after new rules adopted.
Establish River Gages	<ul style="list-style-type: none"> ▪ Can be used to help achieve multiple mitigation goals, particularly 1) protect human lives 2) protect critical facilities ▪ Provides critical information for emergency responders ▪ Provides information for tracking historic floods to project future flooding vulnerability 	<ul style="list-style-type: none"> ▪ Cost of the gage ▪ Maintenance of the gage ▪ Determining responsibility for the gage
Promote Floodproofing of Buildings Where Appropriate and Cost-effective	<ul style="list-style-type: none"> ▪ Can be used to help achieve mitigation goals 1) protect human lives, 5) Prevent future risks of hazards in highly vulnerable areas 2) protect critical facilities ▪ Protects property from damage ▪ HMGP is a potential funding source if cost feasible 	<ul style="list-style-type: none"> ▪ May still requires evacuation of people during major floods, and business lost ▪ Cost of floodproofing can be high, depending on the technique (e.g. elevation)
Protect Water Quality	<ul style="list-style-type: none"> ▪ Can be used to help achieve multiple mitigation goals, particularly 3) protect human and environmental health ▪ EPA a potential funding source for brownfield cleanup 	<ul style="list-style-type: none"> ▪ Cost of relocating facilities that contain hazardous materials out of flood hazard area, or cost of floodproofing hazardous material storage areas, or cost of cleaning up contaminated sites ▪ Cost of maintaining sanitary sewer infrastructure ▪ Cost of protecting potable water infrastructure, wells
Promote and Implement Modern Hazard Warning Systems	<ul style="list-style-type: none"> ▪ Can be used to help achieve multiple mitigation goals, particularly 6) help people to protect themselves ▪ Reduces resources to be expended by emergency responders if people get out of harm's way themselves ▪ County population is spread out and becoming increasingly elderly ▪ Grant programs available for NOAA radios 	<ul style="list-style-type: none"> ▪ Cost of warning equipment, programs ▪ Staff time to educate people about use of hazard warning systems ▪ Marquette County at the end of media market – little coverage ▪ Increased cell phone and computer usage among populations

Mitigation Strategy	Benefits	Drawbacks/Costs
Increase Access to Flood Insurance	<ul style="list-style-type: none"> Reduce amount property owners have to spend personally to recover from flood damages Identify repetitive loss properties once a property has been enrolled and experiences 2+ losses within 10 years 	<ul style="list-style-type: none"> Does not directly achieve any priority mitigation goals Personal costs of insurance Staff time to educate residents about benefit of flood insurance, host open houses with insurance providers
Other Potential Strategies		
Improve Coordination and Communication Among Emergency Responders	<ul style="list-style-type: none"> Can be used to help achieve multiple mitigation goals, particularly 7) promote partnerships in mitigation Maximize use of limited resources by working together, maximizing the use of technology, and improving efficiency Potential funding sources available (but not HMGP) 	<ul style="list-style-type: none"> Cost of improving/updating communication systems Time investment to improve coordination Current over commitment/shortage of Emergency Response personnel.
Develop Emergency Water and Power Sources	<ul style="list-style-type: none"> Can be used to help achieve mitigation goal 3) protect human and environmental health 	<ul style="list-style-type: none"> Cost of providing emergency water and power Has not been a critical need to date Less of a long-term solution than protecting existing water and power infrastructure from flooding damages
Monitor Vulnerable Populations	<ul style="list-style-type: none"> Can be used to help achieve mitigation goal 3) protect human and environmental health Helps to prioritize emergency response actions 	<ul style="list-style-type: none"> Staff time to maintain and update list
Construct Structural Flood Control Projects	<ul style="list-style-type: none"> Can be used to help achieve mitigation goal 2) protect critical facilities Reduces threats to people and property from flooding 	<ul style="list-style-type: none"> Not likely to be grant funded Can exacerbate flooding in other areas Not a long-term solution Cost of maintenance, repair Environmental costs; risks to habitat

Table B2: Priority Dam Failure Mitigation Strategies

Mitigation Strategy	Benefits	Drawbacks/Costs
1st Priority		
Pursue Regular Community Outreach and Education	<ul style="list-style-type: none"> Can be used to help achieve all mitigation goals, particularly 1) protect human lives, 6) help people protect themselves, and 7) promote partnerships in mitigation Community-supported strategy Cost and time required to implement can be minimal Improves coordination among multiple agencies and units of government 	<ul style="list-style-type: none"> Cost of materials, programs, and staff time Large seasonal and tourists populations can be hard to reach
Develop or Maintain Emergency Action Plans through WDNR	<ul style="list-style-type: none"> Can be used to help achieve multiple mitigation goals, particularly 1) protect human lives, 2) protect critical facilities Informs local government on potential impact of dam failures and allows appropriate planning. Creates a protocol for regular dam 	<ul style="list-style-type: none"> Cost of developing and maintaining the plan

Mitigation Strategy	Benefits	Drawbacks/Costs
	maintenance and monitoring	
Implement an Effective Program of Dam Maintenance and Monitoring (including clearing and removal of obstructions from drainage ways and securing of dam houses)	<ul style="list-style-type: none"> ▪ Can be used to help achieve multiple mitigation goals, particularly 1) protect human lives and 2) protect critical facilities ▪ Greatly reduces risk of injury/death from dam failures ▪ Community and politically-supportable strategy 	<ul style="list-style-type: none"> ▪ Cost of any new infrastructure needed ▪ Cost of maintaining existing infrastructure ▪ May be environmental regulations associated with removal of vegetation from waterways
2nd Priority		
Improve Planning and Regulatory Practices	<ul style="list-style-type: none"> ▪ Can be used to help achieve multiple mitigation goals, particularly 5) Prevent future risks of hazards in highly vulnerable areas and ▪ Can be used as a tool to prevent future development or activities that increase dam failures 	<ul style="list-style-type: none"> ▪ Can sometimes meet resistance to planning and regulation by the public ▪ Costs to develop plans or improve regulations ▪ Time and political commitment to regulation enforcement, after new rules adopted.

Table B3: Severe Storm, Tornado, and Winter Storm Mitigation Strategies Prioritization Matrix

Mitigation Strategy	Benefits	Drawbacks/Costs
1st Priority		
Pursue Regular Community Outreach and Education	<ul style="list-style-type: none"> ▪ Can be used to help achieve all mitigation goals, particularly 1) protect human lives, 6) help people protect themselves, and 7) promote partnerships in mitigation ▪ Community-supported strategy ▪ Cost and time required to implement can be minimal ▪ Opportunities to partner with several organizations 	<ul style="list-style-type: none"> ▪ Cost of materials, programs, and staff time ▪ Large seasonal and tourists populations can be hard to reach
Promote and Implement Modern Hazard Warning Systems	<ul style="list-style-type: none"> ▪ Can be used to help achieve multiple mitigation goals, particularly 6) help people to protect themselves ▪ Reduces resources to be expended by emergency responders if people get out of harm’s way themselves ▪ Grant programs available for NOAA radios 	<ul style="list-style-type: none"> ▪ Cost of warning equipment, programs ▪ Staff time to educate people about use of hazard warning systems ▪ Marquette County at the end of media market – little coverage ▪ Increased cell phone and computer usage among populations
Advance the Construction of Shelters and Saferooms	<ul style="list-style-type: none"> ▪ Can be used to help achieve multiple mitigation goals, particularly 1) protect human lives and 6) help people to protect themselves ▪ Greatly reduces risk of injury/death of people in structures that are not hazard-resistant; in the case of mobile homes, reduces risk to lower income groups. ▪ Community and politically-supportable strategy ▪ Technically and financially feasible ▪ Construction fundable through HMGP 	<ul style="list-style-type: none"> ▪ Cost of constructing saferooms ▪ Cost of materials and personnel time to educate property owners on saferoom identification/construction techniques and benefits

Mitigation Strategy	Benefits	Drawbacks/Costs
Develop Reliable and Multiple Evacuation Routes from Key Places of Assembly	<ul style="list-style-type: none"> ▪ Can be used to help achieve multiple mitigation goals, particularly 1) protect human lives and 6) help people to protect themselves ▪ Most cost effective to protect concentrations of vulnerable populations ▪ Construction fundable through HMGP 	<ul style="list-style-type: none"> ▪ Cost of constructing roads or elevating existing ones can be high ▪ Finding a technically feasible and environmentally acceptable 2nd access can be challenging
Promote Active Tree Management	<ul style="list-style-type: none"> ▪ Can be used to help achieve multiple mitigation goals, particularly 1) protect human lives, 2) protect critical facilities, and 6) help people to protect themselves ▪ Community and politically-supportable strategy ▪ Technically and financially feasible ▪ Potentially fundable through HMGP if protecting utilities 	<ul style="list-style-type: none"> ▪ Personnel time to implement ▪ Cost of materials and personnel time to educate property owners on tree management techniques and benefits
Protect Critical Facilities and Infrastructure	<ul style="list-style-type: none"> ▪ Can be used to help achieve multiple mitigation goals, particularly 2) protect critical facilities ▪ Can reduce/eliminate loss of productivity at businesses that lose access to the highway when roadways/bridges are blocked with storm debris ▪ Protect community’s ability to respond to disasters by protecting critical facilities used in disasters ▪ Reduce economic impacts from damages to critical facilities and infrastructure ▪ Reduce risk to safety and property of damaged aboveground utility lines/poles 	<ul style="list-style-type: none"> ▪ Cost of structural retrofitting materials/labor ▪ Cost of materials and personnel time to educate critical facilities operators of structural retrofitting techniques and benefits ▪ Cost of bracing/undergrounding utilities
2nd Priority		
Improve Coordination and Communication Among Emergency Responders	<ul style="list-style-type: none"> ▪ Can be used to help achieve multiple mitigation goals, particularly 7) promote partnerships in mitigation ▪ Maximize use of limited resources by working together and improving efficiency ▪ Potential funding sources available (but not HMGP) 	<ul style="list-style-type: none"> ▪ Cost of improving/updating communication systems ▪ Time investment to improve coordination
Recruit additional Storm Spotters and Train Them	<ul style="list-style-type: none"> ▪ Can be used to help achieve mitigation goal 3) protect human and environmental health ▪ Helps to prioritize emergency response actions 	<ul style="list-style-type: none"> ▪ Staff time to maintain and update list ▪ County already has a strong team of spotters
Other Potential Strategies		
Conduct Structural Retrofitting of Non-Critical Facilities	<ul style="list-style-type: none"> ▪ Can be used to help achieve multiple mitigation goals, particularly 1) protect human lives and 6) help people to protect themselves ▪ Can be implemented as part of routine building maintenance ▪ Reduces likelihood of damages to structures and personal property ▪ Fundable through HMGP 	<ul style="list-style-type: none"> ▪ Cost of retrofitting materials/labor ▪ Reduces, but does not eliminate risk to certain structures including mobile homes and industrial buildings ▪ Cost of materials and personnel time to educate property owners on structural retrofitting techniques and benefits

Mitigation Strategy	Benefits	Drawbacks/Costs
Monitor Vulnerable Populations	<ul style="list-style-type: none"> Can be used to help achieve mitigation goal 3) protect human and environmental health Helps to prioritize emergency response actions 	<ul style="list-style-type: none"> Staff time to maintain and update list Some of this has already been completed through the HMP process
Increase Use of Crop Insurance	<ul style="list-style-type: none"> Can be used to help achieve mitigation goal 6) help people to protect themselves Reduce amount farm owners have to spend personally to recover from storm damages 	<ul style="list-style-type: none"> Personal costs of insurance Personnel time to educate farm owners about benefit of crop insurance Local efforts may not greatly improve upon state and federal efforts to increase use of crop insurance
Develop Emergency Water and Power sources	<ul style="list-style-type: none"> Can be used to help achieve mitigation goal 3) protect human and environmental health 	<ul style="list-style-type: none"> Cost of providing emergency water and power Has not been a critical need to date Less of a long-term solution, except in Emergency Operations Center, than protecting existing water and power infrastructure from storm damages
Advance an Initiative of Voluntary Acquisition of Structures and Relocation of People	<ul style="list-style-type: none"> Can be used to help achieve mitigation goal 1) protect human lives 	<ul style="list-style-type: none"> Potential to involve several implementation hurdles: overcoming public misperceptions of intent of the program; getting political and public buy-in Cost of acquisitions Not likely to be funded by outside sources Impractical to implement as risk of storm damage is a county-wide threat

Table B4: Drought Mitigation Strategies Prioritization Matrix

Mitigation Strategy	Benefits	Drawbacks/Costs
1st Priority		
Pursue Regular Community Outreach and Education	<ul style="list-style-type: none"> Can be used to help achieve all mitigation goals, particularly 6) help people protect themselves Community-supported strategy Cost and time required to implement can be minimal Opportunities to partner with several organizations 	<ul style="list-style-type: none"> Cost of materials, programs, and staff time
Promote Use of Best Management Practices for Yards and Agriculture	<ul style="list-style-type: none"> Can be used to help achieve mitigation goal 3) protect human and environmental health and 6) help people to protect themselves Offers a more sustainable approach to drought mitigation 	<ul style="list-style-type: none"> Personnel time to educate and encourage farmers and property owners to adopt BMPs.
2nd Priority		
Improve Planning and Regulatory Practices	<ul style="list-style-type: none"> Can be used to help achieve multiple mitigation goals, particularly 3) protect human and environmental health Funding sources available for planning activities Offers a more sustainable approach to drought mitigation 	<ul style="list-style-type: none"> Can sometimes meet resistance to planning and regulation by the public Costs to develop plans or improve regulations Time and political commitment to regulation enforcement

Mitigation Strategy	Benefits	Drawbacks/Costs
Other Potential Strategies		
Increase Use of Crop Insurance	<ul style="list-style-type: none"> Can be used to help achieve mitigation goal 3) protect human and environmental health and 6) help people to protect themselves Reduce amount farm owners have to spend personally to recover from drought 	<ul style="list-style-type: none"> Personal costs of insurance Personnel time to educate farm owners about benefit of crop insurance Local efforts may not greatly improve upon state and federal efforts to increase use of crop insurance
Promote and Implement Modern Hazard Warning Systems	<ul style="list-style-type: none"> Can be used to help achieve multiple mitigation goals, particularly 6) help people to protect themselves Grant programs available for NOAA radios 	<ul style="list-style-type: none"> Cost of warning equipment, programs Staff time to educate people about use of hazard warning systems
Improve Hazard Threat Recognition	<ul style="list-style-type: none"> Can be used to help achieve multiple mitigation goals, particularly 6) help people to protect themselves Improves ability to implement mitigation actions in a timely manner, such as water conservation 	<ul style="list-style-type: none"> Personnel time to improve monitoring of drought forecasts and monitor local groundwater resources
Develop Emergency Water Sources	<ul style="list-style-type: none"> Can be used to help achieve mitigation goal 3) protect human and environmental health 	<ul style="list-style-type: none"> Cost of providing emergency water sources Has not been a critical need to date Less of a long-term solution than water conservation methods

Table B5: Extreme Temperatures Mitigation Strategies Prioritization Matrix

Mitigation Strategy	Benefits	Drawbacks/Costs
1 st Priority		
Pursue Regular Community Outreach and Education	<ul style="list-style-type: none"> Can be used to help achieve all mitigation goals, particularly 1) protect human lives, 6) help people protect themselves, and 7) promote partnerships in mitigation Community-supported strategy Increasingly elderly population is most susceptible Cost and time required to implement can be minimal Opportunities to partner with several organizations 	<ul style="list-style-type: none"> Cost of materials, programs, and staff time Large seasonal and tourists populations can be hard to reach
2 nd Priority		
Promote And Improve Use Of Cooling Centers (Possibly Similar Spaces As Saferooms)	<ul style="list-style-type: none"> Can be used to help achieve multiple mitigation goals, particularly 1) protect human lives and 6) help people to protect themselves Greatly reduces risk of illness/death of vulnerable populations. 	<ul style="list-style-type: none"> Cost of materials and personnel time to educate property owners on locations and hours of cooling centers
Other Potential Strategies		
Monitor Locations of Vulnerable Populations and Improve Access to Adequate Heating/Cooling	<ul style="list-style-type: none"> Can be used to help achieve mitigation goal 3) protect human and environmental health Helps to prioritize emergency response actions Extreme temperatures are one of the greatest risks particularly to low-income and elderly and 	<ul style="list-style-type: none"> Staff time to monitor and educate vulnerable populations Cost to subsidize heating/cooling for vulnerable populations

Mitigation Strategy	Benefits	Drawbacks/Costs
	therefore monitoring those populations' access to adequate heating and cooling can have significant impact	
Promote Home Weatherization	<ul style="list-style-type: none"> Can be used to help achieve mitigation goal 3) protect human and environmental health and 6) help people protect themselves Community and politically-supportable strategy Technically and financially feasible 	<ul style="list-style-type: none"> Existing snow and utility programs Staff time/materials needed to strengthen home weatherization program
Promote and Implement Modern Hazard Warning Systems	<ul style="list-style-type: none"> Can be used to help achieve multiple mitigation goals, particularly 6) help people to protect themselves Reduces resources to be expended by emergency responders if people get out of harm's way themselves Grant programs available for NOAA radios 	<ul style="list-style-type: none"> Cost of warning equipment, programs Staff time to educate people about use of hazard warning systems
Improve Coordination and Communication Among Emergency Responders	<ul style="list-style-type: none"> Can be used to help achieve multiple mitigation goals, particularly 7) promote partnerships in mitigation Maximize use of limited resources by working together and improving efficiency Potential funding sources available (but not HMGP) 	<ul style="list-style-type: none"> Cost of improving/updating communication systems Time investment to improve coordination
Increase Use of Crop Insurance	<ul style="list-style-type: none"> Can be used to help achieve mitigation goal 6) help people to protect themselves Reduce amount farm owners have to spend personally to recover from damages from extreme temperatures 	<ul style="list-style-type: none"> Personal costs of insurance Personnel time to educate farm owners about benefit of crop insurance Local efforts may not greatly improve upon state and federal efforts to increase use of crop insurance

Table B6: Earthquake Mitigation Strategies Prioritization Matrix

Mitigation Strategy	Benefits	Drawbacks/Costs
1st Priority		
Promote and Implement Modern Hazard Warning Systems	<ul style="list-style-type: none"> Can be used to help achieve multiple mitigation goals, particularly 6) help people to protect themselves Reduces resources to be expended by emergency responders if people get out of harm's way themselves Grant programs available for NOAA radios 	<ul style="list-style-type: none"> Cost of warning equipment, programs Staff time to educate people about use of hazard warning systems Earthquakes not expected to have a serious impact in the County
2nd Priority		
Pursue Regular Community Outreach and Education	<ul style="list-style-type: none"> Can be used to help achieve all mitigation goals, particularly 1) protect human lives, 6) help people protect themselves, and 7) promote partnerships in mitigation Cost and time required to implement can be minimal Opportunities to partner with several organizations 	<ul style="list-style-type: none"> Cost of materials, programs, and staff time Public may not take warnings seriously Earthquakes not expected to have a serious impact in the County

Mitigation Strategy	Benefits	Drawbacks/Costs
Protect Critical Facilities And Infrastructure	<ul style="list-style-type: none"> ▪ Can be used to help achieve multiple mitigation goals, particularly 2) protect critical facilities ▪ Can reduce/eliminate loss of productivity at businesses that lose access to the highway when roadways/bridges are blocked with storm debris ▪ Protect community’s ability to respond to disasters by protecting critical facilities used in disasters ▪ Reduce economic impacts from damages to critical facilities and infrastructure ▪ Reduce risk to safety and property of damaged aboveground utility lines/poles 	<ul style="list-style-type: none"> ▪ Cost of structural retrofitting materials/labor ▪ Cost of materials and personnel time to educate critical facilities operators of structural retrofitting techniques and benefits ▪ Cost of bracing/undergrounding utilities
Other Potential Strategies		
Promote Structural Retrofitting and Property Protection of Non-Critical Facilities	<ul style="list-style-type: none"> ▪ Can be used to help achieve multiple mitigation goals, particularly 1) protect human lives, 2) protect critical facilities, and 6) help people to protect themselves ▪ Can be implemented as part of routine building maintenance ▪ Reduces likelihood of damages to structures and personal property ▪ Community and politically-supportable strategy ▪ Technically and financially feasible ▪ HMGP fundable 	<ul style="list-style-type: none"> ▪ Cost of retrofitting materials/labor ▪ Reduces, but does not eliminate risk to certain structures including mobile homes and industrial buildings ▪ Cost of materials and personnel time to educate property owners on structural retrofitting techniques and benefits
Improve Planning and Regulatory Practices	<ul style="list-style-type: none"> ▪ Can be used to help achieve multiple mitigation goals, particularly 5) Prevent future risks of hazards in highly vulnerable areas ▪ Funding sources available for planning activities ▪ Can be used as a tool to improve hazard-resistance of new development 	<ul style="list-style-type: none"> ▪ Can sometimes meet resistance to planning and regulation by the public ▪ Costs to develop plans or improve regulations ▪ Time and political commitment to regulation enforcement
Improve Coordination and Communication among Emergency Responders	<ul style="list-style-type: none"> ▪ Can be used to help achieve multiple mitigation goals, particularly 7) promote partnerships in mitigation ▪ Maximize use of limited resources by working together and improving efficiency ▪ Potential funding sources available (but not HMGP) 	<ul style="list-style-type: none"> ▪ Cost of improving/updating communication systems ▪ Time investment to improve coordination
Improve Hazard Threat Recognition	<ul style="list-style-type: none"> ▪ Can be used to help achieve multiple mitigation goals, particularly 6) help people to protect themselves, and 7) promote partnerships in mitigation ▪ Provides critical information for emergency responders 	<ul style="list-style-type: none"> ▪ Cost personnel time and materials for storm spotter training/recruitment ▪ May not have as great an impact as other strategies as the County currently has good connection with state emergency management communication
Monitor Vulnerable Populations	<ul style="list-style-type: none"> ▪ Can be used to help achieve mitigation goal 3) protect human and environmental health ▪ Helps to prioritize emergency response actions 	<ul style="list-style-type: none"> ▪ Staff time to maintain and update list
Develop Emergency Water and Power Sources	<ul style="list-style-type: none"> ▪ Can be used to help achieve mitigation goal 3) protect human and environmental health 	<ul style="list-style-type: none"> ▪ Cost of providing emergency water and power ▪ Has not been a critical need to date ▪ Less of a long-term solution than protecting existing water and power infrastructure from storm damages

Table B7: Priority Wildfire Mitigation Strategies

Mitigation Strategy	Benefits	Drawbacks/Costs
1 st Priority		
Support Active Forest Management to Minimize the Potential for Catastrophic Fires	<ul style="list-style-type: none"> ▪ Can be used to help achieve multiple mitigation goals, particularly 1) protect human lives, 2) protect public and environmental health, and 5) prevent future risks in vulnerable areas ▪ Community-supported strategy ▪ Opportunities to partner with several organizations 	<ul style="list-style-type: none"> ▪ Currently, no full-time Fire Ranger stationed in Marquette County ▪ Cost of implementing program
Engage in Good Land Use Planning, Proper Home Siting, and Provide Adequate Access to Homes in Fire Prone Areas	<ul style="list-style-type: none"> ▪ Can be used to help achieve multiple mitigation goals, particularly 5) Prevent future risks of hazards in highly vulnerable areas ▪ Funding sources available for planning activities ▪ Potential enrollment in the WDNR Firewise Program 	<ul style="list-style-type: none"> ▪ Can sometimes meet resistance to planning and regulation by the public ▪ Costs to develop plans or improve regulations ▪ Time and political commitment to regulation enforcement
2 nd Priority		
Pursue Regular Community Outreach and Education	<ul style="list-style-type: none"> ▪ Can be used to help achieve all mitigation goals, particularly 1) protect human lives, 6) help people protect themselves, and 7) promote partnerships in mitigation ▪ Community-supported strategy ▪ Cost and time required to implement can be minimal ▪ Opportunities to partner with several organizations 	<ul style="list-style-type: none"> ▪ Cost of materials, programs, and staff time ▪ Large seasonal and tourists populations can be hard to reach
Improve Coordination and Communication Among Emergency Responders	<ul style="list-style-type: none"> ▪ Can be used to help achieve multiple mitigation goals, particularly 7) promote partnerships in mitigation ▪ Maximize use of limited resources by working together, maximizing the use of technology, and improving efficiency ▪ Potential funding sources available (but not HMGP) 	<ul style="list-style-type: none"> ▪ Cost of improving/updating communication systems ▪ Time investment to improve coordination ▪ Current over commitment/shortage of Emergency Response personnel.

Table B8: Human-Caused and Disease Outbreak Mitigation Strategies Prioritization Matrix

Mitigation Strategy	Benefits	Drawbacks/Costs
Priority 1 Priority		
Improve Coordination and Communication Among Emergency Responders	<ul style="list-style-type: none"> ▪ Can be used to help achieve multiple mitigation goals, particularly 7) promote partnerships in mitigation ▪ Maximize use of limited resources by working together and improving efficiency ▪ Potential funding sources available (but not HMGP) 	<ul style="list-style-type: none"> ▪ Cost of improving/updating communication systems ▪ Time investment to improve coordination
Pursue Regular Community Outreach and Education	<ul style="list-style-type: none"> ▪ Can be used to help achieve all mitigation goals, particularly 1) protect human lives, 6) help people protect themselves, and 7) promote partnerships in mitigation ▪ Community-supported strategy ▪ Cost and time required to implement can be minimal ▪ Opportunities to partner with several organizations 	<ul style="list-style-type: none"> ▪ Cost of materials, programs, and staff time
Promote and Implement Modern Hazard Warning Systems	<ul style="list-style-type: none"> ▪ Can be used to help achieve multiple mitigation goals, particularly 6) help people to protect themselves ▪ Reduces resources to be expended by emergency responders if people get out of harm's way themselves ▪ Grant programs available for NOAA radios (but not HMGP) 	<ul style="list-style-type: none"> ▪ Cost of warning equipment, programs ▪ Staff time to educate people about use of hazard warning systems
Priority 2 Priority		
Identify and Address Infrastructure Hazard Vulnerability	<ul style="list-style-type: none"> ▪ Can be used to help achieve multiple mitigation goals, particularly 5) protect critical facilities ▪ Protect community's ability to respond to disasters by protecting critical facilities used in disasters ▪ Reduce economic impacts from damages to critical facilities and infrastructure ▪ Reduce risk to safety and property of damaged aboveground utility lines/poles 	<ul style="list-style-type: none"> ▪ Cost of structural retrofitting materials/labor ▪ Cost of materials and personnel time to educate critical facilities operators of structural retrofitting techniques and benefits