Hazard Mitigation Plan
for
Lake County
and
Constituent Local Governments

Update Completed in 2014
Adopted by Lake County
June 10, 2015

WMSRDC
WEST MICHIGAN SHORELINE
REGIONAL DEVELOPMENT COMMISSION

WEST MICHIGAN SHORELINE
REGIONAL DEVELOPMENT COMMISSION
(WMSRDC)

The WMSRDC is a federal and state designated regional planning and development agency serving 120 local governments in Lake, Mason, Muskegon, Newaygo, and Oceana counties.

The mission of WMSRDC is to promote and foster regional development in West Michigan through cooperation amongst local governments.

WMSRDC
WEST MICHIGAN SHORELINE
REGIONAL DEVELOPMENT COMMISSION

Project Staff:

Stephen Carlson, Senior Planner
Josh Croff, Planner

Prepared by WMSRDC in conjunction with the
Lake County Emergency Management Department and the
Lake County Local Emergency Planning Committee

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Sample Letter of Transmittal from Chief Elected Official

Dear Mr./ Ms.:

Attached is the Lake County Hazard Mitigation Plan Update. This plan has been developed by Lake County in conjunction with the West Michigan Shoreline Regional Development Commission, the State of Michigan, affected businesses, local governments, and interested members of the public. The plan provides the process for evaluation of land use and development in the county from a hazard mitigation perspective, which will protect lives and property in the community.

It is my expectation that all future development decisions in Lake County will consider hazard vulnerability reduction as a standard business practice and that such considerations will be incorporated into land use plans and zoning ordinances, as appropriate. The intent of the hazard mitigation plan is not to limit development, but to ensure that all development avoids the possibility of damage from natural and technological hazards to the extent practicable.

It is my hope that your community will consider adopting this plan by resolution. Doing so will help your community qualify for certain types of hazard mitigation funds, especially those that become available following a disaster.

Questions and concerns related to content and use of this plan should be directed to the office of the Lake County Emergency Management / Homeland Security Department, at (231) 745-6205.

Sincerely,

Chairperson
Lake County Board of Commissioners

HAZARD MITIGATION

PLAN ADOPTION

RESOLUTION 06/10/15 #1332

WHEREAS, Lake County, Michigan has experienced repetitive disasters that have damaged commercial, residential and public properties, displaced citizens and businesses, closed streets and bridges dividing the community both physically and emotionally, and presented general public health and safety concerns; and

WHEREAS, the community has prepared a *Hazard Mitigation Plan* that outlines the community's options to reduce overall damage and impact from natural and technological hazards; and

WHEREAS, the *Hazard Mitigation Plan* has been reviewed by community residents, business owners, and federal state and local agencies, and has been revised to reflect their concerns;

NOW THEREFORE BE IT RESOLVED THAT:

1. The *Hazard Mitigation Plan* is hereby adopted as an official plan of the County of Lake.

2. The Lake County Local Emergency Planning Committee (LEPC) is hereby established as a permanent community advisory body whose members are subject to the approval of the Lake County Board of Commissioners. The group's duties shall be as designated in the *Hazard Mitigation Plan.*

3. The Lake County Emergency Management Director, or designee, is charged with supervising the implementation of the Plan's recommendations within the funding limitations as provided by the County of Lake or other sources.

4. The Lake County Emergency Management Director shall convene the LEPC quarterly. The LEPC shall monitor implementation of the plan and shall submit a written progress report to Lake County in accordance with the following format:

   a. A review of the original plan.
   b. A review of any disasters or emergencies that occurred during the previous calendar year.
   c. A review of the actions taken, including what was accomplished during the previous year.
   d. A discussion of any implementation problems.
   e. Recommendations for new projects or revised action items. Such recommendations shall be subject to approval by the Lake County Board of Commissioners.

STATE OF MICHIGAN)
)SS
COUNTY OF LAKE)

I, Shelly Myers, Clerk of the Board of Commissioners for the County of Lake, do hereby certify that the above and foregoing is a true and correct copy of a resolution passed by the Lake County Board of Commissioners at a regular meeting held on June 10, 2015

IN TESTIMONY WHEREOF, I have hereunto set my hand and affixed the official seal at Baldwin, Michigan, this 10th day of June, 2015.

Shelly Myers

Shelly Myers, Clerk to the Board

HAZARD MITIGATION PLAN

Part A
PURPOSE AND PLANNING PROCESS

Purpose

The Lake County Hazard Mitigation Plan was created to protect the health, safety, and economic interests of residents by reducing the impacts of natural and technological hazards through hazard mitigation planning, awareness, and implementation. Hazard mitigation is any action taken to permanently eliminate or reduce the long-term risk to human life and property from natural and technological hazards. It is an essential element of emergency management along with preparedness, response and recovery.

This plan serves as the foundation for hazard mitigation activities within the county. Implementation of the plan's recommendations will reduce injuries, loss of life, and destruction of property due to natural and technological hazards. The plan provides a path toward continuous, proactive reduction of vulnerability to the most frequent hazards that result in repetitive and often severe social, economic and physical damage. The ideal end-state is total integration of hazard mitigation activities, programs, capabilities and actions into normal, day-to-day governmental functions and management practices.

Some of the mitigation activities recommended in this document are inexpensive to accomplish while others require funding. The Federal Emergency Management Agency's (FEMA's) Pre-Disaster Mitigation (PDM) program and Hazard Mitigation Grant Program (HMGP) can assist with funding for many activities. Authorized under Section 404 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act, the HMGP is administered by FEMA and provides grants to states and local governments to implement long-term hazard mitigation measures after a major disaster declaration. The purpose of the program is to reduce the loss of life and property due to natural disasters and to enable mitigation measures to be implemented during the immediate recovery from a disaster.

However, communities must have participated in the development of this plan and adopt it to be eligible to apply. Section 104 of the Disaster Mitigation Act of 2000 (42 USC 5165) states that after November 1, 2003 (later changed to November 1, 2004), local governments applying for pre- and post- disaster mitigation funds must have approved local mitigation plans. Pursuant to these requirements, which are spelled out in 44 CFR (Code of Federal Regulations) Part 201, the Lake County Hazard Mitigation Plan was adopted by Lake County in 2006 and fully approved by FEMA in 2008. Further, all 17 jurisdictions within Lake County (2 villages and 15 townships) were successful in adopting the county's multi-jurisdictional hazard mitigation plan at the local level.

In addition, mitigation planning regulations state that "a local jurisdiction must review and revise its plan to reflect changes in development, progress in local mitigation efforts, and changes in priorities, and resubmit it for approval within 5 years in order to continue to be eligible for mitigation project grant funding." Thus in 2010, efforts began to perform the mandated five-year update, resulting in this document.

Planning Process

The Lake County Hazard Mitigation Plan examines a wide array of hazards and mitigation activities on a multi-jurisdictional level (county, village, and township). Emphasis is placed on hazards, both natural and human-induced, that have had significant impacts on the county in the past. Because this is a multi-jurisdictional plan, the very first action of the planning process was to request a Letter of Participation from each local unit of government within Lake County. Eden Township was the only municipality out of 17 local units that did not submit a letter of participation. Community participation is discussed later in this chapter.

The planning process followed in the update of the Lake County Hazard Mitigation Plan consists of the following steps:

- Public and stakeholder involvement;
- Establishment of an Advisory Team;
- Identification of hazards, risks and vulnerabilities;
- Identification and definition of goals and objectives;
- Identification of alternatives for solving problems;
- Selection of evaluation criteria to prioritize alternatives;
- Selection of potential hazard mitigation actions;
- Preparation of a draft plan;
- Preparation of the final plan;
- Implementation of the plan; and
- Monitoring and periodic revision of the plan.

Planning Approach

The Lake County Hazard Mitigation Plan was developed by the West Michigan Shoreline Regional Development Commission (WMSRDC) under the guidance of the Lake County Local Emergency Planning Committee (LEPC), the Lake County Hazard Mitigation Advisory Team, and the Lake County Office of Emergency Management.

WMSRDC is a federal and state designated regional planning and development agency serving 120 local governments in Lake, Mason, Muskegon, Newaygo, and Oceana counties. WMSRDC is also the planning agency for the metropolitan transportation planning (MPO) program for Muskegon and Northern Ottawa counties, and is responsible for the management and administration of the homeland security program for the counties of Clare, Ionia, Isabella, Kent, Lake, Mason, Mecosta, Montcalm, Muskegon, Newaygo, Oceana, Osceola, and Ottawa.

The Lake County LEPC is a twenty-three member committee whose members represent elected officials, District Health Department #10, health organizations, law enforcement, fire departments, transportation, emergency management, communications, Red Cross, and EMS. The LEPC Chair, Vice Chair, and Secretary positions are appointed through a vote every December. With the exception of these elected positions, committee members may serve unlimited terms and membership is essentially voluntary. By law, the Michigan Emergency Planning and Community Right-to-Know Commission designates emergency planning districts. Title III of the Superfund Amendment and Reauthorization Act of 1986 (SARA Title III) requires that the following groups be represented on the LEPC:

- Elected state and local officials;
- Law enforcement;
- Civil defense;
- Fire-fighting;
- First aid and health;
- Local environmental;
- Hospital;
- Transportation personnel;
- Broadcast and print media;
- Community groups; and
- Owners/operators of facilities subject to the reporting requirement of SARA Title III.

Additionally, the Michigan Emergency Planning Commission recommends that representatives from the following sectors also be appointed to the LEPC:

- Organized labor;
- Education; and
- Agriculture.

The Advisory Team was assembled by the Lake County Emergency Manager to aid the process of reviewing and updating the Lake County Hazard Mitigation Plan. All LEPC members were invited to join the team, which was eventually comprised of eleven representatives from Lake County Emergency Management Department, Department of Human Services, Family Health Care, District #10 Health Department, GEO Group, Yates Dial-a-Ride, Lake County Equalization, Lake County Road Commission, and Lake County Central Dispatch. This body was established and utilized at the beginning stages of the update process; however, as the Update evolved, the full LEPC emerged as the primary advisory body to the Plan Update.

Appendix E includes the following plan documentation: LEPC membership (2013); Advisory Team members; attendance lists from LEPC meetings and other public meetings where hazard mitigation was discussed during the Update Process; resources utilized during the formation of this Plan and Update; and public notices and hazard mitigation articles published in WMSRDC newsletters.

Outreach, Input and Participation

Lake County Emergency Management and the LEPC provided ongoing guidance and assistance in the plan development. Meetings where the LEPC specifically discussed hazard mitigation are listed in Appendix E. In addition, valuable input was obtained through a survey sent to 110 individuals in February 2012. LEPC members received the survey, as well as representatives of agencies and departments listed below. The survey was also made available to the public on the WMSRDC website during the drafting stage of the planning process.

- County commissioners
- County planning commissioners
- Local planning commissioners
- Local zoning officials
- Village presidents and township supervisors
- Fire chiefs and law enforcement
- Public works directors
- School superintendents
- Chambers of commerce
- Public utilities
- Lake County Chief Fiscal Officer
- Lake County Road Commission Superintendent
- Lake County Drain Commissioner
- Lake County Equalization Director
- Lake County Council on Aging
- District #10 Health Department Emergency Services Coordinator
- West Michigan Community Mental Health System
- American Red Cross – Lakeshore & West Shore Chapter
- Lake/Newaygo Department of Human Services Director
- Baldwin Family Health Care
- Life EMS
- Mason-Lake Intermediate School District

- Lake County Central Dispatch Director
- Lake County MSU Extension Office
- Michigan DNR Forest Resources
- Huron-Manistee National Forest Fire Management Officer
- Osceola-Lake Conservation District Administrator
- Yates Dial-a-Ride
- Baldwin Municipal Airport

The survey, developed with assistance of the Michigan State Police Emergency Management Division, was distributed early in the planning process and served a number of functions. First, the broad distribution of the survey to local, county, and regional agencies, organizations, and stakeholders was intended to raise awareness throughout the community of hazard mitigation planning, as well as to encourage local input and participation. Second, the survey included a list of historical hazard events, as reported in the original Lake County Hazard Mitigation Plan. This offered an opportunity for recipients to not only identify past and potential hazards in their community, but also allowed them to verify the accuracy of the Plan's previous edition. Third, the survey provided a prioritized list of hazards identified in the Lake County Hazard Mitigation Plan, and asked recipients to rank those hazards according to their own priorities. Although feedback obtained from this section was inherently subjective, it was useful for gauging community opinion and was taken into consideration when the hazard rating and rankings were revisited during this Plan Update.

The survey incited responses from a wide range of local and regional entities; including Lake County Emergency Management, USDA Forest Service, Michigan DNR Forest Management, West Michigan Community Mental Health, District #10 Health Department, Newkirk Township, and Peacock Township. Survey feedback was used to help identify hazards, establish goals and objectives, recommend activities and prioritize actions. Although the survey produced a meager 6.4% response rate, it was successful in increasing awareness of hazard mitigation throughout Lake County. Explanations for the low response rate include the survey length, as well as the possibility that some recipients simply agreed with the survey content and chose not to respond. A copy of the survey, cover letter, and summary of responses can be found in Appendix D.

Attempts to obtain input from county stakeholders via email and mail were utilized at other stages of the Planning Process as well. In April 2012, the chief elected official and in some cases the professional manager of each local jurisdiction received a copy of its community profile section for review and comment. In November 2013, these individuals were asked to review the Action Agenda and comment on any hazard mitigation progress that had been made since 2006. These efforts provided information about hazard mitigation and invited individuals to participate in the Plan Update.

The chart on the following page shows the hazard mitigation participation status of each local jurisdiction in Lake County. Participation is based on whether or not a representative from a jurisdiction (1) attended a hazard mitigation meeting, (2) responded to a request for information, or (3) contributed to the plan in any other way during the planning process.

Neighboring counties were notified of the plan through a communication sent to their Emergency Manager on October 15, 2013. All were asked to identify any concerns of hazards in their county that may impact Lake County, and vice versa. Lake County is bounded by Manistee and Wexford counties to the north; Mecosta, Newaygo, and Oceana counties to the south; Mason County to the west; and Osceola County to the east. All were given the option of reviewing drafts of this document.

Lake County Hazard Mitigation Plan Jurisdiction Participation					
Jurisdiction	**Adopted 2006 Lake Co HazMit Plan***	**2006 HazMit Plan Participant**	**2011 Letter to Participate**	**HazMit Plan Update Participant**	**Participant Status**
Lake County	✓	✓	✓	✓	Continuing
Baldwin Village	✓		✓	✓	**New Participant**
Chase Twp	✓		✓	✓	**New Participant**
Cherry Valley Twp	✓		✓		
Dover Twp	✓	✓	✓	✓	Continuing
Eden Twp	✓				Non-Participant
Elk Twp	✓		✓	✓	**New Participant**
Ellsworth Twp	✓		✓	✓	**New Participant**
Lake Twp	✓	✓	✓	✓	Continuing
Luther Village	✓		✓		
Newkirk Twp	✓		✓	✓	**New Participant**
Peacock Twp	✓	✓	✓	✓	Continuing
Pinora Twp	✓	✓	✓	✓	Continuing
Pleasant Plains Twp	✓		✓		
Sauble Twp	✓		✓		
Sweetwater Twp	✓		✓		
Webber Twp	✓	✓	✓		
Yates Twp	✓		✓		

** Approved by FEMA in 2008*

Public Engagement

The Lake County LEPC hosted a public meeting to discuss hazard mitigation at the beginning of the planning process at its March 8, 2012 meeting. It was noticed in the Lake County Star, discussed in the WMSRDC electronic newsletter, and announced in the February 2012 survey mailing. The meeting featured a presentation about the hazard mitigation planning process, and the public was invited to comment upon and discuss the survey that was distributed and made available on the WMSRDC website.

A second public meeting was held during the drafting stage of the planning process. This meeting was hosted by the LEPC at its quarterly meeting on September 11, 2014. The meeting was noticed in the Lake County Star; announced on the WMSRDC website and in the WMSRDC newsletter; and invitations were mailed and emailed to the LEPC members, chief elected official of each jurisdiction in Lake County, and members of the Lake County Board. These communications invited recipients to review the Hazard Analysis and Goals & Objectives sections, which were posted on the WMSRDC website prior to the public meeting. Invitees were offered an opportunity to comment on the drafted sections by attending the public meeting or by submitting comments, in writing to WMSRDC staff prior to the meeting.

Hazard mitigation was featured several times in the WMSRDC's bi-monthly print newsletter. Hazard mitigation was also featured in WMSRDC Updates, an electronic newsletter emailed, at a minimum, bi-monthly (opposite the printed newsletter). Not only were the newsletters distributed to all constituents in Lake, Mason, Muskegon, Newaygo and Oceana counties, but they also reached a majority of the county's neighboring communities. These communications were also presented on the WMSRDC's website. Lastly, the WMSRDC website, www.wmsrdc.org, offered an opportunity for the public to become familiar with hazard mitigation and participate in the plan development at. This website provided general information about hazard mitigation;

offered access to the latest approved edition of the county's Hazard Mitigation Plan; and provided access to surveys and draft sections for public review.

WMSRDC staff discussed hazard mitigation at the "Water, Woods, & Wetlands" regional forum on October 23, 2013 in Muskegon, Michigan. The hazard mitigation session addressed the potential for coordination between hazard mitigation and a variety of environmental initiatives. Examples of successful mitigation projects in Michigan highlighted many common interests, such as culvert improvements, flood control, and stream bank stabilization. Attendees of the forum included representatives from international, regional, and local environmental groups; federal agencies including USGS, USFWS, and NOAA; Michigan agencies MDEQ Office of Great Lakes, MDEQ Coastal Zone Management, MDEQ Non-Point Source, and MDNR; non-profit organizations; and private engineering and consulting firms. The forum also drew attendance from local watershed groups, local government officials, and residents.

Process for Approval and Adoption

At the conclusion of the planning process, Lake County Emergency Management is to submit the Draft Plan prepared by the WMSRDC to the Federal Emergency Management Agency (FEMA) and the Michigan State Police, Emergency Management and Homeland Security Division (MSP-EMHSD) to verify that the requirements of a hazard mitigation plan have been met. Subsequent to these approvals, the LEPC (and by extension the Advisory Team) then reviews any comments, approves any necessary adjustments to the Draft Plan, and submits the Final Draft of the Hazard Mitigation Plan Update to the County Board of Commissioners for consideration. Following County Board approval, the plan is then sent to local governments for public hearings and adoption, as desired, to qualify them for pre- and post- disaster hazard mitigation assistance. Documentation of all local adoptions should be returned to the county Emergency Manager for notification to MSP-EMHSD and FEMA.

Part B

COMMUNITY PROFILE DESCRIPTIONS RELATED TO HAZARD RISK

(see Appendix A for detailed community profiles)

1.0 COUNTY PROFILE SUMMARY

1.01 Lake County

Lake County is located in a rural area of western-central Lower Michigan. Mason County borders Lake to the west, Manistee County and Wexford County to the north, Osceola County to the east and Newaygo County to the south. According to the 2010 Census, the county population totaled 11,539 (20.3 people per square mile), a growth of 1.8% from 2000. Of the total population in 2010, 87.0% of the citizens were white, 9.2% were African American, 0.8% were Native American, and about 3.0% were of other ethnicities. In 2010, Lake County had 14,966 total housing units (26.4 per square mile), with 5,158 of them being occupied and 9,808 being vacant. A significant portion of the vacant units, 8,774, was comprised of seasonal, recreational or occasional use dwellings. Per capita income in 2010 was $16,084 while the median household income was $31,205.

1.02 History and Development

The land now known as Lake County was surveyed in 1836 and given the name of Aishcum. It received its current name in 1843 and was officially organized in 1871. The Village of Baldwin has remained the county seat since 1874. Settlement began in 1863 when a new state road was constructed to connect Grand Rapids with Traverse City. In 1866, the construction of a sawmill near Sherman in Wexford County signified the beginning of the lumber industry in the area. Lumbering continued to increase in importance with the extension of the Grand Rapids and Indiana Railroad in 1871-72, and the Ann Arbor Railroad in 1887. Many early settlers farmed during the summer and logged during the winter. As virgin forests were depleted, more and more people turned to farming as the principle means of livelihood. The acreage of farmland reached a peak in 1912, when 70,000 acres in Lake County were farmed. Many farms on the more droughty soils were later abandoned and replanted with pines. Timber harvesting and milling continued as an important industry, although on a diminishing scale. During the 1930's, the lumbering industry virtually ceased. Presently, the more productive soils remain in cultivation. Logging operations are limited to pulpwood and a small amount of timber harvesting for lumber. Today, Lake County remains a rural area with limited residential, commercial and industrial developments. The rural nature of the county offers residents and visitors a multitude of outdoor recreational activities.

1.03 Land Use

The 2008 Lake County Michigan Land Ownership Plat Book listed a total of 575 square miles within the county, with 567 of them as land and 7 as water. An incredible 176,705 acres of the county were public lands (federal, state, and local). The 1998 Lake County Land Use Plan reported that the county had a land area of about 567.4 sq. miles. Of that, 77.36% of the land was woodland, 6.09% was agricultural land, 5.21% was residential development, 0.16% was commercial development, and the remaining 11.18% was comprised of public/institutional, recreational, industrial, resource extraction, potential wetland, water, or vacant land. Land uses remain much the same in 2012. Residential development concentrations are located near the villages of Baldwin and Luther, and also around various lakes throughout the county. The federally-owned Manistee National Forest and the state-owned Pere Marquette State Forest both claim portions of the county's land. Despite its suggestive name, Lake County's water area only totals about 7.2 sq. miles. Major

lakes and rivers include: Big Star Lake, Big Bass Lake, Wolf Lake, Pere Marquette River, Little Manistee River, Pine River, Baldwin River and Sauble River.

1.04 Climate

January is generally the coldest month of the year with an average temperature of 20.1 degrees farenheight, while July is the warmest with an average of 68.9 degrees farenheight. The highest temperature recorded in Baldwin was 104 degrees in June 1949. The lowest temperature recorded in Baldwin was 38 degrees below zero in February 1996. The county usually receives between 70 and 90 inches of snow each year, generally falling eight months out of the year. January has the greatest snowfall, averaging 25 inches. Six months of the year average over three inches of precipitation, with August topping the list at 3.62 inches. February has the least precipitation with 1.68 inches. The prevailing wind is from the west-southwest with an average wind speed of 10 miles per hour.

1.05 Physiography

Lake County's land surface was sculpted by the most recent glacial period, the Wisconsin glaciation. Approximately 35% of the land is made up of steep rolling glacial moraines. Most of the remainder is undulating or nearly level glacial outwash plain.

Bedrock geology in Lake County consists of Mississippian and Pennsylvanian sedimentary deposits which dip to the southeast at a low angle. The sedimentary rocks consist of shale, sandstone and evaporates. Minor Jurassic Red Beds of sandstone are located in the lower southeastern portion of the county. A small portion of the northwest corner of the county contains Coldwater Shale. The remainder of the county has deposits of the Marshall Sandstone, the Michigan Formation and the Saginaw Sandstone, in that order from northwest to southeast. Red rock topography ranges from a high of greater than 550 feet in the north-central and southwest portions of the county.

Lake County Watercourses

Name	Location	Watershed
Pere Marquette R.	Lake Twp, Pleasant Plains Twp, Sweetwater Twp	Pere Marquette R.
Little Manistee R.	Luther Village, Eden Twp, Ellsworth Twp, Elk Twp, Newkirk Twp, Peacock Twp	Manistee R.
Middle Br Pere Marquette R.	Chase Twp, Pleasant Plains Twp, Yates Twp	Pere Marquette R.
Pine R.	Dover Twp, Ellsworth Twp, Newkirk Twp	Manistee R.
Baldwin R.	Baldwin Village, Pleasant Plains Twp, Webber Twp, Cherry Valley Twp, Newkirk Twp	Pere Marquette R.
Sanborn Cr.	Baldwin Village, Cherry Valley Twp, Pleasant Plains Twp, Pinora Twp, Webber Twp	Pere Marquette R.
Stronach Cr.	Eden Twp, Elk Twp	Manistee R.
Little S Br Pere Marquette R.	Pleasant Plains Twp, Yates Twp	Pere Marquette R.
Big Sable R.	Sauble Twp	Big Sable R.
West Branch Twin Cr.	Newkirk Twp	Manistee R.
Silver Cr.	Dover Twp, Newkirk Twp	Manistee R.
Mc Carthy Cr.	Sauble Twp	Big Sable R.
Blood Cr.	Yates Twp	Pere Marquette R.
Danaher Cr.	Pleasant Plains Twp	Pere Marquette R.
Kinney Cr.	Sweetwater Twp, Webber Twp	Pere Marquette R.
Twin Lakes Cr.	Sauble Twp	Big Sable R.
North Branch Cole Cr.	Cherry Valley Twp	Pere Marquette R.
South Branch Cole Cr.	Cherry Valley Twp	Pere Marquette R.
East Branch Twin Cr.	Newkirk Twp	Manistee R.
Jenks Cr.	Pleasant Plains Twp	Pere Marquette R.
Johnson Cr.	Chase Twp	Muskegon R.
Buckhorn Cr.	Chase Twp	Muskegon R.
Knuth Cr.	Chase Twp	Muskegon R.
Little Sable R.	Sauble Twp	Big Sable R.
Hewitt Cr.	Pinora Twp	Muskegon R.
Carr Cr.	Lake Twp	Pere Marquette R.
Poplar Cr.	Newkirk Twp	Manistee R.
Muckwan Cr.	Elk Twp	Big Sable R.
Big Beaver Cr.	Ellsworth Twp	Manistee R.

2.0 VILLAGE PROFILE SUMMARIES

2.01 Baldwin Village

First organized in the early 1870's during the Lumber era, Baldwin was originally but unofficially named Hanibal after an early settler to the area. In 1872, the first store was built by Issac Grant, who called a committee to give the community an official name. They decided on "Baldwin City," after then Governor of Michigan, Henry P. Baldwin. It was given a station on the Pere Marquette Railroad in 1873, became the County Seat in 1874, and was incorporated as a village in 1887.

Baldwin is currently the county seat for Lake County, and is located at the junction of M-37 and US-10. It is situated on the Baldwin River, about three miles north of the Pere Marquette River. There are over a dozen lakes within only five miles of the city limits. Baldwin is known for its specialty fishing lure and equipment shops, not to mention gifts and antiques as well. This town is the center of activity for the many resorts and cottages in the area. It celebrates its “Troutarama“ festival each summer and the “Blessing of the Bikes” each May.

The 2010 population of the village was 1,208, with a population density of 929.2 people per square mile. A total of 223 persons communted to work daily, mostly outside the village. In 2010, there were 478 total housing units (367.7 per square mile) of which 404 were occupied and 18 were for seasonal or occasional use. Major critical public or private facilities in the village consist of four schools, a teen health center, one nursing home, two elderly housing complexes, one family housing complex, Lake County Courthouse and jail, Lake County Sheriff Department, a residential reentry program (Michigan Department of Corrections), Baldwin Fire Station, US Post Office, wastewater treatment plant, USFS Ranger Station, Lake County Road Commission, Lake County Emergency Management, Lake County Central Dispatch, an emergency siren, US-10, M-37, Marquette Rail railroad, Lake County Informational Designation (historic marker), and approximately 5 major employers. Major natural terrain features include Bush Lake and Baldwin River.

2.02 Luther Village

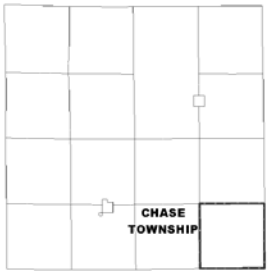
Luther is located in the northeastern quarter of Lake County in Ellsworth Township. In 1880, the firm of Luther and Wilson established a sawmill there. Initially named Wilson, the town was renamed Luther in 1881, after B.T. Luther of the firm. The Grand Rapids & Indiana Railroad built a station in Luther in 1881 during the big lumber boom, and the town was organized as a village in 1893.

Despite its rural location and small size, Luther has survived since the lumber years, primarily as a tourist community. It has its own school, post office, and community building, with a few small businesses, stores and restaurants. The Little Manistee River flows through town, forming a pond at the backside of the recently rebuilt dam.

The 2010 population of the village was 318, with a population density of 318 people per square mile of land area. A total of 85 persons commuted to work daily, mostly outside the village. In 2010, there were 190 housing units (190 per square mile), of which 137 units were occupied and 31 were for seasonal or occasional use. Major critical public or private facilities in the village consist of one school, the Luther Fire Department, a US Post Office, a library, a township hall, and the Luther Pond Dam. Major natural terrain features include Little Manistee River and the Luther Mill Pond.

3.0 TOWNSHIP PROFILE SUMMARIES

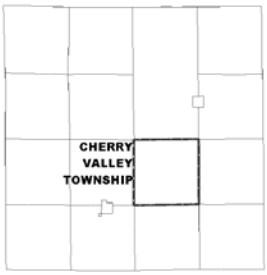
3.01 Chase Township



Chase Township is located in the southeastern quarter of Lake County, bordering Osceola County to the east and Mecosta County to the south. It is bisected by US-10 to the north. This area was first settled by Lorenzo Conklin, who arrived here in 1862. The area was then known as Grendale, which was a clerical error for what should have been Green Dell. In 1869, Charles Joiner built a sawmill and broom-handle factory in the area. The township received its name from the post office, built in 1872, which was named after Salmon Portland Chase, an Ohio governor. The township's main community, and home of the Township Hall, is the unincorporated town of Chase, situated on the headwaters of the Pere Marquette River. This area is a mixture of small farms and some residential areas that are beginning to develop because of their location relative to Big Rapids.

The 2010 population of the township was 1,137, with a population density of 31.97 people per square mile. A total of 556 persons commuted to work daily, mostly outside of the township. In 2010, there were 581 total housing units (16.34 per square mile), of which 447 were occupied and 77 were for seasonal or occasional use. Mobile homes make up over 1/4 of the housing supply. Major critical public or private facilities in the township include a libarly, town hall, post office, US-10, and a power transmission line. Major natural terrain features include the Pere Marquette River Middle Branch and the Manistee National Forest.

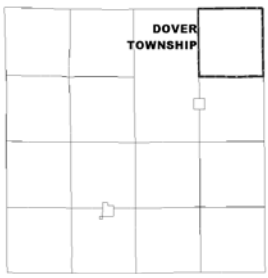
3.02 Cherry Valley Township



Cherry Valley Township is located in the southeast quarter of Lake County. Its southern border is US-10, which runs westward four miles to Baldwin, and eight miles eastward towards Reed City. Over three fourths of this highly wooded township is included in the Pere Marquette State Forest. The Baldwin River, fed by fresh water swamps and Sanborn Creek, originates here. A thriving lumber community once existed at the junction of US-10 and King's Highway. It was founded in 1874 by Darwin Knight who discovered a large tract of premium white pine in the area. Fond of Oriental religion, he registered the town under the name of Nirvana, Buddhist for "highest heaven." He also built a hotel here called the Indra House, named after the principal god of the Ayran-Vedic religion. At the peak of its existence, the town had eleven saw mills and the Flint & Pere Marquette Railroad running through. The town disappeared following the lumber boom. Today it is a small community of houses, many of which are seasonal use.

The 2010 population of the township was 396, with a population density of 11.1 people per square mile. The summertime population may reach 1,102 people. A total of 139 commuted to work daily, mostly outside the township. In 2010, there were 522 total housing units (14.55 per square mile), of which 178 were occupied and 318 were for seasonal or occasional use. Approximately 1/3 of the housing supply is comprised of mobile homes. Major critical public or private facilities in the township include a natural gas pipeline, a power transmission line, US-10, and a township hall. Major natural terrain features include the Pere Marquette State Forest, the Manise National Forest, and Baldwin River.

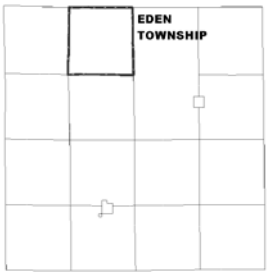
3.03 Dover Township



Dover Township is situated at the northeast corner of Lake County, with Wexford County to the north and Osceola County to the east. It contains the small, unincorporated community of Bristol, which consists of a store and two churches. The town, founded by Bertram B. Payne in 1887, was once larger during the lumbering days. It had a post office that remained open until 1904. The surrounding area is primarily a rural, wooded area with a few small farms. Over half of the township land lies within the boundaries of the Manistee National Forest.

The 2010 population of the township was 395, with a population density of 10.7 people per square mile. A total of 196 communited to work daily, mostly outside of the township. In 2010, there were 370 total housing units (10 per square mile), of which 169 were occupied and 187 were for seasonal or occasional use. Approximately 1/3 of the housing supply is comprised of mobile homes. With the exception of the Lake Olga Dam and a township hall, there are no major critical public or private facilities in the township. Major natural terrain features include portions of the Manistee National Forest, the Pere Marquette State Forest and the Pine River.

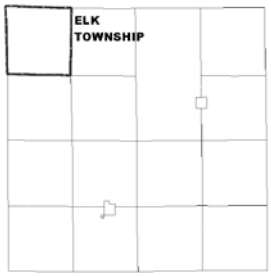
3.04 Eden Township



Eden Township is located in the northwestern quarter of Lake County. It was first settled in 1877 when the lumber town of Willville, later renamed Eden, was built. Shortly afterwards, the Chicago & Western Michigan Railroad, (later Pere Marquette Railroad) built a line to the area. The community of Irons was settled in 1894, and named after a family of early settlers to the area. Irons is a seasonal tourist town that attracts many summer visitors to its horse arena and surrounding recreation areas. Almost the entire township is located within the borders of the Manistee National Forest.

The 2010 population of the township was 487, with a population density of 13.4 people per square mile. A total of 80 persons commuted to work daily, mostly outside of the township. In 2010, there were 793 total housing units (21.8 per square mile), of which 228 were occupied and 544 for seasional or occasional use. Because there is more than twice the number of seasonal homes than regularly occupied homes, the township's summertime seasonal population may increase to around 1,651 people. Almost 1/2 of the entire housing supply is comprised of mobile homes. Major critical public or private facilities in the township include the Irons Fire & Rescue Station #2, a U.S. Post Office, M-37, a township hall and a power transmission line. Major natural terrain features include portions of the Manistee National Forest, the Pere Marquette State Forest and the Little Manistee River.

3.05 Elk Township



Elk Township is located in the northwest corner of Lake County, nestled within the Manistee National Forest. This area is full of resorts and summer cottages, centered around a chain of several dozen lakes that run south into adjoining Sauble Township.

The 2010 population of the township was 985, with a population density of 26.8 people per square mile. A total of 283 persons commuted to work daily, mostly outside the township. In 2010, there were 1,589 total housing units (43.2 per square mile), of which 492 were occupied and 1,029 were for seasonal or occasional use. Because there is almost twice the number of seasonal homes than regulary occupied homes, the township's summertime seasonal population my increase to over 3,033 people. Almost 1/3 of the housing supply is comprised of mobile homes. With the exception of a power transmission line and township hall, there are no major critical public or private facilities in the township. Major lakes include Little and Big Bass Lakes, Elbow Lake, Loon Lake and Harper Lake. The Little Manistee also runs northwest through the township, making for great canoeing and fly-fishing.

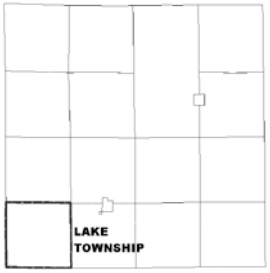
3.06 Ellsworth Township

Ellsworth Township is located in the northeastern quarter of Lake County. Settled in 1867, it was named after Colonel Ephriam Alexander Ellsworth, the first Union officer killed during the Civil War. He was commander of the New York Zouaves, with which the First Michigan Infantry Regiment at Alexandria, Va. fought side-by-side. The land consists primarily of small farms, with the village of Luther on its western border and Osceola County on its eastern

border. The Little Manistee River, considered one of the better trout streams in the area, flows through the township as well.

The 2010 population of the township 817, with a population density of 23.1 people per square mile. A total of 222 persons commuted to work daily, mostly outside the township. In 2010, there were 622 total housing units (17.6 per square mile), of which 340 were occupied and 237 were for seasonal or occasional use. Major critical public or private facilities in the township include the township hall, a power transmission line, and the Historic John & Katharine Tunkun Podjun Farm. Major natural terrain features include portions of the Pere Marequette State Forest, Pine River, and Little Manistee River.

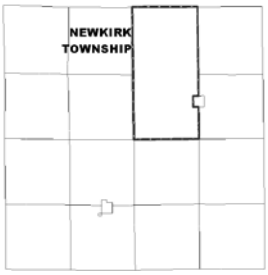
3.07 Lake Township



Lake Township is situated in the southwestern corner of Lake County. Lumbermen first settled this area shortly after the Civil War. In 1867, 12 Union Army veterans of a unit from St. Lawrence County, New York, came here filing timber claims. Named Carr's Settlement, after their leader Charles Carr, it lasted until all the lumber was harvested. It was located at what is today the junction of Tyndall Road and 64th Street. About one half of the township now lies within the Manistee National Forest. The other half consists of a chain of lakes, which contributed to the naming of the County. Big Star Lake is the largest, covering over two square miles. The Pere Marquette River briefly cuts through the northeast corner of the township as well.

The 2010 population of the township was 862, with a population density of 23.9 people per square mile. A total of 205 persons commuted to work daily, mostly outside of the township. In 2010, there were 2,341 total housing units (65 per square mile), of which 437 were occupied and 1,832 were for seasonal or occasional use. Because there is more than four times the number of seasonal homes than regularly occupied homes, the township's summertime seasonal population may increase to around 4,471 people. Almost ¼ of the housing supply is comprised of mobile homes. The major critical public or private facilities in the township are the Lake Township Fire & Rescue, emergency Siren, and township hall.

3.08 Newkirk Township



Newkirk Township is located in the northeastern quarter of Lake County. Until being completely harvested in the late 1800's, this area once contained one of the best tracts of mature white pine trees in Michigan. The swift deforestation of the township was aided by the construction of the Grand Rapids & Indiana Railroad. Today this double-sized township, (12 X 6 square miles), is basically an uninhabited area consisting of freshwater swampland, scrub brush, woods and an occasional farm. Most of the township is scattered with portions of the Pere Marquette State Forest. The Pine River runs through its northeast corner, and the Little Manistee River bisects the southern half of the township as it flows westward from the Village of Luther.

The 2010 population of the township was 632, with a population density of 8.7 people per square mile. A total of 204 persons commuted to work daily, mostly outside of the township. In 2010, there were 860 total housing units (11.8 per square mile), of which 302 were occupied and 502 were for seasonal or occasional use. Over 1/3 of the housing supply is comprised of mobile homes. A power transmission line, the Little Widewaters Flooding Dam, and a township hall are the only major critical public or private facilities in the township.

3.09 Peacock Township

Peacock Township is located in the northwestern quarter of Lake County. It began as a lumbering community in 1897 when the Chicago & Northwestern Railroad built a line through the area. It was named after David J. Peacock, who was the first postmaster. Today, over 80 percent of the township is located

within the boundaries of either the Manistee National Forest or the Pere Marquette State Forest. Its main feature is Wolf Lake, Michigan's shallowest inland lake, with a maximum depth of seven feet. Several resorts, cottages and restaurants can be found along M-37 near the lake. The Little Manistee River also runs through the northern section, crossing M-37.

The 2010 population of the township was 492, with a population density of 13.7 people per square mile. A total of 74 persons commuted to work daily, mostly outside of the township. In 2010, there were 1,132 total housing units (31.6 per square mile), of which 245 were occupied and 841 were for sesonal or occasional use. Because there is almost four times the number of seasonal homes than regularly occupied homes, the township's summertime seasonal population may increase to around 2,182 people. Over 1/3 of the housing supply is comprised of mobile homes. Major public or private facilities located in Peacock are the Lake County EMS 2, M-37, the M-37 bridge over the Little Manistee River, a township hall, and one major employer. Major natural terrain features include the Manistee National and Pere Marquette State Forests, Wolf and Syers Lakes, and the Pere Marquette River.

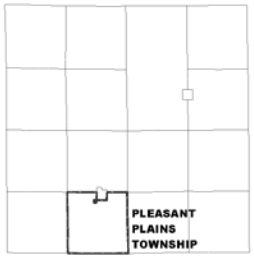
3.10 Pinora Township

Pinora Township is located in eastern Lake County, along the Osceola County border. It is a scenic, hilly area on high ground, dotted with fields, forests, and a couple of small lakes. The township is sparsely populated, consisting mainly of farms and small cattle ranches, along with some cabins and summer cottages. About one fourth of the township is included in the Pere Marquette State Forest. The township building is located on Deer Lake Road, three miles north of US-10.

The 2010 population of the township was 717, with a population density of 20.1 people per square mile. A total of 282 persons commuted to work daily, mostly outside the township. In 2010, there were 461 total housing units (12.9 per square mile), of which 286 were occupied and 147 were for seasonal or occasional use. Over 1/3 of the housing supply is comprised of mobile homes. The major critical public or private facilities include a natural gas pipeline, a power transmission line, and a township hall. Major natural terrain features include the Manistee National and Pere Marquette State Forests and Sandborn Creek.

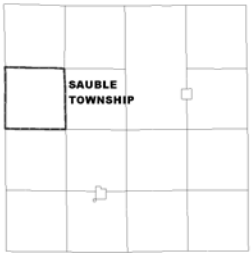
3.11 Pleasant Plains Township

Pleasant Plains Township is located in southern Lake County. It is bisected by M-37, which runs south into Newaygo County and north into Baldwin. This township contains many small lakes and streams, as well as the Pere Marquette River. It is a popular tourist area, especially suitable for canoers and fly-fishermen. A major point of interest includes the Shrine of the Pines, a unique and historical log cabin on the Pere Marquette River, located a few miles south of Baldwin. Over half of the Township is located within the borders of the Manistee National Forest. Township offices are located in Baldwin, which lies on the township's northern border.



The 2010 population of the township was 1,581,with a population density of 44.8 people per square mile. A total of 371 persons commuted to work daily, mostly outside of the township. In 2010, there were 1,676 total housing units (47.5 per square mile), of which 706 were occupied and 835 were for seasonal or occasional use. Because there are as many seasonal homes as regularly occupied homes, the township's summertime seasonal population may increase to around 3,518 people. Major critical public or private facilities include the Danaher Lake Dam, Baldwin Municipal Airport, the Marquette Rail railroad, US-10, M-37, M-37 bridges over the Pere Marquette and Baldwin Rivers, a township hall, the Marlborough Historic District and two major employers. The major natural terrain features include the Manistee National Forest and the Baldwin and Pere Marquette Rivers.

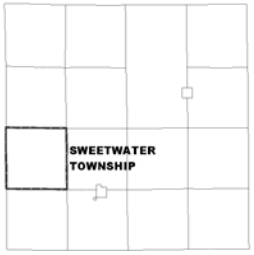
3.12 Sauble Township



Sauble Township is located in the northwestern quarter of Lake County within the Manistee National Forest boundaries. Its borders include Mason County to the west, Elk Township to the north, Peacock Township to the east, and Sweetwater Township to the south.

The 2010 population of the township was 333, with a population density of 9.6 people people per square mile. A total 127 persons commuted to work daily, mostly outside of the township. In 2010, there were 688 total housing units (19.9 per square mile), of which 179 were occupied and 481 were for seasonal or occasional use. Because there is more than twice the number of seasonal homes than regularly occupied homes, the township's summertime seasonal population may increase to around 1,228 people. Almost ¼ of the housing supply is comprised of moble homes. The only major critical public or private facilities in the township are the Irons Fire & Rescue Station #1, and a township hall. Major natural terrain features include the Sauble River and the Mainistee National Forest.

3.13 Sweetwater Township



Sweetwater Township is located in the southwestern quarter of Lake County, bordering Mason County. The land was first settled around 1873 by Benjamin Barnett, who built a hotel for lumbermen in a small community on the Mason/Lake County line at US-10 named Branch. It was named after the north branch of the Pere Marquette River. The Pere Marquette Railroad built a line to the area in 1876. A post office was opened at approximately the same time, with Barnett as the postmaster. Today, the township is bisected by US-10. Over three fourths of this Township is situated in the Manistee National Forest. The Pere Marquette River Flows through here providing many outdoor recreation opportunities.

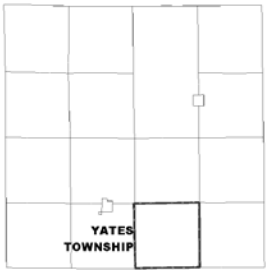
The 2010 population of the township was 248, with a population density of 6.8 people per square mile. A total of 49 persons commuted to work daily, mostly outside the township. In 2010, there were 364 total housing units (10.2 per square mile), of which 116 were occupied and 206 were for seasonal or occasional use. Because there is almost twice the number of seasonal homes than regularly occupied homes, the township's summertime seasonal population may increase to around 825 people. About 1/3 of the housing supply is comprised of mobile homes. Major critical public or private facilities in the township include a U.S. Post Office, US-10, a natural gas pipeline, a township hall, and Marquette Rail railroad. Major natural terrain features include the Pere Marquette River and Manistee National Forest.

3.14 Webber Township

Webber Township is located in the southwestern quarter of Lake County, bordered on the south by the Village of Baldwin and Pleasant Plains Township. It contains the junction of M-37 and US-10. Over three quarters of the township is included in either the Pere Marquette State Forest (to the east) or the Manistee National Forest (to the west). It also contains several lakes, including Leverentz Lake and Government Lake.

The 2010 population of the township was 1,699, with a population density of 47.9 people per square mile. A total of 378 persons commuted to work daily, mostly outside of the township. In 2010, there were 1,513 total housing units (42.6 per squre mile), of which 664 were occupied and 583 were for seasonal or occasional use. About 1/3 of the housing supply is comprised of mobile homes. Major critical public or private facilities in the township include the Webber Township Fire Department, Lake County Care Center (medical facility), Michigan DNR Baldwin Field Office, North Lake Correctional Facility (currently closed), a natural gas pipeline, the NOAA transmission tower and 5 major employers. Major natural terrain features include the Baldwin River and Manistee National Forest.

3.15 Yates Township



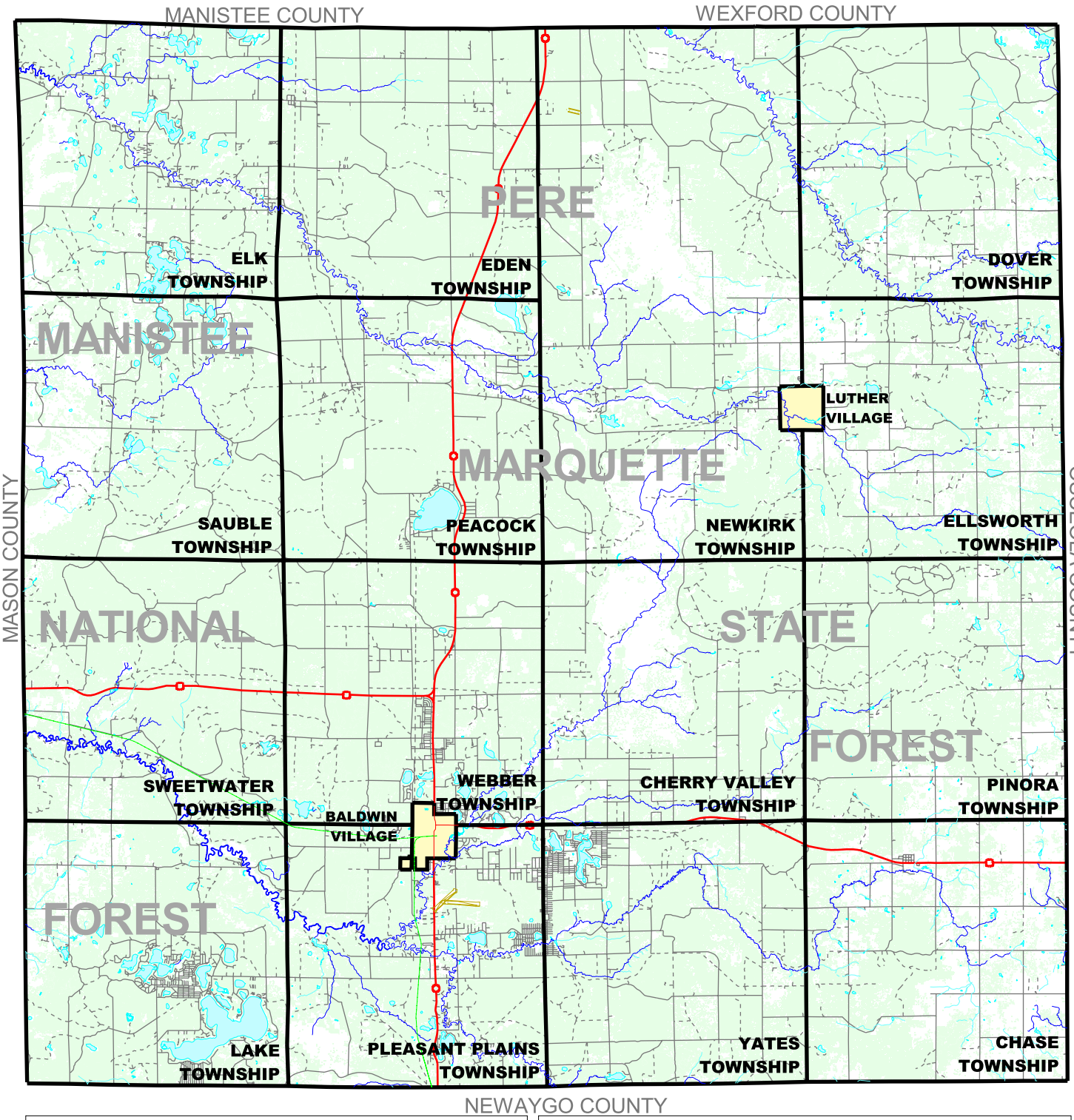
Yates Township is located in the southeastern quarter of Lake County within the Manistee National Forest. Its borders include Newaygo County to the south, Chase Township to the east, Cherry Valley Township to the north, and Pleasant Plains Township to the west. The township has the unincorporated community of Idlewild located within its borders.

The 2010 population of the township was 761, with a population density of 21.3 people per square mile. A total of 76 persons commuted to work daily, mostly outside the township. In 2010, there were 1,454 total housing units (40.7 per square mile), of which 379 were occupied and 958 were for seasonal or occasional use. Because there is almost three times the number of seasonal homes than regularly occupied homes, the township's summertime seasonal population may increase to around 2,687 people. Major critical public or private facilities include the Yates Township Fire Department, a library, a post office, US-10, a siren at the former fire department, the Lake Connamara Dam, and a power transmission line. Major natural terrain features include the Pere Marquette River Middle Branch, Idlewild Lake, and the Manistee National Forest.

Sources:

- Soil Survey of Lake and Wexford Counties, National Cooperative Soil Survey, August 1985 (p.1-4)
- Lake County Land Use Plan, November 1998
- Lake County Land Use Plan, 2012
- http://www.infomi.com/, 8/5/04
- U.S. Census Bureau, 2010 Census
- Lake County Emergency Management

Lake County
BASE MAP



Legend

- Highways
- Streets/ County Roads
- Two-Track/Seasonal
- Railroads
- Political Boundary
- Airport
- Forest Land
- Village
- Lake
- Drains and Intermit. Streams
- Rivers and Streams

0 2 4 Miles

Souce: Michigan Geographic Data Library
Created by WMSRDC
November 2004

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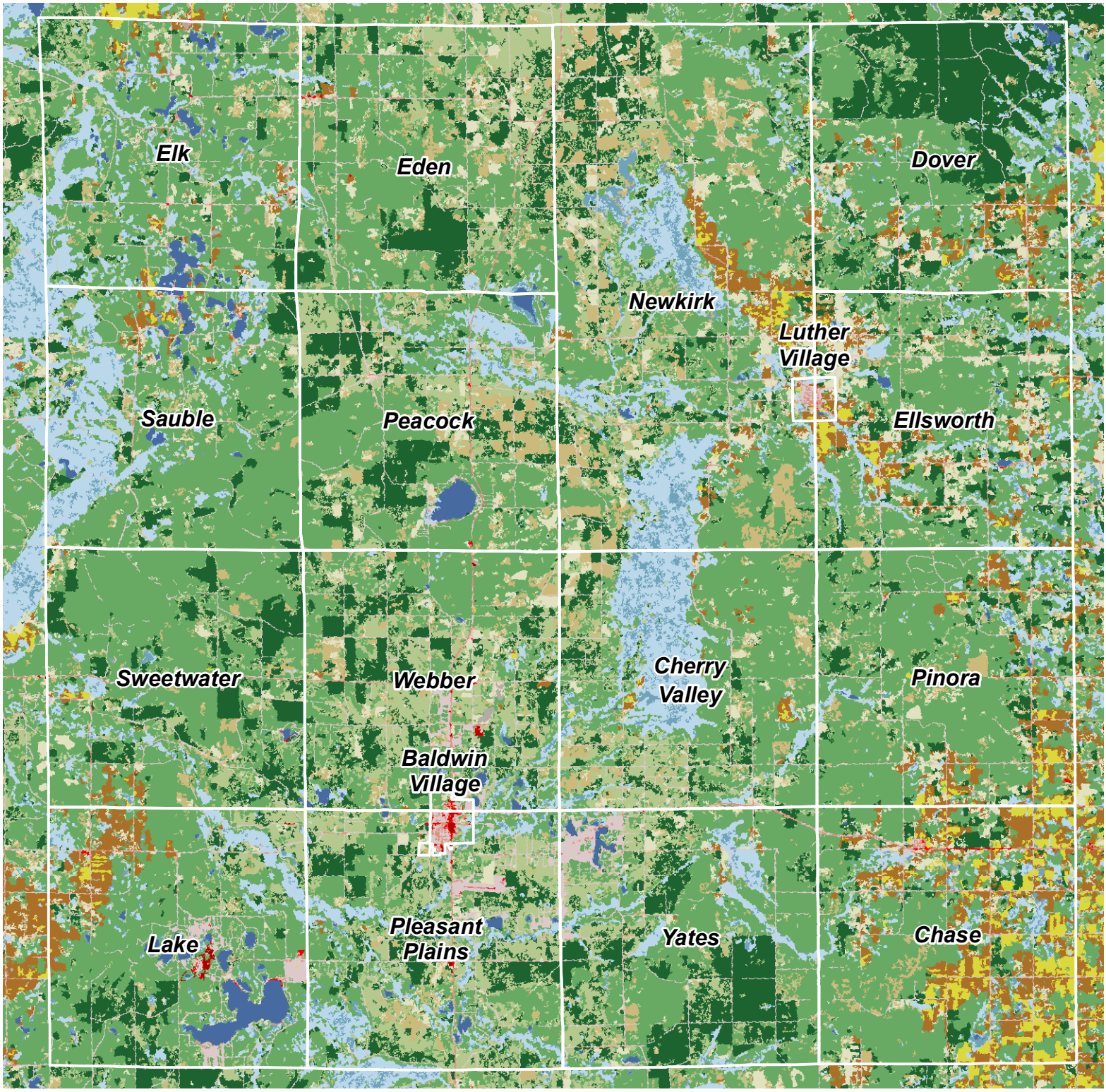
Lake County
2011 Land Cover



NLCD Classifications

- Woody Wetlands
- Unclassified
- Shrub/Scrub
- Open Water
- Mixed Forest
- Herbaceuous
- Hay/Pasture
- Evergreen Forest
- Emergent Herbaceuous Wetlands
- Developed, Open Space
- Developed, Medium Intensity
- Developed, Low Intensity
- Developed, High Intensity
- Deciduous Forest
- Cultivated Crops
- Barren Land

WMSRDC WEST MICHIGAN SHORELINE REGIONAL DEVELOPMENT COMMISSION

Map Created November 2014 Source: MRLC NLCD Database 2011 , MI Geographic Framwork V12

Part C
IDENTIFICATION OF COMMUNITY HAZARDS

(See Appendix B for the Hazard Identification Profile for each local governmental unit in the county)

Although FEMA requires that only natural hazards be addressed in the Hazard Mitigation Plan (44CFR Part 201), the Michigan Department of State Police (MSP) recommends that plans also look at technological and human-related hazards. MSP believes that it is important to discuss **all** known hazards that **could** impact the area, even those that pose no known threat, and to document the analyses on all hazards. Such documentation assures that risks from all hazards were considered and none were overlooked in the hazard analysis.

For hazards that are not considered significant, it is recommended that statements be included to explain why they are not. For example, a nuclear plant located over 50 miles away may not pose a threat to the area. Thus, if Lake County is located over 100 miles away from a nuclear power plant, it is sufficient analysis to state the fact. Further analysis is not required.

The Michigan Hazard Mitigation Plan, 2011 edition (MHMP), produced by the Michigan State Police, Emergency Management and Homeland Security Division (MSP-EMHSD), considers a wide range of potential hazards in the state. The table below reveals the classification of those hazards as presented in the statewide plan.

NATURAL HAZARDS	TECHNOLOGICAL HAZARDS	HUMAN-RELATED HAZARDS
Weather Hazards: ▪ Thunderstorms, including Hail & Lightning ▪ Severe Winter Weather, including Ice, Sleet, & Snow ▪ Severe Winds ▪ Tornadoes ▪ Extreme Temperatures ▪ Fog Hydrological Hazards: ▪ Riverine/Urban Flooding ▪ Great Lakes Shoreline Hazards ▪ Dam Failures ▪ Drought Ecological Hazards: ▪ Wildfire ▪ Invasive Species Geological Hazards: ▪ Earthquakes ▪ Subsidence ▪ Celestial Impact	Industrial Hazards: ▪ Structural Fires ▪ Scrap Tire Fires ▪ HAZMAT – Fixed Site ▪ HAZMAT – Transportation ▪ Nuclear Power Plant Emergencies ▪ Petroleum & Natural Gas Pipeline Accidents ▪ Oil & Natural Gas Well Accidents Infrastructure Problems: ▪ Infrastructure Failures ▪ Energy Emergencies ▪ Transportation Accidents, including Air, Rail, Highway & Marine	▪ Catastrophic Incidents (National Emergencies) ▪ Civil Disturbances ▪ Nuclear Attack ▪ Public Health Emergencies ▪ Terrorism and Similar Criminal Activities

The list above represents a significant expansion and reorganization of potential hazards contained within the MHMP. The hazards addressed in this plan have therefore been expanded and reorganized to remain consistent with the MHMP. Hazard descriptions within this chapter draw heavily upon the wealth of information and data contained within the MHMP. The MHMP can be consulted for information additional to that which is included in this document, especially with regard to hazard analyses conducted at the state-level, as opposed to the county and local levels.

Analysis of each individual natural, technological, and human-related hazard is included in the remainder of this chapter. The analyses are organized alphabetically, and draw heavily on historical records,

especially those of the National Climatic Data Center (NCDC), a division of the National Oceanic and Atmospheric Administration (NOAA). NCDC receives information from the National Weather Service (NWS) and maintains records of tornadoes from 1950, of thunderstorm winds and hail since 1955 and of all storms (including lightning) since 1993. Storm Data are categorized by County or by NWS Forecast Zone. Smaller (areal coverage) events are collected by County for Tornado, Thunderstorm Winds, Flash Floods and Hail events. Larger scale events are collected by NWS Forecast Zone for Heat, Cold, Drought, Flood, Tropical, and Winter Weather events. Lake County is situated in the Southwest Lower Michigan Forecast Area of the NWS, headquartered in Grand Rapids, MI.

A few words of caution: Severe weather observations are strongly population-dependent. The likelihood of a report being made is proportional to population density. Therefore it is likely that many severe weather events in less-populated areas have gone unreported to the NCDC Storm Events Database. This may understate the actual frequency of a particular hazard in a particular area. On the other hand, the observations that are made will tend to come from areas of human development which may be more likely to benefit from hazard mitigation actions.

Preceding the individual analyses is a summary of notable natural hazard events in the county, including Declarations of Major Disasters and Emergencies by the President, as well as Declarations of Disasters by the Governor. A major disaster is defined as "any natural catastrophe (including any hurricane, tornado, storm, high water, wind driven water, tidal wave, tsunami, earthquake, volcanic eruption, landslide, mudslide, snowstorm, or drought), regardless of cause, any fire, flood, or explosion, in any part of the U.S. which in the determination of the President causes damage of sufficient severity and magnitude to warrant major disaster assistance under this Act to supplement the efforts and available resources of states, local governments, and disaster relief organizations in alleviating the damage, loss, hardship, or suffering caused thereby." An emergency is defined as "any occasion or instance for which, in the determination of the President, federal assistance is needed to supplement state and local efforts and capabilities to save lives and to protect property and public health and safety, or to lessen or avert the threat of a catastrophe in any part of the U.S."

Significant Updates

While the general format of this chapter has remained the same, a number of significant updates have been made. Five new hazards have been introduced to the plan, increasing the total number of hazards addressed within to 31. These additional hazards include Celestial Impacts, Fog, Invasive Species, Energy Emergencies, and Catastrophic Incidents.

Further, a number of hazards have been renamed or reorganized. For example, "Flooding: Shoreline" is now considered "Great Lakes Shoreline Hazards" and "Snow/Ice/Storms" is now "Winter Weather." "Land Subsidence" is now simply "Subsidence," and has been classified under Natural Hazards, rather than Technological Hazards. Lastly, "Weapons of Mass Destruction/Terrorism Incidents" has been revised to "Terrorism and Similar Criminal Activities."

Where appropriate, other updates within this chapter include: revisions to hazard descriptions; inclusion of recent hazard events, or additional events identified by research; and adjustments to "Frequency of Occurrence."

Historically Significant Natural Hazard Events

Drought:

- Droughts lasting eight or more months (12): 1895-96, 1899-1900, 1901-02, 1909-11, 1925-26, 1930-31, 1956-57, 1962-63, 1971-72, 1976-77, and 2002-03.

Extreme Temperatures:

- February 10-13, 1899: Record cold. Consecutive lows of -36, -49, -48, and -37, Village of Baldwin.
- July 1936: Heat wave. 570 deaths statewide, 364 in Detroit.
- Summer 1988: 39 days in Michigan with temperatures over 90 degrees Fahrenheit.
- March 2012: Record warmth. Early growing season led to $209.8m crop losses in Michigan.

Floods (shoreline, riverine, urban):

- September 10-19, 1986: Flooding. Gubernatorial Disaster Declaration, Presidential Major Disaster Declaration
- February 10, 2001: Flooding. $100k property damage across western Lower Michigan.
- May 21-23, 2004: Flooding. $25m property damage, $4.6m crop damage across western Lower Michigan.
- June 6-13, 2008: Flash flood. Presidential disaster declaration. $2m property damage and $500k crop damage, Northwest Lake County.
- May 3, 2012: Flash flood. $70k property damage, Lake County.
- April 17-23, 2013: Flooding. $3m property damage, Lake County.

Thunderstorm Hazards (severe winds, tornadoes, hail, lightning):

- May 31, 1998: Severe thunderstorm winds. Local state of emergency and $1.1m property damage, Lake County.
- August 9, 2000: 1.75 inch hail. $50k property damage, $25k crop damage, Village of Luther.
- August 30, 2001: Severe thunderstorm winds. $100k property damage, Pleasant Plains and Yates townships.
- July 26, 2005: Tornado, EF-1. $150k property damage, $50k crop damage, Lake Township.
- May 3, 2012: Strong thunderstorms. $500k property damage, Lake County.
- August 7, 2013: Severe thunderstorm winds. $100 property damage, Lake County.
- November 17, 2013: High wind. $75k property damage, Lake County.

Severe Winter Weather (ice, sleet, snow storms):

- January 26, 1978: Blizzard, snowstorm. Declaration of statewide emergency by President. Declaration of statewide disaster by Governor.
- January 12-21, 1994: Heavy lake effect snow. $500k property damage, western Lower Michigan.
- January 27, 1994: Heavy snow and freezing rain. $5m property damage across region.
- March 9, 1998: Winter storm. $100k property damage across region.
- January 2-25, 1999: Blizzard, lake effect snow. “Blizzard of ‘99”. Southern Lower Michigan.
- April 3, 2003: Ice storm. $4.9m property damage throughout West Michigan.
- December 11, 2010: Winter storm. $250k property damage across Lower Michigan.
- March 2-3, 2012: Heavy snow. $100k property damage, power outages, and shelters opened in Lake County.

Wildfires:

- October 1871: Wildfires. 1.2m acres burned, 200 fatalities, Lower Peninsula.
- May-September, 1891: Uncontrollable wildfires across Michigan during the drought of 1891.
- 1994: County Line Fire. 900 acres burned, Pleasant Plains Township.
- May 9, 2011: 8th Street Fire. 153 acres burned, Newkirk Township.

1.0 NATURAL HAZARDS

1.01 CELESTIAL IMPACT

An impact or threatened impact from a meteorite, asteroid, comet, satellite, space vehicle, space debris, solar storm, or similar phenomena that may cause physical damages or other disruptions.

Summary: Historically, celestial impact has not been considered as a significant hazard in Lake County. However, this hazard is discussed by the Michigan Hazard Mitigation Plan and is summarized in this plan to increase awareness among emergency responders, public safety officials, and community leaders. The following hazard description is only a portion of the information contained within the state plan, which can be referenced for additional information.

The most likely effect of celestial impacts in Lake County appears to be "space weather" generated by the sun. This is considered relevant to Lake County primarily for its potential to disrupt complex modern communication systems (i.e. satellites, television, radio, GPS, power supply networks), as well as the extensive human and technological infrastructure that rely upon those communication and utility networks. Physical collision of an object on the Earth's surface, although potentially devastating or even catastrophic, is considered to be significantly less likely.

Hazard Description: The celestial impact hazard primarily concerns the effects of large forces (from objects or energy) upon the Earth or its atmosphere. Most such forces are extraterrestrial in origin—meteors (which burn up in the atmosphere) or meteorites (which impact physically upon the ground) that were originally asteroids or comets from elsewhere in the solar system. Even in cases where no meteorite actually strikes the ground, the explosive energies from the meteor's impact upon the many layers of atmosphere can create an intense heat and blast area, along with very strong winds, and can release more energy than even the largest nuclear bombs. Massive or fast moving bodies that impact upon either the ground, the oceans, or the atmosphere can cause widespread destruction and disruption of both human and natural systems, including secondary hazards such as earthquakes, volcanoes, tsunamis, and severe winds.

Although it has been estimated that a major impact from a physical body upon the Earth occurs approximately once per century, recent discoveries (and the fact that human activities continue to expand across the Earth's surface) have increased concern over this hazard. Celestial objects are more likely to strike a body of water rather than land because, according to the United States Geological Survey (USGS), approximately 70% of the Earth's surface is water. This should not underscore the potential effects an ocean strike can have upon land, such as widely damaging tsunamis and seismic activity.

Much more common than physical collisions is the flare-up of energy and charged particles that are emitted and ejected by the Sun towards the Earth. Solar flares and storms (also known as "space weather") are highly relevant for their potential impacts and possible disruption of these complex modern communication systems—satellites, television, radio, GPS, power supply networks, and the extensive human and technological infrastructure that relies upon those communication and utility networks. The space weather hazard is far more likely to cause disruptive effects, economic impacts, and risks to human life in the near term. The effects of space weather have already had strong impacts upon Michigan within the normal historical timeframe typical for this type of plan.

The following discussion of asteroids, comets, and space weather is provided primarily to be "on the safe side" so that readers and emergency managers can be well-informed in the event that a very serious incident does occur, or threatens to occur.

Asteroids: Most asteroids are located in the main asteroid belt and have well-defined orbits there between 200 and 310 million miles from the Sun, but thousands of asteroids also exist in other

parts of the solar system. There are groups of "Trojan" asteroids that share an orbit with Jupiter, for example, located 60 degrees both ahead of and behind that planet itself while going around the Sun. Asteroids that have paths which cross over Earth's orbit are classified as Near-Earth Objects (NEOs), and are called Apollo asteroids. Two other types of NEOs are Amor asteroids, which approach the Earth's orbit from positions outside of it, and Aten asteroids, which approach the Earth's orbit from the direction of the Sun. As of January 2009, there were 6,021 NEOs identified, of which 1,026 were classified as posing the possibility of threat (having the potential to come within 466,000 miles of the Earth's orbit). The typical asteroid would impact upon the Earth at an angle of 45 degrees and a speed of 10 miles per second.

Comets: More than 99% of all meteorites come from asteroids, but some comet impacts have also been confirmed (9 are known, constituting less than 0.03% of all meteorites). The main difference between comets and asteroids is that comets tend to have elliptical orbits that carry them out beyond the "nebular frost line" (located in the main asteroid belt, about 250 million miles from the Sun) and thus their composition includes a substantial amount of icy and frozen matter. Comets usually lose about 0.1% of this matter each time they pass by the sun, due to the effects of warming and the pressure of solar radiation, and this matter trails behind them in their long "tails," which include charged particles (with associated magnetic fields) and can stretch across many tens of millions of miles of space. Where such tails cross the Earth's orbit, this matter (typically small and harmless to us) generates sometimes spectacular "meteor showers" as it periodically burns up in the Earth's atmosphere at regular times during the year. After a certain number of orbits, however, the comet simply breaks apart. Even if less dense than the average asteroid, a comet's heavy nucleus can be sizeable (from several hundred meters to over 40km in diameter), and a comet impact upon the Earth would typically occur at a speed of 31 miles per second—about three times as fast as the average asteroid, with a proportionally larger momentum of destructive energy if the amount of mass is the same. (It is worth noting here that the maximum impact upon the Earth for any object orbiting the Sun would be no more than 44.5 miles per second.)

Comets are classifiable by their orbital period, with long period comets taking more than 200 years to travel around the Sun, and short period comets taking less than that. The short period comets are further subdivided into Halley-type comets with orbital periods between 30 and 200 years, and Jupiter-type comets with orbital periods of less than 30 years. Long period comets originate in the farthest reaches of the Solar System (the Oort Cloud) and approach the Sun and Earth from any direction, while short period comets originate from the "Kuiper Belt" that exists beyond Neptune and is approximately in the same plane as all of the major planets.

A physical impact by a celestial object that is either sufficiently massive or fast-moving can cause effects comparable to any number of other hazards described in this plan. For example, it could compare to a nuclear blast in terms of the amount of energy released in the form of pressure (shock) waves and thermal effects (heat/fire). Additionally, major earthquake activity would be felt in areas that normally wouldn't have had to worry about such effects. An impact into any major water body (including the Great Lakes) can cause tsunamis and significant shoreline flooding, and severe winds could also result in extensive physical damages many miles (or hundreds of miles) from the main impact site. Depending upon the mass and velocity of the meteorite, the effects on the public may range from barely noticeable to complete destruction in a given area.

If advance notice of an approaching meteor, asteroid, or comet is available, then widespread alerts may be distributed, similar to when the explosive breakup of the Space Shuttle Columbia in 2003 prompted warnings and alerts across the southwestern U.S. due to the possible effects of falling debris. In this case, debris needed special handling for both investigation purposes and out of concern of exposure to hazardous substances. The threat of a celestial impact could be much more dangerous and far-reaching. One clear example of the potential damage was seen in the impact of

the comet Shoemaker-Levy 9 on the planet Jupiter, in 1994, which resulted in blasts that were estimated as the equivalent of ten million megatons of explosives. In comparison, the 1979 Mount St. Helens eruption was roughly 5 megatons, and the 1885 Krakatoa eruption in Indonesia was about 100 megatons. Following the Shoemaker-Levy comet impact, Congress authorized new research to analyze this type of celestial impact hazard.

Space Weather: The Sun does not "burn" in the sense that we usually experience that common heat-generating process on Earth, but rather emits huge amounts of energy from the continuous processes of nuclear fusion that take place in the Sun's core. The gravitational pressures of the Sun's enormous mass, pulling toward itself, are thus generally offset by outward pressures from the fusion processes that take place at its core. Enormous amounts of energy are radiated from the Sun, including the spectrum of electromagnetic waves up through gamma wave frequencies. These include infrared (heat) radiation, ultraviolet, all colors of visible light, x-rays, microwaves, and radio waves. The intensity of these forms of radiation varies, and gamma waves are normally only emitted during solar flare events (to be explained shortly). It should also be understood that in the midst of all these solar interactions of matter and energy are powerful magnetic forces, which also affect the distribution of heat energy in and around the Sun and sometimes cause cooler areas, called sunspots, to form for a while, readily visible even with crude forms of observational equipment. (Although an observer should never look directly at the Sun, a pinprick of solar light projected onto a surface provides one basic means of seeing a Solar image). The relatively low temperatures of sunspot areas, however, are coupled with a rise in energy above the Sun's surface. Solar prominences are arches of plasma that soar above the Sun's surface, in a pattern that is itself shaped by the powerful magnetic fields present. In some cases, these magnetic fields have become too twisted to maintain such forces within these ordinary patterns, and a solar flare is generated, which releases a huge amount of energy from the Sun. Normally, a solar wind exists in the form of milder pressures exerted by emitted photons, ions, and other particles that flow outward from the Sun until they are eventually halted (beyond the orbit of Neptune, at an area called the heliopause) by the pressure of interstellar gases. Within the realm of the Sun's planets, however, the solar wind is an ongoing feature of the space environment, constantly sending energy and charged particles outward.

Space weather is a term that denotes the impacts of the Sun's activity upon the bodies within this sphere inside the heliopause, including our own Earth. As with the weather on Earth, there are some clear patterns that are exhibited by space weather. More turbulent space weather is produced during times when more sunspots are present (called a solar maximum), and space weather is calm during times when sunspots are rare and small (or not even seen to be present at all, called a solar minimum). A sunspot cycle exists, in which sunspot activity regularly shifts between a minimum and maximum level. As with our Earthly seasons, however, it cannot be known in advance exactly how turbulent or calm things will be at a given moment during the sunspot cycle—only that calmer periods regularly give way to more turbulent periods. As to the regularity of the sunspot cycle itself, although it has been found that the average amount of time between a solar minimum and a solar maximum is about 11 years, the actual length varies quite a bit within each cycle. The interval is sometimes as long as 15 years and sometimes as short as 7 years. In addition, it has been observed that long periods can occur with little or no sunspot activity. The "Maunder minimum," which occurred between the years 1645 and 1715, is the primary example of such long-term variation from the normal cycle, but it is not yet known what caused it, or when it might recur. The Earth's atmosphere serves as a shield for us against many types of particles and radiation zipping across space, and Earth also has a magnetosphere that similarly provides protection against most of the charged particles traveling through space. There are some weak spots in the Earth's magnetic field, however, that exist near its two magnetic poles and allow many ions to penetrate, where they collide with atoms in the Earth's upper atmosphere and glow to produce the beautiful auroras in the skies of the arctic regions of the north and south. In addition, the Earth is surrounded by "belts" of charged particles (called Van Allen belts) which

are hazardous to spacecraft and astronauts. These are known and predictable conditions of calm space weather, however, and the actual hazard is the turbulence that is generated by large solar flares, causing problems with radio communications, damage to satellites, and even disruptions in power delivery networks on the Earth. As of early 2011, sunspot cycle number 24 proceeded from a solar minimum that was reached in December 2008, and was projected to transition to a solar maximum by the middle of 2013.

Another type of solar disturbance is a coronal mass ejection (CME), in which built-up pressures cause the sudden release of gases and magnetic fields at tremendous speeds, with impacts that reach far across interplanetary space. Like solar flares, CME events are a source of geomagnetic storms on Earth (usually 1 to 4 days after the solar event), and occur more frequently during periods with more sunspots. An additional effect of space weather involves increased exposure to ionizing radiation, especially to those in aircraft at high altitudes and along polar flight paths. Extra costs in fuel and delays are imposed upon airlines during periods of harmful space weather.

Space weather may result in the disruption of transportation and communication systems, and in some cases may result in fatal transportation accidents, economic losses, and widespread power supply interruptions. A catastrophic physical impact event would require extensive use of mutual aid and state/federal disaster and emergency assistance, with the likelihood that all normal response resources would be disabled within the area of impact, and would need to be replaced by resources from adjacent local areas, or even from beyond the state. In addition, an extremely large impact, even if not in Michigan, could cause a National Emergency situation to arise, which Michigan may have to help to respond to and recover from (please refer to the chapter on National Emergencies).

Historically Significant and Related Events: The Michigan Hazard Mitigation Plan includes an extensive list of historical celestial impacts and solar weather events. A few of these are included below to provide examples of potential effects of this hazard.

March 19, 1996 – International

A celestial "close call" involved asteroid 1996 JA1 (large enough to cause catastrophic damage), which came within 280,000 miles—nearly as close as the Moon.

Feb 1, 2003 – National

The Space Shuttle Columbia broke apart violently when returning from a mission, causing a widespread alert about the potential for falling debris across the southwestern United States. More than 2,000 debris impact sites were eventually reported, but fortunately these were predominantly in sparsely populated areas. NASA issued warnings that the shuttle debris could contain hazardous materials and that it should remain untouched (and instead reported to authorities upon discovery).

March 26, 2003 – "Park Forest event" in Suburban Chicago, Illinois

Hundreds of meteorites fell across residential areas in the suburbs of Chicago. This event was highly unusual, having been described as "the most densely populated region to be hit by a meteorite shower in modern times." Coincidentally, the area of impact was in the midst of numerous highly-trained experts associated with the University of Chicago and other scientific institutions. The original meteoroid was calculated to have been between 1 and 7 thousand kilograms (possibly more) before it broke apart in the atmosphere. About 30 kilograms of meteorite fragments were recovered, with the largest weighing 5.26kg. Numerous holes were punched through windows, roofs, and ceilings in homes, and also a fire station. One roof hole was caused by a meteorite that weighed only 545 grams. There were about 18 documented fragments of about that size or larger across a couple of square miles of neighborhoods.

December 2005 – International

A geomagnetic storm caused the disruption of satellite-to-ground communications and GPS (Global Positioning System) navigational signals. Although this disruption only lasted about 10 minutes, it threatened the safety of commercial air flights and marine traffic during that time.

September 20, 2007 – Southern Peru

After a loud explosion was heard, residents of an isolated village found a large crater measuring 41 feet in diameter near Lake Titicaca and filled with water. A 1.5 magnitude earthquake was detected in the area.

The unusual aspect of this incident is that many villagers subsequently reported symptoms such as headaches and nausea. It has been proposed that the impact of a meteorite, along with the heat that was generated, caused the release of toxic fumes from the ground.

Frequency of Occurrence: It is likely that the next major celestial physical impact will occur somewhere in the world other than Michigan, and that Michigan's role as part of the United States would at most involve the provision of support to the impacted areas. If a major impact happens to occur in North America, state-level mutual aid may result, and possibly even the intake of evacuees, as had taken place during the Katrina and Rita hurricane disasters of 2005.

The space weather hazard, by contrast, is likely to cause one or more serious infrastructure failures in the near future, due to the extent of our reliance on complicated electronic and satellite systems that are vulnerable to disruption. In addition to power failures and phone communication breakdowns, it is also quite possible for the disruption of radio and navigational systems to cause risks for air and marine traffic. Even if cautious transportation providers are diligent about maintaining safety during such events, considerable economic impacts and delays can result from the electronic breakdowns caused by solar geomagnetic storm events.

1.02 DROUGHT

A water shortage caused by a deficiency of rainfall, generally lasting for an extended period of time.

Summary: Lake County is located near the world's fifth largest body of fresh water, yet is still vulnerable to drought. Droughts experienced in Michigan can cause significant economic losses and increase the likelihood of brush and forest fires. The gradual and unpredictable onset and recession of a drought, combined with the relative impacts it may have from location to location, complicate mitigation efforts for this hazard.

Hazard Description: Drought is the consequence of a natural reduction in the amount of precipitation expected over an extended period of time, usually a season or more in length. Drought is a normal part of the climate of Michigan and of virtually every climate around the world – including areas with high and low average rainfall. In low rainfall areas, drought differs from normal arid conditions in that the extent of aridity exceeds even that which is unusual for the climate. The severity of a drought depends not only on its location, duration, and geographical extent, but also on the area's water supply needs for human activities and vegetation. This local variation of drought standards makes the hazard difficult to define a drought and assess when and where one is likely to occur.

Drought differs from other natural hazards in several ways. First, droughts lack an exact beginning and ending, as effects may accumulate slowly and linger long after the event is generally considered over. Second, the lack of a clear-cut definition of drought can make it difficult to confirm whether one actually exists, and/or its degree of severity. Third, drought impacts are often less obvious than other natural hazards, and are typically spread over a larger geographic area. Fourth, due primarily to the aforementioned reasons, most communities do not have a drought contingency plan in place. This lack of preparation can hinder support for drought mitigation capabilities that would otherwise effectively increase awareness and reduce drought impacts.

Some of the potential drought impacts on communities and regions include: 1) water shortages for human consumption, industrial, business and agricultural uses, power generation, recreation and navigation; 2) a decrease in quantity and quality of agricultural crops; 3) decline of water quality in lakes, streams and other natural bodies of water; 4) malnourishment of wildlife and livestock; 5) increase in wildfires and wildfire-related losses to timber, homes, and other property; 6) decline in tourism in areas dependent on water-related activities; 7) decline in land values due to physical

damage from the drought conditions and/or decreased economic or functional use of the property; 8) reduced tax revenue due to income losses in agriculture, retail, tourism and other economic sectors; 9) increases in insect infestations, plant disease, and wind erosion; and 10) possible loss of human life due to food shortages, extreme heat, fire, and other health-related problems such as diminished sewage flows and increased pollutant concentrations in surface water.

Although it is difficult to determine when a drought is actually occurring, once a drought is recognized it can be classified within four categories: meteorological, hydrologic, agricultural, and socioeconomic. A *meteorological* drought is based on the degree of dryness, or the departure of actual precipitation from an expected average or normal amount based on monthly, seasonal, or annual periods. These droughts are generally short-lived. A *hydrologic* drought involves the effects of precipitation shortfalls on stream flows and reservoir, lake, and groundwater levels. Human activity, such as land use or dam construction, may exacerbate naturally occurring drought conditions. Onset and recovery of hydrologic droughts typically lag behind the other types of drought. An *agricultural* drought concerns soil moisture deficiencies relative to the water demands of plant life, usually crops. A *socioeconomic* drought is when the effective demand for water exceeds the supply, as a result of weather-related shortfalls.

The U.S. Drought Monitor uses four classifications of severity, from the least intense category (D1) to the most intense (D4), with an additional category (D0) used to designate a "drought watch" area in which long-term impacts such as low reservoir levels are probably present. The Drought Monitor summary map is available online, identifying general drought area and labeling their intensity. While not the only way to characterize droughts, the U.S. Drought Monitor is a standardized and convenient representation of drought conditions which is widely referenced in various reports and assessments. The Drought Monitor is available at the website http://droughtmonitor.unl.edu/.

Another useful index for monitoring drought conditions is the Palmer Drought Severity Index, which was developed in the 1960's. The U.S. Drought Monitor and the Palmer Index are compared in the following table along with other drought indices.

Drought Classification Categories

Category	Description	Possible Impacts	Palmer Drought Index	CPC Soil Moisture Model, USGS Weekly Streamflow, Objective Short & Long-term Drought Indicator Blends (percentiles)	Standardized Precipitation Index (SPI)
D0	Abnormally Dry	Going into drought: short-term dryness that slows planting, growth of crops or pastures. Coming out of drought: some lingering water deficits; pastures or crops not fully recovered.	-1.0 to -1.9	21-30	-0.5 to -0.7
D1	Moderate Drought	Some damage to crops, pastures, streams, reservoirs, or wells low; some water shortages developing or imminent; voluntary water-use restrictions requested.	-2.0 to -2.9	11-20	-0.8 to -1.2
D2	Severe Drought	Crop or pasture losses likely; water shortages common; water restrictions imposed.	-3.0 to -3.9	6-10	-1.3 to -1.5
D3	Extreme Drought	Major crop/pasture losses; widespread water shortages or restrictions.	-4.0 to -4.9	3-5	-1.6 to -1.9
D4	Exceptional Drought	Exceptional and widespread crop/pasture losses; shortages of water in reservoirs, streams, and wells creating water emergencies.	-5.0 or less	0-2	-2.0 or less

Source: Michigan Hazard Mitigation Plan, 2011

Historically Significant and Related Events: To aid the tracking and analysis of drought conditions in the state, the Michigan Hazard Mitigation Plan 2011 edition divided the state into ten climate divisions and analyzed historical data from the National Climatic Data Center (NCDC) dating back to 1895. Lake County is grouped with Mason, Muskegon, Newaygo and Oceana counties in west-central Lower Michigan. The statewide plan lists the following 12 drought events recorded within this division lasting eight months or greater: 1895-1896 (15 months), 1899-1900 (11 months), 1901-1902 (10 months), 1909-1911 (24 months), 1925-1926 (11 months), 1930-1931 (18 months), 1956-1957 (8 months), 1962-1963 (9 months), 1971-1972 (12 months), 1976-1977 (13 months), and 2002-2003 (12 months). The most extreme of these droughts was in January 1931, when the Palmer Drought Severity Index hit a record low of -7.20.

In addition, the Michigan plan identified the percentages of years and months exhibiting a degree of drought in Lake County's climate division. The minimum qualification for drought in this analysis is a Palmer Index of -2.0, which is considered a moderate drought on the U.S. Drought Monitor (category D1).

Percentage of Drought Months and Years, 1895 to 2010
Lake, Mason, Muskegon, Newaygo, and Oceana Counties

	No Drought	Palmer ≤ -2.0	Palmer ≤ -3.0	Palmer ≤ -4.0	Palmer ≤ -5.0	Palmer ≤ -6.0	Palmer ≤ -7.0
Drought Years	43%	57%	29%	12%	2%	2%	1%
Drought Months	77.9%	22.1%	8.2%	2.5%	0.7%	0.4%	0.1%

Source: Michigan Hazard Mitigation Plan, 2011

In August 2012, the United States Department of Agriculture (USDA) issued a Secretarial Designation for all 83 counties in the State of Michigan as primary natural disaster areas for drought and excessive heat conditions which began in March 2012. The counties designated by USDA as natural disaster or contiguous disaster areas means that qualified farm operators are eligible for low interest emergency (EM) loans from USDA's Farm Service Agency (FSA), provided eligibility requirements are met.

Frequency of Occurrence: A review of historic drought events reveals that Lake County is certain to occasionally experience drought. Mild droughts are common, while severe droughts are less frequent and generally of shorter duration. A severe drought in Lake County may significantly lower the water table and pose multiple threats as described in the preceding Hazard Description. Low water levels could possibly hinder water-based recreation and tourism, negatively affect agriculture, increase risk of wildfire, and also affect the drinking water supply.

According to NCDC records, Lake County has experienced drought conditions of eight months or greater 12 times in the 116-year period from 1895 to 2010. Of those events, 11 occurred over three separate spans of 21 years or less: 1895-1911 (4 events, 16 years), 1925-1931 (2 events, 6 years), and 1956-1977 (5 events, 21 years). The outlying event occurred in 2002-2003. Overall, historical trends suggest there is an approximate 10 percent chance of experiencing lengthy drought conditions in any given year.

Drought conditions of shorter duration are more common than lengthy events, as 57 percent of the years from 1895 to 2010 attained a Palmer Index rating of at least -2.0. This statistic however, may overstate the prevalence and effects of drought in Lake County because it fails to address their duration and severity. A more precise indication of drought frequency is revealed in the percentage of months experiencing drought from 1895 to 2010, which is 22.1 percent.

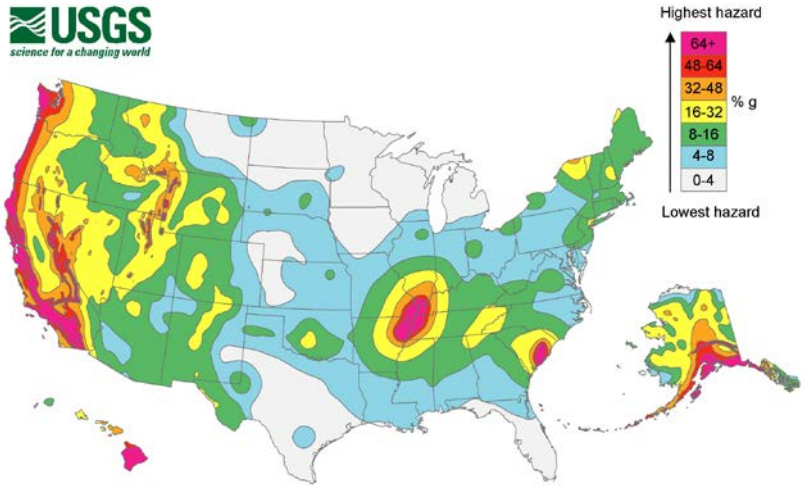
1.03 EARTHQUAKE

A shaking or trembling of the crust of the earth caused by the breaking and shifting of rock beneath the surface.

Summary: The earthquake hazard is low for Lake County. The United States Geological Survey predicts a 2% probability of an earthquake occurring in the next 50 years of a magnitude capable of a peak acceleration of 4% g (gravity). This might cause damage and possible collapse of buildings constructed before 1940.

Hazard Description: Earthquakes range in intensity from slight tremors to great shocks. They may last from a few seconds to several minutes, or come as a series of tremor over a period of several days. Earthquakes, whose energy is released through a series of seismic waves, usually occur without warning. In some instances, advanced warnings of unusual geologic events may be issued. However, it is not yet possible to forecast or predict where an earthquake will occur. Earthquakes tend to strike repeatedly along faults, which are formed where tectonic forces in the earth's crust cause the movement of rock bodies against each other. Risk maps have been produced, such as the map shown below, which show areas earthquakes are more likely to occur. Earthquake monitoring is conducted by the U.S. Geological Survey, the National Oceanic and Atmospheric Administration, and universities throughout the country.

USGS National Seismic Hazard Map



Source: http://earthquake.usgs.gov/hazards/products/

Actual movement of the ground in an earthquake is seldom the direct cause of injury or death. Most casualties result from falling objects and debris. Disruption of communications systems, electric power lines, and gas, sewer and water mains can be expected. Water supplies can become contaminated by seepage around water mains. Damage to roadways and other transportation systems may create food and other resource shortages if transportation is interrupted. In addition, earthquakes may trigger other emergency situations such as fires and hazardous material spills, thereby compounding the difficulties of an emergency situation.

Historically Significant and Related Events: No records were found that document an earthquake or earthquake damage in Lake County. The nearest significant tremors have historically been no closer than the lower third of the state. On August 9, 1947 a 4.6 magnitude earthquake shook southern Michigan. According to the USGS, it is the largest earthquake to occur in Michigan. More recently, a magnitude 5.8 earthquake in central Virginia on August 23, 2011 was felt well into the Midwestern states. At least weak shaking was widely reported across the southern half of Lower Michigan.

The New Madrid Seismic Zone is the most likely source of seismic activity to affect the area. It is located in the vicinity of the Mississippi River in Missouri, Tennessee, and Arkansas, poses a minimal threat to Lake County. Notable historic earthquakes emanating from this area occurred in 1811, 1812 and 1895, with intensities ranging from to 6.6 about 8.0 on the Richter Scale. These earthquakes sent vibrations across the eastern United States, including southern Lower Michigan.

Frequency of Occurrence: According to U.S. Geological Survey maps, Lake County lies north of the area of impact that would be expected to result from a maximum intensity earthquake anywhere along the New Madrid Seismic Zone. Earthquakes are not considered a significant hazard in Lake County.

1.04 EXTREME TEMPERATURES

Prolonged periods of very high or very low temperatures, often accompanied by other extreme meteorological conditions.

Summary: Lake County enjoys a relatively stable and comfortable climate year-round, thanks to the moderating influence of nearby Lake Michigan. However, the significant extremes in temperature are experienced countywide. High humidity in summer and high winds in winter exacerbate the effects of temperature extremes, placing human health and property at increased risk.

Temperatures above 100 degrees and lower than -30 degrees have been recorded at the Village of Baldwin in Lake County. In the climatological period from 1981 to 2010, the village annually averaged 7.9 days with a high temperature of 90 degrees or more and 14 days with a minimum temperature of 0 degrees or less. Public education about these extreme temperature hazards, early notification of impending extremes, and the availability of cooling and warming shelters are all beneficial actions in mitigating the impacts of these hazards upon people. Prolonged periods of extreme temperatures, whether extreme summer heat or extreme winter cold, can pose life-threatening problems for residents. Although quite different from each other in terms of conditions and impacts, the two hazards share a commonality in that they both pose particular problems for the most vulnerable segments of society: the elderly, children, impoverished persons, and persons in poor health. Extreme temperatures can also negatively impact livestock, crops, wildlife, and infrastructure.

Hazard Description: Temperature extremes are broken down into two categories: extreme heat and extreme cold. Both extremes can last for weeks, affect large expanses, and occur without any advance warning and in the middle of a seemingly normal weather pattern. Additionally, both extreme heat and extreme cold can cause loss of life to vulnerable populations, sporadic damage to infrastructure, and disruptions to schools and businesses. About 900 annual deaths nationwide have been attributed to extreme temperatures (mostly from extreme cold, which claims about 700 deaths). Risks and potential costs of each type of extreme temperature are given in the following discussion.

<u>Extreme heat</u> occurs primarily in the summer months of June, July, and August and is marked by temperatures over 90 degrees Fahrenheit. When these conditions persist over a prolonged period of time, it is known as a heat wave. Heat can be lethal by taxing the human body beyond its abilities to maintain homeostasis. Conditions characterized by a combination of very high temperature and high humidity can result in several dangerous and potentially life-threatening health conditions including heat cramps, heat exhaustion, and heatstroke.

- *Heat cramps* are muscular pains that are caused by an imbalance of fluids in the body because of dehydration from heavy sweating. These cramps usually involve the legs or abdominal muscles.

- *Heat exhaustion* is often the result of exercise or heavy work in a hot place. Physical exertion causes a person to lose fluids through heavy sweating. Blood flow to the skin increases, causing blood flow to vital organs to decrease, leading to a mild form of shock. Symptoms include dizziness, weakness, and fatigue. Heat exhaustion can usually be treated by drinking fluids and staying in a cool place until the body temperature and fluids return to normal.
- *Heatstroke* is a life threatening condition that results when a person's temperature control system, which produces sweating to cool the body, stops working. When this happens, the body's temperature can rise so high that brain damage and death may result if the body is not cooled quickly.

In general, fatigue sets in (80 to 90 degrees), followed by heat exhaustion (90 to 105 degrees), then sunstroke or heatstroke (106 to 130 degrees). Urban areas are especially prone to high heat, with impervious surfaces reflecting sunlight, air pollutants trapping heat, and lessened air circulation in densely developed areas. Individuals in urban and rural areas who are young, elderly, impoverished, in poor health, or isolated are at additional risk to extreme heat due to poor access to air conditioning or having physical limitations.

The "Heat Index" table indicates an estimation of how warm temperatures might actually feel to the human body when combined with a given humidity. It should be noted that conditions for each individual will vary with the duration and type of weather, activity, exposure, personal health, extent of acclamation, and the type of clothing worn. Also, actual indoor conditions may vary, trapping heat and/or humidity in some locations and making them potentially more dangerous.

Heat Index

Relative Humidity	Actual Temperature (degrees Fahrenheit)									
	90	92	94	96	98	100	102	104	106	108
40%	91	94	97	101	105	109	114	119	129	130
45%	92	96	100	104	109	114	119	124	130	137
50%	95	99	103	108	113	118	124	131	137	144
55%	97	101	106	112	117	124	130	137	145	
60%	100	105	110	116	123	129	137	145		
65%	103	108	114	121	128	136	144			
70%	106	112	119	126	134	143				
75%	109	116	124	132	141					
80%	113	121	129	138						
85%	117	126	135	145						
90%	122	131	141							
95%	127	137								

Source: Michigan Hazard Mitigation Plan, 2011

Prolonged extreme heat can also have an economic impact on society, through (1) lost work, (2) increased electricity usage, leading to brown-outs or black-outs, (3) drought conditions, (4) increased stress on farm crops, streams and lakes, (5) increased stress on farm animals, pets, and wildlife, and (6) increased stress on infrastructure and on commercial and residential buildings. Between 1981 and 2010, a temperature of 90 degrees was achieved or exceeded at the Village of Baldwin an average of 0.2 days in May, 2.1 days in June, 3.4 days in July, 2.0 days in August, and 0.2 days in September.

Extreme cold is primarily associated with the wintery months of November through April and categorized by temperatures plunging near or below 0 degrees Fahrenheit. Periods of extreme cold are risky for those in both urban and rural areas. Frostbite and hypothermia are common in rural areas where people are trapped outdoors and do not adjust properly to the temperatures. Even indoors, hypothermia is a concern for individuals living in inadequately heated dwellings. Loss of life can occur with either of these situations. Damage to buildings and infrastructure can also occur

in bitter cold conditions, resulting in expensive repairs and potential days of business and school shutdowns.

Strong winds accompanying the cold temperatures work to intensify their effects. Like extreme heat, exposure to extreme cold can create significant health problems. Most cold-related deaths are not the direct result of freezing, but rather the result of pre-existing illness and diseases that are exacerbated by the extreme temperatures. These illnesses may include stroke, heart disease, and/or pneumonia. Health conditions directly resulting from exposure to extreme cold include:

- *Frostbite* is the freezing or partial freezing of some part of the body, usually occurring in the extremities such as toes, fingers, ears, or nose. Frostbite rarely results in death, but does damage the tissue that has been frozen, and in extreme cases may require amputation. A loss of feeling and a white or pale appearance in body parts are symptoms of frostbite.
- *Hypothermia* is a condition brought on when the body's temperature drops significantly due to exposure to cold. Hypothermia becomes serious when the body's internal temperature goes below 95 degrees Fahrenheit. When the body falls below 90 degrees, normal shivering reactions stop and emergency treatment is necessary. Symptoms of hypothermia include uncontrollable shivering (when body temperature is above 90 degrees), slowed speech, memory lapses, frequent stumbling, drowsiness, and exhaustion. If left untreated or treated improperly, hypothermia can lead to death. Unlike frostbite, hypothermia can occur in a person who is exposed to only moderately cold temperatures (even when indoors)—typically over a prolonged period of time. Infants, the elderly, and persons with conditions that do not allow their bodies to heat normally are most susceptible to this form of hypothermia.

Wind chill temperatures reflect the effects of winds and cold, based on the rate of heat loss from exposed skin. Wind chill does not affect inanimate objects such as car radiators or exposed water pipes because they do not cool below the actual air temperature. As extreme cold and winds cool the skin, frostbite can occur as the body tissue begins to freeze. Hypothermia occurs when a person cools to an abnormally low body temperature (below 95 degrees). Similar to extreme heat, individuals who are young, elderly, impoverished, in poor health, or isolated in a rural location are at additional risk to extreme cold due to poor access to heating or having physical limitations.

The "Wind Chill" table indicates an estimation of how cold temperatures might actually feel to the human body when combined with a given wind speed. Actual conditions for each individual will vary with the duration and type of weather, activity, exposure, personal health, extent of acclamation, and the type of clothing worn.

Wind Chill

Wind Speed (mph)	Actual Temperature (degrees Fahrenheit)									
	40	30	20	10	0	-10	-20	-30	-40	-50
5	36	25	13	1	-11	-22	-34	-46	-57	-69
10	34	21	9	-4	-16	-28	-41	-53	-66	-78
15	32	19	6	-7	-19	-32	-45	-58	-71	-83
20	30	17	4	-9	-22	-35	-48	-61	-74	-88
25	29	16	3	-11	-24	-37	-51	-64	-78	-91
30	28	15	1	-12	-26	-39	-53	-67	-80	-94
35	28	14	0	-14	-27	-41	-55	-69	-82	-96
40	27	13	-1	-15	-29	-43	-57	-71	-84	-98
45	26	12	-2	-16	-30	-44	-58	-72	-86	-100
50	26	12	-3	-17	-31	-45	-60	-74	-88	-102
55	25	11	-3	-18	-32	-46	-61	-75	-89	-104
60	25	10	-4	-19	-33	-48	-62	-76	-91	-105

Source: Michigan Hazard Mitigation Plan, 2011

The economic impacts of extreme cold include (1) lost work, (2) increased use of utilities, (3) increased stress to farm animals, pets and wildlife, (4) damage to infrastructure, particularly roadways and water systems, and (5) disrupted transportation. Unusually cold temperatures during the growing season, even if not normally defined as "extreme" under other circumstances, can harm or destroy agricultural crops, drastically reducing crop yields and thus causing economic hardship for farmers and farming communities. Severe, extended below-freezing temperature situations are defined as when the air temperature or wind factor temperature stays below 20 degrees Fahrenheit for 12 hours or more. These conditions pose the greatest risk when partnered with another hazard such as severe winter weather, transportation accidents, and infrastructure failure. Between 1981 and 2010, the temperature dropped to 0 degrees or less at the Village of Baldwin an average of 2.2 days in December, 5.1 days in January, 4.6 days in February, and 1.9 days in March.

Historically Significant and Related Events: While Lake County is certainly susceptible to prolonged periods of hot, humid weather in the summer and extreme cold during the winter, their impacts are somewhat mitigated due to the county's proximity to Lake Michigan. This geographic relation leads to increased cloudiness and snowfall during the fall and winter, and moderated temperatures throughout the year. The maximum recorded temperature in Lake County was 104 degrees on June 27, 1949; the minimum temperature was -38 degrees on February 3, 1996. Undoubtedly, the effect on county residents was significantly greater than the stand-alone temperatures would indicate.

The National Climatic Data Center (NCDC) Storm Events Database has documented one cold event in western Lower Michigan in January 1994. Lake County was not included in the Presidential Declaration of Major Disaster for underground freeze resulting from the record cold, however the county was included in the NCDC list of 32 counties suffering a combined $50 million in damages from the cold spell. Communities receiving the declaration were primarily in the Upper Peninsula. The combination of strong winds at times with the snow and record cold temperatures combined to cause numerous problems across the state. Hundreds of schools were closed for several days in a row in many areas of the state. This was because the very low wind chills made waiting for the school bus too dangerous in most areas of the state. On Wednesday the 19th alone, over 300 schools across the state were closed. Detroit Edison, after just having set a record of daily power usage on the 6th of January, set another record on the 18th, with 7,237,000 kilowatts. The cold weather caused power lines to snap resulting in brief outages. This made the problem of frozen water pipes in many areas even worse. Many areas, especially in the Upper Peninsula, had whole towns with frozen water pipes for over a week. In many cases bursting water pipes caused damage in many homes and businesses across the state. Damage just from the frozen water pipes in the Upper Peninsula alone is estimated at over $12 million! Added to that is the cost of repairing downed power lines, lost school and work days, replacing damaged engine parts due to the extreme cold. Many hospitals reported numerous cases of frozen lungs and frost bite.

In addition, the Michigan Hazard Mitigation Plan notes four consecutive days of record low temperatures at Baldwin from February 10-13, 1899. Readings of -36, -49, -48, and -37 were recorded; however this event predates current NWS records and therefore is not an official record.

The Michigan Hazard Mitigation Plan also lists a number of significant heat waves affecting Michigan. For example, extreme heat was recorded for the summer of 1936, which caused 570 deaths statewide. In the summer of 1988, the central and eastern regions of the U.S. experienced drought and heat wave conditions that caused an estimated 5,000 to 10,000 deaths (depending on one's definition of "heat-related" death). In that year, a Michigan state record was set for consecutive days of 90 degrees or more, 39 days. The previous record of 36 days was set during the "Dust Bowl" era in 1934. Undoubtedly these events had some degree of impact on Lake County; however specific accounts were not identified.

While not extreme in terms of annual temperatures, anomalous temperatures were realized across the Great Lakes region, including Lake County, for a significant duration in March 2012. The following is summary of the event taken from the "March 2012 Climate Summary for Southwest Lower Michigan" by the National Weather Service in Grand Rapids, MI. Lake County resides within the forecast area of this NWS Forecast Office.

> *"March 2012 was a historically warm March, setting records at the primary climate sites. Average temperatures ranged from 45 degrees to over 50 degrees, which is 13 to 16 degrees above normal across Southwest Lower Michigan and most of the Great Lakes region. Grand Rapids, Lansing and Muskegon all set or equaled the all-time March high temperature records on the 20th. This happened again on the 21st. The new record highs for March are 87 degrees in Grand Rapids, 86 degrees in Lansing and 82 degrees in Muskegon. Temperatures were most extreme from the 11th through the 25th. There were only about ten days during the month with values near or just below normal."*
>
> *"The daily temperatures were well above normal nearly continuously from the 6th through the 28th. From the 14th through the 23rd temperatures were more than 20 degrees above normal every day. That is the all-time record for any month for days in a row with temperatures 20 degrees or more above normal. There have only been 2 years on record with more than 10 days at 20 degrees above normal, 1894 and 1990, both of those years had 11 days for the entire year."*

The March warmth was a major contributing factor to the spring of 2012 becoming the most extreme season of any kind in U.S. history to date. This historically significant event triggered an early growing season across much of the U.S. In Michigan, this put sensitive crops and agriculture at a significant risk of exposure to freezing temperatures following the warm spell. At the time this description was written, the crop loss was estimated to be $209.8 million in Michigan, while the total estimated economic impact of the crop loss was $502.9 million.

Frequency of Occurrence: Extreme or anomalous temperatures are inevitable in Lake County and are possible any given day of the year. In the climatological period from 1981 to 2010, the Village of Baldwin averaged 7.9 days with a high temperature of 90 degrees or more and 14 days with a minimum temperature of 0 degrees or less. Long stretches of these conditions are certainly less likely than short duration events. While extreme temperatures should be expected to occur every winter and summer, recent records indicate that Lake County is likely to experience more days of severe cold than severe heat.

1.05 FLOODING: RIVERINE/URBAN

The overflowing of rivers, streams, drains and lakes due to excessive rainfall, rapid snowmelt or ice.

Summary: Annual flood losses amount to several billion dollars per year nationwide, along with over 140 fatalities on average. In Michigan, as well as across the nation, the leading cause for disaster declarations by the Governor or the President is flooding.

Lake County is drained by four watersheds and has a number of rivers and streams whose flows occasionally exceed their banks. Five communities in the county participate in the National Flood Insurance Program (NFIP). These communities, all townships, are located within the Pere Marquette River watershed. Flood insurance rate maps (FIRM) have been created for Pleasant Plains Township and Yates Township, and reveal 100-year floodplains within those communities.
In addition, three rivers in Lake County are included in the National Wild and Scenic River System: Manistee, Pere Marquette, and Pine. These rivers are prized for their scenic, natural states, as well

as their outstanding recreational attributes such as paddling and fishing. Therefore, the recreational nature of the county's water features must be considered along with issues involving development in and adjacent to floodplains.

Hazard Description: Flooding of lands adjacent to the normal course of a stream, river, drain, lake, or reservoir has been a natural occurrence throughout recorded history. If these floodplain areas were left in their natural state, floods would not cause significant damage. In addition, developments near waterways increase the potential for serious flooding by increasing runoff rates and decreasing opportunities for natural infiltration. Impervious surfaces such as streets, parking lots and rooftops, and man-made channels and pipes, increase rainfall runoff that would otherwise soak into the ground, or take several days to reach a river or stream via a natural drainage basin (also known as a watershed). Developments within a floodplain are not only at a risk for significant damage, but they may also impede the carrying capacity of the drainage area, increasing flood levels and putting additional development at risk.

Floods can damage or destroy public and private property, disable utilities, make roads and bridges impassable, destroy crops and agricultural lands, cause disruption to emergency services, and result in fatalities. People may be stranded in their homes for several days without power or heat, or they may be unable to reach their homes at all. Long-term collateral dangers include the outbreak of disease, widespread animal death, broken sewer lines causing water supply pollution, downed power lines, broken gas lines, fire, release of hazardous materials, and dam failure.

Most riverine flooding occurs in the early spring as the result of excessive rainfall and/ or the combination of rainfall and snowmelt. Ice jams (in winter and early spring), log jams, and any other type of debris jam can also lead to flooding. These blockages can cause flash flooding if the jam suddenly gives way. Severe thunderstorms are yet another cause flooding which are most likely during the spring, summer, or fall. These instances are normally localized events and have more impact on watercourses with smaller drainage areas.

It is widely known that controlling floodplain development is the key to reducing flood-related damages. Although there are state and local programs to regulate new development and substantial improvements in flood-prone areas, the opportunity to mitigate flood hazards ultimately rests with local governments since they control the regulation or direction of land development. Proper land use management and strict enforcement of building codes can make communities safer from flood hazards and help reduce the high cost of flood losses.

The Federal Emergency Management Agency's National Flood Insurance Program (NFIP) is designed to identify and map floodplains, to provide flood insurance to flood-prone locations, and also to encourage flood protection activities. Through the NFIP Community Rating System (CRS), communities involved in the program are awarded points based on the various flood protection activities they are engaged in. These points are then applied to a rating system used to grant insurance premium reductions based on the number of points attained by each community. There are no communities in Lake County currently participating in the CRS.

One goal of the NFIP is to reduce the number of "repetitive loss properties." A repetitive loss property is any property receiving two or more flood insurance claim payments for at least $1,000 within any 10-year period since 1978. Repetitive loss properties are a high priority because they account for approximately 33% of the total NFIP claim payments. As of October 2013, there had been seven repetitive losses in Lake County, all located in Pleasant Plains Township along the Pere Marquette River. The following table summarizes current NFIP flood insurance policies and flood claims since 1978.

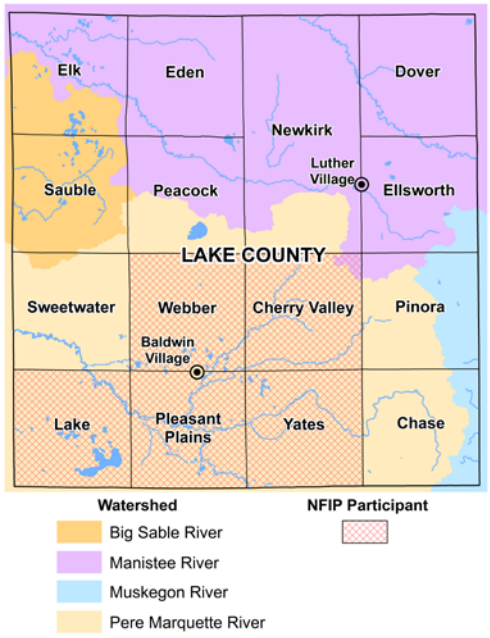
NFIP Insurance Policies
- As of November 30, 2014 -

Community	Total Premium	Number of Policies	Policy Coverage	Since 1978	
				# of Claims	*Claims Paid*
Cherry Valley Township	$975	2	$395,000	2	$97,979
Lake Township	$1,083	2	$117,600	0	$0
Pleasant Plains Township	$10,555	19	$2,436,200	28	$289,887
Webber Township	$0	0	$0	3	$55,520
Yates Township	$1,240	2	$91,600	0	$0
Lake County Total	**$13,853**	**25**	**$3,040,400**	**33**	**$443,386**

Source: *Federal Emergency Management Agency*

There are currently five townships in Lake County participating in the NFIP: Cherry Valley, Lake, Pleasant Plains, Webber, and Yates. A map on the following page shows these communities, along with the major watersheds that drain the county: Big Sable River, Manistee River, Muskegon River, and Pere Marquette River. It is important to recognize that land use and land cover changes that increase water runoff and/or inhibit natural water infiltration anywhere within a watershed can increase the frequency and/or severity of flooding downstream within that watershed.

Flooding may not always be attributable to the overflowing of a natural water feature. Rather it may result from a combination of excessive rainfall and/or snowmelt, saturated ground, and inadequate drainage. Flooding may also occur from a combined sewer system if it becomes overloaded by an excessive amount of water in a short time span, such as during a heavy thunderstorm. These additional sources of flooding typically result in flooded basements and ponding of water over roads or other low-lying areas because surface water of any kind will always gravitate to the lowest elevation. Flooding in such locations may lead to significant property damage, infrastructure failure, crop loss, and/or public health and safety concerns, even if it occurs outside a floodplain. Because the vast majority of Lake County is undeveloped, sources of flooding other than rivers and streams are mitigated somewhat by natural vegetation. Even so, roads, bridges, and culverts in the County are susceptible to flash flooding from excessive rainfall.



NFIP participation as of November 1, 2014

Flooding is a hazard whose risks are routinely underestimated by the public, who may be inclined to attempt to walk or drive through shallow waters, or to allow their children and pets to play in the water as if it were part of a beach or swimming pool. Public education is vital so that there is widespread knowledge of the contaminants and germs that floodwaters may contain, and a greater awareness of the risks that floodwaters pose to drivers and pedestrians. Drivers need to know that roads and bridges are often weakened and degraded by flood impacts, and that the road they assume is still there under shallow waters may no longer be intact. Less than a foot of flowing water can cause travelers to end up in a ditch or sinkhole where it may be impossible to escape a submerged vehicle under the pressure exerted by flowing water. Pedestrians should be informed that floodwaters tend to conceal open manholes and dangerous debris, such as rusty nails and metal, or live electrical wires.

Flooding is generally part of a natural cycle that has many important and beneficial functions for

the environment. Flooding raises the water table in wetlands, maintains biodiversity, and replenishes soil nutrients. Additionally, high water tables allow fish and vegetation to recolonize and may also help to control some invasive species. Flooding, however, becomes a problem in the built environment. Impervious surfaces cause increased runoff, which may carry pollutants into natural water resources. Increased runoff also promotes erosion, which can lead to road washouts and increased sediment in surface water features. A sudden inundation of rainfall runoff, especially when enhanced by impervious surfaces, may also pose serious dangers to persons recreating in and near watercourses. Finally, drainage systems and city sewers can become overwhelmed, causing raw sewage to enter basements, spread onto roadways, and infiltrate groundwater supplies. Residential septic systems can also be flooded, which may cause a release of household waste and chemicals into the environment.

Historically Significant and Related Events: Lake County has been included in one Presidential Declaration of Major Disaster for flooding. This came in September 1986, when the county experienced its worst flood in recent history. In response, the State of Michigan initially approved projects for acquisition and relocation of properties in three Michigan communities. After further assessment, the state later made an additional $7 million available to numerous communities throughout Michigan for flood hazard mitigation through the Community Development Block Grant Program and FEMA.

In February 2001, extensive flooding began on the 9th as a result of the combination of heavy rain and melting snow. Numerous roads were closed across all of southwestern and south central Lower Michigan, including portions of M-37 in Lake County. The area experienced only minor property damage of about $100,000 from this flood.

Another flood occurred across Lower Michigan in May 2004. This event was the worst since 1986. It caused an estimated $25 million of property damage and $4.6 million of crop damage across 23 counties in Lower Michigan. Directly south of Lake County, the Muskegon River experienced its 6th highest flood crest in recorded history at Newaygo, consequently flooding 10 homes and prompting a gubernatorial disaster declaration. Downriver from Newaygo, Muskegon County received over nine inches of rain during this event.

On June 13, 2008, a round of strong to severe thunderstorms accompanied by very heavy rainfall resulted in significant flash flooding across Mason and Lake counties. Damage resulting from flash flooding included a 30 foot wide by 10 foot deep sinkhole which developed near the 18 Mile Bridge, five miles west of Irons. Numerous roads were washed out and several mudslides were also reported. Rainfall totals across the areas hardest hit ranged from five to eleven inches, all of which fell in only a six to eight hour time period. Damage to public infrastructure was estimated at about $2 million to property and $500 thousand to crops; mainly due to all of the road and bridge washouts. This event led Lake County to be included in a presidential disaster declaration for severe storms, tornadoes, and flooding in 11 counties across Lower Michigan.

Lake County experienced significant floods each year between 2012 and 2014. In 2012, an estimated 5 to 7 inches of heavy rain fell across a fairly large part of Lake County on May 3, resulting in several roads that were either flooded or washed out. This episode caused an estimated $70,000 in property damage. In early to mid-April 2013, rainfall led to significant flooding and caused $3 million in property damage in Lake County. The flood resulted in a presidential disaster declaration for many areas in Michigan. In April 2014, another flood impacted the area causing the Governor to issue a disaster declaration for eight counties in western Lower Peninsula (not including Lake County).

Frequency of Occurrence: Minor riverine flooding is likely to naturally occur every year in Lake County. In addition, identified floodplain areas, by definition, have at least a 1% chance per year of

flooding. Two communities, Pleasant Plains Township and Yates Township, have identified floodplain areas along the Pere Marquette River.

For the 18-year period from 1996 through 2013, the NCDC lists ten flood or flash flood events; nine of which had property or crop damages reported. If this trend continues, Lake County can expect a damaging flood event approximately every other year. A major flood affected Lake County three times since the 1980's (1986, 2008, and 2013); therefore the county might expect to experience a significant flooding event approximately once every 10 years. Considering the recent flooding experienced in 2012, 2013, and 2014, it should be noted that notable floods have been observed more frequently in recent years.

1.06 FOG

Condensed water vapor in cloud-like masses close to the ground and limiting visibility.

Summary: Historically, fog has not been considered as a significant hazard in Lake County. However, this hazard is addressed by the Michigan Hazard Mitigation Plan, and is therefore discussed in this plan.

The NCDC does include fog and freezing fog events in its Storm Events Database; however documentation for these events is not as extensive and standardized as it is for other natural hazards, such as thunderstorms and winter weather.

Hazard Description: Fog forms near the ground when water vapor condenses into tiny liquid water droplets that remain suspended in the air. Many different processes can lead to the formation of fog, but the main factor is saturated air. Two ways that air can become saturated are by cooling it to its dew point temperature or by evaporating moisture into it to increase its water vapor content. Fog is often hazardous when visibility is reduced to 1/4 mile or less. The interaction between humans and fog can be a dangerous situation, sometimes resulting in disastrous consequences. The National Weather Service issues dense fog advisories when fog reduces visibility to 1/8 mile or less over a widespread area. For marine environments, dense fog advisories are issued for widespread or localized fog reducing visibilities to regionally or locally defined limitations not to exceed 1 nautical mile. Freezing fog (a hazard for which the National Weather Service issues special statements) can cause direct harm by causing slickness on roadways and thus leading to serious transportation accidents.

In considering severe and high-impact meteorological events, attention can easily become focused on the more dramatic storms. Tornadoes and hurricanes for example, are readily recognized by the general public and the meteorological community alike for their devastating consequences. Fog, on the other hand, does not lend itself as readily to this categorization. Yet, in terms of cost and casualties, fog has consistently impacted society. In particular, the transportation sector is vulnerable to fog, with sometimes deadly consequences. Fog has played a contributing role in several multi-vehicle accidents over the past several years. While statistics suggest that highway accidents and fatalities have generally decreased in recent history, that trend is not evident with respect to accidents and fatalities caused by fog.

Fog may be widespread or localized, and can be very dangerous because it reduces visibility. Although some forms of transport can penetrate fog using radar, road vehicles have to travel slowly and use more lights. Localized fog is especially dangerous, as drivers can be caught by surprise. Fog is particularly hazardous at airports, where some attempts have been made to develop methods to aid fog dispersal, such as using heating or spraying salt particles. These methods have seen some success at temperatures below freezing.

The primary risks from fog involve the dangers of traveling under conditions of limited visibility. Although some modes of transportation such as aircraft are well-regulated, other modes, including simple pedestrian travel, may involve risks that have not been properly accounted for by those who are focused merely on reaching their destination as quickly as possible. The most substantial impacts have recently involved drivers whose bad habits (primarily that of not maintaining safe speeds and following distances) proved to be simply unsustainable under conditions of reduced visibility, resulting in severe crashes and subsequent roadway obstruction. In some circumstances, these conditions of reduced visibility can arise very quickly, although careless drivers, in their desire for fast travel conditions, may erroneously try to ignore the risks from reduced visibilities, in the hope that the condition will suddenly correct itself before any harm is caused. Fog may also increase the threat of hazardous materials (HAZMAT) transportation accidents. That hazard is addressed as a separate hazard in this document.

In addition to creating potentially hazardous automotive and air transportation conditions, fog may cause increased risks to outdoor recreation activities, such as boating, off-roading, and snowmobiling. These outdoor activities are common in Lake County.

Historically Significant and Related Events: There is one fog or freezing fog event listed in the NCDC for Lake County, which took place in January 1995. Dense fog blanketed much of Lower Michigan during the period from the evening on the 11th through the morning on the 13th. The fog caused numerous traffic accidents, which resulted in four fatalities. School openings were delayed in parts of southwest Michigan as visibilities dropped to near zero. Low visibilities caused most of the flights at Detroit's metro airport to be cancelled, delayed or diverted on the 12th. Approximately 75 flights were also delayed or cancelled at Kent County International Airport in Grand Rapids.

Another, more recent fog event in the neighboring county of Manistee demonstrates the potential threat of fog to outdoor recreational activities. On May 22, 2010, dense fog inhibited visibility in the area, and a fishing boat struck a pier and at the entrance to Manistee Harbor. It subsequently took on water and submerged, requiring the rescue of seven persons from the water. The accident led to one indirect fatality, two injuries requiring treatment at a Manistee hospital, and four minor injuries that were treated on-site.

Frequency of Occurrence: According to the Michigan Hazard Mitigation Plan, one major fog event is estimated to occur in Michigan approximately every two years. Property damage can be significant for vehicles, although real property and structures are usually unaffected.

Although Lake County was included in one dense fog event reported to the NCDC, there is insufficient fog data from which to derive a frequency of occurrence. Fog is possible at any time of the year; and especially during the winter and spring seasons when relatively warm and moist air is most likely to encounter a melting snowpack from recent snowfall.

1.07 GREAT LAKES SHORELINE HAZARDS

High or low water levels that cause flooding or erosion, and other threatening shoreline conditions, including storm surges, rip currents, and shoreline recession.

Summary: Located approximately 20 miles inland of Lake Michigan, Lake County is not considered at risk from Great Lakes shoreline hazards. However, inland lakes in the county may occasionally experience the effects of low and high water levels, as well as shoreline flooding and erosion. These instances are generally just a nuisance in Lake County, and are not considered significant threats at this time. For purposes of this plan, shoreline flooding of inland lakes is addressed as a component of the Riverine/Urban Flood hazard section. The following hazard

description was readily available from the Michigan Hazard Mitigation Plan, and was therefore included in this section for informational purposes.

Hazard Description: Michigan has over 3,200 miles of Great Lakes coastline (the longest freshwater coastline in the world), and about 4.8 million persons live in the state's 41 coastline counties. Wind, waves, and water level constantly affect the communities along the shores of the Great Lakes. Shoreline flooding and erosion are natural processes, occurring at high, average, and even low Great Lakes water levels. However, during periods of high water, the effects of flooding and erosion are more evident, causing serious damage to homes and businesses, roads, water and wastewater treatment facilities, and other structures in coastal communities. Low lake levels can also pose hazards, such as shallow shipping channels and increased exposure of pollution lake-bottom debris. Long-term and seasonal variations in precipitation and evaporation rates primarily control the Great Lakes water levels and their fluctuations.

Over one hundred years of record keeping have not indicated a simple, easily-predictable cycle of water levels on the Great Lakes. (However, geologic research has indicated quasi-periodic cycles of 33 years and 160 years for lake level fluctuations; e.g. Baedke and Thompson's article in the Journal of Great Lakes Research, v.26 p. 416-426, 2000.) The time between periods of high and low water levels can vary widely. Records indicate the maximum differences in levels have varied from nearly four feet on Lake Superior to over six and one-half feet on Lakes Michigan and Huron. Seasonal fluctuations caused by more water runoff can cause lake level fluctuations averaging about one foot on Lakes Superior, Michigan and Huron, and one and one-half feet on Lake Erie.

In addition to natural causes of water level fluctuation, there are four man-made factors that can also affect water levels to some degree: (1) diversion of water for power generation, municipal water supply, and navigation, (2) regulation of water levels via dams and other control structures, (3) dredging of connecting waterways for navigation purposes, and (4) covering land surfaces with impervious materials that cause storm runoff to be delivered to water bodies more quickly than the pre-development runoff rates. Although these man-made factors do impact water levels, natural factors such as precipitation, evaporation and winds have a far greater overall impact. The vast majority of shoreline flooding and erosion that occurs along the Great Lakes is caused by natural factors. However, it should be remembered that it is humans who place themselves in harm's way by building structures in dynamic coastal areas. If that did not occur, the natural processes of flooding and erosion would not be viewed as problems.

Generally, low-lying lands along the coastline are prone to shoreline flooding during both high and low lake water periods. The Michigan Department of Environmental Quality (MDEQ) estimates that approximately 10% of Michigan's Great Lakes shoreline (30 counties encompassing greater than 45,000 acres) is floodprone.

Under Part 323, Shorelands Protection and Management, the MDEQ has determined communities with high-risk erosion areas. A high-risk erosion area is defined by the MDEQ as an area where erosion studies have indicated that the erosion hazard line is receding at an average of one foot or more per year over a minimum 15-year period. The MDEQ has identified 121 township areas along the Great Lakes coast as containing one or more sections of high-risk erosion areas. Within those areas, any new permanent structure must comply with building setback regulations that require a minimum distance between the existing erosion hazard line and the structure. The MDEQ also designated 41 communities on Michigan's shoreline as flood risk areas, meaning that they have floodplain-like areas with a 1% annual chance of a designated flood level being exceeded.

The intent of these and other applicable building restrictions is to minimize the extent and magnitude of shoreline flooding and serious erosion problems along the Great Lakes shoreline. Although shoreline flooding and erosion is inevitable, severe damage can be avoided if prudent

shoreland management practices are followed and adequate emergency procedures are implemented. Coordination of federal, state and local shoreland management and emergency preparedness efforts is vital to keeping Michigan's shoreline areas as safe and undamaged as possible. The recession of the Great Lakes water levels is also inevitable, but there is not much, other than dredging, that can be done to combat the negative effects. That is why it is important for all those involved in water transportation to be prepared for all types of water fluctuations.

Much of Michigan's character is defined by the Great Lakes, as well as inland water features. The beaches provide numerous recreational opportunities and are considered prime real estate. Unfortunately, the inherent hazards of coastal areas are not always apparent. Development activities along the shoreline significantly alter the natural ebb and flow of coastal dynamics. Continuing and increasing development of coastal areas threatens to exacerbate the shoreline flooding and erosion problem. As more people and structures are put in harm's way, the problem of shoreline flooding and erosion will continue to grow in frequency and significance.

The MDEQ administers programs aimed at balancing the impact of shoreline flooding and erosion with the development pressures facing the Great Lakes shoreline by implementing non-structural approaches, such as construction setbacks and lowest floor elevation requirements. These types of approaches do not interfere with the natural processes of erosion and flooding, but instead take what is known about the coastal hazard and develop construction standards to prevent the premature collision between homes and nature.

The MDEQ has the responsibility of administering the permitting programs that implement the coastal construction standards. However, under Part 323, local governments have the authority to take over the permitting programs for high-risk erosion and flood risk areas. In the area of floodplain management, permitting responsibility is handled at the local level due to the overlap of regulations found in Part 323, the NFIP, and the building codes. However, few communities have shown an interest in adding the regulatory responsibility of the erosion program to their already busy building and zoning departments. As with many regulatory programs that address private property development rights, the potential for conflict in these areas is high. This is especially true in the realm of expensive shoreline real estate where a view of the water can outweigh the threat of future flood or erosion damage. Political pressure can also come into play in some situations. Compliance with these regulations has best been achieved through cooperation between the State and local governments. Public understanding and support of these programs can be increased by improved communication with property owners regarding natural shoreline hazards.

Weather-related events can also cause fluctuations that can last from several hours to several days. For example, windstorms combined with differences in barometric pressure can temporarily tilt the surface of a lake up at one end as much as eight feet. This phenomenon, known as storm surge, can drive lake waters inland over large areas. After the storm surge, an oscillation phenomenon called a seiche (pronounced sigh-shh or saysh) is likely to take place. As the water level retreats on one shore, it then shifts back to the opposite side of the lake, but with less intensity. This oscillation is repeated until the body of water becomes calm again and water levels return to normal.

Historically Significant and Related Events: According to the Michigan Hazard Mitigation Plan, about 10 major periods of flooding/erosion have occurred on the Great Lakes since 1918, or once about every 8.3 years. During one of these periods in1972-1973, high water levels caused shoreline flooding in over 30 Michigan counties that border the Great Lakes, resulting in an excess of $50 million in public and private damage. Thousands of people were forced to evacuate their homes. Similar high water level flooding occurred in the early 1950s and late 1960s, also resulting in millions of dollars worth of damage to shoreline communities.

Frequency of Occurrence: Thanks to its inland location, Lake County cannot be subjected to

shoreline hazards from any of the Great Lakes. Therefore, these are not considered significant hazards in Lake County.

1.08 HAIL

Conditions where atmospheric water particles from thunderstorms form into rounded or irregular lumps of ice that fall to the earth.

Summary: Hail is a hazard that often coincides with thunderstorms, and may occur simultaneously with other hazards such as lightning, severe winds, tornadoes, and heavy rains. Lake County experiences between 30 and 34 thunderstorms annually, many of which produce hail. There are numerous records of golf ball-sized hail in the county, as well as approximately $185,000 in total damages to property and crops associated with hail events documented by the National Climatic Data Center.

The impacts of hail are somewhat mitigated by Lake County's relatively low population density, scattered nature of development, and limited agriculture. Even so, it is incumbent upon public safety officials and county residents to monitor forecasts from the National Weather Service, and to heed severe thunderstorm watches and warnings to minimize the effects on people and property.

Hazard Description: Hail is a product of the strong thunderstorms that frequently move across the Midwest. As one of these thunderstorms passes over, hail usually falls near the center of the storm, along with the heaviest rain. Sometimes, strong winds occurring at high altitudes in the thunderstorm can blow the hailstones away from the storm center, causing an unexpected hazard at places that otherwise might not appear threatened. Downdrafts produced by thunderstorms may also accelerate the descent of hail, thereby increasing the potential for damages.

Most hailstones range in size from a pea (¼ inch) to a golf ball (1¾ inches), but hailstones larger than softballs have occurred with the most severe thunderstorms. Hail is formed when strong updrafts within the storm carry water droplets above the freezing level, where they remain suspended and continue to grow larger until their weight can no longer be supported by the winds. They finally fall to the ground, battering crops, denting autos, and injuring wildlife and people. Large hail is a characteristic of severe thunderstorms, and it may precede the occurrence of a tornado.

Hail Size Chart

Diameter	Description
1/4"	Pea
1/2"	Plain M&M
3/4"	Penny
7/8"	Nickel
1" (severe)	Quarter
1¼"	Half Dollar
1½"	Ping Pong Ball
1¾"	Golf Ball
2"	Lime
2½"	Tennis Ball
2¾"	Baseball
3"	Teacup
4"	Grapefruit
4½"	Softball
4¾" – 5"	Compact Disk

Source: National Weather Service

The National Weather Service (NWS) issues severe thunderstorm watches for areas when the meteorological conditions are conducive to the development of severe thunderstorms. People in the watch area are instructed to stay tuned to National Oceanic and Atmospheric Administration (NOAA) weather radio and local radio or television stations for weather updates, and watch for developing storms. Once radar or a trained Skywarn spotter detects the existence of a severe thunderstorm, the NWS will issue a severe thunderstorm warning. The warning will identify where the storm is located, the direction in which it is moving, and the time frame during which the storm is expected to be in the area. Persons in the warning area are instructed to seek shelter immediately.

The State and local government agencies are warned via the Law Enforcement Information Network (LEIN), NOAA weather radio, and the Emergency Managers Weather Information Network (EMWIN). Public warning is provided through the Emergency Alert System (EAS). The NWS stations in Michigan transmit information directly to radio and television stations, which in turn pass the warning on to the public. The NWS also provides detailed warning information on the Internet at www.weather.gov, where an interactive map can be used.

Severe thunderstorm forecasts by the NWS usually give sufficient warning time to allow residents to take appropriate action to reduce the effects of hail damage on vehicles and some property. However, little can be done to prevent damage to agriculture, natural vegetation, and wildlife. In addition, hail can damage some fruit and vegetable plants, rendering them unsuitable for human consumption, and leading to an increased risk of bacteria that can kill healthy trees and nearby wildlife. Hail can also potentially exacerbate flooding and flash flooding through increased soil erosion, as well as jamming or reduced effectiveness of drainage paths, culverts, and grates.

In 2009, the NWS increased the definition of severe hail from ¾ inch to 1 inch in central and western U.S. states, including Michigan. This practice was implemented nationwide on January 5, 2010.

Historically Significant and Related Events: Lake County is no stranger to hailstorms. The NCDC lists 20 such events since 1955, 10 of which meet today's criteria for "severe" hail. Between 1996 and May 2012, there are 18 documented events, nine of which were severe. Damages from hail (both sub-severe and severe) have been recorded six times since 1996, totaling $120,000 in reported property damages and $65,000 in reported crop damages.

A notable severe hail event was observed in August 2000, when 1.75 inch hailstones caused $50,000 in property damages and $25,000 in crop damages in and around the Village of Luther. Another significant hail event took place in Pleasant Plains Township on June 8, 2003. While this event failed to reach "severe" criteria, ¾ inch hailstones caused approximately $20,000 in property damages and $20,000 in crop damages. This instance shows that hail need not be severe to cause damage.

The 20 hail events documented by the NCDC all occurred in the months of March through October. Of these events, May was the most common month with 35% of the reports, while June and August each claimed 15%.

Severe Hail in Lake County
1955 - May 2012

Date	Location	Size
08-15-78	Lake County	1.25 in.
05-18-96	Baldwin	1.75 in.
03-30-98	Baldwin	1.00 in.
03-30-98	Pleasant Plains Twp	1.75 in.
09-26-98	Wolf Lake	1.00 in.
10-13-99	Baldwin	1.75 in.
05-08-00	Baldwin	1.00 in.
08-09-00	Luther	1.75 in.
7-16-08	Baldwin	1.00 in.
4-10-11	Wolf Lake	1.00 in.

Source: National Climatic Data Center

Frequency of Occurrence: With between 30 and 34 thunderstorm days per year (Michigan Hazard Mitigation Plan), it is highly likely that Lake County will experience multiple sub-severe hail events annually. There are 10 cases of severe hail (one inch or larger) documented by the NCDC in the 58 years encompassing 1955 though 2012. This data suggests that the county will experience a severe hail event once every five to six years. However, as population has increased and reporting techniques have improved, this estimate may understate the actual frequency. More recent records from the 17 years from 1996 through 2012 show 18 reported events, nine of which were severe. Therefore, based on recent trends, Lake County could expect to receive severe hail once every one to two years. Sub-severe hail will almost certainly occur more often, and in most cases will cause little or no damage.

1.09 INVASIVE SPECIES

A species that has been introduced by human action to a location where it did not previously occur naturally, becomes capable of establishing a breeding population in the new location without further intervention by humans, and becomes a pest by threatening the local biodiversity and causing human health impacts, significant economic costs, and/or ecological effects.

Summary: Historically, invasive species has not been considered as a significant hazard in Lake

County. However, this hazard is discussed by the Michigan Hazard Mitigation Plan and is summarized in this plan to increase awareness among emergency responders, public safety officials, and community leaders. The following hazard description is only a portion of the information contained within the state plan, which can be referenced for additional information.

Because a vast majority of Lake County is covered by forests and natural vegetation, it is susceptible to a wide range of exotic species that may threaten the natural environment upon which much of the county's economy depends. In addition, Lake County welcomes a significant number of visitors each year to recreate in the wilderness, thereby increasing the opportunities for accidental importation of non-native species. The most likely effects of invasive species in Lake County appear to be from forest pests and aquatic invaders.

Hazard Description: An invasive species is defined as a species that is (1) non-native (alien) to the ecosystem under consideration and (2) whose introduction causes or is likely to cause economic or environmental harm, or harm to human health. Invasive species can be plants, animals, and other organisms (e.g., microbes). Human actions are the primary consideration here as a means of invasive species' introduction (thus distinguishing the situation from natural shifts in the distribution of species). Nationally, the current environmental, economic, and health costs of invasive species were estimated as exceeding the costs of all other natural disasters combined.

Invasive species can be transported in many ways, such as on animals, vehicles, ships, commercial goods, produce, and clothing. Although non-native (exotic) species are the foundation of U.S. agriculture, and also are used to prevent erosion, to provide fishing and hunting opportunities, and as ornamental plants and pets, occasionally a non-native organism flourishes too well and causes unwanted economic, ecological, or human health impacts. The terms "invasive" or "nuisance" are used to describe such species. New environments may affect rates of reproduction, susceptibility to disease, and other features that affect a species' success. Consequently, a plant or animal that causes little damage to agriculture or natural ecosystems in one area may cause significant problems in another. Certain nonnative species are very successful in their new habitats because they out-compete native plants or animals and have no natural controls (predators, diseases, etc.) in the new area. At least 200 well-known, high-impact, non-native species presently occur in the United States. They range from the European gypsy moth and emerald ash borer to crabgrass, dandelions, and German cockroaches, annually costing well over a billion dollars to control. Some even pose human health risks. Others, like the zebra mussel, threaten widespread disruption of ecosystems and the displacement or loss of native plants and animals.

Hundreds of new species from other countries are introduced intentionally or accidentally into the United States each year. These invasive species may arrive in a variety of ways. Transportation efficiencies that make it possible to travel around the globe in hours rather than weeks enable organisms to survive transportation from one continent to another.

As more adaptable and generalized species are introduced to environments already impacted adversely by human activities, native species are often at a disadvantage to survive in what was previously a balanced ecosystem. There are many examples of decreased biodiversity in such areas. One of the primary threats to biodiversity is the spread of humanity into what were once isolated areas, with land clearing and habitation putting significant pressure on local species. Agriculture, livestock, and fishing can also introduce changes to local populations of indigenous species and may result in a previously innocuous native species becoming a pest, due to a reduction of natural predators. This threat intensifies the need for scientists, managers, and stakeholders to cooperate to build better systems to prevent invasion, improve early detection of invaders, track established invaders, and to coordinate containment, control, and effective habitat restoration.

Although invasive species, in most cases, primarily cause environmental damage and degradation, there are situations in which serious threats to public health, safety, and well-being can occur due to animal disease or plant/animal infestations. For example, certain diseases could wipe out large segments of an animal population, creating a potentially serious public health emergency and the need to properly (and rapidly) dispose of the dead animal carcasses.

Similarly, a widespread insect infestation, such as that of the Emerald Ash Borer, can create serious public safety threats (especially in densely populated urban areas) due to dead and dying trees being fire prone (because of their dry, brittle nature) or to partial/total collapse due to high winds or ice/snow accumulation. The falling trees or limbs can also bring down power lines, cause damage to public and private structures, and cause injuries or even death.

County and local officials should cooperate closely with state and federal agencies that actively monitor and manage invasive threats, such as the U.S. Forest Service, U.S. Fish and Wildlife Service, Michigan Department of Natural Resources, and the Michigan State Police, Emergency Management Division.

Historically Significant and Related Events: The Emerald Ash Borer has caused extensive damage to trees in Michigan, and those weakened trees have often (1) collapsed and caused property damage, or (2) required removal, at considerable expense. A disaster declaration request was sent to FEMA, but the request was not accepted by that agency, leaving state and local budgets, residents, and insurance companies to try to cover the considerable expenses and efforts involved in dealing with the problem.

Sea lampreys are an aquatic invader that is a constant threat to the rivers and streams in Michigan, including Lake County. According to the Great Lakes Science Center (GLSC), "the sea lamprey is one of the few aquatic invasive species that is being successfully controlled." Numerous techniques have been attempted in the past, including screen weirs, electric screens, and chemicals. Beginning in 1989, an electric weir was employed on the Pere Marquette River by the U.S. Fish and Wildlife Service and the Michigan Department of Natural Resources. It was located near Custer Road in Mason County, about ten miles west of Lake County. By 2010 however, the electric weir was deemed cost-ineffective and subsequently retired. A more effective method, a lampricide known as TFM, is now used in its place to control the sea lamprey population and protect the valued cold water fishery. TFM treatments cost $500,000 every three to four years.

Frequency of Occurrence: Insufficient data exists regarding significant impacts incurred as a result of invasive species. However, it should be recognized that invasive species are a constant threat to Lake County, especially those that occur in forest and aquatic habitats.

1.10 LIGHTNING

Discharge of electricity from within a thunderstorm.

Summary: Lightning is a hazard produced by thunderstorms, and may occur simultaneously with other hazards such as hail, severe winds, tornadoes, and heavy rains. Lake County experiences between 30 and 34 thunderstorms annually, all of which produce lightning.

It is virtually impossible to provide complete protection to individuals and structures from lightning, therefore this hazard will continue to be a risk for Lake County's residents. However, lightning deaths, injuries, and property damage can be reduced through a combination of public education, human vigilance, technology, proper building safety provisions, and simple common sense. It is incumbent upon public safety officials and county residents to monitor forecasts from the National Weather Service, and to heed severe thunderstorm watches and warnings to minimize

the effects on the population.

Hazard Description: Lightning is a random and unpredictable product of a thunderstorm's tremendous energy which produces an intense electrical field like a giant battery, with the positive charge concentrated at one end and the opposite charge concentrated at the other. Lightning strikes when a thunderstorm's electrical potential (the difference between its positive and negative charges) becomes great enough to overcome the resistance of the surrounding air. Bridging that difference, lightning can jump from cloud to cloud, cloud to ground, ground to cloud, or even from the cloud to the air surrounding the thunderstorm. Lightning strikes can generate current levels of 30,000 to 40,000 amperes, with air temperatures often superheated to higher than 50,000 degrees Fahrenheit (hotter than the surface of the sun) and speeds approaching one-third the speed of light.

Globally, there are about 2,000 thunderstorms occurring at any given time, and those thunderstorms cause approximately 100 lightning strikes to earth each second. In the United States, approximately 100,000 thunderstorms occur each year, and every one of those storms generates lightning. It is not uncommon for a single thunderstorm to produce hundreds or even thousands of lightning strikes. However, to the majority of the general public, lightning is perceived as a minor hazard. That perception lingers despite the fact that lightning damages many structures and kills and injures more people in the United States per year, on average, than tornadoes or hurricanes. Many lightning deaths and injuries could be avoided if people would have more respect for the threat lightning presents to their safety.

Lightning deaths are usually caused by the electrical force shocking the heart into cardiac arrest or throwing the heartbeat out of its usual rhythm. Lightning can also cut off breathing by paralyzing the chest muscles or damaging the respiratory center in the brain stem. It takes only about one-hundredth of an ampere of electric current to stop the human heartbeat or send it into ventricular fibrillation. Lightning can also cause severe skin burns that can lead to death if complications from infection set in.

As an indicator of the circumstances involving lightning fatalities, injuries and damage in the U. S., consider the following statistics compiled by the National Oceanic and Atmospheric Administration (NOAA) and the National Lightning Safety Institute (NLSI) for the period of 1959-1994:

<u>Location of Lightning Strikes</u>
· 40% at unspecified locations
· 27% in open fields and recreation areas (not including golf courses)
· 14% to someone under a tree (not including golf courses)
· 8% water-related (boating, fishing, swimming, etc.)
· 5% golf-related (on golf course or under tree on golf course)
· 3% related to heavy equipment and machinery
· 2.4% telephone-related
· 0.7% radio, transmitter and antenna-related

<u>Gender of Victims</u>
· 84% male; 16% female

<u>Months of Most Strikes</u>
· July (30%); August (22%); June (21%)

<u>Most Likely Time Period of Reported Strikes</u>
· 2:00 PM – 6:00 PM

<u>Number of Victims</u>
· One victim (91%); two or more victims (9%)

The NLSI has estimated that 85% of lightning victims are children and young men (ages 10-35) engaged in recreation or work-related activities. Approximately 20% of lightning strike victims

die, and 70% of survivors suffer serious long-term after-effects such as memory and attention deficits, sleep disturbance, fatigue, dizziness, and numbness.

In terms of property losses from lightning, statistics vary widely according to source. The Insurance Information Institute (a national clearinghouse of insurance industry information) estimates that lightning damage amounts to nearly 5% of all paid insurance claims, with residential claims alone exceeding $1 billion. Information from insurance companies shows one homeowner's damage claim for every 57 lightning strikes. The NLSI has estimated that lightning causes more than 26,000 fires annually, with damage to property exceeding $5-6 billion. Electric utility companies across the country estimate as much as $1 billion per year in damaged equipment and lost revenue from lightning. The Federal Aviation Administration (FAA) reports approximately $2 billion per year in airline industry operating costs and passenger delays from lightning. Because lightning-related damage information is compiled by so many different sources, using widely varying collection methods and criteria, it is difficult to determine a collective damage figure for the U.S. from lightning. However, annual lightning-related property damages are conservatively estimated at several billion dollars per year, and those losses are expected to continue to grow as the prevalent use of computers and other lightning-sensitive electronic components continues.

Because it is virtually impossible to provide complete protection to individuals and structures from lightning, it will continue to be a problem for Michigan's residents. However, lightning deaths, injuries, and property damage can be reduced through a combination of public education, human vigilance, technology, proper building safety provisions, and simple common sense.

The National Weather Service (NWS) issues severe thunderstorm watches for areas when the meteorological conditions are conducive to the development of severe thunderstorms. People in the watch area are instructed to stay tuned to National Oceanic and Atmospheric Administration (NOAA) weather radio and local radio or television stations for weather updates, and watch for developing storms. Once radar or a trained Skywarn spotter detects the existence of a severe thunderstorm, the NWS will issue a severe thunderstorm warning. The warning will identify where the storm is located, the direction in which it is moving, and the time frame during which the storm is expected to be in the area. Persons in the warning area are instructed to seek shelter immediately.

The State and local government agencies are warned via the Law Enforcement Information Network (LEIN), NOAA weather radio, and the Emergency Managers Weather Information Network (EMWIN). Public warning is provided through the Emergency Alert System (EAS). The NWS stations in Michigan transmit information directly to radio and television stations, which in turn pass the warning on to the public. The NWS also provides detailed warning information on the Internet at www.weather.gov, where an interactive map can be used.

Severe thunderstorm forecasts by the NWS usually give sufficient warning time to allow residents to take appropriate action to reduce the risks of lightning. Large outdoor gatherings (e.g., sporting events, concerts, campgrounds, fairs, festivals, etc.) are particularly vulnerable to lightning strikes that could result in many deaths and injuries. This vulnerability underscores the importance of developing site-specific emergency procedures for these types of events, with particular emphasis on adequate early detection, monitoring, and warning of approaching thunderstorms. Early detection, monitoring, and warning of lightning hazards, combined with prudent protective actions, can greatly reduce the likelihood of lightning injuries and deaths. In addition, close coordination between event organizers, local emergency management officials, and response agencies (i.e., police, fire, emergency medical care) can help prevent unnecessary (and often tragic) delays and mistakes in rendering care should a lightning incident occur.

In addition to the significant risks to individuals, lightning may also damage buildings, electrical and communications infrastructure, and trees, as well as spark wildfires. In fact, lightning is the most common natural cause of wildfire.

Historically Significant and Related Events: There are no lightning events listed by the NCDC for Lake County. There are, however, statewide statistics derived from NCDC data that lend historical credence to the risk of lightning in Lake County. The tables on following page detail lightning-related injuries and deaths in Michigan from 1959 to 2005.

Lightning-Related Deaths in Michigan - 1959-July 2005 -

Lightning Deaths: 101		
Number of Deaths	Location	Percent of Total
29	Open fields, ball fields	29%
26	Under trees, not golf	26%
11	Boats / water-related	11%
10	Golf course	10%
4	Near tractors / heavy equipment	4%
2	At telephone	2%
19	Other location / unknown	19%

Source: Storm Data, National Climatic Data Center

Lightning-Related Injuries in Michigan - 1959-July 2005 -

Lightning Injuries: 711		
Number of Injuries	Location	Percent of Total
243	Open fields, ball fields	34%
104	Under trees, not golf	15%
35	Golf course	5%
26	Boats / water-related	4%
19	At telephone	3%
20	Near tractors / heavy equipment	3%
264	Other location / unknown	37%

Source: Storm Data, National Climatic Data Center

Frequency of Occurrence: Although Lake County typically experiences between 30 and 34 thunderstorm days per year according to the Michigan State Police (see Thunderstorm Hazards map in Appendix C), there are no NCDC-documented lightning events for the county. Lightning is possible in any month of the year; however it is most likely to occur in the spring, summer, and early fall months. Unfortunately, these are the peak seasons for many popular outdoor activities in Lake County. Statistics show that individuals engaged in outdoor activities are generally at a higher risk from lightning during a thunderstorm. This is a significant concern because outdoor recreation is a major characteristic of Lake County.

1.11 SEVERE WINDS

Non-tornadic winds of 58 miles per hour or greater.

Summary: Severe winds are generally produced by thunderstorms or by strong weather systems. Severe winds are the most common thunderstorm hazard in Lake County and may occur simultaneously with other hazards such as lightning, hail, tornadoes, and heavy rains. Lake County experiences between 30 and 34 thunderstorms annually, many of which produce some or all of these hazards.

Advanced warning and weather monitoring are effective ways to mitigate the effects of severe winds. Therefore, it is incumbent upon public safety officials and county residents to monitor forecasts from the National Weather Service, and to heed severe thunderstorm and high wind watches and warnings to minimize the effects on people and property.

Hazard Description: Severe winds spawned by thunderstorms or other storm events have had devastating effects on Michigan, including 118 deaths, nearly 700 injuries, and hundreds of millions of dollars in damage to public and private property and agricultural crops since 1970. Severe wind events are characterized by wind velocities of 58 miles per hour or greater, with gusts sometimes exceeding 74 miles per hour (hurricane velocity), but do not include tornadoes.

Severe winds, including those produced by thunderstorms and wind events produced by strong weather systems, can be very damaging to communities. Severe winds have the potential to cause loss of life from property damage and flying debris, but do not produce as many deaths as tornadoes. However, the property damage from severe wind events can be just as extreme as that of a tornado, since the damage can be widespread rather than isolated.

According to NOAA's National Severe Storms Laboratory, damage from severe thunderstorm winds account for half of all severe weather reports in the lower 48 states and is more common than damage from tornadoes. Wind speeds can reach up to 100 miles per hour and can produce a damage path extending for hundreds of miles. These winds are often called "straight-line" winds to differentiate the damage they cause from tornado damage. The following narrative describes a number of different processes that can produce strong thunderstorm winds.

Types of damaging winds

- *Straight-line winds* – a term used to define any thunderstorm wind that is not associated with rotation, and is used mainly to differentiate from tornadic winds.
- *Downdrafts* – A small-scale column of air that rapidly sinks toward the ground. A downburst is a result of a strong downdraft.
- *Downbursts* – A strong downdraft with horizontal dimensions larger than 4 km (2.5 mi) resulting in an outward burst or damaging winds on or near the ground. (Imagine the way water comes out of a faucet and hits the bottom of the sink.) Downburst winds may begin as a microburst and spread out over a wider area, sometimes producing damage similar to a strong tornado. Although usually associated with thunderstorms, downbursts can occur with showers too weak to produce thunder.
- *Microbursts* – A small concentrated downburst that produces an outward burst of damaging winds at the surface. Microbursts are generally small (less than 4km across) and short-lived, lasting only 5-10 minutes, with maximum wind speeds up to 168 mph. There are two kinds of microbursts: wet and dry. A wet microburst is accompanied by heavy precipitation at the surface. Dry microbursts, common in places like the high plains and the intermountain west, occur with little or no precipitation reaching the ground.
- *Gust front* – A gust front is the leading edge of rain-cooled air that clashes with warmer thunderstorm inflow. Gust fronts are characterized by a wind shift, temperature drop, and gusty winds out ahead of a thunderstorm. Sometimes the winds push up air above them, forming a shelf cloud or detached roll cloud.
- *Derecho* – A derecho is a widespread thunderstorm wind event caused when new thunderstorms form along the leading edge of an outflow boundary (a surface boundary formed by the horizontal spreading of thunderstorm-cooled air). The thunderstorms feed on this boundary and continue to reproduce themselves. Derechos typically occur in the summer months when complexes of thunderstorms form over the plains and northern plains states. Usually these thunderstorms produce heavy rain and severe wind reports as they rumble across several states during the night. The word "derecho" is of Spanish origin and means "straight ahead." They are particularly dangerous because the damaging winds can last a long time and can cover such a large area.
- *Bow Echo* – A radar echo which is linear but bent outward in a bow shape. Damaging straight-line winds often occur near the "crest" or center of a bow echo. Bow echoes can be over 300km in length, last for several hours, and produce extensive swaths of wind damage at the ground.

The National Weather Service (NWS) issues severe thunderstorm watches for areas when the meteorological conditions are conducive to the development of severe thunderstorms. People in the watch area are instructed to stay tuned to National Oceanic and Atmospheric Administration (NOAA) weather radio and local radio or television stations for weather updates, and watch for developing storms. Once radar or a trained Skywarn spotter detects the existence of a severe

thunderstorm, the NWS will issue a severe thunderstorm warning. The warning will identify where the storm is located, the direction in which it is moving, and the time frame during which the storm is expected to be in the area. Persons in the warning area are instructed to seek shelter immediately.

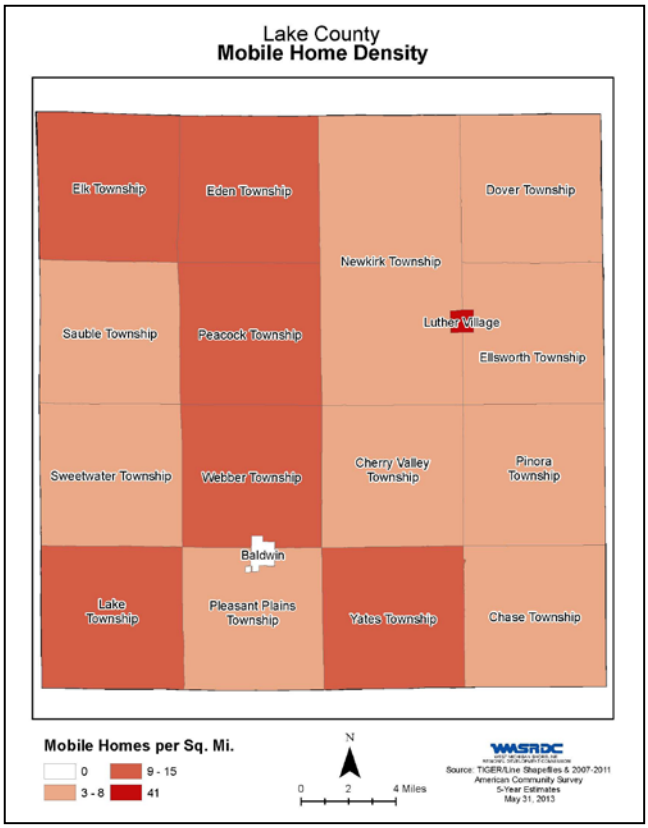
The State and local government agencies are warned via the Law Enforcement Information Network (LEIN), NOAA weather radio, and the Emergency Managers Weather Information Network (EMWIN). Public warning is provided through the Emergency Alert System (EAS). The NWS stations in Michigan transmit information directly to radio and television stations, which in turn pass the warning on to the public. The NWS also provides detailed warning information on the Internet at www.weather.gov, where an interactive map can be used.

Severe thunderstorm and high wind forecasts by the NWS usually give sufficient warning time to allow residents to take appropriate action to reduce the effects of wind damage on people and some property. A particular concern with severe winds is the prevalence of buildings without basements, which may be overturned or damaged by strong winds. Such buildings include mobile and manufactured homes, seasonal homes, workplaces, remote hunting lodges, campgrounds, etc. According to the 2006-2010 American Community Survey 5-year Estimates, mobile homes alone make up about 28% of Lake's housing. This type of housing may either be concentrated in mobile home parks (such as at Wolf Lake in Peacock Township) or scattered (generally in rural areas). According to FEMA's Building Performance Assistance Team, newer manufactured housing anchored to permanent foundations performs better than older manufactured housing in windstorms. Such mitigation measures must be taken well prior to issuance of a severe thunderstorm watch or warning. See table and map below for information on mobile home densities and distribution in Lake County.

Mobile Homes in Lake County

Community	# Mobile Homes	% of Homes in Municipality
Lake County *	4,124	27.8
Baldwin Village	0	0
Luther Village	38	18.4
Chase Township	186	28.7
Cherry Valley Township	147	32.9
Dover Township	118	32.0
Eden Township	380	44.9
Elk Township	356	23.7
Ellsworth Township	188	31.4
Lake Township	526	22.2
Newkirk Township	316	34.2
Peacock Township	398	34.9
Pinora Township	165	36.9
Pleasant Plains Township	274	14.9
Sauble Township	179	24.1
Sweetwater Township	136	33.1
Webber Township	426	32.1
Yates Township	329	26.4

** total of townships only; village totals already included within township totals*
Source: American Community Survey 2006-2010 5-year Estimates



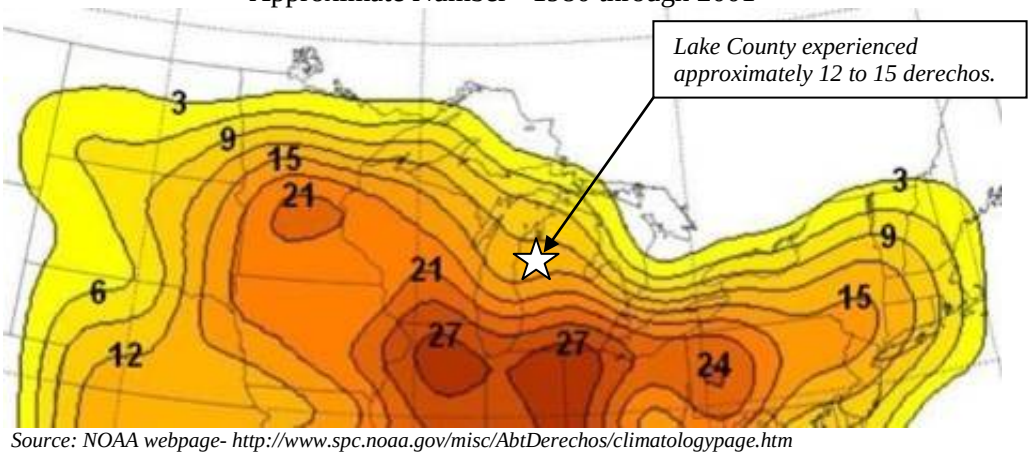
In addition to property damage to buildings (especially unsecured and less sturdy structures such as storage sheds, outbuildings, etc.), there is a risk for infrastructure damage from downed power lines due to falling limbs and trees. Downed power lines also carry the risk of electrocution to people and animals. Large scale power failures, with hundreds of thousands of customers affected, are common during straight-line wind events.

The Federal Emergency Management Agency (FEMA) has produced a wind zone classification map for the United States that divides the country into four winds zones and identifies areas that are susceptible to hurricanes and special wind regions (see map in Appendix C). The zones range from I – IV, with IV having the highest potential winds. According to the map, Lake County is located within zone IV; meaning winds are capable of reaching speeds of up to 250 miles per hour. Wind speeds of this magnitude are possible in extreme tornadoes. Please refer to the Tornadoes section for more information on that hazard.

Historically Significant and Related Events: Severe winds are a fairly common occurrence in Lake County; and although severe winds are possible any time throughout the year, they are most likely to occur in association with severe thunderstorms during the spring, summer and fall. The NCDC has documented wind events on 33 days in Lake County since 1976, 27 of which were attributed to thunderstorms. One-quarter of all recorded wind events occurred in June, which is more than any other month. In the 20-year period from 1994 through 2013, non-thunderstorm wind events affected Lake County on six days, while thunderstorm wind events were observed on 21 days. Reported property damages from severe thunderstorm winds during that period totaled $1.6 million; $1.1 million of which came from the storm described in the following narrative.

The most damaging severe wind event in recent history occurred on May 31, 1998, in association with a thunderstorm-spawned derecho event. According to the MSP-EMHSD Damage and Injury Assessment Report, Lake County sustained $89,176 in public damage costs, and the Lake County Star newspaper reported $514,850 in private property and $502,500 in clean-up costs. Fortunately, there were no reported injuries in Lake County. Across Michigan however, the derecho killed four people, injured 146 people, and caused an estimated $166 million worth of damages. Consumers Energy (the largest utility company in western and central Lower Michigan) reported the event was the most destructive weather event in the company's history.

"Moderate and High Intensity" Derechos
Approximate Number - 1980 through 2001



Source: NOAA webpage- http://www.spc.noaa.gov/misc/AbtDerechos/climatologypage.htm

A pair of other notable severe thunderstorm wind events each caused $100,000 worth of property damage. One struck Pleasant Plains and Yates townships on August 30, 2001, and the other afflicted damage countywide on August 7, 2013. For lists of other recent damaging severe thunderstorm documented by the NCDC, see the "Hazard Identification Profile" tables in Appendix

B and "National Climatic Data Center: Storm Events" tables in Appendix C.

Lake County has also experienced numerous severe wind events associated with strong weather systems. These damaging events are often characterized by constant strong winds, with occasionally severe gusts, affecting large areas for hours or even days. Six "high wind" events listed by the NCDC have involved Lake County between 1993 and May 2012. One of these events affected Lake County on October 30, 2004, when widespread high winds swept across Lower Michigan. Wind gusts between 58 and 60 miles per hour caused approximately $1.15 million in property damages in southwest Michigan, and cut off power to approximately 100,000 people statewide.

Frequency of Occurrence: Lake County is subject to between 30 and 34 thunderstorms per year according to the Michigan Hazard Mitigation Plan. Since most thunderstorms produce some straight-line winds as a result of outflow generated by the thunderstorm downdraft, anyone living in Lake County is at risk of experiencing this phenomenon.

Long-term data from 1955 through 2013 suggests that Lake County averages about one severe wind event every one to two years (34 events in 59 years). However, thanks to improved storm documentation, records dating to the early 1990's suggest that Lake County will experience wind events more frequently. Records from 1994 through 2013 yield 27 events over 20 years. At that rate, severe wind events have been observed about one to two times per year within Lake County.

According to the NOAA Storm Prediction Center's webpage titled "About Derechos," Lake County is situated in a zone that typically experiences one derecho every two years.

1.12 SUBSIDENCE

The lowering or collapse of the land surface caused by natural or human-induced activities that erode or remove sub-surface support.

Summary: Subsidence is not considered a significant threat in Lake County. Although there are a number of potential subsidence risks, abandoned mines is not one of them. These risks include the presence of solution mining and brine wells near the county's northwest corner; underground natural gas storage fields and the Michigan coal basin along the county's eastern border; and risks associated with groundwater withdrawal. Because residents and visitors to the county depend on groundwater as the primary potable water source, excessive groundwater withdrawal might be considered the greatest subsidence threat to Lake County.

Hazard Description: Natural subsidence occurs when the ground collapses into underground cavities produced by the dissolution of limestone or other soluble materials by groundwater. Human-induced subsidence is caused principally by groundwater withdrawal, drainage of organic soils, and underground mining. In the United States, these activities have caused nearly 17,000 square miles of surface subsidence, with groundwater withdrawal (10,000 square miles of subsidence) being the primary culprit. In addition, approximately 18% of the United States' land surface is underlain by cavernous limestone, gypsum, salt, or marble, making the surface of these areas susceptible to collapse into sinkholes. Generally, subsidence poses a greater risk to property than to life. Nationally, the average annual damage from all types of subsidence is conservatively estimated to be at least $125 million. The National Research Council estimates of annual damage from various types of subsidence are outlined in the following table.

Land Subsidence: Estimated Annual National Damage

Type of Subsidence	Annual Damage ($)
Drainage of organic soils	40,000,000
Underground fluid withdrawal	35,000,000
Underground mining	30,000,000
Natural compaction	10,000,000
Sinkholes	10,000,000
Hydrocompaction (collapsible soils)	N/A
TOTAL:	**$125,000,000**

Source: National Research Council, Multi-Hazard Identification and Risk Assessment, FEMA

In Michigan, the primary cause of subsidence is underground mining. Although mine subsidence is not as significant a hazard in Michigan as in other parts of the country, many areas in Michigan are potentially vulnerable to mine subsidence hazards. Mine subsidence is a geologic hazard that occurs when the ground surface collapses into underground mined areas. It can strike with little or no warning and can result in very costly damage to buildings and disruption of underground utilities. In extreme cases, mine subsidence can literally swallow whole buildings or sections of ground into sinkholes, endangering anyone that may be present at that site. Mine subsidence may take years to manifest. Examples of collapses occurring 100 years after mines were abandoned have been documented in several areas of the country. Records of abandoned mines are often sketchy and sometimes non-existent. Therefore, it is often difficult to determine exactly where the mines were located. Many areas of Michigan may have developed over abandoned mines and may not even be aware of it. Oftentimes, the one way a community or home/business owner becomes aware of a potential hazard is when subsidence actually occurs and damage or destruction results.

Compaction of soils in some aquifer systems can accompany excessive ground-water pumping and cause subsidence. Excessive pumping of such aquifer systems has resulted in permanent subsidence and related ground failures. In some systems, when large amounts of water are pumped, the subsoil compacts, thus reducing in size and number the open pore spaces in the soil that previously held water. This can result in a permanent reduction in the total storage capacity of the aquifer system. More than 80% of the identified subsidence in the United States is a consequence of human impact on subsurface water. Three distinct processes account for most of the water-related subsidence: compaction of aquifer systems, drainage and subsequent oxidation of organic soils, and dissolution and collapse of susceptible rocks.

- *Mining Groundwater* - Groundwater in the pore spaces of an aquifer supports some of the weight of the overlying materials. When groundwater is depressurized or even removed from aquifers, where the materials are very compressible and pore pressures can be high, compaction may occur. This subsidence may be partially recoverable if pressures rebound, but much of it is not. Thus the aquifer is permanently reduced in capacity, and the surface of the ground may also subside.

- *Drainage of Organic Soils* - Land subsidence may occur when soils rich in organic carbon are drained for agriculture or other purposes. The most important cause of this subsidence is microbial decomposition, which, under drained conditions, readily converts organic carbon to carbon-dioxide gas and water. Compaction, desiccation, erosion by wind and water, and prescribed or accidental burning can also be significant factors.

- *Collapsing Cavities* - This type of subsidence is commonly triggered by ground-water-level declines caused by pumping and by enhanced percolation of groundwater. Collapse features tend to be associated with specific rock types, such as evaporites (salt, gypsum, and anhydrite) and carbonates (limestone and dolomite). These rocks are susceptible to dissolution in water and the

formation of cavities. Salt and gypsum are much more soluble than limestone, the rock type most often associated with catastrophic sinkhole formation. Evaporite rocks underlie about 35 to 40% of the United States, though in many areas they are buried at great depths. Collapse sinkholes may develop over a period of hours and cause extensive damage.

In the past there has been pressure for the Great Lakes states to export bulk quantities of water to various locations in the United States. If plans to withdraw large amounts of water from the Great Lakes ever took place, it may have a major affect on the level of the groundwater tables in Michigan, which may make subsidence a more common occurrence. Currently, broken water pipes and the improper discharge of rainwater are the most common causes of water-related subsidence in Michigan. It most commonly occurs on sandy or silty ground when the water from the leak washes out the fine particles beneath the foundation causing voids that result in collapse or subsidence.

Historically Significant and Related Events: Portions of Chase Township and Pinora Township on the eastern border of the county are located above the Reed City & Loreed underground natural gas storage field. Additionally, according to the MDEQ "Potential Subsidence Hazards" map (see Appendix C, page C-20), the entire eastern side of the county is also located in the Michigan coal basin. However, there is no record of coal mining in Lake and so the basin should not present a subsidence threat. There are no documented incidences of subsidence in Lake County, however potential risks, such as underground gas storage fields, the Michigan coal basin, solution mining, and groundwater withdrawal, are notable and warrant a cursory analysis of subsidence as a hazard.

Frequency of Occurrence: Lack of documented subsidence events in Lake County prohibits the prediction of its frequency.

1.13 TORNADOES

An intense rotating column of wind that extends from the base of a severe thunderstorm to the ground.

Summary: Although just two tornadoes have been observed in Lake County between 1950 and May 2012, tornadoes occur in Michigan every year with grim regularity. The Federal Emergency Management Agency (FEMA) has produced a wind zone classification map for the United States that divides the country into four winds zones (see map in Appendix C). The zones range from I to IV, with IV having the highest potential winds. According to the map, Lake County is located within zone IV; meaning winds are capable of reaching speeds of up to 250 miles per hour. Wind speeds of this magnitude are possible in extreme tornadoes.

Tornado damages can range from minor to devastating. Deaths and property loss are frequent by-products of these events. Improved public education in tornado safety, through community efforts and media coverage, has increased the public's awareness of potential hazards from tornadoes and their response to those hazards. The National Weather Service has improved warning lead times from six to thirteen minutes. Local TV stations can also provide advanced warning with Doppler radar. Education and early awareness need to be continually improved to mitigate tornado hazards. Injuries can also occur during rescue and clean-up efforts after a tornado strikes.

Hazard Description: Tornadoes in Michigan are most frequent in the spring and early summer when warm, moist air from the Gulf of Mexico collides with cold air from the polar regions to generate severe thunderstorms. These thunderstorms often produce the violently rotating columns of wind known as funnel clouds. Michigan lies at the northeastern edge of the nation's primary tornado belt, which extends from Texas and Oklahoma through Missouri, Illinois, Indiana, and Ohio. Most of a tornado's destructive force is exerted by the powerful winds that knock down walls

and lift roofs from buildings in the storm's path. The violently rotating winds then carry debris aloft that can be blown through the air as dangerous missiles.

A tornado may have winds up to 300+ miles per hour and an interior air pressure that is 10-20% below that of the surrounding atmosphere. The typical length of a tornado path is approximately 16 miles, but tracks much longer than that – even up to 200 miles – have been reported. Tornado path widths are generally less than one-quarter mile wide. Typically, tornadoes last only a few minutes on the ground, but those few minutes can result in tremendous damage and devastation. Historically, tornadoes have resulted in tremendous loss of life, with the mean national annual death toll being around 87 persons. Property damage from tornadoes is in the hundreds of millions of dollars every year.

Tornado intensity is measured on the Enhanced Fujita Scale, which examines the damage caused by a tornado on homes, commercial buildings, other man-made structures, and trees. The scale rates the intensity of a tornado based on damaged caused, not by its size. It is important to remember that the size of a tornado is not necessarily an indication of its intensity. Large tornadoes can be weak, and small tornadoes can be extremely strong, and vice versa. It is very difficult to judge the intensity and power of a tornado while it is occurring. Generally, that can only be done after the tornado has passed, using the Enhanced Fujita Scale as the measuring stick. The Enhanced Fujita Scale, presented on the following page, is a set of wind estimates (not measurements) based on damage. Its uses three-second gusts estimated at the point of damage based on a judgment of 8 levels of damage to 28 different indicators.

Enhanced Fujita (EF) Scale of Tornado Intensity

EF Rating	Wind Speeds	Expected Damage		
EF-0	65-85 mph	'Minor' damage: shingles blown off or parts of a roof peeled off, damage to gutters/siding, branches broken off trees, shallow rooted trees toppled.		
EF-1	86-110 mph	'Moderate' damage: more significant roof damage, windows broken, exterior doors damaged or lost, mobile homes overturned or badly damaged.		
EF-2	111-135 mph	'Considerable' damage: roofs torn off well constructed homes, homes shifted off their foundation, mobile homes completely destroyed, large trees snapped or uprooted, cars can be tossed.		
EF-3	136-165 mph	'Severe' damage: entire stories of well constructed homes destroyed, significant damage done to large buildings, homes with weak foundations can be blown away, trees begin to lose their bark.		
EF-4	166-200 mph	'Extreme' damage: Well constructed homes are leveled, cars are thrown significant distances, top story exterior walls of masonry buildings would likely collapse.		
EF-5	> 200 mph	'Massive/incredible' damage: Well constructed homes are swept away, steel-reinforced concrete structures are critically damaged, high-rise buildings sustain severe structural damage, trees are usually completely debarked, stripped of branches and snapped.		

Source: NOAA, National Weather Service

Although tornadoes cannot be predicted, prevented or contained, their potential impacts on Michigan's citizens and communities can certainly be reduced. In general, improved surveillance and warning systems implemented by the National Weather Service and emergency management agencies, coupled with extensive public education campaigns, have been very effective in keeping the death toll down in recent years. However, this is not to say that a major death toll could not occur again if a strong tornado should strike a highly populated area. History has clearly shown that tornadoes must always be treated with the utmost respect and caution. Other initiatives, such as structural bracing, urban forestry practices, manufactured home anchoring, and strengthening electrical system components, can help to reduce public and private property damage.

Every community that is susceptible to tornados should have an availability of secure shelter areas for those who live in mobile homes, or at temporary and seasonal locations. This need is backed by the fact that about 28% of Lake County's housing is comprised of mobile homes. Regardless of any amount of preparation, ample warning is the best way to save lives in the event of a tornado.

Historically Significant and Related Events: In 63 years from 1950 through 2012, there have been two tornadoes in Lake County reported to the NCDC. One tornado struck on June 8, 1985 and was estimated to be a "F1" on the Fujita Scale of Tornado Intensity. There is no information about this tornado regarding its exact location, path, and associated property or crop damages. The other tornado spawned on July 26, 2005, causing $150,000 in property damage and $50,000 in crop damage. This EF1 tornado touched down in Lake Township, three miles west of Baldwin. Its path was four miles long and a half mile at its widest point. Top winds were estimated at 120 miles per hour. The damage began at Evergreen and 64th Street and ended at Wingelton and 52nd Street. The Bowman Bridge Campground sustained extensive damage, where hundreds of trees were either uprooted or snapped. Fortunately, no fatalities or injuries occurred as a result of this event.

The surrounding counties of Manistee, Mason, Mecosta, Newaygo, Oceana, Osceola and Wexford have seen 53 tornadoes (55 including Lake) over the same period. Therefore the total number of observed tornadoes in Lake County, as it relates to the county's overall risk of experiencing tornadoes, is misleading. Out of the 55 reported tornadoes, 42 (76.4%) were F0, F1, EF0, or EF1 strength. The strongest tornado was an F4 in Manistee County on April 3, 1956.

Tornado Touchdowns by Month
- 1950 through May 2012 -

Lake County and Adjacent Counties*								
Month	**Mar.**	**Apr.**	**May**	**June**	**July**	**Aug.**	**Sept.**	**Oct.**
Tornadoes	6	9	2	12	11	7	3	5
Percentage	10.9%	16.4%	3.6%	21.8%	20.0%	12.7%	5.5%	9.1%

**Including Manistee, Mason, Mecosta, Newaygo, Oceana, Osceola, and Wexford counties*
Source: Storm Data, National Climatic Data Center

Frequency of Occurrence: Lake County experienced two "F1" tornadoes in the years from 1950 to 2012. However, since Lake County and its adjacent counties have seen 55 tornadoes in those 62 years, the annual chance of tornado activity in the area is substantially greater. The monthly occurrence of tornadoes has been the greatest in June and July, combining for about 42% of all tornado touchdowns. And although tornadoes in Michigan tend to be most common in the spring and early summer, trends in this area reveal nearly equal occurrences from March through June (52.7%), and from July through October (47.3%). The trend over this time period for Lake County and its seven neighbors is to average one tornado every one to two years somewhere in the area.

1.14 WILDFIRE

An uncontrolled fire in grass lands, brush lands, or forested areas.

Summary: Forests cover approximately 86 percent, or 315,200 acres, of Lake County's land area. The vast forest cover is a boon for both industry and recreation. However, it also makes most of the county potentially vulnerable to wildfires. Most Michigan wildfires occur close to where people live and recreate, which puts people, property, and the environment at risk. Development within and around rural forested areas often increases the potential for loss of life and property from wildfires, since most fires are caused by human activities, such as outdoor burning.

Hazard Description: Wildfires are a normal ecological phenomenon and serve long-term functions for vegetation and the natural environment. Wildfires can burn excessive brush, maintain large savannah-like openings, and restore wetlands by forcing out unwanted brush and vegetation. The natural function of fires within the environment can be considered a renewal or "cleansing process" as long as the fire is not too severe.

The negative impacts and immediate danger from wildfires are destruction of timber, property, wildlife, and injury or loss of life to persons who live in the affected area or who are using recreational facilities in the area. Other long-term and corollary effects of wildfire may include:

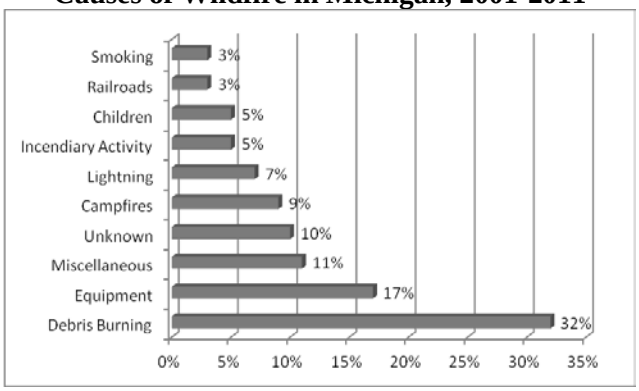
- Increased erosion and flooding, due to the disappearance of vegetation that would otherwise protect soils and slow surface runoff of water;
- Smoke (low visibilities and reduced air quality), closed roadways, and infrastructure impacts that may interfere with ordinary life, an area's economy, and planned tourism-based events; and
- Structural fires, particularly near areas of outdoor recreation and along wildlife-urban interfaces.

The threat of wildfire may be elevated in times of drought, high heat, and/or low humidity. Unfortunately these conditions often correspond to peak seasons of outdoor activity and recreation. Therefore, wildfires are often induced by human activity, rather than as a part of natural processes. Other factors that may increase the risk or severity of wildfire include: mild winters with abnormally low precipitation, allowing brush and other wildfire fuels to dry out; and severe wind storms that knock down trees, increasing the availability of fuel for wildfires.

An additional caveat of the wildfire hazard is the slight potential for it to be used maliciously due to the low cost and limited technical expertise required, the potential for causing large-scale damage, and the low risk of apprehension. This aspect of wildfire may be related to the "Terrorism and Similar Criminal Activities" hazard which is discussed in section 3.05.

Historically Significant and Related Events: Contrary to popular belief, lightning strikes are not the primary cause of wildfires in Michigan. Between 2001 and 2010, only about 7% of all wildfires in Michigan were caused by lightning strikes, while most other causes were attributed to human activity. Outdoor debris burning is the leading cause of wildfires in Michigan in recent years, comprising nearly one-third of the total. Most Michigan wildfires occur close to where people live and recreate, which puts both people and property at risk.

Causes of Wildfire in Michigan, 2001-2011



Source: Michigan Hazard Mitigation Plan, 2011

Wildfires have occurred regularly and have had significant effects on the Lake County area. The first recorded catastrophic fire in

Michigan occurred in October of 1871 after a prolonged drought over much of the Great Lakes region in the preceding summer months. Logging waste and debris, dried from the drought, greatly contributed to the spread of the fire. A similar series of wildfires burned in the spring and summer months of 1891. These fires played a role in dismantling Michigan's logging industry, and subsequently weakening Lake's economy.

Wildfire incidents have continued to occur in Lake County and nearby areas of the state since the late 1800's despite advances in firefighting technology and methodology. These advances have drastically reduced the number of acres burned per year and have helped prevent major wildfires such as those of 1871 and 1891. Firebreaks installed in sections of the forests may help manage and contain any future wildfires. Spotters and planes are alert for signs of wildfire, and response to sighted fires has been very good, with many trained fire fighters prepared to respond. Since about 30% of the county's land is national forest, the county has state and federal assistance at its disposal for wildfire response.

In May 1980, a wildfire in Oscoda County (known as the Mack Lake fire) proved that wildfires are still a significant threat in Michigan. It burned 24,000 acres, destroyed 44 homes and buildings, forced the evacuation of 1,500 people, killed one firefighter, and cost a total of $2 million in property and timber losses. In 1994, the so-called "County Line Fire" burned approximately 900 acres south of Baldwin in Pleasant Plains Township near Lilley Township, Newaygo County. More recently, the "8th Street Fire" burned 153 acres in Newkirk Township on May 9, 2011.

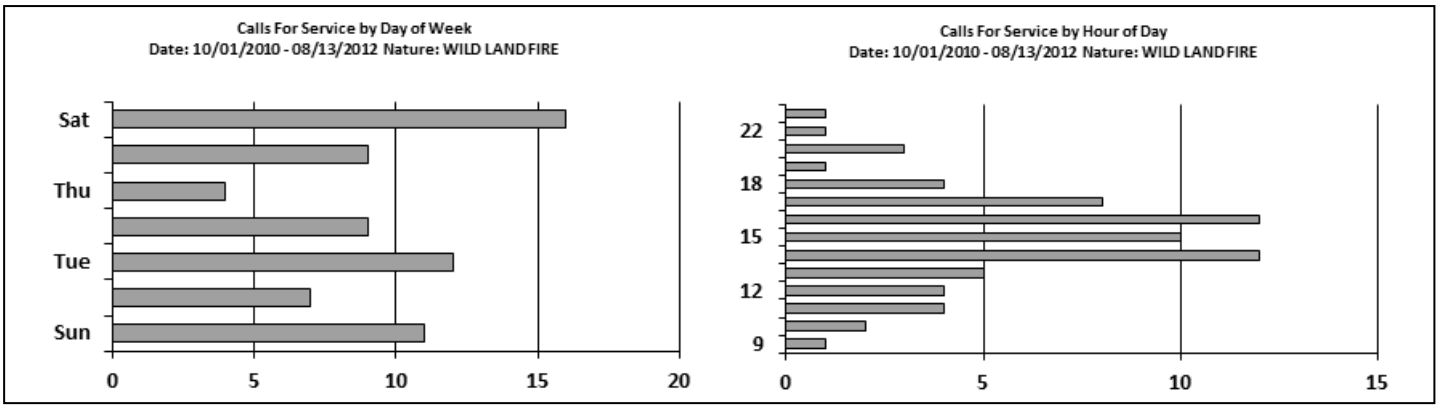
There were a total of 153 wildfires **reported** by the MDNR in Lake County that burned over 769 acres between 1981 and 2000. However, between 1981 and 2010, the number of reported wildfires under MDNR jurisdiction more than doubled to 315, with a total of 1,283.5 acres burned. Over this 30-year period, the county annually averaged about 11 wildfires and 43 burned acres per year. Since many minor wildfires over Lake's rural landscape may go unreported to the MDNR, these statistics likely underscore the actual amounts.

Frequency of Occurrence: Recent trends, such as above average temperatures, low water levels, below average precipitation (both rain and snow), and the occasional addition of fuel to the forests from the fallen trees by wind storms all help to ensure that wildfires will occur annually. It is difficult, however, to determine their frequency due to unpredictable weather patterns and human activity. In addition, wildfire statistics for Lake County are difficult to pin down because the United States Forest Service, Michigan Department of Natural Resources, and local fire departments all respond to wildfires in the area

Statistics show that over 90 percent of wildfires are human-induced in Michigan. Although Lake County has a permanent population of just 11,539, there are numerous opportunities for outdoor recreation (especially in warmer months conducive to both recreation and wildfire) which increase the concentration of people in the county, as well as the number of people interacting with nature. Therefore, wildfires are almost certain to occur numerous times each year within Lake County. The severity of each occurrence will depend greatly upon the time of year, climatological conditions, as well as the response efforts of federal, state, and local fire suppression resources.

The following tables detail calls for fire service received by the Lake County 911 from October 1, 2010 through August 13, 2012 regarding wildland fires. During that period, more calls were received on Saturdays than any other, and calls were most frequent in the afternoon hours from 2:00 to 6:00.

Lake County 911 - Calls for Wildfire Service



Source: Lake County 911

1.15 WINTER STORMS

Severe winter weather hazards include snowstorms, blizzards, and ice and sleet storms.

Summary: Severe winter hazards include snowstorms, blizzards, sleet, and ice storms. Extreme cold is another winter hazard that is addressed in the Extreme Temperatures section. Winter-like storms are possible from late October through April in Lake County; however they are most likely from mid November through early April. As a northern state, Michigan is vulnerable to all of these hazards as the result of arctic air interaction with any number of meteorological factors. It is not unusual for an area to experience any combination of these hazards in a given winter storm, thereby enhancing their effects. In addition, Lake County is susceptible to significant lake effect snow accumulations due to its close proximity to Lake Michigan. Annual costs of snow plowing, snow removal, vehicle damage from snow and ice-caused accidents, and damage from ice storms have a significant economic impact on the county.

Hazard Description: Winter storms typically cover large areas, leading to millions of dollars worth of estimated damage. Snowstorms involve the rapid precipitation and accumulation of snow, often accompanied by high winds, cold temperatures, and low visibility. Blizzards are the most dramatic and perilous of all snowstorms, characterized by low temperatures and strong winds (35+ miles per hour) bearing profuse amounts of snow. Snow accompanying a blizzard is wind-blown in such great quantities that visibility can be reduced to only a few feet, and snow drifts many feet deep can develop. Blizzards have the potential to result in property damage and loss of life. Just the cost of clearing the snow can be debilitating to a community.

Ice storms, also known as freezing rain, are the result of cold rain that freezes on contact with the surface, coating the ground, trees, buildings, overhead wires and other exposed objects with ice, sometimes causing extensive damage. Massive traffic accidents and power outages from downed tree limbs and utility lines are common when an ice storm occurs. Ice storms usually have a regional effect whereas groups of counties are affected instead of just one county or community. Often times, ice storms are accompanied by snowfall, which camouflages accumulated ice and creates treacherous transportation conditions. Sleet storms, which involve small pellets of ice accumulating on surfaces, are less dangerous than ice storms, but can still prove hazardous to transportation and electrical systems. Both ice and sleet storms occur when the temperature is close to 32°F, but are far more severe with temperatures in the 20s.

The western half of the Lower Peninsula experiences heavy snowfall and a significant number of snowstorms. One reason for this is the "lake effect," a process by which cold winter air moving across Lakes Michigan and Superior picks up moisture from the warmer lake waters, resulting in greater snowfall amounts in the western part of the state.

All winter hazards exist in Lake County and may be exacerbated due to the county's widely scattered population and rural nature. People may be snowed in for days before all of the roads can be cleared, potentially causing problems for special populations who have immediate needs. The County Road Commission is alert to trees that may be downed across roads in forested areas, and has equipment that can deal with such problems. Efforts taken by the County Road Commission, such as, salting, de-icing, and plowing, help maintain safe road conditions greatly helping to reduce hazardous impacts of winter weather. The greatest concern with winter hazards seems to be the potential impacts upon transportation, electrical, and/or water and sewer infrastructure. When electric lines are downed, households may be without power for several days, resulting in significant economic loss and disruption of essential services in affected communities.

By observing winter storm watches and warnings, adequate preparation can usually be made to reduce the impact of snowstorms on Michigan communities. Providing for the mass care and sheltering of residents left without heat or electricity, and mobilizing sufficient resources to clear blocked roads, are the primary challenges facing community officials. Severe winter weather has a propensity to affect Lake County. It should therefore plan and prepare for winter emergencies; including the identification of mass care facilities and necessary resources such as cots, blankets, food supplies and generators, as well as snow clearance and removal equipment and services. In addition, communities should develop debris management procedures (to include the identification of multiple debris storage, processing and disposal sites) so that the tree and other storm-related debris can be handled in the most expedient, efficient, and environmentally safe manner possible.

Historically Significant and Related Events: In the 40 years from 1974 through 2012, Lake County was included in one Presidential Declaration of Major Disaster or Emergency granted as a result of severe winter weather. The county was included in a statewide Declaration of Disaster by the Governor and also a statewide Presidential Declaration of Emergency for the historic blizzard that swept through Michigan January 26-27, 1978. Nearly two decades later, Lake felt the impacts of the strongest winter storm since 1978. The so-called "Blizzard of '99" dumped 13 inches of snow on Lake County from January 2-4. After the storm, 31 Michigan counties were granted a Presidential Emergency Declaration, however Lake was not included. The impacts of this initial storm system were exacerbated over the following weeks by a series of lake effect snow events that continued across West Michigan through January 15.

Significant Winter Storms in Lake County

Date	Event	Details	Location
January 26-27, 1978	Blizzard, snowstorm	Gubernatorial Declaration of Disaster, Presidential Declaration of Emergency	Statewide
January 12-13, 1993	Heavy snow	$50,000 property damage	Northern Lower Michigan
April 1, 1993	Heavy Snow	$50,000 property damage	Lower Michigan
January 12-21, 1994	Heavy lake effect snow	$500,000 property damage	Upper MI & Western Lower MI
January 27-28, 1994	Heavy snow, freezing rain	$5 million property damage	Statewide
January 2-25, 1999	Blizzard, lake effect snow	"Blizzard of '99"; worst since 1978	Southern Lower Michigan
April 3-4, 2003	Icestorm	$4.9 million property damage	Western Lower Michigan
March 1, 2007	Winter storm	$25,000 property damage	West-Central Lower MI
December 11-12, 2010	Winter storm	$250,000 property damage	Southwest Lower MI
March 2-3, 2012	Heavy snow	$100,000 property damage	Northern Lower Michigan

Source: Michigan State Police Emergency Management Division; National Climatic Data Center

In all, the NCDC lists 79 severe winter weather events in the 20 years from 1993 through 2012 in Lake County. The events included blizzards, snowstorms, lake effect snow, and ice storms. Nine of these events resulted in reported damages ranging from $25 thousand to $5 million across Lake County's zone (typically west-central or southwest Michigan). The most recent significant winter storm occurred on March 2nd and 3rd in 2012. In addition to causing $100,000 in property damage, heavy snow from the event left many Lake County residents without electricity, which prompted

the activation of emergency shelters in the county.

Frequency of Occurrence: Since 70-90 inches of snow fall every year on the Lake County (see Average Annual Snowfall map in Appendix C), it is safe to say that winter hazards are an annual threat. Between 1971 and 2000, the Village of Baldwin averaged 85 inches of snow per year. Snow averages include the months of October through April, with 75% of the total accumulating in the months of December, January, and February.

Severe Winter Events
- 1993 through December 2012 -

Month	Nov.	Dec.	Jan.	Feb.	Mar.	Apr
Events	2	23	23	19	10	3
Percentage	2.5%	28.8%	28.8%	23.8%	12.5%	3.8%

Source: Storm Data, National Climatic Data Center

Based on 80 severe winter weather reports collected by the NCDC from 1993 through December 2012, Lake County has averaged approximately four notable winter storms annually from mid November through early April. Eighty-one percent of the total number of reports occurred in the months of December, January, and February.

Significant ice/freezing rain was reported 11 times over the same 20-year period. Although these storms were observed in each month from December through April, over 80% of them occurred in January, February, or March.

Since 1978, there have been 10 disaster-level / damaging winter storms in Lake County documented by NWS and MSP-EMHSD. Nine of those events were documented since 1993, when the NCDC began documenting winter storms. From 1993 through December 2012, Lake County experienced a damaging severe winter weather event once every two to three years.

2.0 TECHNOLOGICAL HAZARDS

2.01 DAM FAILURE

The uncontrolled release of impounded water resulting in downstream flooding.

Summary: Dams can fail as a result of both natural and human influences. Either case may result in downstream flooding with the potential to harm people, property, and the environment. The relatively sudden increase of downstream flow can have a similar effect as a flash flood; and impacts may also be incurred upstream, as well as downstream from a failed dam.

Because dam failures are a byproduct of the intentional impoundment of water (thus not occurring naturally), this hazard is considered a technological hazard in this plan, rather than a natural hazard. Although the risks and threats associated with dam failures are similar to those of flooding and flash flooding, mitigation actions are primarily focused on proper maintenance and regular monitoring of dams prior to failure, as well as monitoring development within the hydraulic shadow of a dam.

There are six dams in Lake County listed in the U.S. Army Corps of Engineers, National Inventory of Dams (NID). These dams range from low to significant hazard potential.

Hazard Description: A dam failure can result in loss of life and extensive property or natural resource damage within many miles downstream from the dam, with no regard for jurisdictional boundaries. Dam failures occur not only during times of excessive precipitation, which may cause overtopping of a dam, but also as a result of poor operation, vandalism, and/or lack of maintenance and repair. Dam failures can be catastrophic if they occur unexpectedly, allowing little or no time for evacuation.

Dams may serve any number of functions, such as recreation, scenery, and the production of hydroelectricity. They can create reservoirs that are desirable locations for humans to live and recreate, and if lost, can have negative impacts on the local economy. The loss of a reservoir may reduce the value of residential properties, and eliminate recreational uses such as boating, swimming, and fishing. An emptied reservoir may also lead to public health issues if people come into contact with newly exposed sediment that is polluted. A suddenly emptied reservoir may also be a breeding ground for insects and disease.

Dams in Michigan are regulated by Part 315 of The Natural Resources and Environmental Protection Act, 1994 PA 451, as amended. Part 315, Dam Safety provides for the inspection of dams. This statute requires the MDEQ to rate each dam as either "high," "significant," or "low" hazard potential, according to the potential downstream impact if the dam were to fail (not according to the physical condition of the dam). The MDEQ has identified and rated over 2,400 dams. Dams over 6 feet in height that create an impoundment with a surface area of 5 acres or more are regulated by this statute. Dam owners are required to maintain an Emergency Action Plan (EAP) for "high" and "significant" hazard potential dams. Owners are also required to coordinate with local emergency management officials to assure consistency with the local emergency operations plan (EOP).

A report from the American Society of Civil Engineers, Michigan Section released in 2009 discusses some serious threats associated with dams in Michigan. For example, over 90% of Michigan's 2,581 dams will reach or exceed their design life by 2020; many dams are abandoned, no longer serve any useful purpose, and pose safety hazards to downstream residents. Limited, if any, funding is currently available in Michigan to help dam owners repair, rehabilitate or remove aging dams. In addition, with the exception of 110 hydropower dams, only a few dams in Michigan (mostly lake level control structures) produce any income or have a mechanism for funding needed

maintenance or repairs. Owners of dams that do not generate revenue generally do not set aside funds for their eventual repair, rehabilitation or removal; and often cannot afford to properly care for their dams. This combined with a lack of State or other public-funding mechanisms to assist dam owners causes inadequate or crumbling dams to go unattended, posing significant safety hazards to downstream residents and local and regional economies.

Lake County has six dams that are identified in the National Inventory of Dams (NID), which classifies dams as high, significant, or low hazard potential. See Appendix C for more information on the hazard potential class definitions. Of the Lake County dams, two are rated significant and four are rated low. The dams rated as "significant hazard potential" are in the villages of Baldwin and Luther. The four "low hazard potential" dams are located in the townships of Dover, Newkirk, Pleasant Plains, and Yates. There is also a berm situated at the south end of Syers Lake in Peacock Township.

In 2014, the owner of the private dam in Baldwin applied to the Michigan Department of Environmental Quality for a permit to perform a number of repairs to the dam and water control structures.

Historically Significant and Related Events: The MDEQ has documented approximately 287 dam failures in Michigan since 1888. There have been four documented in Lake County; three of which occurred in September of 1986, when the region received 8"-17" of rainfall between September 9 and September 11. These three were located in the Village of Baldwin, the Village of Luther, and Pleasant Plains Township. The fourth dam failure occurred in the Village of Luther, and was attributed to poor reconstruction. The dam has since been rebuilt and is regularly monitored by the MDEQ. Failure of theses dams offers sufficient proof that Lake County is susceptible to dam failures.

Frequency of Occurrence: According to the MSP-EMHSD, there is no correlation between hazard potential and the number of documented failures in Michigan. Dams in Lake County are believed to be in good shape and are monitored constantly; however future failures in the county are still expected. With four known failures between 1970 and 2012, the county averaged up to one failure every ten to eleven years. However, since the inception of record keeping for dam failures is unknown, this estimated frequency might be too high. In addition, all of these dam failures were the direct or indirect result of one weather event. It could therefore be argued that there will be approximately one weather event every 43 years severe enough to cause dam failures.

2.02 ENERGY EMERGENCIES

An actual or potential shortage of gasoline, electrical power, natural gas, fuel oil, or propane of sufficient magnitude and duration to potentially threaten public health and safety, and/or economic and social stability.

Summary: Historically, energy emergencies have not been considered as a significant hazard in Lake County. However, this hazard is discussed by the Michigan Hazard Mitigation Plan and is summarized in this plan to increase awareness among emergency responders, public safety officials, and community leaders. The following hazard description is only a portion of the information contained within the state plan, which can be referenced for additional information.

Energy supplies in Lake County are largely at the mercy of events beyond the county's borders, as well as greater regional and national trends. This hazard is addressed in order to raise awareness of this vulnerability and highlight the fact that Lake County's energy needs are closely connected to statewide and national issues. For more detailed information about this potential hazard, please refer to the Michigan Hazard Mitigation Plan.

Hazard Description: An adequate energy supply is critical to Michigan's (and the nation's) economic and social well-being. The American economy and lifestyle are dependent on an uninterrupted, reliable, and relatively inexpensive supply of energy that includes gasoline to fuel our vehicles, and electricity, natural gas, fuel oil and propane to operate our homes, businesses and public buildings. Energy emergencies became a serious national issue in the 1970s when two major "energy crises" exposed America's increasing vulnerability to long term energy disruptions. Americans have always dealt with short term energy disruptions caused by severe weather damage (i.e., downed power lines and poles), broken natural gas and fuel pipelines, and shortages caused by the inability of the energy market to adequately respond to consumer demand and meet needed production levels. However, the Oil Embargo of 1973-74, the natural gas shortage of 1976-77, the 1979 major price increases in oil resulting from the Iranian Revolution, the Gulf War in 1991 (after Iraq invaded Kuwait and destroyed many of its oil fields) and the aftermath of the September 11, 2001 terrorist attacks in the U.S. forced the country to recognize its vulnerability to energy disruptions. That vulnerability was again exposed during the Great Blackout of 2003 when about 50 million electric customers in the northeast United States lost power due to a power grid malfunction. The oil price increases during 2007 and 2008 pushed American gasoline prices to over $4 a gallon and caused major economic and energy related issues as well.

There are three types of energy emergencies. The first and most frequent type of energy emergency involves physical damages to energy production or distribution facilities, caused by severe storms, tornadoes, floods, earthquakes, or sabotage. Michigan has experienced a number of these short-term energy disruptions in recent history, mostly due to high winds associated with severe thunderstorms or damage caused by ice storms. While there have been only a few incidents of sabotaged energy systems in this country, networks supporting terrorist activity exist throughout the world and the possibility of more frequent incidents in the United States is always present. This category of energy emergency also covers short-term disruptions caused by human error, accidents or equipment failure, such as the power outages that occurred in Detroit in December 1998 and the Summer of 2000, the Wolverine Pipeline Company pipeline rupture in Jackson County in June 2000, the Mackinac Island power failure in July 2000, and the Great Blackout of 2003 that affected over 50 million energy customers. (Refer to the Infrastructure Failures, Severe Winds, and Ice/Sleet Storms sections of this document for additional information on short-term energy emergencies caused by weather, accidents, and equipment failure.)

The second type of energy emergency involves a sharp, sudden escalation in energy prices, usually resulting from a curtailment of oil supplies. Michigan experienced this type of energy emergency in the mid- and late 1970s due to events in the world oil market, and in 1991 following Iraq's invasion of Kuwait. The winter of 2000/2001 saw a sharp spike in natural gas costs due to reduced availability. However, many Michigan customers were unaffected, due to a price freeze on Michigan's major gas utilities. When oil reserves in Louisiana were blocked during Hurricane Katrina (August 2005), the effects were felt in Michigan and the Governor issued a State of Energy Emergency due to a gasoline shortage. Since 2001, energy costs for the average U.S. household have more than doubled, and sharply escalating gasoline prices have again strained the budgets of lower and middle class families. The summer of 2008 had the highest oil prices on record, following a dramatic rise in prices from 2007 to 2008. Gasoline prices peak at more than $4 per gallon. This contributed to the economic downtown beginning in 2007, as well as a move toward more fuel-efficient vehicles.

The third type of energy emergency is a sudden surge in energy demand caused by a national security emergency involving mobilization of U.S. defense forces. National defense, in a time of crisis, will demand an increase in energy. Although the regulated natural gas and electric utilities have approved state and federal priority allocation systems that are in place, regulatory changes to

introduce competition into natural gas and electric markets have not fully addressed how such shortages might be managed once these markets are fully opened.

Historically Significant and Related Events: Listed below are a few examples of statewide energy emergencies that have affected Lake County residents.

December 2000 – State of Michigan: Propane Supply Problems

Going into the winter of 2000 - 2001, propane supplies were very tight and inventories were low. In the Midwest, propane inventories in mid-October 2000 were 44% below levels of one year earlier. In December 2000, the state experienced record cold weather. Heating degree-days showed temperatures were 27 degrees colder than normal, the second coldest December on record and the snowiest on record. The propane industry found it increasingly difficult to maintain deliveries in light of the high levels of demand. In response to industry requests and in view of the heavy snows and very cold weather, the Chair of the Michigan Public Service Commission, in consultation with the Emergency Management and Homeland Security Division of the Michigan State Police, requested a 10-day waiver of limits on driver hour restrictions from the Regional Administrator of the Federal Motor Carrier Safety Administration. Waivers were granted for Michigan (and also Indiana, at their request). The extremely tight supply coupled with additional demand to use propane as a substitute for natural gas (which also had a sharp run up in prices) caused residential propane prices to reach a record high in Michigan of $1.76 per gallon in January 2001 before declining to $1.00 per gallon by the end of the heating season. A significant warming trend in January allowed the industry time to replace seriously depleted supplies. Had this not occurred, the situation could have become much more serious.

August 2005 – State of Michigan: Petroleum Product Supply Problems

On August 31, 2005, Governor Granholm issued three executive orders to address energy-related issues in Michigan caused by Hurricane Katrina. The massive hurricane blocked off oil refineries stationed in Louisiana and affected the supply in Michigan. Executive Order 2005-16 declared a State of Energy Emergency in accordance with 1982 PA 191. Executive Order 2005-17 temporarily waived regulations relating to motor carriers and drivers transporting gasoline, diesel fuel, and jet fuel. Executive Order 2005-18 provided for a temporary suspension of rules for gasoline vapor pressure. The State of Energy Emergency was in effect until November 29, 2005.

2007-2008 – United States: Oil Price Increases

Crude oil prices reached an all-time high in Michigan in July-September 2008. During 2003, the price rose above $30 a barrel in the peak summer months, and reached $60 a barrel by August 2005 nationally. The dramatic rise in oil prices began in March of 2007 with a steady increase that included little break during the 2007-2008 winter's traditional low point. March of 2008 started the very large increase in oil prices, starting at just over $80 a barrel, eclipsing $100 a barrel in May 2008, and finally peaking at $147 a barrel in July 2008. Following the July 2008 peak, oil prices then took a dramatic dive, and by November 2008 returned to just under $40 a barrel, the lowest level since March 2005. The increase in prices led to gasoline prices of over $4 a gallon during the summer of 2008. Commentators attributed these price increases to many factors, including reports from the United States Department of Energy and others, such as the decline in petroleum reserves, concern about high demand for oil, Middle East tension, and oil price speculation. Also, an unusual number of fires and other outages among U.S. refineries in the summer of 2007 disrupted supplies. A reduction in routine refinery maintenance was made necessary by the need to operate near full capacity to make up for a loss in refinery capacity from the 2005 Atlantic hurricane season; and deferred maintenance on refineries that escaped hurricane damage led to an increase in fires and accidents in 2007. Hurricane Ike in 2008 played a role in the price spike. Also, rising demand from U.S. consumers stretched refinery capacity to the limit and made the whole system more vulnerable to disruptions.

Frequency of Occurrence: Localized interruptions of electrical service are undoubtedly the most likely type of energy emergency in the county (see section 2.07 Infrastructure Failures for more information regarding power outages). However, the short list of energy emergencies presented above demonstrates that Lake County residents are not immune to other types of energy emergencies as well.

2.03 FIRE: SCRAP TIRES

A large and uncontrolled fire that burns scrap tires being stored for recycling/re-use.

Summary: Scrap tire fires produce a slew of complications, including toxic smoke and groundwater contamination, and require significant resources to snuff out. Significant concentrations of scrap tires have not been found to currently exist in Lake County. Even so, the threat remains for such concentrations to develop, and careful steps should be taken to ensure proper disposal of scrap tires.

Hazard Description: With the disposal of an estimated 290 million vehicle tires annually in the United States, management of scrap tires has become a major economic and environmental issue. Michigan generates approximately 10 million scrap tires each year. Although responsible means of storage and disposal have become more common, tire dumps of the last forty years still present environmental and safety hazards. In November 2009, the State of Michigan identified a total of over 990,400 tires (those that pose the greatest fire danger) in outdoor stockpiles scattered around the state. Since the MDEQ Michigan Scrap Tire Program began in 1991, the total amount of Michigan's scrap tire stockpile has gone from 31 million to about 3,400,000. The department estimated that most of the remaining tires could be disposed of before the program's ending date in December 2012.

Issues pertaining to the management of scrap tire disposal sites are difficult and diverse. Whole tires are difficult to landfill because they tend to float to the surface. Whole tires are banned from disposal in Michigan landfills due to their associated problems. Scrap tires are breeding grounds for mosquitoes, which can reproduce at thousands of times their natural rate in a scrap tire disposal site. These mosquitoes can carry and transmit life-threatening diseases. Stockpiles also are home to snakes and small mammals such as rats, opossums, skunks, and raccoons. Stockpiled tires are often soiled with mud, dirt, or other foreign materials that limit potential markets and increase processing costs. From an emergency management perspective, the most serious problem that scrap tire disposal sites pose is that they can be a tremendous fire hazard if not properly designed and managed.

Tire disposal sites can be serious fire hazards due to the sheer number of tires typically present at a site. This large quantity of "fuel," coupled with the fact that the shape of a tire allows air to flow into the interior of a large tire pile, renders standard fire fighting practices nearly useless. Flowing burning oil released by the tires spreads the fire to adjacent areas. Some scrap tire fires have burned for months, creating acrid smoke and an oily residue that can leach into the soil, creating long-term environmental problems.

Deep stockpiles of compacted tire shreds can undergo a progressive series of exothermic reactions that increase pile temperatures and generate combustible gases. Surface symptoms of this phenomenon can be subtle, such as a slight sulfur odor, vapor steaming from isolated sections of the pile surface, or a slight oil sheen on adjacent standing water after rainfall. Due to the potential for auto-ignition, surface fires can ignite on a shredded tire stockpile, especially as shreds are removed from the area near the hot zone. Gases and shreds are then exposed to air and may ignite.

Scrap tire fires differ from conventional fires in several respects: 1) even relatively small scrap tire fires can require significant resources to control and extinguish; 2) the costs of fire management are often far beyond that which local government can absorb; 3) the environmental consequences of a major tire fire are significant; and 4) as alluded to earlier, the extreme heat converts a standard passenger vehicle tire into about two gallons of oily residue, which can leach into the soil or drain into streams.

Current technologies are sufficient to address the reuse of newly generated scrap tires, but some waste tires still migrate to the least expensive disposal method, which usually means they end up in legal and illegal scrap tire disposal sites. Lightning strikes, equipment overheating or sparks, unattended burning of debris/refuse, and arson are the leading causes of tire fires. Fires are also sometimes started by site operators or local residents in the wake of publicity over clean-up activities. This publicity can include enforcement proceedings or initial abatement activities, suggesting that a landowner may be acting out of frustration or attempting to avoid costs associated with tire abatement.

Much work still needs to be done to mitigate the impacts of scrap tire fires. Incident management planning, recognition of the hazardous material potential of fires at scrap tire sites, and improving and enhancing disposal site selection and design processes are all critical pre-incident preparedness factors that must be addressed by government and the private sector. In light of the potential consequences of scrap tire fires, prevention must become a primary goal in the treatment of scrap tire disposal sites. The Rubber Manufacturers Association maintains a website that contains extensive information regarding scrap tires that may be useful to local officials. This website can be accessed at: http://www.rma.org/scrap_tires/.

According to the Michigan DEQ, there are no legitimate scrap tire disposal sites in Lake County as of May 2012. Therefore, scrap tires are more likely to merely add problems to an already existing fire, rather than cause problems of their own. It is doubtful that a fire involving a small, isolated concentration of tires would in itself cause a severe emergency or disaster. In lieu of significant concentrations, mitigation measures must involve the prevention of indiscriminate scrap tire dumping, including proper disposal, recycling, and reuse. Various "junk days," such as the yearly waste removal day in Elk Township, are held at various places throughout the county to encourage the disposal of garbage, such as scrap tires. This service has helped to control mass accumulations of scrap tires within the county.

Historically Significant and Related Events: Research for this document was unable to reveal a history of scrap tire fires in Lake County. The neighboring counties of Mecosta and Osceola, however, have experienced significant scrap tire fires in the recent past.

April 16, 1997 – Osceola County

The worst tire fire ever in Michigan occurred in Osceola County. The salvage yard where the blaze started contained over 6 million tires. All of the fire departments in a five county area were contacted. Residents within a three-mile radius were evacuated. The fire was extinguished in about two and one-half days by digging a trench around the perimeter of the fire to prevent its spread, and capping the fire with sand. In all, 478 firefighters from 34 different departments fought the blaze. The final cost of putting the fire out came to approximately $300,000. Over 1.5 million tires, two buildings and some trailers were lost in the fire.

February 24, 2000 – Mecosta County

A fire broke out at a tire recycling plant located in Hinton Township in Mecosta County. The fire had started in a pole barn that contained approximately 50,000 shredded tires. Nearby structures that also contained scrap tires were in danger of catching fire as well. Approximately 150 fire personnel from 13 local fire departments fought the blaze. Eventually, sand was brought in by a local contracting firm to smother the flames. Investigators determined that the apparent cause of the fire was a machine that had caught fire earlier and had not been adequately extinguished. The fire had then spread from the machine to the tires.

Lake County received a state grant in January 2000 for scrap tire cleanup. Presently, there is no estimated amount of scrap tires in Lake County; and no known significant concentrations exist. Since the automobile is the primary mode of transportation in Lake County, there is a constant potential for accumulation of discarded tires. Therefore this hazard cannot be ignored as a potential threat to public health and safety in the future.

Frequency of Occurrence: Although there is no record of a serious scrap tire fire in Lake County, the possibility of one cannot be entirely discounted as a threat in the future. However, it is doubtful that a fire involving scrap tires would in itself cause a severe emergency or disaster. Therefore scrap tire fires are not considered a significant hazard in Lake County.

2.04 FIRE: STRUCTURAL

A fire, of any origin, that ignites one or more structures, causing loss of life and/or property.

Summary: Every 23 seconds, a fire department responds to a fire somewhere in the nation. A structural fire occurs at the rate of one every 65 seconds, and in particular a residential fire occurs every 85 seconds. In 2011, structure fires represented 34.9% of the total fires across the United States.

In terms of average annual loss of life and property, structural fires – often referred to as the "universal hazard" because they occur in virtually every community – are by far the most common hazard facing most communities in Michigan and across the country. Because of its rural character, Lake County has less risk of experiencing a widespread structural fire, also known as a conflagration, than more developed areas of Michigan.

Hazard Description: Structural fires are most threatening when they occur in densely developed or urban environments, where there is a potential for a single fire to become a conflagration. According to the National Fire Protection Association (NFPA), in 2011, there were 2,640 civilian deaths and 15,635 civilian injuries as a result of structural fire in the United States. There were 21 fatalities in 2011 where firefighters became ill or injured while on the scene of a structure fire. There were an estimated 484,500 structural fires in 2011, while direct property damage due to fires was estimated at $9.7 billion.

The 2011 statistics continue a declining trend in fires, casualties, and injuries over the past few decades. For example, from 1977 to 1979, the nation averaged 1,065,500 structural fires, 6,275 civilian deaths, 25,382 civilian injuries, and property damages of about $14.8 billion (when adjusted for inflation).

Unfortunately, although the United States has made great strides in lessening deaths and injuries caused by other types of disasters, structural fires are a worse problem in this country than in many other industrialized countries (even those with a more densely-developed population pattern). The United States Centers for Disease Control (CDC) figures indicate that fire-associated mortality rates in the United States are approximately 2-3 times greater than those in many other developed countries. According to the Federal Emergency Management Agency's National Fire Data Center, residential fires represent 78% of all structural fires and cause 80% of all fire fatalities. Approximately 83% of those fatalities occur in single-family homes and duplexes. Perhaps the most tragic statistic of all is that over 40% of residential fires and 60% of residential fatalities occur in homes with no smoke alarms. (Studies have repeatedly shown that a working smoke alarm dramatically increases a person's chance of surviving a fire.)

Michigan's fire experience generally mirrors the national fire situation. According to statistics compiled by the Fire Marshal Division of the Michigan Department of Energy, Labor and Economic Growth for 2003, nearly 19,000 structural fires occurred in Michigan, resulting in 161 deaths and 624 injuries. The dollar loss for all fires was estimated at over $230 million. The Fire Marshal Division estimated that a structural fire occurred in Michigan about every 28 minutes in 2003. The U.S. Fire Administration reports that Michigan's fire death rate was 15.4 persons per million in 2007 and 16.4 per million in 2009. In 2009, Michigan ranked 11th among states in the nation, and was well above the national average of 11.0 deaths per million population.

Structural fires are especially likely to happen in the winter, when wood stoves and sub-standard heating implements are used most often. Rural homes are more likely to use wood stoves, fireplaces and liquid propane heating equipment, and they may also have a greater exposure to wildfire threats during warm seasons. Rural homes may present other special concerns associated with their locations off the beaten path. Complications may arise for emergency responders if they encounter: 1) home addresses that are not visible from main roads; 2) driveways, two-tracks, or dirt roads that are too narrow for large vehicles to enter, turn around, or pass other vehicles; or 3) driveways that are "gated."

Lake County does not have a county-wide zoning ordinance, and only seven out of fifteen townships are zoned. This is a concern in Lake County because many structural fire hazards may be mitigated in part through enforcement of local zoning ordinances. Although the risk of conflagration is mitigated by the county's rural nature, another concern in Lake County is the presence of various historic "main street" areas characterized by a row of attached structures where modern fireproofing retrofits, such as firewalls, have not been installed between units.

Historically Significant and Related Events: Statistics from the Michigan State Police, Fire Marshal Division estimated that the county's fire incident rate was 3.09 fires per 1,000 population in 1998. If this rate held true for the 2010 county population (11,539), Lake would have experienced approximately 36 fire incidents in that year. It should be noted that this estimate includes all types of fire incidents.

In 2003, Michigan fire departments reported 43,509 fires to the National Fire Incident Reporting System (NFIRS), with 18,759 of them (43%) involving "structures." Therefore, in Michigan in 2003, there was a fire of any origin once every 12 minutes and 7 seconds, and one structural fire every 28 minutes and 6 seconds. These fires resulted in 161 civilian deaths, 624 civilian injuries, and 514 fire service on-duty injuries. The remaining fires are listed as "outside/other" (15,285) or "mobile properties" (9,475). There were 103 fires in Lake County in 2003 which caused property and contents losses of $182,020. Based on the proportion of structural fires to all other types of fire in Michigan, it is likely that 44 (43%) of the reported fires in 2003 involved structures.

Frequency of Occurrence: There will certainly be structural fires each year in Lake County. Fortunately most of these fires will be confined to a single site and widespread damages will be limited. Based on the 2003 and 2010 fire estimates discussed above (estimated 36-44 fires per year), Lake County should expect to average some sort of fire once every 8 to 10 days. The actual number of fires experienced in the county can vary greatly from season to season, and year to year.

2.05 HAZARDOUS MATERIAL INCIDENTS: FIXED SITE (including industrial accidents)

An uncontrolled release of hazardous materials from a fixed site capable of posing a risk to life, health, safety, property or the environment.

Summary: The potential release of hazardous materials exists wherever that material may be located. Hazardous materials are chemical substances which, if released or misused, can pose a threat to people, property, or the environment. These chemicals are used in industry, agriculture, medicine, research, and consumer goods. As many as 500,000 products pose physical or health hazards and can be defined as "hazardous chemicals." Each year, over 1,000 new synthetic chemicals are introduced.

There are currently no sites in Lake County known to store potentially dangerous amounts of hazardous materials. Therefore, this hazard is not considered a significant threat to Lake County.

Also included in this section are industrial accidents, defined as a fire, explosion, or other severe accident (especially if it involves hazardous materials) at an industrial facility that results in serious property damage, injury, or loss of life.

Hazard Description: Over the past few decades, new technologies have developed at a stunning pace. As a result, hazardous materials are present in quantities of concern in business and industry, agriculture, universities, hospitals, utilities, and other facilities in our communities. Hazardous materials are materials or substances which, because of their chemical, physical, or biological nature, pose a potential risk to life, health, property, or the environment if they are released. Examples of hazardous materials include corrosives, explosives, flammable materials, radioactive materials, poisons, oxidizers, and dangerous gases. Hazardous materials are highly regulated by federal and state agencies to reduce risk to the general public and the environment. A facility is subject to SARA Title III provisions if extremely hazardous substances, as determined by the US Environmental Protection Agency (EPA), are present at the Facility in quantities at or above the minimum threshold quantities established in Section 302 of the Act.

Industrial accidents differ from hazardous material incidents in the scope and magnitude of offsite impacts. Whereas hazardous material incidents typically involve an uncontrolled release of material into the surrounding community and environment that may require evacuations or in-place sheltering of the affected population, the impacts from industrial accidents are often confined to the site or facility itself, with minimal physical outside impacts. Nonetheless, industrial accidents, such as fires, explosions, and excessive exposure to hazardous materials, may cause injury or loss of life to workers at the facility, and significant property damage. Industrial accidents may result in severe economic disruption to the facility and surrounding community, as well as significant long-term impacts on the families of the workers injured or killed.

Despite precautions taken to ensure careful handling during the manufacture, transport, storage, use, and disposal of these materials, accidents do occur. Often, these incidents can cause severe harm to people or the environment if proper action is not immediately taken. Most incidents are the result of human error. Occasionally, incidents can be attributed to natural causes, such as a flood that washes away barrels of chemicals stored at a site. However, those situations are the exception rather than the rule.

As of October 2012, there were no sites in Lake County designated as a SARA Title III, Section "302 Site." Should there be any future site designations, law requires each site to have an emergency plan on file with the Local Emergency Planning Committee (LEPC), fire department, and at the facility. The LEPC's are responsible for developing emergency response plans for communities that have facilities in their jurisdiction that are subject to SARA Title III Emergency Planning Requirements. The LEPC is the primary mechanism through which local SARA Title III planning, training and exercising activities are implemented. Despite such extensive guidelines, the possibility of human error in complying with these plans means that a hazard would still exist in the event that a location in the county becomes designated as a "302 Site." When a "302 Site" is located near other developments, compliance with LEPC planning is especially important.

Historically Significant and Related Events: There are no documented uncontrolled releases of hazardous materials from a fixed site or industrial explosions in Lake County.

Frequency of Occurrence: Since the county lacks "302 Sites," an uncontrolled release of hazardous materials from a fixed site is not considered a significant hazard in Lake County.

2.06 HAZARDOUS MATERIAL INCIDENTS: TRANSPORTATION

An uncontrolled release of hazardous materials during transport, capable of posing a risk to life, health, safety, property or the environment.

Summary: Although there are currently no sites in Lake County known to store potentially dangerous amounts of hazardous materials (see discussion in 2.05 Hazardous Material Incidents: Fixed Site), there are two highways and an active freight railway that traverse the county. These important routes may host the transportation of hazardous materials at any given time. At least one highway or railroad is present in 10 out of the 17 villages and townships in the county.

Hazard Description: As a result of the extensive use of chemicals in our society, all modes of transportation - highway, rail, air, marine, and pipeline - are transporting hazardous materials on a daily basis through local communities. A transportation accident involving any one of those hazardous material shipments could cause a local emergency with the potential to affect many people. Smaller incidents, while problematic for the affected community, are fairly common in Michigan, and are effectively dealt with by local and state emergency responders and hazardous material response teams. Larger incidents, however, pose a whole new set of problems and concerns for the affected community. Large-scale or serious hazardous material transportation incidents that involve a widespread release of harmful material (or have the potential for such a release) can adversely impact the life safety and/or health and well-being of those in the area surrounding the accident site, as well as those who come in contact with the spill or airborne plume. In addition, damage to property and the environment can be severe as well. Statistics show that nearly every hazardous material transportation incident is the result of an accident or other human error. Incidents are rarely caused solely by mechanical failure of the carrying vessel.

Although there is no record of a serious hazardous materials incident occurring on Lake County transportation routes, there have been minor incidents. There have also been many minor petroleum and hazardous materials spills throughout the years on the U.S. highway system. The major highways within the county, US-10 and M-37, are primarily two lanes. These routes are congested at times in the summer months and may quickly become icy or impassable in the winter. In addition to the roadways, the Marquette Rail, owned by RailAmerica, is a major freight railroad that makes daily runs between Grand Rapids (Kent County) and Manistee (Manistee County). The rail runs north and south between Grand Rapids and Baldwin, and then east and west between Baldwin and Mason County. The Baldwin Municipal Airport is classified as a “Basic Utility” airport. It does not offer commercial passenger or cargo transportation, therefore is not a “hazardous materials” concern. Whether it is by roadway, railway, or both, a serious hazardous materials incident may occur within the county at any given time.

Historically Significant and Related Events: There have been no documented incidences involving the transportation of hazardous materials in Lake County. However, two incidents prompting minor, short-term evacuations have been reported nearby in Newaygo County along the railroad running between Grand Rapids and Ludington.

February 4, 1978 – Woodland Park (Newaygo County)

A freight train derailment caused a chemical spill of ethylene oxide, carbolic acid, methylene chloride and phropheline oxide. A total of 50 persons were evacuated from the vicinity of the accident scene.

June 22, 1979 – Newaygo (Newaygo County)

A freight train derailment caused a chlorine leak that eventually sealed itself. A total of 300 persons were evacuated as a precautionary measure.

Frequency of Occurrence: Since the county has no documented incidences involving the transportation of hazardous materials, frequency of this hazard cannot be determined for Lake County.

2.07 INFRASTRUCTURE FAILURES

The failure of critical public or private utility infrastructure resulting in a temporary loss of essential functions and/or services.

Summary: Power loss is the most common form of infrastructure failure in Lake County, often occurring in conjunction with natural hazards. Isolated residences in rural areas may be exceptionally vulnerable to extended power loss events, especially during the winter months. As reported in a 2009 study by the National Academy of Sciences, an electrical blackout "has the potential to affect virtually all sectors of society: communications, transportation, banking and finance, commerce, manufacturing, energy, government, education, health care, public safety, emergency services, the food and water supply, and sanitation."

Hazard Description: Michigan's citizens are dependent on public and private utility infrastructure to provide essential life supporting services such as electric power, heating and air conditioning, water, sewage disposal and treatment, storm drainage, communications, and transportation. When one or more of these independent, yet interrelated, systems fail due to disaster or other cause - even for a short period of time - it can have devastating consequences. For example, when power is lost during periods of extreme heat or cold, people can literally die in their homes if immediate action is not taken. When the water or wastewater treatment systems in a community are inoperable, serious public health problems may arise and require immediate attention in order to prevent outbreaks of disease. When storm drainage systems fail due to damage or an overload of capacity, serious flooding can occur. These are just some examples of the types of infrastructure failures that can occur, and all of these situations can lead to disastrous public health and safety consequences if immediate mitigation actions are not taken.

Typically, special populations such as the elderly, children, impoverished, and people in poor health are the most impacted by infrastructure failures and must receive special consideration when failures occur. If the failure involves more than one infrastructure system, or is large enough in scope and magnitude, whole communities and possibly even regions can be severely impacted.

Although Michigan has in place many codes and standards that govern the design, construction and operation of public and private utility infrastructure, these codes and standards are often inadequate to protect the infrastructure from disaster-related damage. In many cases, the codes and standards call for the minimum level of structural integrity and operational performance recommended in accepted engineering practice, when a higher level would result in less disaster damage. Obviously, a balance must be reached between structural integrity, operational reliability, and short- and long-term costs associated with upgrading facility codes and standards.

It is possible to design and operate facilities that are virtually "disaster-proof". However, in many cases it is not economically feasible to do so. Too extensive of increases in integrity and reliability can result in prohibitive increases in cost. It is often too expensive to upgrade infrastructure codes and standards much beyond their current levels. However, in those cases where recurring, severe damage and system down-time occur due to natural or technological hazard events, it makes sense to explore the possibility of enhancing infrastructure design, construction, and operational codes and standards.

As Michigan's public and private utility infrastructure systems continue to age, infrastructure disasters will undoubtedly become more common. Because many of these systems were developed decades ago, the costs of repairing and replacing aging sections and/or components have greatly increased. As a result, many communities cannot afford to do the maintenance work necessary to keep the system in ideal operational mode. Increasing demands on the systems also lead to increased deterioration and in many cases pipes have far exceeded their useful service life. This creates a situation of increasing risk for infrastructure-related disasters, either as a primary event, or

as a secondary event to floods, windstorms, snow and ice storms, or other natural or technological hazards. When those disasters do occur, they cause great inconvenience to the affected population and they can also create subsequent public health and safety concerns.

According to the Michigan Asset Management Council, the condition of 10,000 miles of Michigan's federal aid eligible roads went from either "good" or "fair" to "poor" between 2004 and 2007. According to the US Census Bureau, Michigan has been ranked in the bottom ten of all states for over 40 years in its level of funding. After a decade of stagnant revenues in road funding, the Michigan Department of Transportation (MDOT) showed an additional 15 percent decline in funding between 2008 and 2011. Another challenge for Michigan's roads and bridges is the annual winter freeze and thaw cycle that causes a continual breakdown of road and bridge surfaces. According to the July 2008 report by the Citizens Advisory Committee on Transportation Funding, Michigan's roads and bridges will require an estimated annual investment of $6.1 billion, which is nearly two times the current funding level, for basic improvements to its road and bridge system.

Historically Significant and Related Events: Infrastructure failures are common in Lake County, with power loss as the most significant and frequent failure. The NCDC Storm Events Database mentions downed power lines 18 times for Lake County between 1997 and 2012; all of which were the result of thunderstorms, high wind events, or winter weather. Notable power outages are listed in the table below.

Widespread Power Outages Affecting Lake County

Date	Event	Number of Outages
April 6-7, 1997	Windstorm	180,000-200,000 in Michigan
March 9, 1998	Blizzard	1,900 in Lake, Clare, Oceana, and Muskegon counties
November 10, 1998	Windstorm	167,000 in West Michigan
April 3, 2003	Ice Storm	Hundreds of thousands in Southwest Lower Michigan
October 30, 2004	Windstorm	100,000 in Michigan
June 28, 2008	Thunderstorm	¾ of Lake County
March 2, 2012	Heavy Snow	Outage number unknown. Shelters activated for residents.

Source: NCDC Storm Events Database, Local Reports

Transportation infrastructure in Lake County is also susceptible to failure or interruption. In the 12 years spanning from 2001 to 2012, the NCDC has documented three events where washouts resulted from heavy rain or flash flooding. One of these events contributed to the inclusion of Lake County in a Major Disaster Declaration for June 6-13, 2008. The NCDC reports that "damage resulting from flash flooding included a 30 foot by 10 foot deep sinkhole which developed near the 18 Mile Bridge five miles west of Irons. Numerous roads were washed out and several mudslides were also reported. Rainfall totals across the areas hardest hit ranged from five to eleven inches, all of which fell in only a six to eight hour time period. Damage to public infrastructure was estimated at about two million dollars, mainly due to all of the road and bridge washouts." In addition, a notable flooding event on February 9-10, 2001 caused portions of state highway M-37 to be closed.

Site-based water and septic utilities, which are common in Lake County, are often more reliable than municipal utilities. They are, however, not immune to failure. In January 1994, a prolonged period of severely cold weather in Michigan caused ground frost to extend well below normal depths and affecting many site-based sewage systems.

Frequency of Occurrence: Natural hazards, especially thunderstorms, windstorms and winter weather, are the primary cause of infrastructure failure in Lake County. Since these hazards are expected to affect the county a number of times annually, infrastructure failures are possible anywhere in the county in any given season.

NCDC Storm Data includes 20 instances of downed power lines or outages in Lake County between 1997 and May 2014. At this rate, Lake County experienced one to two incidents per year. Widespread power failure events were less common, occurring once every two to three years. Isolated power failures can be resolved in a matter of hours, while widespread events may take days to fully recover.

Between 2000 and 2012, the NCDC documented three instances where heavy rain resulted in a road washout. At this rate, Lake County has experienced a washout once every four to five years. In addition, interruptions in transportation infrastructure, such as snowdrifts, water ponding, or downed trees, are almost certain to happen multiple times per year in Lake County.

2.08 NUCLEAR POWER PLANT EMERGENCIES

An actual or potential release of radioactive material at a commercial nuclear power plant or other nuclear facility, in sufficient quantity to constitute a threat to the health and safety of the off-site population.

Summary: The nearest nuclear power plant is about 75 miles west of Lake County's western border, well beyond the facility's Emergency Planning Zone. Nuclear power plant emergencies are therefore not considered a significant threat to Lake County.

Hazard Description: Though the construction and operation of nuclear power plants are closely monitored and regulated by the Nuclear Regulatory Commission (NRC), accidents at these plants are considered a possibility and appropriate on-site and off-site emergency planning is conducted. An accident could result in the release of potentially dangerous levels of radioactive materials into the environment that could affect the health and safety of the public living near the nuclear power plant. A nuclear power plant accident might involve both a release of air borne radioactive materials and radioactive contamination of the environment around the plant. The degree and area of environmental contamination could vary greatly depending on the type and amount of radioactivity and weather conditions. Response to a nuclear power plant accident requires specialized personnel who have been trained to handle radioactive materials safely, who have specialized equipment to detect and monitor radiation, and who are trained in personal radiation exposure control.

The closest nuclear facility is the Point Beach Nuclear Power Plant in Wisconsin. It is about 75 miles west-northwest of Lake County, well beyond the facility's secondary emergency planning zone. The second closest nuclear facility is the Palisades Power Plant over 100 miles to the south in Van Buren County. Such distant sites are not considered to be a threat in Lake County. Even if a major plume cloud were to be released from one of the nuclear power plants state, most radioactive materials would probably have dispersed into relatively harmless quantities over the long distance separating the county from these sites.

History: Lake County has never experienced damage from a nuclear power facility.

Frequency of Occurrence: Nuclear power plant accidents are not considered a significant threat in Lake County.

2.09 OIL AND NATURAL GAS WELL ACCIDENTS

An uncontrolled release of oil or natural gas, or the poisonous by-product hydrogen sulfide, from production wells.

Summary: There are a number complications and hazards that may be associated with oil and gas

wells, highlighted by the potential for uncontrolled releases of hydrogen sulfide. Although oil and gas wells are relatively common around Lake County, there are no known incidents.

Hazard Description: Oil and natural gas are produced from fields scattered across 63 counties in the Lower Peninsula. From 1927 to January 2009, there have been 56,525 oil and natural gas wells drilled in Michigan, of which roughly half have produced oil and gas. To date, Michigan wells have produced over 1.4 billion barrels of crude oil and 6 trillion cubic feet of gas.

The petroleum and natural gas industry is highly regulated and has a fine safety record, but the threat of accidental releases, fires and explosions still exists. In addition to these hazards, many of Michigan's oil and gas wells contain extremely poisonous hydrogen sulfide (H2S) gas. Hydrogen sulfide is a naturally occurring gas mixed with natural gas or dissolved in the oil or brine and released upon exposure to atmospheric conditions. Over 1,300 wells in Michigan have been identified as having H2S levels exceeding 300 parts per million (ppm).

As the table below indicates, at concentrations of 700 ppm, as little as one breath of hydrogen sulfide can kill. Although hydrogen sulfide can be detected by a "rotten egg" odor in concentrations from .03 ppm to 150 ppm, larger concentrations paralyze a person's olfactory nerves so that odor is no longer an indicator of the hazard. Within humans, small concentrations can cause coughing, nausea, severe headaches, irritation of mucous membranes, vertigo, and loss of consciousness. Hydrogen sulfide forms explosive mixtures with air at temperatures of 500 degrees Fahrenheit or above, and is dangerously reactive with powerful oxidizing materials. Hydrogen sulfide can also cause the failure of high-strength steels and other metals. This requires that all company and government responders be familiar not only with emergency procedures for the well site, but also with the kinds of materials that are safe for use in sour gas well response.

Physiological Response to H_2S

10 ppm	Beginning eye irritation
50-100 ppm	Slight conjunctivitis and respiratory tract irritation after 1 hour exposure
100 ppm	Coughing, eye irritation, loss of sense of smell after 2-15 minutes. Altered respiration, eye pains and drowsiness after 15-30 minutes followed by throat irritation after 1 hour. Several hours of exposure results in gradual increase in severity of symptoms and death may occur within the next 48 hours.
200-300 ppm	Marked conjunctivitis and respiratory tract irritation after 1 hour of exposure.
500-700 ppm	Loss of consciousness and possibly death in 30 minutes to 1 hour.
700-1000 ppm	Rapid unconsciousness, cessation of respiration and death.
1000-2000 ppm	Unconsciousness at once, with early cessation of respiration and death in a few minutes. Death may occur even if the individual is removed to fresh air at once.

Source: American National Standards Institute, Standard: 237.2-1972

An unplugged abandoned well, also known as an orphan well, can be a hazard to the health and safety of the surrounding people and environment. There are many situations where an unplugged well can become dangerous. For example, a rusted-out casing in a gas well can let natural gas flow underground and accumulate in the basement of a nearby building, possibly causing an explosion. Occasionally, gas leaking from an old well can contaminate a nearby water well. An old well might also be a conduit for salt brine from deeper formations to pollute fresh groundwater, or to discharge at the surface. In some cases, oil leaks from abandoned wells, polluting soil and water.

According to the Michigan DEQ, Office of Oil, Gas and Minerals, there are 268 total oil and gas wells in Lake County, 34 of which were active or producing as of October 2012. This is a relatively small quantity when compared other counties in the state, but the number is still sizable. Adding to this concern is the fact that several different organizations and individuals own the wells. As a general rule, most gas companies prefer to respond to incidents involving their wells themselves; and in the vast majority of cases that is what happens. Because gas companies often have controlled burns, and deal with wells on a daily basis, it is impossible to ascertain how many incidents have actually occurred in Lake County. However, there is still the possibility that an emergency response agency could find itself in the situation of responding to an incident at a gas

well. Responders must understand the dangers associated with H_2S and must have a working knowledge of these wells that are in their areas of responsibility. In other cases, the rare event may occur in which gases are released in a way that affects adjacent areas. Twelve wells in the county are known to have detectable levels of hydrogen sulfide; one is in Sauble Township and 11 are in Peacock Township. It is important to note that any type of oil or gas well, even one that has been capped, is capable of leaking dangerous levels of hydrogen sulfide.

In addition to the scattered oil and gas wells in the county, the Reed City & Loreed underground natural gas storage field extends into Pinora Township from Osceola County. Chances of an incident occurring here are minimal; however knowledge of its existence is important.

Historically Significant and Related Events: There are no identified oil or gas well incidents in Lake County. However, the neighboring county of Mecosta experienced a gas well explosion in December of 2006 which resulted in the evacuation of several nearby residents. The issue was later resolved, with no additional threat to public safety.

Frequency of Occurrence: Because Lake County has a moderate number of oil and gas wells, the occurrence of an accident is a possibility. However, there is no basis for predicting the frequency of such an event in Lake County.

2.10 PIPELINE ACCIDENTS

An uncontrolled release of petroleum or natural gas, or the poisonous by-product hydrogen sulfide, from a pipeline.

Summary: Although a large portion of Lake County's residents and vacationers rely upon liquefied petroleum (LP) gas, some parts of the county have access to natural gas utility offered by MichCon. Natural gas pipelines are the only identified type in the county. One pipeline accident, involving a natural gas main near Baldwin, is known to have occurred in Lake County.

Hazard Description: Though often overlooked, petroleum and natural gas pipelines pose a real threat in many Michigan communities. Petroleum and natural gas pipelines can leak or erupt and cause property damage, environmental contamination, injuries, and even loss of life. The vast majority of pipeline accidents that occur in Michigan are caused by third-party damage to the pipeline, often due to construction or some other activity that involves trenching or digging operations. Many structures are located right next to pipelines and thus may be at-risk. Pipelines can also cross through rivers, streams, and wetlands, thus posing the possibility of extensive environmental damage in the event of a major failure.

Michigan is both a major consumer and producer of natural gas and petroleum products. According to the federal Energy Information Administration, Michigan's consumption of petroleum products, particularly liquefied petroleum gases (LPG) is high; Michigan is the largest residential LPG market in the nation, due mostly to high residential and commercial propane consumption. The state has a single petroleum refinery but a large network of product pipelines. More than 78% of the overall home heating market uses natural gas as its primary fuel. With over one-tenth of U.S. capacity, Michigan has the greatest underground natural gas storage capacity in the nation and supplies natural gas to neighboring states during high-demand winter months. Driven largely by the residential sector, Michigan's natural gas consumption is high. Nearly four-fifths of Michigan households use natural gas as their primary energy source for home heating.

The State Energy Data System (SEDS) released data in August 2009 that describes energy consumption by source and total consumption per capita. Michigan ranks 13th in the nation in production of natural gas with 264.9 billion cubic feet and 7th in consumption at 847.8 billion cubic feet. These figures underscore the fact that vast quantities of petroleum and natural gas are

extracted from, transported through, and stored in the state, making many areas vulnerable to petroleum and natural gas emergencies. Michigan's gas and petroleum networks are highly developed and extensive, representing every sector of the two industries – from wells and production facilities, to cross-country transmission pipelines that bring the products to market, to storage facilities, and finally to local distribution systems. Pipeline users have response and recovery systems in place for all the pipelines under their control, and continually monitor the status of pipelines in the county, state, and throughout the country.

While it is true that the petroleum and natural gas industries have historically had a fine safety record, and that pipelines are by far the safest form of transportation for these products, the threat of fires, explosions, ruptures, and spills nevertheless exists. In addition to these hazards, there is the danger of hydrogen sulfide (H_2S) release. These dangers (fully explained in section "2.08: Oil and Gas Well Accidents") can be found around oil and gas wells, pipeline terminals, storage facilities, and transportation facilities where the gas or oil has high sulfur content. Hydrogen sulfide is not only an extremely poisonous gas, but is also explosive when mixed with air at temperatures of 500 degrees Fahrenheit or above.

Despite its rural character, Lake County has substantial ties with the oil and natural gas industry. Underground storage fields in Michigan, such the one located in and adjacent to Pinora Township (mentioned in section 2.08), provide an estimated 45% of the state's total winter natural gas needs. In addition, a portion of Lake County has natural gas utility service from MichCon. According to maps produced by the Michigan Public Service Commission, these communities include Baldwin Village and the townships of Cherry Valley, Pleasant Plains, Pinora, Sweetwater, and Webber.

Historically Significant and Related Events: Lake County's only identified incident occurred on June 23, 1999. A broken gas main near the intersection of M-37 and US-10 in Pleasant Plains Township prompted the evacuation of nearby residents, including senior and low-income housing complexes.

Less than 10 miles south of Lake County, in the unincorporated community of Woodland Park, a propane explosion on October 21, 2000 demolished a summer home, killing four members of a family shortly after they arrived for a weekend visit. Two other family members survived the blast, which may have originated in the basement of the home. Although this occurred outside of Lake County, an incident such as this is certainly possible in Lake County, where both LP fuel usage and vacation homes/cabins are common.

Frequency of Occurrence: Pipeline accidents are a rare occurrence in Lake County; however the June 1999 incident is proof that the county is susceptible to pipeline accidents.

2.11 TRANSPORTATION ACCIDENTS

A crash or accident involving an air, land or water-based commercial passenger carrier.

Summary: Possible accidents involving commercial transportation in Lake County are primarily limited to school buses, public transit, and the occasional tour bus travelling along the county's two highways. Natural weather hazards, as well as high traffic volumes, occasionally increase the risk of accident involving any of these modes of transportation.

Hazard Description: Communities vulnerable to transportation accidents would contain an airport offering commercial passenger service, railroad tracks on which commercial rail service is provided, commercial inter-city passenger bus or local transit bus service, school bus service and/or commercial marine passenger service. A serious accident involving any of modes of passenger transportation could result in a mass casualty incident requiring immediate life-saving community

response. When responding to any of these types of transportation accidents, emergency personnel may be confronted with a number of problems, such as: 1) suppressing fires; 2) rescuing and providing emergency first aid for survivors; 3) establishing mortuary facilities for victims; 4) detecting the presence of explosive or radioactive materials; and 5) providing crash site security, crowd and traffic control, and protection of evidence.

A land transportation accident in Michigan could involve a commercial intercity passenger bus, a local public transit bus, a school bus, or an intercity passenger train. These modes of land transportation have a good safety record, however accidents do occur. Nationally, an average of about six persons die each year in charter and commuter bus crashes, and 11 school children die in school bus accidents. About 8,500 children are injured each year in school bus crashes. Typically, bus accidents are caused when busses slip off the roadway in inclement weather, or collide with another vehicle. Intercity passenger train accidents usually involve a collision with a vehicle attempting to cross the railroad tracks before the train arrives at the crossing. Unless the train accident results in a major derailment, serious injuries are usually kept to a minimum. Bus accidents, on the other hand, can be quite serious - especially if the bus has tipped over. The local transit system and occasional tourist busses are the primary land transportation concerns in Lake County. Lake County's only local transit service is the Yates Dial-A-Ride. This service utilizes 28 vehicles to provide public transportation to the county and also has a partnership with Baldwin Community Schools to provide school transportation. Tour buses may occasionally traverse the county, utilizing highways US-10 (east-west) and M-37 (north-south).

Statistics from the National Transportation Safety Board (NTSB) and the airline industry show that over 75% of airplane crashes and accidents occur during the takeoff or landing phases of a flight. As a result, developed areas that are adjacent to major airports, and along airport flight paths, are particularly vulnerable to this hazard. Accordingly, the greater the number of landings and takeoffs, the greater the probability of a crash or accident. The challenge for jurisdictions with a passenger air carrier airport is to develop adequate procedures to handle a mass casualty incident that could result from an airplane crash or accident. Baldwin Municipal Airport, classified as "Basic Utility," is Lake County's main airport and does not offer commercial passenger services. Therefore Lake County has a very low risk of a commercial air transportation accident. Any possible hazards from commercial air transportation would likely be the result of flights between regional destinations such as Minneapolis, Grand Rapids, Detroit, and New York.

A concern associated with accidents in Lake County is the availability of area responders and current capacity of medical facilities to handle a major accident. A significant accident on any mode of transportation may require more attention than the county can provide, or it may tie up all available resources leaving the rest of the county vulnerable. Although the 2-lane highways in Lake County are in some ways more dangerous than the spacious 4 to 8 lane roads of more metropolitan areas, the lesser traffic volumes greatly reduce the chance of a major land transportation accident happening. Land transportation accidents are more likely to occur in areas of heavy traffic (such as a holiday weekend) and industrial activity, as well as during periods of inclement weather.

Historically Significant and Related Events: There are no identified major transportation accidents in Lake County for commercial passenger carriers.

Frequency of Occurrence: Minor traffic accidents are a common occurrence, and take place daily in Lake County. Periods of heavy traffic are most likely around holidays, especially during warm weather seasons. Inclement weather is possible any time during the year; however treacherous traveling conditions are most common during the winter months. Other types of transportation accidents are possible, but not common in the county. There is no historical data for predicting accidents with commercial carriers within the county.

3.0 HUMAN RELATED HAZARDS

3.01 CATASTROPHIC INCIDENTS (National Emergencies)

A large-scale event that has severe effects upon large numbers of persons, across a wide area, and immediately overwhelms State, tribal, and local response capabilities. Such incidents are likely to require coordination activities from many states, including Michigan, even if the event took place in a distant location.

Summary: Many of the hazards addressed in this chapter may achieve "catastrophe" status. Inclusion of catastrophic incidents as a stand-alone hazard is intended to highlight the extraordinary circumstances that such events produce, with the hope that it will assist planners and analysis in further developing mutual aid arrangements at all levels, to accommodate a wider variety of needs, and to suggest some possible repercussions that may not have previously been considered in existing planning and exercise scenarios.

Hazard Description: Within the past decade, the nation has been affected by disastrous events that have caused various states, including Michigan, to undertake significant actions to respond to, assist, or help accommodate the impact of events that took place well outside of their borders. Mutual aid agreements are in place between states to provide one another with supplemental resources and capabilities that are needed to help respond to and recover from a disastrous event. It is also possible that certain types of events outside of U.S. territory may require coordinated response, as well.

The National Response Framework (aka Federal Response Plan) involves a recognition of, and reaction to, events of national significance. This was observed during the terrorist events of September 11, 2001—along with the federal government, all states went into a mode of heightened alert and exchanged various information and resources in a coordinated manner. More recently, Hurricanes Katrina and Rita caused such disruption in the southern states that nation-wide assistance and coordination was needed. Not only were resources deployed to the disaster areas themselves, but distant states such as Michigan also needed to accommodate large numbers of evacuees who were temporarily displaced from their homes, jobs, businesses, and even families. Some evacuees even chose to permanently change their residence to new homes in other communities across the U.S.

In some disaster scenarios, although the State of Michigan may experience some direct impacts, it may turn out that much greater effects in other states or nations (e.g. Canada) may require extensive additional actions to be taken by Michigan government and personnel. In recognition of these extra tasks, a Catastrophic Incident hazard is now identified, in addition to the many hazards that are known to potentially have a direct impact within Michigan.

FEMA has (in its Catastrophic Incident Annex of November 2008) defined the nature of the catastrophic disaster situation. It "will result in large numbers of casualties and/or displaced persons, possibly in the tens to hundreds of thousands… The nature and scope of a catastrophic incident will immediately overwhelm State, tribal, and local response capabilities and require immediate Federal support… A catastrophic incident will have significant international dimensions, including impacts on the health and welfare of border community populations, cross-border trade, transit, law enforcement coordination, and others."

Special aspects that may be part of catastrophic incidents include the possibility of occurrence without warning, the occurrence of multiple incidents over a wide-ranging area (or even without any clearly defined incident site), may involve large-scale evacuations (whether organized or self-directed), may cause widespread homelessness and displacement (either temporary or permanent),

may overwhelm existing health-care systems, and may produce severe environmental impacts that exceed governmental abilities to achieve a timely recovery.

There are a great many possible situations that can result in nationwide activation of mutual aid and other response and recovery mechanisms, so it is not intended that this section will provide an exhaustive list of everything that may happen. Below are a number of situations that may arise and be considered to be a catastrophic incident.

- Major Hazardous Materials Incidents
- Energy Emergencies and "Great Blackouts"
- A "Supervolcano" Event
- Major Terrorist Attack
- Major Earthquakes
- Celestial Impact
- Hurricanes
- Tsunami Events
- Pandemics or other Public Health Emergencies

A catastrophic incident may require the coordination of emergency responders (and associated personnel) between states, and even from across the nation or between nations (e.g. Canada, or its Ontario province). The most direct impact of a national emergency upon responders would be dealing with the logistics of interstate mutual aid (or even its international equivalents). In an event such as the 9-11-2001 terrorist events, or the 2005 Hurricane events, numerous response personnel may have to juggle their time, resources, and efforts involving activities that assist other states or jurisdictions with disaster response and recovery, while simultaneously ensuring that their own jurisdictions' preparedness and response needs are also met. An additional potential impact may arise from events that occur in one's home jurisdiction after various aid has been granted to some other area—various staff, equipment, expertise, and funds may suddenly be needed "back at home" in the midst of complicated and important response or recovery operations abroad. Extra complexity would also be entailed in the tracking of expenses and the paperwork involved in reimbursement procedures, which might ordinarily be used on activities that are of clearer importance to the home jurisdiction's own emergency needs.

Another effect of national emergencies is the potential need to deal with evacuees coming from affected areas, who would need food, shelter, and other types of assistance under conditions of displacement and even duress. Such evacuees would tend to have numerous financial and material needs, since the emergency event may have caused severe material hardships for them (or at least temporarily denied them access to their homes and wealth). In addition, various disaster and emergency events tend to cause emotional, social, and psychological hardships, as well as material and economic ones, since various trauma may have been experienced during the emergency events (including the loss of family and friends), and the uncertainties and stresses of relocations, job loss, etc. would often require a social and psychological support structure to be sought (and often provided by the host community) in order to restore a degree of security to the evacuees conditions and lifestyle. As a part of long-term recovery, such evacuees would ideally be able to restore their lifestyles to some sort of normalcy, perhaps even including successful relocation back to their original homes and the resumption of their previous circumstances.

Historically Significant and Related Events: There have been a number of catastrophic events to affect the United States in the recent past. Some of these events are listed below. Their precise effects upon Lake County are unknown.

- Major warfare, such as World War II
- Great Blackouts, such as those of 1965 and 2003
- Anticipated or threatened infrastructure breakdowns (such as "Y2K")
- Major terrorist incidents or threats, such as 9/11 and the subsequent anthrax events
- Hurricanes, such as Katrina and Rita in 2005 (with many displaced evacuees)

In response to hurricanes Katrina and Rita, which struck the Gulf Coast of the United States in 2005, a gubernatorial disaster declaration and a presidential emergency declaration were issued in September 2005 for hurricane evacuation. These declarations made certain types of financial assistance available to communities providing assistance to hurricane evacuees.

Frequency of Occurrence: National emergencies are bound to occur from time to time, and could break out at any time of the year. However, the frequency of a catastrophic event having a significant impact on Lake County cannot be estimated.

3.02 CIVIL DISTURBANCES

Collective behavior that results in a significant level of lawbreaking, perceived threat to public order, or disruption of essential functions and quality of life.

Summary: No significant civil disturbances are known to have happened in Lake County. In addition, the county's greatest perceived civil disturbance threat, the Michigan Youth Correctional Facility (now known as the North Lake Correctional Facility), was closed in October 2005 and has not been re-opened. Although future incidents are certainly possible, there are no specific concerns at this time, and civil disturbance is not considered to be a significant hazard.

Hazard Description: Civil disturbances can be classified within the following four types: (1) act or demonstration of protest, (2) hooliganism, (3) riot, or (4) insurrection. Most of these share similarities with each other, and the classifications presented here are not absolute and mutually exclusive.

Types of civil disturbance

- *Protest* – Usually contains some level of formal organization or shared discontent that allows goal oriented activities to be collectively pursued. This includes political protests and labor disputes.
- *Hooliganism* – relatively unorganized and involves individual or collective acts of deviance inspired by the presence of crowds, in which the means (and responsibility) for ordinary levels of social control are perceived to have slackened or broken down. Examples include disorder following a sporting event or college parties.
- *Riot*– may stem from motivations of protest, but lacks the organization of formal protests. Although legitimate and peaceful protests may spontaneously form when people gather publicly for a mutually shared cause, riots tend to involve violent gatherings of persons whose level of shared values and goals is not sufficiently similar to allow their collective concerns or efforts to coalesce in a relatively organized manner.
- *Insurrection* – involves a deliberate collective effort to disrupt or replace an established authority or its representatives, by persons within a society or under its authority. An insurrection has the deliberate goal of either replacing established authorities or power structure with anarchy or a smaller-scale set of recognized criminal, ethnic, or other group networks and power structures.

Although destructive civil disturbances are rare, the potential is always there for an incident to occur. It is possible that risks for future disturbances may be exacerbated today by the ability of modern mass media (television, radio, the Internet, and various wireless communication devices) to instantly relay information (factual or not), in real time, to large numbers of people. That coverage may help to spread awareness of protests, discontent, riots, disorderly "parties," or other incidents to other areas or interested groups and persons, potentially exacerbating an already difficult situation. For example, media coverage of certain events has, in the past, spurred uprisings inside prisons. Real-time media coverage of unfolding events is a fact of modern life that is inescapable. As a result, law enforcement officials must be skilled in monitoring all forms of media coverage to anticipate public and perpetrator actions and event progression.

It is always a good idea for important community facilities and functions, such as schools and festival areas, to be aware of individuals or organizations that may create a disturbance. Local festivals, such as the Cowboy Weekend in Irons (Eden Township) and Troutarama in Baldwin, generally do not attract groups that cause disturbances. Political protests are not a concern in the rural communities within Lake County because most of the controversial political issues that could generate violent protest do not originate from the local or county-level government.

In the recent past, the greatest civil disturbance threat in Lake County was perceived to be the Michigan Youth Correctional Facility in Webber Township. This privately-owned for-profit prison was closed in October 2005 and has yet to re-open. In 2011, the facility was expanded to accommodate 2,580 Level 1 through Level 5 inmates and was renamed North Lake Correctional Facility. It is unclear if or when it will reopen. Other correctional facilities in the county include the Lake County Jail and the Lake County Residential Reentry Program (Michigan Department of Corrections) which has a 300-inmate capacity.

Historically Significant and Related Events: No major civil disturbance has been documented in Lake County in recent history. However in September 2012, two inmates escaped from the Lake County Residential Reentry facility in Baldwin. The escapees fled the county, engaged in a six-day crime-spree, and were eventually apprehended in Indiana. There were no reported impacts in Lake County.

Frequency of Occurrence: Although there have been no major civil disturbances documented in Lake County, the chance of a civil disturbance cannot be entirely discounted. Any disturbance would probably be restricted to an isolated location or gathering, and is not considered a significant threat.

3.03 NUCLEAR ATTACK

A hostile act taken against the United States which involved nuclear weapons and results in destruction of property and/or loss of life.

Summary: The possibility of a nuclear attack is a serious and grim consideration. The effects of such an occurrence on United States' soil would have a wide range of social, economical, political, and environmental impacts well beyond the immediate location of detonation.

Hazard Description: Nuclear weapons are explosive devices that manipulate atoms to release enormous amounts of energy. Compared to normal chemical explosives such as TNT or gunpowder, nuclear weapons are far more powerful and create harmful effects not seen with conventional bombs. A single nuclear weapon is able to devastate an area several miles across and inflict thousands of casualties. Although nuclear attack is an unlikely threat, the severe damage that would be caused by even one weapon requires the danger to be taken seriously.

World events in recent years have greatly changed the nature of the nuclear attack threat against the United States. In the last half of the 20th Century, this threat has primarily been associated with the Cold War between the United States and the Soviet Union. Although the Cold War has ended, there remains a threat of nuclear attack. A greater number of nations have developed nuclear weapons and there is also the possibility that terrorists could obtain a nuclear weapon for use against the United States.

A nearby strike with a one-megaton bomb would have a clear impact on those within Lake County. Sheltering would be required during the initial explosion, and if detonation occurred on the ground, a sheltering/evacuation plan would have to be followed to protect residents from the effects of fallout. Electronic equipment and communications would be damaged by the electromagnetic pulse

created by such a blast, which may include a breakdown in transportation, fire and EMS systems if their computerized equipment and vehicular ignition systems fail to operate as a result. Finally, although Lake County may lack "attractive" nuclear attack targets, consideration must be given to the county's ability to facilitate and/or accommodate mass evacuations from other areas in Michigan and perhaps around the country.

Historically Significant and Related Events: There have been no incidences involving nuclear weapons in Lake County.

Frequency of Occurrence: Although unlikely, the significant threats associated with this hazard seem to offset its low probability and therefore merit consideration when planning for the protection of large numbers of people, necessary agricultural processes, and the community's "lifeline" services. The LEPC is in charge of doing so.

3.04 PUBLIC HEALTH EMERGENCIES

A widespread and/or severe epidemic, incident of contamination, or other situation that presents a danger to or otherwise negatively impacts the general health and well being of the public.

Summary: The public health emergencies category includes a wide range of potential causes, from naturally occurring epidemics; to failure of infrastructure; to malicious releases of harmful agents. Such events pose threats to individuals' health and well-being of the population, as well as the economy and delivery of services. Because of limited number/availability of medical facilities in Lake County, medical resources from outside the county would likely be needed in the event of a widespread public health emergency.

Hazard Description: Public health emergencies can take many forms such as: disease epidemics, large-scale incidents of food or water contamination, extended periods without adequate water and sewer services, exposure to chemical, radiological or biological agents, and large-scale infestations of disease-carrying insects or rodents. Public health emergencies can occur as primary events, or they may be secondary events to another disaster such as a flood, tornado, power outage, or hazardous material incident. The common characteristic of most public health emergencies is that they adversely impact, or have the potential to adversely impact, a large number of people. Public health emergencies can be statewide, regional, or localized in scope and magnitude.

Michigan has had several large-scale public health emergencies in recent history, but fortunately nothing that caused widespread severe injury or death. The 1973 PBB contamination incident is unprecedented in U.S. history, but the long-term implications of contamination on that level so far appear minimal. Similarly, the northern Michigan water and sewer infrastructure disaster of 1994 is also unprecedented in scope, magnitude, and public health and safety implications for the affected communities. These events, though unusual, have heightened awareness of the broad nature of threats that can result in a public health emergency. Such emergencies no longer simply involve the spread of disease, but rather can arise out of a variety of situations and circumstances.

In 2001, Michigan health officials were introduced to the emerging health threats posed by foot-and-mouth disease and the West Nile encephalitis virus. Although foot-and-mouth disease is a highly contagious disease that only affects animals, a widespread outbreak such as that which occurred in parts of the United Kingdom in the spring of 2001 could have significant public health implications for humans as well, due to the potentially large numbers of dead animal carcasses that would have to be disposed of to prevent disease outbreaks. The Michigan Department of Agriculture and Rural Development, in conjunction with numerous other federal, state and local agencies and the agriculture industry, continually monitors the foot-and-mouth disease situation and takes necessary steps to prevent the introduction and spread of the disease.

The West Nile encephalitis virus, which arrived in Michigan in August 2001, presents an equally challenging scenario for public health officials. Transmitted to humans by the bite of an infected mosquito, the West Nile virus is commonly found in Africa, West and Central Asia, and the Middle East. Health officials do not know how the virus was introduced to the United States. However, in 1999 and 2000, it caused an outbreak of human encephalitis in and around New York City that created a national stir and raised fears across the country that it would cause a full-blown public health emergency. The virus eventually spread to Michigan in 2001, peaking in 2002 with 644 reported cases, including 51 deaths, in the state. There has been a decline in reported cases every year since then.

Michigan is fortunate to have an excellent public health system that constantly monitors the threats that could lead to a widespread or significant public health emergency. However, even the best monitoring and surveillance programs cannot always prevent such incidents from occurring. When they do occur, Michigan's public health agencies have shown the ability to effectively muster the resources necessary to identify and isolate the problem, and mitigate its effects on the population. In addition, if the problem is such that a multi-agency and jurisdictional response is required, the emergency management system in Michigan can be utilized to enhance coordination and effectiveness of the response and recovery effort.

Although no area is completely immune to public health emergencies, areas with high population concentrations will always be more vulnerable. In addition, densely populated areas will tend to have more vulnerable members of society who are more at risk than the general population, such as the elderly, children, impoverished individuals, and persons in poor health. This not only applies to dense urban areas; it also applies to resident camps and nursing homes.

The primary types of public health impacts involve the threat or presence of disease, contamination, or sanitation problems. Disease epidemics or pandemics have the potential to cause widespread debilitation or loss of life, associated medical expenditures, and decreases in productivity and quality of life. Contamination can at least temporarily lower property values, as well. Sanitation problems require effort and expense to resolve. Contamination and sanitation issues increase the probability and variety of diseases that may affect the population. Facilities may be shut down, as a means of preventing disease transmission or of containing contamination, and thus cause a loss of the services being provided to the public (by schools, for example). Medical resources may become overwhelmed and unable to deal with any additional needs. As traditional medical services become increasingly difficult to access (or if their quality declines due to overwork or understaffing) then increasing numbers may turn to less responsible and effective alternative means of treatment (or may forego treatment entirely).

Lake County has a limited amount of medical resources, which would be especially stressed either during a public health emergency, or during a disaster event. The nearest hospital is 17 miles to the east of Baldwin in Reed City, Osceola County. If a health epidemic of large proportions were to occur in the area, especially during "surge" population seasons, responders would have serious staffing problems. Even a public health emergency on a local scale in Lake County would have potential to strain existing medical resources, and interrupt businesses and services. Because of limited number/availability of medical facilities in Lake County, medical resources from outside the county would likely be needed in the event of a widespread public health emergency.

Historically Significant and Related Events: There are no recorded public health emergencies in Lake County within recent history. However, like the rest of the United States and the world, Lake County has had serious outbreaks of diseases like smallpox, measles, mumps, and influenza. It has been many years since the county has had to deal with diseases like polio, which gripped the country in the 1950's.

The county annually experiences power losses, creating the potential for unhealthy conditions. Fortunately no outages have caused widespread health problems.

Frequency of Occurrence: This is a difficult hazard to assess because there are many undefined factors; such as the unexpected development of new diseases such as influenza outbreaks, and the threat of an intentional release of a radiological, chemical or biological agent intended to adversely impact a large number of people.

Although each year brings a new strain of influenza to the county, it has been over 50 years since an incidence such as polio has threatened a large number of residents in Lake County.

3.05 TERRORISM AND SIMILAR CRIMINAL ACTIVITIES

Terrorism: "…activities that involve violent… or life-threatening acts… that are a violation of the criminal laws of the United States or of any State and… appear to be intended (i) to intimidate or coerce a civilian population; (ii) to influence the policy of a government by intimidation or coercion; or (iii) to affect the conduct of a government by mass destruction, assassination, or kidnapping" Federal criminal code. 18 U.S.C. §2331

Summary: Terrorism is the use of violence by individuals or groups to achieve political goals by creating fear. The political motives of terrorism distinguish it from ordinary crime. Terrorism is carried out for a cause; not for financial gain, personal revenge, or a desire for fame.

Hazard Description: Terrorism is a long-established strategy that is practiced by many groups in many nations. The United States is threatened not only by international terrorists such as Al Qaeda, but also by home-grown domestic terrorist groups including racist, ecological, anti-abortion, and anti-government terrorists.

A wide range of techniques can be used by terrorists, including bombings, shootings, arson, and hijacking. Regardless of the specific tactics used, terrorists seek the greatest possible media exposure. The goal of terrorists is to frighten as many people as possible, not necessarily to cause the greatest damage possible. Media coverage allows terrorists to affect a much larger population than those who are directly attacked.

Non-terrorist criminal activity may resemble terrorism, but lacks a political objective. Emergency management is typically not concerned with routine, individual crimes, but does need to prepare for crimes that impact large portions of the population. Such attacks may require resources not available to local law enforcement agencies. Crimes of this sort include mass shootings, random sniper attacks, sabotage of infrastructure, and cyber-attacks. The types of criminal attacks considered in this section are those that resemble terrorism or that may cause widespread immediate disruption to society.

In today's world, sabotage/terrorism can take on many forms, although civilian bombings, assassination and extortion are probably the methods with which we are most familiar. Internationally, such acts have become commonplace as various religious, ethnic, and nationalistic groups have attempted to alter and dictate political and social agendas, seek revenge for perceived past wrongdoing, or intentionally disrupt the political, social and economic infrastructure of individual businesses, units of government, or nations. The Middle East and European continent, in particular, have been hard hit by acts of sabotage and terrorism over the past several decades. Parts of Asia and South America have also experienced a high level of activity.

Unfortunately, with advances in transportation and technology, sabotage/terrorism has now crossed the oceans into the United States. Equally alarming is the rapid increase in the scope and

magnitude of sabotage/terrorism methods and threats, which now include: 1) nuclear, chemical and biological weapons; 2) information warfare; 3) ethnic/religious/gender intimidation (hate crimes); 4) state and local militia groups that advocate the overthrow of the U.S. government; 5) eco-extremism designed to destroy or disrupt specific research or resource-related activities; and 6) widespread and organized narcotics (and other contraband) smuggling and distribution organizations. Just as the methods and potential instigators have increased, so too have the potential targets of sabotage/terrorism.

As recent events across the country have shown, virtually any public facility, segment of infrastructure, or place of public assembly can be considered a target of sabotage. In addition, certain types of businesses engaged in controversial activities are also potential targets. With the advent of the information age and growth in the number of computer "hackers", computer systems (especially those of government agencies, large businesses, financial institutions, health care facilities, and colleges/universities) are potential targets as well. One of the primary common denominators of most saboteurs is their general desire for organizational recognition, but not necessarily individual recognition. They often seek publicity for their "cause" or specific agenda, but they go to great lengths to avoid individual detection by law enforcement agencies. The exception to this might be individuals and organizations involved in narcotics or other contraband smuggling and distribution, which seek to keep their clandestine operations out of public and law enforcement scrutiny. Another commonality is that innocent people are always the ones that suffer the most in these senseless and cowardly criminal acts.

Historically Significant and Related Events: Although Lake County has never experienced a significant act of terrorism or major criminal incident, recent high profile national events have increased concern among local officials for this hazard. Examples of such events have included: 1) school and workplace violence; 2) cyber terrorism; 3) sabotage/arson; and 4) domestic/international terrorism.

Frequency of Occurrence: Although Lake County's rural nature and low population density make it an unlikely target for terrorism, the possibility cannot be completely discounted. A more detailed study may be performed by Lake County Emergency Management to review the county's level of preparedness for various scenarios. This hazard is not addressed beyond the cursory level in this document.

Part D
HAZARD RISK & VULNERABILITY ASSESSMENT

The primary goal of the Risk & Vulnerability Assessment is to utilize information regarding the previous occurrences, locations and extent of hazards to gain some idea of how often they might arise, where they might occur, and how much harm they might do in the future. When hazards affect the entire county, it is important to consider potential impacts they might have on different parts of the county, especially areas that may have a harder time preparing for and responding to an event (for instance, severe snowstorms and blizzards could close roads throughout the county but the most remote and least traveled roads are plowed last, leaving their residents snowed in for days). It is also important to consider "worst-case scenarios", wherein one hazard causes others (such as severe winds causing infrastructure failures causing public health concerns), and to assess the limits of response capabilities (for example, a public health emergency may temporarily overwhelm medical service capabilities).

The simplest technique to assess risk and vulnerability is to: (1) compare the community profile map with hazard maps for the same area and (2) determine areas where hazards overlap with the locations of people, structures, and infrastructure. Areas where hazards might overlap with development are examined more closely to estimate what kinds of damages might occur during an emergency event. Maps throughout this document can be used to help facilitate this process. County-level maps at the end of this section show critical facilities/infrastructure and hazards, respectively. Other county-level maps are included in Part B for Natural Features and Land Cover. Appendix A contains municipal-level USGS Topographic maps which provide some information about locations of man-made structures. Appendix B includes municipal-level Hazard Risk maps which show critical facilities/infrastructure and mappable hazards. Altogether, the maps in this document are useful for conducting cursory hazard risk and vulnerability assessments. However, a detailed assessment would likely require additional means of investigation because some maps may lack a requisite level of accuracy and/or currency.

Another technique, which is more effective when hazards tend to be area-wide rather than location specific, is to rate and rank hazards in each community according to a standard set of variables. Such rankings will help to prioritize mitigation efforts according to the severity of a given hazard's risks in a given community. A quantitative assessment helps to measure the potential threats of each hazard; however, there is no need to reach perfect accuracy with these measurements. They are mainly used to compare hazards with each other, to prioritize them and determine the ones to which the community is most vulnerable.

The previous edition of this plan employed a "weighted average" technique of assessing and prioritizing hazards to quantify and compare the different hazards facing each community. While this is an effective technique for comparing hazards against each other, some individuals found it to be too subjective and rather complicated. Therefore, an alternative methodology was sought for this plan update. The first step involved a review of numerous hazard assessment techniques employed by other FEMA-approved hazard mitigation plans. A unique system was then devised, reviewed by MSP-EMHSD, and finally reviewed and accepted by the Lake County LEPC.

The revised rating and ranking methodology used in this plan factors the probability of each hazard's occurrence, as well as its likely impact on people, impact on property, and impact on the economy of the community. These four *hazard metrics* are each rated on a scale of 0 to 3, according to a unique set of benchmarks, for each hazard in each municipality in the county. Ratings were influenced by 1) hazard identification and analysis (Part C of this document); 2) ratings assigned in the previous edition of this plan; 3) input obtained through the survey questionnaire (described in Part A); and 4) input from the Lake County LEPC and the Advisory Team. Listed below is the schedule of metrics and benchmarks used to rate hazards in this plan.

Hazard Assessment Rating Benchmarks		
Hazard Metric	Benchmark	Rating
Probability of Occurrence	Unlikely Occurrence	0
	Not likely within 50+ years	1
	Likely within 50 years	2
	Likely within 10 years	3
Population Impact	No one affected	0
	<10% of population	1
	10-50% of population	2
	50-100% of population	3
Property Impact	No effects	0
	Isolated location	1
	Multiple locations	2
	Widespread	3
Economic Impact	No effects	0
	Mere Inconvenience	1
	Slight disruption of Services and Commerce	2
	Extended disruption of Services and Commerce	3

Once rated, each hazard is then ranked. However, each metric has a unique degree of influence upon a community's overall risk and vulnerability to a given hazard. To help account for the varying importance of each metric, unique values (or weights) are applied. The three "impact" metrics receive such weights: *population impact* gets a weight of 3; *property impact* gets a weight of 2; and *economic impact* gets a weight of 1. A higher number shows greater importance. These weighting factors are consistent with those typically used for measuring the benefits of hazard mitigation actions; which helps to develop a more compelling comparison of hazards as they relate to the selection of potential mitigation actions. *Probability of occurrence* is assumed to be the most significant component, one which magnifies the potential impacts of a hazard. To quantify this relationship, the sum of the *weighted impacts* is multiplied by the hazard's probability of occurrence.

Hazard Vulnerability Ranking Formulas
Weighted Impacts = (Population Impact x 3) + (Property Impact x 2) + (Economic Impact x 1)
Hazard Vulnerability Score = Probability of Occurrence x Weighted Impacts

The result is a standardized list of *hazard vulnerability* scores; a tool with which to rank the hazards facing a community. It can be used to 1) establish priority, 2) provide a way to build consensus about these priorities, and 3) explain decisions that have been made from these priorities. It fulfills the requirements of a Vulnerability Assessment.

The Hazard Assessment Ratings and Hazard Vulnerability Rankings for Lake County are revealed in the following. Ratings and rankings for individual municipalities in the county have been placed in Appendix B – Hazard Identification and Analyses.

LAKE COUNTY
Hazard Assessment Ratings

Natural Hazards	Probability of Occurrence	Population Impact	Property Impact	Economic Impact
1.01 Celestial Impacts	1	2	0	2
1.02 Drought	2	2	1	2
1.03 Earthquake	0	-	-	-
1.04 Extreme Temperatures	3	2	1	1
1.05 Flooding: Riverine/Urban	3	1	2	1
1.06 Fog	3	1	0	1
1.07 Great Lakes Shoreline	0	-	-	-
1.08 Hail	3	1	1	1
1.09 Invasive Species	2	1	1	1
1.10 Lightning	3	1	2	1
1.11 Severe Winds	3	2	2	2
1.12 Subsidence	1	1	1	1
1.13 Tornadoes	2	1	2	2
1.14 Wildfire	3	2	2	1
1.15 Winter Storms	3	3	2	2
Technological Hazards				
2.01 Dam Failure	2	1	2	2
2.02 Energy Emergencies	2	2	0	2
2.03 Fire – Scrap Tires	1	1	1	1
2.04 Fire – Structural	3	1	2	2
2.05 HAZMAT – Fixed Site	0	-	-	-
2.06 HAZMAT – Transportation	2	1	1	1
2.07 Infrastructure Failures	3	2	1	2
2.08 Nuclear Power Emergencies	0	-	-	-
2.09 Oil/Natural Gas Well Accidents	2	1	1	1
2.10 Pipeline Accidents	2	1	1	1
2.11 Transportation Accidents	2	1	1	1
Human-Related Hazards				
3.01 Catastrophic Incidents (National Emergencies)	1	3	3	3
3.02 Civil Disturbances	1	1	1	1
3.03 Nuclear Attack	0	-	-	-
3.04 Public Health Emergencies	2	2	0	2
3.05 Terrorism & Similar Criminal Acts	1	1	1	1

LAKE COUNTY
Hazard Vulnerability Rankings

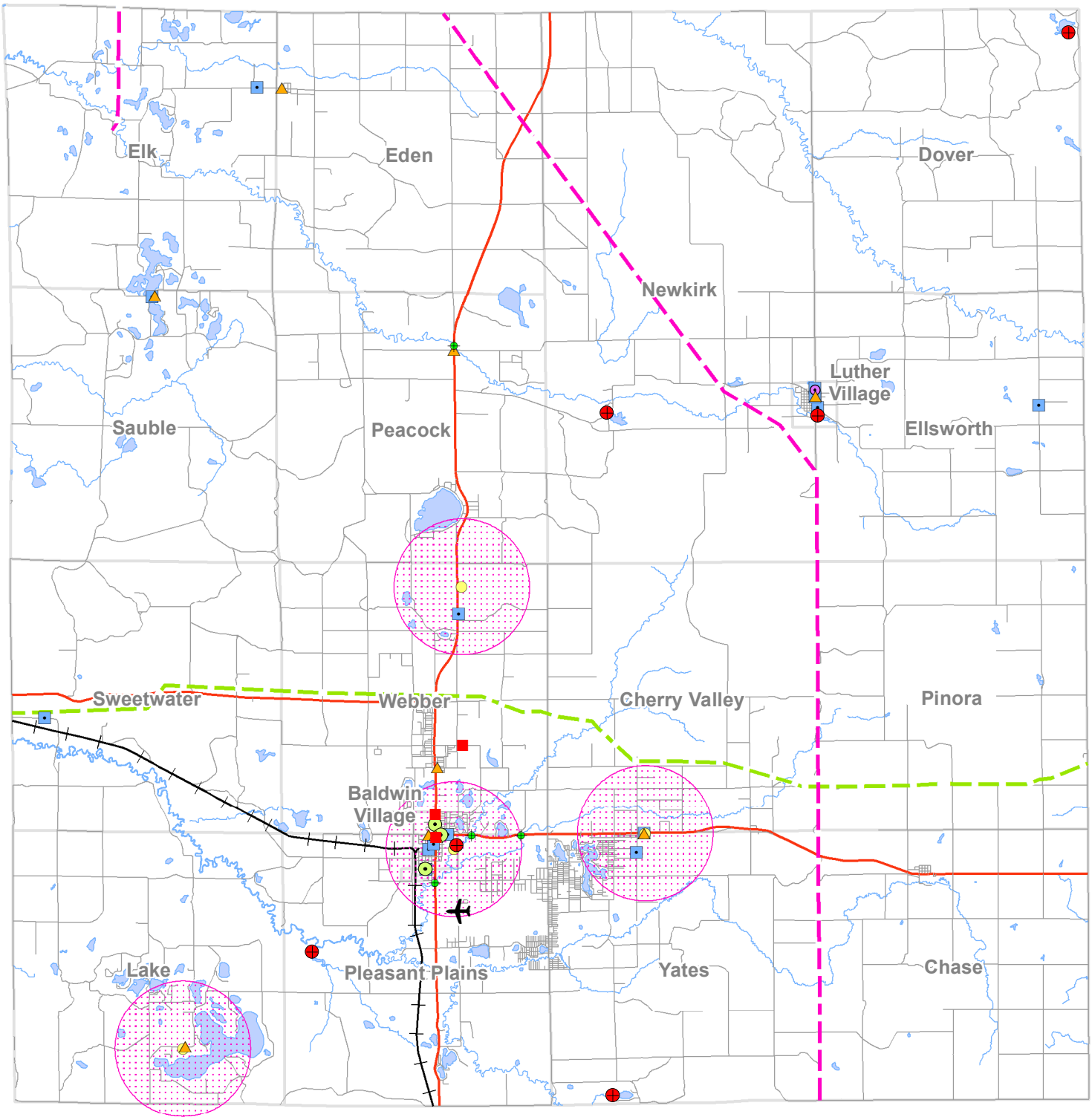
Rank	Hazard	Probability of Occurrence	x	Sum of Weighted Impacts	=	Hazard Vulnerability Ranking
1	Winter Storms	3		15		45
2	Severe Winds	3		12		36
3	Wildfire	3		11		33
4	Infrastructure Failures	3		10		30
5	Extreme Temperatures	3		9		27
5	Fire – Structural	3		9		27
7	Flooding: Riverine/Urban	3		8		24
7	Lightning	3		8		24
9	Drought	2		10		20
10	Catastrophic Incidents	1		18		18
10	Dam failure	2		9		18
10	Hail	3		6		18
10	Tornadoes	2		9		18
14	Energy Emergencies	2		8		16
14	Public Health Emergencies	2		8		16
16	Fog	3		4		12
16	HAZMAT – Transportation	2		6		12
16	Invasive Species	2		6		12
16	Oil/Natural Gas Well Accidents	2		6		12
16	Pipeline Accidents	2		6		12
16	Transportation Accidents	2		6		12
22	Celestial Impacts	1		8		8
23	Civil Disturbances	1		6		6
23	Fire – Scrap Tires	1		6		6
23	Subsidence	1		6		6
23	Terrorism & Similar Criminal Acts	1		6		6
n/a	Earthquake	0		-		-
n/a	Great Lakes Shoreline	0		-		-
n/a	HAZMAT – Fixed Site	0		-		-
n/a	Nuclear Attack	0		-		-
n/a	Nuclear Power Emergencies	0		-		-

The revised rating and ranking system produced results similar to the previous edition of the Lake County Hazard Mitigation Plan. The county's top six hazards remain the same, with *winter storms* in the #1 slot. *Severe winds* was promoted to #2, after swapping places with the #4 ranked *infrastructure failures*. *Extreme temperatures* was raised into a 5th place tie with *structural fire*.

The individual community level hazard rankings, located in Appendix B, are similar to the county rankings. For all villages and townships, the top three priority hazards are *winter storms*, *severe winds*, and *infrastructure failures*. After that, some variations in hazard ranking and priorities occur mainly between urban and rural areas. For example, *structural fire* is more of a concern in more developed communities rather than in rural areas. Likewise *drought* may be more of a concern to a predominately agricultural community, rather than one that is more commercialized.

2014 Rank	Hazard	2006 Rank	Change
1	Winter Storms	1	*- no change -*
2	Severe Winds	4	**↑2**
3	Wildfire	3	*- no change -*
4	Infrastructure Failures	2	**↓2**
5	Extreme Temperatures	6	**↑1**
5	Fire – Structural	5	*- no change -*
7	Flooding: Riverine/Urban	12	**↑5**
7	Lightning	7	*- no change -*
9	Drought	8	**↓1**
10	Catastrophic Incidents	-	**new hazard**
10	Dam failure	10	*- no change -*
10	Hail	11	**↑1**
10	Tornadoes	9	**↓1**
14	Energy Emergencies	-	**new hazard**
14	Public Health Emergencies	13	**↓1**
16	Fog	-	**new hazard**
16	HAZMAT – Transportation	15	**↓1**
16	Invasive Species	-	**new hazard**
16	Oil/Natural Gas Well Accidents	18	**↑2**
16	Pipeline Accidents	14	**↓2**
16	Transportation Accidents	16	*- no change -*
22	Celestial Impacts	-	**new hazard**
23	Civil Disturbances	19	**↓4**
23	Fire – Scrap Tires	17	**↓6**
23	Subsidence	20	**↓3**
23	Terrorism & Similar Criminal Acts	*not ranked*	-
not ranked	Earthquake	*not ranked*	**-**
not ranked	Great Lakes Shoreline	*not ranked*	**-**
not ranked	HAZMAT – Fixed Site	*not ranked*	**-**
not ranked	Nuclear Attack	*not ranked*	**-**
not ranked	Nuclear Power Emergencies	*not ranked*	**-**

LAKE COUNTY
Critical Facilities

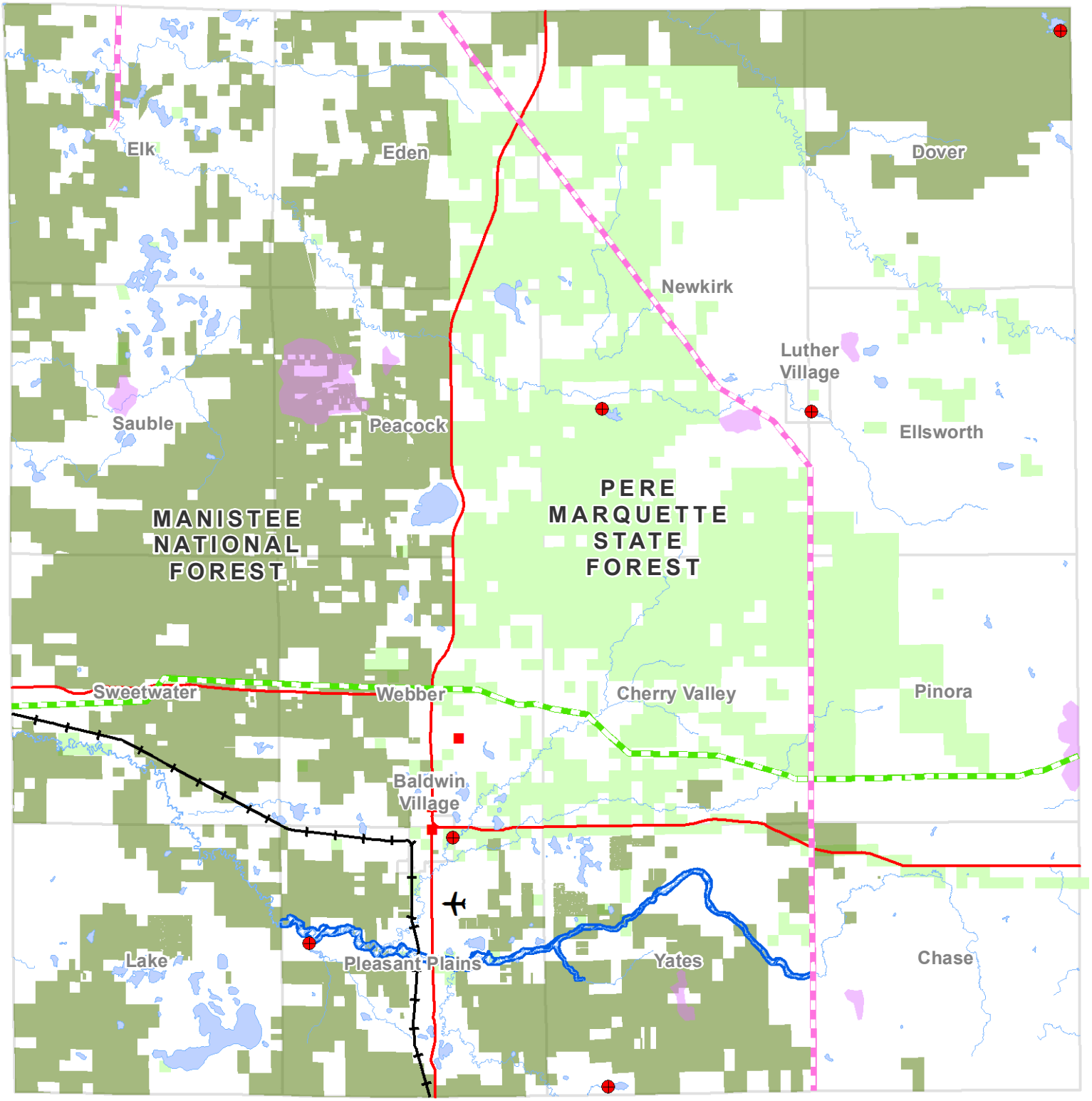


State Trunkline
Street
Railroad
Gas Pipeline
Power Line
Airport
Bridge
Fire/Police/911/EMS
School
Shelter
Dam
Medical Facility
Correctional Facility
Siren
Approximate Siren Coverage (1.5 mi radius)

WMSRDC
WEST MICHIGAN SHORELINE REGIONAL DEVELOPMENT COMMISSION

Source: Michigan Geographic Data Library V 12b, United States Geological Survey, Lake Co. Hazard Mitigation Update 2014

LAKE COUNTY
Potential Hazards



State Trunkline
Railroad
Gas Pipeline
Power Line
Dam
Correctional Facility
Airport
Federal Land
State Land
Oil/Gas Field
Floodplain

WMSRDC
WEST MICHIGAN SHORELINE REGIONAL DEVELOPMENT COMMISSION

Source: Michigan Geographic Data Library V12b, United States Geological Survey, Lake Co. Hazard Mitigation Plan update 2014

Part E
HAZARD MITIGATION GOALS AND OBJECTIVES

Goals are general guidelines that explain what the county wants to achieve. They are usually long-term and represent global visions such as "protect public health and safety". Objectives define strategies or implementation steps to attain the identified goals. Objectives are more specific and measurable than goals, making them more likely to have a defined completion date.

The development of clear goals and objectives helps clarify problems, issues, and opportunities in hazard mitigation as well as other areas. An important feature of developing them is raising community awareness of the relationship between community development practices and the level of hazard vulnerability and risk. Also, raising citizen awareness can help gain support for ongoing mitigation planning efforts.

The following goals and objectives were established for hazard mitigation efforts in Lake County. They are based on the county's hazard analyses and input from LEPC members, county officials, local media, emergency management officials, fire and police officials, local planning and zoning officials, elected officials, and critical facility managers.

For the 2014 edition of this plan, the goals and objectives from the previous edition were reviewed by the Lake County LEPC prior to, and then discussed at its December 12, 2013 meeting. It was determined that the goals and objectives remain valid, and therefore no significant changes or additions were proposed. The two foremost factors contributing to this conclusion were that: 1) conditions within the county have remained generally the same; and 2) the revamped risk assessment findings were comparable to the previous risk assessment.

OVERALL HAZARD MITIGATION GOAL:
Reduce or eliminate the long-term risk to human life and property from the full range of disasters.

GOAL 1. Promote growth in a sustainable, hazard-free manner.

Objective 1.1. Incorporate hazard provisions in building code standards, ordinances, and procedures.
Objective 1.2. Incorporate hazard mitigation into land use and capital improvement planning and development activities.
Objective 1.3. Incorporate hazard mitigation into existing land use regulation mechanisms to ensure that development will not put people in danger or increase threats to existing properties.
Objective 1.4. Research, recommend, adopt and enforce programs, plans, and ordinances that protect natural resources so that they can, in turn, provide hazard protection.

GOAL 2. Protect existing and new properties.

Objective 2.1. Use the most cost-effective approaches to keep hazards away from existing buildings and facilities.
Objective 2.2. Use the most cost-effective approaches to protect existing buildings and sites from hazards.
Objective 2.3. Maximize insurance coverage to provide financial protection against hazard events.
Objective 2.4. Maximize the resources for investment in hazard mitigation, including the use of outside sources of funding.

GOAL 3. Protect public health and safety.

Objective 3.1. Assure that threat recognition (watches) and warning systems are adequate and appropriate and that they utilize the latest technology.
Objective 3.2. Protect infrastructure and services.
Objective 3.3. Build and support local capacity, commitment and partnerships to continuously become less vulnerable to hazards.
Objective 3.4. Enlist support of committed volunteers to safeguard the community before, during, and after a disaster.

GOAL 4. Increase public understanding, support, and participation in hazard mitigation.

Objective 4.1. Heighten public awareness of the full range of existing natural and man-made hazards and actions they can take to prevent or reduce the risk to life or property.
Objective 4.2. Encourage local communities, agencies, organizations and businesses to participate in the hazard mitigation process.
Objective 4.3. Encourage cooperation and communication between planning and emergency management officials.

In order for these goals and objectives to succeed, they must be integrated into and compatible with other community goals. They must also be divided into manageable components, or actions, that can be accomplished and they must be prioritized so local officials can better focus their attention on developing alternatives.

The following sections guide and encourage concrete actions to be taken. Parts F and G contain alternatives that can be utilized by the county to accomplish hazard mitigation. Also included in Part F is information about the known employment of those alternatives within Lake County. Part H explains how the recommended action items are selected from the list of potential actions; and Part I reveals the recommended action agenda for plan implementation.

Part F
HAZARD MITIGATION ALTERNATIVES

The identification of risks and vulnerabilities, paired with established goals and objectives, should lead planners directly to a consideration of various mitigation alternatives that might be applied to improve the safety and security of residents, property, the environment, the economy, and quality of life. A mitigation alternative is not the same as a project or specific action that will definitely be implemented. Rather, an alternative is one in a set of potential actions or strategies that will be evaluated and compared.

It is important to recognize that "hazard mitigation" is often presented as something entirely distinct from "preparedness, response, and recovery," (known together as the four phases of emergency management). However, state planners in Michigan prefer to not place clear limits or distinctions around the mitigation alternatives, since all phases of emergency management share the same ultimate goals of protecting life and property, etc. Many of the mitigation alternatives discussed in this section may seem to include other aspects of emergency management.

There is a multitude of alternatives for mitigating hazards, which can be organized into the five basic strategies summarized in the table below.

Basic Hazard Mitigation Strategies

Mitigation Strategy	Description	Examples of Measures	Advantages / Limitations
MODIFYING THE HAZARD	Modifying the hazard itself (which involves removing or eliminating the hazard), reducing its size or amount, or controlling the rate of release of the hazard. In the right circumstances, this strategy can be successful but it is often difficult to do.	• Cloud seeding to modify precipitation • Slope planting to prevent erosion or collapse • Stream modification or widening to divert or improve water flow • Dredging to deepen water channel or body to improve water flow and capacity	• Can be cost-effective in many situations • Application is limited and therefore may not be as effective as other strategies • Does not always reduce or eliminate damage on a wide scale • Some hazards simply cannot be modified
SEGREGATING THE HAZARD	Attempts to "keep the hazard away from people." Primarily for flood hazards but also has applicability to other hazards. Measures are designed to redirect the impacts of a hazard away from people and development	• Dams • Dikes / Levees • Floodwalls • Flood drainage channels • Debris basins • Designated routes for hazardous transport • Buffer zones around hazard sites • Defensible space around development • Safe rooms (indoor shelter space) to protect building occupants from harm	• Can be effective for some hazard situations • Some measures can be expensive • Some measures may cause or exacerbate environmental problems • May protect one community but cause problems for adjacent communities • Economically marginal for many situations and locations
PREVENTING OR LIMITING DEVELOPMENT	Preventing or limiting development in locations where people and development would be at risk. This strategy is based on "keeping the people away from the hazard" and includes a variety of land use planning and development regulation tools. Attempts to reduce or eliminate community hazard vulnerability through wise and prudent land use and development decision-making.	• Comprehensive planning • Zoning ordinances • Building codes • Subdivision regulations • Floodplain management ordinances and other special area, use and design regulations • Capital improvements planning • Disclosure laws • Acquisition and relocation of hazard prone properties	• Can be highly effective in promoting safe, sustainable development • Widespread application (i.e., statewide, regional, local) • Proactive – seeks to prevent or reduce future vulnerabilities • Reduces future incident response / recovery costs • Administrative tools have minimal associated costs • May in some cases reduce future tax revenue if development does not occur
ALTERING DESIGN OR CONSTRUCTION	Altering the design or construction of development to make it less vulnerable (more resilient) to disaster damage. This strategy allows hazards to interact with human systems that have been designed and planned to withstand potentially destructive impacts. This strategy allows development in hazard prone areas, but requires that the development meet stringent disaster resistant performance criteria.	• Elevating flood-prone structures • Wet / dry flood proofing to improve flood damage resistance • Defensible space (vegetation buffer zones) in urban / wildland intermix areas • Wind bracing to improve wind damage resistance • Insulating water and sewer lines to prevent ground freeze damage	• Balances the dual needs of enhancing a community's economic base while at the same time reducing community hazard vulnerability • Can result in safe, sustainable development if done properly • Reduces future incident response / recovery costs • Allows for maximum land use potential • Resilient structures "rebound" better from incident impacts
EARLY WARNING AND PUBLIC EDUCATION	Seeks to ensure that the public is aware of the hazards it faces, and that proper warning and communication systems and practices are in place to save lives and protect property.	• Community hazard identification / analysis • Early warning systems (indoor and outdoor) • Tailored public awareness / education campaigns regarding hazards, warning systems and protective actions • Warning devices in congregate facilities • Special needs population warning systems	• Universal strategy – should be applied in all communities • Typically the last line of defense against serious disaster related injury, loss of life and property damage • Recognizes that some hazards cannot be prevented and therefore must be dealt with using proper safety precautions • Enhances community awareness of and support for emergency management efforts

Source: MSP/EMHSD Pub. 106a, Michigan Hazard Mitigation Success Stories, 2011

The remainder of this chapter considers a variety of mitigation alternatives for the county's top hazards. They are presented in one or more of the following groups: Preventative Measures, Corrective Measures, Resource Protection, Emergency Services, and Public Education and Awareness. Much of the following narrative was either borrowed from, or supplemented by information compiled in the Michigan Hazard Mitigation Plan.

For the 2014 edition of this plan, descriptions of mitigation alternatives were reviewed and updated as needed. How alternatives are being utilized within Lake County (the capabilities of the community) were also reviewed and updated. Other updates to this chapter include a revised description of basic mitigation strategies (see table on previous page), and the inclusion of common mitigation funding sources.

1. Preventive Measures.

Preventive mitigation is desirable because it seeks to prevent future problems from occurring. Wise land use planning and building design, small-scale retrofitting, and early warning and public education fall under this category. Doing it right the first time is almost always preferable to going back and trying to correct recurring problems at a later date. Preventive mitigation is generally easier to implement than other types of mitigation because the administrative mechanisms that guide the land development process – planning and plan review, zoning, capital improvements programming, building codes and standards, etc. – are available to every local community and only require adoption and consistent application to be highly effective in reducing or eliminating hazard vulnerability. Prevention is also generally more flexible and cost-effective and can significantly reduce or eliminate future hazard vulnerability. Preventive mitigation can help ensure that, at the very least, responsible agencies do not contribute to the increasing severity of the problem through unwise decision-making.

Preventive measures protect new construction from hazards and assure that future development does not increase the potential for losses. They are particularly important in Lake County where there is an abundance of land that could be developed. Planning, zoning, and code enforcement offices usually administer preventive measures.

A. Building Codes. Building codes are designed to ensure that a structure will be constructed in such a manner as to be safe for occupancy and use. These codes also regulate health and sanitation requirements for water, ventilation, plumbing, electricity, mechanical equipment, and air conditioning, and contain minimum construction standards for natural hazard resistance. Building codes, used in concert with other available land use / development guidance measures, can be effective in reducing or eliminating damage caused by many natural hazards such as high winds, wildfire, and flooding. In communities where comprehensive planning is not done (many municipalities in Lake County do not engage in comprehensive planning), the building code may be the only land use regulatory measure available.

Building codes provide one of the best methods of addressing the hazards in this plan, and are a prime measure to protect new construction from damage caused by natural hazards. Many times, minimum building code requirements make the difference between a structure that suffers minimal or no damage and one that suffers major damage or is a total loss. Hazard protection standards for all new and improved or repaired buildings can be incorporated into the local building code. Such standards may include:

- Making sure roofing systems will handle high winds and expected snow/ice/sleet/hail loads;
- Making sure windows, doors and siding can handle high winds;
- Providing special standards for tying the roof, walls and foundation together (crossbracing and anchoring walls to foundations, and roof rafters to walls) to resist the effects of wind;
- Requiring new buildings to have tornado "safe rooms";
- Making sure electrical systems are grounded and fire walls and sprinklers are installed in attached structures;
- Including insulation standards that ensure protection from extreme heat and cold;

- Securing the "envelope" of a structure, to reduce water-related damage; and
- Mandating overhead sewers for all new basements to prevent sewer backup.

Lake County currently enforces the 2009 Michigan Residential and the 2009 Michigan Building codes, along with the 2009 International Energy Conservation Code, Plumbing, Electrical, and Mechanical codes. Building codes such as these provide the basis for good building safety programs, especially protection from fire and electrical hazards, and are constantly being evaluated and updated to reflect new information and recommended practices. The county employs a building inspector, a plumbing inspector, a mechanical inspector, and an electrical inspector to enforce codes throughout the county.

Pursuant to 1972 PA 230, adopted November 5, 1974 and amended by 1999 PA 245, all communities in Michigan are subject to the State Construction Code, which establishes general minimum construction standards for buildings and structures in all Michigan municipalities. The State Construction Code is a compilation of the International Residential Code, the International Building Code, the International Mechanical Code, the International Plumbing Code published by the International Code Council, the National Electrical Code published by the National Fire Prevention Association, and the Michigan Uniform Energy Code with amendments, additions, or deletions as the Michigan Department of Energy, Labor and Economic Growth determines appropriate. The Code became effective statewide on July 31, 2001. The State Construction Code provides for statewide uniformity of application and implementation of rules governing the construction, use, and occupancy of buildings and structures.

FEMA, the Insurance Institute for Business and Home Safety (IBHS), and Insurance Services Office (ISO) are three national organizations that conduct evaluations, and then suggest revisions for insufficient or inappropriate codes. For example, FEMA often utilizes a Building Performance Assistance Team (BPAT) to assess tornado damages to code-conforming structures. If building performance is deemed inadequate, the BPAT may then recommend revisions to the codes to protect structures from future hazard damage.

The IBHS is a non-profit insurance industry research center that is dedicated to maintaining specific building code standards to reduce deaths, injuries, property damage, economic losses and human suffering caused by natural disasters such as wildfire, tornadoes, freezing weather, and hail. Its "FORTIFIED for Safer Living" program is one component of the IBHS suite of "FORTIFIED" programs dedicated to improving the quality of residential and light commercial buildings. The "Safer Living" section specifies construction, design, and landscaping guidelines to increase a new home's resistance to disaster from the ground up. A bevy of FORTIFIED resources for governments, business owners, and homeowners are available on the IBHS website, www.http://www.disastersafety.org/fortified/.

The ISO administers the Building Code Effectiveness Grading Schedule (BCEGS), a program designed to foster better building code enforcement and thereby reduce natural hazard damage. Local building departments are "graded" on their building codes and how those codes are enforced, with special emphasis on mitigation of losses from natural hazards. Communities with good codes and code enforcement programs in place will receive a better grade than those communities that don't, and property owners in the higher-graded communities will be rewarded with homeowners' insurance premium credits. ISO began implementing the program in states with high exposure to wind (hurricane) hazards, then moved to states with high seismic exposure, and then continued through the rest of the country.

The BCEGS was developed after determining that much of the construction failure resulting from natural disasters was due, in large part, to construction not built to comply with codes. The insurance industry's experience has shown that communities with effective codes and code enforcement have a more favorable (lower) insurance loss experience because they have less disaster-related damage to structures. BCEGS is modeled after a similar and long-standing ISO fire-grading program, which assesses local fire departments and water supplies. It is similar to and acknowledged by the Community Rating System (CRS) of the National Flood Insurance Program (NFIP), which awards CRS

credit according to BCEGS rating. The BCEGS and CRS operate under the assumption that communities with well-enforced, up-to-date codes will experience fewer damages. Homeowners within the participating communities can therefore receive lower insurance rates. This often provides communities with enough incentive to rigorously enforce their building codes.

Over 1,100 Michigan communities have received a BCEGS rating. Fire chiefs, chief building officials, and community chief administrative officials may request a single copy of the BCEGS free of charge. If a community has not yet received a BCEGS grading, or if the community has recently made improvements in its building code enforcement services, it may be eligible for a BCEGS survey.

B. Standards for Manufactured Homes. Manufactured or "mobile" homes are usually not regulated by local building codes since they are built in out-of-state factories and then shipped to sites. However, they must comply with the U.S. Department of Housing and Urban Development's National Manufactured Home Construction and Safety Standards (effective June 15, 1976) and meet local standards for on-site installation, both in terms of location and technique. The greatest mitigation concern with manufactured housing is protection from wind damage, which is best achieved through appropriate installation. FEMA's Building Performance Assistance Team (BPAT) found that newer manufactured housing, designed to better transmit wind up-lift and overturning forces to the foundation, performed better when anchored to permanent foundations. Unfortunately, they also found that building officials were often unaware of manufacturer's installation guidelines with respect to permanent foundations.

The Michigan Manufactured Housing Commission Act of 1987 (PA 96, as amended) and its implementing Administrative Rules provide regulation on the placement of manufactured homes and establishes construction criteria. Manufactured homes are prohibited from being placed within a floodway, as determined by the Department of Environmental Quality. In addition, manufactured homes sited within a floodplain must install an approved anchoring system to prevent the home from being moved from the site by floodwaters (or by high wind), and be elevated above the 100-year elevation. These provisions are highly effective when properly carried out and enforced.

Although about 28% of all homes in Lake County are mobile homes, research for this plan revealed only one mobile home park within the county located in Peacock Township.

C. Planning, Zoning, and Capital Improvements. While building codes provide guidance on *how* to build in hazardous areas, planning and zoning activities direct development *away* from these areas, especially floodplains and wetlands. They do this by designating land uses that are suitable to the natural conditions of the land, such as open space or recreation in a flood plain, or by simply allowing developers more flexibility in arranging structures on a parcel of land through the planned development approach.

The purpose of a comprehensive plan is to establish an orderly, convenient, efficient and enjoyable environment in a community, and to improve the quality of life for all its citizens. A comprehensive plan provides for future development or improvement of the land use pattern and public service program of the community. In Michigan, planning commissions are required to prepare and adopt a comprehensive plan if the community is enforcing a zoning ordinance. (The zoning ordinance must be based on an adopted comprehensive plan to be legally defensible and enforceable.) This is may be the most significant responsibility of the planning commission. Once adopted (by the planning commission and/or the community's legislative body), the comprehensive plan serves as the foundation document for the preparation and subsequent implementation of other land use / development measures such as the zoning ordinance, capital improvements planning, subdivision regulations, and special area use or design regulations. All of these other measures can be used to implement hazard mitigation measures, so the importance of the comprehensive plan in relation to mitigation cannot be understated.

The Lake County Master Plan (2012) is intended to promote consistent, sensible, and sustainable land use planning throughout the county. Although the Master Plan states specific land use and development

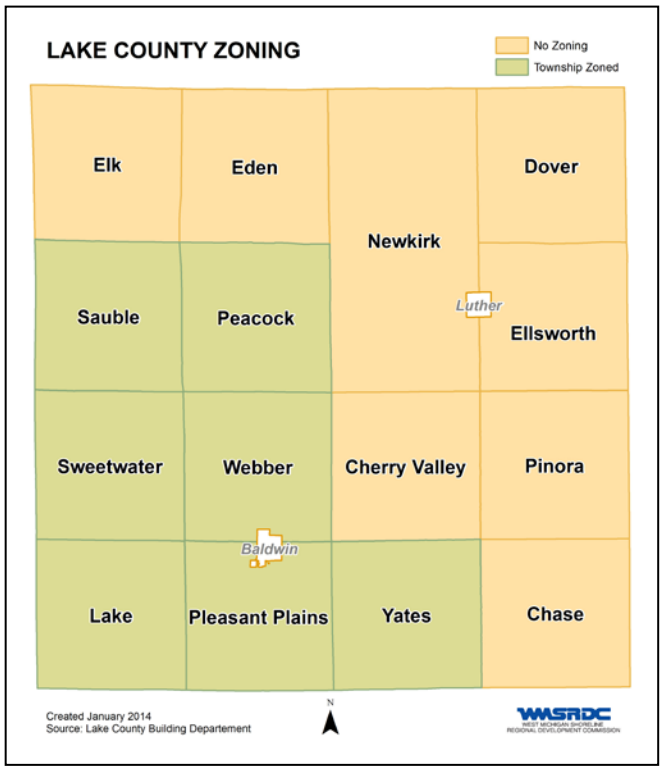
policy and proposes specific land use arrangements, it has no regulatory power. It must therefore be implemented by county and local decisions, public facility and infrastructure improvements, and the actions of private property owners. The Plan contains various goals and objectives focused on cooperation and coordination between Lake County, local municipalities, neighboring communities, and regional planning efforts. It also contains a goal of promoting the preservation of natural areas, rivers, streams, and lakes.

A zoning ordinance is probably the most effective measure a community has for guiding and regulating development and the land use pattern, and it can be very effective in mitigating hazard risk and vulnerability. The zoning ordinance provides a mechanism for implementing the policy decisions articulated in the comprehensive plan concerning the desired locations of various land uses and public facilities. The zoning ordinance is based on the comprehensive plan and therefore is developed and adopted after the comprehensive plan has been formally adopted by the community. One major difference between the two mechanisms is the timeframe upon which they are based. Generally, the comprehensive plan is designed to guide development for the next 20-30 years, whereas the zoning ordinance will typically be adopted on the basis of a 7-10 year land use development need projection.

A zoning ordinance typically addresses three areas: 1) the use of land and structures and the height and bulk of structures; 2) the density of population and intensity of land and structural use; and 3) the provision for space around structures (i.e., requirements for side yards, rear yards, open space, building setback lines, etc.).

Some zoning ordinances may specifically address potential hazards to life and property, although there is no requirement to do this. The ordinance itself consists of a map or maps delineating the zoning districts in the community where various land uses will be allowed, and an accompanying set of administrative procedures, standards and methods for enforcing the zoning regulations. Zoning districts typically include various types of industrial, commercial, residential, agricultural, and public facility uses. Specific zoning districts are tailored to the particular needs of the community. For example, communities that have a significant amount of lakefront properties may have a special zoning district for residential development around lakes.

Through zoning, communities can also prohibit development in some areas; such as in flood plains, along shorelines or in the hydraulic shadow of dams (where flooding would occur if a dam failed). Zoning ordinances usually set minimum lot sizes for each zoning district but communities can allow flexibility in lot sizes and location so that developers can avoid hazardous areas. One way to encourage such flexibility is to use the planned unit development (PUD) approach, which allows the developer to easily incorporate flood hazard mitigation measures into the project. Open space and/or floodplain preservation can be accommodated with site design standards and adjusted land use densities. Granting larger minimum lot sizes, i.e., four or five acres, for areas next to water courses allows streams to run near lot lines, and gives developers flexibility to build on higher ground while still including floodplains in backyards.



Zoning ordinances in seven out of the 15 Lake County townships are adopted and enforced by local jurisdictions (see map). Lake County had some zoning authority over the remaining townships from

2001 through 2005 under the guidance of an interim zoning ordinance; however a permanent zoning ordinance was not adopted.

A Capital Improvements Plan (CIP) is the mechanism through which a community identifies, prioritizes, and establishes financing methods for needed public improvements such as new or improved public buildings, roads, bridges, treatment plants, water and sewer infrastructure, etc. Under Michigan law, planning commissions are required to annually prepare and adopt a CIP and recommend it to the legislative body for their use in considering public works projects. Generally, public improvements included in the CIP are those that require a substantial expenditure of public funds. (Each jurisdiction must decide what constitutes a substantial expenditure.) The CIP can be an effective implementing mechanism for the community's comprehensive plan and zoning ordinance because it dictates the nature and timing of public facility expenditures. Normally, the CIP is established for a six-year period. The first year of the CIP becomes the year's capital budget and is the basis for making appropriations for capital improvements. As a result, the annually approved items are the highest priority public improvements to be built in planned areas.

From a hazard mitigation perspective, the CIP, if coordinated with the community's comprehensive plan and zoning ordinance, can be an effective mechanism for creating a desirable, less vulnerable land use and development pattern. Planning commissions, because they create and adopt each of the three mechanisms, are instrumental in ensuring that public investment is done in such a way that it helps reduce or eliminate the community's risk and vulnerability to hazards. Capital expenditures may include acquisition of open space within hazardous areas; extension of public services into hazardous areas; installing or improving storm sewers and drainage ditches, culverts and spillways; increasing the depth of water lines; retrofitting existing public structures to withstand hazards; tree management; water detention and retention basins, debris detention basins, debris removal, bridge construction and modification, etc.

D. Subdivision Regulations. Subdivision regulations are the legally established standards of design and construction for dividing a land parcel into smaller ones for the purpose of selling or leasing the property**.** The Land Division Act (1967 PA 288, as amended by 1996 PA 591, 1997 PA 87, and 2004 PA 524) governs the subdivision of land in Michigan. The Act requires that the land being subdivided be suitable for building sites and public improvements, that there be adequate drainage and proper ingress and egress to lots, and that reviews be conducted at the local, county and state levels to ensure that the land being subdivided is suitable for development. The Act also requires conformance with all local planning codes. From a hazard mitigation standpoint, that point is important because it gives the local planning commission the authority to approve subdivision development in accordance with the local comprehensive plan and regulatory standards.

In terms of process, the subdivision of land has three major phases. The first involves a preliminary review of the engineering aspects of the project – roads, drainage, utilities, and other necessary services, by local and county reviewing agencies. The second phase involves a review of the proposal by the Michigan Department of Environmental Quality, the Michigan Department of Transportation, and the Michigan Department of Energy, Labor and Economic Growth to ensure compliance with state standards regarding location and engineering. At the end of this phase, the developer can obtain tentative approval from the local governing body of the jurisdiction in which the project is located. The final phase involves preparation of the final plat or map of the subdivision. Local and state reviewing agencies again review the final design to ensure compliance with local and state standards. Once approved, the plat is registered with the county register of deeds.

Subdivision regulations can be an effective tool in reducing risk and vulnerability to certain hazards, such as flooding and wildfires, if mitigation factors are incorporated into the subdivision process through mechanisms such as local planning codes. For example, a community may allow a subdivision to be placed in a heavily wooded area susceptible to wildfire if proper engineering measures are taken regarding lot size and ingress and egress, thereby providing a basic level of protection to developed home sites and the residents occupying those home sites.

From a flood hazards viewpoint, proposed subdivisions are typically reviewed by the County Drain Commissioner for proper drainage. Lake County does not elect a Drain Commissioner; therefore the Road Commission assumes this responsibility. The Michigan Department of Environmental Quality / Land and Water Management Division reviews subdivisions for floodplain impacts. (Refer to the Riverine Flooding chapter of the Michigan Hazard Analysis section in the MHMP for specific MDEQ provisions that directly address flood mitigation.)

Like any regulation, the Land Division Act can be effective if it is enforced and coordinated with other land use / development mechanisms in an effort to reduce overall community risk and vulnerability to hazards.

The subdivision rules relating to flooding are implemented through a review process and use of restrictive deed covenants. However, the restrictive deed covenants that are filed under the Act are only effective if the local building official is aware of and enforces the restrictions. Continuing education for the local building officials is essential for effective implementation of the Act.

The rules currently allow the construction of basements below the 100-year flood elevation, but these basements must be flood proofed, or it must be demonstrated by an engineering analysis that the basement will not be adversely impacted by hydrostatic pressures exerted by floodwaters. The developer must also obtain a letter of map revision (LOMR) from FEMA, certifying that the property has been filled above the 100-year flood elevation and the soil has been properly compacted. The LOMR officially removes the property from the 100-year floodplain.

The design standards for a flood proofed basement are fairly involved. Unless the building official is aware of the restrictive deed covenants and the design standards, and is enforcing these requirements, there is considerable potential for flood damage to basements even in subdivisions platted under the current act. Thus, as noted earlier, continuing education is essential.

Other examples of hazard protection standards that may be addressed through subdivision regulation may include:

- Identification of all hazardous areas;
- Road standards that allow passage of fire fighting equipment and snow plows and are no more than one foot below flood elevation;
- Buried power or phone lines; and
- Minimum water pressures adequate for fire fighting.

E. Open Space Preservation. The best approach to preventing damage to new developments is to limit, prevent, or remove development within flood plains and other hazard areas. Open space can be maintained in agricultural use or can serve as parks, greenway corridors, and golf courses. Capital improvement plans and comprehensive land use plans can identify areas to be preserved through any or all of the following means:

- Acquisition;
- Dedication by developers;
- Dedicating or purchasing an easement to keep the land open; or
- Specifying setbacks or buffer zones where development is not allowed.

Additional examples of special area, use and design regulations include:

- Local floodplain management ordinances;
- Coastal zone management regulations;
- Watershed management regulations;
- Special infrastructure design standards and regulations;

- Drainage regulations;
- Housing regulations;
- Wetland protection regulations;
- Natural rivers protection regulations;
- Farmland and open space protection regulations;
- Endangered species / habitat regulations; and
- Historic preservation regulations (among many others).

These regulations (most of which are administered by a state or federal agency in cooperation with local officials) are designed to regulate a certain aspect of the natural or built environment to ensure protection of the public health, safety and welfare, or some significant or unique natural feature. Not surprisingly, most of the regulations have goals that are remarkably similar to those of hazard mitigation. They provide valuable mechanisms for achieving mitigation objectives. These regulations are discussed in greater detail in the following sections of this plan.

To be effective, the provisions of these special regulations must be fully integrated into the comprehensive planning process at the local level. Major provisions of pertinent regulations must be included or addressed in the comprehensive plan and primary implementing mechanisms such as the zoning ordinance, capital improvements plan, etc. The Lake County Master Plan (2012) helps set the table for open space preservation in the county. A stated goal of the document is to "preserve and improve the condition of the county's natural resources and existing infrastructure."

Two programs administered by the State of Michigan provide good examples of special area / use measures that, while originally designed to accomplish something else, also contribute to a reduction in a community's risk and vulnerability to hazards (flooding and wildfires in these two instances):

Natural Rivers Program
This program, administered by the Michigan Department of Environmental Quality, seeks to establish a system of outstanding rivers in Michigan and to preserve, protect and enhance their wildlife, fisheries, scenic, historical, recreational and other values. Through the natural rivers designation process, a natural river district is established and a zoning ordinance is adopted. Within the natural river district, permits are required for building construction, land alteration, platting of lots, cutting of vegetation, and bridge construction. Not all of the zoning ordinances on the natural rivers have the same requirements, although they all have building setback requirements and vegetative strip requirements.

Although not specifically designed to reduce flood losses, the program nonetheless has flood hazard mitigation benefits by requiring building to be constructed away from the river and out of the floodplain. The program is very effective when administered as intended. Like any regulatory program, if the administrator and the variance board are aware of the requirements of the program and their duties, it is very effective.

Lake County contains two rivers currently included in the Michigan Natural Rivers Program: Pere Marquette River and Pine River.

Farmland and Open Space Preservation Program
This program, administered by the Michigan Department of Agriculture and Rural Development, has the primary goal of preserving unique and beneficial open space. It does this by transferring development rights and acquiring easements. There are two categories of land eligible. The first category makes up historic, riverfront, and shoreland areas. The second category includes land that conserves natural or scenic resources, enhances recreational opportunities, promotes the conservation of soils, wetlands and beaches, or preserves historic sites and idle farmland.

The largest component of the program provides landowners with an opportunity to get a break on their property taxes for designating parcels of land that will remain undeveloped. Thus, this

mechanism could be used to reduce risk and vulnerability to wildfires by preventing development in heavily forested areas. It could also reduce vulnerability to flooding by preventing development along rivers and in floodplains. However, the program does have a drawback in that the agreements are not in perpetuity and may be relinquished under certain circumstances. The land can be removed from the program under certain circumstances, with the payment of a penalty. Over the short-term, the program is very effective at slowing the development of the special open spaces. It does not, however, necessarily eliminate future development on the parcels and therefore should not be considered an effective long-term mitigation tool. However, there is also a Purchase of Development Rights program, which does purchase development rights in perpetuity. In addition, landowners may donate development rights to the State and to local conservation programs.

F. Stormwater Management. New construction in a floodplain increases the amount of development exposed to damage and can aggravate flooding on neighboring properties. Development outside a floodplain can also contribute to flooding problems since stormwater runoff is increased when natural ground cover is replaced by development. Land use and land cover changes anywhere within a watershed can increase water runoff and/or inhibit natural water infiltration, increasing the frequency and/or severity of flooding downstream within that watershed. Development in a watershed that drains to a river can aggravate downstream flooding, overload the community's drainage system, cause erosion, and impair water quality. Stormwater management encompasses two approaches to protecting new construction from damage by surface water:

- Regulating development in the floodplain to ensure that it will be protected from flooding and that it won't divert floodwaters onto other properties; and
- Regulating all development to ensure that the post-development peak runoff will not be greater than under pre-development conditions.

The National Flood Insurance Program (NFIP) and the Michigan Department of Natural Resources (MDNR) set minimum requirements for regulating development in identified floodplains. All new buildings must be protected from base elevations or 100-year floodplains and no development may cause an increase in flood heights or velocities. Five townships in Lake County participate in the NFIP. They are the townships of: Cherry Valley, Lake, Pleasant Plains, Webber, and Yates. Of these five, only Pleasant Plains and Yates have significant flood hazard areas identified.

There is currently no state law that regulates stormwater runoff quantity. Any regulation that exists is done at the local/county level. The MDEQ has prepared a stormwater management best management practices guidebook to assist local governments in their stormwater management efforts.

The Michigan Drain Code (1956), administered by county drain commissioners, contains regulations regarding set-backs from the established drain channels to assure proper carrying capacity of the drains. The code officially "establishes laws relating to the laying out of drainage districts, the consolidation of drainage districts, the construction and maintenance of drains, sewers, pumping equipment, bridges, culverts, fords, and the structures and the mechanical devices to properly purify the flow of drains". It also "gives authority to provide for flood control projects, to provide for water management, water management districts and sub-districts, and for flood control and drainage projects within the districts".

At the current time, Lake County does not have a drain commission or commissioner. Since the county does not elect a Drain Commissioner, responsibility for drain control and maintenance lies with the Lake County Road Commission. Stormwater runoff regulations supplement other efforts to regulate development by requiring developers to build retention or detention basins to minimize the increases in the runoff rate caused by impervious surfaces and new drainage systems. In general, each development must not let stormwater leave at a rate higher than it did under pre-development conditions.

Stormwater ordinances set requirements for managing runoff from new developments and may require storage facilities based on the size of the development and capacity. The ordinance and proper site planning reduce runoff and the impact of the development on the surrounding area. Examples include:

- Promoting the use of native vegetation within the runoff storage basins;
- Requiring buffers along streams, lakes, wetlands, etc.;
- Requiring retention or infiltration of the initial runoff; and
- Requiring existing depressional storage (areas not designated as floodplains) to be compensated for at a 1:1 ratio.

Stormwater ordinances may also provide for the development of watershed plans. Watershed plans examine the unique characteristics of each watershed and may adopt more or less stringent requirements. The ordinances can also provide for a fee, in lieu of site runoff storage, in the event a watershed plan recommends the use of a larger central basin. Lake County does not have a stormwater ordinance.

2. Corrective Measures.

Corrective mitigation can be expensive, resource intensive, time consuming, and sometimes only marginally effective. Structural protection measures, hazard modification, and large-scale retrofitting fall under this category. Attempting to go back and fix something that is problematic is almost always more difficult than doing it right the first time. However, when dealing with hazard prone property (i.e., structures in a floodway, floodplain or other hazard area), it is often necessary to go back and try to correct the problem in order to protect the affected community and individual property owners from future harm.

When structures and communities are located in hazardous areas, corrective measures are directed at working with current conditions. They are emphasized for areas that suffer recurring or particularly severe disaster damages and impacts or that offer unique mitigation opportunities that can be addressed with existing resources. Examples of the more common corrective measures include:

Modifications. Modifications to a site and/or to a structure. Examples include landscape grading, or retrofitting existing structures to be damage resistant (i.e. floodproofing existing buildings, adding structural braces to buildings to improve earthquake or wind resistance, etc.).

Relocation. Permanent evacuation of hazard-prone areas through movement of existing hazard-prone development and population to safer areas. The two common approaches to relocation are physical removal of buildings to a safer area with future use of the vacated area limited to permanent open space, and replacing existing land uses with others that are less vulnerable to the hazard.

Acquisition. Public acquisition and management of lands that are vulnerable to damage from local hazards. Following acquisition, land uses more appropriate to the degree of risk may be chosen. Public acquisition has been achieved by: a) purchase at full market value; b) purchase at less than full market value through such methods as foreclosure of tax delinquent property, bargain sales, purchase and lease back, etc.; c) donation, through reserved real estate, donation by will, donation and lease back; d) leases; and e) easements.

Modification measures are normally implemented by property owners and include actions to modify the site to keep the hazard from reaching the building; to modify the building/site, or retrofit it, so that it can withstand the impacts of the hazard; and to insure the property to provide financial relief after damage occurs. Relocation and acquisition measures can be implemented by property owners and/or governments through technical and financial assistance.

A. Site Modification (Keeping the Hazard Away). Natural hazards generally do not damage vacant areas but instead threaten people and improved property. In some cases, properties can be modified so the hazard does not reach the damage-prone improvements.

For example, a home may survive a wildfire because a "defensible space" was created and maintained between it and adjacent wild lands. This "defensible space" is similar in concept to that of "firebreaks", wherein brush and other fuel are cleared away in areas of state and national forests. A clearing around homes for at least 30 feet on all sides will discourage wildfires from spreading directly to them. Proper maintenance of adjacent property (short grass, thinned trees, removal of low-hanging branches, selection of fire-resistant vegetation, etc.) is also helpful in keeping wildfires away. Restricting campfires to controlled areas, away from homes, and requiring burn permits lowers risks to occupied properties. Homes should also be set back from slopes (which allow fires to spread faster than on flat terrain). The need for local homeowners to "fireproof" their properties is probably the county's primary wildfire vulnerability.

Four common methods used to "keep flooding away" include:

- Erect a barrier between the building and the source of flooding;
- Move the building out of the floodprone area;
- Elevate the building above the flood level; and
- Demolish the building.

A flood protection barrier can be built of dirt or soil, which is called a "berm" or "levee", or concrete or steel, which is called a "floodwall". Careful design is needed so as not to create flooding or drainage problems on neighboring properties. Depending on the porosity of the ground, if floodwaters stay up for more than an hour or two, the design must account for leaks, seepage of water underneath, and rainwater that falls inside the perimeter. This is usually done with a sump and/or drain to collect the internal groundwater and surface water, and a pump and pipe to remove the internal drainage over the barrier. Barriers can only be built so high and can therefore be overtopped by floods higher than expected. Berms can settle over time, and are susceptible to erosion from rain and floodwaters if not properly sloped, covered with grass, and maintained, lowering their protection level. Floodwalls can crack, weaken, and lose their watertight seals. Therefore, barriers need careful design and maintenance and should be insured in case of failure.

The surest and safest way to protect a building from flooding is to move it to higher ground. Almost any building can be moved but the cost climbs for heavier structures, such as those with exterior brick and stone walls, and for large or irregularly shaped buildings. In areas subject to flash flooding, deep waters, or other high hazard, relocation is often the only safe approach. Relocation is also preferred for large lots that include buildable areas outside the floodplain or where the owner has a new flood-free lot (or portion of the existing lot) available.

Raising a building above the flood level can be almost as effective as moving it out of the floodplain. Water flows under the building, causing little or no damage to the structure or its contents. Raising a building above the flood level is cheaper than moving it and can be less disruptive to a neighborhood. Elevation has proven to be an acceptable and reasonable means of complying with floodplain regulations that require new, substantially improved, and substantially damaged buildings to be elevated above the base flood elevation. On the other hand, elevating a building will change its appearance. If the required amount of elevation is low, the result is similar to putting a building on a 2' or 3' high crawlspace. If the building is raised 4', 6', or more, owners are often concerned about its appearance and may decline to implement an elevation project. Another problem with this approach is with basements. Only the first floor and higher are elevated. The basement remains as the foundation. All utilities are elevated and the basement is filled in to protect the walls from water pressure. The owner loses the use of the basement, which may deter him or her from trying this approach. A third problem with elevation is that it may expose the structure to greater impacts from other hazards. If not braced and anchored properly, an elevated building may have less resistance to the shaking of an earthquake and the pressures of high winds. A fourth problem is that access can be lost when floodwaters overtop local roads, driveways, and culverts or ditches. If this happens frequently and alternate access is not available, roadways might have to be elevated and crossing points improved.

Some buildings, especially heavily damaged or repetitively flooded ones (such as those in the floodways, the most dangerous portions of the floodplains that naturally carry the majority of fast moving waters), are not worth the expense to protect them from future damage (floodways have many code requirements for repair, expansion or replacement of structures). It is cheaper to demolish them and either replace them with new, flood-protected structures, or relocate the occupants to a safer site. In general, demolition projects are undertaken by a government agency so the cost is not borne by the property owner. The land may then be converted to public use, such as a park. Acquisition, followed by demolition, is most appropriate for buildings that are difficult to move (such as larger, slab foundation, or masonry structures) and for dilapidated structures that are not worth protecting. One problem sometimes resulting from an acquisition and demolition project is a "checkerboard" pattern in which non-adjacent properties are acquired. This can occur when some owners, especially those who have and prefer a waterfront location, prove reluctant to relocate.

B. Building or Site Modification (Retrofitting). An alternative to modifying the site to keep the hazard away is to modify or "retrofit" the site or building to minimize or even prevent damage. There are a variety of techniques to do this. This section looks at the measures that can be implemented to protect existing buildings from damage by wildfires, structural fires, floods, sewer backup, tornadoes, high winds, winter storms, hail, and extreme temperatures.

Modifications to prevent damages from wildfires not only include the creation of a "defensible space" but also a number of other very effective actions such as the use of fire-resistant siding and roofing materials as well as functional shutters and heavy fire-resistant drapes. Homeowners can sweep clean their roofs, decks and eaves to prevent blowing embers from igniting twigs and leaves. They can move woodpiles and combustibles away from buildings, enclose eaves and any openings under structures that would allow blown embers in, and clean up yard and house waste and flammable oils and spills, which are generally in garages and driveways. Homeowners can also keep private roads and driveways accessible to vehicles and fire equipment. Driveways should be relatively straight and flat, with at least some open spaces to turn, bridges that can support emergency vehicles, and clearance wide and high enough for two-way traffic and emergency vehicle access. This is especially true in areas where space is limited by the local topography. In addition, spare keys to gates around property should be provided to the local fire department, addresses should be clearly visible from the main road, and homeowners can make sure that adequate water supply is available for fire-fighters (small pond, cistern, well, swimming pool, garden hoses, etc.).

The National Fire Protection Association administers the Firewise Communities Program which encourages local solutions for safety by involving homeowners in taking individual responsibility for preparing their homes from the risk of wildfire. Firewise is a key component of Fire Adapted Communities – a collaborative approach that connects all those who play a role in wildfire education, planning and action with comprehensive resources to help reduce risk. The program is co-sponsored by the USDA Forest Service, the US Department of the Interior, and the National Association of State Foresters.

The Firewise Communities/USA Recognition Program is a process that empowers neighbors to work together in reducing their wildfire risk. Communities may pursue this using a five-step process to develop an action plan that guides their residential risk reduction activities, while engaging and encouraging their neighbors to become active participants:

- Obtain a wildfire risk assessment as a written document from your state forestry agency or fire department.
- Form a board or committee, and create an action plan based on the assessment.
- Conduct a "Firewise Day" event.
- Invest a minimum of $2 per capita in local Firewise actions for the year.
- Submit an application to your state Firewise liaison.

Modifications to prevent damages from structural fires include: the safe installation and maintenance of electrical outlets and wiring; the installation of firewalls; and provision of equipment needed to inhibit fire dangers (such as sprinkler systems, smoke alarms, and fire extinguishers). In urban areas, the denser pattern of development may allow a fire in one structure to spread to one or more other structures. Appropriate firewall use in connected units or downtown commercial/pedestrian strips can help to protect property against the spread of fire. Older attached structures especially should be checked for safety and code compliance. Any special facility such as a nursing home, day care center, or health clinic should ensure that it has a workable fire plan and is equipped with the equipment needed to inhibit fire dangers, such as sprinkler systems, functioning smoke alarms, and usable fire extinguishers. In rural areas, proper education on and maintenance of non-utility heat sources will help allay this hazard. The National Fire Protection Association has information available for homeowners on how to prevent fires. Proper cleaning of chimneys, fire places and wood stoves, keeping objects away from heating sources to prevent malfunction or ignition, and proper installation and fueling of heaters are all important. Space heaters should be at least three feet from objects.

Flood retrofitting measures include dry floodproofing where all areas below the flood protection level are made watertight. Walls are coated with waterproofing compounds or plastic sheeting. Openings (doors, windows, and vents) are closed, either permanently, or with removable shields or sandbags. Sump pumps are used to remove any water that enters. Dry floodproofing of new and existing non-residential buildings in the regulatory floodplain is permitted under state, FEMA and local regulations. Dry floodproofing existing residential buildings in the floodplain is also permitted as long as the building is not substantially damaged or being substantially improved. Dry floodproofing is also a viable option for homes located outside the regulatory floodplain.

The alternative to dry floodproofing is wet floodproofing, where water is let in and everything that could be damaged by a flood is removed or elevated above the flood level. Structural components below the flood level are replaced with materials that are not subject to water damage. For example, concrete block walls are used instead of wooden studs and gypsum wallboard. The furnace, water heater, and laundry facilities are permanently relocated to a higher floor or raised on blocks or platforms where the flooding is not deep. Simply moving furniture and electrical appliances out of a basement can prevent a great deal of damage.

A third flood protection modification addresses flooding caused by overloaded sanitary or combined sewers. Four approaches may be used to protect a structure against sewer backup: floor drain plugs, floor drain stand-pipes, overhead sewers, and backflow protection valves. The first two devices keep water from discharging out of the lowest opening into the building, the floor drain, and are inexpensive. However, if water becomes deep enough in the sewer system, it can flow out of the next lowest opening, such as a toilet or tub, or it can overwhelm a drain plug by hydrostatic pressure and flow into the building through the floor drain. The other two measures, overhead sewers and backflow protection valves keep water in the sewer line during a backup. They are more secure but more expensive.

Other considerations for the minimization of flooding damages include: stronger anchoring requirements for propane tanks and hazardous materials in the floodplain/floodway; assurance of proper location, cleaning and maintenance of septic tanks; and back-up power for sump pumps. Critical facilities should have written flood response and recovery plans to identify the equipment and materials necessary to protect them. Cost-sharing programs, such as rebates, to encourage low cost (under $10,000) property protection measures on private property (surface and sub-surface drainage, sewer back-up protections, berms and regrading, sewer back-up protection, furnace and water heater relocations, lightning rods, etc.) should be considered.

Tornado and severe wind retrofitting measures include constructing underground shelters or “safe rooms” in residences and constructing shelter areas for those who live in mobile homes or temporary, seasonal locations. Another retrofitting approach for tornadoes and high winds is to secure the roof, walls, and foundation with adequate fasteners or tie downs and cross-bracing. These devices help hold the building together when the combination of high wind and barometric pressure differences work to

pull the building apart. A third tornado and high wind protection modification is to strengthen garage doors, windows (with laminated glass panes) and other large openings. If winds break the building's "envelope," the pressures on the structure are greatly increased. Trailers and mobile homes can be secured to foundations, functional wind shutters can be installed over windows, and yard items can be secured or brought inside to avoid damage. Inter-locking shingles on roofs can offer much additional protection against wind and hail damage. Workplaces, remote hunting lodges, campgrounds, fairgrounds, mobile homes, and other such facilities may still have vulnerabilities for proper warning and shelter. It is important to provide inhabitants with safe and accessible sheltering options before, during and after severe weather events.

Retrofitting approaches to protect buildings from the effects of thunderstorms include storm shutters, lightning rods, and strengthening connections and tie-downs (similar to tornado retrofitting). Roofs could be replaced with materials less susceptible to damage by hail, such as modified asphalt or formed steel shingles. Loose materials and yard items should also be secured so that they can't blow away.

Burying utility lines is a retrofitting measure that addresses the impacts of severe winds, tornadoes, and winter storms. Installing or incorporating backup power supplies minimizes the effects of power losses caused by downed lines. Surge suppressors protect delicate appliances from lightning damage. "Retrofitting" trees that hang over power lines, as discussed later in the discussion on Urban Forestry, is yet another option.

Winter storm retrofitting measures include improving insulation on older buildings and relocating water lines from outside walls to interior spaces. Windows can be sealed or covered with an extra layer of glass (storm windows) or plastic sheeting. Roofs can be retrofitted to shed heavy loads of snow and prevent ice dams that form when snow melts. Water and sewer lines can be buried below the frost line or insulated to protect against ground freeze. Roads can be protected from blowing snow by the installation of snow fences beside them, especially along highways and in residential developments with limited access. These fences can be "living" fences (lines of trees).

Air conditioning is probably the most effective measure for mitigating the effects of extreme summer heat on people. Unfortunately, those most vulnerable to heat often do not live or work in air-conditioned environments. The use of fans to move air may help some, but recent research indicates that increased air movement may actually exacerbate heat stress in many individuals. However, air circulation is important and is limited for those unwilling to open windows because of security concerns. In these instances, inexpensive safety latches can be installed to allow windows to be opened far enough for air to circulate, while at the same time preventing them from being completely opened from the outside.

C. Insurance. Technically speaking, insurance does not mitigate damage caused by a natural hazard. However, it does help the owner repair, rebuild and (hopefully) afford to incorporate some of the other mitigation measures in the process.

A standard homeowner's insurance policy will cover a property for the hazards of tornado, wind, hail, and winter storms. Separate endorsements are usually needed for damages from sump pump failure, sewer back-up, and earth movement and can be added to a homeowner's insurance policy. Each company has different amounts of coverage, exclusions, deductibles, arrangements, and costs. Most exclude damage from surface flooding and owners must purchase such coverage through the National Flood Insurance Program, which is available if they live in communities participating in the program. Banks and mortgage companies require flood insurance when loans are for purchase or repair of properties located in flood plains if the loans are federally insured. Agricultural insurance is available to protect growers from crop loss in the event of a drought.

Critical facilities should be inventoried and proper insurance coverage should be reviewed (both types and amount, including deductibles and policy limits) and assured. Larger local governments can self-insure and absorb the cost of damage to one facility, but if many properties are exposed to damage, self-

insurance can be a major drain on the treasury. Communities cannot expect federal disaster assistance to make up the difference. Under Section 406(d) of the Stafford Act "if an eligible insurable facility damaged by flooding is located in a [mapped floodplain] … and the facility is not covered (or is underinsured) by flood insurance on the date of such flooding, FEMA is required to reduce Federal disaster assistance by the *maximum* amount of insurance proceeds that would have been received had the buildings and contents been fully covered under a National Flood Insurance Program (NFIP) standard flood insurance policy". Generally, the maximum amount of proceeds for a non-residential property is $500,000. In other words, the law expects public agencies to be fully insured as a condition of receiving federal disaster assistance.

D. Technical and Financial Assistance. Property protection measures are usually considered the responsibility of the property owner. However, there are various roles the county or a municipality can play in encouraging and supporting implementation of these measures.

One of the first duties of a local government is to protect its own facilities. Critical facilities should be a high priority for retrofitting projects and insurance coverage. Often public agencies discover after the disaster that their "all-hazard" insurance policies did not cover the property for the type of damage incurred. Flood insurance is even more important as a mitigation measure because of the Stafford Act provisions discussed above.

Providing basic information to property owners is an important action that can be taken to support property protection measures. Another step is to help pay for a retrofitting project. Financial assistance can range from full funding of a project to helping residents find money from other programs. Some communities assume responsibility for sewer backups, street flooding, and other problems that arise from an inadequate public sewer or public drainage system. Less expensive community programs include low-interest loans, forgivable (after a certain period of occupancy) loans and rebates. These approaches don't always fully fund the project but they either cost the community less or increase the owner's commitment to the retrofitting project. In addition, communities can assist residents with referrals to home repair programs and heating assistance programs.

The community can be the focal point of a project, such as floodplain property acquisition. Most funding programs require a local public agency to sponsor the project. The county or a municipality could process the funding application, work with the owners, and/or provide some or the entire local share. In some cases, the local government would be the ultimate owner of the property, but in other cases a public agency could assume ownership and maintenance responsibilities. The West Michigan Land Conservancy is an organization that can help by purchasing and holding certain lands until a government agency or other party can take possession.

Mandates are considered a last resort if information, funding, and incentives aren't enough to cause protective actions. Examples of retrofitting mandates are the requirements that downspouts be disconnected from sanitary sewer lines or that buildings in flood plains be elevated or brought up to current flood protection codes if "substantial" repair costs equal or exceed 50% of the value of the original building. Another possible mandate is to require less expensive hazard protection steps as a condition of a home improvement project. If a person were to apply for a permit for electrical work, the community could require that the service box be moved above the base flood elevation or that separate ground fault interrupter circuits be installed in the basement. An extreme mandate would be to "Fill your Basement with Water". For example, if the mandate is issued in an NFIP community during flood conditions under FEMA procedures, FEMA funds would later be made available to assist with repairs. However, those repairs would be less expensive since filling the basement would equalize pressure from saturated soils on building walls with water tight, near water tight, or pumped out basements. It would also facilitate clean-up because there is clean water instead of silt and sewage-laden muddy water in the structure.

Repetitive Loss properties deserve special attention because they are more prone to damage by natural hazards than other properties and protecting such buildings is a priority with FEMA and MSP-EMHSD

mitigation funding programs. (It should be noted that Lake County has seven repetitive losses, all within Pleasant Plains Township.) Appropriate property protection measures are based on studies of flood and building conditions. General guidelines, which are not site specific, are as follows.

- Buildings in high hazard areas (in the floodway or where the 100-year flood is two or more feet over the first floor) or in less than good condition should be acquired and demolished.
- Buildings with basements and split level foundations in high hazard areas should be acquired and demolished. They are too difficult to elevate and the hydrostatic pressures on the walls from deeper flooding make them too risky to protect in place.
- Buildings subject to shallow flooding from local drainage should be protected through area-wide flood control or sewer improvement projects.
- Buildings in good condition on crawlspaces should be elevated or relocated.
- Buildings in good condition on slab, basement or split level foundations subject to shallow flooding (less than 2 feet) can be protected by barriers and dry floodproofing.

The most common sources for hazard mitigation assistance are listed in the table below. Unfortunately, some are only available after a disaster, not before, when damage could be prevented. Following past disaster declarations, FEMA, the Michigan State Police, Emergency Management and Homeland Security Division (MSP-EMHSD), and the Michigan Department of Natural Resources have provided advice on how to qualify and apply for these funds. A detailed listing of potential federal and state funding sources for hazard-specific measures is included in Appendix F.

Common Hazard Mitigation Sources

Program	Eligibility	Eligible Activities	Program Type / Cost Share
HAZARD MITIGATION GRANT PROGRAM (HMGP) HMGP grants are provided to implement long-term hazard mitigation measures after a major disaster declaration. The purpose of the HMGP is to reduce the loss of life and property due to natural disasters and to enable mitigation measures to be implemented during the immediate recovery from a disaster.	Eligible Subapplicants: · State agencies · Tribal governments · Local governments · Private nonprofit orgs	· Property acquisition / structure demolition or relocation · Structure elevation · Dry floodproofing of historic residential structures · Dry floodproofing of non-residential structures · Minor localized flood reduction projects · Structural / non-structural retrofitting · Safe room construction · Infrastructure retrofitting · Soil stabilization · Wildfire mitigation · Post-disaster code enforcement · Hazard mitigation planning	Disaster Based (Stafford Act Major Disaster Declaration Required) 75% Federal 25% Non-Federal
PRE-DISASTER MITIGATION PROGRAM (PDMP) PDMP funds are provided for hazard mitigation planning and the implementation of mitigation projects prior to a disaster. Funding these plans and projects reduces overall risks to the population and structures from future hazard events, while also reducing reliance on federal funding from future major disaster declarations.	Eligible Subapplicants: · State agencies · Tribal governments · Local governments · Universities	· Property acquisition / structure demolition or relocation · Structure elevation · Dry floodproofing of historic residential structures · Dry floodproofing of non-residential structures · Minor localized flood reduction projects · Structural / non-structural retrofitting · Safe room construction · Infrastructure retrofitting · Soil stabilization · Wildfire mitigation · Hazard mitigation planning	Annual Appropriation 75% Federal 25% Non-Federal 90% Federal 10% Non-Federal if subgrantee is a small impoverished community
FLOOD MITIGATION ASSISTANCE PROGRAM (FMAP) FMAP funds are provided to implement measures that reduce or eliminate the long term risk of flood damage to buildings, manufactured homes, and other structures insured under the National Flood Insurance Program (NFIP). The goal of the FMAP is to reduce or eliminate claims under the NFIP.	Eligible Subapplicants: · State agencies · Tribal governments · Local governments	· Property acquisition / structure demolition or relocation · Structure elevation · Dry floodproofing of historic residential structures · Dry floodproofing of non-residential structures · Minor localized flood reduction projects · Hazard mitigation planning	Annual Appropriation 75% Federal 25% Non-Federal
REPETITIVE FLOOD CLAIMS PROGRAM (RFCP) RFCP funds are provided to reduce flood damages to insured properties that have had one or more claims under the NFIP and that will result in the greatest savings to the National Flood Insurance Fund (NFIF) in the shortest period of time. (Note: RFCP funds are only available to sub- applicants who cannot meet the cost share requirements of the FMAP.)	Eligible Subapplicants: · State agencies · Tribal governments · Local governments	· Property acquisition / structure demolition or relocation · Structure elevation · Dry floodproofing of historic residential structures · Dry floodproofing of non-residential structures · Minor localized flood reduction projects	Annual Appropriation 100% Federal
SEVERE REPETITIVE LOSS PROGRAM (SRLP) SRLP funds are provided to reduce or eliminate the long-term risk of flood damage to severe repetitive loss (SRL) structures insured under the NFIP, and that will result in the greatest amount of savings to the NFIF in the shortest period of time.	Eligible Subapplicants: · State agencies · Tribal governments · Local governments	· Property acquisition / structure demolition or relocation · Structure elevation · Mitigation reconstruction · Dry floodproofing of historic residential structures · Minor localized flood reduction projects	Annual Appropriation 75% Federal 25% Non-Federal

*States, Territories and Indian Tribal Governments are eligible HMA applicants. Interested and eligible subapplicants must apply to the applicant for HMA funding consideration. Individuals and businesses are not eligible to apply for HMA funds; however, an eligible subapplicant may apply for funding to mitigate private structures.

Source: MSP/EMHSD Pub. 106a, Michigan Hazard Mitigation Success Stories, 2011

3. Resource Protection.

Resource protection activities are generally aimed at preserving (or in some cases restoring) natural areas as development occurs so that these areas can, in turn, provide hazard protection. For instance, watersheds, floodplains, and wetlands can reduce run-off from rainwater and snow melt in pervious areas; reduce overland flood flow and store floodwaters; remove and filter excess nutrients, pollutants and sediments; absorb flood energy and reduce flood scour; and recharge groundwater.

These natural benefits can be preserved though regulatory steps for protecting natural areas or natural functions. General regulatory programs are discussed in the section on Preventive Measures. This section covers resource protection programs and standards, including the following:

- Wetland protection;
- Erosion and sedimentation control;
- River restoration;
- Best management practices;
- Dumping regulations;
- Urban forestry; and
- Farmland protection.

A. Wetland Protection. Wetlands are often found in floodplains and depressional areas of a watershed. Many wetlands receive and store floodwaters, thus slowing and reducing downstream flows. They also serve as natural filters, helping to improve water quality. Wetlands that are part of the waters of the United States are regulated by the U.S. Army Corps of Engineers and the U.S. Environmental Protection Agency under Section 404 of the Clean Water Act. Proposed development in these wetlands requires a "404" permit, which can't be issued until plans are reviewed and approved by several agencies including the Corps and the U.S. Fish and Wildlife Service. Small projects that meet certain criteria, as well as projects that are not in the Corps' wetlands, may proceed under nationwide permits instead of under individual permits and are regulated by local authorities (i.e. the Michigan Department of Environmental Quality). In either case, the impact of the development must be mitigated.

Wetland mitigation, as defined in each issued permit, can include creation, restoration, enhancement or preservation of wetlands on the site or elsewhere – even in another watershed. It should be noted that, when a wetland is mitigated at another site, there are drawbacks to consider. First, it takes many years for a new wetland to approach the same quality as an existing one. Second, a new wetland in a different location (especially if it's in a different watershed) will not have the same flood damage reduction benefits as the original one did. Some developers and government agencies mitigate by buying into wetland banks, which are large wetlands created for the purpose of mitigation. The bank accepts money to reimburse the owner for setting the land aside from development.

B. Soil Erosion and Sedimentation Control. Farmlands and construction sites typically contain large areas of exposed soil. Surface water runoff can erode soil from these sites, sending sediment into downstream waterways. Erosion also occurs along streambanks and shorelines as water flow and wave action wash away the soil. Suspended sediment tends to settle out where flowing water slows down and can clog storm sewers, drain tiles, culverts and ditches and can reduce the transport and storage capacity of water channels. When they are constricted and flooding cannot deposit sediment in the bottomlands, even more is left in the channels. The result is either clogged streams or increased dredging or "channelization" (straightening, deepening, or widening the channel) costs.

There are two principal strategies to address these problems: minimize erosion and control sedimentation. Techniques to minimize erosion include phased construction, minimal land clearing, and stabilizing bare ground and slopes as soon as possible with vegetation and other soil stabilizing practices (geo-textile fabrics, rip-rap boulders, etc.). Techniques to control sedimentation include: silt fences, sediment traps and vegetated filter strips. Runoff can be slowed down by terraces, contour strip

farming, no-till farm practices, hay or straw bales, constructed wetlands, and impoundments (e.g., sediment basins and farm ponds) to reduce the volume of topsoil eroded from the site.

Erosion and sedimentation control regulations, which are usually oriented toward construction sites, mandate that these types of practices be incorporated into construction plans. They also require applicants for permits to submit erosion and sediment control plans for construction projects. Michigan's Soil Erosion and Sedimentation Control (Part 91) ordinance requires permits for projects or activities (not crop production) involving earth changes that disturb one or more acres of land or are located within 500 feet of a lake or stream. Enforcement of the ordinance can be handled by a designated county department, with assistance from the Conservation District, or a municipality. The Lake County Building Department is the enforcing agent for the DEQ Part 91 Soil Erosion program. Other agencies that may provide assistance include the Lake County Road Commission, Osceola-Lake Conservation District, and Mason-Lake Conservation District. Municipalities have the opportunity to adopt and enforce more stringent regulations, as long as they don't conflict with the state ordinance and have state approval.

C. River Restoration. Approaches such as "stream conservation," "bioengineering," and "riparian corridor restoration" aim to return streams, streambanks and adjacent lands to more natural conditions. "Ecological restoration" aims to restore native indigenous plants and animals to an area. Native plantings along banks; such as willow cuttings, wetland plants, and/or rolls of landscape material covered with natural fabric that decomposes after plants take root; resist erosion. Studies have shown that, after establishing appropriate vegetation on banks, long-term maintenance costs are lower than for maintenance of concrete banks or conventional landscape (e.g., mowing turf grass). These approaches are not required but are recommended by economics.

Another restoration option is to improve culverts. Restoring the natural flow of a watercourse through culvert improvements and streambank treatments around the culvert can have numerous benefits that may appeal to a variety of governmental and environmental groups. Potential benefits include: water quality improvement; coldwater tributary protection / restoration; fish habitat improvement; and decreased risk of culvert failure which may lead to flooding and washouts.

There are two watershed groups that include Lake County within their borders: Little Manistee Watershed Conservation Council, and Pere Marquette Watershed Council.

D. Best Management Practices. *Point source* pollutants are discharged from pipes (such as the outfall of a municipal wastewater treatment plant) and are regulated by the U.S. EPA and the Michigan Department of Environmental Quality. *Non-point source* pollutants come from non-specific locations and are harder to regulate. Examples of non-point source pollutants are lawn fertilizers, pesticides, and other farm chemicals, animal wastes, oils from street surfaces and industrial areas, and sediment from agriculture, construction, mining and forestry. The term "best management practices" (BMP's) refers to design, construction and maintenance practices and criteria that minimize the impact of stormwater runoff, prevent erosion, protect natural resources and capture non-point source pollutants (including sediment). They can prevent increases in downstream flooding by attenuating runoff and enhancing infiltration of stormwater. They also minimize water quality degradation, maintain natural base flows, and provide multiple uses of drainage and storage facilities.

E. Dumping Regulations. BMP's usually address pollutants that are liquids or are suspended in water while dumping regulations address solid matter, such as shopping carts, appliances, and landscape waste that can be accidentally or intentionally thrown into channels or wetlands. Such materials may not pollute the water, but they can obstruct even low flows and reduce the channels' and wetlands' ability to convey or clean stormwater. Nuisance ordinances can prohibit dumping garbage or other "objectionable waste" on public or private property. Waterway dumping regulations can prohibit "non-objectionable" waste (grass clippings or tree branches) which can kill ground cover or cause obstructions in channels. These regulations can be enforced with penalties but programs should have public information components since property owners might not be aware of the impact of their actions

(i.e. re-grading their yards, discarding leaves or branches in a watercourse, etc.). Voluntary compliance by property owners and annual "clean-up" programs by local communities can be quite effective.

F. Urban Forestry. The major damage caused by wind and snow/ice/sleet storms is to trees. Downed trees and branches break utility lines and damage buildings, parked vehicles, and anything else under them. An urban forestry program, developed by a municipality, can reduce the damage potential of trees by addressing proper tree care prior to a storm and recommend actions for managing trees before, during, and after a storm. Urban foresters or arborists can select hardier trees that better withstand high wind and ice accumulation and trees that are shorter than utility lines for use in power and telephone line rights-of-way. They can review damaged trees to determine if they should be pruned or removed.

A properly written and enforced urban forestry plan can lessen the frequency of fallen trees and limbs caused by wind and ice build-up, reduce liability, assist in assuring that utility lines are not damaged, and provide guidance on repairs and pruning after a storm. Such a plan helps a community qualify to be a "Tree City USA." The "Tree City USA" program is sponsored by The National Arbor Day Foundation, in cooperation with the USDA Forest Service and the National Association of State Foresters, to ensure that every qualifying community has a viable tree management plan and program. It provides direction, technical assistance, public attention, and national recognition for urban and community forestry programs.

In addition, utility companies are heavily involved in tree management. A recent Consumers Energy brochure states that; since the company is responsible for providing safe, reliable electricity; employees (and companies hired to help) "are sent out on a planned, rotating schedule to clear trees and bushes from electric rights-of-way." Following guidelines from the American National Standards Institute (ANSI) and working under required permits, Consumers Energy promises the following actions.

- Trees next to distribution lines, which carry electricity from pole to pole, will be trimmed a safe, clear distance from lines.
- The safety of employees and the public, particularly children, may require removal of a tree. A tree may have to be removed because it is dead, dying, damaged, or subject to falling because of wind or a shallow root system-making it a safety and power outage threat. Some fast-growing trees can be a continuing hazard and may have to be removed.
- Trimming methods are aimed at helping the tree heal, decreasing future trimming needs, and directing future growth away from electric lines.

The need for these activities is eliminated when utility lines are buried. Burying the lines is recommended when they are being upgraded or installed for new developments.

G. Farmland Protection. The purpose of farmland protection is to provide planning and zoning mechanisms for preserving prime, unique, or important agricultural land from conversion to non-agricultural uses. Farm owners feel forced to sell their land to residential or commercial developers if it is taxed based on the value of the property, if developed, instead of farmed and the increased taxation can't be afforded. The ensuing development brings more buildings, roads, and other infrastructure that can create additional stormwater runoff and emergency management difficulties. To offset this situation, the Farmland Protection Program in the U.S. Department of Agriculture's 2002 Farm Bill (Part 519) allows for funds to go to states, tribes, local governments, and non-profit organizations to help purchase easements on agricultural land to protect against the development of the land. Eligible lands include cropland, range land, grass land, pasture land, and forestland that are part of an agricultural operation. Certain lands with historical or archaeological resources are also included. The hazard mitigation benefits of farmland protection are similar to those of open space preservation.

In addition to protecting farmland, efforts can be made to protect crops. These efforts can include the support of agricultural programs that promote soil health, preserve soil moisture, and monitor soil moisture levels to help minimize loss of crops and topsoil during drought conditions. They can also include recommendations for water supply infrastructure that is not vulnerable to drought and planting

crops tolerant of low moisture levels. Drought ordinances can prioritize or control water use during drought conditions. Drought mitigation plans can be developed which include:

- Collection and analysis of drought-related information;
- Criteria for declaring drought emergencies and triggering various mitigation and response activities;
- Information flow between and within levels of government;
- Definition of the duties and responsibilities of all agencies with respect to drought;
- A current inventory of state and federal programs used in assessing and responding to drought emergencies;
- Identification of drought-prone areas and vulnerable economic sectors, individuals, or environments;
- Identification of mitigation actions to address vulnerabilities and reduce drought impacts; a mechanism to ensure timely and accurate assessment of drought's impacts on agriculture, industry, municipalities, wildlife, tourism and recreation, health, and other areas;
- Public information methods; and
- A strategy to remove obstacles to the equitable allocation of water during shortages and establish requirements or provide incentives to encourage water conservation.

4. Emergency Services.

Emergency service measures protect people during and after a disaster. A good emergency management program addresses all hazards and involves all departments. At the state level, programs are coordinated by the Michigan State Police, Emergency Management and Homeland Security Division (MSP-EMHSD); while at the county level, programs are coordinated through Lake County Emergency Management Department. These measures can be divided into four stages:

- Threat Recognition (Watch);
- Warning;
- Response; and
- Post-Disaster Recovery and Mitigation.

A. Threat Recognition (Watch). The first step in responding to a snowstorm, windstorm, tornado, flood, or other natural hazard is to know when weather conditions are such that an event could occur and issuing a "watch." Proper and timely threat recognition systems allow for adequate warnings to be disseminated. Systems are described below for flooding, tornadoes and thunderstorms, and winter storms.

A flood threat recognition system predicts the time and height of the flood crest. This can be done by measuring rainfall, soil moisture, and stream flows upstream of the community and calculating the subsequent flood levels. On smaller rivers, local rainfall and river gauges are needed. In the absence of gauges, local personnel and/or volunteers monitor rainfall and stream conditions. While specific flood crests and times are not predicted, advance notice of potential local or flash flooding is provided.

On larger rivers, measuring and calculating is done by the National Weather Service (NWS), which is in the U.S. Department of Commerce's National Oceanic and Atmospheric Administration (NOAA), with support from cooperating state and local partners. Forecasts are made through the Advanced Hydrologic Prediction Service (AHPS), which utilizes river gauges for information. There are currently no river gauges in Lake County.

Flood threat predictions are broadcasted on the NOAA Weather Wire and Weather Radio, the official source for weather information, to those who have equipment to receive it (state police, 911 and dispatch centers, municipalities, and critical facilities). Weather radios can be tone-activated through the Emergency Alert Radio System (EARS). Predictions are also transmitted through social media, and

by television, radio, and cable television through the Emergency Alert System (EAS), previously known as the Emergency Broadcast System.

The NWS is the prime agency for detecting meteorological threats, such as tornadoes and thunderstorms. The agency uses transmitters located at Wolf Lake in Peacock Township and near Hesperia in Oceana County to the south for service in Lake County. Severe weather warnings are transmitted through the NOAA Weather Radio System and, subsequently, through the Michigan State Police's Law Enforcement Information Network (LEIN). The network includes law enforcement agencies and emergency service providers such as "911" who then issue their own warnings. However, NWS coverage is done on a large scale and only considers if conditions are appropriate for formation of a tornado or thunderstorm. More site-specific and timely recognition is provided by sending out NWS trained spotters to watch and report on the weather when the NWS issues a watch or warning. Training for spotters is provided annually, usually in the spring, by the NWS office in Grand Rapids.

The NWS is also the prime agency for predicting winter storms. Severe snowstorms can often be forecasted days in advance of the expected event, which allows time for warning and preparation. Though more difficult, the NWS can also forecast ice storms.

In summation, Lake County receives threat recognition information from NOAA weather radios or from the Michigan State Police who monitor the NOAA Weather Wire. The NWS also activates public notice through EAS when the hazard impacts a large area. The Michigan State Police disseminate weather threats through the LEIN system to 911 and other dispatch centers around the state. Police and fire stations, schools and other public facilities may also receive alerts from 911. When conditions are appropriate, Lake County Emergency Management and NWS use their formal organization of storm spotters.

B. Warning. When the NWS determines that a flood, tornado, thunderstorm, winter storm or other hazard has been observed or is coming, a warning is issued to take immediate action and the systems described above are again utilized to notify police, 911 and dispatch centers, municipalities, the public, and staff of other agencies and critical facilities. Early warning allows for a greater number of people to implement protection measures.

More specific warnings may be issued by communities and are included on the following list, which contains methods already discussed, as well as common and cutting edge methods.

- NOAA All Hazards Radio;
- The Weather Channel;
- Commercial or public radio or TV stations;
- Cable TV emergency news inserts;
- Tone activated receivers in key facilities;
- Outdoor warning sirens and fire department call-in sirens;
- Sirens on public safety vehicles;
- Mobile public address systems;
- E-mail notifications;
- Broadcast faxes;
- Pocket paging services for the hearing impaired;
- AT&T language line for those who speak a different language;
- Automated telephone notification services;
- Telephone trees/mass telephone notification;
- Mobile device text messages and apps;
- Social media outlets; and
- Door-to-door contact.

Warning systems need to be evaluated, updated to include new technologies, and expanded to include warnings to people with "special needs" continually and should include warnings for slow onset as well

as fast onset hazards. Different warning systems are required for different hazards, some of which are location-specific and some of which are area-wide. In addition, any confusion over warnings needs to be eliminated. The public is often confused by fire station alarms and doesn't know if the alarm indicates a hazard or is just calling in fire fighters.

Multiple or redundant systems are very effective. If people do not hear one warning, they may still get the message from another. In addition, the most effective warnings provide public information about the hazard and what to do. However, each method has advantages and disadvantages that are partially described below.

- Radio and television, when turned on, provide useful information.
- NOAA Weather Radio, where available, can provide short messages of any impending weather hazard or emergency and advise people to turn on their radios or televisions, or to access the internet.
- Outdoor warning sirens can quickly reach many people, particularly those who are outside, and trigger them to turn on a radio or television or to access the internet to find out what hazard is coming. They do not reach people in tightly insulated buildings or those surrounded by loud noise, such as in a factory, during a thunderstorm, or near an air conditioning unit.
- Automated telephone notification services are also fast, but can be expensive and do not work when phone lines are down or for unlisted numbers and calling screener services.
- Going door-to-door and conducting manual "telephone trees" can be effective but require a longer lead time.
- Social media alerts require individuals to be active on those networks and require access to the internet.
- Mobile device alerts are only effective if there is adequate cell phone service, and when devices are turned on.

Lake County contains four operating sirens that may be activated by 911, or manually by authorized personnel such as fire and police chiefs, presidents and superintendents. The locations of these sirens include: Baldwin Fire Department, Lake Township Fire Department, Webber Township Fire Department, and Yates Township. Although they are all located in the southern portion of the county, these locations cover a significant portion of the population.

In areas not serviced by outdoor sirens, the most effective means of warning are radio, television, and cable systems (EAS), EARS tone alert radios, social media, NOAA Weather Radios, and messages send directly to mobile devices. Lake County currently utilizes Code Red, a system that can be used to disseminate messages to the population regarding emergency situations such as dangerous weather or critical community alerts. Code Red notifications are activated through Lake County Central Dispatch and sent to telephone numbers throughout the county. Residents and visitors may register their private home and cell phone numbers to receive notifications. Lake County Emergency Management may also provide emergency and disaster early warning information on a request basis to special needs populations.

The NWS established the "StormReady" program to help local governments improve the timeliness and effectiveness of hazardous weather-related warnings for the public. A community must satisfy a set of guidelines to receive "StormReady" recognition. The guidelines are organized into six categories:

- Communications;
- NWS Information Reception;
- Hydrometeorological Monitoring;
- Local Warning Dissemination;
- Community Preparedness; and
- Administrative.

Certain requirements for each guideline may vary depending on the population of the community. More information on the program is available at http://www.stormready.noaa.gov/index.html. Lake County achieved StormReady status in 2012. The designation will expire in 2015, unless renewed by the county.

NWS also established the Turn Around Don't Drown (TADD) campaign "to warn people of the hazards of walking or driving a vehicle through flood waters." One activity is to warn motorists of the dangers of flooded roads, particularly when there are barricades, since it is impossible to tell the depth of the water or the condition of the road under the water. Barricades are very definite warnings and should never be ignored. An additional and inexpensive warning technique is the use of PVC markers on roads prone to flooding which show the depth at which motorists should not attempt passage.

C. Response. The protection of life and property is the foremost task of emergency responders. A community should respond to hazards with threat recognition, warnings and actions that can prevent or reduce damage and injuries. Typical actions and responding parties in a flooding event include the following:

- Activating the emergency operations center (emergency management);
- Closing streets or bridges (police or public works);
- Shutting off power to threatened areas (utility company);
- Passing out sand and sandbags (public works);
- Ordering an evacuation (governor, upon local recommendation);
- Holding children at school/releasing children from school (school district);
- Opening evacuation shelters (Red Cross);
- Activating volunteers to check on/assist vulnerable populations;
- Monitoring water levels (engineering); and
- Security and other protection measures (police).

Additional activities for different types of events include: advertising heating and cooling shelters when extreme temperatures occur; having volunteers check on those needing assistance when there are infrastructure failures; sending vulnerable folks (in parks, campgrounds, mobile home parks, shopping malls, and large public or private buildings) to tornado shelters when high winds are predicted; etc.

An emergency action plan ensures that all bases are covered and that response activities are appropriate for the expected threat. These plans can be developed for municipalities, critical facilities, SARA sites, businesses, etc. and should include coordination with all of the agencies, offices, first responders and service providers that are given various responsibilities. They should consider the possibility of "mutual aid" and utilize volunteer groups such as Radio Amateur Civil Emergency Services (RACES). Emergency response plans should be updated annually to keep contact names and telephone numbers current and to make sure that supplies and equipment that will be needed are still available. They should be critiqued and revised after disasters and exercises to take advantage of the lessons learned and changing conditions.

The Lake County Emergency Action Guidelines (EAG) is a document designed to provide a measure for determining whether the community's emergency management planning documents are adequate, and also to expedite this process again in the future, when needed. It was assembled in January 2004, and is constantly being revised, under the supervision of the Michigan State Police Emergency Management Division. The document has an "Incident Response" section that has helped to present a common platform for coordination of major response activities for all types of natural and technological hazards through the assignment of responsibilities during a disaster. Additionally, the EAG is augmented with annexes, standard operating procedures and other guidance documents that cover the details of various aspects of emergency response, such as communications, evacuation, sheltering, damage assessment, and severe weather.

The Incident Response section in the EAG is required for Lake County's participation in the Michigan Emergency Management Assistance Compact (MEMAC), an initiative of the Michigan State Police, Emergency Management and Homeland Security Division (MSP/EMHSD). MEMAC creates an organized process and structure spelled out in advance for jurisdictions large and small across the state to render or receive assistance in times of crisis. It addresses problematic issues concerning workmen's compensation insurance, expense reimbursement and liability coverage before assistance is needed and requested. Designed to be flexible, MEMAC is also intended to supplement rather than replace existing, local mutual aid agreements already in place to handle "routine" public safety services among neighboring jurisdictions and fire departments. It is important to note that the implementation of MEMAC helps to facilitate the receipt of state or federal disaster funds through the Public Assistance Program.

Planning is best done with adequate data. One of the best tools in a flooding event is a flood stage forecast map that shows what areas would be under water at various flood stages. Emergency management staff can identify the number of properties flooded, which roads will be under water, which critical facilities will be affected, etc. With this information, an advanced plan can be prepared that shows problem sites and determines what resources will be needed to respond to the predicted flood level.

A Geographic Information System (GIS) allows for this type of analysis as it works with digitized layers of geographic data. For instance, the locations of buildings can be overlaid with areas of concern for development (topography, infrastructure, land use, zoning, fire service areas, etc.) and areas of concern for flooding (floodplains, hydraulic shadows of dams, etc.). GIS can model the effects of different levels of flooding and be used for hydrologic monitoring and modeling of the effects of removing/raising bridges over rivers to remove constriction to the flow of floodwater.

Protecting critical facilities during a disaster is the responsibility of the facility owner or operator. Some critical facilities have their own emergency response plans. Michigan law requires hospitals, nursing homes, and other public health facilities to develop such plans. Many facilities would benefit from early warning, response planning, and coordination with community response efforts. If critical facilities are not prepared for an emergency and are damaged, workers and resources may be unnecessarily drawn away from other disaster response efforts. If they are adequately prepared by the owner or operator, the community's emergency response efforts will be better supported.

D. Recovery and Mitigation. After a disaster, communities should undertake activities to protect public health and safety, facilitate recovery, and help prepare people and property for the next disaster. Throughout the recovery phase, everyone wants to get "back to normal." However, "normal" can't mean the way things were before the disaster or there would again be the same exposure to future disasters. Here are some examples of potential recovery actions:

- Patrolling evacuated areas to prevent looting (police).
- Providing safe drinking water (public works).
- Monitoring for diseases (health department).
- Vaccinating residents for tetanus (health department).
- Clearing streets (road commission).
- Cleaning up debris and garbage (road commission).
- Providing referrals to recovery vendors for post-disaster goods and services (emergency services).
- Regulating reconstruction to ensure that it meets all code requirements (building inspectors).

Requiring permits for building repairs and conducting inspections are vital activities to ensure that damaged structures are safe for people to re-enter and repair. There is a special requirement to do this in identified floodplains, regardless of the type of disaster or cause of damage. The National Flood Insurance Program (NFIP) directs local officials to enforce the substantial damage regulations. These rules require that if the cost to repair a building in the mapped floodplain equals or exceeds 50% of the building's market value, the building must be retrofitted to meet the standards of a new building in the

floodplain. In most cases, this means that a substantially damaged building must be elevated above the base flood elevation. This requirement can be very difficult for understaffed and overworked offices after a disaster. If these activities are not carried out properly, not only does the community miss a tremendous opportunity to redevelop or clear out a hazardous area, it may be violating its obligations under the NFIP.

A chance is also available to assess the strength of buildings; the effectiveness of emergency action plans for communities, critical facilities, and businesses; and the readiness of responders. Should efforts be deemed inadequate, improvements can be recommended such as revisions to building codes, increased training for responders, and improvements to existing plans or creation of sample plans.

Reviews of emergency response plans and programs should focus on whether all involved communities had coordinators and liaisons, if all information was provided (flood plain map, critical facilities, etc.), if there were post-disaster procedures for public information, and if adequate warnings were provided. Model business disaster plans can include details on response such as evacuation plans; data protections, security, and recovery; property security; drills; and first-aid training and CPR. They could also include post-disaster mitigation actions such as facilities management; damage assessment; relocation of both services and people; insurance; contractors; list of resources for public and private assistance; and evaluate, test, and update plans.

Reviews of building strengths should be similar to FEMA's, wherein a Building Performance Assessment Team (BPAT) may recommend revisions after a disaster. Other considerations for revisions could include the following.

- Did fire fighters have adequate detection and fire fighting equipment?
- Did critical facilities have necessary back-up generators?
- Did electrical distribution systems have built-in redundancies to limit the impact of failures?
- Did the Road Commission have the equipment and personnel to be able to clear the roads?
- Was there a place to store personal property?
- Were there detention areas for debris disposal (snow, ice, branches, power/phone lines, etc.)?
- Were critical facilities protected with lightning rods and surge protection devices?
- Was the Health Department able to monitor threats and take the necessary steps to prevent or limit the scope and magnitude of threats?
- Were emergency responders sufficiently trained and able to communicate?

An assessment of damages is necessary and can be provided by state and federal officials, as is the case in flooding events, or by local emergency responders and emergency staff. The EAG delegates who will take on this responsibility. Assessments can be facilitated by GIS, which could detail damages, identify mitigation projects, establish environmental baselines, and monitor changes in land use. FEMA offers courses, free of charge, to emergency staff for evaluation training.

In addition to identifying the amount of damage, communities can acquire substantially or repeatedly damaged properties from willing sellers, plan for long-term mitigation activities, and apply for post-disaster mitigation funds.

5. Public Education and Awareness.

Public education and awareness programs are necessary to periodically inform the public (property owners, renters, businesses and local officials) about the county's hazards, the measures necessary to minimize potential damage and injury, and what actions are being taken. This information is primarily intended to precipitate appropriate actions.

Information can be disseminated through the media (newspapers, newsletters, websites, television, radio, etc.) and at public forums and civic meetings. It can be distributed through schools and made available in

public buildings or shopping areas. Brochures can be available at libraries and government offices, including building inspection offices. Special populations can be reached through direct mailings, workshops, and seminars. Signage along hazardous areas can also be effective.

A. Distribution of Existing Information. There is a great deal of information regarding hazards and hazard mitigation available to communities and the public on the national level. Both FEMA and American Red Cross present information on the Internet and in documents and brochures. The National Weather Service makes information available through its "StormReady" program and "Turn Around Don't Drown" campaign, to name just a few.

Insurance companies and non-profit programs have been heavily involved in identifying and responding to hazards. The Institute for Business and Home Safety (IBHS) gives detailed information on how to increase a home, business, or new construction's resistance to disaster through its suite of FORTIFIED programs. The National Fire Protection Association (NFPA) provides information about co-existing with wildfire along with mitigation information through its Firewise Communities program. The NFPA also has information available for homeowners on how to prevent fires. The National Arbor Day Federation provides direction on tree management.

Unfortunately, this information doesn't always reach the intended target audience; whether that audience is communities, the general public, or specific populations. Local efforts can be made to select pertinent information and get it to places and people where it is needed (such as wildfire hazard information to campers). Programs and web sites can be publicized. Brochures can be stockpiled and distributed. This information can be very helpful, although it is not specific to the community.

B. Distribution of Local Information. In addition to the national-level information discussed above, there is an abundance of information available locally to educate and warn the public of hazards. Local newspapers and television stations frequently update the public on hazards. Lake County Emergency Management is an excellent source of information on a variety of topics as varied as the location of shelters or financial assistance in hazard response and mitigation. Local building inspectors can provide advice regarding protection measures, property compliance, and required building permits. District health department reports may also prove to be valuable resources for local hazard information.

Mitigation efforts the county takes to protect its residents, including the creation and adoption of this plan to qualify itself (and local communities which participate in the planning process and adopt the plan) for federal disaster funding, can be publicized. The general public, or eligible target groups, can be notified when financial resources for hazard response and mitigation become available.

C. Technical Assistance. Communities often have information that can assist homeowners. If they have FEMA's Flood Insurance Rate Maps and Flood Insurance Studies available, they can provide information to residents and can assist them in submitting requests for map amendments and revisions (Letter of Map Revision, or LOMR) when a building is not in the flood plain but a part of the property is. Lenders will notify applicants for federally insured loans if the involved property is in the flood plain and require flood insurance as a condition of the loan.

Local building inspectors can provide advice regarding protection measures, property compliance and required building permits.

Emergency Management can recommend that residents develop Family Emergency Plans, including the preparation of Disaster Supply Kits, identification of emergency telephone numbers, and the preparation of pre-planned escape routes. The county can assist local communities through the provision of local information regarding hazards, risks and protections. For example, a GIS system could lay out the location of homes in floodplains so that mitigation measures can be considered. It can also assist communities in the development of the plans identified in this document by researching and providing model plans to them.

Part G
POTENTIAL HAZARD MITIGATION ACTIONS

The previous chapter identified a multitude of alternatives for addressing hazard concerns; some of which may not be economically feasible or appropriate for a county with limited financial and professional resources, such as Lake. In addition, many of Lake County's top hazards are natural and weather-related and cannot be easily mitigated. Nothing can be done to eliminate severe winds or snow/ice/sleet storms or to alter their frequency, intensity or spatial distribution across the landscape. Mitigation actions associated with natural hazards must focus on limiting the impacts on the populations or structures that are being affected. For instance, power failures caused by severe winds and snow/sleet/ice storms can be reduced by several mitigation activities and the impacts on residents and properties from the power failures can be alleviated.

The potential actions in this section are presented because they may potentially help to save lives and protect communities and important agencies, rather than because they are considered pure "mitigation actions" distinct from other types of emergency management actions. However, in the final selection of strategies for any hazard mitigation plan, care should be taken to ensure the inclusion of at least some strategies that are clearly hazard mitigation. That is, a true hazard mitigation strategy is an effort to prevent hazard impacts, or to take advance, proactive steps toward the long-term reduction of the impacts of hazards on a community. If some of these take place during the response or recovery phases of a disaster, or happen to also increase an agency's preparedness, the existence of such overlap is primarily of academic interest so long as the community's safety is being served. On occasion, specific criteria for hazard mitigation must be met to satisfy the requirements of a given grant. Thus it is useful to be aware of both the distinctions and the overlap between hazard mitigation and other types of emergency management activities.

Identification of a possible mitigation measure does not necessarily mean that it can or even should be implemented. Implementation (and the desirability) of a mitigation measure is highly dependent on a number of factors – environmental, social, economic and political. Just because a measure may reduce or eliminate the effects of a hazard does not necessarily mean that it should be implemented. There may be extenuating factors or circumstances that could (or even should) preclude its implementation. Those decisions will be made in the local and state political arenas and in the land use / land development decision-making processes. Typically, mitigation measures will be implemented if they are able to balance environmental, social, economic and political factors, and are cost-effective. It does not make sense to implement a measure that will not be supported by state and/or local officials and the citizenry, or that cannot be economically justified. Although implementability cannot (and should not) always be the final litmus test for a potential mitigation measure, it certainly should be considered when identifying and developing measures. In general, those mitigation opportunities that could not pass this basic litmus test have been excluded from this plan.

The following potential actions are presented according to the county's hazard mitigation goals and objectives identified in Part E. For each goal, there are several objectives; and under each objective, there are several action items. These potential action items are "snapshots" of some of the alternatives discussed in the previous chapter. The highest priority action items are selected from this set and discussed further in "Part I - Plan Implementation."

For the updated edition of this plan, many of the potential action items remain the same, though minor revisions were made to improve the readability of the action items. A few action items were added and a few were removed according to the preference of the Advisory Team / LEPC. Care was taken to ensure that there are numerous potential action items presented to address each of the county's top priority hazards.

Goal 1. Promote growth in a sustainable, hazard-free manner.

Objective 1.1. Incorporate hazard provisions in building code standards, ordinances, and procedures.

Action Item 1. Review local building codes to determine if revisions are needed to improve structural ability to withstand greater wind velocities, snow weight, ice, and hail; to provide better protection against structural fires and flooding; and to provide better protection from extreme temperatures.

Action Item 2. Contact Insurance Services Office (ISO) to request a copy of the community's Building Code Effectiveness Grading Scale (BCEGS), and work to improve the BCEGS rating through improvements to building codes and enforcement.

Action Item 3. Utilize the Institute for Business and Home Safety (IBHS) guidelines provided through the "FORTIFIED" programs to guard new and existing structures against hazards (such as structural fire, wildfire, tornadoes, and freezing weather), and consider incorporating them into existing codes.

Action Item 4. Review code requirements for the installation of mobile homes and manufactured homes to assure protection against severe winds and tornadoes.

Action Item 5. Assess the need to strengthen anchoring requirements for propane tanks and hazardous materials in the floodplain/floodway.

Action Item 6. Assure proper location, installation, cleaning and maintenance of septic systems, particularly in the floodplain/floodway and around lakes.

Objective 1.2. Incorporate hazard mitigation into land use and capital improvement planning and development activities.

Action Item 7. Incorporate mitigation provisions into comprehensive plans and land use plans; such as identification of acceptable land uses and densities based on consideration of flood-prone areas, soil types, topography, etc.

Action Item 8. Integrate hazard mitigation into the capital improvement planning process so that public infrastructure does not lead to development in hazard areas and so that possible set-asides for planned and engineered structural projects (berms, levees, floodwalls, detention and retention ponds, debris storage areas, culvert replacement, etc.) are considered.

Objective 1.3. Incorporate hazard mitigation into existing land use regulation mechanisms to ensure that development will not put people in danger or increase threats to existing properties.

Action Item 9. Incorporate hazard mitigation provisions and recommendations into local zoning ordinances and resolutions as they restrict or direct development; with consideration given to dams, floodplains, topography, and wildfire risks; and as they allow flexibility in lot sizes and locations, such as in Planned Unit Developments (PUD).

Action Item 10. Enforce the existing Michigan Drain Code requirement for "set-back" from the drain channel, thereby assuring proper carrying capacity of the drain.

Action Item 11. Enforce Michigan's Part 91, Soil Erosion and Sedimentation Control, of the Natural Resources and Environmental Protection Act, regarding earth changes affecting an acre or more or within 500' of a lake or stream, and consider adopting and enforcing more stringent local regulations.

Action Item 12. Enforce Michigan's Land Division Act as it furthers the orderly layout and use of land, provides for proper ingress and egress to lots and parcels, controls residential building development within floodplain areas, provides for reserving easements for utilities, and governs internal drainage.

Action Item 13. Consider regulation of development in the hydraulic shadows of dams (where flooding would occur if there was a severe dam failure).

Objective 1.4. Research, recommend, adopt and enforce programs, plans, and ordinances that protect natural resources so that they can, in turn, provide hazard protection.

Action Item 14. Develop a Stormwater Management Plan to identify best management practices (BMP's), and to assess the efficacy of local stormwater ordinances and rules.

Action Item 15. Develop and enact a Community Forestry Program to reduce the damage potential of trees by addressing proper tree care prior to a storm (pruning, maintenance, removal, and replacement) by communities and property owners and by managing trees before, during, and after a storm. This is a standard for qualification as a "Tree City USA" community.

Action Item 16. Develop policies or ordinances aimed at mitigating the impacts of drought conditions, such as: the promotion of planting crops tolerant of low moisture levels; partner with programs that promote soil health and monitor and preserve soil moisture; and prioritize or control water use during drought conditions.

Action Item 17. Review and update the Lake County Community Wildfire Protection Plan (CWPP) every five years. The next five-year update will be due in 2016.

Goal 2. Protect existing and new properties.

Objective 2.1. Use the most cost-effective approaches to keep hazards away from existing buildings and facilities.

Action Item 18. Raise or relocate buildings above the 100-year flood level, and/or acquire properties in flood areas for demolition and re-use of the land as open space.

Action Item 19. Structural projects to channel water away from people and property (e.g. berms, dikes, levees, or floodwalls), or to improve drainage capabilities (e.g. culvert improvements, bridge modifications, spillways, relief drains, or floodgates).

Action Item 20. Environmental restoration projects to lessen the impacts of flooding and improve water quality and wildlife habitat, such as erosion control techniques (streambank modification), dredging / clearance of sediment and debris from drainage channels, and protection / restoration of wetlands and natural water retention areas.

Action Item 21. Maintain the Lake County Community Wildfire Protection Plan (CWPP), and work to implement the Community Firewise Project Goals contained within the plan.

Action Item 22. Enforce Michigan P.A. 102 of 2012 which prohibits the open burning of household trash that contains plastic, rubber, foam, chemically treated wood, textiles, electronics, chemicals, or hazardous materials.

Objective 2.2. Use the most cost-effective approaches to protect existing buildings and sites from hazards.

Action Item 23. Encourage property owners and public facility operators to increase their property's resilience and resistance to hazards.

Action Item 24. Adopt and enforce the Michigan Rehabilitation Code to hold repaired buildings to higher standards for protection against natural hazards, similar to the standards for newly constructed buildings.

Action Item 25. Utilize mandates for upgrading homes, such as requiring upgraded electrical work for substantial rehabilitation of existing properties, or for issuing "Fill Your Basement With Water" orders.

Action Item 26. Review the energy efficiency, winter readiness, and electrical protection of critical facilities and government buildings in the community and consider replacing aged facilities and equipment.

Action Item 27. Install lightning protection devices on the community's communications infrastructure and appropriate public facilities; and lightning grade surge protection devices on critical electronic components used by government, public service, and public safety facilities.

Objective 2.3. Maximize insurance coverage to provide financial protection against hazard events.

Action Item 28. Assure insurance coverage on properties and obtain additional insurance coverage as appropriate (sump pump failure, sewer back-up, wildfire, dam failure, etc.).

Action Item 29. Encourage and assist municipalities that are at risk to flooding, or that have been exposed to flooding in the past, to join the National Flood Insurance Program (NFIP) so that residents can obtain flood insurance.

Action Item 30. Encourage NFIP-participant municipalities to join the NFIP's Community Rating System (CRS), implement the CRS minimum standards, and implement additional flood loss reduction activities to reduce the cost of NFIP flood insurance.

Action Item 31. Inventory critical facilities and assure proper insurance coverage, both type and amount, including deductibles and policy limits. Evaluate self-insurance coverage in light of its expense and NFIP policies.

Objective 2.4. Maximize the resources for investment in hazard mitigation, including the use of outside sources of funding.

Action Item 32. Utilize federal programs; such as but not limited to FEMA's Pre-Disaster Mitigation Program, Flood Mitigation Assistance Program, and Hazard Mitigation Grant Program; to address community needs for hazard mitigation.

Action Item 33. Utilize, and assist those with special needs to utilize, available programs for assistance with home repairs, weatherization, and heating costs to address hazards for persons and properties.

Action Item 34. Facilitate donations for heating assistance through cooperation with local utility providers and local charitable organizations to assure that all residents have heat during the winter, regardless of their ability to pay.

Action Item 35. Establish a cost sharing program to encourage low cost (under $10,000) property protection measures against natural hazards on private property, such as rebates offered through a "flood-proofing" program for instances when acquisition and/or relocation is not required.

Action Item 36. Establish a voluntary floodway property acquisition and land re-use program, with corresponding changes in zoning, and purchase/transfer of development rights for properties.

Action Item 37. Tap into state and federal funding and technical assistance for dam/spillway repairs.

Action Item 38. Leverage the Lake County Community Wildfire Protection Plan to obtain funding for wildfire mitigation projects.

Goal 3. Protect public health and safety.

Objective 3.1. Assure that threat recognition (watches) and warning systems are adequate and appropriate and that they utilize the latest technology.

Action Item 39. Regularly evaluate the effectiveness of the public warning system including the threat detection process, management system, communications links, and methods of dissemination. Evaluation should consider warning for slow onset as well as short onset hazards, new technologies, public views of the warning system and the effect this has on response to warnings (especially confusion about fire station sirens), disseminating warnings to people with "special needs," redundancies, and effective methods of risk communication.

Action Item 40. Maintain a description of the public warning process and coordinate actions in a section of the Emergency Action Guidelines (EAG).

Action Item 41. Increase the coverage and use of NOAA All-Hazards radios and weather alert systems (Emergency Alert Radio System, etc.) to people and communities in need.

Action Item 42. Encourage the MDNR, U. S. Geological Survey, National Weather Service, and U. S. Army Corps of Engineers to continue to operate and monitor stream gauging stations and groundwater monitoring wells and consider whether the exposure to flooding on smaller rivers and streams warrants additional Advanced Hydrologic Prediction Services (AHPS) or local rain and stream gauging and flood threat recognition systems.

Action Item 43. Maintain adequate monitoring and surveillance capabilities by the District Health Department to monitor public health threats and take the necessary steps to prevent or limit the scope and magnitude of threats.

Action Item 44. Utilize the NWS "Turn Around Don't Drown" system to warn motorists and pedestrians not to enter or cross flooded areas, and install PVC markers alongside roads to illustrate dangerous water levels.

Objective 3.2. Protect infrastructure and services.

Action Item 45. Encourage electrical utilities to bury or protect power lines wherever possible, but especially when upgrading lines or running power to new developments.

Action Item 46. Recommend design of the electrical distribution system with built-in redundancies such that isolated failures do not lead to wide scale outages; recommend consideration of back-up generators powered with wind, sun, gasoline, or natural gas; and assess and improve electric service system reliability as needed.

Action Item 47. Install back-up generators, as needed for short-term relief from power failures, at critical facilities such as sewage pump stations, road commissions, medical centers, nursing home facilities, schools, and shelters.

Action Item 48. Bury water/sewer lines below the frost line or insulate and maintain lines to protect against ground freeze.

Action Item 49. Establish safe and appropriate locations for temporary debris disposal sites.

Action Item 50. Assure the county has adequate personnel and equipment (road barriers, sand bags, portable lighting, snow plows, etc.) to respond to widespread weather events.

Action Item 51. Refine state, county, and local road and bridge maintenance / vegetation management programs to maintain visibilities, provide for living snow fences, reduce erosion, slow stormwater runoff, and so as not to undermine the structural integrity of transportation infrastructure.

Objective 3.3. Build and support local capacity, commitment and partnerships to continuously become less vulnerable to hazards.

Action Item 52. Adopt this Hazard Mitigation Plan by official resolution to assure both consideration of natural hazards and eligibility for funding through the Pre-Disaster Mitigation Program and Hazard Mitigation Grant Program.

Action Item 53. Explore funding options for a Hazard Mitigation Coordinator position, either on a county or regional level, to facilitate the actions contained in this plan.

Action Item 54. Develop and review coordinated response plans and programs across service providers, agencies and local governments, and assure both mutual aid and the ability to communicate during emergencies.

Action Item 55. Share vital public safety services and resources more effectively and efficiently through county participation in MEMAC, which helps facilitate the receipt of state or federal disaster funds through the Public Assistance Program.

Action Item 56. Refer emergency responders and emergency staff to FEMA and MSP/EMHSD training for conducting Damage Assessments and determining “Substantial Damage” for an efficient and accurate assessment of building damages.

Action Item 57. Design and plan for water supply infrastructure systems that include a consideration of, and are more resistant to, drought events.

Action Item 58. Obtain extra fire-fighting equipment, including specialized equipment for limited access areas (such as wildland/urban interface areas) and snow-blocked areas, thermal imaging devices to help detect lightning-related fires, and special equipment for water and ice rescues.

Action Item 59. Construct concrete storm / tornado safe rooms in homes, public buildings, major industrial sites, shopping malls, and other large complexes; and shelter areas in parks, campgrounds, fairgrounds, mobile home parks, and other vulnerable public areas.

Action Item 60. Coordinate with the Conservation District, local watershed councils andlake associations to maintain healthy, free-flowing watercourses with minimal erosion and sedimentation, and to restore / preserve wetlands.

Action Item 61. Adopt the recommendations and strategies of the "Firewise” program, which include encouraging all residents living in the wildland/urban interface area to become acquainted with Firewise mitigation strategies to protect their property from wildfire hazards and recommending to production companies and land owners that they employ Firewise principles of proper grounds maintenance, equipment storage, vegetation clearance, and other techniques.

Action Item 62. Maintain Lake County’s “Storm Ready” status with the National Weather Service every three years, beginning in 2015.

Objective 3.4. Enlist support of committed volunteers to safeguard the community before, during, and after a disaster.

Action Item 63. Establish an Amateur Radio Club to bring awareness to the community and increase the number of licensed radio operators in Lake County.

Action Item 64. Utilize volunteer communication networks by amateur radio operators (such as RACES and ARES) to facilitate communication during emergencies when phone lines may be inoperable.

Action Item 65. Designate amateur radio operators to relay information on "immediately dangerous" weather situations and storm damage reports to the NWS, Central Dispatch, and/or Lake County Emergency Management.

Action Item 66. Create a volunteer outreach program, whereby a network of individuals regularly checks on the needs and conditions of elderly, disabled, homebound, and other special-needs groups during and after severe weather conditions; delivers goods / assistance to them; and disseminates information about emergency shelters.

Action Item 67. Utilize NWS-trained weather spotters to watch for developing storms, take flood water measurements, and monitor stream conditions.

Action Item 68. Conduct an annual "clean-up" program when trash, limbs, barrels, shopping carts and other potential blockages are removed from drainage culverts, channels, and adjacent lands.

Goal 4. Increase public understanding, support, and participation in hazard mitigation.

Objective 4.1. Heighten public awareness of the full range of existing natural and man-made hazards and actions they can take to prevent or reduce the risk to life or property from them.

Action Item 69. Obtain and distribute available information on hazards and cost-effective mitigation actions individuals can implement (for example, Firewise pamphlets), and post-disaster repair and cleanup guidance.

Action Item 70. Produce local emergency preparedness and safety information for distribution to the general public and/or targeted groups (seasonal populations, floodplain residents, developers and builders, farm owners and operators, decision makers, Spanish speaking, etc.). Include local resources for information such as fire stations, local radio stations and utilities.

Action Item 71. Produce and distribute information on mitigation measures the county is taking/will take, as identified in this hazard mitigation plan, to local units of government and encourage them to participate in the plan and take mitigation actions.

Action Item 72. Promote educational and informational programming through the media, especially related to the early warning network and individual actions that can be taken to protect citizens, properties, and businesses. For example, inform the general public about the Code Red notification system and encourage citizens and visitors to register unlisted phone numbers.

Action Item 73. Provide local schools with information for the classroom regarding severe weather hazards and how families can prepare for and respond to them.

Action Item 74. Encourage residents to develop a Family Emergency Preparedness Plan; including the preparation of a Disaster Supply Kit, the posting of emergency telephone numbers, and pre-planned escape routes.

Action Item 75. Promote public awareness on fire hazards such as recreational fires (especially in resort/vacation home areas), smoking, fireworks, campfires, wood stoves, and outdoor burning; and support safe disposal of yard and house waste rather than open burning.

Action Item 76. Research availability of local and Michigan-based recovery "vendors" for post-disaster goods and services to support disaster recovery efforts.

Action Item 77. Identify and advertise available heated and cooled shelters to the elderly and other special populations who may be at risk during extreme temperature events and power outages.

Action Item 78. Provide local units of government and builders with information and guidance on methods of protecting new construction from wind damage. Encourage builders and contractors to design wind resistance into the construction of new homes and major home renovation projects.

Action Item 79. Through coordination with the District Health Department, increase public awareness of the causes, symptoms and protective actions for disease outbreaks and other potential public health emergencies.

Objective 4.2. Encourage local communities, agencies, organizations and businesses to participate in the hazard mitigation process.

Action Item 80. Assist local governments in the participation of programs such as NFIP, CRS, Firewise, Tree City USA, Fortified…for safer living, Storm Ready, TADD, etc.

Action Item 81. Develop model hazard mitigation and contingency plans and regulations (such as stormwater ordinance, waterway dumping regulations, community forestry program, drought plan and ordinance, etc.) and provide them to interested communities.

Action Item 82. Develop model business and critical facility disaster plans that include details on disaster response (evacuation plans; data protection, security, and recovery; property security; drills; first-aid training and CPR; and post disaster mitigation actions), facilities management, damage assessment, relocation of both services and people, insurance, contractors, list of resources for assistance, and evaluation, testing, and updating plans. Inform business owners about available disaster-recovery training programs.

Action Item 83. Notify communities of hazard mitigation funds, as they become available, and assist them in applying for funds.

Action Item 84. Encourage meetings between utility providers and local Public Works and Road Commission departments to determine the resources and funding required to mitigate recurring infrastructure failures.

Action Item 85. Support agricultural programs that promote soil health, preserve soil moisture, and monitor soil moisture levels to help to minimize loss of crops and topsoil during drought conditions and promote educational programming relating to water conservation, especially in irrigation and farming, during periods of drought.

Objective 4.3. Encourage cooperation and communication between planning and emergency management officials.

Action Item 86. Assist Lake County activities related to developing and continually revising Emergency Action Guidelines (EAG) detailing coordinated response plans of emergency responders (emergency management, damage assessment, communications, law enforcement, public works, public information, medical, fire, public health, and services, etc.) and needs (such as a portable command center).

Action Item 87. Strengthen the role of hazard mitigation in the land development process, incorporating goals, objectives, and action items into land use plans, comprehensive plans, and zoning ordinances.

Action Item 88. Utilize the County Geographic Information System (GIS) capabilities to support pre-disaster planning (such as the creation of flood stage forecast maps, and maps showing the locations of secluded, gated, and seasonal homes), disaster response activities, and post-disaster recovery activities.

Action Item 89. Coordinate with American Red Cross to ensure the countywide availability of designated and accessible emergency shelters; with consideration given to the seasonal populations in homes, cabins and mobile homes without basements; and assure facilities are inspected, certified, and have back-up power.

Part H
EVALUATION CRITERIA TO SELECT AND PRIORITIZE ACTION ITEMS

The selection of appropriate evaluation criteria is intended to ensure that the recommended implementation action items reflect the values, policies, and desires of the community; and to communicate to governing officials which measures are the most meritorious and desirable.

Local input and planning principles were used to select action items for implementation from the list of potential actions presented in Part G. Common mitigation criteria helped guide the selection process, and included evaluation of each action item's *economic justifiability, technical feasibility, social equitability,* and *environmental soundness*. If, for example, relocation of a structure is proposed, the following conditions must be met in order to satisfy the criteria:

- The cost of relocation must be less than the cost of the repetitive repairs that would be necessary (along with other costs from displacement, loss of services, etc.) if there were no relocation.
- The structures must be able to be moved from their present location to a suitable site.
- The relocation must be acceptable to those who are to participate.
- The relocation must be affordable to all it affects, and not discriminate against those who are unable to bear the cost of either moving the structure, or finding comparable housing.
- In the case of a public facility, such as a fire station, the relocation should not result in an inequitable distribution of fire protection services.
- The relocation project must meet appropriate environmental regulations, and not cause any adverse effects.

Additional considerations used in selecting action items for implementation included: 1) ensuring an appropriate number of mitigation actions be selected to address each of the county's top-priority hazards; and 2) ensuring that an appropriate number of measures be selected to accomplish each of the four hazard mitigation goals established by this plan. Bonus consideration was given to action items that also addressed the goals of other community planning initiatives, and action items that provide clear and obvious solutions for hazard mitigation.

The next chapter presents a schedule of recommended action items for implementation. For each measure, the plan identifies basic details needed in order for it to be accomplished, including who will take the action and when it will be taken. Possible sources of technical or financial assistance, as previously discussed in Part F - Identification of Alternatives for Solving Problems, are matched to the actions as well.

In some cases, a local government may be able to implement an action, while the county can only make recommendations. Therefore applicability of each action item is assigned to the appropriate governments in a table on the last page. As a result, objectives will work on multiple scales and can be overseen by several governments. The benefits of combining all of the objectives into one plan include: the ability to recognize contradictions in policy more easily; the ability to cooperate in shared objectives; the ability to eliminate or reduce redundancy in efforts; and the fact that local governments will have a local-level plan for adoption and implementation, qualifying those governments for hazard mitigation funding.

Part I
PLAN IMPLEMENTATION

The previous edition of this hazard mitigation plan (2006) included 20 action items that were recommended for implementation and then assigned to the appropriate jurisdictions within Lake County. This chapter contains a review of the 2006 Action Agenda, as well as a revised Action Agenda for this updated edition.

Review of Hazard Mitigation Progress

To identify any mitigation progress that had been made on the 2006 Action Agenda, discussions were held with county officials and the LEPC / Advisory Team. A questionnaire was also sent to Lake County Emergency Management, LEPC / Advisory Team, and the chief elected official of each village and township that had adopted the 2006 plan. The questionnaire listed the 2006 Action Agenda, along with a place for the respondent to identify whether each item on the agenda was *Complete*, *Ongoing or In-Progress*, *Action Pending*, or *Incomplete* within his or her jurisdiction. If a particular action item was incomplete, the respondent was encouraged to explain why. This review process revealed the following:

1) At least some progress has been made on most of the action items.
2) Many inherited items on the Action Agenda remained priorities as of the time this plan was updated.
3) 2006 Action Item #54 (addressing fire-fighting and rescue equipment) is no longer considered a priority action item and will not be included on the revised Action Agenda.

Six out of the 18 local units of government in Lake County responded to the questionnaire. Two LEPC / Advisory Team members took part in the exercise: Lake County Emergency Management and District #10 Health Department. At least some progress was reported for 19 out of the 20 items on the Action Agenda. The results of the questionnaire exercise are compiled into the two tables following this narrative. The "Status Report" table summarizes the status of items on the 2006 Action Agenda, and reports any additional comments or information gleaned from the questionnaire. The "Progress by Jurisdiction" table shows the known degree of progress that has been made towards the 2006 Action Agenda, by jurisdiction, in Lake County.

2006 Action Agenda
STATUS REPORT

2006 Action Items	Status in 2014				Comments
	Complete	Ongoing or In-Progress	Pending	Incomplete or Unknown	
#2. Consider and encourage participation in ISO's Building Code Effectiveness Grading Schedule (BCEGS), as recognized by FEMA for the Community Rating System of the National Flood Insurance Program.		X			
#4. Review code requirements for the installation of mobile homes and manufactured homes to assure protection against severe winds and tornadoes.		X			
#7. Incorporate mitigation provisions into comprehensive plans and land use plans, especially as they address open space preservation and development restrictions (particularly in flood plains and the hydraulic shadows of dams).		X	X		
#9. Incorporate hazard mitigation provisions and recommendations into local zoning ordinances as they restrict or direct development; with consideration given to dams, flood plains, soil type, and topography; and as they allow flexibility in lot sizes and locations, such as in Planned Unit Developments.		X	X		
#18. Create firebreaks, wherein brush and other fuel is cleared away, in wildland areas to help protect them and nearby property from forest fires. Research the availability of resources for creating them and for acquiring land, as necessary, to achieve continuity needed for firebreak areas.		X		X	**Lake Twp –** Lack of resources.

#19. Maximize the participation of property owners in protecting their properties from natural hazards.	X	X		X	**Lake Co. Emergency Mgmt. –** Have promoted StormReady and Firewise programs. **Elk Twp –** Awaiting county direction. **Pinora Twp –** Participated in Firewise program about 3 years ago.
#25. Encourage municipalities to join the National Flood Insurance Program (NFIP) so that residents can obtain flood insurance.		X		X	
#26. Encourage municipalities to join the Community Rating System (CRS), implement the minimum CRS standards, and implement additional flood loss reduction activities (such as the adoption of this plan) to reduce the cost of NFIP flood insurance.		X		X	
#28. Utilize federal programs; such as but not limited to FEMA's Pre-Disaster Mitigation Program, Flood Mitigation Assistance Program, and Hazard Mitigation Program; to address community needs for hazard mitigation.		X			
#38. Increase the coverage and use of NOAA All-Hazards radios and weather alert systems (Emergency Alert Radio System, etc.) to people and communities in need.	X			X	**Lake Co. Emergency Mgmt. –** Qualified as a StormReady county by the National Weather Service in 2012. **Lake Co 911 –** Currently switching emergency alert systems from CityWatch to Code Red, ensuring efficient and cost-effective emergency notifications. **Elk Twp –** Lack of resources.
#39. Encourage the MDNR, USGS, NWS, and/or USACE to establish and monitor stream gauging stations and groundwater monitoring well and consider whether the exposure to flooding on smaller rivers and streams warrants additional Advanced Hydrologic Prediction Services (AHPS) or local rain/stream gauging and flood threat recognition systems.				X	
#44. Install back-up generators, as needed, for short-term relief from power failures at critical facilities such as sewage pump stations, road commissions, medical centers, nursing home facilities, shelters, and schools.	X	X		X	**Baldwin Village –** No generator at Baldwin Family Health Care (medical center). **Elk Twp –** Lack of resources; have made requests to no avail for a generator for the Twp Hall to be used for a shelter.
#47. Continue and refine State, County, and local road and bridge maintenance programs, assure that road commissions have adequate equipment to respond to widespread weather events, and promote living snow fences beside highways and other roads to decrease snow on roads.	X	X			
#49. Explore funding options for a Hazard Mitigation Coordinator position, either on a county or regional level, to facilitate the actions contained in this plan.	X				**Lake Co. Emergency Mgmt. –** Item considered, but no action taken.
#54. Obtain extra fire-fighting equipment, including specialized equipment for limited access areas (WUI areas) and snow-blocked areas, thermal imaging devices to help detect or mitigate lightning-related fires, and special equipment for water and ice rescues.		X		X	
#60. Create volunteer outreach programs by a network of amateur radio operators and others to regularly check on the needs and conditions of the elderly, disabled and homebound persons, and other special-needs groups during and after severe weather conditions and deliver goods or assistance to them.		X	X	X	**Lake Co 911 –** Five HAM operators within Lake Co. Network of amateur radio operators in surrounding counties may be called upon to assist if needed. **Pinora Twp –** Lack of resources.
#63. Distribute already produced information on hazards and cost-effective mitigation actions individuals can implement to residents and/or targeted groups most likely to experience significant impacts due to natural hazards.	X	X	X		**Pinora Twp –** Firewise programs; other information is available through 211.
#64. Produce and distribute local emergency preparedness and safety information concerning all natural hazards to the general public and/or targeted groups (seasonal populations, floodplain residents, developers and builders, farm owners and operators, decision makers, Spanish speaking, etc.).		X	X	X	**Lake Twp –** Lack of resources.
#75. Assist local communities in participating in programs Such as NFIP, CRS, Firewise Communities/USA, Tree City USA, BCEGS, Fortified…for safer living, Storm Ready, and Turn Around Don't Drown.		X			**Lake Co. Emergency Mgmt. –** Lake County has been StormReady certified (2012) and has promoted Firewise (2011) throughout the county.
#81. Assist the LEPC in its activities related to developing and continually revising the EAG, detailing coordinated response plans of emergency responders and needs (such as a portable command center).		X			**Baldwin Village –** Don't know who/what LEPC is.

2006 Action Agenda

PROGRESS BY JURISDICTION

UNIT OF GOVERNMENT	ACTION ITEMS																			
	2 BCEGS	4 CODE REQUIREMENTS	7 COMP. PLAN/ LAND USE	9 ZONING ORDINANCES	18 FIREBREAKS	19 HOMEOWNER MITIGATION	25 NFIP	26 CRS	28 FEDERAL FUNDING	38 NOAA WEATHER RADIOS	39 STREAM GAUGES/ AHPS	44 GENERATORS	47 ROAD MAINTENANCE	49 MITIGATION COORDINATOR	54 FIRE/RESCUE EQUIPMENT	60 VOLUNTEERS	63 HAZARD AND MITIGATION INFORMATION	64 PREPAREDNESS AND SAFETY INFORMATION	75 LOCAL ASSISTANCE	81 EAG UPDATES
COUNTY Lake	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
VILLAGES Baldwin			●	●	●		●	●	●			●	●		●	●				
Luther			●	●	●		●	●	●			●	●		●	●				
TOWNSHIPS Chase					●		●	●	●			●				●				
Cherry Valley					●			●	●			●				●				
Dover					●		●	●	●							●				
Eden					●		●	●	●			●			●	●				
Elk					●		●	●	●						●	●				
Ellsworth					●		●	●	●							●				
Lake			●	●	●			●	●						●	●				
Newkirk					●		●	●	●							●				
Peacock			●	●	●		●	●	●							●				
Pinora					●		●	●	●							●				
Pleasant Plains			●	●	●			●	●							●				
Sauble			●	●	●		●	●	●						●	●				
Sweetwater			●	●	●		●	●	●							●				
Webber			●	●	●			●	●			●			●	●				
Yates			●	●	●			●	●							●				

- ● ***Action Item applicable to community (per 2006 Hazard Mitigation Plan)***
- ***Complete***
- ***Ongoing or In Progress***
- ***Action Pending***

Revised Action Agenda

The action items highlighted in this section were selected from the list of potential hazard mitigation actions presented in Part G and are presented below as the Action Agenda for 2015-2019. The selection process was guided by criteria described in Part H. All items on this revised Action Agenda are considered to be of the highest priority. Implementation of these action items may be appropriate on the county level and / or the local level. The "List of Hazard Mitigation Actions Applicable to Governmental Units" at the end of the chapter assigns action items to appropriate jurisdictions within Lake County. Each action item includes the following information to help facilitate implementation:

Priority Level

All identified action items are considered priorities within this Hazard Mitigation Plan. In order to help structure implementation of the Plan, a further prioritization of high, medium, or low is assigned to each measure. This is intended to convey a sense of importance relative to the other action items from a countywide perspective.

Timeframe

Generally identifies when an action item might begin. Where appropriate, prerequisite activities are discussed.

Applicable Governmental Unit(s) / Responsible Person (s)

Identifies key players for initiating and implementing each action. Often the work will be shared by a number of individuals and agencies.

Potential Technical / Financial Assistance

Identifies common sources of technical and financial assistance. In many cases, identified parties will provide referrals to currently available or specialized assistance and / or guidance. Detail provided is not intended to be exhaustive because opportunities for assistance may come and go; such as following a disaster declaration. **A detailed listing of potential federal and state funding sources for hazard-specific measures is included in Appendix F.**

Comments

Additional details or helpful information about the action item. This feature was added for the revised edition of this plan.

Action Item 2. Contact Insurance Services Office (ISO) to request a copy of the community's Building Code Effectiveness Grading Scale (BCEGS), and work to improve the BCEGS rating through improvements to building codes and enforcement.

Priority Level: Low

Timeframe: 2015-2016

Applicable Governmental Unit(s)/Responsible Person(s):
Lake County Building Department.

Potential Technical/Financial Assistance Sources:
Local resources.

Comments:
A free copy of the community's BCEGS report is available upon the request of a community's chief elected official or building official. This information can be used to identify deficiencies in existing building codes and enforecment. Addressing those deficiencies can enhance the resiliency of new and rehabilitated structures.

This action item should be incorporated into the process of reviewing and updating building codes.

Action Item 4. Review code requirements for the installation of mobile homes and manufactured homes to assure protection against severe winds and tornadoes.

Priority Level: Medium

Timeframe: Coincide with regular review / revision of codes

Applicable Governmental Unit(s)/Responsible Person(s):
County Building Inspectors.

Potential Technical/Financial Assistance Sources:
Local resources.

Comments:
A substantial proportion of the county's housing stock is comprised of mobile / manufactured housing. Following review of code requirements, the next step will be to consistently enforce the codes.

Action Item 7. Incorporate mitigation provisions into comprehensive plans and land use plans; such as identification of acceptable land uses and densities based on consideration of flood-prone areas, soil types, topography, etc.

Priority Level: Medium

Timeframe: To be completed when land use plans are written or updated

Applicable Governmental Unit(s)/Responsible Person(s):
Lake County Planning Commission; Local units of government that practice land use planning.

Potential Technical/Financial Assistance Sources:
Local resources.

Comments:
Land use planning helps provide rationale for local rules and policies, so it is important to integrate principals of hazard mitigation into this process. Following adoption of this plan, local units of government and the county will be encouraged to consider the contents of this hazard mitigation plan when writing or updating local plans. State law in Michigan requires that master plans must be reviewed, and updated if necessary, every five years.

Action Item 9. Incorporate hazard mitigation provisions and recommendations into local zoning ordinances and resolutions as they restrict or direct development; with consideration given to dams, floodplains, topography, and wildfire risks; and as they allow flexibility in lot sizes and locations, such as in Planned Unit Developments (PUD).

Priority Level: Low

Timeframe: To be completed when zoning ordinances are written or updated

Applicable Governmental Unit(s)/Responsible Person(s):
Local units of government that practice zoning.

Potential Technical/Financial Assistance Sources:
Local resources.

Comments:
Resources such as the IBHS suite of FORTIFIED programs can provide the latest guidance for increasing the resistance of new and existing structures to hazards through zoning. Zoning is an effective tool for mitigating hazards because it can be used to direct new development away from known hazardous areas, such as floodplains.

Action Item 21. Maintain the Lake County Community Wildfire Protection Plan (CWPP), and work to implement the Community Firewise Project Goals contained within the plan.

Priority Level: Medium

Timeframe: Ongoing (update CWPP in 2016)

Applicable Governmental Unit(s)/Responsible Person(s):
Lake County Emergency Management (LCEM); Local units of government; Fire chiefs; USDA – Forest Service; Michigan MDNR.

Potential Technical/Financial Assistance Sources:
USDA – Forest Service; Michigan MDNR; MSU Extension (MSUE).

Comments:
This action is a new addition to the Action Agenda for 2014. Goals identified within the CWPP include: provide Firewise training; establish cleanup days to remove woody debris from communities; implement fuel treatment programs on private lands adjacent to home ignition zones; and provide fuel breaks and access in strategic locations. The CWPP will need a 5-year update in 2016.

Action Item 23. Encourage property owners and public facility operators to increase their property's resilience and resistance to hazards.

Priority Level: Low

Timeframe: Ongoing

Applicable Governmental Unit(s)/Responsible Person(s):
LCEM; County building inspectors; Local elected officials; Local zoning officials.

Potential Technical/Financial Assistance Sources:
Michigan State Police – Emergency Management and Homeland Security Division (MSP-EMHSD); LCEM.

Comments:
Hazard mitigation concepts and strategies will be incorporated into the day-to-day activities of elected officials, zoning officials, and building inspectors; especially those activities that involve interaction with local land owners and facility operators. Local officials should refer to Part F (Hazard Mitigation Alternatives) for information about potential mitigation strategies.

Action Item 29. Encourage and assist municipalities that are at risk to flooding, or that have been exposed to flooding in the past, to join the National Flood Insurance Program (NFIP) so that residents can obtain flood insurance.

Priority Level: High

Timeframe: 2015-2016

Applicable Governmental Unit(s)/Responsible Person(s):
LCEM.

Potential Technical/Financial Assistance Sources:
MSP-EMHSD; MDEQ NFIP Coordinator.

Comments:
All municipalities are eligible to participate in the program, even if there are no identified floodplains. NFIP flood insurance can only be acquired in communities that participate in the program. Municipalities that currently do not participate in the NFIP include: the villages of Baldwin and Luther; and the townships of Chase, Dover, Eden, Elk, Ellsworth, Newkirk, Peacock, Pinora, Sauble, and Sweetwater.

Action Item 30. Encourage NFIP-participant communities to join the NFIP's Community Rating System (CRS), implement the CRS minimum standards, and implement additional flood loss reduction activities to reduce the cost of NFIP flood insurance.

Priority Level: Medium

Timeframe: 2015-2016

Applicable Governmental Unit(s)/Responsible Person(s):
LCEM; NFIP-Participant Communities.

Potential Technical/Financial Assistance Sources:
MDEQ NFIP Coordinator.

Comments:
Current NFIP participants include the townships of Cherry Valley, Lake, Pleasant Plains, Webber, and Yates.

Action Item 32. Utilize federal programs; such as but not limited to FEMA's Pre-Disaster Mitigation Program, Flood Mitigation Assistance Program, and Hazard Mitigation Grant Program; to address community needs for hazard mitigation.

Priority Level: Medium

Timeframe: As funding becomes available, and especially following a disaster declaration

Applicable Governmental Unit(s)/Responsible Person(s):
LCEM; Local units of government that participate in the development of, and subsequently adopt, this Hazard Mitigation Plan.

Potential Technical/Financial Assistance Sources:
Federal Emergency Management Agency (FEMA); MSP-EMHSD.

Comments:
HMGP funding opportunities are made available following a disaster declaration. Annual funding opportunities may be made available through the PDM and FMA programs, which are nationally competitive.

Action Item 41. Increase the coverage and use of NOAA All-Hazards radios and weather alert systems (Emergency Alert Radio System, etc.) to people and communities in need.

Priority Level: Low

Timeframe: As funding becomes available

Applicable Governmental Unit(s)/Responsible Person(s):
LCEM.

Potential Technical/Financial Assistance Sources:
Homeland Security Grant Program (HSGP); State Homeland Security Program (SHSP); Local resources.

Comments:
Although a number of NOAA radios have been acquired and distributed in recent years, increasing thier use and availability in Lake County remains a priority.

Action Item 42. Encourage the MDNR, U. S. Geological Survey (USGS), National Weather Service (NWS), and U. S. Army Corps of Engineers (USACE) to continue to operate and monitor stream gauging stations and groundwater monitoring wells and consider whether the exposure to flooding on smaller rivers and streams warrants additional Advanced Hydrologic Prediction Services (AHPS) or local rain and stream gauging and flood threat recognition systems.

Priority Level: High

Timeframe: Every 6 months

Applicable Governmental Unit(s)/Responsible Person(s):
LCEM.

Potential Technical/Financial Assistance Sources:
MSP-EMHSD; MDNR; USGS; NWS; USACE.

Comments:
Lake County needs a stream gauge or monitoring system to improve / enhance flood warnings.

Action Item 47. Install back-up generators, as needed for short-term relief from power failures, at critical facilities such as sewage pump stations, road commissions, medical centers, nursing home facilities, schools, shelters, and village / township halls.

Priority Level: Medium

Timeframe: 2015; or as funding becomes available

Applicable Governmental Unit(s)/Responsible Person(s):
LCEM; Critical facility managers.

Potential Technical/Financial Assistance Sources:
MSP-EMHSD; Local resources.

Comments:
Though many facilities in Lake County have generators, some remain in need of backup power. It is known that Baldwin Family Health Care and Elk Township are in need of generators. To accomplish this action item, LCEM might consider conducting an inventory of critical facilities that need a generator.

Action Item 49. Establish safe and appropriate locations for temporary debris disposal sites.

Priority Level: High

Timeframe: 2015

Applicable Governmental Unit(s)/Responsible Person(s):
LCEM.

Potential Technical/Financial Assistance Sources:
National Forest Service (NFS); Michigan Department of Environmental Quality (MDEQ); Local resources.

Comments:
This action is a new addition to the Action Agenda for 2014. It coincides with the Disaster Response & Recovery Plan that is maintained by LCEM.

Action Item 50. Assure the county has adequate personnel and equipment (road barriers, sand bags, portable lighting, snow plows, etc.) to respond to widespread weather events.

Priority Level: Medium

Timeframe: Annually

Applicable Governmental Unit(s)/Responsible Person(s):
LCEM; Lake County Road Commission.

Potential Technical/Financial Assistance Sources:
MSP-EMHSD; Local resources.

Comments:
Components of this action may include an inventory of supplies, acquisition of needed supplies, and coordination with neighboring counties to ensure public safety needs can be met in the event of a disaster.

Action Item 63. Establish an Amateur Radio Club to cultivate awareness of amateur radio in the community and to increase the number of licensed radio operators in Lake County.

Priority Level: High

Timeframe: 2015

Applicable Governmental Unit(s)/Responsible Person(s):
LCEM; Lake County Central Dispatch.

Potential Technical/Financial Assistance Sources:
Voluntary contributions; Homeland Security Grant Program (HSGP).

Comments:
This action is a new addition to the Action Agenda for 2014. Lake County currently has a fairly small number of licensed radio operators; however those individuals would likely be busy taking care of their primary responsibilities during an emergency. In addition, some radio operators from neighboring counties may be able to assit in Lake County, but there is no guarantee that they would be available. By increasing interest and participation in amateur radio, this action item will help ensure the availability of qualified amateur radio operators in Lake County.

Action Item 66. Create a volunteer outreach program, whereby a network of individuals regularly checks on the needs and conditions of elderly, disabled, homebound, and other special-needs groups during and after severe weather conditions; delivers goods / assistance to them; and disseminates information about emergency shelters.

Priority Level: High

Timeframe: 2015-2017

Applicable Governmental Unit(s)/Responsible Person(s):
LCEM; Lake County Central Dispatch; Local units of government.

Potential Technical/Financial Assistance Sources:
Voluntary contributions; MSP-EMHSD; HSGP.

Comments:
This action will be incorporated into the county's Disaster Response & Recovery Plan.

Action Item 69. Obtain and distribute available information on hazards and cost-effective mitigation actions individuals can implement (for example, Firewise pamphlets), and post-disaster repair and cleanup guidance.

Priority Level: Medium

Timeframe: Seasonally

Applicable Governmental Unit(s)/Responsible Person(s):
LCEM; Local units of government.

Potential Technical/Financial Assistance Sources:
MSP-EMHSD; FEMA; MSUE; NFIP; Red Cross; Salvation Army.

Comments:
Activities towards accomplishing this action item will include an annual Disaster Preparedness Fair organized by the LCEM; as well as dissemination of mitigation and disaster recovery information via social media. LCEM will consider distributing auch information in the days and weeks ahead of a given season; e.g. the distribution of fire safety information in the early spring.

Action Item 70. Produce local emergency preparedness and safety information for distribution to the general public and/or targeted groups (seasonal populations, floodplain residents, developers and builders, farm owners and operators, decision makers, Spanish speaking, etc.). Include local resources for information such as fire stations, local radio stations and utilities.

Priority Level: High

Timeframe: Ongoing

Applicable Governmental Unit(s)/Responsible Person(s):
LCEM; Lake County Departments.

Potential Technical/Financial Assistance Sources:
HMGP; MSP-EMHSD; HSGP; Local resources; Utilities.

Comments:
This action item is intended to support efforts that are already underway; and to encourage additional distribution of pertinent information through additional means, such as 211, social media, public meetings, etc.

Action Item 80. Assist local governments in the participation of programs such as NFIP, CRS, Firewise, Tree City USA, Fortified…for safer living, Storm Ready, TADD, etc.

Priority Level: High

Timeframe: Ongoing; or as funds / time allow

Applicable Governmental Unit(s)/Responsible Person(s):
LCEM.

Potential Technical/Financial Assistance Sources:
MSP-EMHSD; Local resources.

Comments:
LCEM will continue to promote NFIP and Firewise programs, and will continue to be a source of information for local governments.

Action Item 86. Assist Lake County activities related to developing and continually revising Emergency Action Guidelines (EAG) detailing coordinated response plans of emergency responders (emergency management, damage assessment, communications, law enforcement, public works, public information, medical, fire, public health, and services, etc.) and needs (such as a portable command center).

Priority Level: High

Timeframe: To be completed when EAG updates are needed

Applicable Governmental Unit(s)/Responsible Person(s):
LCEM; Local units of government.

Potential Technical/Financial Assistance Sources:
MSP-EMHSD; Local resources.

Comments:
Like any planning document, the EAG is only as good as the input and the level of cooperation achieved during its creation. Emergency responders and local government officials are encouraged to become familiar with the Lake County EAG.

Action Agenda 2015-2019

List of Hazard Mitigation Actions Applicable to Governmental Units

ACTION AGENDA

APPLICABLE LOCAL GOVERNMENT

Action Item	BCEGS	MOBILE HOME CODES	LAND USE PLANNING	ZONING ORDINANCES	IMPLEMENT CWPP	OWNER MITIGATION	NFIP	CRS	FEDERAL FUNDING	NOAA WEATHER RADIOS	WATER LEVEL MONITORING	GENERATORS	DEBRIS MAINTENANCE	DISASTER RESPONSE CAPABILITIES	AMATEUR RADIO CLUB	VOLUNTEER OUTREACH	HAZARD AND MITIGATION INFO.	PREPAREDNESS AND SAFETY INFORMATION	PROGRAM PARTICIPATON	EAG UPDATES
Action Item #	2	4	7	9	21	23	29	30	32	41	42	47	49	50	53	66	69	70	80	86
Lake County	•	•	•		•	•	•		•	•	•	•	•	•	•	•	•	•	•	•
Baldwin Vil.			•	•	•	•	•		•			•				•	•			•
Luther Vil.			•	•	•	•	•									•	•			•
Chase T.					•	•	•		•							•	•			•
Cherry Valley T.					•	•		•								•	•			•
Dover T.					•	•	•		•							•	•			•
Eden T.					•	•	•									•	•			•
Elk T.					•	•	•		•			•				•	•			•
Ellsworth T.					•	•	•		•							•	•			•
Lake T.			•	•	•	•		•	•							•	•			•
Newkirk T.					•	•	•		•							•	•			•
Peacock T.			•	•	•	•	•		•							•	•			•
Pinora T.					•	•	•		•							•	•			•
Pleasant Plains T.			•	•	•	•		•								•	•			•
Sauble T.			•	•	•	•	•									•	•			•
Sweetwater T.			•	•	•	•	•									•	•			•
Webber T.			•	•	•	•		•								•	•			•
Yates T.			•	•	•	•		•								•	•			•

Part J

PLAN MONITORING, REVISIONS, AND INCORPORATION

Communities and plans are both dynamic entities. Communities grow and change over time. In order to be effective, plans must also grow and evolve to avoid becoming void and obsolete. Planning doesn't stop once the plan is initiated. The plan must be evaluated and updated periodically to ensure the success of the hazard mitigation program.

This section describes a monitoring system that will help in the annual Hazard Mitigation Plan evaluation and periodic update. A monitoring system also helps keep the plan running on schedule even when there are other jobs or duties to perform. Local officials wear different hats and are responsible for multiple assignments. Few have the luxury of focusing on one assignment, task or plan. Because the local community is often involved in administering numerous other programs, it is important to develop a monitoring system (e.g. project work schedule) to help remind each participant of their part in carrying out the plan, as well as when associated tasks should be completed.

Ideally, the system for plan maintenance (monitoring, evaluating, and updating the plan) would be the responsibility of a locally funded Hazard Mitigation Coordinator, with support from the Lake County Emergency Management Director and the LEPC. Unfortunately, planning for such a position appears unrealistic at this time. Maintenance of this plan would therefore need to fit into existing schedule and workloads of the Emergency Management Director with assistance from the LEPC.

Monitoring

The Lake County Emergency Management Director would be responsible for monitoring the implementation of the Hazard Mitigation Plan at the end of each calendar year, as work schedules allow. Such monitoring would include noting the following events throughout the year: occurrence of hazards, adoption of the plan by local governments, applications for hazard mitigation funds, grant awards, and project implementation. In addition to county staff and LEPC knowledge, sources of this information would be obtained from comments submitted to the Emergency Management office or to the West Michigan Shoreline Regional Development Commission (WMSRDC). It would also be obtained from declarations of disasters and emergencies by the President and the Governor and updates on NOAA and NCDC websites.

Evaluating

The Emergency Management Director would prepare and present a brief annual progress report for the LEPC at its first meeting of the year. This report would include recommendations to achieve goals and objectives of the plan, or explain the need to change them in light of new issues and circumstances. The following outline should be used to guide preparation of the report:

- A review of the goals and objectives of the plan;
- A review of disasters or emergencies that occurred during the year;
- A review of what elements or objectives of the plan were accomplished the previous year;
- A discussion of why any objectives were not reached or why implementation is behind schedule; and
- Recommendations for new projects/action items (with updated information on responsible persons, time schedules and sources of assistance) or revised objectives.

After LEPC review, the report could be submitted to the County Board of Commissioners at the direction of the LEPC. The report could also be made available to local governments and the public through the county's website, and / or the WMSRDC website. In the event that workloads prohibit the preparation of an annual report, a more streamlined version (perhaps verbal) would be presented by the Emergency Management Director to the LEPC and County Board of Commissioners.

Updating

The county would comply with the FEMA requirement that the plan be reviewed every five years and updated if necessary. This work would be overseen by the Emergency Management Director, with assistance from the LEPC. Projects that were completed over that time would be replaced with new ones. Priorities would be re-assessed. Development patterns would be analyzed to see if they have rendered the previous hazard analysis out-of-date. Lastly, those hazard mitigation goals, priorities and information contained in the most current edition of the Michigan Hazard Mitigation Plan would also be heavily considered during the five-year update.

The mandatory five-year review and update of the community mitigation plan is necessary because of ever-changing circumstances. Risks may change, areas may have increased or decreased risks and vulnerabilities, and therefore goals and priorities might have to be altered. There may even be new hazards that appear in that time. Evaluations of the plan should also assess how well the plan is working and if there are problems (financial, legal, coordination, etc.) with implementing the action items in the document.

While adjustments would be made throughout the process as new issues emerge and evolve, this method would ensure that the county remains on course in implementing the program.

Continued Public Involvement

In addition to the mandatory update and evaluation of the plan, there must be a process by which public involvement can continue to occur as the hazard mitigation plan is updated. Copies of the plan will be available in the Emergency Management office and at the WMSRDC. It will also be presented on the WMSRDC website, www.wmsrdc.org. The website offers an on-going opportunity to input into the plan, its implementation, and its update. All comments received by the WMSRDC will be forwarded to the Emergency Management Director who will receive all other forms of correspondence. The Emergency Management Department will also be listed as a contact point. The Emergency Management phone number is included in the Letter of Transmittal at the beginning of this document.

During the update of the plan, all methods previously used for assuring public involvement will again be considered: surveys, contacts with neighboring counties, LEPC meetings, public hearings, etc.

Incorporation into Existing Planning Mechanisms

The County's transmittal of the Hazard Mitigation Plan to local governments requests that they incorporate the document into local land use plans and zoning ordinances, as appropriate. About half of the townships in Lake County have adopted land use plans and regularly update them. According to Public Act 33 of 2008, municipal jurisdictions must notify neighboring jurisdictions, the county, the region, and any registered public utility, railroad, or other governmental entities of the municipality's intention to amend, revise, or create a totally new plan. By law, each of these entities has the opportunity to comment on local land use plans, and is encouraged to do so in order to promote more coordinated land use planning.

Appendix A:

Community Profiles

LAKE COUNTY

1.	**major geographic features:**	- 20.3 people per square mile of land area - 26.4 housing units per square mile of land area - Manistee National forest, Pere Marquette State Forest - Pere Marquette River, Little Manistee River, Pine River, Sauble River, Baldwin River - Big Star Lake, Big Bass Lake, Wolf Lake
2.	**Population Concentrations** (including special facilities)	
a.	**group homes:**	- Beech Street, 610 Fifth St. Baldwin, MI (6 capacity) - Riverside Adult Assisted Living, 10710 6 Mile Rd, Luther, MI (3 capacity) - Sweetwater Creek AFC, 758 S Tyndall, Branch, MI (6 Capacity) - Grand Oaks Nursing Center, 600 Denmark St., Baldwin, MI (79 capacity)
b.	**large apartment buildings:**	- Duvernay Park Apartments, Lyndon St., Idlewild (6 buildings, 24 family units) - Hollister Manor, 105 Fournier Dr., Baldwin, MI (86 elderly units) - Idlewild Garden Housing, 587 Lansing Dr., Idlewild, MI (23 elderly units) - Kahlil Village, 670 Kahlil Dr., Baldwin, MI (62 family units) - Oakwood Manor, 401 Washington St., Baldwin, MI (32 elderly units)
c.	**schools:**	- Baldwin Community High School, 525 W. 4th St. (180 students, 17 staff) - Baldwin Community Middle School, 525 W. 4th St. (184 students, 21 staff) - Baldwin Community Elementary, 525 W. 4th St. (341 students, 36 staff) - Baldwin Community Alternative High, 525 W. 4th St. (33 students, 3 staff) - Baldwin Community Preschool, 525 W. 4th St. (16 capacity) - Pine River Area Preschool, 924 N. State St. (18 capacity)
d.	**large office buildings:**	- See 4.g.
e.	**other: (describe – i.e. stadiums, concert halls, amusement parks, fairgrounds, correctional facilities, nursing homes, other special populations or large crowd assembly areas)**	**Refer to individual Village or Township Profiles**
f.	**major employers:** *Number of employees estimated	- Austin Tube Products, 5629 Forman Rd. (30 employees) - Baldwin Community Schools, 525 W. 4th St. (70 employees) - Baldwin Teen Health Center, 4967 Michigan Ave. (34 employees) - Houseman's Foods, 9559 S. M-37 (58 employees) - Jerome Miller Lumber Company, 7000 S. James Rd. (25 employees) - Lake County Courthouse, 800 10th St. (125 employees) - Lake County Road Commission Garage, 1180 Michigan Ave. (40 employees) - Lake-Osceola State Bank, 790 Michigan Ave. (25 employees) - Peacock Industries, Inc., 2431 S. M-37 (40 employees) - Rothig Forest Products, 3600 N. M-37 (28 employees) - US Forest Service – Baldwin Station, 650 Michigan Ave. (25 employees) - Yates Dial-A-Ride, 1399 US-10, Idlewild, MI 49642 (30 employees)
3.	**Population Shifts** (location; time, date or season of shift; extent of shift)	
a.	**daily:**	- 3,242 commuters with an average commuting time of 29.3 minutes - 1,725 school-aged children
b.	**seasonal:**	- 14,966 total housing units: 5,158 occupied/9,808 vacant; of the vacant, 8,774 are for seasonal recreational or occasional use

4.	**Important or Critical Public and Private Facilities**	
a.	**police precincts:**	- Lake County Sheriff Department, 1153 Michigan Ave.
b.	**fire stations:**	- Baldwin Fire Station, 620 Washington St (20 volunteers) - Lake Township Fire & Rescue, 15580 S Star Lake Rd (12 volunteers) - Luther Fire Department, 714 State St. (17 part-time) - Webber Township Fire Department, 2451 W 36th St (7 part-time firemen) - Yates Township Fire Department, 2155 E US 10 (20 volunteers) - Irons Fire & Rescue Station 1, 9606 W 6 Mile Rd - Irons Fire & Rescue Station 2, 5869 W 10 ½ Mile Rd
c.	**public works yards:**	- Baldwin Department of Public Works - Luther Street Department, 315 Maple Dr.
d.	**pumping stations:**	- None Identified
e.	**community shelters:**	- Baldwin Assembly of God, 10063 M-37, Baldwin, MI 49304 - Baldwin Congregational United Church of Christ, 870 Beech St, Baldwin, MI 49304 - Baldwin Elementary School, 525 Fourth St, Baldwin, MI 49304 - Baldwin Middle/High School, 525 W. Fourth St, Baldwin, MI 49304 - Edgetts Wesleyan Church, Luther, MI 49656, Luther, MI 49656 - Faith Fellowship Church, 8889 W 6 Mile Rd, Irons, MI 49644 - Fellowship Baptist Church, 308 Elm St, Luther, MI 49656 - First Baptist Church of Baldwin, 1210 Washington St, Baldwin, MI 49304 - Luther Lion's Club, 1003 State St, Luther, MI 49656 - St Ann's Senior Center, 690 E 9th St, Baldwin, MI 49304 - St Bernard Catholic Church, 5734 W 10 ½ Mile Rd, Irons, MI 49644 - St Ignatius Catholic Church, 701 N State St, Luther, MI 49656 - Sweetwater Town Hall, 11265 Stevenson Ave, Branch, MI 49402 - Yates Township Fire Department, 2155 US-10, Idlewild, MI 49642 - Yates Township Hall, 6437 S Nelson Rd, Idlewild, MI 49642
f.	**community medical facilities, hospitals:**	- Baldwin Teen Health Center, 525 W. Forth St. (Baldwin) - Baldwin Family Health Care, 1615 Michigan Ave. (Baldwin) - Loretta Adams-Ashby Health Center, 1101 E. Washington (Baldwin) - Life EMS of Lake County, 734 Washington (Baldwin) - Life EMS of Lake County, 4 ½ Mile Rd & M-37
g.	**historic sites:**	- Brown Trout Informational Designation (historic marker), M-37 in Pleasant Plains Twp - Idlewild Historic District (Includes 500 Structures), Idlewild in Yates Twp - John & Katharine Tunkun Podjun Farm, 9581 1-Mile Rd in Ellsworth Twp - Lake County Informational Designation (historic marker), Lake County Courthouse in Baldwin - Marlborough Historic Distrct, James Rd. in Pleasant Plains Twp - Shrine of the Pines, M-37 in Pleasant Plains Twp
h.	**other: (describe - i.e., government buildings, record center, major construction companies, warehouses, demolition companies, heavy equipment rental, emergency equipment and vehicle storage areas, etc.)**	**Refer to individual Village or Township Profiles**

5.	**Vital or Critical Infrastructure**	
a.	**roads, railroads, and bridges:**	- US-10 - M-37 - M-37 bridge over Little Manistee River, Pere Marquette River, Baldwin River - Marquette Rail Railroad (Genesee & Wyoming Inc.) - Marquette Rail Railroad bridge over Pere Marquette River
b.	**dams, power**	- Baldwin Wastewater Treatment Plant

	stations, water treatment plants, sanitary lift stations, etc.:	- Baldwin Lift Station - Danaher Lake Dam (Pleasant Plains Twp), Luther Pond Dam (Luther Village), Lake Connamara Dam (Yates Twp), Olga Lake Dam (Dover Twp), Baldwin Fish Hatchery Dam (Baldwin), Little Widewaters Flooding Dam (Newkirk Twp) - Consumers Energy Power Line (Eden Twp, Elk Twp, Newkirk Twp)
c.	**other: (describe – i.e. airports, pipelines, bus terminals, train stations, military bases, marine passenger ferry services, etc.)**	- Baldwin Municipal Airport - MichCon Gas Pipeline (Cherry Valley Twp, Pinora Twp, Sweetwater Twp, Webber Twp)

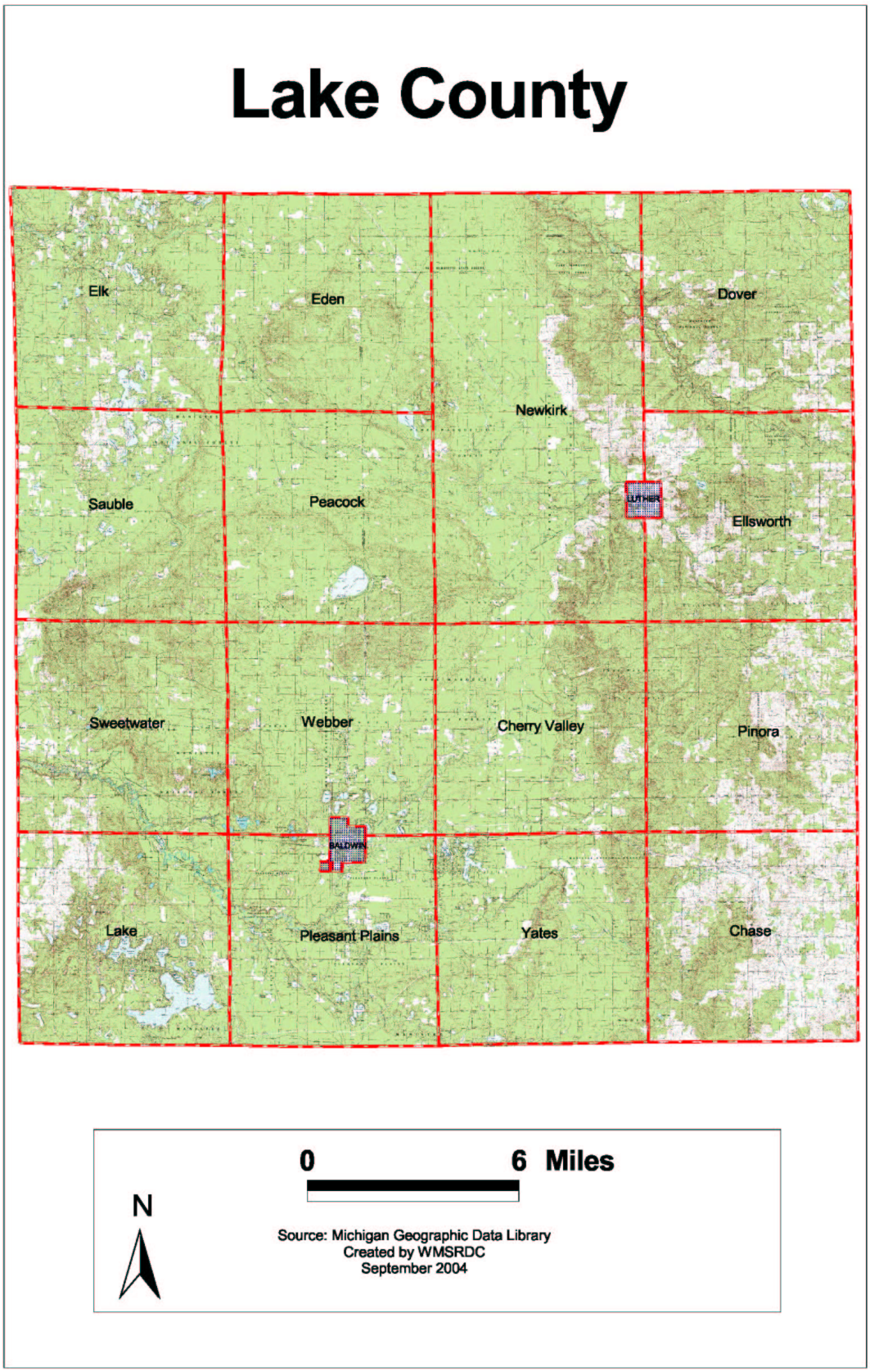
6. Socio-Economic Profile of Sector

a.	**total population (night):**		11,539
b.	**peak population (seasonal):**		30,491 (estimate)
c.	**percent over 65:**		23.7
d.	**percent under 18:**		17.9
e.	**percent that are homeowners:**		81.6
f.	**percent below poverty level:**		19.5
g.	**percent with disability or mobility limitation:**		*(Population 5 years & over)* 31.2
h.	**estimated property insurance coverage (Real and Personal Equalized Valuations):**	Agricultural: Commercial: Industrial: Residential: Timber-Cutover: Total Personal: Total:	$18,804,221 $86,299,739 $879,512 $423,134,896 $3,261,176 $28,488,200 $560,867,744
i.	**flood insurance coverage:**	Total Claims since 01/01/78: Total Payments since 01/01/78: Policies In-Force: Total Insurance In-Force:	25 $229,090 18 $2,198,000
j.	**location of floodplains:**	**Refer to individual Village or Township Profiles**	

7. Emergency Warning System Coverage

a.	**siren locations and/or description of warning system:**	- Functioning sirens located at Baldwin Fire Station, Lake Township Fire Hall, Yates Township FD - NOAA Transmission Tower at Wolf Lake
b.	**percent of population covered by warning sirens or system:**	- Sirens cover a ½ to 2 mile radius depending on wind and humidity - NOAA Transmission Tower covers Lake County, Mason County, and Osceola County

(Note: Map showing warning siren and system coverage is included in Part D.)


Lake County
Elk
Eden
Dover
Newkirk
Sauble
Peacock
LUTHER
Ellsworth
Sweetwater
Webber
Cherry Valley
Pinora
BALDWIN
Lake
Pleasant Plains
Yates
Chase
0
6 Miles
N
Source: Michigan Geographic Data Library
Created by WMSRDC
September 2004

VILLAGE OF BALDWIN

1.	**major geographic features:**	- 929.2 people per square mile of land area - 367.7 housing units per square mile of land area - Moderately dense residential area - Baldwin River - Bush Lake
2.	**Population Concentrations** (including special facilities)	
a.	**group homes:**	- Beech Street, 610 Fifth St. Baldwin, MI (6 capacity) - Grand Oaks Nursing Center, 600 Denmark St., Baldwin, MI (79 capcity)
b.	**large apartment buildings:**	- Hollister Manor, 105 Fournier Dr. (86 elderly units) - Kahlil Village, 670 Kahlil Dr. (62 family units) - Oakwood Manor, 401 Washington St. (32 elderly units)
c.	**schools:**	- Baldwin Community High School, 525 W. 4th St. (180 students, 17 staff) - Baldwin Community Middle School, 525 W. 4th St. (184 students, 21 staff) - Baldwin Community Elementary, 525 W. 4th St. (341 students, 36 staff) - Baldwin Community Preschool, 525 W. 4th St. (16 capacity)
d.	**large office buildings:**	- See 4.g.
e.	**other: (describe – i.e. stadiums, concert halls, amusement parks, fairgrounds, correctional facilities, nursing homes, other special populations or large crowd assembly areas)**	- Baldwin Community High School Football Stadium, 525 W. 4th St. - Lake County Jail, 1153 Michigan Ave. (38 capacity) - Lake County Residential Re-Entry, 5565 S. M-37 (300 inmate capacity) - Grand Oaks Nursing Center, 5565 S. M-37 (89 beds) - Dream Catcher Motel, 9425 S M-37 (5 units) - Summer Concerts, Wenger Pavilion (Wednesdays. Saturdays) - Trout-A-Rama (festival), last full weekend of July - Blessing of the Bikes, 3rd weekend of May - Wolf Lake Mobile Home Park, #2 Box 2493
f.	**major employers:**	- Lake County Courthouse, 800 10th St. (125 employees) - Baldwin Community Schools, 525 W. 4th St. (70 employees) - Lake Co. Road Commission Garage, 1180 Michigan Ave. (40 employees) - US Forest Service – Baldwin Station, 650 Michigan Ave. (25 employees) - Lake-Osceola State Bank, 790 Michigan Ave. (25 employees) - Fair Salvage, 8702 U.S. 10
3.	**Population Shifts** location; time, date or season of shift; extent of shift *(also included in Pleasant Plains and Webber Townships)*	
a.	**daily:**	- 223 commuters with an average commuting time of 17.1 minutes - 580 attend school
b.	**seasonal:**	- 478 total housing units: 404 occupied/74 vacant; of the 74 vacant, 18 are for seasonal recreational or occasional use
4.	**Important or Critical Public and Private Facilities**	
a.	**police precincts:**	- Lake County Sheriff Department, 1153 N Michigan Ave.
b.	**fire stations:**	- Baldwin Fire Station, 620 Washington St
c.	**public works yards:**	- Baldwin Department of Public Works
d.	**pumping stations:**	- None Identified
e.	**community shelters:**	- Baldwin Community Schools, 525 W 4th St, Baldwin, MI 49304

		- Baldwin Congressional Church, 870 Beech St, Baldwin, MI 49304 - First Baptist Church of Baldwin, 1210 Washington, Baldwin, MI 49304 - St Ann's Senior Center, 690 E 9th St, Baldwin, MI 49304
f.	**community medical facilities:**	- Baldwin Teen Health Center, 525 W. Fourth St. - Baldwin Family Health Care, 1615 Michigan Ave. - Loretta Adams-Ashby Health Center, 1101 E. Washington - Life EMS of Lake County, 734 Washington
g.	**historic sites:**	- Lake County Informational Designation (historic marker), Lake County Courthouse
h.	**other (describe – i.e., government buildings, record center, major construction companies, warehouses, demolition companies, heavy equipment rental, emergency equipment and vehicle storage areas, etc.):**	- Lake County Building, 800 10th St - Lake County EM/Homeland Security, 800 10th St - Lake County Central Dispatch, 800 10th St - Lake County EMS 1, 734 W Washington - Village of Baldwin, 887 7th St. - Pleasant Plains Township Hall, 885 8th St. - Lake County Courthouse, 800 10th St. - Pathfinder Community Library, 812 Michigan Ave. - Lake County Road Commission Garage, 1180 N Michigan Ave. - US Forest Service – Baldwin Ranger Station, 650 Michigan Ave. - Michigan DNR Wildlife Office, 2468 W. 24th St. - Lake County FIA, 5653 S. M-37 - United States Post Office – Baldwin, 513 Michigan Ave.

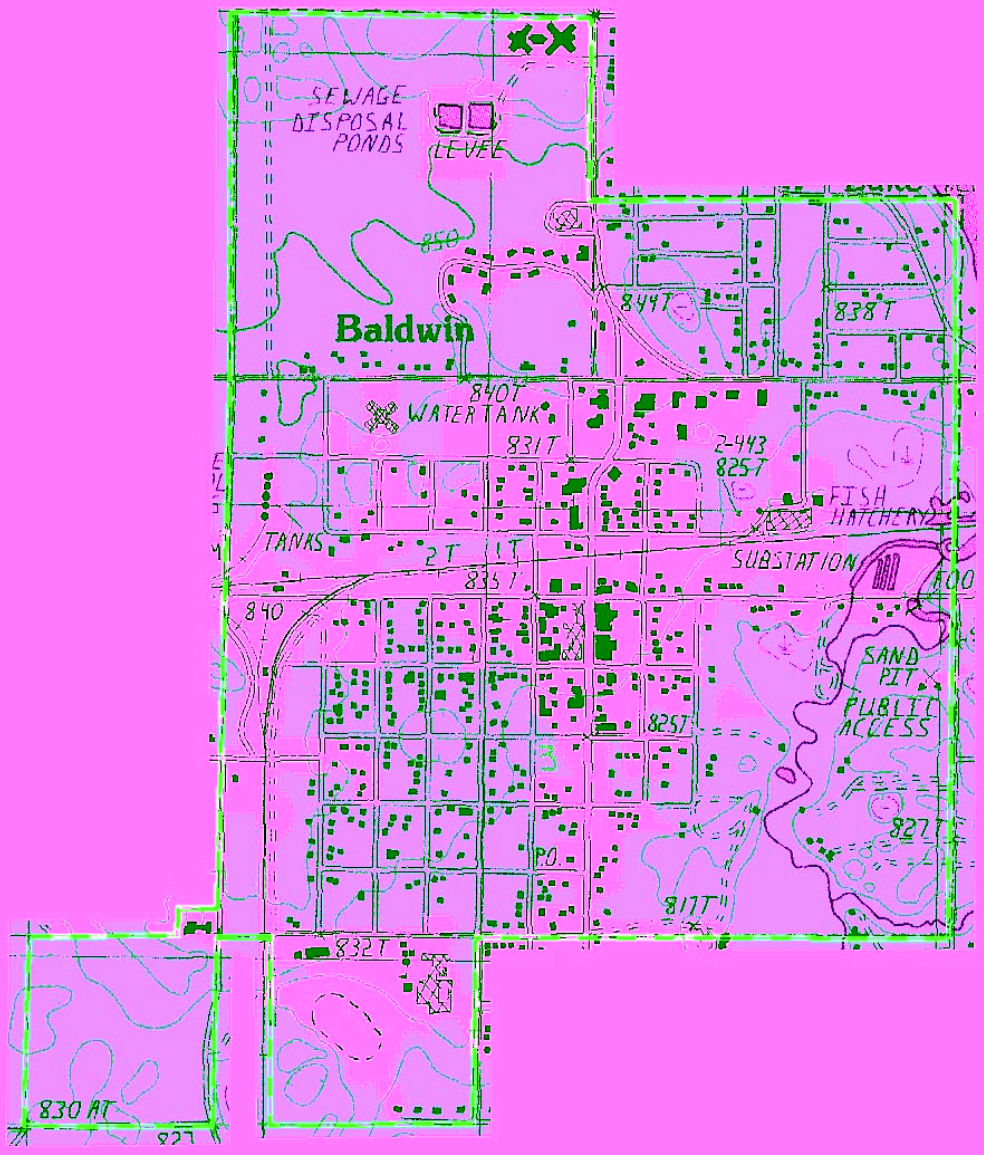
5.	**Vital or Critical Infrastructure**	
a.	**roads, railroads, and bridges:**	- US-10 - M-37 - Marquette Rail Railroad (Genesee & Wyoming Inc.)
b.	**dams, power stations, water treatment plants, sanitary lift stations, etc.:**	- Baldwin Wastewater Treatment Plant - Baldwin Lift Station - Baldwin Fish Hatchery Dam
c.	**other: (describe – i.e. airports, pipelines, bus terminals, train stations, military bases, marine passenger ferry services, etc.)**	- None Identified

6.	**Socio-Economic Profile of Sector**		
a.	**total population (night):**	*(also included in Pleasant Plains and Webber Townships)*	1,208
b.	**peak population (seasonal):**	*(also included in Pleasant Plains and Webber Townships)*	1,245 (estimate)
c.	**percent over 65:**		15.2
d.	**percent under 18:**		20.3
e.	**percent that are homeowners:**		35.1
f.	**percent below poverty level:**		19.5
g.	**percent with disability or mobility limitation:**	*(Population 5 years and over)*	37.7
h.	**estimated property insurance coverage (Real and Personal Equalized Valuations):**	Agricultural:	N/A
		Commercial:	N/A
		Industrial:	N/A
		Residential:	N/A
		Timber-Cutover:	N/A
		Total Personal:	N/A
		Total:	N/A

i.	**flood insurance coverage:**	Total Claims since 01/01/78: Total Payments since 01/01/78: Policies In-Force: Total Insurance In-Force:	N/A N/A N/A N/A
j.	**location of floodplains:**	- None Identified	

7.	**Emergency Warning System Coverage**	
a.	**siren locations and/or description of warning system:**	- Siren at Baldwin Fire Station, 620 Washington St
b.	**percent of population covered by warning sirens or system:**	- Siren covers a ½ to 2 mile radius depending on wind and humidity
(Note: Map showing warning siren location and system coverage is included in Part D)		

Village of Baldwin



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Source: Michigan Geographic Data Library
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September 2004

VILLAGE OF LUTHER

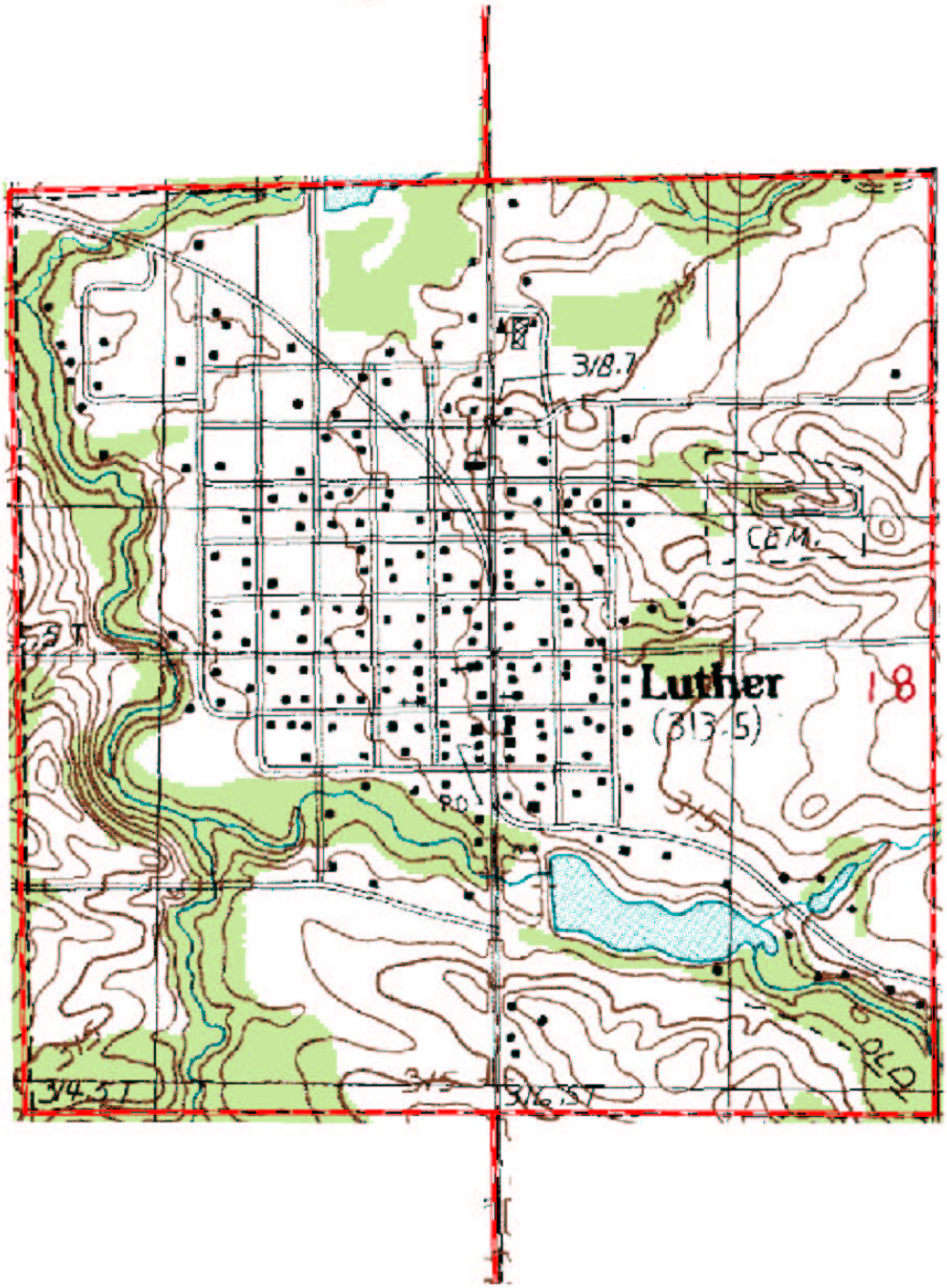
1.	**major geographic features:**	- 318 people per square mile of land area - 190 housing units per square mile of land area - Moderately dense residential area - Little Manistee River - Luther Mill Pond
2.	**Population Concentrations** (including special facilities)	
a.	**group homes:**	- Riverside Adult Assisted Living, 10710 6 Mile Rd, Luther, MI (3 units)
b.	**large apartment buildings:**	- None Identified
c.	**schools:**	- Pine River Area Head Start, 900 N. State St. (14 students)
d.	**large office buildings:**	- See 4.g.
e.	**other: (describe – i.e. stadiums, concert halls, amusement parks, fairgrounds, correctional facilities, nursing homes, other special populations or large crowd assembly areas)**	- Luther Area Museum, 708 N State (summer weekends) - Luther Logger Days (festival), 4th of July weekend
f.	**major employers:**	- None Identified
3.	**Population Shifts** location; time, date or season of shift; extent of shift *(also included in Ellsworth and Newkirk Townships)*	
a.	**daily:**	- 85 commuters with an average commuting time of 25.5 minutes - 128 attend school
b.	**seasonal:**	- 190 total housing units: 137 occupied/53 vacant; of the 53 vacant, 31 are for seasonal recreational or occasional use
4.	**Important or Critical Public and Private Facilities**	
a.	**police precincts:**	- None Identified
b.	**fire stations:**	- Luther Fire Department, 714 State St.
c.	**public works yards:**	- Luther Street Department, 315 Maple Dr.
d.	**pumping stations:**	- None Identified
e.	**community shelters:**	- Luther Lion's Club, 1003 State Rd, Luther, MI 49656 - St Ignatius Catholic Church, 701 N State Rd, Luther, MI 49656 - Fellowship Baptist Chruch, 308 Elm St, Luther, MI 49656
f.	**community medical facilities, hospitals:**	- None Identified
g.	**historic sites:**	- None Identified
h.	**other (describe – i.e., government buildings, record center, major construction companies, warehouses, demolition companies, heavy equipment rental, emergency equipment and vehicle storage areas, etc.):**	- Village of Luther, 301 N. State St. - Ellsworth Township Hall, 210 N. State St. - Luther Area Public Library, 300 Ash St. - Lake County Road Commission, 103 Garfield St. - United States Post Office - Luther, 207 State St

5.	Vital or Critical Infrastructure	
a.	**roads, railroads, and bridges:**	- Old M-63
b.	**dams, power stations, water treatment plants, sanitary lift stations, etc.:**	- Luther Pond Dam
c.	**other: (describe – i.e. airports, pipelines, bus terminals, train stations, military bases, marine passenger ferry services, etc.)**	- None Identified

6.	Socio-Economic Profile of Sector		
a.	**total population (night):**	*(also included in Ellsworth and Newkirk Townships)*	318
b.	**peak population (seasonal):**	*(also included in Ellsworth and Newkirk Townships)*	390 (estimate)
c.	**percent over 65:**		18.2
d.	**percent under 18:**		24.5
e.	**percent that are homeowners:**		80.3
f.	**percent below poverty level:**		49
g.	**percent with disability or mobility limitation:**	*(Population 5 years and over)*	29
h.	**estimated property insurance coverage (Real and Personal Equalized Valuations):**	Agricultural:	N/A
		Commercial:	N/A
		Industrial:	N/A
		Residential:	N/A
		Timber-Cutover:	N/A
		Total Personal:	N/A
		Total:	N/A
i.	**flood insurance coverage:**	Total Claims since 01/01/78:	N/A
		Total Payments since 01/01/78:	N/A
		Policies In-Force:	N/A
		Total Insurance In-Force:	N/A
j.	**location of floodplains:**	- None Identified	

7.	Emergency Warning System Coverage	
a.	**siren locations and/or description of warning system:**	- None Identified
b.	**percent of population covered by warning sirens or system:**	N/A

Village of Luther



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CHASE TOWNSHIP

1.	**major geographic features:**	- 31.97 people per square mile of land area - 16.34 housing units per square mile of land area - Scattered rural housing - Densely forested in areas (Manistee National Forest) and moderate agricultural areas - Pere Marquette River Middle Branch - 20 to 24 small lakes and ponds, 4 to 6 small creeks

2.	**Population Concentrations** (including special facilities)	
a.	**group homes:**	- None Identified
b.	**large apartment buildings:**	- None Identified
c.	**schools:**	- None Identified
d.	**large office buildings:**	- See 4.g.
e.	**other: (describe – i.e. stadiums, concert halls, amusement parks, fairgrounds, correctional facilities, nursing homes, other special populations or large crowd assembly areas)**	- D Bar D Ranch, 6746 E. 64th St. (25 sites)
f.	**major employers:**	- None Identified

3.	**Population Shifts** (location; time, date or season of shift; extent of shift)	
a.	**daily:**	- 556 commuters with an average commuting time of 30.3 minutes - 388 attend school
b.	**seasonal:**	- 581 total housing units: 447 occupied/134 vacant; of the 134 vacant, 77 are for seasonal recreational or occasional use

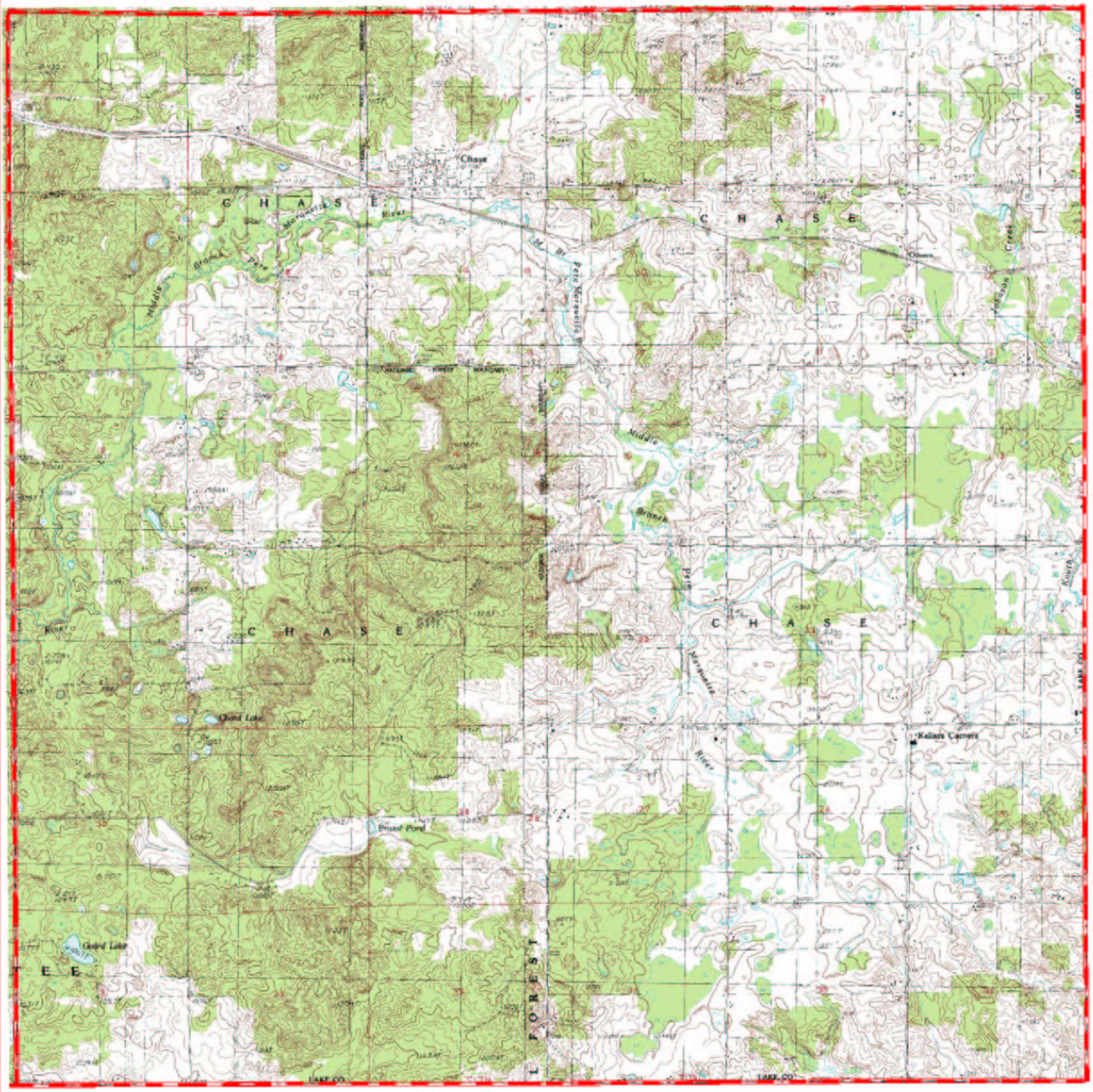
4.	**Important or Critical Public and Private Facilities**	
a.	**police precincts:**	- None Identified
b.	**fire stations:**	- None Identified
c.	**public works yards:**	- None Identified
d.	**pumping stations:**	- None Identified
e.	**community shelters:**	- None Identified
f.	**community medical facilities, hospitals:**	- None Identified
g.	**historic sites:**	- None Identified
h.	**other (describe – i.e., government buildings, record center, major construction companies, warehouses, demolition companies, heavy equipment rental, emergency equipment and vehicle storage areas, etc.):**	- Chase Township Hall, 8264 US-10 - Chase Public Library, 8400 North St. - United States Post Office - Chase, 6958 S Depot St

5.	Vital or Critical Infrastructure	
a.	**roads, railroads, and bridges:**	- US-10
b.	**dams, power stations, water treatment plants, sanitary lift stations, etc.:**	- None Identified
c.	**other: (describe – i.e. airports, pipelines, bus terminals, train stations, military bases, marine passenger ferry services, etc.)**	- None Identified

6.	Socio-Economic Profile of Sector		
a.	**total population (night):**		1,137
b.	**peak population (seasonal):**		1,332 (estimate)
c.	**percent over 65:**		14.3
d.	**percent under 18:**		23.8
e.	**percent that are homeowners:**		89.0
f.	**percent below poverty level:**		8.1
g.	**percent with disability or mobility limitation:**	*(Population 5 years and over)*	21.9
h.	**estimated property insurance coverage (Real and Personal Equalized Valuations):**	Agricultural:	$6,471,682
		Commercial:	$887,809
		Industrial:	$28,229
		Residential:	$17,523,942
		Timber-Cutover:	$1,452,229
		Total Personal:	$3,937,700
		Total:	$30,301,591
i.	**flood insurance coverage:**	Total Claims since 01/01/78:	N/A
		Total Payments since 01/01/78:	N/A
		Policies In-Force:	N/A
		Total Insurance In-Force:	N/A
j.	**location of floodplains:**	- None Identified	

7.	Emergency Warning System Coverage	
a.	**siren locations and/or description of warning system:**	- None Identified
b.	**percent of population covered by warning sirens or system:**	N/A

Chase Township



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Source: Michigan Geographic Data Library
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September 2004

CHERRY VALLEY TOWNSHIP

1.	**major geographic features:**	- 11.1 people per square mile of land area - 14.66 housing units per square mile of land area - Scattered rural housing - Densely forested (Pere Marquette State Forest) - Baldwin River - 2 to 4 small lakes and ponds, 4 to 6 small creeks

2.	**Population Concentrations** (including special facilities)	
a.	**group homes:**	- None Identified
b.	**large apartment buildings:**	- None Identified
c.	**schools:**	- None Identified
d.	**large office buildings:**	- See 4.g.
e.	**other: (describe – i.e. stadiums, concert halls, amusement parks, fairgrounds, correctional facilities, nursing homes, other special populations or large crowd assembly areas)**	- Bluegrass Country Weekend, Whispering Winds Music Park, 4118 S Kings Highway, July - Fall Country Music Festival, Whispering Winds Music Park, 4118 S Kings Highway, October - Baldwin Fish Farm, 1435 8th St. (10 sites) - Whispering Winds Campground, 4118 S Kings Highway (75 sites)
f.	**major employers:**	- None Identified

3.	**Population Shifts** (location; time, date or season of shift; extent of shift)	
a.	**daily:**	- 139 commuters with an average commuting time of 20.7 minutes - 93 attend school
b.	**seasonal:**	- 522 total housing units: 178 occupied/344 vacant; of the 344 vacant, 318 are for seasonal recreational or occasional use

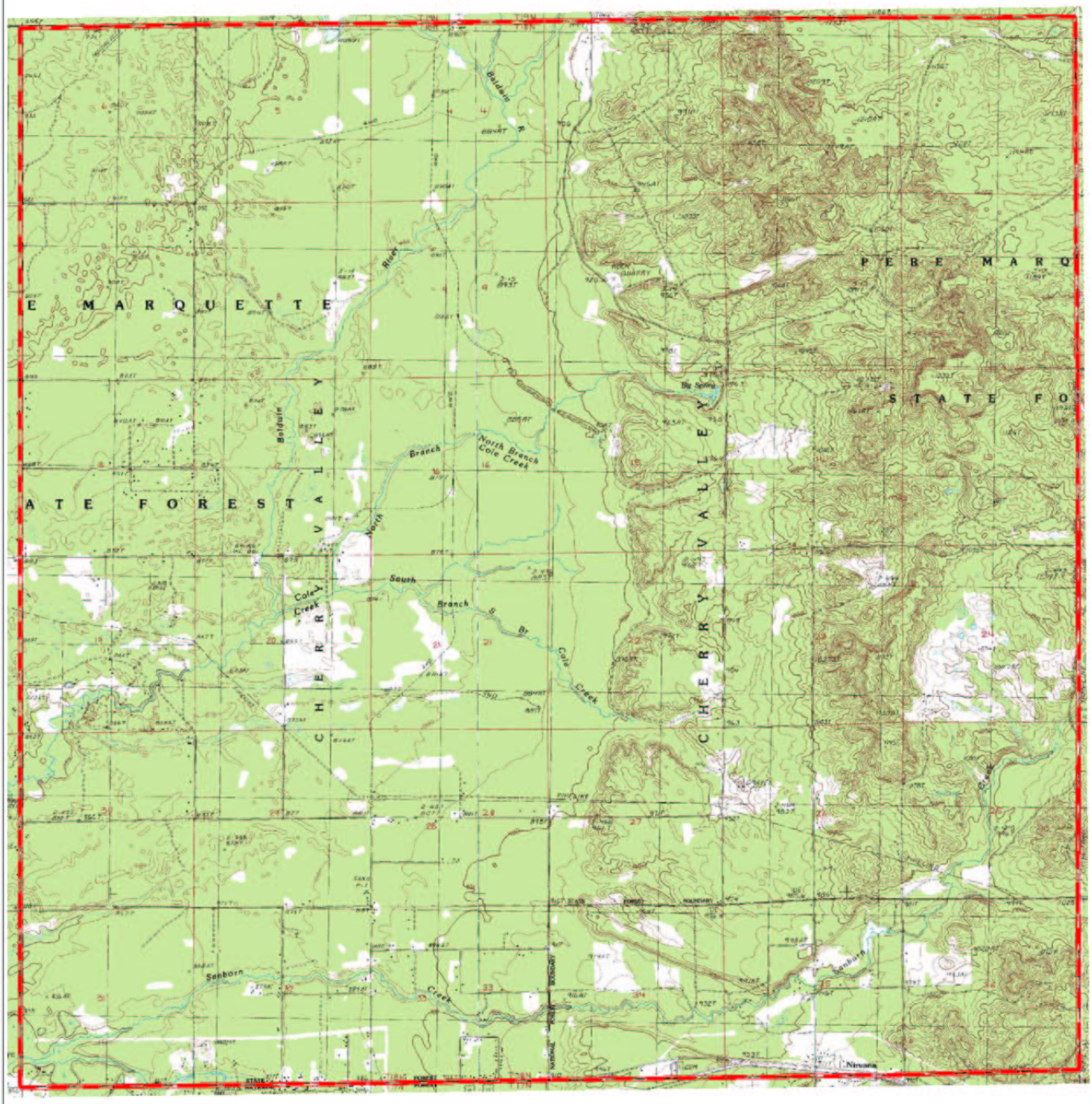
4.	**Important or Critical Public and Private Facilities**	
a.	**police precincts:**	- None Identified
b.	**fire stations:**	- None Identified
c.	**public works yards:**	- None Identified
d.	**pumping stations:**	- None Identified
e.	**community shelters:**	- None Identified
f.	**community medical facilities, hospitals:**	- None Identified
g.	**historic sites:**	- None Identified
g.	**other (describe – i.e., government buildings, record center, major construction companies, warehouses, demolition companies, heavy equipment rental, emergency equipment and vehicle storage areas):**	- Cherry Valley Township Hall, 5850 S. Kings Highway

5.	Vital or Critical Infrastructure	
a.	**roads, railroads, and bridges:**	- US-10
b.	**dams, power stations, water treatment plants, sanitary lift stations, etc.:**	- None Identified
c.	**other: (describe – i.e. airports, pipelines, bus terminals, train stations, military bases, marine passenger ferry services, etc.)**	- MichCon Gas Pipeline

6.	Socio-Economic Profile of Sector		
a.	**total population (night):**		396
b.	**peak population (seasonal):**		1102 (estimate)
c.	**percent over 65:**		28.3
d.	**percent under 18:**		18.9
e.	**percent that are homeowners:**		89.9
f.	**percent below poverty level:**		20.6
g.	**percent with disability or mobility limitation:**	*(Population 5 years and over)*	33.4
h.	**estimated property insurance coverage (Real and Personal Equalized Valuations):**	Agricultural:	$255,071
		Commercial:	N/A
		Industrial:	$8,854
		Residential:	$12,565,430
		Timber-Cutover:	$291,584
		Total Personal:	$425,900
		Total:	$12,546,839
i.	**flood insurance coverage:**	Total Claims since 01/01/78:	3
		Total Payments since 01/01/78:	$97,979
		Policies In-Force:	2
		Total Insurance In-Force:	$395,000
j.	**location of floodplains:**	- None Identified	

7.	Emergency Warning System Coverage	
a.	**siren locations and/or description of warning system:**	- None Identified
b.	**percent of population covered by warning sirens or system:**	N/A

Cherry Valley Township



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Source: Michigan Geographic Data Library
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DOVER TOWNSHIP

1.	**major geographic features:**	- 10.7 people per square mile of land area - 10 housing units per square mile of land area - Scattered rural housing - Densely forested in areas (Manistee National Forest) and moderate agricultural areas - Pine River - Lake Olga - 12 to 14 small lakes and ponds, 4 to 6 small creeks
2.	**Population Concentrations** (including special facilities)	
a.	**group homes:**	- None Identified
b.	**large apartment buildings:**	- None Identified
c.	**schools:**	- None Identified
d.	**large office buildings:**	- See 4.g.
e.	**other (describe – i.e. stadiums, concert halls, amusement parks, fairgrounds, correctional facilities, nursing homes, other special populations or large crowd assembly areas:**	- None Identified
f.	**major employers:**	- None Identified
3.	**Population Shifts** (location; time, date or season of shift; extent of shift)	
a.	**daily:**	- 196 commuters with an average commuting time of 41.1 minutes - 107 attend school
b.	**seasonal:**	- 370 total housing units: 169 occupied/201vacant; of the 201 vacant, 184 are for seasonal recreational or occasional use
4.	**Important or Critical Public and Private Facilities**	
a.	**police precincts:**	- None Identified
b.	**fire stations:**	- None Identified
c.	**public works yards:**	- None Identified
d.	**pumping stations:**	- None Identified
e.	**community shelters:**	- None Identified
f.	**community medical facilities, hospitals:**	- None Identified
g.	**historic sites:**	- None Identified
h.	**other (describe – i.e., government buildings, record center, major construction companies, warehouses, demolition companies, heavy equipment rental, emergency equipment vehicle storage areas, etc):**	- Dover Township Hall, 10978 8 Mile Rd.

5.	Vital or Critical Infrastructure	
a.	**roads, railroads, and bridges:**	- None Identified
b.	**dams, power stations, water treatment plants, sanitary lift stations, etc.:**	- Lake Olga Dam
c.	**other: (describe – i.e. airports, pipelines, bus terminals, train stations, military bases, marine passenger ferry services, etc.)**	- None Identified

6.	Socio-Economic Profile of Sector		
a.	**total population (night):**		395
b.	**peak population (seasonal):**		826 (estimate)
c.	**percent over 65:**		20
d.	**percent under 18:**		20.8
e.	**percent that are homeowners:**		84
f.	**percent below poverty level:**		17.4
g.	**percent with disability or mobility limitation:**	*(Population 5 years and over)*	33.7
h.	**estimated property insurance coverage (Real and Personal Equalized Valuations):**	Agricultural: Commercial: Industrial: Residential: Timber-Cutover: Total Personal: Total:	$1,608,326 $40,350 $0 $10,370,772 $0 $329,600 $12,349,048
i.	**flood insurance coverage:**	Total Claims since 01/01/78: Total Payments since 01/01/78: Policies In-Force: Total Insurance In-Force:	N/A N/A N/A N/A
j.	**location of floodplains:**	- None Identified	

7.	Emergency Warning System Coverage	
a.	**siren locations and/or description of warning system:**	- None Identified
b.	**percent of population covered by warning sirens or system:**	N/A

Dover Township

0 2 Miles

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Source: Michigan Geographic Data Library
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September 2004

EDEN TOWNSHIP

1.	**major geographic features:**	- 13.4 people per square mile of land area - 21.8 housing units per square mile of land area - Scattered rural housing - Densely forested (Manistee National Forest and Pere Marquette State Forest) - Syers Lake - Little Manistee River - 1 to 2 small lakes and ponds, 2 to 4 small creeks

2.	**Population Concentrations** (including special facilities)	
a.	**group homes:**	- None Identified
b.	**large apartment buildings:**	- None Identified
c.	**schools:**	- None Identified
d.	**large office buildings:**	- See 4.g.
e.	**other: (describe – i.e. stadiums, concert halls, amusement parks, fairgrounds, correctional facilities, nursing homes, other special populations or large crowd assembly areas)**	- Old Grade Campground, Forest Service Rd. 5190 (20 campsites) - Bear Track Campground, Forest Service Rd. 5202 (20 campsites) - Irons Motel, 10642 N. Merrillville Rd. (4 units) - Irons Flea Roast and Ox Market (festival), 4th weekend of June, Skinner Park. - Skinner Park Campground, 5090 W 10 ½ Mile Rd. (75 sites) - Hawg Heaven Campground, 4220 E 5-Mile Rd. (30 sites) - Irons RV Park and Campground, 4623 W 10 ½ Mile Rd. (45 sites)
f.	**major employers:**	- None Identified

3.	**Population Shifts** (location; time, date or season of shift; extent of shift)	
a.	**daily:**	- 80 commuters with an average commuting time of 35.6 minutes - 42 attend school
b.	**seasonal:**	- 793 total housing units: 228 occupied/565 vacant; of the 565 vacant, 544 are for seasonal recreational or occasional use

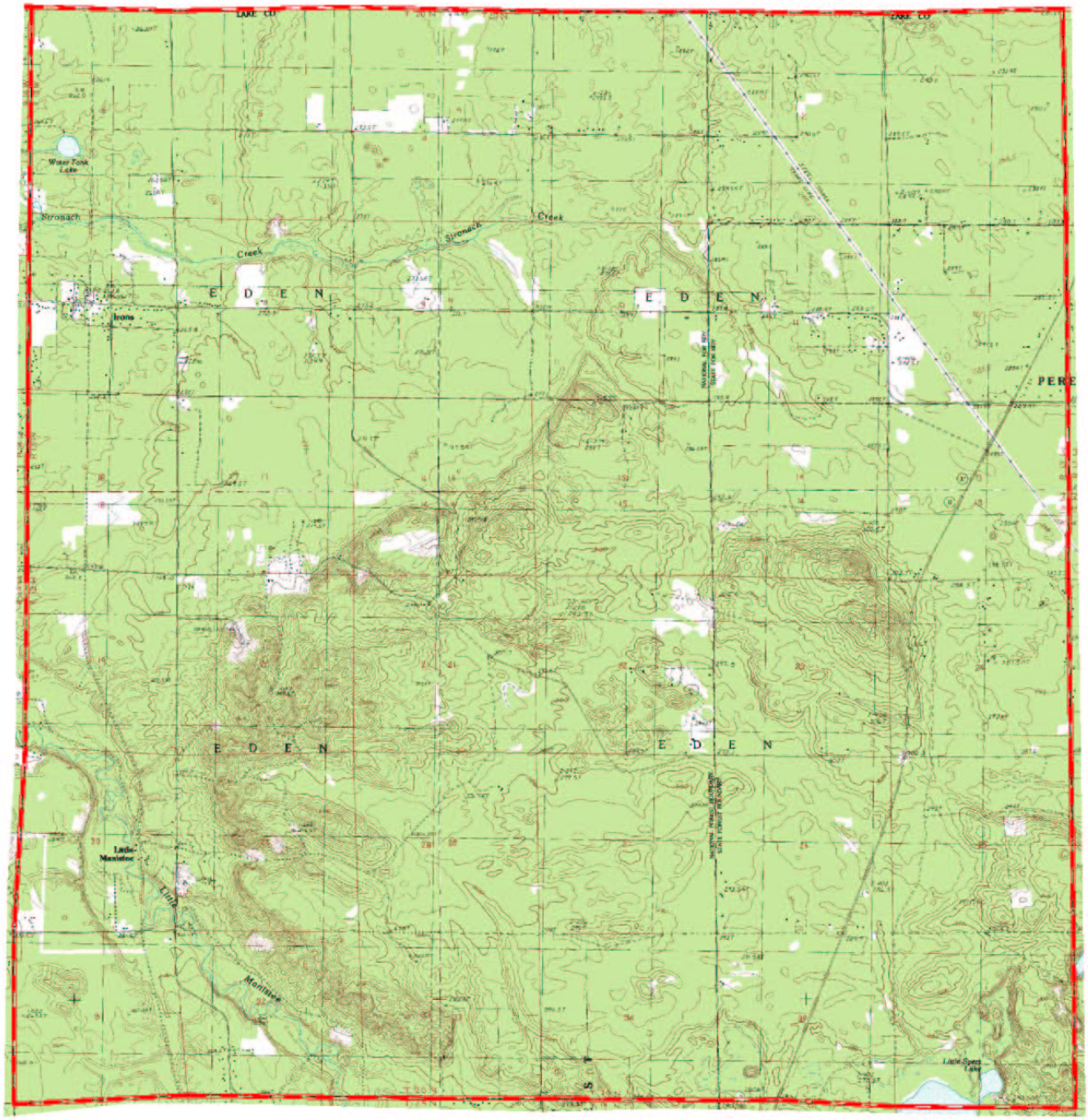
4.	**Important or Critical Public and Private Facilities**	
a.	**police precincts:**	- None Identified
b.	**fire stations:**	- Irons Fire & Rescue Station 2, 5869 W 10 ½ Mile Rd
c.	**public works yards:**	- None Identified
d.	**pumping stations:**	- None Identified
e.	**community shelters:**	- St Bernard Catholic Church, 5734 W 10 ½ Mile Rd
f.	**community medical facilities, hospitals:**	- None Identified
g.	**historic sites:**	- None Identified
h.	**other (describe – i.e., government buildings, record center, major construction companies, warehouses, demolition companies, heavy equipment rental, emergency equipment and vehicle storage areas):**	- Eden Township Hall, 5837 W. 10 ½ Mile Rd. - United States Post Office – Irons, 5574 W 10 1/2 Mile Rd

5.	Vital or Critical Infrastructure	
a.	**roads, railroads, and bridges:**	- M-37
b.	**dams, power stations, water treatment plants, sanitary lift stations, etc.:**	- Consumers Energy Power Line
c.	**other: (describe – i.e. airports, pipelines, bus terminals, train stations, military bases, marine passenger ferry services, etc.)**	- None Identified

6.	Socio-Economic Profile of Sector		
a.	**total population (night):**		487
b.	**peak population (seasonal):**		1,651 (estimate)
c.	**percent over 65:**		21.8
d.	**percent under 18:**		15.8
e.	**percent that are homeowners:**		83.3
f.	**percent below poverty level:**		30.8
g.	**percent with disability or mobility limitation:**	*(Population 5 years and over)*	35
h.	**estimated property insurance coverage (Real and Personal Equalized Valuations):**	Agricultural:	$0
		Commercial:	$826,970
		Industrial:	$29,292
		Residential:	$18,505,362
		Timber-Cutover:	$407,589
		Total Personal:	$673,100
		Total:	$21,255,643
i.	**flood insurance coverage:**	Total Claims since 01/01/78:	N/A
		Total Payments since 01/01/78:	N/A
		Policies In-Force:	N/A
		Total Insurance In-Force:	N/A
j.	**location of floodplains:**	- None Identified	

7.	Emergency Warning System Coverage	
a.	**siren locations and/or description of warning system:**	- None Identified
b.	**percent of population covered by warning sirens or system:**	N/A

Eden Township



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ELK TOWNSHIP

1.	**major geographic features:**	- 26.8 people per square mile of land area - 43.2 housing units per square mile of land area - Scattered rural housing, moderate residential areas near lakes - Big Bass Lake - Little Manistee River - 46 to 50 small lakes and ponds, 6 to 8 small creeks

2.	**Population Concentrations** (including special facilities)	
a.	**group homes:**	- None Identified
b.	**large apartment buildings:**	- None Identified
c.	**schools:**	- None Identified
d.	**large office buildings:**	- See 4.g.
e.	**other: (describe – i.e. stadiums, concert halls, amusement parks, fairgrounds, correctional facilities, nursing homes, other special populations or large crowd assembly areas)**	- Enchanted Acres Canoe and Campground, 9581 Brooks Rd (63 RV sites) - Grant's Resort, 7010 N Bass Lake Rd (cabins on Big Bass Lake) - Our Family Campground, 1 North of Dexter Rd. (12 sites) - Pleasant Acres Trailer Park Assoc., Route #1, Bass Lake Rd. (52 sites)
f.	**major employers:**	- None Identified

3.	**Population Shifts** (location; time, date or season of shift; extent of shift)	
a.	**daily:**	- 283 commuters with an average commuting time of 47.9 minutes - 120 attend school
b.	**seasonal:**	- 1,589 total housing units: 492 occupied/1,097 vacant; of the 1,097 vacant, 1,029 are for seasonal recreational or occasional use

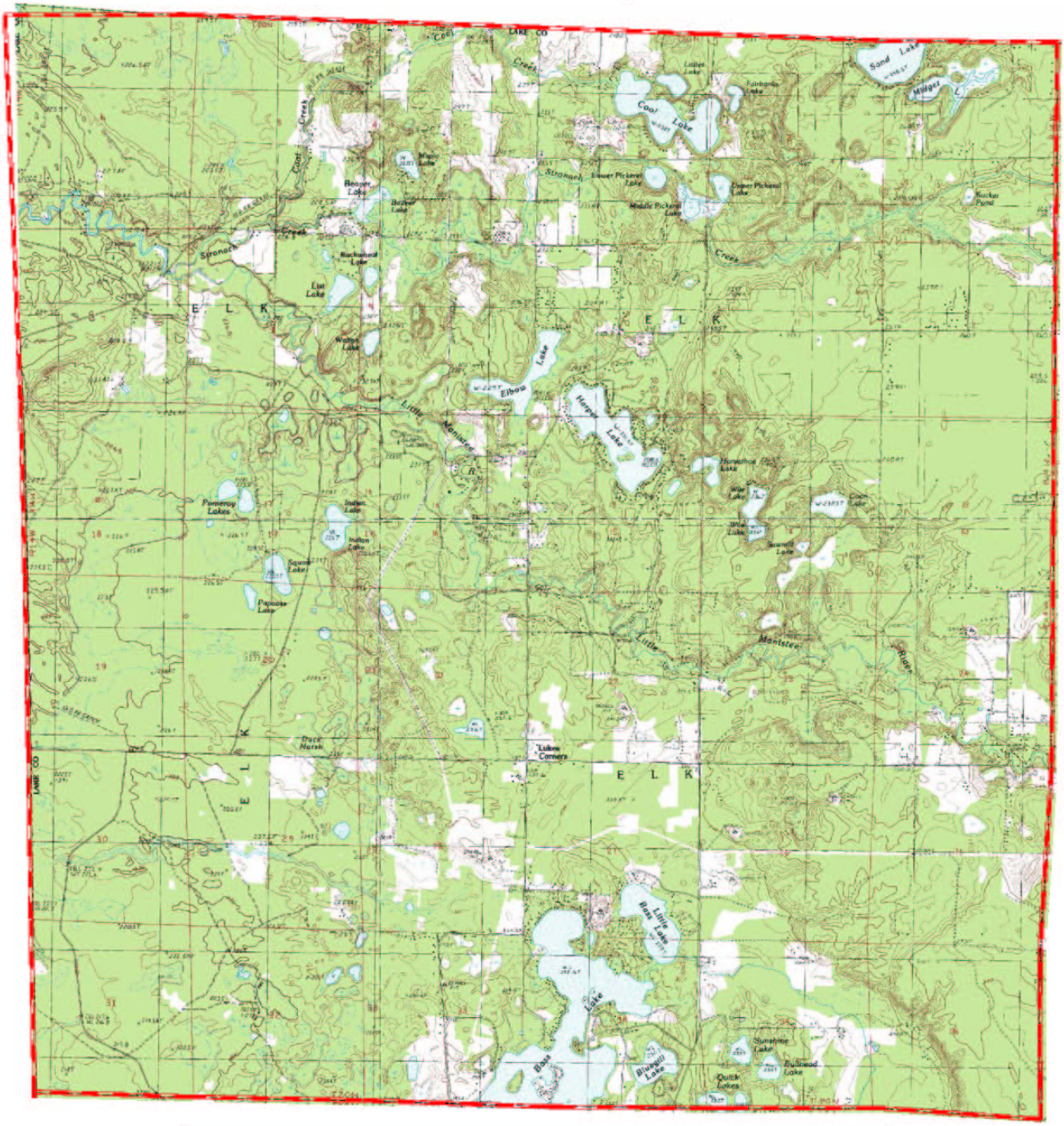
4.	**Important or Critical Public and Private Facilities**	
a.	**police precincts:**	- None Identified
b.	**fire stations:**	- None Identified
c.	**public works yards:**	- None Identified
d.	**pumping stations:**	- None Identified
e.	**community shelters:**	- St Bernard Catholic Church, 5734 W 10 ½ Mile Rd, Irons, MI 49644
f.	**community medical facilities, hospitals:**	- None Identified
g.	**historic sites:**	- None Identified
h.	**other (describe – i.e., government buildings, record center, major construction companies, warehouses, demolition companies, heavy equipment rental, emergency equipment and vehicle storage areas, etc.):**	- Elk Township Hall, 8966 N. Bass Lake Rd.

5.	Vital or Critical Infrastructure	
a.	**roads, railroads, and bridges:**	- None Identified
b.	**dams, power stations, water treatment plants, sanitary lift stations, etc.:**	- Consumers Energy Power Line
c.	**other: (describe – i.e. airports, pipelines, bus terminals, train stations, military bases, marine passenger ferry services, etc.)**	- None Identified

6.	Socio-Economic Profile of Sector		
a.	**total population (night):**		985
b.	**peak population (seasonal):**		3,033 (estimate)
c.	**percent over 65:**		34.2
d.	**percent under 18:**		12.3
e.	**percent that are homeowners:**		89.8
f.	**percent below poverty level:**		18
g.	**percent with disability or mobility limitation:**	*(Population 5 years and over)*	27.4
h.	**estimated property insurance coverage (Real and Personal Equalized Valuations):**	Agricultural:	$626,474
		Commercial:	$447,319
		Industrial:	$109,748
		Residential:	$63,125,340
		Timber-Cutover:	$0
		Total Personal:	$2,118,600
		Total:	$66,427,481
i.	**flood insurance coverage:**	Total Claims since 01/01/78:	N/A
		Total Payments since 01/01/78:	N/A
		Policies In-Force:	N/A
		Total Insurance In-Force:	N/A
j.	**location of floodplains:**	- None Identified	

7.	Emergency Warning System Coverage	
a.	**siren locations and/or description of warning system:**	- None Identified
b.	**percent of population covered by warning sirens or system:**	N/A

Elk Township



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Source: Michigan Geographic Data Library
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ELLSWORTH TOWNSHIP

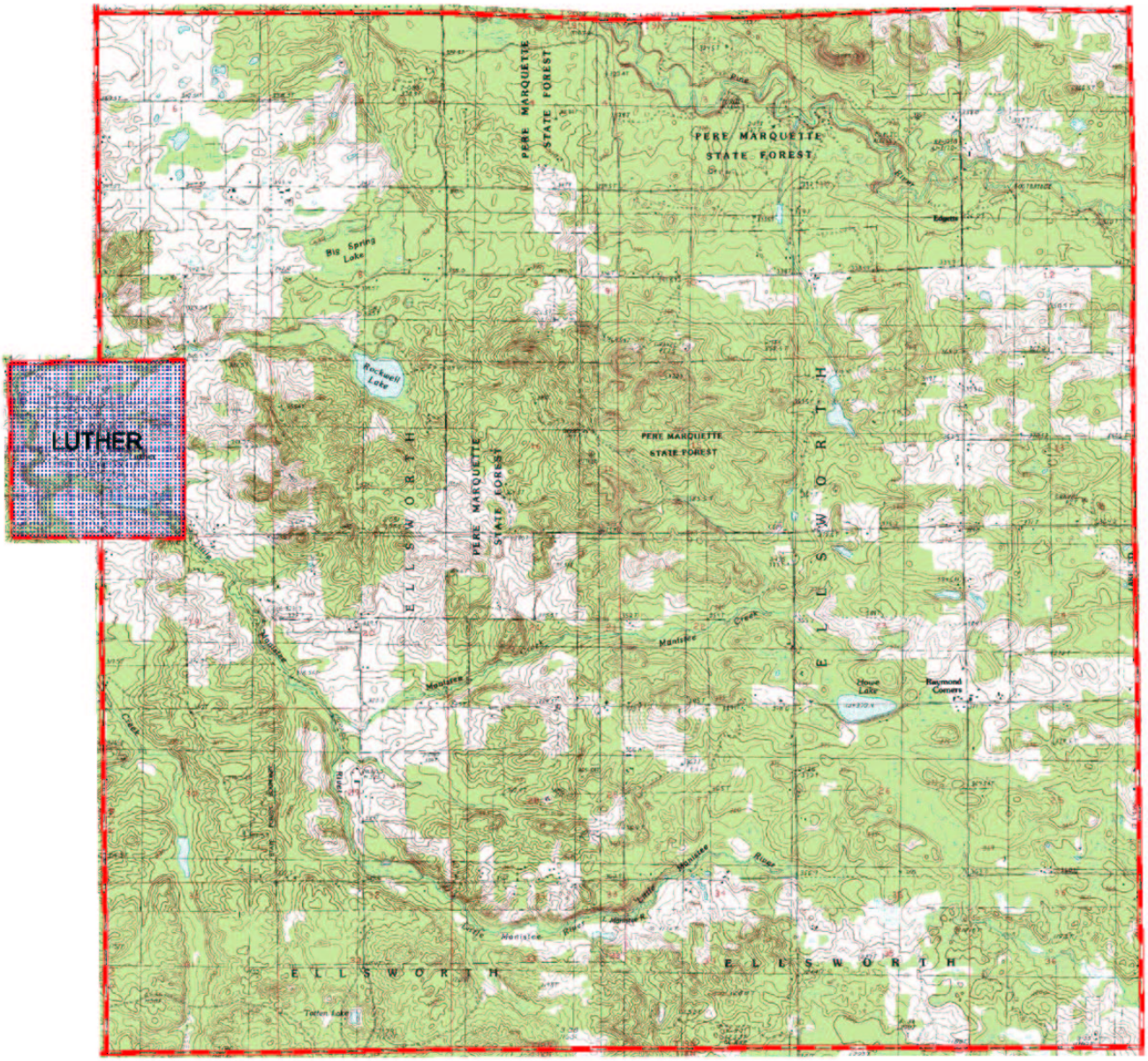
1.	**major geographic features:**	- 23.1 people per square mile of land area - 17.6 housing units per square mile of land area - Scattered rural housing - Moderately forested, moderate agricultural areas - Pine River - Little Manistee River - 20 to 22 small lakes and ponds, 4 to 6 small creeks
2.	**Population Concentrations** (including special facilities)	
a.	**group homes:**	- None Identified
b.	**large apartment buildings:**	- None Identified
c.	**schools:**	- None Identified
d.	**large office buildings:**	- See 4.g.
e.	**other (describe – i.e. stadiums, concert halls, amusement parks, fairgrounds, correctional facilities, nursing homes, other special populations or large crowd assembly areas):**	- None Identified
f.	**major employers:**	- None Identified
3.	**Population Shifts** location; time, date or season of shift; extent of shift *(numbers include Village of Luther)*	
a.	**daily:**	- 222 commuters with an average commuting time of 25.7 minutes - 201 attend school
b.	**seasonal:**	- 622 total housing units: 340 occupied/282 vacant; of the 282 vacant, 237 are for seasonal recreational or occasional use
4.	**Important or Critical Public and Private Facilities**	
a.	**police precincts:**	- None Identified
b.	**fire stations:**	- None Identified
c.	**public works yards:**	- None Identified
d.	**pumping stations:**	- None Identified
e.	**community shelters:**	- Edgetts Wesleyan Church, 3446 N. Raymond Rd, Luther, MI 49656
f.	**community medical facilities, hospitals:**	- None Identified
g.	**historic sites:**	- John & Katharine Tunkun Podjun Farm, 9581 1-Mile Rd
h.	**other (describe – i.e., government buildings, record center, major construction companies, warehouses, demolition companies, heavy equipment rental, emergency equipment and vehicle storage areas, etc.):**	- Ellsworth Township Hall, 210 N State St

5.	Vital or Critical Infrastructure	
a.	**roads, railroads, and bridges:**	- None Identified
b.	**dams, power stations, water treatment plants, sanitary lift stations, etc.:**	- None Identified
c.	**other: (describe – i.e. airports, pipelines, bus terminals, train stations, military bases, marine passenger ferry services, etc.)**	- None Identified

6.	Socio-Economic Profile of Sector		
a.	**total population (night):**	*(numbers include Village of Luther)*	817
b.	**peak population (seasonal):**	*(numbers include Village of Luther)*	1,386 (estimate)
c.	**percent over 65:**		19.2
d.	**percent under 18:**		21.5
e.	**percent that are homeowners:**		90
f.	**percent below poverty level:**		20.4
g.	**percent with disability or mobility limitation:**	*(Population 5 years and over)*	23.5
h.	**estimated property insurance coverage (Real and Personal Equalized Valuations):**	Agricultural:	$2,659,842
		Commercial:	$123,865
		Industrial:	$5,286
		Residential:	$19,169,810
		Timber-Cutover:	$0
		Total Personal:	$1,021,500
		Total:	$22,980,303
i.	**flood insurance coverage:**	Total Claims since 01/01/78:	N/A
		Total Payments since 01/01/78:	N/A
		Policies In-Force:	N/A
		Total Insurance In-Force:	N/A
j.	**location of floodplains:**	- None Identified	

7.	Emergency Warning System Coverage	
a.	**siren locations and/or description of warning system:**	- None Identified
b.	**percent of population covered by warning sirens or system:**	N/A

Ellsworth Township



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Source: Michigan Geographic Data Library
Created by WMSRDC
September 2004

LAKE TOWNSHIP

1.	**major geographic features:**	- 23.9 people per square mile of land area - 65 housing units per square mile of land area - Scattered rural housing, moderately dense residential areas near lakes - Densely forested (Manistee National Forest) - Big Star Lake - Pere Marquette River - 24 to 26 small lakes and ponds, 6 to 8 small creeks

2.	**Population Concentrations** (including special facilities)	
a.	**group homes:**	- None Identified
b.	**large apartment buildings:**	- None Identified
c.	**schools:**	- None Identified
d.	**large office buildings:**	- See 4.g.
e.	**other (describe - i.e. stadiums, concert halls, amusement parks, fairgrounds, correctional facilities, nursing homes, other special populations or large crowd assembly areas):**	- Bowman Bridge Campground, 8500 W. 52nd St. (24 campsites) - Gleason's Landing, 7770 Brooks Rd. (6 campsites) - Blueberry Patch Motel, 6090 W. 76th St. (4 units, 1 cabin) - Big Star Lake Trailer & RV Resort, 9975 Star Lake Dr. (122 sites) - Burger's Hideaway, 10840 S Burger Rd (capacity 8) - Tall Oaks Odd Fellow & Rebekah Youth Camp, 7153 S Rebecca Rd (RV/ tent camping sites, 16 cabins, 60 sites) - Marquette Trail Golf Course & Condos, 6409 W. 76th St. (18 holes) - Pat and Pearls Trailer Park, 1380 N. Lakeside Dr. (35 sites) - Snug Harbor Resort, 6990 Snug Harbor Rd. (42 sites)
f.	**major employers:**	- None Identified

3.	**Population Shifts** (location; time, date or season of shift; extent of shift)	
a.	**daily:**	- 205 commuters with an average commuting time of 26.9 minutes - 42 attend school
b.	**seasonal:**	- 2,341 total housing units: 437 occupied/1,904 vacant; of the 1,904 vacant, 1,832 are for seasonal recreational or occasional use

4.	**Important or Critical Public and Private Facilities**	
a.	**police precincts:**	- None Identified
b.	**fire stations:**	- Lake Township Fire & Rescue, 15580 S Star Lake Rd
c.	**public works yards:**	- None Identified
d.	**pumping stations:**	- None Identified
e.	**community shelters:**	- None Identified
f.	**community medical facilities, hospitals:**	- None Identified
g.	**historic sites:**	- None Identified
h.	**other (describe – i.e., government buildings, record center, major construction companies, warehouses, demolition companies, heavy equipment rental, emergency equipment and vehicle storage, etc.):**	- Lake Township Hall, 15580 Star Lake Dr.

5.	Vital or Critical Infrastructure	
a.	**roads, railroads, and bridges:**	- None Identified
b.	**dams, power stations, water treatment plants, sanitary lift stations, etc.:**	- None Identified
c.	**other: (describe – i.e. airports, pipelines, bus terminals, train stations, military bases, marine passenger ferry services, etc.)**	- None Identified

6.	Socio-Economic Profile of Sector		
a.	**total population (night):**		862
b.	**peak population (seasonal):**		4,471 (estimate)
c.	**percent over 65:**		32.8
d.	**percent under 18:**		11.4
e.	**percent that are homeowners:**		93.8
f.	**percent below poverty level:**		19.1
g.	**percent with disability or mobility limitation:**	*(Population 5 years and over)*	38.2
h.	**estimated property insurance coverage (Real and Personal Equalized Valuations):**	Agricultural:	$1,344,857
		Commercial:	$1,152,379
		Industrial:	$0
		Residential:	$88,808,650
		Timber-Cutover:	$26,949
		Total Personal:	$2,151,100
		Total:	$93,483,935
i.	**flood insurance coverage:**	Total Claims since 01/01/78:	0
		Total Payments since 01/01/78:	$0
		Policies In-Force:	2
		Total Insurance In-Force:	$117,600
j.	**location of floodplains:**	- None Identified	

7.	Emergency Warning System Coverage	
a.	**siren locations and/or description of warning system:**	- Siren at Lake Township Fire & Rescue 15580 S. Star Lake Drive, Baldwin, MI 49304
b.	**percent of population covered by warning sirens or system:**	- Siren covers a ½ to 2 mile radius depending on wind and humidity

(Note: Map showing warning siren location and system coverage is included in Part D)

Lake Township

0 2 Miles

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Source: Michigan Geographic Data Library
Created by WMSRDC
September 2004

NEWKIRK TOWNSHIP

1.	**major geographic features:**	- 8.7 people per square mile of land area - 11.8 housing units per square mile of land area - Scattered rural housing - Densely forested (Pere Marquette State Forest), moderate agricultural areas - Little Manistee River - Pine River - 10 to 12 small lakes and ponds, 6 to 8 small creeks
2.	**Population Concentrations** (including special facilities)	
a.	**group homes:**	- None Identified
b.	**large apartment buildings:**	- None Identified
c.	**schools:**	- None Identified
d.	**large office buildings:**	- See 4.g.
e.	**other (describe - i.e. stadiums, concert halls, amusement parks, fairgrounds, correctional facilities, nursing homes, other special populations or large crowd assembly areas):**	- Carrieville State Forest Campground, 3500 N. Kings Highway (31 campsites) - Lincoln Bridge State Forest Campground, 5000 E. Lincoln Bridge Rd. (9 campsites) - Camp Living Waters, 5 E. 6th Rd (20 sites) - Four Seasons Campground, 4220 E. 5-Mile Rd. (30 sites) - Redfoot Hills Golf Course, 10117 N. State Rd. (9 holes) - Silver Creek State Forest Campground, 8700 N. State Rd. (26 campsites)
f.	**major employers:**	- Fair Salvage, 8702 U.S. 10
3.	**Population Shifts** location; time, date or season of shift; extent of shift *(numbers include Village of Luther)*	
a.	**daily:**	- 204 commuters with an average commuting time of 24.4 minutes - 148 attend school
b.	**seasonal:**	- 860 total housing units: 292 occupied/568 vacant; of the 568 vacant, 502 are for seasonal recreational or occasional use
4.	**Important or Critical Public and Private Facilities**	
a.	**police precincts:**	- None Identified
b.	**fire stations:**	- None Identified
c.	**public works yards:**	- None Identified
d.	**pumping stations:**	- None Identified
e.	**community shelters:**	- None Identified
f.	**community medical facilities, hospitals:**	- None Identified
g.	**historic sites:**	- None Identified

h.	**other (describe – i.e., government buildings, record center, major construction companies, warehouses, demolition companies, heavy equipment rental, emergency equipment and vehicle storage areas, etc.):**	- Newkirk Township Hall, 301 State St.

5. Vital or Critical Infrastructure

a.	**roads, railroads, and bridges:**	- M-37
b.	**dams, power stations, water treatment plants, sanitary lift stations, etc.:**	- Little Widewaters Flooding Dam - Consumers Energy Power Line
c.	**other: (describe – i.e. airports, pipelines, bus terminals, train stations, military bases, marine passenger ferry services, etc.)**	- None Identified

6. Socio-Economic Profile of Sector

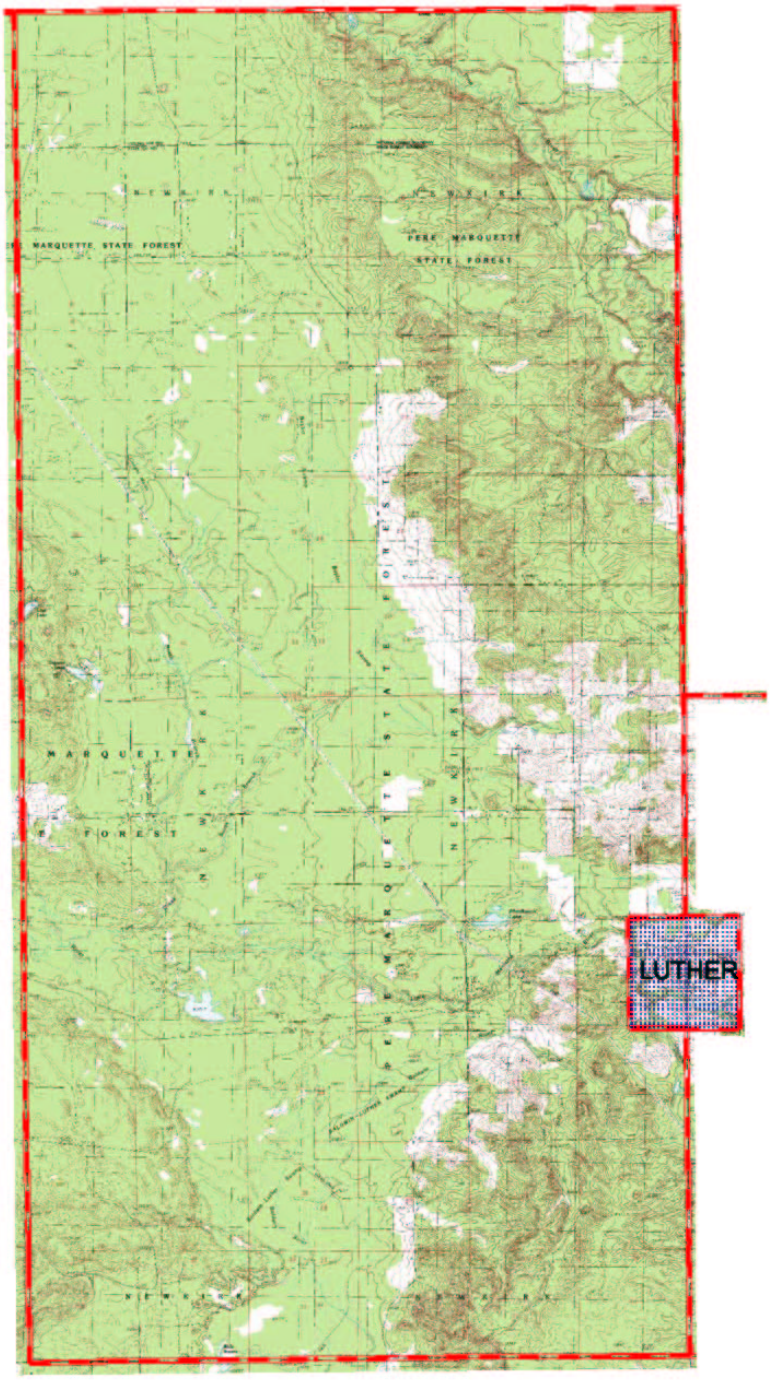
a.	**total population (night):**	*(numbers include Village of Luther)*	632
b.	**peak population (seasonal):**	*(numbers include Village of Luther)*	1,716 (estimate)
c.	**percent over 65:**		25.9
d.	**percent under 18:**		18.2
e.	**percent that are homeowners:**		80.8
f.	**percent below poverty level:**		26.2
g.	**percent with disability or mobility limitation:**	*(Population 5 years and over)*	26.7

h.	**estimated property insurance coverage (Real and Personal Equalized Valuations):**	Agricultural:	$4,503,730
		Commercial:	$533,339
		Industrial:	$28,104
		Residential:	$17,680,520
		Timber-Cutover:	$0
		Total Personal:	$738,000
		Total:	$23,483,693
i.	**flood insurance coverage:**	Total Claims since 01/01/78:	N/A
		Total Payments since 01/01/78:	N/A
		Policies In-Force:	N/A
		Total Insurance In-Force:	N/A
j.	**location of floodplains:**	- None Identified	

7. Emergency Warning System Coverage

a.	**siren locations and/or description of warning system:**	- None Identified
b.	**percent of population covered by warning sirens or system:**	N/A

Newkirk Township



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Source: Michigan Geographic Data Library
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September 2004

PEACOCK TOWNSHIP

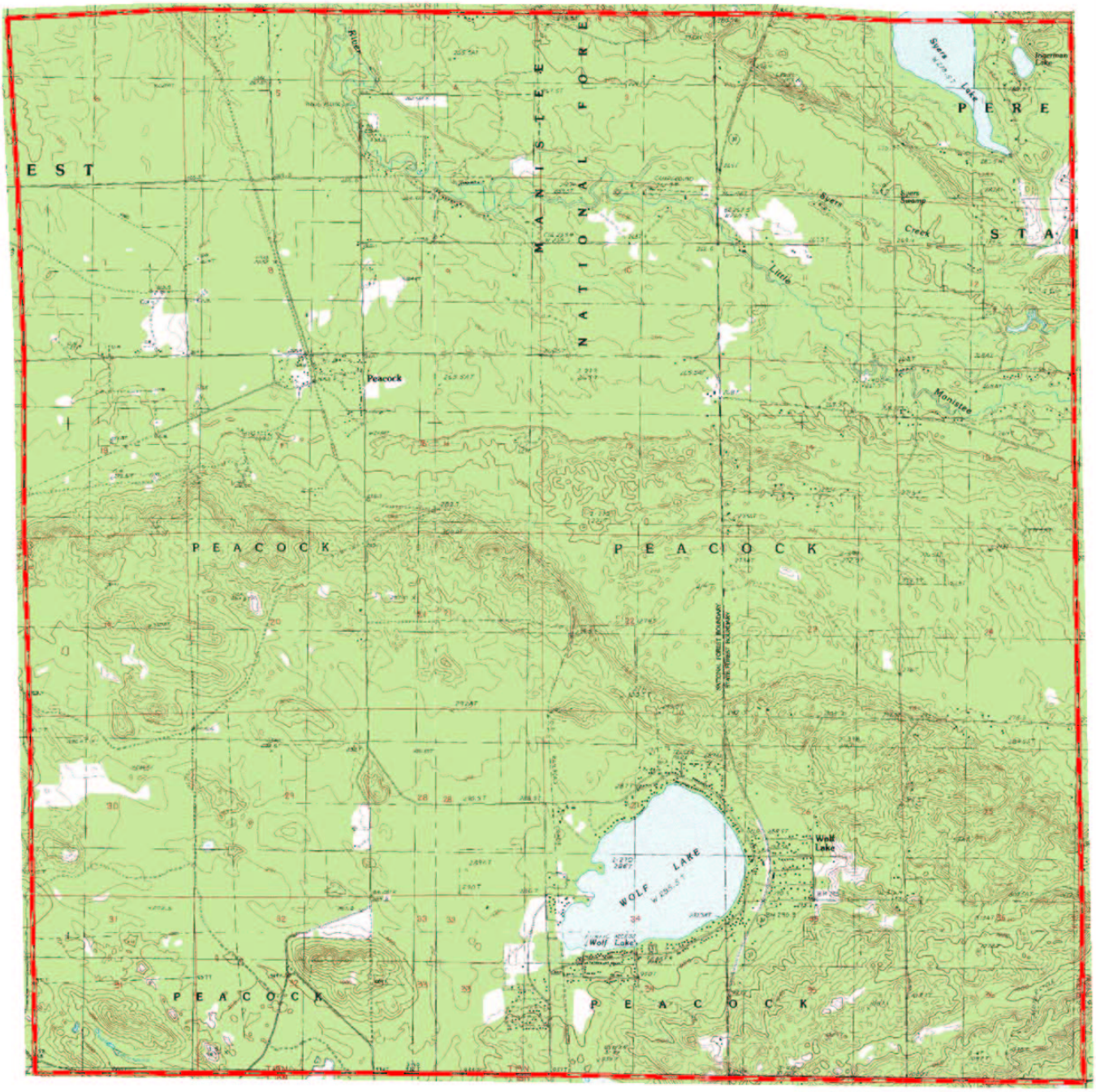
1.	**major geographic features:**	- 13.7 people per square mile of land area - 31.6 housing units per square mile of land area - Scattered rural housing, moderate residential areas near lakes - Densely forested (Manistee National Forest) - Wolf Lake - Syers Lake - Little Manistee River - 1 small lake, 2 to 4 small creeks
2.	**Population Concentrations** (including special facilities)	
a.	**group homes:**	- None Identified
b.	**large apartment buildings:**	- None Identified
c.	**schools:**	- None Identified
d.	**large office buildings:**	- See 4.g.
e.	**other (describe – i.e. stadiums, concert halls, amusement parks, fairgrounds, correctional facilities, nursing homes, other special populations or large crowd assembly areas):**	- Lamplite Trailer Port, Wolf Lake Dr. (44 campsites) - Day Star Motel, 1141 N. M-37 (11 rooms) - Wolf Lake Motel & Resort, 1197 N. M-37 (16 units) - River's Edge Log Cabins, 1853 W Old M 63
f.	**major employers:**	- Rothig Forest Products, 3600 N. M-37 (28 employees) - Wheeler's Wolf Lake Sawmill, 195 N. M-37 (5 employees) - Club 37 Bar & Restaurant, M-37
3.	**Population Shifts** (location; time, date or season of shift; extent of shift)	
a.	**daily:**	- 74 commuters with an average commuting time of 59 minutes - 27 attend school
b.	**seasonal:**	- 1,132 total housing units: 245 occupied/887 vacant; of the 887 vacant, 841 are for seasonal recreational or occasional use
4.	**Important or Critical Public and Private Facilities**	
a.	**police precincts:**	- None Identified
b.	**fire stations:**	- None Identified
c.	**public works yards:**	- None Identified
d.	**pumping stations:**	- None Identified
e.	**community shelters:**	- None Identified
f.	**community medical facilities, hospitals:**	- Life EMS of Lake County, 4 ½ Mile Rd & M-37
g.	**historic sites:**	- None Identified
h.	**other (describe – i.e., government buildings, record center, major construction companies, warehouses, demolition companies, heavy equipment rental, emergency equipment and vehicle storage areas, etc.):**	- Peacock Township Hall, 4480 W. 4 Mile Rd. - Lake County EMS 2, 3890 N M-37 - NW Lake County Senior Center, 4240 W. 4 Mile Rd.

5.	Vital or Critical Infrastructure	
a.	**roads, railroads, and bridges:**	- M-37 - M-37 bridge over Little Manistee River
b.	**dams, power stations, water treatment plants, sanitary lift stations, etc.:**	- None Identified
c.	**other: (describe – i.e. airports, pipelines, bus terminals, train stations, military bases, marine passenger ferry services, etc.)**	- None Identified

6.	Socio-Economic Profile of Sector		
a.	**total population (night):**		492
b.	**peak population (seasonal):**		2,182 (estimate)
c.	**percent over 65:**		31.3
d.	**percent under 18:**		12.4
e.	**percent that are homeowners:**		87.3
f.	**percent below poverty level:**		9.5
g.	**percent with disability or mobility limitation:**	*(Population 5 years and over)*	30.2
h.	**estimated property insurance coverage (Real and Personal Equalized Valuations):**	Agricultural: Commercial: Industrial: Residential: Timber-Cutover: Total Personal: Total:	$0 $1,320,911 $0 $28,358,144 $0 $844,900 $30,523,955
i.	**flood insurance coverage:**	Total Claims since 01/01/78: Total Payments since 01/01/78: Policies In-Force: Total Insurance In-Force:	N/A N/A N/A N/A
j.	**location of floodplains:**	- None Identified	

7.	Emergency Warning System Coverage	
a.	**siren locations and/or description of warning system:**	- None Ideintified
b.	**percent of population covered by warning sirens or system:**	- None Identified

Peacock Township



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Source: Michigan Geographic Data Library
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September 2004

PINORA TOWNSHIP

1.	**major geographic features:**	- 20.1 people per square mile of land area - 12.9 housing units per square mile of land area - Scattered rural housing - Moderately forested (Manistee National Forest), moderate agricultural areas - 8 to 10 small lakes and ponds, 2 small creeks

2.	**Population Concentrations** (including special facilities)	
a.	**group homes:**	- None Identified
b.	**large apartment buildings:**	- None Identified
c.	**schools:**	- None Identified
d.	**large office buildings:**	- See 4.g.
e.	**other (describe – i.e. stadiums, concert halls, amusement parks, fairgrounds, correctional facilities, nursing homes, other special populations or large crowd assembly areas):**	- None Identified
f.	**major employers:**	- None Identified

3.	**Population Shifts** (location; time, date or season of shift; extent of shift)	
a.	**daily:**	- 282 commuters with an average commuting time of 26.3 minutes - 114 attend school
b.	**seasonal:**	- 461 total housing units: 286 occupied/175 vacant; of the 175 vacant, 147 are for seasonal recreational or occasional use

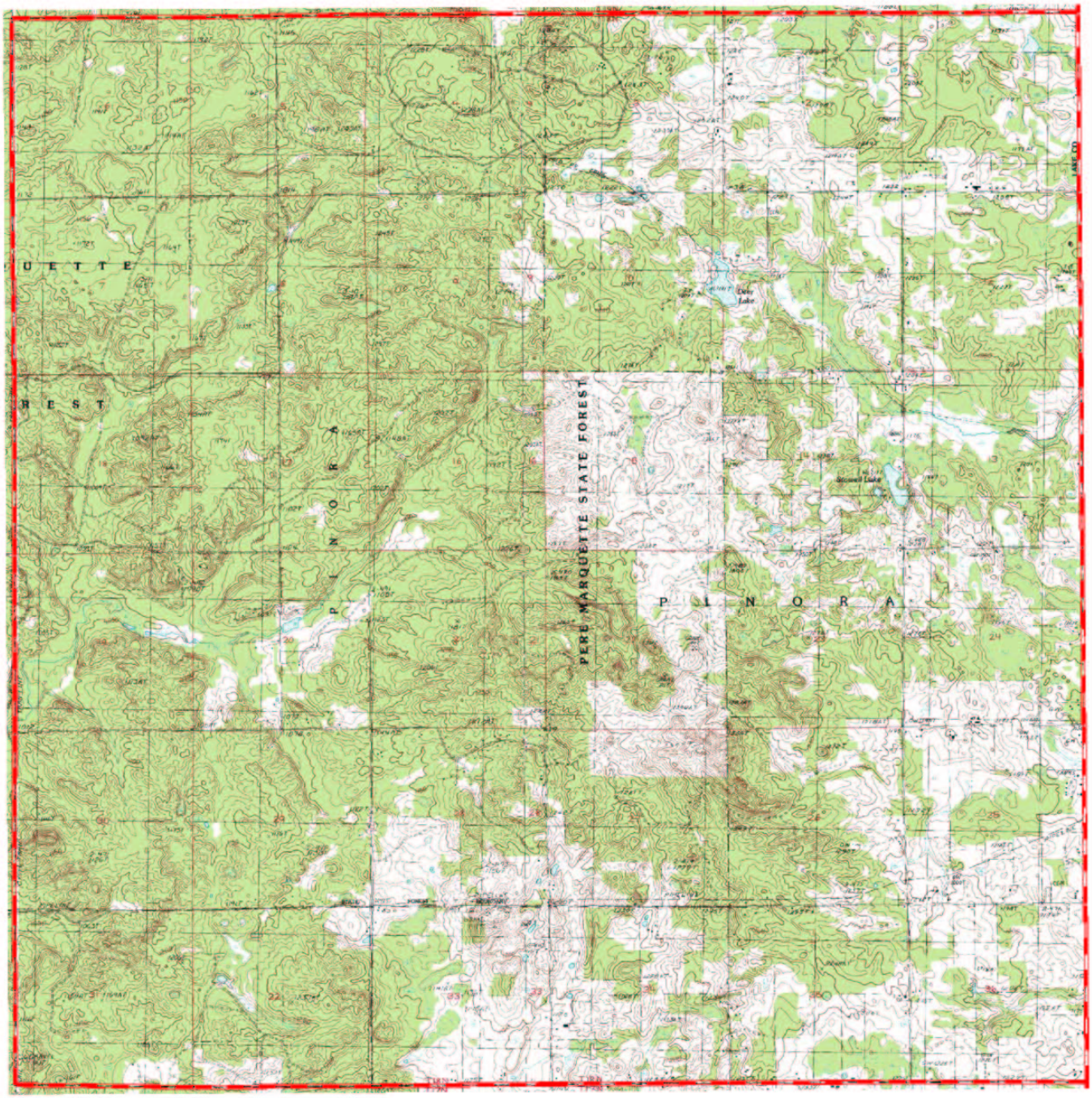
4.	**Important or Critical Public and Private Facilities**	
a.	**police precincts:**	- None Identified
b.	**fire stations:**	- None Identified
c.	**public works yards:**	- None Identified
d.	**pumping stations:**	- None Identified
e.	**community shelters:**	- None Identified
f.	**community medical facilities, hospitals:**	- None Identified
g.	**historic sites:**	- None Identified
h.	**other (describe – i.e., government buildings, record center, major construction companies, warehouses, demolition companies, heavy equipment rental, emergency equipment and vehicle storage areas, etc.):**	- Pinora Township Hall, 4032 S. Deer Lake Rd.

5.	Vital or Critical Infrastructure	
a.	**roads, railroads, and bridges:**	- None Identified
b.	**dams, power stations, water treatment plants, sanitary lift stations, etc.:**	- None Identified
c.	**other: (describe – i.e. airports, pipelines, bus terminals, train stations, military bases, marine passenger ferry services, etc.)**	- MichCon Gas Pipeline

6.	Socio-Economic Profile of Sector		
a.	**total population (night):**		717
b.	**peak population (seasonal):**		1,083 (estimate)
c.	**percent over 65:**		18.5
d.	**percent under 18:**		20.9
e.	**percent that are homeowners:**		85.7
f.	**percent below poverty level:**		12.9
g.	**percent with disability or mobility limitation:**	*(Population 5 years and over)*	22.2
h.	**estimated property insurance coverage (Real and Personal Equalized Valuations):**	Agricultural:	$1,309,003
		Commercial:	$0
		Industrial:	$120,683
		Residential:	$16,361,957
		Timber-Cutover:	$0
		Total Personal:	$1,156,100
		Total:	$18,947,743
i.	**flood insurance coverage:**	Total Claims since 01/01/78:	N/A
		Total Payments since 01/01/78:	N/A
		Policies In-Force:	N/A
		Total Insurance In-Force:	N/A
j.	**location of floodplains:**	- None Identified	

7.	Emergency Warning System Coverage	
a.	**siren locations and/or description of warning system:**	- None Identified
b.	**percent of population covered by warning sirens or system:**	N/A

Pinora Township



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Source: Michigan Geographic Data Library
Created by WMSRDC
September 2004

PLEASANT PLAINS TOWNSHIP

1.	**major geographic features:**	- 44.8 people per square mile of land area - 47.5 housing units per square mile of land area - Scattered rural housing, moderate residential areas near lakes - Densely forested (Manistee National Forest) - Pere Marquette River - Baldwin River - 28 to 32 small lakes and ponds, 3 to 4 small creeks

2.	**Population Concentrations** (including special facilities)	
a.	**group homes:**	- None Identified
b.	**large apartments:**	- None Identified
c.	**schools:**	- None Identified
d.	**large office buildings:**	- See 4.g.
e.	**other (describe – i.e. stadiums, concert halls, amusement parks, fairgrounds, correctional facilities, nursing homes, other special populations or large crowd assembly areas):**	- Shrine of the Pines (historic site), M-37 & Pere Marquette River - Whispering Oaks Campground & RV Park, 8585 S. M-37 (20 sites, 10 cabins) - Ivan's Campground and Cabins, 7332 S M-37 (7 cabins, 50 sites) - Knotty Pine Inn, 9261 S M-37 - Pere Marquette Campground, M-37, 3 miles south of Baldwin (50 sites) - Pere Marquette River Lodge, 8841 S M-37 (10 rooms, 5 cabins, 2 homes) - Red Moose Lodge, 8982 S M-37 (6 units) - Pere Marquette Oaks Condo RV Park, 6106 W. 76th St. (46 sites) - Blessing of the Bikes (festival), 3rd Sunday of May, Baldwin Municipal Airport.
f.	**major employers:**	- Houseman's Foods, 9559 S. M-37 (58 employees) - Jerome Miller Lumber Company, 7000 S. James Rd. (25 employees)

3.	**Population Shifts** location; time, date or season of shift; extent of shift *(numbers include Village of Baldwin)*	
a.	**daily:**	- 371 commuters with an average commuting time of 27.8 minutes - 546 attend school
b.	**seasonal:**	- 1,676 total housing units: 706 occupied/970 vacant; of the 970 vacant, 835 are for seasonal recreational or occasional use

4.	**Important or Critical Public and Private Facilities**	
a.	**police precincts:**	- None Identified
b.	**fire stations:**	- None Identified
c.	**public works yards:**	- None Identified
d.	**pumping stations:**	- None Identified
e.	**community shelters:**	- None Identified
f.	**community medical facilities, hospitals:**	- None Identified
g.	**historic sites:**	- Brown Trout Informational Designation (historic marker), M-37 - Marlborough Historic Distrct, James Rd. - Shrine of the Pines, M-37

h.	**other (describe – i.e., government buildings, record center, major construction companies, warehouses, demolition companies, heavy equipment rental, emergency equipment and vehicle storage areas, etc.):**	- Pleasant Plains Township Hall, 885 8th St.

5. Vital or Critical Infrastructure

a.	**roads, railroads, and bridges:**	- US-10 - M-37 - Marquette Rail Railroad (Genesee & Wyoming Inc.) - Marquette Rail Railroad bridge over Pere Marquette River - M-37 bridge over Baldwin River
b.	**dams, power stations, water treatment plants, sanitary lift stations, etc.:**	- Danaher Lake Dam
c.	**other: (describe – i.e. airports, pipelines, bus terminals, train stations, military bases, marine passenger ferry services, etc.)**	- Baldwin Municipal Airport

6. Socio-Economic Profile of Sector

a.	**total population (night):**	*(numbers include Village of Baldwin)*	1,581
b.	**peak population (seasonal):**	*(numbers include Village of Baldwin)*	3,518 (estimate)
c.	**percent over 65:**		18.3
d.	**percent under 18:**		22.6
e.	**percent that are homeowners:**		70.8
f.	**percent below poverty level:**		19.4
g.	**percent with disability or mobility limitation:**	*(Population 5 years and over)*	32.9

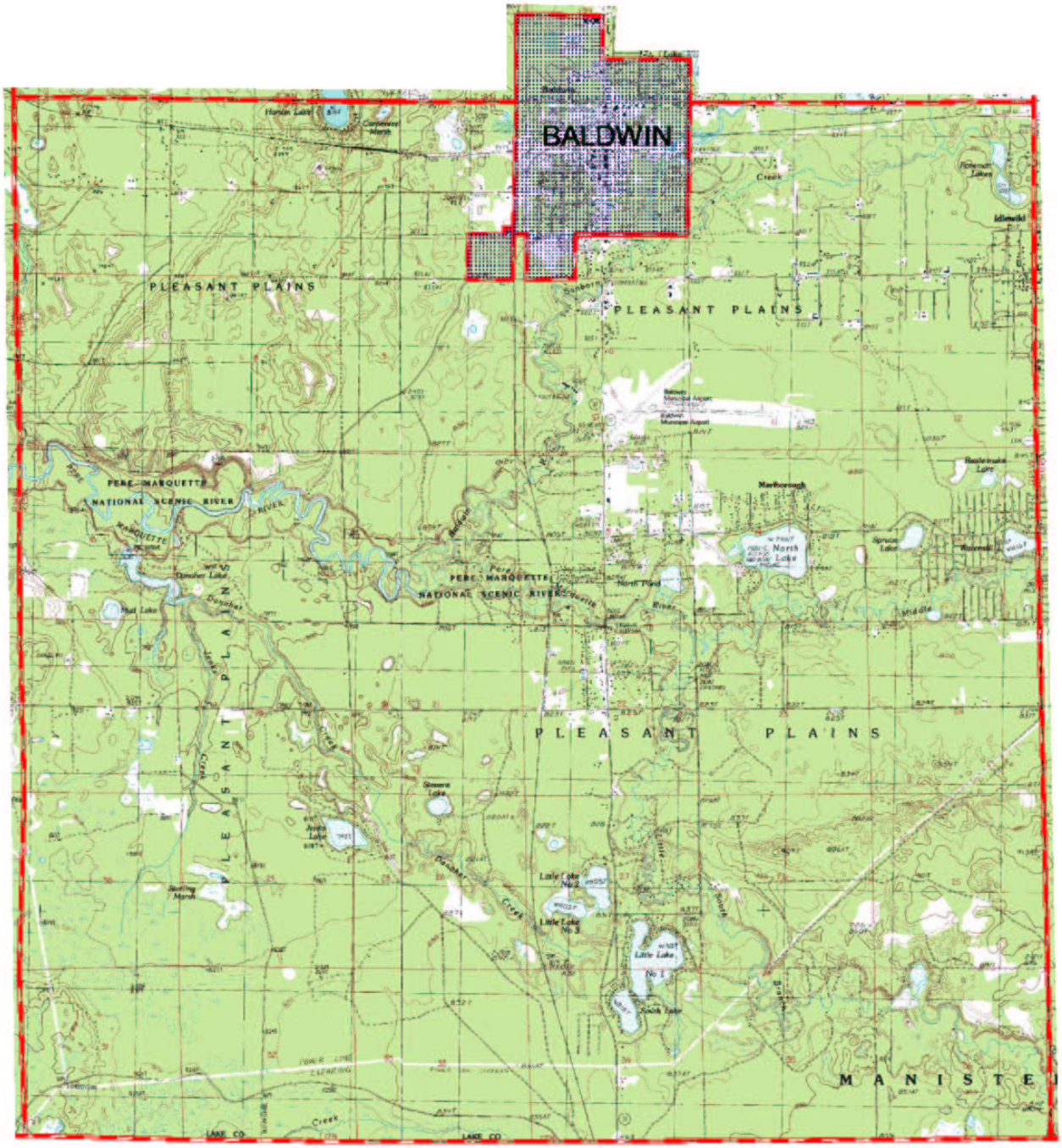
h.	**estimated property insurance coverage (Real and Personal Equalized Valuations):**	Agricultural:	$0
		Commercial:	$7,838,560
		Industrial:	$104,166
		Residential:	$41,954,278
		Timber-Cutover:	$319,116
		Total Personal:	$2,981,900
		Total:	$53,198,020
i.	**flood insurance coverage:**	Total Claims since 01/01/78:	28
		Total Payments since 01/01/78:	$289,887
		Policies In-Force:	19
		Total Insurance In-Force:	$2,436,200
j.	**location of floodplains:**	Floodplain along Pere Marquette River	

7. Emergency Warning System Coverage

a.	**siren locations and/or description of warning system:**	- None Identified
b.	**percent of population covered by warning sirens or system:**	N/A

USGS Topographic Map

Pleasant Plains Township



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Source: Michigan Geographic Data Library
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September 2004

SAUBLE TOWNSHIP

1.	**major geographic features:**	- 9.6 people per square mile of land area - 19.9 housing units per square mile of land area - Scattered rural housing - Densely forested (Manistee National Forest) - Sauble River - 32 to 36 small lakes and ponds, 6 to 8 small creeks
2.	**Population Concentrations** (including special facilities)	
a.	**group homes:**	- None Identified
b.	**large apartment buildings:**	- None Identified
c.	**schools:**	- None Identified
d.	**large office buildings:**	- See 4.g.
e.	**other (describe – i.e. stadiums, concert halls, amusement parks, fairgrounds, correctional facilities, nursing homes, other special populations or large crowd assembly areas):**	- Jungle Haven Resort, 6875 W. 5 Mile Rd. - Leisure Time Campground, 9214 W 5 Mile Rd (90 sites) - Big Bass Lake Campground, 9274 W. Ruby Dr. (21 sites) - Enchanted Acres Campground, Brooks Rd. (63 sites) - Sauble Lake Campground, 7546 W. 5-Mile Rd. (14 sites)
f.	**major employers:**	- None Identified
3.	**Population Shifts** (location; time, date or season of shift; extent of shift)	
a.	**daily:**	- 127 commuters with an average commuting time of 35.1 minutes - 68 attend school
b.	**seasonal:**	- 688 total housing units: 179 occupied/509 vacant; of the 509 vacant, 481 are for seasonal recreational or occasional use
4.	**Important or Critical Public and Private Facilities**	
a.	**police precincts:**	- None
b.	**fire stations:**	- Irons Fire & Rescue Station 1, 8906 W 6 Mile Rd
c.	**public works yards:**	- None Identified
d.	**pumping stations:**	- None Identified
e.	**community shelters:**	- Faith Fellowship Church, 8889 W 6 Mile Rd, Irons, MI 49644
f.	**community medical facilities, hospitals:**	- None Identified
g.	**historic sites:**	- None Identified
h.	**other (describe – i.e., government buildings, record center, major construction companies, warehouses, demolition companies, heavy equipment rental, emergency equipment and vehicle storage areas, etc.):**	- Sauble Township Hall, 8906 W. 6 Mile Rd.

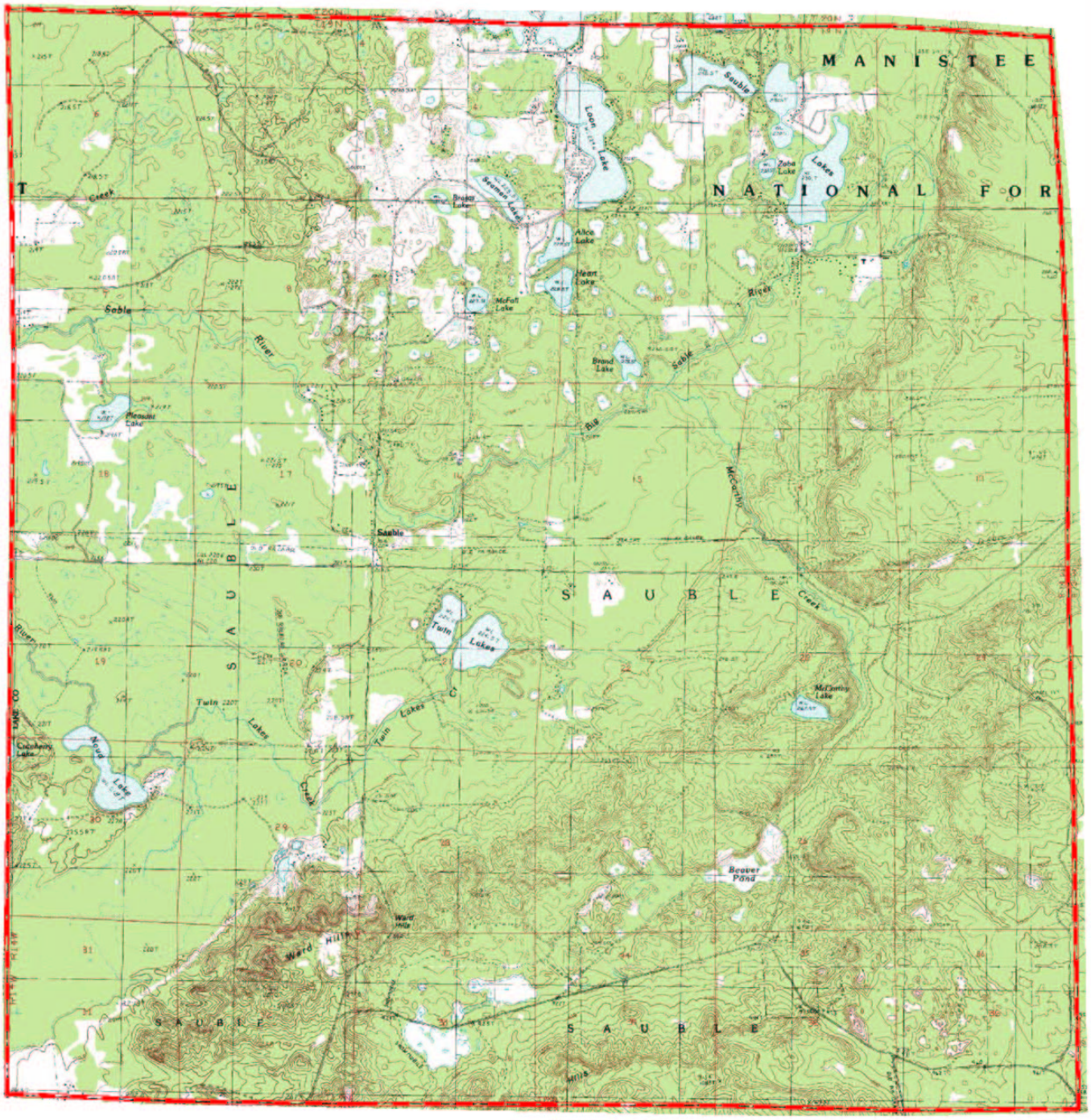
5.	Vital or Critical Infrastructure	
a.	**roads, railroads, and bridges:**	- None Identified
b.	**dams, power stations, water treatment plants, sanitary lift stations, etc.:**	- None Identified
c.	**other: (describe – i.e. airports, pipelines, bus terminals, train stations, military bases, marine passenger ferry services, etc.)**	- None Identified

6.	Socio-Economic Profile of Sector		
a.	**total population (night):**		333
b.	**peak population (seasonal):**		1,228 (estimate)
c.	**percent over 65:**		36.3
d.	**percent under 18:**		9.6
e.	**percent that are homeowners:**		91.6
f.	**percent below poverty level:**		8.7
g.	**percent with disability or mobility limitation:**	*(Population 5 years and over)*	24.7
h.	**estimated property insurance coverage (Real and Personal Equalized Valuations):**	Agricultural:	$0
		Commercial:	$606,454
		Industrial:	$0
		Residential:	$23,831,790
		Timber-Cutover:	$0
		Total Personal:	$968,700
		Total:	$25,406, 944
i.	**flood insurance coverage:**	Total Claims since 01/01/78:	N/A
		Total Payments since 01/01/78:	N/A
		Policies In-Force:	N/A
		Total Insurance In-Force:	N/A
j.	**location of floodplains:**	- None Identified	

7.	Emergency Warning System Coverage	
a.	**siren locations and/or description of warning system:**	- None Identified
b.	**percent of population covered by warning sirens or system:**	N/A

USGS Topographic Map

Sauble Township



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Source: Michigan Geographic Data Library
Created by WMSRDC
September 2004

SWEETWATER TOWNSHIP

1.	**major geographic features:**	- 6.8 people per square mile of land area - 10.2 housing units per square mile of land area - Scattered rural housing - Densely forested (Manistee National Forest) - Pere Marquette River - 6 to 8 small lakes and ponds, 2 to 4 small creeks
2.	**Population Concentrations** (including special facilities)	
a.	**group homes:**	- Sweetwater Creek AFC, 758 S Tyndall, Branch, MI (6 Capacity)
b.	**large apartment buildings:**	- None Identified
c.	**schools:**	- None Identified
d.	**large office buildings:**	- See 4.g.
e.	**other (describe – i.e. such as stadiums, concert halls, amusement parks, fairgrounds, correctional facilities, nursing homes, other special populations or large crowd assembly areas):**	- Pere Marquette Campground, 11713 W. 40th St (30 sites)
f.	**major employers:**	- None Identified
3.	**Population Shifts** (location; time, date or season of shift; extent of shift)	
a.	**daily:**	- 49 commuters with an average commuting time of 23.6 minutes - 83 attend school
b.	**seasonal:**	- 364 total housing units: 116 occupied/248 vacant; of the 248 vacant, 206 are for seasonal recreational or occasional use
4.	**Important or Critical Public and Private Facilities**	
a.	**police precincts:**	- None Identified
b.	**fire stations:**	- None Identified
c.	**public works yards:**	- None Identified
d.	**pumping stations:**	- None Identified
e.	**community shelters:**	- Sweetwater Town Hall, 11265 Stevenson, Branch, MI 49402
f.	**community medical facilities, hospitals:**	- None Identified
g.	**historic sites:**	-None Identified
h.	**other (describe – i.e., government buildings, record center, major construction companies, warehouses, demolition companies, heavy equipment rental, emergency equipment and vehicle storage areas, etc.):**	- Sweetwater Township Hall, 11265 W. Stevenson Rd. - United States Post Office - Branch Main Office, 11952 W. US Highway 10

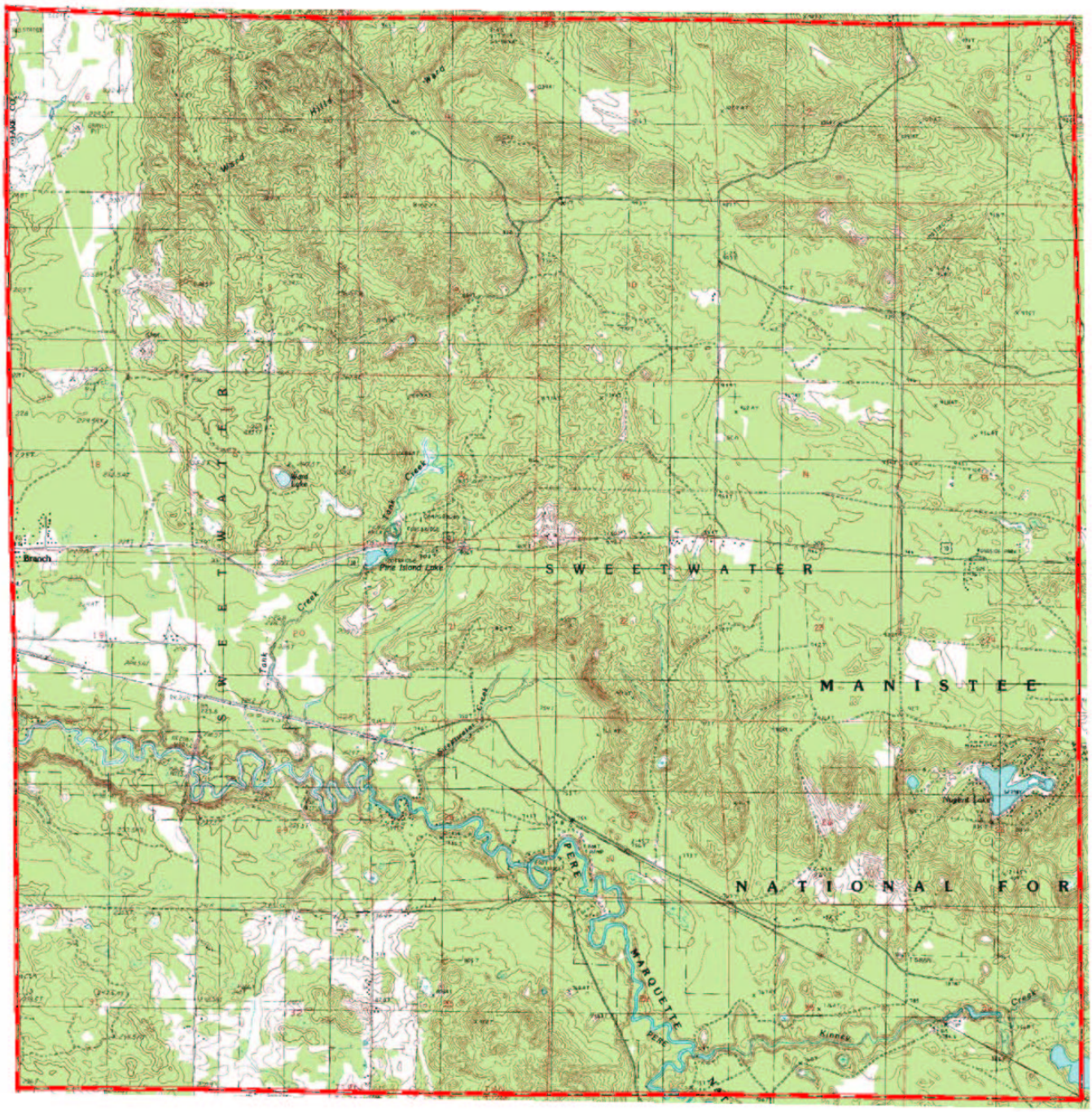
5.	Vital or Critical Infrastructure	
a.	**roads, railroads, and bridges:**	- US-10 - Pere Marquette Railroad (Genesee & Wyoming Inc.)
b.	**dams, power stations, water treatment plants, sanitary lift stations, etc.:**	- None Identified
c.	**other: (describe – i.e. airports, pipelines, bus terminals, train stations, military bases, marine passenger ferry services, etc.)**	- None Identified

6.	Socio-Economic Profile of Sector		
a.	**total population (night):**		248
b.	**peak population (seasonal):**		825 (estimate)
c.	**percent over 65:**		29.4
d.	**percent under 18:**		12.7
e.	**percent that are homeowners:**		90.5
f.	**percent below poverty level:**		37.3
g.	**percent with disability or mobility limitation:**	*(Population 5 years and over)*	32.8
h.	**estimated property insurance coverage (Real and Personal Equalized Valuations):**	Agricultural: Commercial: Industrial: Residential: Timber-Cutover: Total Personal: Total:	$0 $339,215 $30,565 $10,843,456 $107,134 $4,265,900 $15,586,270
i.	**flood insurance coverage:**	Total Claims since 01/01/78: Total Payments since 01/01/78: Policies In-Force: Total Insurance In-Force:	N/A N/A N/A N/A
j.	**location of floodplains:**	- None Identified	

7.	Emergency Warning System Coverage	
a.	**siren locations and/or description of warning system:**	- None Identified
b.	**percent of population covered by warning sirens or system:**	N/A

USGS Topographic Map

Sweetwater Township



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Source: Michigan Geographic Data Library
Created by WMSRDC
September 2004

WEBBER TOWNSHIP

1.	**major geographic features:**	- 47.9 people per square mile of land area - 42.6 housing units per square mile of land area - Scattered rural housing, moderate residential areas near Baldwin - Densely forested (Manistee National Forest) - Baldwin River - 18 to 20 small lakes and ponds, 4 to 6 small creeks
2.	**Population Concentrations** (including special facilities)	
a.	**group homes:**	- None Identified
b.	**large apartment buildings:**	- None Identified
c.	**schools:**	- None Identified
d.	**large office buildings:**	- See 4.g.
e.	**other (describe – i.e. stadiums, concert halls, amusement parks, fairgrounds, correctional facilities, nursing homes, other special populations or large crowd assembly areas):**	- Lake County Care Center, 4153 S. M-37 (nursing home) - Williams Child and Family Development Center, 2448 W. 44th (56 units) - Bray Creek State Forest Campground, 2501 W. 40th St. (9 campsites) - Leverentz Lake State Forest Campground, 5500 S. Forest Dr. (18 campsites) - Canoe Country Motel, 3216 S. M-37 - Tarry Motel, 3280 S. M-37 (11 rooms) - Cloud Nine, 2733 S. M-37 (8 cabins) - North Country Campground and Country Store, 1928 S M-37 (25 sites) - Putman Lake Campground, 2240 Wonderland St. (42 sites) - Whispering Oaks Campground, 8586 S. M-37 (35 sites) - North Lake Correctional Facility, 1805 W 32nd St (2,580 inmate capacity)
f.	**major employers:**	- Peacock Industries, Inc., 2431 S. M-37 (40 employees) - Baldwin Teen Health Center, 4967 Michigan Ave. (34 employees) - Austin Tube Products, 5629 Forman Rd. (30 employees)
3.	**Population Shifts** location; time, date or season of shift; extent of shift *(numbers include Village of Baldwin)*	
a.	**daily:**	- 378 commuters with an average commuting time of 13.1 minutes - 242 attend school
b.	**seasonal:**	- 1,513 total housing units: 664 occupied/849 vacant; of the 849 vacant, 583 are for seasonal recreational or occasional use
4.	**Important or Critical Public and Private Facilities**	
a.	**police precincts:**	- None Identified
b.	**fire stations:**	- Webber Township Fire Department, 2451 W 36th St
c.	**public works yards:**	- None Identified
d.	**pumping stations:**	- None Identified
e.	**community shelters:**	- Baldwin Assembly of God, 10063 S M-37, Baldwin, MI 49304
f.	**community medical facilities, hospitals:**	- Lake County Care Center, 4153 S. M-37
g.	**historic sites:**	- None Identified
h.	**other (describe – i.e.,**	- Webber Township Hall, 2286 W. Springtime St.

	government buildings, record center, major construction companies, warehouses, demolition companies, heavy equipment rental, emergency equipment and vehicle storage areas, etc.):	- Michigan Department of Natural Resources – Baldwin Field Office, 2468 W. 24th St.

5. Vital or Critical Infrastructure

a.	**roads, railroads, and bridges:**	- US-10 - M-37
b.	**dams, power stations, water treatment plants, sanitary lift stations, etc.:**	- None Identified
c.	**other: (describe – i.e. airports, pipelines, bus terminals, train stations, military bases, marine passenger ferry services, etc.)**	- MichCon Gas Pipeline

6. Socio-Economic Profile of Sector

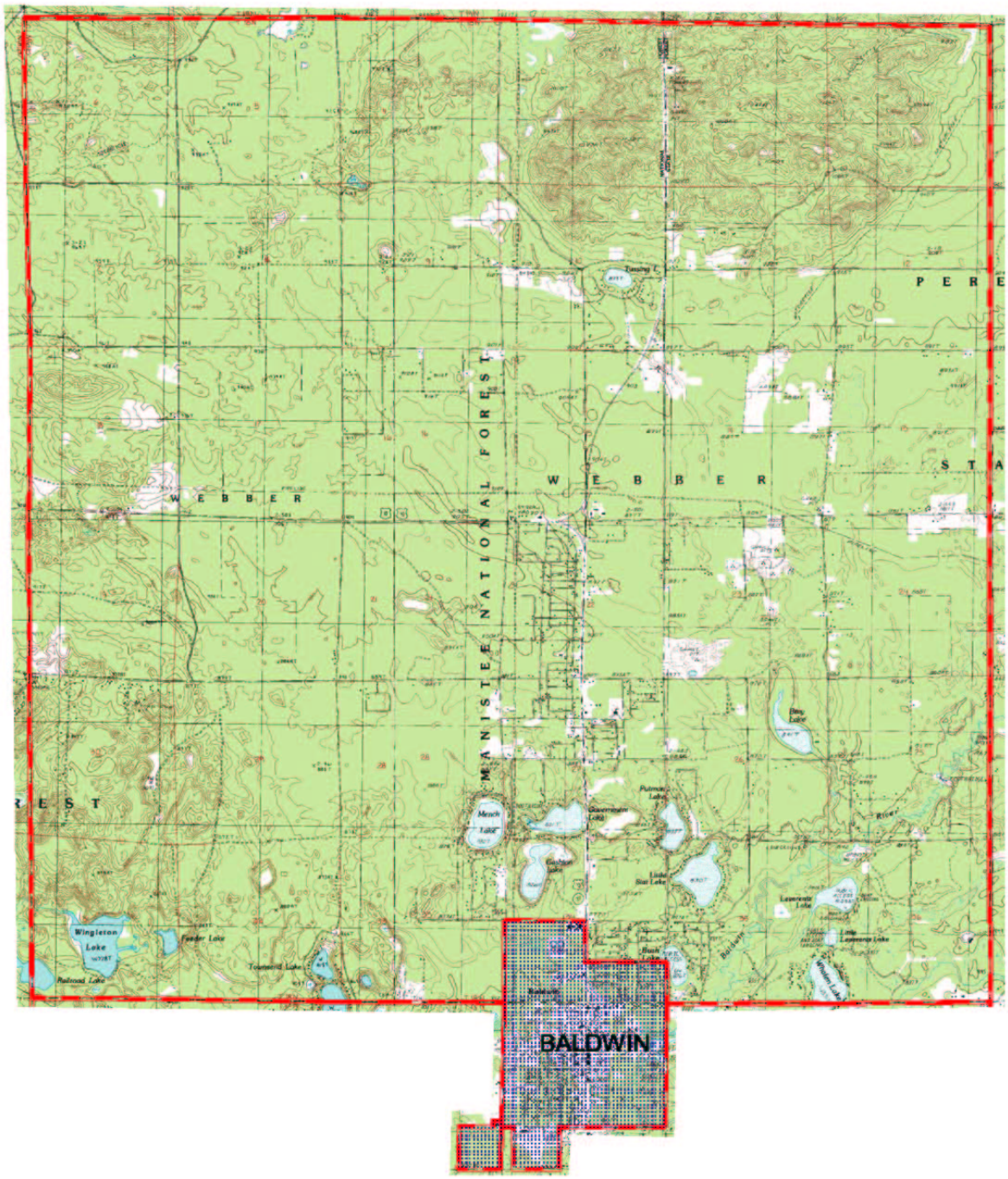
a.	**Total population (night):**	*(numbers include Village of Baldwin)*	1,699
b.	**peak population (seasonal):**	*(numbers include Village of Baldwin)*	2,888 (estimate)
c.	**percent over 65:**		21.5
d.	**percent under 18:**		16.5
e.	**percent that are homeowners:**		64
f.	**percent below poverty level:**		27.9
g.	**percent with disability or mobility limitation:**	*(Population 5 years and over)*	41.9
h.	**estimated property insurance coverage (Real and Personal Equalized Valuations):**	Agricultural: Commercial: Industrial: Residential: Timber-Cutover: Total Personal: Total:	$0 $70,990,693 $414,585 $28,906,976 $0 $5,876,500 $106,188,754
i.	**flood insurance coverage:**	Total Claims since 01/01/78: Total Payments since 01/01/78: Policies In-Force: Total Insurance In-Force:	3 $55,520 N/A N/A
j.	**location of floodplains:**	- None Identified	

7. Emergency Warning System Coverage

a.	**siren locations and/or description of warning system:**	- NOAA Transmission Tower Siren
b.	**percent of population covered by warning sirens or system:**	- NOAA Transmission Tower covers Lake County, Mason County, and Osceola County

USGS Topographic Map

Webber Township



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Source: Michigan Geographic Data Library
Created by WMSRDC
September 2004

YATES TOWNSHIP

1.	**major geographic features:**	- 21.3 people per square mile of land area - 40.7 housing units per square mile of land area - Scattered rural housing, moderate residential area near lakes - Densely forested (Manistee National Forest) - Idlewild Lake - Pere Marquette River Middle Branch - 8 to 10 small lakes and ponds, 4 to 6 small creeks
2.	**Population Concentrations** (including special facilities)	
a.	**group homes:**	- None Identified
b.	**large apartment buildings:**	- Idlewild Garden Housing, 587 Lansing Dr. (23 elderly units) - Duvernay Park Apartments, Lyndon St. (6 buildings, 24 family units)
c.	**schools:**	- None Identified
d.	**large office buildings:**	- See 4.g.
e.	**other (describe – i.e. stadiums, concert halls, amusement parks, fairgrounds, correctional facilities, nursing homes, other special populations or large crowd assembly areas):**	- Morton's Motel, 6389 Tacoma St. (17 rooms) - Idlewild Music Festival , Paradise Lake - Idlewild Independence Day Parade
f.	**major employers:**	- Yates Dial-A-Ride, 1399 US-10, Idlewild, MI 49642 (30 employees)
3.	**Population Shifts** (location; time, date or season of shift; extent of shift)	
a.	**daily:**	- 76 commuters with an average commuting time of 28.3 minutes - 66 attend school
b.	**seasonal:**	- 1,454 total housing units: 379 occupied/1,075 vacant; of the 1,075 vacant, 958 are for seasonal recreational or occasional use
4.	**Important or Critical Public and Private Facilities**	
a.	**police precincts:**	- None Identified
b.	**fire stations:**	- Yates Township Fire Department, 2155 E US 10
c.	**public works yards:**	- None Identified
d.	**pumping stations:**	- None Identified
e.	**community shelters:**	- Yates Township Fire Department, 2155 US-10, Idlewild, MI 49642 - Yates Township Hall, 6437 S Nelson Rd, Idlewild, MI 49642
f.	**community medical facilities, hospitals:**	- None Identified
g.	**historic sites:**	- Idlewild Historic District (Includes 500 Structures)
h.	**other (describe – i.e., government buildings, record center, major construction companies, warehouses, demolition companies, heavy equipment rental, emergency equipment and vehicle storage areas, etc.):**	- Yates Township Hall, 639 Lansing Dr. - Yates Township Library, 413 E Baldwin Rd - United States Post Office – Idlewild, 812 Essex Dr

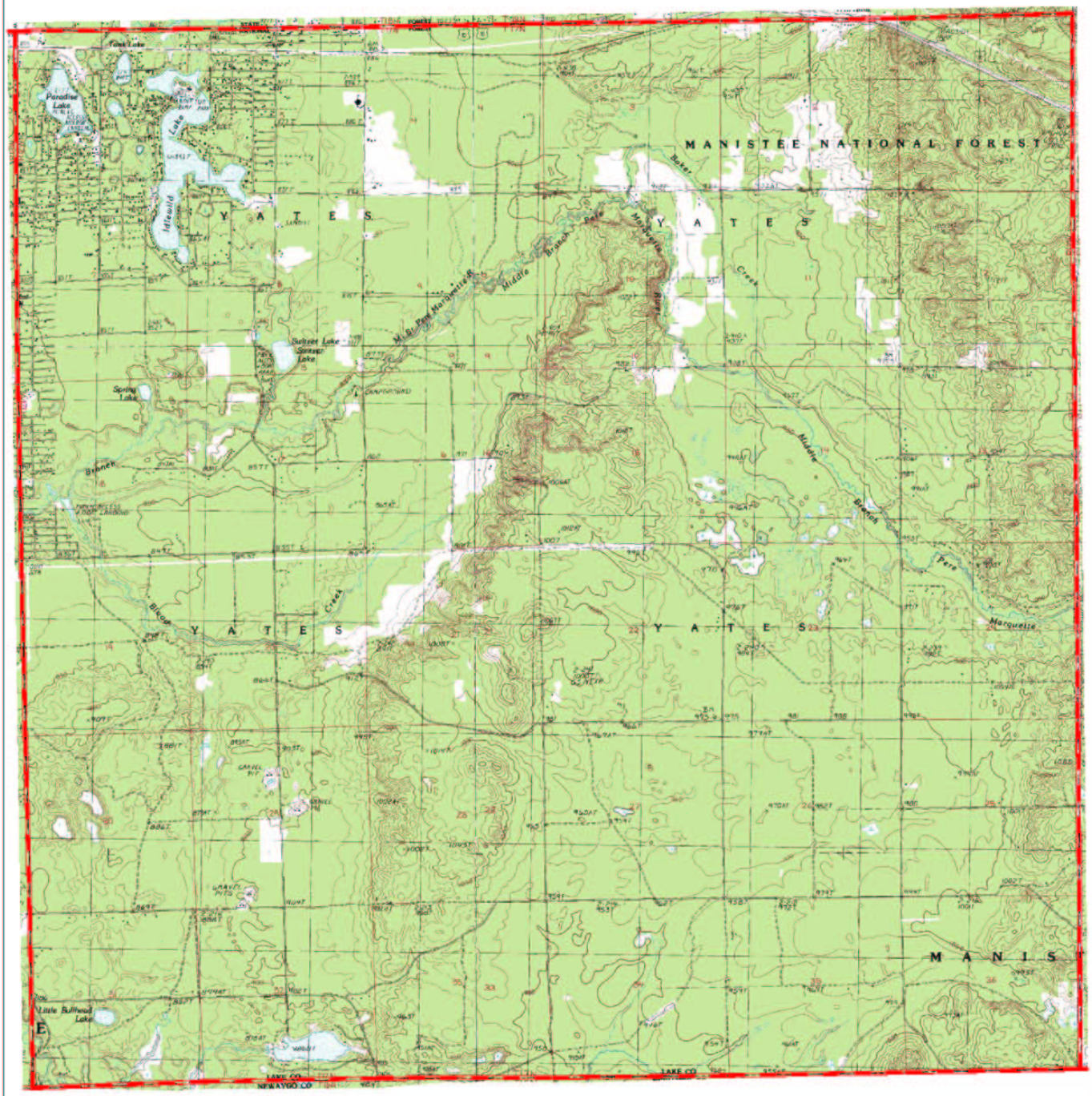
5.	Vital or Critical Infrastructure	
a.	**roads, railroads, and bridges:**	- US-10
b.	**dams, power stations, water treatment plants, sanitary lift stations, etc.:**	- Lake Connamara Dam
c.	**other: (describe – i.e. airports, pipelines, bus terminals, train stations, military bases, marine passenger ferry services, etc.)**	- None Identified

6.	Socio-Economic Profile of Sector		
a.	**total population (night):**		761
b.	**peak population (seasonal):**		2,687 (estimate)
c.	**percent over 65:**		26.3
d.	**percent under 18:**		18
e.	**percent that are homeowners:**		71.5
f.	**percent below poverty level:**		32.5
g.	**percent with disability or mobility limitation:**	*(Population 5 years and over)*	40.3
h.	**estimated property insurance coverage(Real and Personal Equalized Valuations):**	Agricultural: Commercial: Industrial: Residential: Timber-Cutover: Total Personal: Total:	$25,236 $378,545 $0 $25,128,469 $656,575 $998,700 $27,187,525
i.	**flood insurance coverage:**	Total Claims since 01/01/78: Total Payments since 01/01/78: Policies In-Force: Total Insurance In-Force:	0 $0 2 $91,600
j.	**location of floodplains:**	- Floodplains along Pere Marquette River and Blood Creek	

7.	Emergency Warning System Coverage	
a.	**siren locations and/or description of warning system:**	- Siren located at former Yates Township Fire Department, 16237 Lake Drive, Idlewild, MI 49642
b.	**percent of population covered by warning sirens or system:**	- Siren covers a ½ to 2 mile radius depending on wind and humidity

(Note: Map showing warning siren location and system coverage is included in Part D)

Yates Township



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Source: Michigan Geographic Data Library
Created by WMSRDC
September 2004

Appendix B:

Hazard Identifications and Analyses

Hazard Identification Profile

Lake County

1. NATURAL HAZARDS

1.01 Celestial Impacts: - None Identified.

1.02 Drought:

- Summer 1871: Prolonged drought over much of the Great Lakes region.
- May-September, 1891: Drought devastated Michigan's lumber industry.
- 12 recorded drought events in the area (including Lake, Mason, Muskegon, Newaygo, and Oceana counties) lasting eight months or greater: 1895-1896 (15 months), 1899-1900 (11 months), 1901-1902 (10 months), 1909-1911 (24 months), 1925-1926 (11 months), 1930-1931 (18 months), 1956-1957 (8 months), 1962-1963 (9 months), 1971-1972 (12 months), 1976-1977 (13 months), and 2002-2003 (12 months).

1.03 Earthquake: - None Identified.

1.04 Extreme Temperatures:

- February 10-13, 1899: Record cold. Record lows of -36, -49, -48, and -37, Village of Baldwin.
- July 1936: Heatwave. 570 deaths statewide, 364 in Detroit.
- Summer, 1988: 39 days with temperatures over 90 degrees, statewide.
- January 20, 1994: Record cold. $50m property damage across Michigan.
- March 2012: Anomalous temperatures. $209.8m crop damage across Michigan.

1.05 Flooding - Riverine/ Urban:

- September 10-19, 1986: Flooding. Declaration of disaster by Governor, Presidential disaster declaration, Lake County.
- August 6, 1998: Flash flood. $10k property damage, northwest Lake County.
- February 10, 2001: Flooding. $100k property damage, western Michigan.
- May 21-23, 2004: Flooding. $25m property damage, $4.6m crop damage, western Lower Michigan.
- June 13, 2008: Flash flood. $2m property damage, $500k crop damage, Presidential disaster declaration, Lake County.
- May 3, 2012: Flash flood. $70k property damage, Lake County.
- April 17-23, 2013: Flood. $3m property damage, Lake County.
- April 2014: Flood. (details yet to come), Lake County.

1.06 Fog:

- January 11-13, 1995: Dense Fog. Four traffic accident fatalies, school closures, and flight delays across Lower Michigan.

1.07 Great Lakes Shoreline Hazards: - None Identified.

1.08 Hail:

- Severe hail events (1" or greater) recorded in Lake County since 1996: 9
- May 8, 2000: 1 inch Hail. $20k property damage, Village of Baldwin.
- August 9, 2000: 1.75 inch hail. $50k property damage, $25k crop damage, Village of Luther.
- May 23, 2001: .75 inch hail. $10k property damage, $10k crop damage, Village of Baldwin.
- May 11, 2003: .88 inch hail. $10k property damage, $10k crop damage, Bristol (Dover Township).
- June 8, 2003: .75 inch hail. $20k property damage and $20k crop damage, Pleasant Plains Township.

1.09 Invasive Species:

- Invasive species exist in Lake County, however no significant events have been identified.

1.10 Lightning: - None Identified.

1.11 Severe Winds:

- April 6, 1997: High wind. $5m property damage across southwest Lower Michigan.
- May 29, 1998: Severe thunderstorm winds. $10k property damage, Irons.
- May 31, 1998: Severe thunderstorm winds. Declaration of local of emergency and $1.1m property damage, Lake County.
- February 11, 1999: Severe thunderstorm winds and high winds. $10k property damage, Baldwin Village.
- June 6, 1999: Severe thunderstorm winds. $10k property damage, Baldwin Village.
- July 23, 1999: Severe thunderstorm winds. $10k property damage, Irons.
- June 1, 2000: Severe thunderstorm winds. $25k property damage, Lake County.
- July 13, 2000: Severe thunderstorm winds. $25k property damage, Lake County.
- June 18, 2001: High wind. $100k property damage across central Lower Michigan.
- August 9, 2001: Severe thunderstorm winds. $25k property damage, Lake County.
- August 30, 2001: Severe thunderstorm winds. $100k property damage, Pleasant Plains and Yates Townships.
- March 9, 2002: High wind. $485k property damage across southwest Lower Michigan.
- July 13, 2004: Severe thunderstorm winds. $10k property damage, Irons and Big Bass Lake areas.
- August 2, 2004: Severe thunderstorm winds. $10k property damage, Chase and Pleasant Plains townships.
- October 30, 2004: High wind. $1.15m property damage across southwest Lower Michigan.
- July 24, 2005: Severe thunderstorm winds. $25k property damage, Lake County.
- July 26, 2005: Severe thunderstorm winds. $25k property damage, Lake County.
- September 13, 2005: Severe thunderstorm winds. $20k property damage, Peacock Township.
- April 25, 2005: Severe thunderstorm winds. $20k property damage, northwest Lake County.
- May 3, 2012: Severe thunderstorm winds. $500k property damage, Lake County.
- August 7, 2013: Severe thunderstorm winds. $100k property damage, Lake County.
- November 17, 2013: High wind. $75k property damage, Lake County.

1.12 Subsidence: - None Identified.

1.13 Tornadoes:

- June 8, 1985: F1 tornado. No documented damages, unknown location in Lake County.
- July 26, 2005: F1 tornado. $150k property damage and $50k crop damage, Lake Township.

1.14 Wildfire:

- October 1871: Wildfires. 1.2m acres burned, 200 fatalities, Lower Peninsula.
- May-September, 1891: Uncontrollable wildfires across Michigan during the drought of 1891.
- 1994: "County Line Fire." 900 acres burned, Pleasant Plains Township.
- 1981-2010: Approximately 11 wildfires and 43 acres burned per year on county lands under MDNR jurisdiction (315 total wildfires, 1,283.5 total acres burned).
- May 9, 2011: "8th St. Fire." 153 acres burned in Newkirk Township.

1.15 Winter Storms:

- January 26, 1978: Blizzard, snowstorm. Declaration of statewide emergency by President, disaster by Governor.
- January 12, 1993: Heavy snow. $50k property damage, northern Lower Michigan.
- April 1, 1993: Heavy snow. $50k property damage, Lower Michigan.
- January 12-21, 1994: Heavy lake effect snow. $500k property damage across western Lower Michigan.
- January 27, 1994: Heavy snow and freezing rain. $5m property damage across region.
- March 9, 1998: Winter storm. $100k property damage across region.
- January 2-25, 1999: Blizzard, lake effect snow. "Blizzard of '99". southern Lower Michigan.
- April 3, 2003: Ice storm. $4.9m property damage throughout West Michigan.
- December 11-12, 2010: Winter storm. $250k property damage, west-central Lower Michigan.
- March 2-3, 2012: Heavy snow. $100k property damage, power outages, and shelters opened in Lake County.

2. TECHNOLOGICAL HAZARDS

2.01 Dam Failure:

- September 1986: Floods triggered dam failures at Baldwin's Rearing Pond, Danaher Lake, and Luther Mill Pond.
- May 1993: Luther Dam failed, due to poor reconstruction, as impoundment was being refilled.

2.02 Energy Emergencies: - None Identified.

2.03 Fire - Scrap Tire: - None Identified.

2.04 Fire - Structural:

- County fire rate per 1,000 population in 1998: 3.09

2.05 Hazard Material Incidents - Fixed Site (including industrial accidents): - None Identified.

2.06 Hazard Material Incidents - Transportation: - None Identified.

2.07 Infrastructure Failure:

- Number of NCDC events showing downed power lines or power outages in Lake County, 1997-2012: 18
- April 6-7,1997: 180,000-200,000 without power; 70,000 on second day (high wind event), statewide.
- March 9, 1998: 1,900 power outages (blizzard conditions), Lake, Clare, Oceana and Muskegon counties.
- May 29, 1998: Downed power lines and trees (thunderstorm winds), Irons.
- July 13, 2000: Downed power lines (thunderstorm winds), Sweetwater Township.
- February 9-10, 2001: Portions of M-37 closed (flooding), Lake County.
- August 9, 2001: Power outages, downed power lines and downed trees (thunderstorm winds), Baldwin Village.
- April 3, 2003: Hundreds of thousands lose power (ice storm), Lower Michigan. .
- July 13, 2004: Several trees and wires blown down (thunderstorm winds), Irons and Bass Lake areas.
- October 10, 2004: 100,000 without power (high wind), statewide.
- September 13, 2005: Numerous trees and power lines blown down (thunderstorm winds), Peacock Township.
- June 13, 2008: Numerous roads washed out (flash flood), Lake County.
- June 28, 2008: Three-quarters of Lake County without power (thunderstorm winds), Lake County.
- August 2, 2011: Road washout at 56th and Queens Highway (flash flood), Yates Township.
- May 3, 2012: Several roads flooded or washed out (flash flood), Lake County.
- July 5, 2012: Trees and power lines blown down (thunderstorm winds), Baldwin Village.

2.08 Nuclear Power Plant Emergencies: - None Identified.

2.09 Oil and Natural Gas Well Accidents:

- 268 oil and gas wells within Lake County.
- 11 wells known to have detectable levels of hydrogen sulfide, Peacock Township.
- 1 well known to have detectable levels of hydrogen sulfide, Sauble Township.

2.10 Pipeline Accidents:

- June 23, 1999: Broken gas main. Nearby residences evacuated, Pleasant Plains Township.

2.11 Transportation Accidents: - None Identified.

3. HUMAN -RELATED HAZARDS

3.01 Catastrophic Incidents (National Emergencies): - None Identified.

3.02 Civil Disturbances: - None Identified.

3.03 Nuclear Attack: - None Identified.

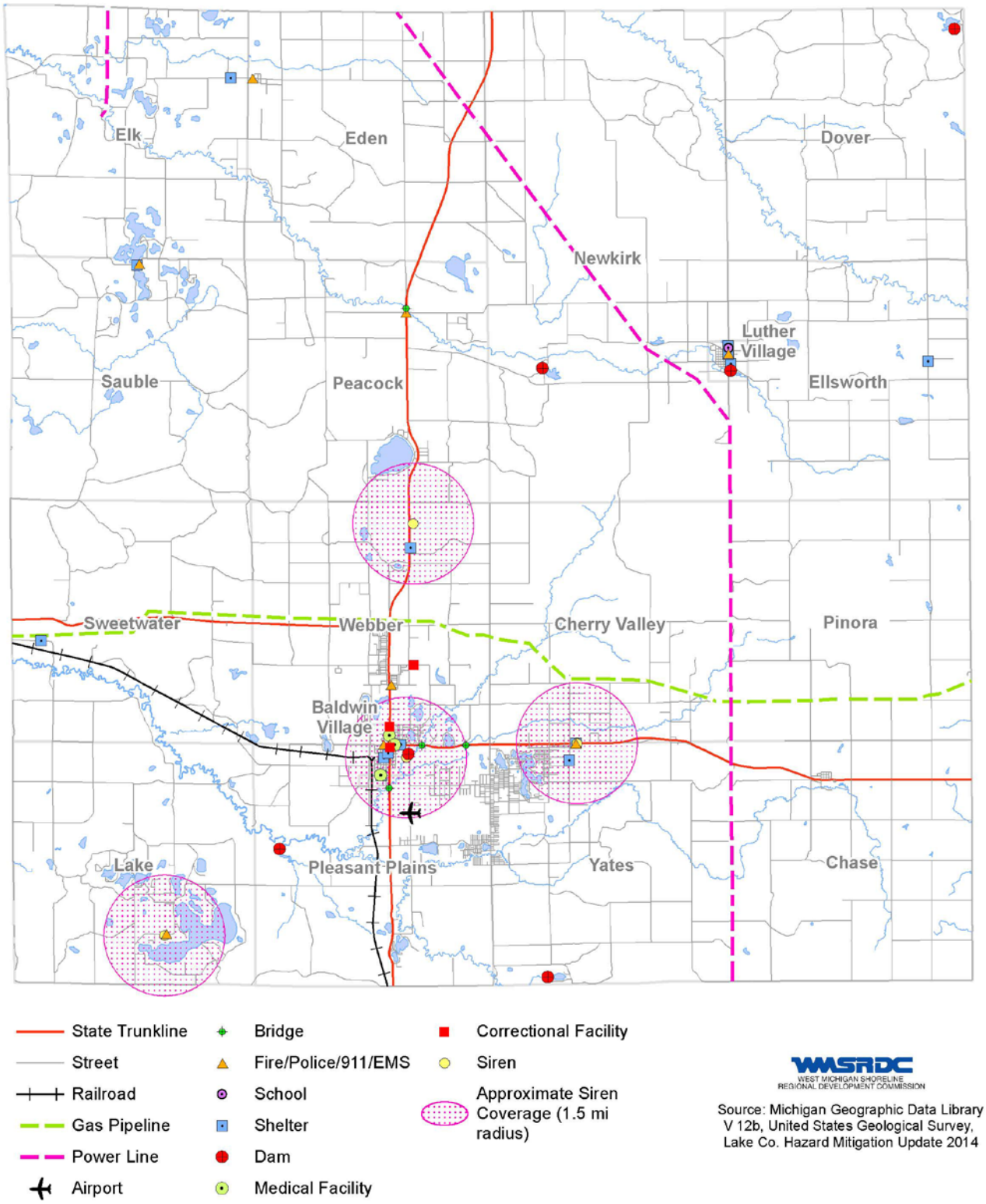
3.04 Public Health Emergencies: - None Identified.

3.05 Terrorism and Similar Criminal Activities: - None Identified.

	Lake County Hazard Rating	Probability of Occurrence	Impact on People	Impact on Property	Impact on Economy	Impacts Total	Hazard Score
1.01	Celestial Impacts	1	2	0	2	8	8
1.02	Drought	2	2	1	2	10	20
1.03	Earthquake	0	-	-	-	-	-
1.04	Extreme Temperatures	3	2	1	1	9	27
1.05	Flooding: Riverine/Urban	3	1	2	1	8	24
1.06	Fog	3	1	0	1	4	12
1.07	Great Lakes Shoreline	0	-	-	-	-	-
1.08	Hail	3	1	1	1	6	18
1.09	Invasive Species	2	1	1	1	6	12
1.10	Lightning	3	1	2	1	8	24
1.11	Severe Winds	3	2	2	2	12	36
1.12	Subsidence	1	1	1	1	6	6
1.13	Tornadoes	2	1	2	2	9	18
1.14	Wildfire	3	2	2	1	11	33
1.15	Winter Storms	3	3	2	2	15	45
2.01	Dam failure	2	1	2	2	9	18
2.02	Energy Emergencies	2	2	0	2	8	16
2.03	Fire – Scrap Tires	1	1	1	1	6	6
2.04	Fire – Structural	3	1	2	2	9	27
2.05	HAZMAT – Fixed Site	0	-	-	-	-	-
2.06	HAZMAT – Transportation	2	1	1	1	6	12
2.07	Infrastructure Failures	3	2	1	2	10	30
2.08	Nuclear Power Emergencies	0	-	-	-	-	-
2.09	Oil/Natural Gas Well Accidents	2	1	1	1	6	12
2.10	Pipeline Accidents	2	1	1	1	6	12
2.11	Transportation Accidents	2	1	1	1	6	12
3.01	Catastrophic Incidents	1	3	3	3	18	18
3.02	Civil Disturbances	1	1	1	1	6	6
3.03	Nuclear Attack	0	-	-	-	-	-
3.04	Public Health Emergencies	2	2	0	2	8	16
3.05	Terrorism & Similar Criminal Acts	1	1	1	1	6	6

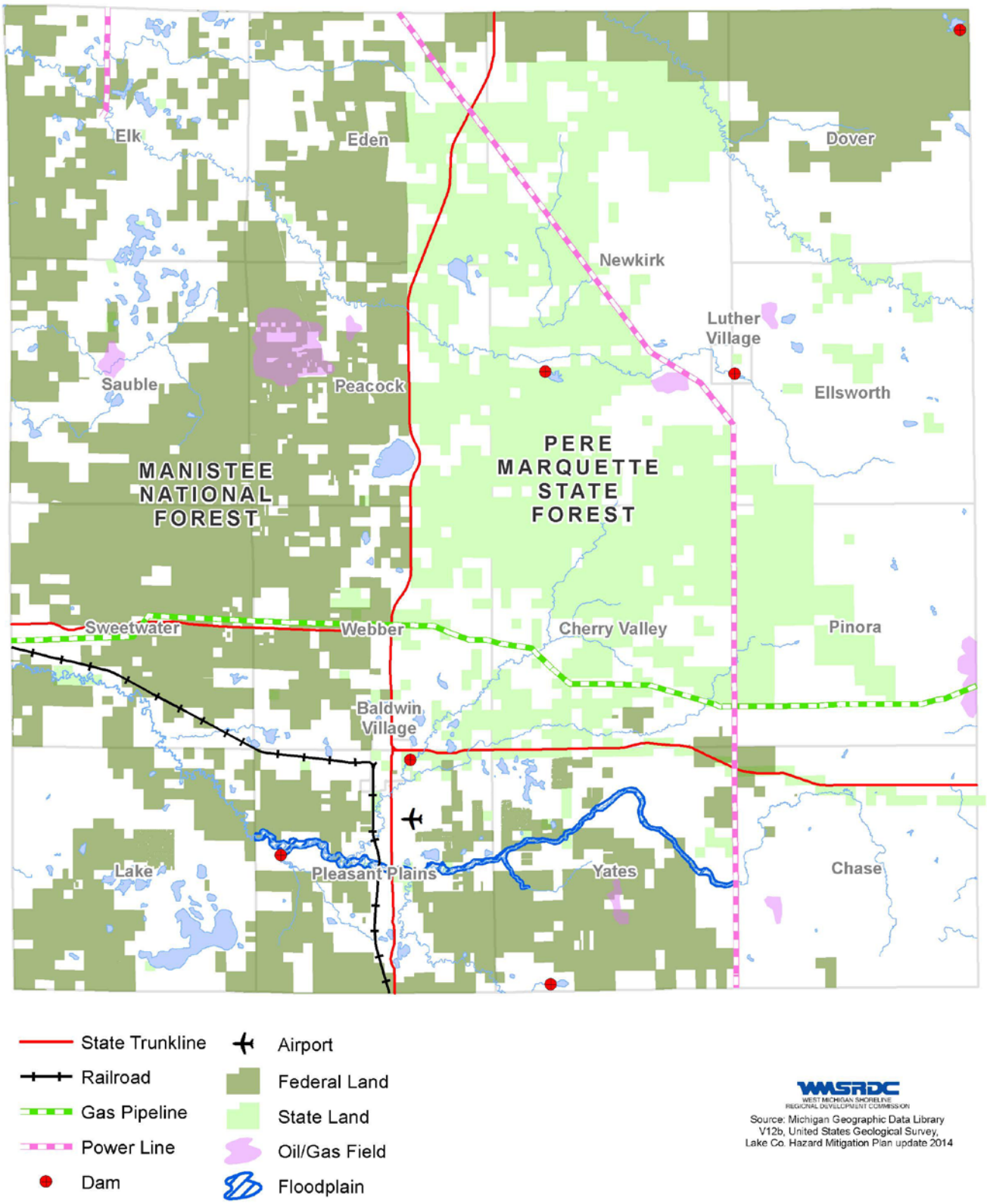
	Lake County Hazard Ranking	Probability of Occurrence	X	Impacts Total	=	Hazard Score
1	Winter Storms	3		15		45
2	Severe Winds	3		12		36
3	Wildfire	3		11		33
4	Infrastructure Failures	3		10		30
5	Extreme Temperatures	3		9		27
5	Fire – Structural	3		9		27
7	Flooding: Riverine/Urban	3		8		24
7	Lightning	3		8		24
9	Drought	2		10		20
10	Catastrophic Incidents	1		18		18
10	Dam failure	2		9		18
10	Hail	3		6		18
10	Tornadoes	2		9		18
14	Energy Emergencies	2		8		16
14	Public Health Emergencies	2		8		16
16	Fog	3		4		12
16	HAZMAT – Transportation	2		6		12
16	Invasive Species	2		6		12
16	Oil/Natural Gas Well Accidents	2		6		12
16	Pipeline Accidents	2		6		12
16	Transportation Accidents	2		6		12
22	Celestial Impacts	1		8		8
23	Civil Disturbances	1		6		6
23	Fire – Scrap Tires	1		6		6
23	Subsidence	1		6		6
23	Terrorism & Similar Criminal Acts	1		6		6
	Earthquake	0		-		-
	Great Lakes Shoreline	0		-		-
	HAZMAT – Fixed Site	0		-		-
	Nuclear Attack	0		-		-
	Nuclear Power Emergencies	0		-		-

LAKE COUNTY
Critical Facilities



Source: Michigan Geographic Data Library V 12b, United States Geological Survey, Lake Co. Hazard Mitigation Update 2014

LAKE COUNTY
Potential Hazards



Hazard Identification Profile

Baldwin Village

1. NATURAL HAZARDS

1.01 Celestial Impacts: - None Identified.

1.02 Drought:

- Summer 1871: Prolonged drought over much of the Great Lakes region.
- May-September, 1891: Drought devastated Michigan's lumber industry.
- 12 recorded drought events in the area (including Lake, Mason, Muskegon, Newaygo, and Oceana counties) lasting eight months or greater: 1895-1896 (15 months), 1899-1900 (11 months), 1901-1902 (10 months), 1909-1911 (24 months), 1925-1926 (11 months), 1930-1931 (18 months), 1956-1957 (8 months), 1962-1963 (9 months), 1971-1972 (12 months), 1976-1977 (13 months), and 2002-2003 (12 months).

1.03 Earthquake: - None Identified.

1.04 Extreme Temperatures:

- February 10-13, 1899: Record cold. Record lows of -36, -49, -48, and -37, Village of Baldwin.
- July 1936: Heatwave. 570 deaths statewide, 364 in Detroit.
- Summer, 1988: 39 days with temperatures over 90 degrees, statewide.
- January 20, 1994: Record cold. $50m property damage across Michigan.
- March 2012: Anomalous temperatures. $209.8m crop damage across Michigan.

1.05 Flooding - Riverine/ Urban:

- September 10-19, 1986: Flooding. Declaration of disaster by Governor, Presidential disaster declaration, Lake County.
- February 10, 2001: Flooding. $100k property damage, western Michigan.
- May 21-23, 2004: Flooding. $25m property damage, $4.6m crop damage, western Lower Michigan.
- June 13, 2008: Flash flood. $2m property damage, $500k crop damage, Presidential disaster declaration, Lake County.
- May 3, 2012: Flash flood. $70k property damage, Lake County.
- April 17-23, 2013: Flood. $3m property damage, Lake County.
- April 2014: Flood. (details yet to come), Lake County.

1.06 Fog:

- January 11-13, 1995: Dense Fog. Four traffic accident fatalies, school closures, and flight delays across Lower Michigan.

1.07 Great Lakes Shoreline Hazards: - None Identified.

1.08 Hail:

- Severe hail events (1" or greater) recorded in Lake County since 1996: 9

- May 8, 2000: 1 inch Hail. $20k property damage, Village of Baldwin.
- May 23, 2001: .75 inch hail. $10k property damage, $10k crop damage, Village of Baldwin.

1.09 Invasive Species:

- Invasive species exist in Lake County, however no significant events have been identified.

1.10 Lightning: - None Identified.

1.11 Severe Winds:

- April 6, 1997: High wind. $5m property damage across southwest Lower Michigan.
- May 31, 1998: Severe thunderstorm winds. Declaration of local of emergency and $1.1m property damage, Lake County.

- February 11, 1999: Severe thunderstorm winds and high winds. $10k property damage, Baldwin Village.
- June 6, 1999: Severe thunderstorm winds. $10k property damage, Baldwin Village.

- June 1, 2000: Severe thunderstorm winds. $25k property damage, Lake County.
- July 13, 2000: Severe thunderstorm winds. $25k property damage, Lake County.
- June 18, 2001: High wind. $100k property damage across central Lower Michigan.
- August 9, 2001: Severe thunderstorm winds. $25k property damage, Lake County.
- March 9, 2002: High wind. $485k property damage across southwest Lower Michigan.
- October 30, 2004: High wind. $1.15m property damage across southwest Lower Michigan.
- July 24, 2005: Severe thunderstorm winds. $25k property damage, Lake County.
- July 26, 2005: Severe thunderstorm winds. $25k property damage, Lake County.
- May 3, 2012: Severe thunderstorm winds. $500k property damage, Lake County
- August 7, 2013: Severe thunderstorm winds. $100k property damage, Lake County.
- November 17, 2013: High wind. $75k property damage, Lake County.

1.12 Subsidence: - None Identified.

1.13 Tornadoes:

- June 8, 1985: F1 tornado. No documented damages, unknown location in Lake County.

1.14 Wildfire:

- October 1871: Wildfires. 1.2m acres burned, 200 fatalities, Lower Peninsula.
- May-September, 1891: Uncontrollable wildfires across Michigan during the drought of 1891.
- 1981-2010: Approximately 11 wildfires and 43 acres burned per year on county lands under MDNR jurisdiction (315 total wildfires, 1,283.5 total acres burned).

1.15 Winter Storms:

- January 26, 1978: Blizzard, snowstorm. Declaration of statewide emergency by President, disaster by Governor.
- January 12, 1993: Heavy snow. $50k property damage, northern Lower Michigan.
- April 1, 1993: Heavy snow. $50k property damage, Lower Michigan.
- January 12-21, 1994: Heavy lake effect snow. $500k property damage across western Lower Michigan.
- January 27, 1994: Heavy snow and freezing rain. $5m property damage across region.
- March 9, 1998: Winter storm. $100k property damage across region.
- January 2-25, 1999: Blizzard, lake effect snow. "Blizzard of '99". southern Lower Michigan.
- April 3, 2003: Ice storm. $4.9m property damage throughout West Michigan.
- December 11-12, 2010: Winter storm. $250k property damage, west-central Lower Michigan.
- March 2-3, 2012: Heavy snow. $100k property damage, power outages, and shelters opened in Lake County.

2. TECHNOLOGICAL HAZARDS

2.01 Dam Failure:

- September 1986: Floods triggered dam failures at Baldwin's Rearing Pond, Danaher Lake, and Luther Mill Pond.

2.02 Energy Emergencies: - None Identified.

2.03 Fire - Scrap Tire: - None Identified.

2.04 Fire - Structural:

- County fire rate per 1,000 population in 1998: 3.09

2.05 Hazard Material Incidents - Fixed Site (including industrial accidents): - None Identified.

2.06 Hazard Material Incidents - Transportation: - None Identified.

2.07 Infrastructure Failure:

- Number of NCDC events showing downed power lines or power outages in Lake County, 1997-2012: 18
- April 6-7,1997: 180,000-200,000 without power; 70,000 on second day (high wind event), statewide.
- March 9, 1998: 1,900 power outages (blizzard conditions), Lake, Clare, Oceana and Muskegon counties.

- February 9-10, 2001: Portions of M-37 closed (flooding), Lake County.

- August 9, 2001: Power outages, downed power lines and downed trees (thunderstorm winds), Baldwin Village.

- April 3, 2003: Hundreds of thousands lose power (ice storm), Lower Michigan. .
- October 10, 2004: 100,000 without power (high wind), statewide.
- June 13, 2008: Numerous roads washed out (flash flood), Lake County.
- June 28, 2008: Three-quarters of Lake County without power (thunderstorm winds), Lake County.
- May 3, 2012: Several roads flooded or washed out (flash flood), Lake County.

- July 5, 2012: Trees and power lines blown down (thunderstorm winds), Baldwin Village.

2.08 Nuclear Power Plant Emergencies: - None Identified.

2.09 Oil and Natural Gas Well Accidents: - None Identified.

2.10 Pipeline Accidents: - None Identified.

2.11 Transportation Accidents: - None Identified.

3. HUMAN -RELATED HAZARDS

3.01 Catastrophic Incidents (National Emergencies): - None Identified.

3.02 Civil Disturbances: - None Identified.

3.03 Nuclear Attack: - None Identified.

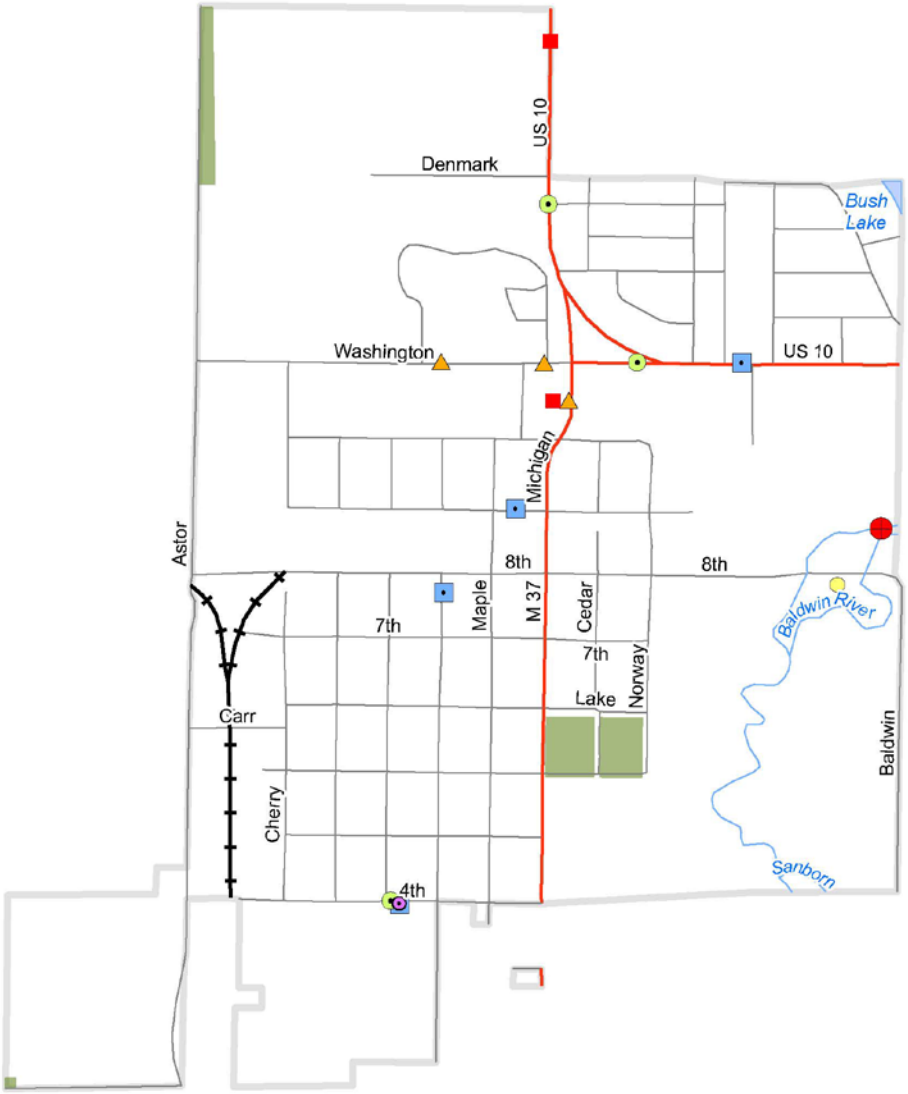
3.04 Public Health Emergencies: - None Identified.

3.05 Terrorism and Similar Criminal Activities: - None Identified.

	Baldwin Village Hazard Rating	Probability of Occurrence	Impact on People	Impact on Property	Impact on Economy	Impacts Total	Hazard Score
1.01	Celestial Impacts	1	2	0	2	8	8
1.02	Drought	2	2	2	3	13	26
1.03	Earthquake	0	-	-	-	-	-
1.04	Extreme Temperatures	3	2	1	2	10	30
1.05	Flooding: Riverine/Urban	3	1	2	1	8	24
1.06	Fog	2	1	0	1	4	8
1.07	Great Lakes Shoreline	0	-	-	-	-	-
1.08	Hail	2	2	2	1	11	22
1.09	Invasive Species	2	1	2	2	9	18
1.10	Lightning	3	1	2	1	8	24
1.11	Severe Winds	3	2	3	2	14	42
1.12	Subsidence	1	1	1	1	6	6
1.13	Tornadoes	1	3	2	2	15	15
1.14	Wildfire	2	2	2	2	12	24
1.15	Winter Storms	3	3	2	3	16	48
2.01	Dam failure	2	1	1	2	7	14
2.02	Energy Emergencies	2	2	0	3	9	18
2.03	Fire – Scrap Tires	1	1	1	1	6	6
2.04	Fire – Structural	3	1	2	2	9	27
2.05	HAZMAT – Fixed Site	2	1	1	2	7	14
2.06	HAZMAT – Transportation	2	1	1	2	7	14
2.07	Infrastructure Failures	3	3	1	2	13	39
2.08	Nuclear Power Emergencies	0	-	-	-	-	-
2.09	Oil/Natural Gas Well Accidents	0	-	-	-	-	-
2.10	Pipeline Accidents	1	1	1	2	7	7
2.11	Transportation Accidents	2	1	1	1	6	12
3.01	Catastrophic Incidents	1	3	3	3	18	18
3.02	Civil Disturbances	1	1	2	1	8	8
3.03	Nuclear Attack	0	-	-	-	-	-
3.04	Public Health Emergencies	2	2	0	3	9	18
3.05	Terrorism & Similar Criminal Acts	1	1	1	1	6	6

	Baldwin Village Hazard Ranking	Probability of Occurrence	X Impacts Total	= Hazard Score
1	Winter Storms	3	16	48
2	Severe Winds	3	14	42
3	Infrastructure Failures	3	13	39
4	Extreme Temperatures	3	10	30
5	Fire – Structural	3	9	27
6	Drought	2	13	26
7	Flooding: Riverine/Urban	3	8	24
7	Lightning	3	8	24
7	Wildfire	2	12	24
10	Hail	2	11	22
11	Catastrophic Incidents	1	18	18
11	Energy Emergencies	2	9	18
11	Invasive Species	2	9	18
11	Public Health Emergencies	2	9	18
15	Tornadoes	1	15	15
16	Dam failure	2	7	14
16	HAZMAT – Fixed Site	2	7	14
16	HAZMAT – Transportation	2	7	14
19	Transportation Accidents	2	6	12
20	Celestial Impacts	1	8	8
20	Civil Disturbances	1	8	8
20	Fog	2	4	8
23	Pipeline Accidents	1	7	7
24	Fire – Scrap Tires	1	6	6
24	Subsidence	1	6	6
24	Terrorism & Similar Criminal Acts	1	6	6
	Earthquake	0	-	-
	Great Lakes Shoreline	0	-	-
	Nuclear Attack	0	-	-
	Nuclear Power Emergencies	0	-	-
	Oil/Natural Gas Well Accidents	0	-	-

BALDWIN VILLAGE
Critical Facilities and Potential Hazards



0 0.25 0.5 Miles

- State Trunkline
- Street
- Railroad
- Dam
- Fire/Police/911/EMS
- Medical Facility
- School
- Correctional Facility
- Shelter
- Siren
- Federal Land

Note: This jurisdiction is subject to many additional hazards; some of which tend to occur across wide areas and cannot be effectively shown on this map.Refer to **Appendix B- Hazard Identifications and Analyses** for more complete information about potential hazards in this community.

WMSRDC
WEST MICHIGAN SHORELINE REGIONAL DEVELOPMENT COMMISSION

Source: Michigan Geographic Data Library V 12b, Lake Co. Hazard Mitigation Plan Update 2014

Hazard Identification Profile

Luther Village

1. NATURAL HAZARDS

1.01 Celestial Impacts: - None Identified.

1.02 Drought:

- Summer 1871: Prolonged drought over much of the Great Lakes region.
- May-September, 1891: Drought devastated Michigan's lumber industry.
- 12 recorded drought events in the area (including Lake, Mason, Muskegon, Newaygo, and Oceana counties) lasting eight months or greater: 1895-1896 (15 months), 1899-1900 (11 months), 1901-1902 (10 months), 1909-1911 (24 months), 1925-1926 (11 months), 1930-1931 (18 months), 1956-1957 (8 months), 1962-1963 (9 months), 1971-1972 (12 months), 1976-1977 (13 months), and 2002-2003 (12 months).

1.03 Earthquake: - None Identified.

1.04 Extreme Temperatures:

- July 1936: Heatwave. 570 deaths statewide, 364 in Detroit.
- Summer, 1988: 39 days with temperatures over 90 degrees, statewide.
- January 20, 1994: Record cold. $50m property damage across Michigan.
- March 2012: Anomalous temperatures. $209.8m crop damage across Michigan.

1.05 Flooding - Riverine/ Urban:

- September 10-19, 1986: Flooding. Declaration of disaster by Governor, Presidential disaster declaration, Lake County.
- February 10, 2001: Flooding. $100k property damage, western Michigan.
- May 21-23, 2004: Flooding. $25m property damage, $4.6m crop damage, western Lower Michigan.
- June 13, 2008: Flash flood. $2m property damage, $500k crop damage, Presidential disaster declaration, Lake County.
- May 3, 2012: Flash flood. $70k property damage, Lake County.
- April 17-23, 2013: Flood. $3m property damage, Lake County.
- April 2014: Flood. (details yet to come), Lake County.

1.06 Fog:

- January 11-13, 1995: Dense Fog. Four traffic accident fatalies, school closures, and flight delays across Lower Michigan.

1.07 Great Lakes Shoreline Hazards: - None Identified.

1.08 Hail:

- Severe hail events (1" or greater) recorded in Lake County since 1996: 9
- ***August 9, 2000: 1.75 inch hail. $50k property damage, $25k crop damage, Village of Luther.***

1.09 Invasive Species:

- Invasive species exist in Lake County, however no significant events have been identified.

1.10 Lightning: - None Identified.

1.11 Severe Winds:

- April 6, 1997: High wind. $5m property damage across southwest Lower Michigan.
- May 31, 1998: Severe thunderstorm winds. Declaration of local of emergency and $1.1m property damage, Lake County.
- June 1, 2000: Severe thunderstorm winds. $25k property damage, Lake County.
- July 13, 2000: Severe thunderstorm winds. $25k property damage, Lake County.
- June 18, 2001: High wind. $100k property damage across central Lower Michigan.
- August 9, 2001: Severe thunderstorm winds. $25k property damage, Lake County.
- March 9, 2002: High wind. $485k property damage across southwest Lower Michigan.
- October 30, 2004: High wind. $1.15m property damage across southwest Lower Michigan.
- July 24, 2005: Severe thunderstorm winds. $25k property damage, Lake County.
- July 26, 2005: Severe thunderstorm winds. $25k property damage, Lake County.
- May 3, 2012: Severe thunderstorm winds. $500k property damage, Lake County.
- August 7, 2013: Severe thunderstorm winds. $100k property damage, Lake County.
- November 17, 2013: High wind. $75k property damage, Lake County.

1.12 Subsidence: - None Identified.

1.13 Tornadoes:

- June 8, 1985: F1 tornado. No documented damages, unknown location in Lake County.

1.14 Wildfire:

- October 1871: Wildfires. 1.2m acres burned, 200 fatalities, Lower Peninsula.
- May-September, 1891: Uncontrollable wildfires across Michigan during the drought of 1891.
- 1981-2010: Approximately 11 wildfires and 43 acres burned per year on county lands under MDNR jurisdiction (315 total wildfires, 1,283.5 total acres burned).

1.15 Winter Storms:

- January 26, 1978: Blizzard, snowstorm. Declaration of statewide emergency by President, disaster by Governor.
- January 12, 1993: Heavy snow. $50k property damage, northern Lower Michigan.
- April 1, 1993: Heavy snow. $50k property damage, Lower Michigan.
- January 12-21, 1994: Heavy lake effect snow. $500k property damage across western Lower Michigan.
- January 27, 1994: Heavy snow and freezing rain. $5m property damage across region.
- March 9, 1998: Winter storm. $100k property damage across region.
- January 2-25, 1999: Blizzard, lake effect snow. "Blizzard of '99". southern Lower Michigan.
- April 3, 2003: Ice storm. $4.9m property damage throughout West Michigan.
- December 11-12, 2010: Winter storm. $250k property damage, west-central Lower Michigan.
- March 2-3, 2012: Heavy snow. $100k property damage, power outages, and shelters opened in Lake County.

2. TECHNOLOGICAL HAZARDS

2.01 Dam Failure:

- September 1986: Floods triggered dam failures at Baldwin's Rearing Pond, Danaher Lake, and Luther Mill Pond.
- May 1993: Luther Dam failed, due to poor reconstruction, as impoundment was being refilled.

2.02 Energy Emergencies: - None Identified.

2.03 Fire - Scrap Tire: - None Identified.

2.04 Fire - Structural:

- County fire rate per 1,000 population in 1998: 3.09

2.05 Hazard Material Incidents - Fixed Site (including industrial accidents): - None Identified.

2.06 Hazard Material Incidents - Transportation: - None Identified.

2.07 Infrastructure Failure:

- Number of NCDC events showing downed power lines or power outages in Lake County, 1997-2012: 18
- April 6-7,1997: 180,000-200,000 without power; 70,000 on second day (high wind event), statewide.
- March 9, 1998: 1,900 power outages (blizzard conditions), Lake, Clare, Oceana and Muskegon counties.
- April 3, 2003: Hundreds of thousands lose power (ice storm), Lower Michigan.
- October 10, 2004: 100,000 without power (high wind), statewide.
- June 13, 2008: Numerous roads washed out (flash flood), Lake County.
- June 28, 2008: Three-quarters of Lake County without power (thunderstorm winds), Lake County.
- May 3, 2012: Several roads flooded or washed out (flash flood), Lake County.

2.08 Nuclear Power Plant Emergencies: - None Identified.

2.09 Oil and Natural Gas Well Accidents: - None Identified.

2.10 Pipeline Accidents: - None Identified.

2.11 Transportation Accidents: - None Identified.

3. HUMAN -RELATED HAZARDS

3.01 Catastrophic Incidents (National Emergencies): - None Identified.

3.02 Civil Disturbances: - None Identified.

3.03 Nuclear Attack: - None Identified.

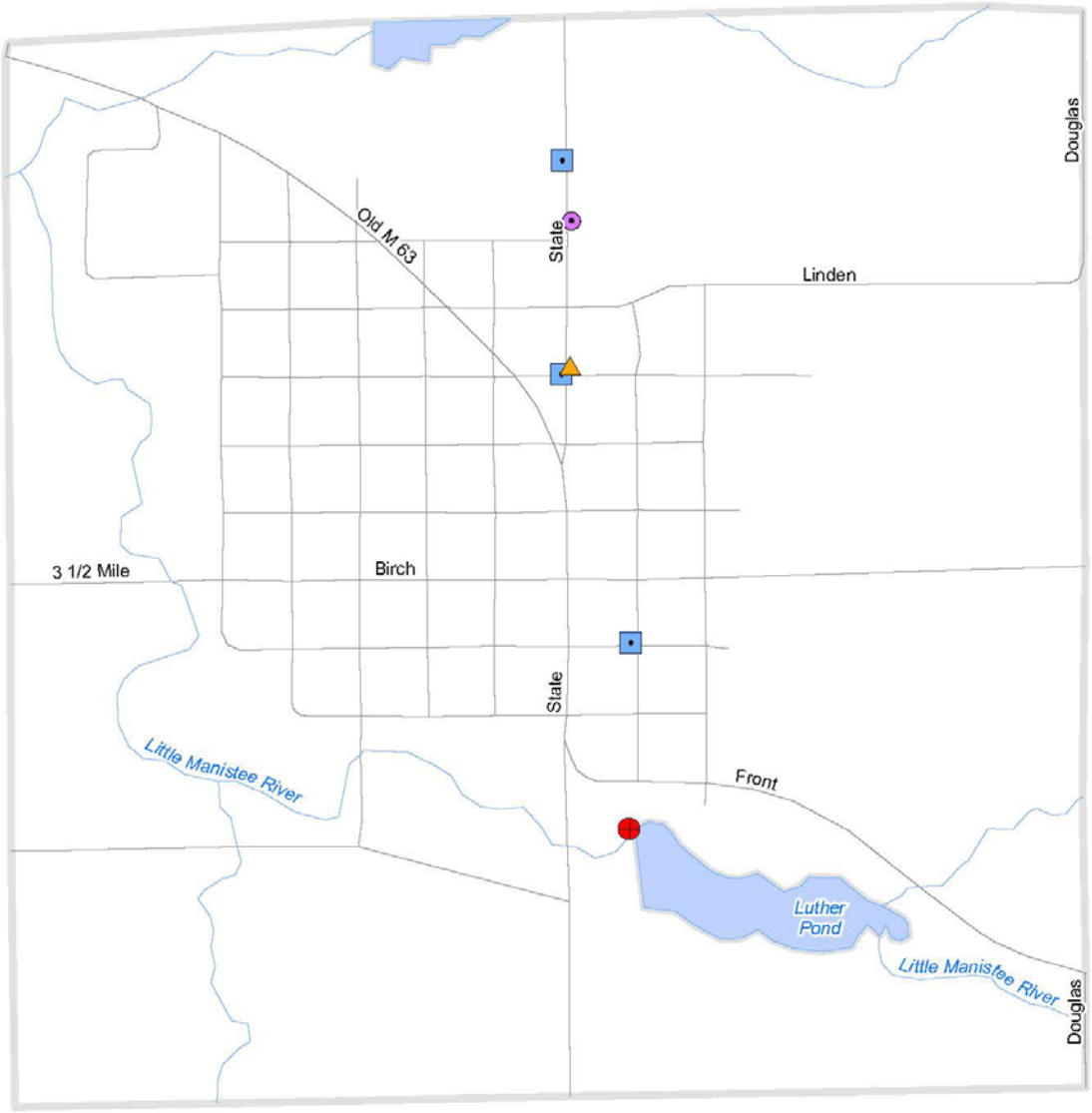
3.04 Public Health Emergencies: - None Identified.

3.05 Terrorism and Similar Criminal Activities: - None Identified.

	Luther Village Hazard Rating	Probability of Occurrence	Impact on People	Impact on Property	Impact on Economy	Impacts Total	Hazard Score
1.01	Celestial Impacts	1	2	0	2	8	8
1.02	Drought	2	2	2	3	13	26
1.03	Earthquake	0	-	-	-	-	-
1.04	Extreme Temperatures	3	2	1	2	10	30
1.05	Flooding: Riverine/Urban	3	1	2	1	8	24
1.06	Fog	2	1	0	1	4	8
1.07	Great Lakes Shoreline	0	-	-	-	-	-
1.08	Hail	2	2	2	1	11	22
1.09	Invasive Species	2	1	1	2	7	14
1.10	Lightning	3	1	2	1	8	24
1.11	Severe Winds	3	2	3	2	14	42
1.12	Subsidence	1	1	1	1	6	6
1.13	Tornadoes	1	3	2	2	15	15
1.14	Wildfire	2	2	2	2	12	24
1.15	Winter Storms	3	3	2	3	16	48
2.01	Dam failure	2	1	2	2	9	18
2.02	Energy Emergencies	2	2	0	3	9	18
2.03	Fire – Scrap Tires	1	1	1	1	6	6
2.04	Fire – Structural	3	1	2	2	9	27
2.05	HAZMAT – Fixed Site	2	1	1	2	7	14
2.06	HAZMAT – Transportation	2	1	1	2	7	14
2.07	Infrastructure Failures	3	3	1	2	13	39
2.08	Nuclear Power Emergencies	0	-	-	-	-	-
2.09	Oil/Natural Gas Well Accidents	0	-	-	-	-	-
2.10	Pipeline Accidents	1	1	1	2	7	7
2.11	Transportation Accidents	2	1	1	1	6	12
3.01	Catastrophic Incidents	1	3	3	3	18	18
3.02	Civil Disturbances	1	1	1	1	6	6
3.03	Nuclear Attack	0	-	-	-	-	-
3.04	Public Health Emergencies	2	2	0	3	9	18
3.05	Terrorism & Similar Criminal Acts	1	1	1	1	6	6

	Luther Village Hazard Ranking	Probability of Occurrence	X Impacts Total	= Hazard Score
1	Winter Storms	3	16	48
2	Severe Winds	3	14	42
3	Infrastructure Failures	3	13	39
4	Extreme Temperatures	3	10	30
5	Fire – Structural	3	9	27
6	Drought	2	13	26
7	Flooding: Riverine/Urban	3	8	24
7	Lightning	3	8	24
7	Wildfire	2	12	24
10	Hail	2	11	22
11	Catastrophic Incidents	1	18	18
11	Dam failure	2	9	18
11	Energy Emergencies	2	9	18
11	Public Health Emergencies	2	9	18
15	Tornadoes	1	15	15
16	HAZMAT – Fixed Site	2	7	14
16	HAZMAT – Transportation	2	7	14
16	Invasive Species	2	7	14
19	Transportation Accidents	2	6	12
20	Celestial Impacts	1	8	8
20	Fog	2	4	8
22	Pipeline Accidents	1	7	7
23	Civil Disturbances	1	6	6
23	Fire – Scrap Tires	1	6	6
23	Subsidence	1	6	6
23	Terrorism & Similar Criminal Acts	1	6	6
	Earthquake	0	-	-
	Great Lakes Shoreline	0	-	-
	Nuclear Attack	0	-	-
	Nuclear Power Emergencies	0	-	-
	Oil/Natural Gas Well Accidents	0	-	-

LUTHER VILLAGE
Critical Facilites and Potential Hazards



0 0.125 0.25 Miles

Note: This jurisdiction is subject to many additional hazards; some of which tend to occur across wide areas and cannot be effectively shown on this map.Refer to **Appendix B- Hazard Identifications and Analyses** for more complete information about potential hazards in this community.

- Street
- Fire/Police/911/EMS
- School
- Shelter
- Dam

WMSRDC
WEST MICHIGAN SHORELINE REGIONAL DEVELOPMENT COMMISSION

Source: Michigan Geographic Data Library V 12b, Lake Co. Hazard Mitigation Plan Update 2014

Hazard Identification Profile

Chase Township

1. NATURAL HAZARDS

1.01 Celestial Impacts: - None Identified.

1.02 Drought:

- Summer 1871: Prolonged drought over much of the Great Lakes region.
- May-September, 1891: Drought devastated Michigan's lumber industry.
- 12 recorded drought events in the area (including Lake, Mason, Muskegon, Newaygo, and Oceana counties) lasting eight months or greater: 1895-1896 (15 months), 1899-1900 (11 months), 1901-1902 (10 months), 1909-1911 (24 months), 1925-1926 (11 months), 1930-1931 (18 months), 1956-1957 (8 months), 1962-1963 (9 months), 1971-1972 (12 months), 1976-1977 (13 months), and 2002-2003 (12 months).

1.03 Earthquake: - None Identified.

1.04 Extreme Temperatures:

- July 1936: Heatwave. 570 deaths statewide, 364 in Detroit.
- Summer, 1988: 39 days with temperatures over 90 degrees, statewide.
- January 20, 1994: Record cold. $50m property damage across Michigan.
- March 2012: Anomalous temperatures. $209.8m crop damage across Michigan.

1.05 Flooding - Riverine/ Urban:

- September 10-19, 1986: Flooding. Declaration of disaster by Governor, Presidential disaster declaration, Lake County.
- February 10, 2001: Flooding. $100k property damage, western Michigan.
- May 21-23, 2004: Flooding. $25m property damage, $4.6m crop damage, western Lower Michigan.
- June 13, 2008: Flash flood. $2m property damage, $500k crop damage, Presidential disaster declaration, Lake County.
- May 3, 2012: Flash flood. $70k property damage, Lake County.
- April 17-23, 2013: Flood. $3m property damage, Lake County.
- April 2014: Flood. (details yet to come), Lake County.

1.06 Fog:

- January 11-13, 1995: Dense Fog. Four traffic accident fatalies, school closures, and flight delays across Lower Michigan.

1.07 Great Lakes Shoreline Hazards: - None Identified.

1.08 Hail:

- Severe hail events (1" or greater) recorded in Lake County since 1996: 9

1.09 Invasive Species:

- Invasive species exist in Lake County, however no significant events have been identified.

1.10 Lightning: - None Identified.

1.11 Severe Winds:

- April 6, 1997: High wind. $5m property damage across southwest Lower Michigan.
- May 31, 1998: Severe thunderstorm winds. Declaration of local of emergency and $1.1m property damage, Lake County.
- June 1, 2000: Severe thunderstorm winds. $25k property damage, Lake County.
- July 13, 2000: Severe thunderstorm winds. $25k property damage, Lake County.
- June 18, 2001: High wind. $100k property damage across central Lower Michigan.
- August 9, 2001: Severe thunderstorm winds. $25k property damage, Lake County.
- March 9, 2002: High wind. $485k property damage across southwest Lower Michigan.
- ***August 2, 2004: Severe thunderstorm winds. $10k property damage, Chase and Pleasant Plains townships.***
- October 30, 2004: High wind. $1.15m property damage across southwest Lower Michigan.
- July 24, 2005: Severe thunderstorm winds. $25k property damage, Lake County.
- July 26, 2005: Severe thunderstorm winds. $25k property damage, Lake County.
- May 3, 2012: Severe thunderstorm winds. $500k property damage, Lake County
- August 7, 2013: Severe thunderstorm winds. $100k property damage, Lake County.
- November 17, 2013: High wind. $75k property damage, Lake County.

1.12 Subsidence: - None Identified.

1.13 Tornadoes:

- June 8, 1985: F1 tornado. No documented damages, unknown location in Lake County.

1.14 Wildfire:

- October 1871: Wildfires. 1.2m acres burned, 200 fatalities, Lower Peninsula.
- May-September, 1891: Uncontrollable wildfires across Michigan during the drought of 1891.
- 1981-2010: Approximately 11 wildfires and 43 acres burned per year on county lands under MDNR jurisdiction (315 total wildfires, 1,283.5 total acres burned).

1.15 Winter Storms:

- January 26, 1978: Blizzard, snowstorm. Declaration of statewide emergency by President, disaster by Governor.
- January 12, 1993: Heavy snow. $50k property damage, northern Lower Michigan.
- April 1, 1993: Heavy snow. $50k property damage, Lower Michigan.
- January 12-21, 1994: Heavy lake effect snow. $500k property damage across western Lower Michigan.
- January 27, 1994: Heavy snow and freezing rain. $5m property damage across region.
- March 9, 1998: Winter storm. $100k property damage across region.
- January 2-25, 1999: Blizzard, lake effect snow. "Blizzard of '99". southern Lower Michigan.
- April 3, 2003: Ice storm. $4.9m property damage throughout West Michigan.
- December 11-12, 2010: Winter storm. $250k property damage, west-central Lower Michigan.
- March 2-3, 2012: Heavy snow. $100k property damage, power outages, and shelters opened in Lake County.

2. TECHNOLOGICAL HAZARDS

2.01 Dam Failure: - None Identified.

2.02 Energy Emergencies: - None Identified.

2.03 Fire - Scrap Tire: - None Identified.

2.04 Fire - Structural:

- County fire rate per 1,000 population in 1998: 3.09

2.05 Hazard Material Incidents - Fixed Site (including industrial accidents): - None Identified.

2.06 Hazard Material Incidents - Transportation: - None Identified.

2.07 Infrastructure Failure:

- Number of NCDC events showing downed power lines or power outages in Lake County, 1997-2012: 18
- April 6-7,1997: 180,000-200,000 without power; 70,000 on second day (high wind event), statewide.
- March 9, 1998: 1,900 power outages (blizzard conditions), Lake, Clare, Oceana and Muskegon counties.
- April 3, 2003: Hundreds of thousands lose power (ice storm), Lower Michigan.
- October 10, 2004: 100,000 without power (high wind), statewide.
- June 13, 2008: Numerous roads washed out (flash flood), Lake County.
- June 28, 2008: Three-quarters of Lake County without power (thunderstorm winds), Lake County.
- May 3, 2012: Several roads flooded or washed out (flash flood), Lake County.

2.08 Nuclear Power Plant Emergencies: - None Identified.

2.09 Oil and Natural Gas Well Accidents:

- 19 oil and gas wells within Chase Township, 3 of which are "active" or "producing."

2.10 Pipeline Accidents: - None Identified.

2.11 Transportation Accidents: - None Identified.

3. HUMAN -RELATED HAZARDS

3.01 Catastrophic Incidents (National Emergencies): - None Identified.

3.02 Civil Disturbances: - None Identified.

3.03 Nuclear Attack: - None Identified.

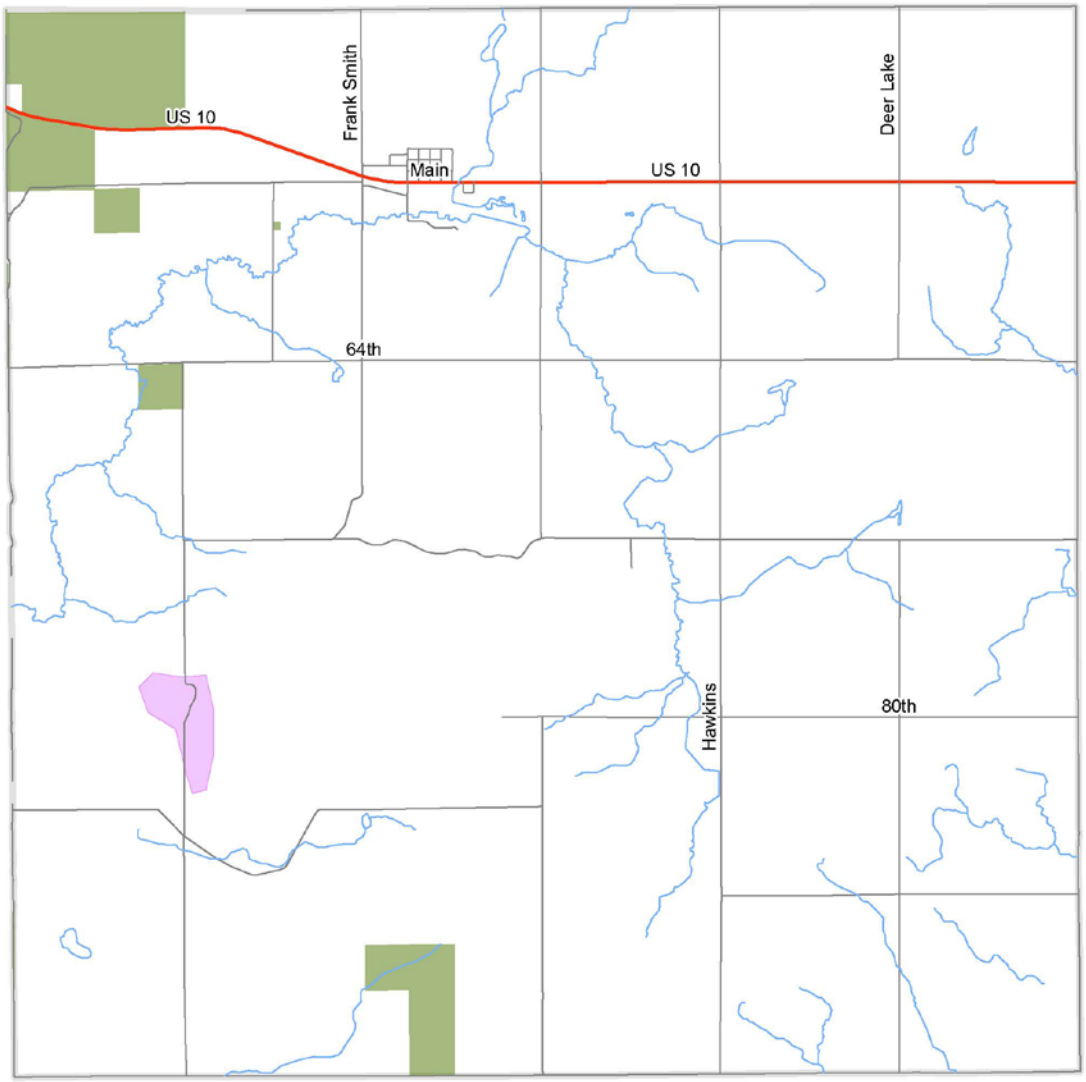
3.04 Public Health Emergencies: - None Identified.

3.05 Terrorism and Similar Criminal Activities: - None Identified.

	Chase Township Hazard Rating	Probability of Occurrence	Impact on People	Impact on Property	Impact on Economy	Impacts Total	Hazard Score
1.01	Celestial Impacts	1	2	0	2	8	8
1.02	Drought	2	2	2	3	13	26
1.03	Earthquake	0	-	-	-	-	-
1.04	Extreme Temperatures	3	2	1	2	10	30
1.05	Flooding: Riverine/Urban	2	1	1	1	6	12
1.06	Fog	2	1	0	1	4	8
1.07	Great Lakes Shoreline	0	-	-	-	-	-
1.08	Hail	2	2	2	1	11	22
1.09	Invasive Species	2	1	1	2	7	14
1.10	Lightning	3	1	2	1	8	24
1.11	Severe Winds	3	2	3	2	14	42
1.12	Subsidence	1	1	1	1	6	6
1.13	Tornadoes	1	3	2	2	15	15
1.14	Wildfire	2	2	2	2	12	24
1.15	Winter Storms	3	3	2	3	16	48
2.01	Dam failure	0	-	-	-	-	-
2.02	Energy Emergencies	2	2	0	3	9	18
2.03	Fire – Scrap Tires	1	1	1	1	6	6
2.04	Fire – Structural	3	1	2	2	9	27
2.05	HAZMAT – Fixed Site	2	1	1	2	7	14
2.06	HAZMAT – Transportation	2	1	1	2	7	14
2.07	Infrastructure Failures	3	3	1	2	13	39
2.08	Nuclear Power Emergencies	0	-	-	-	-	-
2.09	Oil/Natural Gas Well Accidents	0	-	-	-	-	-
2.10	Pipeline Accidents	1	1	1	2	7	7
2.11	Transportation Accidents	2	1	1	1	6	12
3.01	Catastrophic Incidents	1	3	3	3	18	18
3.02	Civil Disturbances	1	1	1	1	6	6
3.03	Nuclear Attack	0	-	-	-	-	-
3.04	Public Health Emergencies	2	2	0	3	9	18
3.05	Terrorism & Similar Criminal Acts	1	1	1	1	6	6

	Chase Township Hazard Ranking	Probability of Occurrence	X Impacts Total	= Hazard Score
1	Winter Storms	3	16	48
2	Severe Winds	3	14	42
3	Infrastructure Failures	3	13	39
4	Extreme Temperatures	3	10	30
5	Fire – Structural	3	9	27
6	Drought	2	13	26
7	Lightning	3	8	24
7	Wildfire	2	12	24
9	Hail	2	11	22
10	Catastrophic Incidents	1	18	18
10	Energy Emergencies	2	9	18
10	Public Health Emergencies	2	9	18
13	Tornadoes	1	15	15
14	HAZMAT – Fixed Site	2	7	14
14	HAZMAT – Transportation	2	7	14
14	Invasive Species	2	7	14
17	Flooding: Riverine/Urban	2	6	12
17	Transportation Accidents	2	6	12
19	Celestial Impacts	1	8	8
19	Fog	2	4	8
21	Pipeline Accidents	1	7	7
22	Civil Disturbances	1	6	6
22	Fire – Scrap Tires	1	6	6
22	Subsidence	1	6	6
22	Terrorism & Similar Criminal Acts	1	6	6
	Dam failure	0	-	-
	Earthquake	0	-	-
	Great Lakes Shoreline	0	-	-
	Nuclear Attack	0	-	-
	Nuclear Power Emergencies	0	-	-
	Oil/Natural Gas Well Accidents	0	-	-

CHASE TOWNSHIP
Critical Facilities and Potential Hazards



0 0.5 1 2 Miles

Note: This jurisdiction is subject to many additional hazards; some of which tend to occur across wide areas and cannot be effectively shown on this map.Refer to **Appendix B- Hazard Identifications and Analyses** for more complete information about potential hazards in this community.

State Trunkline
Street
Federal Land
Oil/Gas Field

WMSRDC
WEST MICHIGAN SHORELINE REGIONAL DEVELOPMENT COMMISSION

Source: Michigan Geographic Data Library V 12b, Lake Co. Hazard Mitigation Plan Update 2014

Hazard Identification Profile

Cherry Valley Township

1. NATURAL HAZARDS

1.01 Celestial Impacts: - None Identified.

1.02 Drought:

- Summer 1871: Prolonged drought over much of the Great Lakes region.
- May-September, 1891: Drought devastated Michigan's lumber industry.
- 12 recorded drought events in the area (including Lake, Mason, Muskegon, Newaygo, and Oceana counties) lasting eight months or greater: 1895-1896 (15 months), 1899-1900 (11 months), 1901-1902 (10 months), 1909-1911 (24 months), 1925-1926 (11 months), 1930-1931 (18 months), 1956-1957 (8 months), 1962-1963 (9 months), 1971-1972 (12 months), 1976-1977 (13 months), and 2002-2003 (12 months).

1.03 Earthquake: - None Identified.

1.04 Extreme Temperatures:

- July 1936: Heatwave. 570 deaths statewide, 364 in Detroit.
- Summer, 1988: 39 days with temperatures over 90 degrees, statewide.
- January 20, 1994: Record cold. $50m property damage across Michigan.
- March 2012: Anomalous temperatures. $209.8m crop damage across Michigan.

1.05 Flooding - Riverine/ Urban:

- September 10-19, 1986: Flooding. Declaration of disaster by Governor, Presidential disaster declaration, Lake County.
- February 10, 2001: Flooding. $100k property damage, western Michigan.
- May 21-23, 2004: Flooding. $25m property damage, $4.6m crop damage, western Lower Michigan.
- June 13, 2008: Flash flood. $2m property damage, $500k crop damage, Presidential disaster declaration, Lake County.
- May 3, 2012: Flash flood. $70k property damage, Lake County.
- April 17-23, 2013: Flood. $3m property damage, Lake County.
- April 2014: Flood. (details yet to come), Lake County.

1.06 Fog:

- January 11-13, 1995: Dense Fog. Four traffic accident fatalies, school closures, and flight delays across Lower Michigan.

1.07 Great Lakes Shoreline Hazards: - None Identified.

1.08 Hail:

- Severe hail events (1" or greater) recorded in Lake County since 1996: 9

1.09 Invasive Species:

- Invasive species exist in Lake County, however no significant events have been identified.

1.10 Lightning: - None Identified.

1.11 Severe Winds:

- April 6, 1997: High wind. $5m property damage across southwest Lower Michigan.
- May 31, 1998: Severe thunderstorm winds. Declaration of local of emergency and $1.1m property damage, Lake County.
- June 1, 2000: Severe thunderstorm winds. $25k property damage, Lake County.
- July 13, 2000: Severe thunderstorm winds. $25k property damage, Lake County.
- June 18, 2001: High wind. $100k property damage across central Lower Michigan.
- August 9, 2001: Severe thunderstorm winds. $25k property damage, Lake County.
- March 9, 2002: High wind. $485k property damage across southwest Lower Michigan.
- October 30, 2004: High wind. $1.15m property damage across southwest Lower Michigan.
- July 24, 2005: Severe thunderstorm winds. $25k property damage, Lake County.
- July 26, 2005: Severe thunderstorm winds. $25k property damage, Lake County.
- May 3, 2012: Severe thunderstorm winds. $500k property damage, Lake County.
- August 7, 2013: Severe thunderstorm winds. $100k property damage, Lake County.
- November 17, 2013: High wind. $75k property damage, Lake County.

1.12 Subsidence: - None Identified.

1.13 Tornadoes:

- June 8, 1985: F1 tornado. No documented damages, unknown location in Lake County.

1.14 Wildfire:

- October 1871: Wildfires. 1.2m acres burned, 200 fatalities, Lower Peninsula.
- May-September, 1891: Uncontrollable wildfires across Michigan during the drought of 1891.
- 1981-2010: Approximately 11 wildfires and 43 acres burned per year on county lands under MDNR jurisdiction (315 total wildfires, 1,283.5 total acres burned).

1.15 Winter Storms:

- January 26, 1978: Blizzard, snowstorm. Declaration of statewide emergency by President, disaster by Governor.
- January 12, 1993: Heavy snow. $50k property damage, northern Lower Michigan.
- April 1, 1993: Heavy snow. $50k property damage, Lower Michigan.
- January 12-21, 1994: Heavy lake effect snow. $500k property damage across western Lower Michigan.
- January 27, 1994: Heavy snow and freezing rain. $5m property damage across region.
- March 9, 1998: Winter storm. $100k property damage across region.
- January 2-25, 1999: Blizzard, lake effect snow. "Blizzard of '99". southern Lower Michigan.
- April 3, 2003: Ice storm. $4.9m property damage throughout West Michigan.
- December 11-12, 2010: Winter storm. $250k property damage, west-central Lower Michigan.
- March 2-3, 2012: Heavy snow. $100k property damage, power outages, and shelters opened in Lake County.

2. TECHNOLOGICAL HAZARDS

2.01 Dam Failure: - None Identified.

2.02 Energy Emergencies: - None Identified.

2.03 Fire - Scrap Tire: - None Identified.

2.04 Fire - Structural:

- County fire rate per 1,000 population in 1998: 3.09

2.05 Hazard Material Incidents - Fixed Site (including industrial accidents): - None Identified.

2.06 Hazard Material Incidents - Transportation: - None Identified.

2.07 Infrastructure Failure:

- Number of NCDC events showing downed power lines or power outages in Lake County, 1997-2012: 18
- April 6-7,1997: 180,000-200,000 without power; 70,000 on second day (high wind event), statewide.
- March 9, 1998: 1,900 power outages (blizzard conditions), Lake, Clare, Oceana and Muskegon counties.
- April 3, 2003: Hundreds of thousands lose power (ice storm), Lower Michigan.
- October 10, 2004: 100,000 without power (high wind), statewide.
- June 13, 2008: Numerous roads washed out (flash flood), Lake County.
- June 28, 2008: Three-quarters of Lake County without power (thunderstorm winds), Lake County.
- May 3, 2012: Several roads flooded or washed out (flash flood), Lake County.

2.08 Nuclear Power Plant Emergencies: - None Identified.

2.09 Oil and Natural Gas Well Accidents:

- 20 oil and gas wells within Cherry Valley Township, none of which are "active" or "producing."

2.10 Pipeline Accidents: - None Identified.

2.11 Transportation Accidents: - None Identified.

3. HUMAN -RELATED HAZARDS

3.01 Catastrophic Incidents (National Emergencies): - None Identified.

3.02 Civil Disturbances: - None Identified.

3.03 Nuclear Attack: - None Identified.

3.04 Public Health Emergencies: - None Identified.

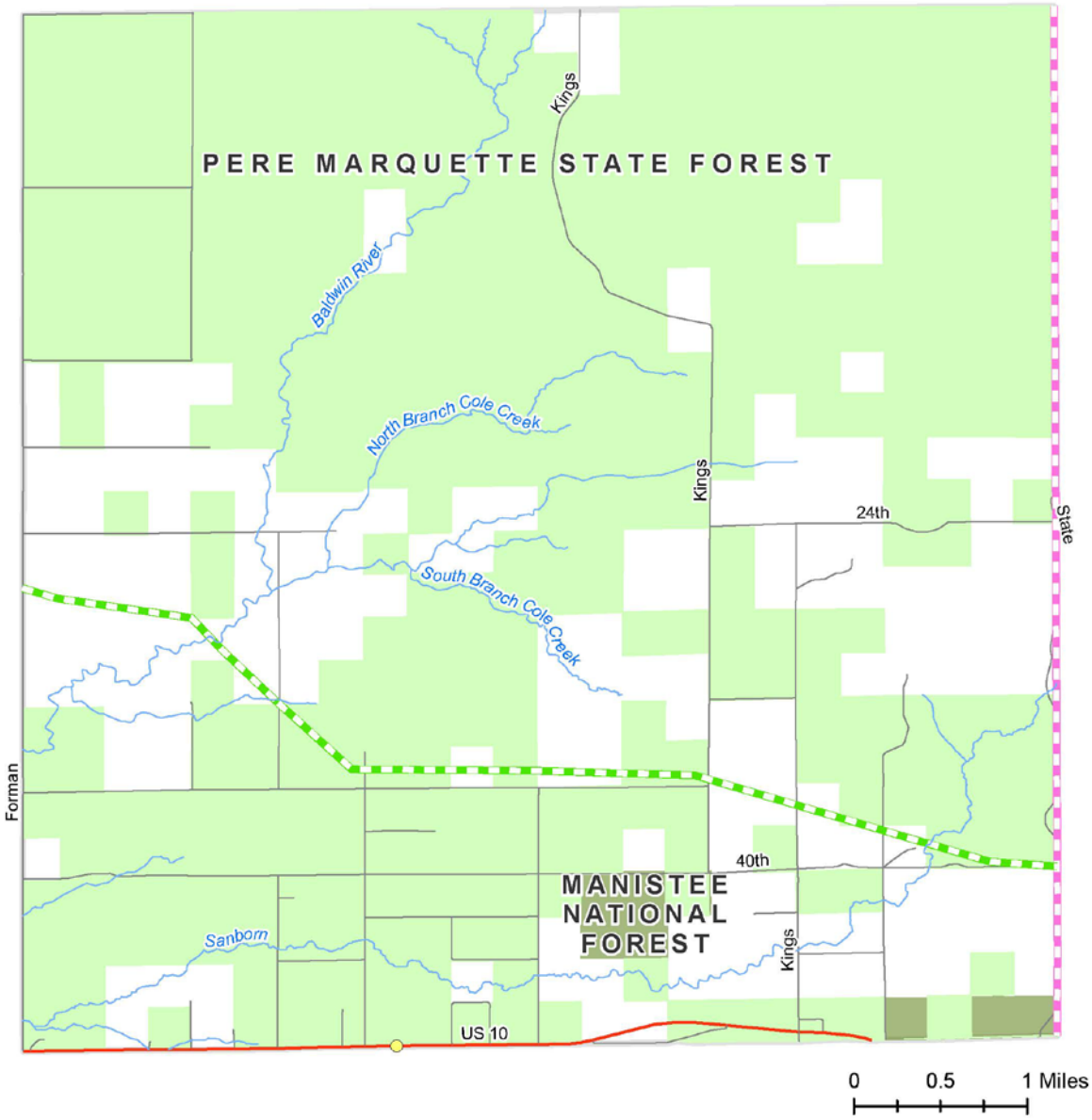
3.05 Terrorism and Similar Criminal Activities: - None Identified.

	Cherry Valley Township Hazard Rating	Probability of Occurrence	Impact on People	Impact on Property	Impact on Economy	Impacts Total	Hazard Score
1.01	Celestial Impacts	1	2	0	2	8	8
1.02	Drought	2	2	2	3	13	26
1.03	Earthquake	0	-	-	-	-	-
1.04	Extreme Temperatures	3	2	1	2	10	30
1.05	Flooding: Riverine/Urban	3	1	2	1	8	24
1.06	Fog	3	1	0	1	4	12
1.07	Great Lakes Shoreline	3	1	2	1	8	24
1.08	Hail	2	2	2	1	11	22
1.09	Invasive Species	2	1	1	1	6	12
1.10	Lightning	3	1	2	1	8	24
1.11	Severe Winds	3	2	3	2	14	42
1.12	Subsidence	1	1	1	1	6	6
1.13	Tornadoes	1	3	2	2	15	15
1.14	Wildfire	2	2	2	2	12	24
1.15	Winter Storms	3	3	2	3	16	48
2.01	Dam failure	2	1	2	2	9	18
2.02	Energy Emergencies	2	2	0	3	9	18
2.03	Fire – Scrap Tires	1	1	1	1	6	6
2.04	Fire – Structural	3	1	2	2	9	27
2.05	HAZMAT – Fixed Site	1	1	1	2	7	7
2.06	HAZMAT – Transportation	1	1	1	2	7	7
2.07	Infrastructure Failures	3	3	1	2	13	39
2.08	Nuclear Power Emergencies	0	-	-	-	-	-
2.09	Oil/Natural Gas Well Accidents	0	-	-	-	-	-
2.10	Pipeline Accidents	1	1	1	2	7	7
2.11	Transportation Accidents	2	1	1	1	6	12
3.01	Catastrophic Incidents	1	3	3	3	18	18
3.02	Civil Disturbances	1	1	1	1	6	6
3.03	Nuclear Attack	0	-	-	-	-	-
3.04	Public Health Emergencies	2	2	0	3	9	18
3.05	Terrorism & Similar Criminal Acts	1	1	1	1	6	6

Cherry Valley Township Hazard Ranking

		Probability of Occurrence	X Impacts Total	= Hazard Score
1	Winter Storms	3	16	48
2	Severe Winds	3	14	42
3	Infrastructure Failures	3	13	39
4	Extreme Temperatures	3	10	30
5	Fire – Structural	3	9	27
6	Drought	2	13	26
7	Flooding: Riverine/Urban	3	8	24
7	Great Lakes Shoreline	3	8	24
7	Lightning	3	8	24
7	Wildfire	2	12	24
11	Hail	2	11	22
12	Catastrophic Incidents	1	18	18
12	Dam failure	2	9	18
12	Energy Emergencies	2	9	18
12	Public Health Emergencies	2	9	18
16	Tornadoes	1	15	15
17	Fog	3	4	12
17	Invasive Species	2	6	12
17	Transportation Accidents	2	6	12
20	Celestial Impacts	1	8	8
21	HAZMAT – Fixed Site	1	7	7
21	HAZMAT – Transportation	1	7	7
21	Pipeline Accidents	1	7	7
24	Civil Disturbances	1	6	6
24	Fire – Scrap Tires	1	6	6
24	Subsidence	1	6	6
24	Terrorism & Similar Criminal Acts	1	6	6
	Earthquake	0	-	-
	Nuclear Attack	0	-	-
	Nuclear Power Emergencies	0	-	-
	Oil/Natural Gas Well Accidents	0	-	-

CHERRY VALLEY TOWNSHIP
Critical Facilities and Potential Hazards



Note: This jurisdiction is subject to many additional hazards; some of which tend to occur across wide areas and cannot be effectively shown on this map.Refer to **Appendix B- Hazard Identifications and Analyses** for more complete information about potential hazards in this community.

- State Trunkline
- Street
- Gas Pipeline
- Power Line
- Siren
- Federal Land
- State Land

WMSRDC
WEST MICHIGAN SHORELINE REGIONAL DEVELOPMENT COMMISSION

Source: Michigan Geographic Data Library V 12b, Lake Co. Hazard Mitigation Plan Update 2014

Hazard Identification Profile

Dover Township

1. NATURAL HAZARDS

1.01 Celestial Impacts: - None Identified.

1.02 Drought:

- Summer 1871: Prolonged drought over much of the Great Lakes region.
- May-September, 1891: Drought devastated Michigan's lumber industry.
- 12 recorded drought events in the area (including Lake, Mason, Muskegon, Newaygo, and Oceana counties) lasting eight months or greater: 1895-1896 (15 months), 1899-1900 (11 months), 1901-1902 (10 months), 1909-1911 (24 months), 1925-1926 (11 months), 1930-1931 (18 months), 1956-1957 (8 months), 1962-1963 (9 months), 1971-1972 (12 months), 1976-1977 (13 months), and 2002-2003 (12 months).

1.03 Earthquake: - None Identified.

1.04 Extreme Temperatures:

- July 1936: Heatwave. 570 deaths statewide, 364 in Detroit.
- Summer, 1988: 39 days with temperatures over 90 degrees, statewide.
- January 20, 1994: Record cold. $50m property damage across Michigan.
- March 2012: Anomalous temperatures. $209.8m crop damage across Michigan.

1.05 Flooding - Riverine/ Urban:

- September 10-19, 1986: Flooding. Declaration of disaster by Governor, Presidential disaster declaration, Lake County.
- February 10, 2001: Flooding. $100k property damage, western Michigan.
- May 21-23, 2004: Flooding. $25m property damage, $4.6m crop damage, western Lower Michigan.
- June 13, 2008: Flash flood. $2m property damage, $500k crop damage, Presidential disaster declaration, Lake County.
- May 3, 2012: Flash flood. $70k property damage, Lake County.
- April 17-23, 2013: Flood. $3m property damage, Lake County.
- April 2014: Flood. (details yet to come), Lake County.

1.06 Fog:

- January 11-13, 1995: Dense Fog. Four traffic accident fatalies, school closures, and flight delays across Lower Michigan.

1.07 Great Lakes Shoreline Hazards: - None Identified.

1.08 Hail:

- Severe hail events (1" or greater) recorded in Lake County since 1996: 9
- ***May 11, 2003: .88 inch hail. $10k property damage, $10k crop damage, Bristol (Dover Township).***

1.09 Invasive Species:

- Invasive species exist in Lake County, however no significant events have been identified.

1.10 Lightning: - None Identified.

1.11 Severe Winds:

- April 6, 1997: High wind. $5m property damage across southwest Lower Michigan.
- May 31, 1998: Severe thunderstorm winds. Declaration of local of emergency and $1.1m property damage, Lake County.
- June 1, 2000: Severe thunderstorm winds. $25k property damage, Lake County.
- July 13, 2000: Severe thunderstorm winds. $25k property damage, Lake County.
- June 18, 2001: High wind. $100k property damage across central Lower Michigan.
- August 9, 2001: Severe thunderstorm winds. $25k property damage, Lake County.
- March 9, 2002: High wind. $485k property damage across southwest Lower Michigan.
- October 30, 2004: High wind. $1.15m property damage across southwest Lower Michigan.
- July 24, 2005: Severe thunderstorm winds. $25k property damage, Lake County.
- July 26, 2005: Severe thunderstorm winds. $25k property damage, Lake County.
- May 3, 2012: Severe thunderstorm winds. $500k property damage, Lake County.
- August 7, 2013: Severe thunderstorm winds. $100k property damage, Lake County.
- November 17, 2013: High wind. $75k property damage, Lake County.

1.12 Subsidence: - None Identified.

1.13 Tornadoes:

- June 8, 1985: F1 tornado. No documented damages, unknown location in Lake County.

1.14 Wildfire:

- October 1871: Wildfires. 1.2m acres burned, 200 fatalities, Lower Peninsula.
- May-September, 1891: Uncontrollable wildfires across Michigan during the drought of 1891.
- 1981-2010: Approximately 11 wildfires and 43 acres burned per year on county lands under MDNR jurisdiction (315 total wildfires, 1,283.5 total acres burned).

1.15 Winter Storms:

- January 26, 1978: Blizzard, snowstorm. Declaration of statewide emergency by President, disaster by Governor.
- January 12, 1993: Heavy snow. $50k property damage, northern Lower Michigan.
- April 1, 1993: Heavy snow. $50k property damage, Lower Michigan.
- January 12-21, 1994: Heavy lake effect snow. $500k property damage across western Lower Michigan.
- January 27, 1994: Heavy snow and freezing rain. $5m property damage across region.
- March 9, 1998: Winter storm. $100k property damage across region.
- January 2-25, 1999: Blizzard, lake effect snow. "Blizzard of '99". southern Lower Michigan.
- April 3, 2003: Ice storm. $4.9m property damage throughout West Michigan.
- December 11-12, 2010: Winter storm. $250k property damage, west-central Lower Michigan.
- March 2-3, 2012: Heavy snow. $100k property damage, power outages, and shelters opened in Lake County.

2. TECHNOLOGICAL HAZARDS

2.01 Dam Failure: - None Identified.

2.02 Energy Emergencies: - None Identified.

2.03 Fire - Scrap Tire: - None Identified.

2.04 Fire - Structural:

- County fire rate per 1,000 population in 1998: 3.09

2.05 Hazard Material Incidents - Fixed Site (including industrial accidents): - None Identified.

2.06 Hazard Material Incidents - Transportation: - None Identified.

2.07 Infrastructure Failure:

- Number of NCDC events showing downed power lines or power outages in Lake County, 1997-2012: 18
- April 6-7,1997: 180,000-200,000 without power; 70,000 on second day (high wind event), statewide.
- March 9, 1998: 1,900 power outages (blizzard conditions), Lake, Clare, Oceana and Muskegon counties.
- April 3, 2003: Hundreds of thousands lose power (ice storm), Lower Michigan.
- October 10, 2004: 100,000 without power (high wind), statewide.
- June 13, 2008: Numerous roads washed out (flash flood), Lake County.
- June 28, 2008: Three-quarters of Lake County without power (thunderstorm winds), Lake County.
- May 3, 2012: Several roads flooded or washed out (flash flood), Lake County.

2.08 Nuclear Power Plant Emergencies: - None Identified.

2.09 Oil and Natural Gas Well Accidents:

- 11 oil and gas wells within Dover Township, none of which are "active" or "producing."

2.10 Pipeline Accidents: - None Identified.

2.11 Transportation Accidents: - None Identified.

3. HUMAN -RELATED HAZARDS

3.01 Catastrophic Incidents (National Emergencies): - None Identified.

3.02 Civil Disturbances: - None Identified.

3.03 Nuclear Attack: - None Identified.

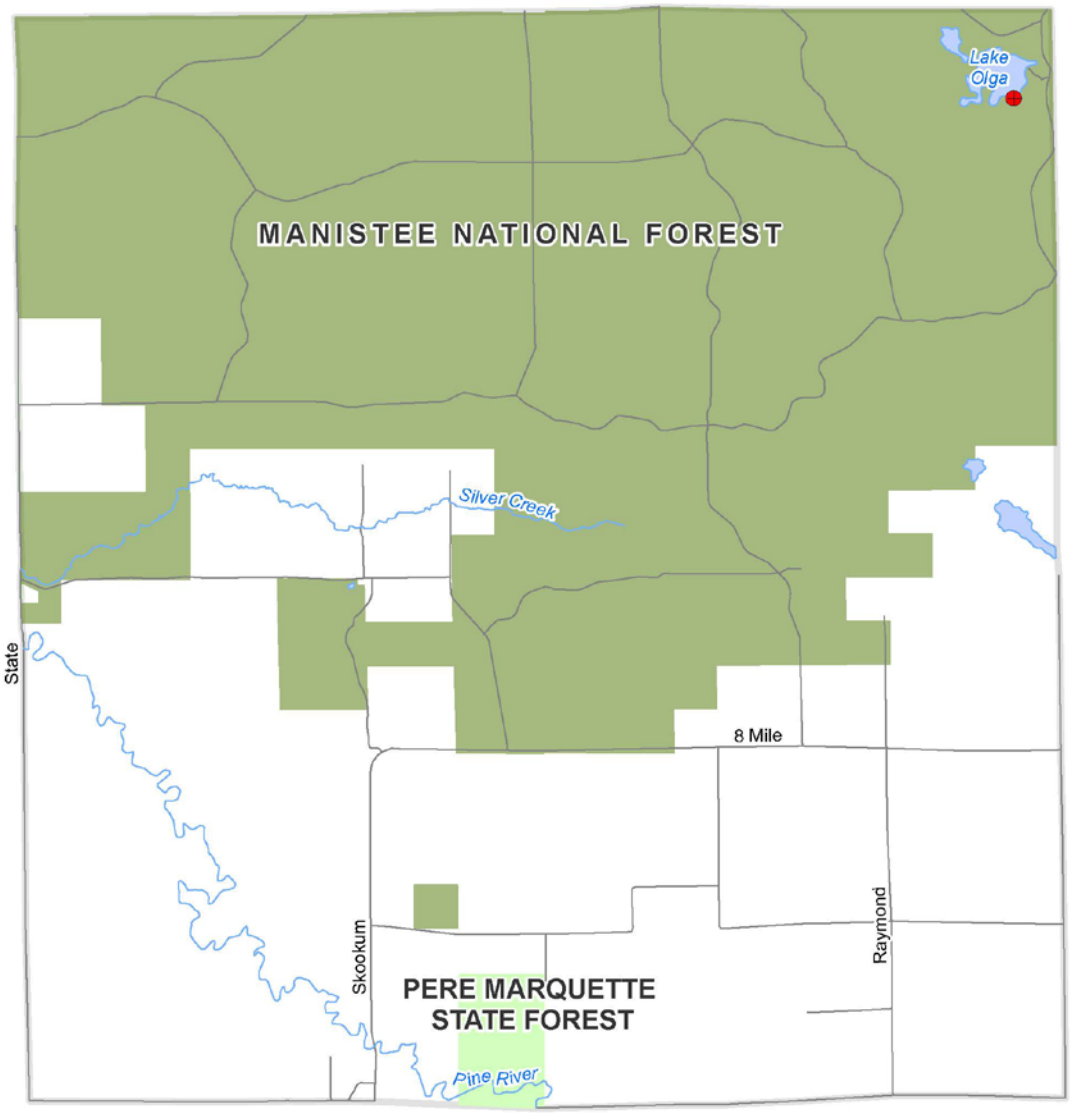
3.04 Public Health Emergencies: - None Identified.

3.05 Terrorism and Similar Criminal Activities: - None Identified.

	Dover Township Hazard Rating	Probability of Occurrence	Impact on People	Impact on Property	Impact on Economy	Impacts Total	Hazard Score
1.01	Celestial Impacts	1	2	0	2	8	8
1.02	Drought	2	2	2	3	13	26
1.03	Earthquake	0	-	-	-	-	-
1.04	Extreme Temperatures	3	2	1	2	10	30
1.05	Flooding: Riverine/Urban	2	1	1	1	6	12
1.06	Fog	2	1	0	1	4	8
1.07	Great Lakes Shoreline	0	-	-	-	-	-
1.08	Hail	2	2	2	1	11	22
1.09	Invasive Species	2	1	1	1	6	12
1.10	Lightning	3	1	2	1	8	24
1.11	Severe Winds	3	2	3	2	14	42
1.12	Subsidence	1	1	1	1	6	6
1.13	Tornadoes	1	3	2	2	15	15
1.14	Wildfire	2	2	2	2	12	24
1.15	Winter Storms	3	3	2	3	16	48
2.01	Dam failure	0	-	-	-	-	-
2.02	Energy Emergencies	2	2	0	3	9	18
2.03	Fire – Scrap Tires	1	1	1	1	6	6
2.04	Fire – Structural	3	1	2	2	9	27
2.05	HAZMAT – Fixed Site	2	1	1	2	7	14
2.06	HAZMAT – Transportation	2	1	1	2	7	14
2.07	Infrastructure Failures	3	3	1	2	13	39
2.08	Nuclear Power Emergencies	0	-	-	-	-	-
2.09	Oil/Natural Gas Well Accidents	1	1	1	1	6	6
2.10	Pipeline Accidents	1	1	1	2	7	7
2.11	Transportation Accidents	2	1	1	1	6	12
3.01	Catastrophic Incidents	1	3	3	3	18	18
3.02	Civil Disturbances	1	1	1	1	6	6
3.03	Nuclear Attack	0	-	-	-	-	-
3.04	Public Health Emergencies	2	2	0	3	9	18
3.05	Terrorism & Similar Criminal Acts	1	1	1	1	6	6

	Dover Township Hazard Ranking	Probability of Occurrence	X Impacts Total	= Hazard Score
1	Winter Storms	3	16	48
2	Severe Winds	3	14	42
3	Infrastructure Failures	3	13	39
4	Extreme Temperatures	3	10	30
5	Fire – Structural	3	9	27
5	Drought	2	13	26
7	Lightning	3	8	24
7	Wildfire	2	12	24
9	Hail	2	11	22
10	Catastrophic Incidents	1	18	18
10	Energy Emergencies	2	9	18
10	Public Health Emergencies	2	9	18
13	Tornadoes	1	15	15
14	HAZMAT – Fixed Site	2	7	14
14	HAZMAT – Transportation	2	7	14
16	Flooding: Riverine/Urban	2	6	12
16	Invasive Species	2	6	12
16	Transportation Accidents	2	6	12
19	Celestial Impacts	1	8	8
19	Fog	2	4	8
21	Pipeline Accidents	1	7	7
22	Civil Disturbances	1	6	6
22	Fire – Scrap Tires	1	6	6
22	Oil/Natural Gas Well Accidents	1	6	6
22	Subsidence	1	6	6
22	Terrorism & Similar Criminal Acts	1	6	6
	Dam failure	0	-	-
	Earthquake	0	-	-
	Great Lakes Shoreline	0	-	-
	Nuclear Attack	0	-	-
	Nuclear Power Emergencies	0	-	-

DOVER TOWNSHIP
Critical Facilities and Potential Hazards



0 0.5 1 Miles

Note: This jurisdiction is subject to many additional hazards; some of which tend to occur across wide areas and cannot be effectively shown on this map.Refer to **Appendix B- Hazard Identifications and Analyses** for more complete information about potential hazards in this community.

Street
Dam
Federal Land
State Land

WMSRDC
WEST MICHIGAN SHORELINE REGIONAL DEVELOPMENT COMMISSION

Source: Michigan Geographic Data Library V 12b, Lake Co. Hazard Mitigation Plan Update 2014

Hazard Identification Profile

Eden Township

1. NATURAL HAZARDS

1.01 Celestial Impacts: - None Identified.

1.02 Drought:

- Summer 1871: Prolonged drought over much of the Great Lakes region.
- May-September, 1891: Drought devastated Michigan's lumber industry.
- 12 recorded drought events in the area (including Lake, Mason, Muskegon, Newaygo, and Oceana counties) lasting eight months or greater: 1895-1896 (15 months), 1899-1900 (11 months), 1901-1902 (10 months), 1909-1911 (24 months), 1925-1926 (11 months), 1930-1931 (18 months), 1956-1957 (8 months), 1962-1963 (9 months), 1971-1972 (12 months), 1976-1977 (13 months), and 2002-2003 (12 months).

1.03 Earthquake: - None Identified.

1.04 Extreme Temperatures:

- July 1936: Heatwave. 570 deaths statewide, 364 in Detroit.
- Summer, 1988: 39 days with temperatures over 90 degrees, statewide.
- January 20, 1994: Record cold. $50m property damage across Michigan.
- March 2012: Anomalous temperatures. $209.8m crop damage across Michigan.

1.05 Flooding - Riverine/ Urban:

- September 10-19, 1986: Flooding. Declaration of disaster by Governor, Presidential disaster declaration, Lake County.
- ***August 6, 1998: Flash flood. $10k property damage, northwest Lake County.***
- February 10, 2001: Flooding. $100k property damage, western Michigan.
- May 21-23, 2004: Flooding. $25m property damage, $4.6m crop damage, western Lower Michigan.
- June 13, 2008: Flash flood. $2m property damage, $500k crop damage, Presidential disaster declaration, Lake County.
- May 3, 2012: Flash flood. $70k property damage, Lake County.
- April 17-23, 2013: Flood. $3m property damage, Lake County.
- April 2014: Flood. (details yet to come), Lake County.

1.06 Fog:

- January 11-13, 1995: Dense Fog. Four traffic accident fatalies, school closures, and flight delays across Lower Michigan.

1.07 Great Lakes Shoreline Hazards: - None Identified.

1.08 Hail:

- Severe hail events (1" or greater) recorded in Lake County since 1996: 9

1.09 Invasive Species:

- Invasive species exist in Lake County, however no significant events have been identified.

1.10 Lightning: - None Identified.

1.11 Severe Winds:

- April 6, 1997: High wind. $5m property damage across southwest Lower Michigan.
- ***May 29, 1998: Severe thunderstorm winds. $10k property damage, Irons.***
- May 31, 1998: Severe thunderstorm winds. Declaration of local of emergency and $1.1m property damage, Lake County.
- ***July 23, 1999: Severe thunderstorm winds. $10k property damage, Irons.***
- June 1, 2000: Severe thunderstorm winds. $25k property damage, Lake County.
- July 13, 2000: Severe thunderstorm winds. $25k property damage, Lake County.
- June 18, 2001: High wind. $100k property damage across central Lower Michigan.
- August 9, 2001: Severe thunderstorm winds. $25k property damage, Lake County.
- March 9, 2002: High wind. $485k property damage across southwest Lower Michigan.
- ***July 13, 2004: Severe thunderstorm winds. $10k property damage, Irons and Big Bass Lake areas.***
- October 30, 2004: High wind. $1.15m property damage across southwest Lower Michigan.
- July 24, 2005: Severe thunderstorm winds. $25k property damage, Lake County.
- July 26, 2005: Severe thunderstorm winds. $25k property damage, Lake County.
- ***April 25, 2005: Severe thunderstorm winds. $20k property damage, northwest Lake County.***
- May 3, 2012: Severe thunderstorm winds. $500k property damage, Lake County.
- August 7, 2013: Severe thunderstorm winds. $100k property damage, Lake County.
- November 17, 2013: High wind. $75k property damage, Lake County.

1.12 Subsidence: - None Identified.

1.13 Tornadoes:

- June 8, 1985: F1 tornado. No documented damages, unknown location in Lake County.

1.14 Wildfire:

- October 1871: Wildfires. 1.2m acres burned, 200 fatalities, Lower Peninsula.
- May-September, 1891: Uncontrollable wildfires across Michigan during the drought of 1891.
- 1981-2010: Approximately 11 wildfires and 43 acres burned per year on county lands under MDNR jurisdiction (315 total wildfires, 1,283.5 total acres burned).

1.15 Winter Storms:

- January 26, 1978: Blizzard, snowstorm. Declaration of statewide emergency by President, disaster by Governor.
- January 12, 1993: Heavy snow. $50k property damage, northern Lower Michigan.
- April 1, 1993: Heavy snow. $50k property damage, Lower Michigan.
- January 12-21, 1994: Heavy lake effect snow. $500k property damage across western Lower Michigan.
- January 27, 1994: Heavy snow and freezing rain. $5m property damage across region.
- March 9, 1998: Winter storm. $100k property damage across region.
- January 2-25, 1999: Blizzard, lake effect snow. "Blizzard of '99". southern Lower Michigan.
- April 3, 2003: Ice storm. $4.9m property damage throughout West Michigan.
- December 11-12, 2010: Winter storm. $250k property damage, west-central Lower Michigan.
- March 2-3, 2012: Heavy snow. $100k property damage, power outages, and shelters opened in Lake County.

2. TECHNOLOGICAL HAZARDS

2.01 Dam Failure: - None Identified.

2.02 Energy Emergencies: - None Identified.

2.03 Fire - Scrap Tire: - None Identified.

2.04 Fire - Structural:

- County fire rate per 1,000 population in 1998: 3.09

2.05 Hazard Material Incidents - Fixed Site (including industrial accidents): - None Identified.

2.06 Hazard Material Incidents - Transportation: - None Identified.

2.07 Infrastructure Failure:

- Number of NCDC events showing downed power lines or power outages in Lake County, 1997-2012: 18
- April 6-7,1997: 180,000-200,000 without power; 70,000 on second day (high wind event), statewide.
- March 9, 1998: 1,900 power outages (blizzard conditions), Lake, Clare, Oceana and Muskegon counties.
- May 29, 1998: Downed power lines and trees (thunderstorm winds), Irons.
- ***February 9-10, 2001: Portions of M-37 closed (flooding), Lake County.***
- April 3, 2003: Hundreds of thousands lose power (ice storm), Lower Michigan.
- ***July 13, 2004: Several trees and wires blown down (thunderstorm winds), Irons and Bass Lake areas.***
- October 10, 2004: 100,000 without power (high wind), statewide.
- June 13, 2008: Numerous roads washed out (flash flood), Lake County.
- June 28, 2008: Three-quarters of Lake County without power (thunderstorm winds), Lake County.
- May 3, 2012: Several roads flooded or washed out (flash flood), Lake County.

2.08 Nuclear Power Plant Emergencies: - None Identified.

2.09 Oil and Natural Gas Well Accidents:

- 2 oil and gas wells within Eden Township, none of which are "active" or "producing."

2.10 Pipeline Accidents: - None Identified.

2.11 Transportation Accidents: - None Identified.

3. HUMAN -RELATED HAZARDS

3.01 Catastrophic Incidents (National Emergencies): - None Identified.

3.02 Civil Disturbances: - None Identified.

3.03 Nuclear Attack: - None Identified.

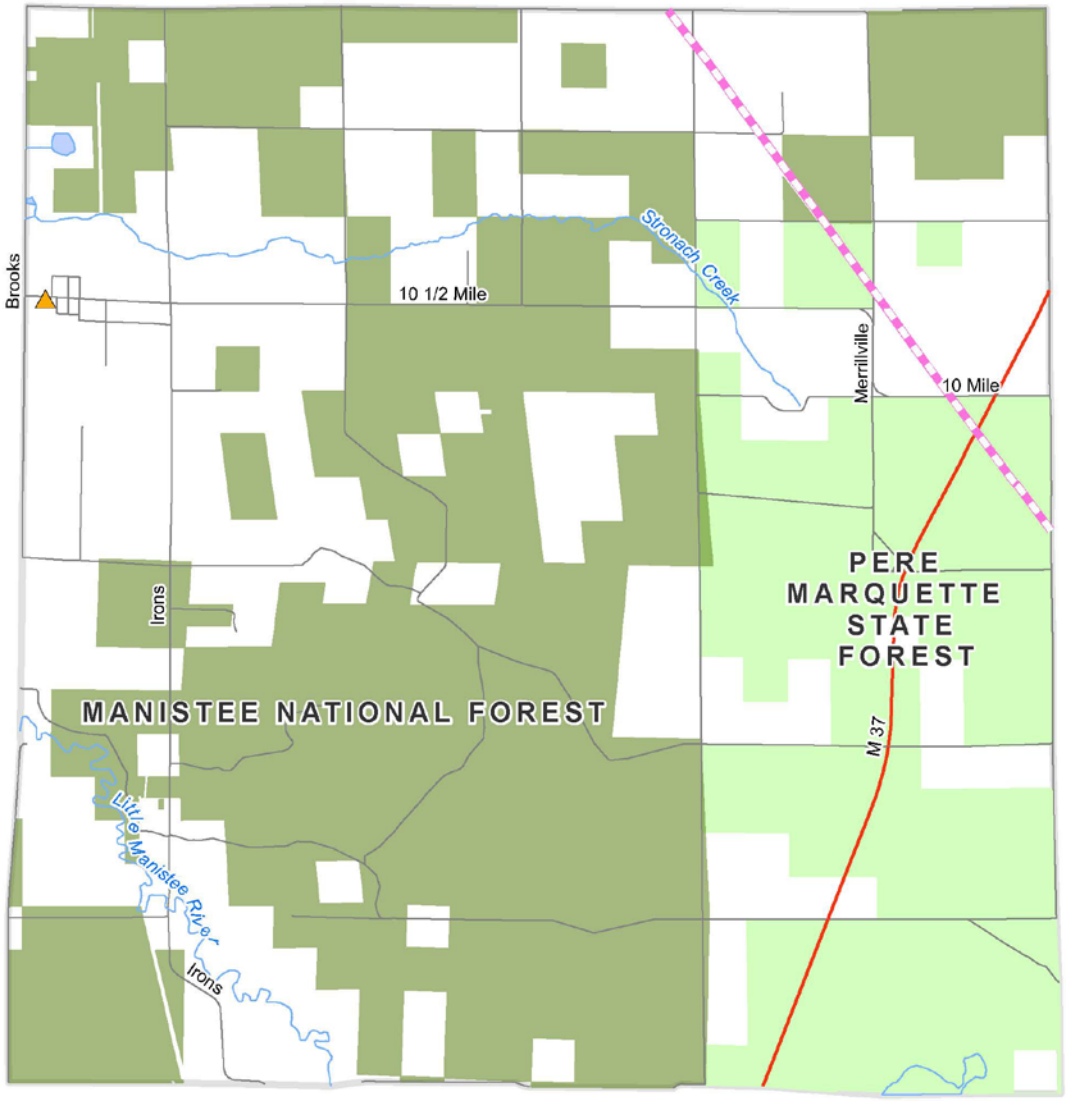
3.04 Public Health Emergencies: - None Identified.

3.05 Terrorism and Similar Criminal Activities: - None Identified.

	Eden Township Hazard Rating	Probability of Occurrence	Impact on People	Impact on Property	Impact on Economy	Impacts Total	Hazard Score
1.01	Celestial Impacts	1	2	0	2	8	8
1.02	Drought	2	2	2	3	13	26
1.03	Earthquake	0	-	-	-	-	-
1.04	Extreme Temperatures	3	2	1	2	10	30
1.05	Flooding: Riverine/Urban	2	1	1	1	6	12
1.06	Fog	2	1	0	1	4	8
1.07	Great Lakes Shoreline	0	-	-	-	-	-
1.08	Hail	2	2	2	1	11	22
1.09	Invasive Species	2	1	1	2	7	14
1.10	Lightning	3	1	2	1	8	24
1.11	Severe Winds	3	2	3	2	14	42
1.12	Subsidence	1	1	1	1	6	6
1.13	Tornadoes	1	3	2	2	15	15
1.14	Wildfire	2	2	2	2	12	24
1.15	Winter Storms	3	3	2	3	16	48
2.01	Dam failure	0	-	-	-	-	-
2.02	Energy Emergencies	2	2	0	3	9	18
2.03	Fire – Scrap Tires	1	1	1	1	6	6
2.04	Fire – Structural	3	1	2	2	9	27
2.05	HAZMAT – Fixed Site	2	1	1	2	7	14
2.06	HAZMAT – Transportation	2	1	1	2	7	14
2.07	Infrastructure Failures	3	3	1	2	13	39
2.08	Nuclear Power Emergencies	0	-	-	-	-	-
2.09	Oil/Natural Gas Well Accidents	0	-	-	-	-	-
2.10	Pipeline Accidents	1	1	1	2	7	7
2.11	Transportation Accidents	2	1	1	1	6	12
3.01	Catastrophic Incidents	1	3	3	3	18	18
3.02	Civil Disturbances	1	1	1	1	6	6
3.03	Nuclear Attack	0	-	-	-	-	-
3.04	Public Health Emergencies	2	2	0	3	9	18
3.05	Terrorism & Similar Criminal Acts	1	1	1	1	6	6

	Eden Township Hazard Ranking	Probability of Occurrence	X Impacts Total	= Hazard Score
1	Winter Storms	3	16	48
2	Severe Winds	3	14	42
3	Infrastructure Failures	3	13	39
4	Extreme Temperatures	3	10	30
5	Fire – Structural	3	9	27
5	Drought	2	13	26
7	Lightning	3	8	24
7	Wildfire	2	12	24
9	Hail	2	11	22
10	Catastrophic Incidents	1	18	18
10	Energy Emergencies	2	9	18
10	Public Health Emergencies	2	9	18
13	Tornadoes	1	15	15
14	HAZMAT – Fixed Site	2	7	14
14	HAZMAT – Transportation	2	7	14
14	Invasive Species	2	7	14
17	Flooding: Riverine/Urban	2	6	12
17	Transportation Accidents	2	6	12
19	Celestial Impacts	1	8	8
19	Fog	2	4	8
21	Pipeline Accidents	1	7	7
22	Civil Disturbances	1	6	6
22	Fire – Scrap Tires	1	6	6
22	Subsidence	1	6	6
22	Terrorism & Similar Criminal Acts	1	6	6
	Dam failure	0	-	-
	Earthquake	0	-	-
	Great Lakes Shoreline	0	-	-
	Nuclear Attack	0	-	-
	Nuclear Power Emergencies	0	-	-
	Oil/Natural Gas Well Accidents	0	-	-

EDEN TOWNSHIP
Critical Facilities and Potential Hazards



0 0.5 1 Miles

State Trunkline
Street
Power Line
Fire/Police/911/EMS
Federal Land
State Land

Note: This jurisdiction is subject to many additional hazards; some of which tend to occur across wide areas and cannot be effectively shown on this map.Refer to **Appendix B- Hazard Identifications and Analyses** for more complete information about potential hazards in this community.

WMSRDC
WEST MICHIGAN SHORELINE REGIONAL DEVELOPMENT COMMISSION

Source: Michigan Geographic Data Library V 12b, Lake Co. Hazard Mitigation Plan Update 2014

Hazard Identification Profile

Elk Township

1. NATURAL HAZARDS

1.01 Celestial Impacts: - None Identified.

1.02 Drought:

- Summer 1871: Prolonged drought over much of the Great Lakes region.
- May-September, 1891: Drought devastated Michigan's lumber industry.
- 12 recorded drought events in the area (including Lake, Mason, Muskegon, Newaygo, and Oceana counties) lasting eight months or greater: 1895-1896 (15 months), 1899-1900 (11 months), 1901-1902 (10 months), 1909-1911 (24 months), 1925-1926 (11 months), 1930-1931 (18 months), 1956-1957 (8 months), 1962-1963 (9 months), 1971-1972 (12 months), 1976-1977 (13 months), and 2002-2003 (12 months).

1.03 Earthquake: - None Identified.

1.04 Extreme Temperatures:

- July 1936: Heatwave. 570 deaths statewide, 364 in Detroit.
- Summer, 1988: 39 days with temperatures over 90 degrees, statewide.
- January 20, 1994: Record cold. $50m property damage across Michigan.
- March 2012: Anomalous temperatures. $209.8m crop damage across Michigan.

1.05 Flooding - Riverine/ Urban:

- September 10-19, 1986: Flooding. Declaration of disaster by Governor, Presidential disaster declaration, Lake County.
- ***August 6, 1998: Flash flood. $10k property damage, northwest Lake County.***
- February 10, 2001: Flooding. $100k property damage, western Michigan.
- May 21-23, 2004: Flooding. $25m property damage, $4.6m crop damage, western Lower Michigan.
- June 13, 2008: Flash flood. $2m property damage, $500k crop damage, Presidential disaster declaration, Lake County.
- May 3, 2012: Flash flood. $70k property damage, Lake County.
- April 17-23, 2013: Flood. $3m property damage, Lake County.
- April 2014: Flood. (details yet to come), Lake County.

1.06 Fog:

- January 11-13, 1995: Dense Fog. Four traffic accident fatalies, school closures, and flight delays across Lower Michigan.

1.07 Great Lakes Shoreline Hazards: - None Identified.

1.08 Hail:

- Severe hail events (1" or greater) recorded in Lake County since 1996: 9

1.09 Invasive Species:

- Invasive species exist in Lake County, however no significant events have been identified.

1.10 Lightning: - None Identified.

1.11 Severe Winds:

- April 6, 1997: High wind. $5m property damage across southwest Lower Michigan.
- May 31, 1998: Severe thunderstorm winds. Declaration of local of emergency and $1.1m property damage, Lake County.
- June 1, 2000: Severe thunderstorm winds. $25k property damage, Lake County.
- July 13, 2000: Severe thunderstorm winds. $25k property damage, Lake County.
- June 18, 2001: High wind. $100k property damage across central Lower Michigan.
- August 9, 2001: Severe thunderstorm winds. $25k property damage, Lake County.
- March 9, 2002: High wind. $485k property damage across southwest Lower Michigan.
- October 30, 2004: High wind. $1.15m property damage across southwest Lower Michigan.
- July 24, 2005: Severe thunderstorm winds. $25k property damage, Lake County.
- July 26, 2005: Severe thunderstorm winds. $25k property damage, Lake County.
- ***April 25, 2005: Severe thunderstorm winds. $20k property damage, northwest Lake County.***
- May 3, 2012: Severe thunderstorm winds. $500k property damage, Lake County
- August 7, 2013: Severe thunderstorm winds. $100k property damage, Lake County.
- November 17, 2013: High wind. $75k property damage, Lake County.

1.12 Subsidence: - None Identified.

1.13 Tornadoes:

- June 8, 1985: F1 tornado. No documented damages, unknown location in Lake County.

1.14 Wildfire:

- October 1871: Wildfires. 1.2m acres burned, 200 fatalities, Lower Peninsula.
- May-September, 1891: Uncontrollable wildfires across Michigan during the drought of 1891.
- 1981-2010: Approximately 11 wildfires and 43 acres burned per year on county lands under MDNR jurisdiction (315 total wildfires, 1,283.5 total acres burned).

1.15 Winter Storms:

- January 26, 1978: Blizzard, snowstorm. Declaration of statewide emergency by President, disaster by Governor.
- January 12, 1993: Heavy snow. $50k property damage, northern Lower Michigan.
- April 1, 1993: Heavy snow. $50k property damage, Lower Michigan.
- January 12-21, 1994: Heavy lake effect snow. $500k property damage across western Lower Michigan.
- January 27, 1994: Heavy snow and freezing rain. $5m property damage across region.
- March 9, 1998: Winter storm. $100k property damage across region.
- January 2-25, 1999: Blizzard, lake effect snow. "Blizzard of '99". southern Lower Michigan.
- April 3, 2003: Ice storm. $4.9m property damage throughout West Michigan.
- December 11-12, 2010: Winter storm. $250k property damage, west-central Lower Michigan.
- March 2-3, 2012: Heavy snow. $100k property damage, power outages, and shelters opened in Lake County.

2. TECHNOLOGICAL HAZARDS

2.01 Dam Failure: - None Identified.

2.02 Energy Emergencies: - None Identified.

2.03 Fire - Scrap Tire: - None Identified.

2.04 Fire - Structural:

- County fire rate per 1,000 population in 1998: 3.09

2.05 Hazard Material Incidents - Fixed Site (including industrial accidents): - None Identified.

2.06 Hazard Material Incidents - Transportation: - None Identified.

2.07 Infrastructure Failure:

- Number of NCDC events showing downed power lines or power outages in Lake County, 1997-2012: 18
- April 6-7,1997: 180,000-200,000 without power; 70,000 on second day (high wind event), statewide.
- March 9, 1998: 1,900 power outages (blizzard conditions), Lake, Clare, Oceana and Muskegon counties.
- April 3, 2003: Hundreds of thousands lose power (ice storm), Lower Michigan.
- ***July 13, 2004: Several trees and wires blown down (thunderstorm winds), Irons and Bass Lake areas.***
- October 10, 2004: 100,000 without power (high wind), statewide.
- June 13, 2008: Numerous roads washed out (flash flood), Lake County.
- June 28, 2008: Three-quarters of Lake County without power (thunderstorm winds), Lake County.
- May 3, 2012: Several roads flooded or washed out (flash flood), Lake County.

2.08 Nuclear Power Plant Emergencies: - None Identified.

2.09 Oil and Natural Gas Well Accidents:

- 8 oil and gas wells within Elk Township, none of which are "active" or "producing."

2.10 Pipeline Accidents: - None Identified.

2.11 Transportation Accidents: - None Identified.

3. HUMAN -RELATED HAZARDS

3.01 Catastrophic Incidents (National Emergencies): - None Identified.

3.02 Civil Disturbances: - None Identified.

3.03 Nuclear Attack: - None Identified.

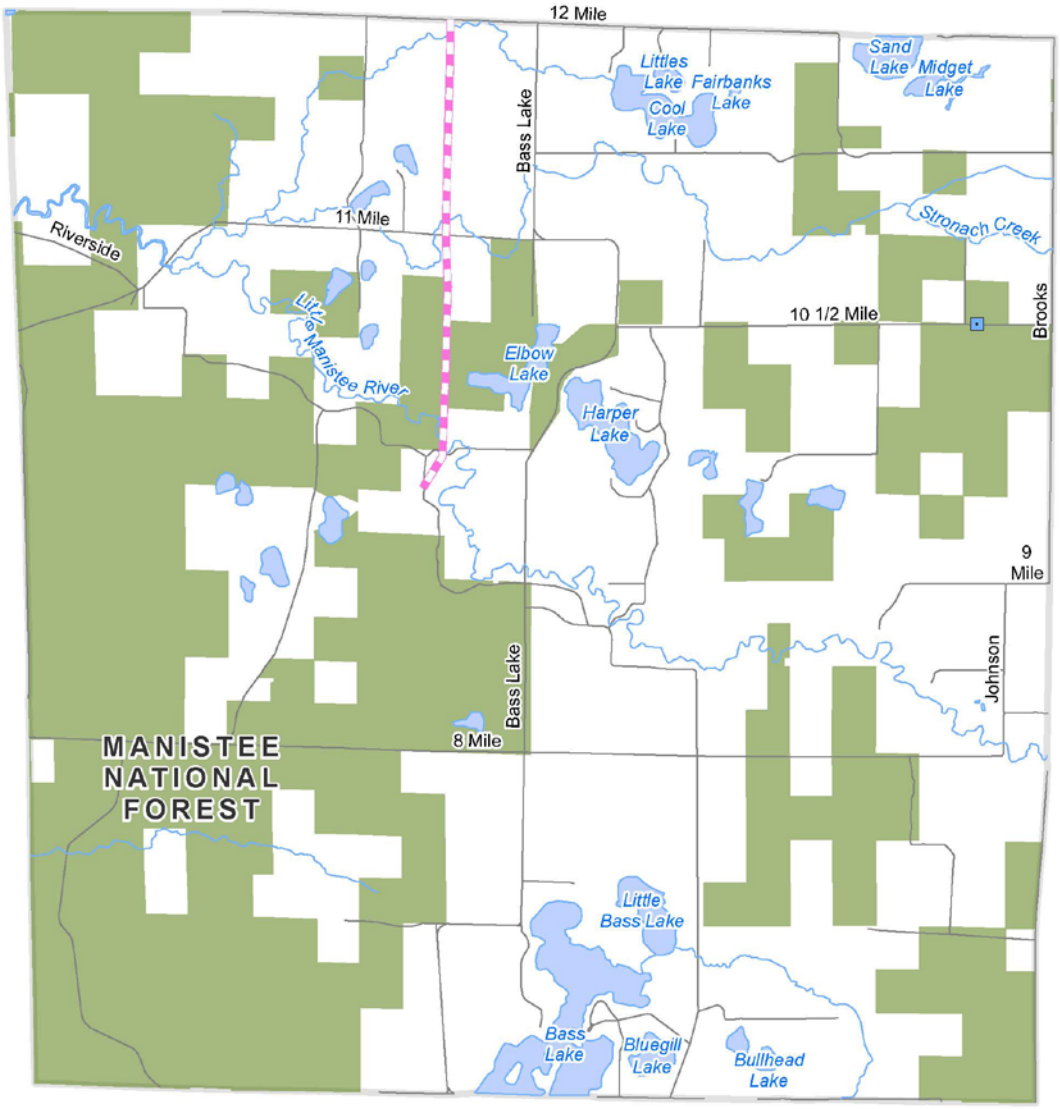
3.04 Public Health Emergencies: - None Identified.

3.05 Terrorism and Similar Criminal Activities: - None Identified.

	Elk Township Hazard Rating	Probability of Occurrence	Impact on People	Impact on Property	Impact on Economy	Impacts Total	Hazard Score
1.01	Celestial Impacts	1	2	0	2	8	8
1.02	Drought	2	2	2	3	13	26
1.03	Earthquake	0	-	-	-	-	-
1.04	Extreme Temperatures	3	2	1	2	10	30
1.05	Flooding: Riverine/Urban	2	1	1	1	6	12
1.06	Fog	2	1	0	1	4	8
1.07	Great Lakes Shoreline	0	-	-	-	-	-
1.08	Hail	2	2	2	1	11	22
1.09	Invasive Species	2	1	1	2	7	14
1.10	Lightning	3	1	2	1	8	24
1.11	Severe Winds	3	2	3	2	14	42
1.12	Subsidence	1	1	1	1	6	6
1.13	Tornadoes	1	3	2	2	15	15
1.14	Wildfire	2	2	2	2	12	24
1.15	Winter Storms	3	3	2	3	16	48
2.01	Dam failure	0	-	-	-	-	-
2.02	Energy Emergencies	2	2	0	3	9	18
2.03	Fire – Scrap Tires	1	1	1	1	6	6
2.04	Fire – Structural	3	1	2	2	9	27
2.05	HAZMAT – Fixed Site	2	1	1	2	7	14
2.06	HAZMAT – Transportation	2	1	1	2	7	14
2.07	Infrastructure Failures	3	3	1	2	13	39
2.08	Nuclear Power Emergencies	0	-	-	-	-	-
2.09	Oil/Natural Gas Well Accidents	1	1	1	1	6	6
2.10	Pipeline Accidents	0	-	-	-	-	-
2.11	Transportation Accidents	2	1	1	1	6	12
3.01	Catastrophic Incidents	1	3	3	3	18	18
3.02	Civil Disturbances	1	1	1	1	6	6
3.03	Nuclear Attack	0	-	-	-	-	-
3.04	Public Health Emergencies	2	2	0	3	9	18
3.05	Terrorism & Similar Criminal Acts	1	1	1	1	6	6

	Elk Township Hazard Ranking	Probability of Occurrence	X Impacts Total	= Hazard Score
1	Winter Storms	3	16	48
2	Severe Winds	3	14	42
3	Infrastructure Failures	3	13	39
4	Extreme Temperatures	3	10	30
5	Fire – Structural	3	9	27
6	Drought	2	13	26
7	Lightning	3	8	24
7	Wildfire	2	12	24
9	Hail	2	11	22
10	Catastrophic Incidents	1	18	18
10	Energy Emergencies	2	9	18
10	Public Health Emergencies	2	9	18
13	Tornadoes	1	15	15
14	HAZMAT – Fixed Site	2	7	14
14	HAZMAT – Transportation	2	7	14
14	Invasive Species	2	7	14
17	Flooding: Riverine/Urban	2	6	12
17	Transportation Accidents	2	6	12
19	Celestial Impacts	1	8	8
19	Fog	2	4	8
21	Civil Disturbances	1	6	6
21	Fire – Scrap Tires	1	6	6
21	Oil/Natural Gas Well Accidents	1	6	6
21	Subsidence	1	6	6
21	Terrorism & Similar Criminal Acts	1	6	6
	Dam failure	0	-	-
	Earthquake	0	-	-
	Great Lakes Shoreline	0	-	-
	Nuclear Attack	0	-	-
	Nuclear Power Emergencies	0	-	-
	Pipeline Accidents	0	-	-

ELK TOWNSHIP
Critical Facilities and Potential Hazards



0 0.5 1 Miles

Note: This jurisdiction is subject to many additional hazards; some of which tend to occur across wide areas and cannot be effectively shown on this map.Refer to **Appendix B- Hazard Identifications and Analyses** for more complete information about potential hazards in this community.

Street
Power Line
Shelter
Federal Land

WMSRDC
WEST MICHIGAN SHORELINE REGIONAL DEVELOPMENT COMMISSION

Source: Michigan Geographic Data Library V 12b, Lake Co. Hazard Mitigation Update 2014

Hazard Identification Profile

Ellsworth Township

1. NATURAL HAZARDS

1.01 Celestial Impacts: - None Identified.

1.02 Drought:

- Summer 1871: Prolonged drought over much of the Great Lakes region.
- May-September, 1891: Drought devastated Michigan's lumber industry.
- 12 recorded drought events in the area (including Lake, Mason, Muskegon, Newaygo, and Oceana counties) lasting eight months or greater: 1895-1896 (15 months), 1899-1900 (11 months), 1901-1902 (10 months), 1909-1911 (24 months), 1925-1926 (11 months), 1930-1931 (18 months), 1956-1957 (8 months), 1962-1963 (9 months), 1971-1972 (12 months), 1976-1977 (13 months), and 2002-2003 (12 months).

1.03 Earthquake: - None Identified.

1.04 Extreme Temperatures:

- July 1936: Heatwave. 570 deaths statewide, 364 in Detroit.
- Summer, 1988: 39 days with temperatures over 90 degrees, statewide.
- January 20, 1994: Record cold. $50m property damage across Michigan.
- March 2012: Anomalous temperatures. $209.8m crop damage across Michigan.

1.05 Flooding - Riverine/ Urban:

- September 10-19, 1986: Flooding. Declaration of disaster by Governor, Presidential disaster declaration, Lake County.
- February 10, 2001: Flooding. $100k property damage, western Michigan.
- May 21-23, 2004: Flooding. $25m property damage, $4.6m crop damage, western Lower Michigan.
- June 13, 2008: Flash flood. $2m property damage, $500k crop damage, Presidential disaster declaration, Lake County.
- May 3, 2012: Flash flood. $70k property damage, Lake County.
- April 17-23, 2013: Flood. $3m property damage, Lake County.
- April 2014: Flood. (details yet to come), Lake County.

1.06 Fog:

- January 11-13, 1995: Dense Fog. Four traffic accident fatalies, school closures, and flight delays across Lower Michigan.

1.07 Great Lakes Shoreline Hazards: - None Identified.

1.08 Hail:

- Severe hail events (1" or greater) recorded in Lake County since 1996: 9

1.09 Invasive Species:

- Invasive species exist in Lake County, however no significant events have been identified.

1.10 Lightning: - None Identified.

1.11 Severe Winds:

- April 6, 1997: High wind. $5m property damage across southwest Lower Michigan.
- May 31, 1998: Severe thunderstorm winds. Declaration of local of emergency and $1.1m property damage, Lake County.
- June 1, 2000: Severe thunderstorm winds. $25k property damage, Lake County.
- July 13, 2000: Severe thunderstorm winds. $25k property damage, Lake County.
- June 18, 2001: High wind. $100k property damage across central Lower Michigan.
- August 9, 2001: Severe thunderstorm winds. $25k property damage, Lake County.
- March 9, 2002: High wind. $485k property damage across southwest Lower Michigan.
- October 30, 2004: High wind. $1.15m property damage across southwest Lower Michigan.
- July 24, 2005: Severe thunderstorm winds. $25k property damage, Lake County.
- July 26, 2005: Severe thunderstorm winds. $25k property damage, Lake County.
- May 3, 2012: Severe thunderstorm winds. $500k property damage, Lake County
- August 7, 2013: Severe thunderstorm winds. $100k property damage, Lake County.
- November 17, 2013: High wind. $75k property damage, Lake County.

1.12 Subsidence: - None Identified.

1.13 Tornadoes:

- June 8, 1985: F1 tornado. No documented damages, unknown location in Lake County.

1.14 Wildfire:

- October 1871: Wildfires. 1.2m acres burned, 200 fatalities, Lower Peninsula.
- May-September, 1891: Uncontrollable wildfires across Michigan during the drought of 1891.
- 1981-2010: Approximately 11 wildfires and 43 acres burned per year on county lands under MDNR jurisdiction (315 total wildfires, 1,283.5 total acres burned).

1.15 Winter Storms:

- January 26, 1978: Blizzard, snowstorm. Declaration of statewide emergency by President, disaster by Governor.
- January 12, 1993: Heavy snow. $50k property damage, northern Lower Michigan.
- April 1, 1993: Heavy snow. $50k property damage, Lower Michigan.
- January 12-21, 1994: Heavy lake effect snow. $500k property damage across western Lower Michigan.
- January 27, 1994: Heavy snow and freezing rain. $5m property damage across region.
- March 9, 1998: Winter storm. $100k property damage across region.
- January 2-25, 1999: Blizzard, lake effect snow. "Blizzard of '99". southern Lower Michigan.
- April 3, 2003: Ice storm. $4.9m property damage throughout West Michigan.
- December 11-12, 2010: Winter storm. $250k property damage, west-central Lower Michigan.
- March 2-3, 2012: Heavy snow. $100k property damage, power outages, and shelters opened in Lake County.

2. TECHNOLOGICAL HAZARDS

2.01 Dam Failure: - None Identified.

2.02 Energy Emergencies: - None Identified.

2.03 Fire - Scrap Tire: - None Identified.

2.04 Fire - Structural:

- County fire rate per 1,000 population in 1998: 3.09

2.05 Hazard Material Incidents - Fixed Site (including industrial accidents): - None Identified.

2.06 Hazard Material Incidents - Transportation: - None Identified.

2.07 Infrastructure Failure:

- Number of NCDC events showing downed power lines or power outages in Lake County, 1997-2012: 18
- April 6-7,1997: 180,000-200,000 without power; 70,000 on second day (high wind event), statewide.
- March 9, 1998: 1,900 power outages (blizzard conditions), Lake, Clare, Oceana and Muskegon counties.
- April 3, 2003: Hundreds of thousands lose power (ice storm), Lower Michigan.
- October 10, 2004: 100,000 without power (high wind), statewide.
- June 13, 2008: Numerous roads washed out (flash flood), Lake County.
- June 28, 2008: Three-quarters of Lake County without power (thunderstorm winds), Lake County.
- May 3, 2012: Several roads flooded or washed out (flash flood), Lake County.

2.08 Nuclear Power Plant Emergencies: - None Identified.

2.09 Oil and Natural Gas Well Accidents:

- 18 oil and gas wells within Ellsworth Township, 8 of which are "active" or "producing."

2.10 Pipeline Accidents: - None Identified.

2.11 Transportation Accidents: - None Identified.

3. HUMAN -RELATED HAZARDS

3.01 Catastrophic Incidents (National Emergencies): - None Identified.

3.02 Civil Disturbances: - None Identified.

3.03 Nuclear Attack: - None Identified.

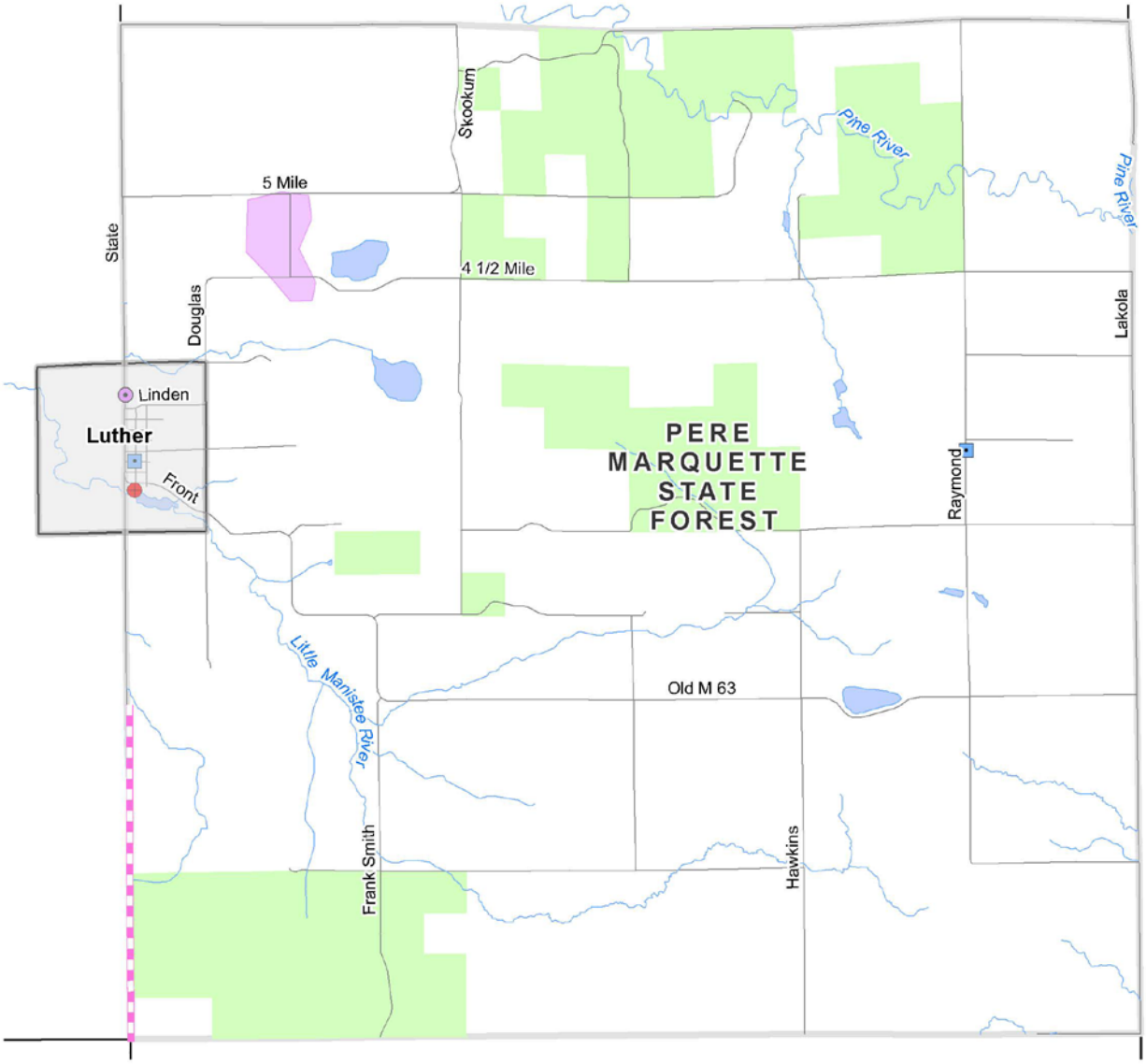
3.04 Public Health Emergencies: - None Identified.

3.05 Terrorism and Similar Criminal Activities: - None Identified.

	Ellsworth Township Hazard Rating	Probability of Occurrence	Impact on People	Impact on Property	Impact on Economy	Impacts Total	Hazard Score
1.01	Celestial Impacts	1	2	0	2	8	8
1.02	Drought	2	2	2	3	13	26
1.03	Earthquake	0	-	-	-	-	-
1.04	Extreme Temperatures	3	2	1	2	10	30
1.05	Flooding: Riverine/Urban	2	1	2	1	8	16
1.06	Fog	3	1	0	1	4	12
1.07	Great Lakes Shoreline	3	1	2	1	8	24
1.08	Hail	3	1	2	1	8	24
1.09	Invasive Species	2	1	2	2	9	18
1.10	Lightning	3	1	2	1	8	24
1.11	Severe Winds	3	2	3	2	14	42
1.12	Subsidence	1	1	1	1	6	6
1.13	Tornadoes	2	1	2	2	9	18
1.14	Wildfire	3	2	2	2	12	36
1.15	Winter Storms	3	3	2	3	16	48
2.01	Dam failure	0	-	-	-	-	-
2.02	Energy Emergencies	2	2	0	3	9	18
2.03	Fire – Scrap Tires	1	1	1	1	6	6
2.04	Fire – Structural	3	1	1	2	7	21
2.05	HAZMAT – Fixed Site	1	1	1	2	7	7
2.06	HAZMAT – Transportation	2	1	1	2	7	14
2.07	Infrastructure Failures	3	3	1	2	13	39
2.08	Nuclear Power Emergencies	0	-	-	-	-	-
2.09	Oil/Natural Gas Well Accidents	2	2	1	1	9	18
2.10	Pipeline Accidents	0	-	-	-	-	-
2.11	Transportation Accidents	2	1	1	1	6	12
3.01	Catastrophic Incidents	1	3	3	3	18	18
3.02	Civil Disturbances	1	1	1	1	6	6
3.03	Nuclear Attack	0	-	-	-	-	-
3.04	Public Health Emergencies	2	2	0	3	9	18
3.05	Terrorism & Similar Criminal Acts	1	1	1	1	6	6

	Ellsworth Township Hazard Ranking	Probability of Occurrence	X Impacts Total	= Hazard Score
1	Winter Storms	3	16	48
2	Severe Winds	3	14	42
3	Infrastructure Failures	3	13	39
4	Wildfire	3	12	36
5	Extreme Temperatures	3	10	30
5	Drought	2	13	26
7	Great Lakes Shoreline	3	8	24
7	Hail	3	8	24
7	Lightning	3	8	24
10	Fire – Structural	3	7	21
11	Catastrophic Incidents	1	18	18
11	Energy Emergencies	2	9	18
11	Invasive Species	2	9	18
11	Oil/Natural Gas Well Accidents	2	9	18
11	Public Health Emergencies	2	9	18
11	Tornadoes	2	9	18
17	Flooding: Riverine/Urban	2	8	16
18	HAZMAT – Transportation	2	7	14
19	Fog	3	4	12
19	Transportation Accidents	2	6	12
21	Celestial Impacts	1	8	8
22	HAZMAT – Fixed Site	1	7	7
23	Civil Disturbances	1	6	6
23	Fire – Scrap Tires	1	6	6
23	Subsidence	1	6	6
23	Terrorism & Similar Criminal Acts	1	6	6
	Dam failure	0	-	-
	Earthquake	0	-	-
	Nuclear Attack	0	-	-
	Nuclear Power Emergencies	0	-	-
	Pipeline Accidents	0	-	-

ELLSWORTH TOWNSHIP
Critical Facilities and Potential Hazards



0 0.5 1 Miles

Street
Power Line
School
Shelter
Dam
State Land
Oil/Gas Field

Note: This jurisdiction is subject to many additional hazards; some of which tend to occur across wide areas and cannot be effectively shown on this map.Refer to **Appendix B- Hazard Identifications and Analyses** for more complete information about potential hazards in this community.

WMSRDC
WEST MICHIGAN SHORELINE REGIONAL DEVELOPMENT COMMISSION

Source: Michigan Geographic Data Library V 12b, Lake Co. Hazard Mitigation Plan Update 2014

Hazard Identification Profile

Lake Township

1. NATURAL HAZARDS

1.01 Celestial Impacts: - None Identified.

1.02 Drought:

- Summer 1871: Prolonged drought over much of the Great Lakes region.
- May-September, 1891: Drought devastated Michigan's lumber industry.
- 12 recorded drought events in the area (including Lake, Mason, Muskegon, Newaygo, and Oceana counties) lasting eight months or greater: 1895-1896 (15 months), 1899-1900 (11 months), 1901-1902 (10 months), 1909-1911 (24 months), 1925-1926 (11 months), 1930-1931 (18 months), 1956-1957 (8 months), 1962-1963 (9 months), 1971-1972 (12 months), 1976-1977 (13 months), and 2002-2003 (12 months).

1.03 Earthquake: - None Identified.

1.04 Extreme Temperatures:

- July 1936: Heatwave. 570 deaths statewide, 364 in Detroit.
- Summer, 1988: 39 days with temperatures over 90 degrees, statewide.
- January 20, 1994: Record cold. $50m property damage across Michigan.
- March 2012: Anomalous temperatures. $209.8m crop damage across Michigan.

1.05 Flooding - Riverine/ Urban:

- September 10-19, 1986: Flooding. Declaration of disaster by Governor, Presidential disaster declaration, Lake County.
- February 10, 2001: Flooding. $100k property damage, western Michigan.
- May 21-23, 2004: Flooding. $25m property damage, $4.6m crop damage, western Lower Michigan.
- June 13, 2008: Flash flood. $2m property damage, $500k crop damage, Presidential disaster declaration, Lake County.
- May 3, 2012: Flash flood. $70k property damage, Lake County.
- April 17-23, 2013: Flood. $3m property damage, Lake County.
- April 2014: Flood. (details yet to come), Lake County.

1.06 Fog:

- January 11-13, 1995: Dense Fog. Four traffic accident fatalies, school closures, and flight delays across Lower Michigan.

1.07 Great Lakes Shoreline Hazards: - None Identified.

1.08 Hail:

- Severe hail events (1" or greater) recorded in Lake County since 1996: 9

1.09 Invasive Species:

- Invasive species exist in Lake County, however no significant events have been identified.

1.10 Lightning: - None Identified.

1.11 Severe Winds:

- April 6, 1997: High wind. $5m property damage across southwest Lower Michigan.
- May 31, 1998: Severe thunderstorm winds. Declaration of local of emergency and $1.1m property damage, Lake County.
- June 1, 2000: Severe thunderstorm winds. $25k property damage, Lake County.
- July 13, 2000: Severe thunderstorm winds. $25k property damage, Lake County.
- June 18, 2001: High wind. $100k property damage across central Lower Michigan.
- August 9, 2001: Severe thunderstorm winds. $25k property damage, Lake County.
- March 9, 2002: High wind. $485k property damage across southwest Lower Michigan.
- October 30, 2004: High wind. $1.15m property damage across southwest Lower Michigan.
- July 24, 2005: Severe thunderstorm winds. $25k property damage, Lake County.
- July 26, 2005: Severe thunderstorm winds. $25k property damage, Lake County.
- May 3, 2012: Severe thunderstorm winds. $500k property damage, Lake County.
- August 7, 2013: Severe thunderstorm winds. $100k property damage, Lake County.
- November 17, 2013: High wind. $75k property damage, Lake County.

1.12 Subsidence: - None Identified.

1.13 Tornadoes:

- June 8, 1985: F1 tornado. No documented damages, unknown location in Lake County.
- ***July 26, 2005: F1 tornado. $150k property damage and $50k crop damage, Lake Township.***

1.14 Wildfire:

- October 1871: Wildfires. 1.2m acres burned, 200 fatalities, Lower Peninsula.
- May-September, 1891: Uncontrollable wildfires across Michigan during the drought of 1891.
- 1981-2010: Approximately 11 wildfires and 43 acres burned per year on county lands under MDNR jurisdiction (315 total wildfires, 1,283.5 total acres burned).

1.15 Winter Storms:

- January 26, 1978: Blizzard, snowstorm. Declaration of statewide emergency by President, disaster by Governor.
- January 12, 1993: Heavy snow. $50k property damage, northern Lower Michigan.
- April 1, 1993: Heavy snow. $50k property damage, Lower Michigan.
- January 12-21, 1994: Heavy lake effect snow. $500k property damage across western Lower Michigan.
- January 27, 1994: Heavy snow and freezing rain. $5m property damage across region.
- March 9, 1998: Winter storm. $100k property damage across region.
- January 2-25, 1999: Blizzard, lake effect snow. "Blizzard of '99". southern Lower Michigan.
- April 3, 2003: Ice storm. $4.9m property damage throughout West Michigan.
- December 11-12, 2010: Winter storm. $250k property damage, west-central Lower Michigan.
- March 2-3, 2012: Heavy snow. $100k property damage, power outages, and shelters opened in Lake County.

2. TECHNOLOGICAL HAZARDS

2.01 Dam Failure: - None Identified.

2.02 Energy Emergencies: - None Identified.

2.03 Fire - Scrap Tire: - None Identified.

2.04 Fire - Structural:

- County fire rate per 1,000 population in 1998: 3.09

2.05 Hazard Material Incidents - Fixed Site (including industrial accidents): - None Identified.

2.06 Hazard Material Incidents - Transportation: - None Identified.

2.07 Infrastructure Failure:

- Number of NCDC events showing downed power lines or power outages in Lake County, 1997-2012: 18
- April 6-7,1997: 180,000-200,000 without power; 70,000 on second day (high wind event), statewide.
- March 9, 1998: 1,900 power outages (blizzard conditions), Lake, Clare, Oceana and Muskegon counties.
- April 3, 2003: Hundreds of thousands lose power (ice storm), Lower Michigan.
- October 10, 2004: 100,000 without power (high wind), statewide.
- June 13, 2008: Numerous roads washed out (flash flood), Lake County.
- June 28, 2008: Three-quarters of Lake County without power (thunderstorm winds), Lake County.
- May 3, 2012: Several roads flooded or washed out (flash flood), Lake County.

2.08 Nuclear Power Plant Emergencies: - None Identified.

2.09 Oil and Natural Gas Well Accidents:

- 1 oil or gas well within Lake Township, which is neither "active" nor "producing."

2.10 Pipeline Accidents: - None Identified.

2.11 Transportation Accidents: - None Identified.

3. HUMAN -RELATED HAZARDS

3.01 Catastrophic Incidents (National Emergencies): - None Identified.

3.02 Civil Disturbances: - None Identified.

3.03 Nuclear Attack: - None Identified.

3.04 Public Health Emergencies: - None Identified.

3.05 Terrorism and Similar Criminal Activities: - None Identified.

	Lake Township Hazard Rating	Probability of Occurrence	Impact on People	Impact on Property	Impact on Economy	Impacts Total	Hazard Score
1.01	Celestial Impacts	1	2	0	2	8	8
1.02	Drought	2	2	2	3	13	26
1.03	Earthquake	0	-	-	-	-	-
1.04	Extreme Temperatures	3	2	1	2	10	30
1.05	Flooding: Riverine/Urban	2	1	2	1	8	16
1.06	Fog	3	1	0	1	4	12
1.07	Great Lakes Shoreline	3	1	2	1	8	24
1.08	Hail	3	1	2	1	8	24
1.09	Invasive Species	2	1	2	2	9	18
1.10	Lightning	3	1	2	1	8	24
1.11	Severe Winds	3	2	3	2	14	42
1.12	Subsidence	1	1	1	1	6	6
1.13	Tornadoes	2	1	2	2	9	18
1.14	Wildfire	3	2	2	2	12	36
1.15	Winter Storms	3	3	2	3	16	48
2.01	Dam failure	0	-	-	-	-	-
2.02	Energy Emergencies	2	2	0	3	9	18
2.03	Fire – Scrap Tires	1	1	1	1	6	6
2.04	Fire – Structural	3	1	1	2	7	21
2.05	HAZMAT – Fixed Site	1	1	1	2	7	7
2.06	HAZMAT – Transportation	2	1	1	2	7	14
2.07	Infrastructure Failures	3	3	1	2	13	39
2.08	Nuclear Power Emergencies	0	-	-	-	-	-
2.09	Oil/Natural Gas Well Accidents	2	2	1	1	9	18
2.10	Pipeline Accidents	0	-	-	-	-	-
2.11	Transportation Accidents	1	1	1	1	6	6
3.01	Catastrophic Incidents	1	3	3	3	18	18
3.02	Civil Disturbances	1	1	1	1	6	6
3.03	Nuclear Attack	0	-	-	-	-	-
3.04	Public Health Emergencies	2	2	0	3	9	18
3.05	Terrorism & Similar Criminal Acts	1	1	1	1	6	6

	Lake Township Hazard Ranking	Probability of Occurrence	X	Impacts Total	=	Hazard Score
1	Winter Storms	3		16		48
2	Severe Winds	3		14		42
3	Infrastructure Failures	3		13		39
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7	Hail	3		8		24
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11	Catastrophic Incidents	1		18		18
11	Energy Emergencies	2		9		18
11	Invasive Species	2		9		18
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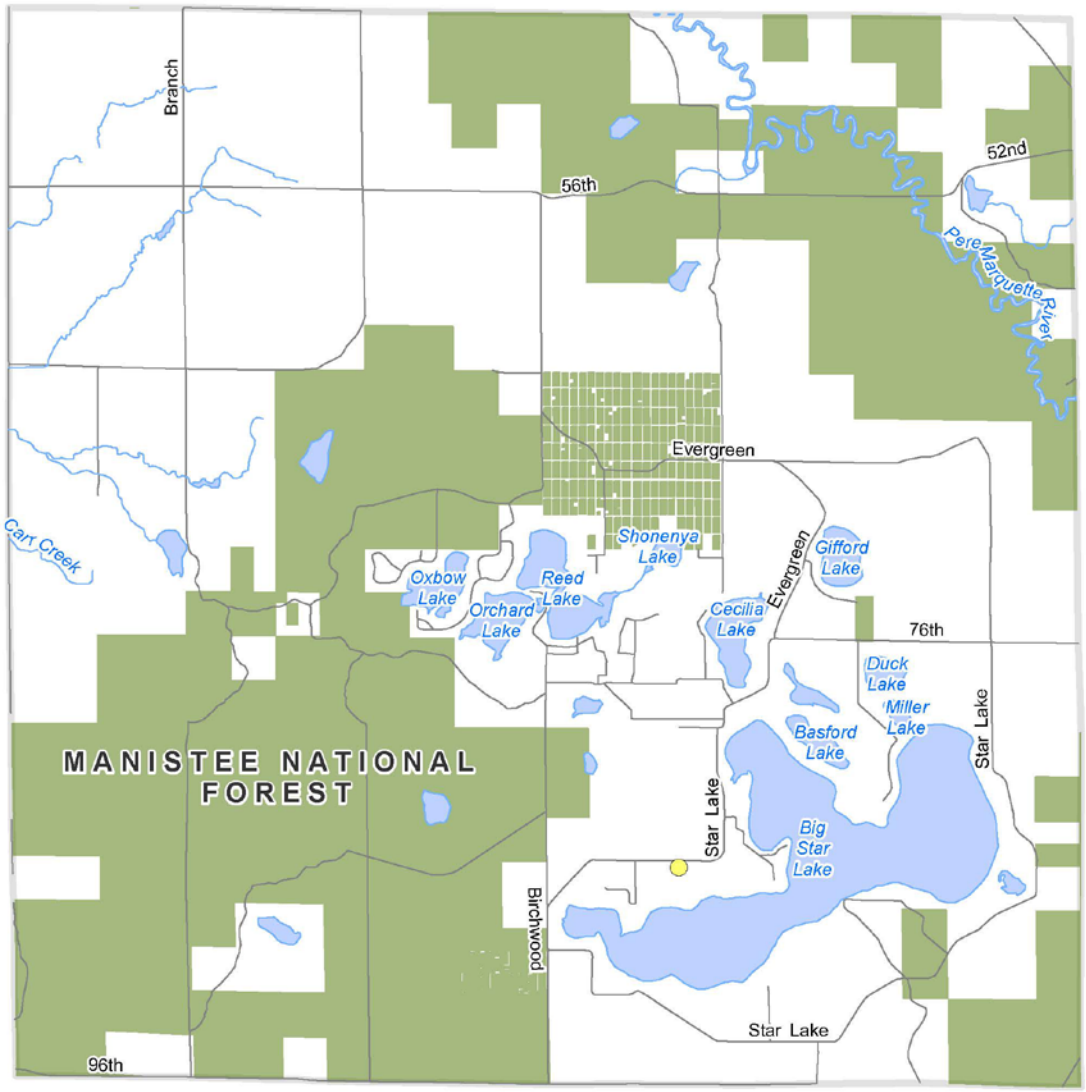
11	Public Health Emergencies	2		9		18
11	Tornadoes	2		9		18
17	Flooding: Riverine/Urban	2		8		16
18	HAZMAT – Transportation	2		7		14
19	Fog	3		4		12
20	Celestial Impacts	1		8		8
21	HAZMAT – Fixed Site	1		7		7
22	Civil Disturbances	1		6		6
22	Fire – Scrap Tires	1		6		6
22	Subsidence	1		6		6
22	Terrorism & Similar Criminal Acts	1		6		6
22	Transportation Accidents	1		6		6
	Dam failure	0		-		-
	Earthquake	0		-		-
	Nuclear Attack	0		-		-
	Nuclear Power Emergencies	0		-		-
	Pipeline Accidents	0		-		-

LAKE TOWNSHIP
Critical Facilities and Potential Hazards



0 0.5 1 Miles

Note: This jurisdiction is subject to many additional hazards; some of which tend to occur across wide areas and cannot be effectively shown on this map.Refer to **Appendix B- Hazard Identifications and Analyses** for more complete information about potential hazards in this community.

Street
Siren
Federal Land

WMSRDC
WEST MICHIGAN SHORELINE REGIONAL DEVELOPMENT COMMISSION

Source: Michigan Geographic Data Library V 12b, Lake Co. Hazard Mitigation Plan Update 2014

Hazard Identification Profile

Newkirk Township

1. NATURAL HAZARDS

1.01 Celestial Impacts: - None Identified.

1.02 Drought:

- Summer 1871: Prolonged drought over much of the Great Lakes region.
- May-September, 1891: Drought devastated Michigan's lumber industry.
- 12 recorded drought events in the area (including Lake, Mason, Muskegon, Newaygo, and Oceana counties) lasting eight months or greater: 1895-1896 (15 months), 1899-1900 (11 months), 1901-1902 (10 months), 1909-1911 (24 months), 1925-1926 (11 months), 1930-1931 (18 months), 1956-1957 (8 months), 1962-1963 (9 months), 1971-1972 (12 months), 1976-1977 (13 months), and 2002-2003 (12 months).

1.03 Earthquake: - None Identified.

1.04 Extreme Temperatures:

- July 1936: Heatwave. 570 deaths statewide, 364 in Detroit.
- Summer, 1988: 39 days with temperatures over 90 degrees, statewide.
- January 20, 1994: Record cold. $50m property damage across Michigan.
- March 2012: Anomalous temperatures. $209.8m crop damage across Michigan.

1.05 Flooding - Riverine/ Urban:

- September 10-19, 1986: Flooding. Declaration of disaster by Governor, Presidential disaster declaration, Lake County.
- February 10, 2001: Flooding. $100k property damage, western Michigan.
- May 21-23, 2004: Flooding. $25m property damage, $4.6m crop damage, western Lower Michigan.
- June 13, 2008: Flash flood. $2m property damage, $500k crop damage, Presidential disaster declaration, Lake County.
- May 3, 2012: Flash flood. $70k property damage, Lake County.
- April 17-23, 2013: Flood. $3m property damage, Lake County.
- April 2014: Flood. (details yet to come), Lake County.

1.06 Fog:

- January 11-13, 1995: Dense Fog. Four traffic accident fatalies, school closures, and flight delays across Lower Michigan.

1.07 Great Lakes Shoreline Hazards: - None Identified.

1.08 Hail:

- Severe hail events (1" or greater) recorded in Lake County since 1996: 9

1.09 Invasive Species:

- Invasive species exist in Lake County, however no significant events have been identified.

1.10 Lightning: - None Identified.

1.11 Severe Winds:

- April 6, 1997: High wind. $5m property damage across southwest Lower Michigan.
- May 31, 1998: Severe thunderstorm winds. Declaration of local of emergency and $1.1m property damage, Lake County.
- June 1, 2000: Severe thunderstorm winds. $25k property damage, Lake County.
- July 13, 2000: Severe thunderstorm winds. $25k property damage, Lake County.
- June 18, 2001: High wind. $100k property damage across central Lower Michigan.
- August 9, 2001: Severe thunderstorm winds. $25k property damage, Lake County.
- March 9, 2002: High wind. $485k property damage across southwest Lower Michigan.
- October 30, 2004: High wind. $1.15m property damage across southwest Lower Michigan.
- July 24, 2005: Severe thunderstorm winds. $25k property damage, Lake County.
- July 26, 2005: Severe thunderstorm winds. $25k property damage, Lake County.
- May 3, 2012: Severe thunderstorm winds. $500k property damage, Lake County.
- August 7, 2013: Severe thunderstorm winds. $100k property damage, Lake County.
- November 17, 2013: High wind. $75k property damage, Lake County.

1.12 Subsidence: - None Identified.

1.13 Tornadoes:

- June 8, 1985: F1 tornado. No documented damages, unknown location in Lake County.

1.14 Wildfire:

- October 1871: Wildfires. 1.2m acres burned, 200 fatalities, Lower Peninsula.
- May-September, 1891: Uncontrollable wildfires across Michigan during the drought of 1891.
- 1981-2010: Approximately 11 wildfires and 43 acres burned per year on county lands under MDNR jurisdiction (315 total wildfires, 1,283.5 total acres burned).
- ***May 9, 2011: "8th St. Fire." 153 acres burned in Newkirk Township.***

1.15 Winter Storms:

- January 26, 1978: Blizzard, snowstorm. Declaration of statewide emergency by President, disaster by Governor.
- January 12, 1993: Heavy snow. $50k property damage, northern Lower Michigan.
- April 1, 1993: Heavy snow. $50k property damage, Lower Michigan.
- January 12-21, 1994: Heavy lake effect snow. $500k property damage across western Lower Michigan.
- January 27, 1994: Heavy snow and freezing rain. $5m property damage across region.
- March 9, 1998: Winter storm. $100k property damage across region.
- January 2-25, 1999: Blizzard, lake effect snow. "Blizzard of '99". southern Lower Michigan.
- April 3, 2003: Ice storm. $4.9m property damage throughout West Michigan.
- December 11-12, 2010: Winter storm. $250k property damage, west-central Lower Michigan.
- March 2-3, 2012: Heavy snow. $100k property damage, power outages, and shelters opened in Lake County.

2. TECHNOLOGICAL HAZARDS

2.01 Dam Failure: - None Identified.

2.02 Energy Emergencies: - None Identified.

2.03 Fire - Scrap Tire: - None Identified.

2.04 Fire - Structural:

- County fire rate per 1,000 population in 1998: 3.09

2.05 Hazard Material Incidents - Fixed Site (including industrial accidents): - None Identified.

2.06 Hazard Material Incidents - Transportation: - None Identified.

2.07 Infrastructure Failure:

- Number of NCDC events showing downed power lines or power outages in Lake County, 1997-2012: 18
- April 6-7,1997: 180,000-200,000 without power; 70,000 on second day (high wind event), statewide.
- March 9, 1998: 1,900 power outages (blizzard conditions), Lake, Clare, Oceana and Muskegon counties.
- ***February 9-10, 2001: Portions of M-37 closed (flooding), Lake County.***
- April 3, 2003: Hundreds of thousands lose power (ice storm), Lower Michigan.
- October 10, 2004: 100,000 without power (high wind), statewide.
- June 13, 2008: Numerous roads washed out (flash flood), Lake County.
- June 28, 2008: Three-quarters of Lake County without power (thunderstorm winds), Lake County.
- May 3, 2012: Several roads flooded or washed out (flash flood), Lake County.

2.08 Nuclear Power Plant Emergencies: - None Identified.

2.09 Oil and Natural Gas Well Accidents:

- 21 oil and gas wells within Newkirk Township, none of which are "active" or "producing."

2.10 Pipeline Accidents: - None Identified.

2.11 Transportation Accidents: - None Identified.

3. HUMAN -RELATED HAZARDS

3.01 Catastrophic Incidents (National Emergencies): - None Identified.

3.02 Civil Disturbances: - None Identified.

3.03 Nuclear Attack: - None Identified.

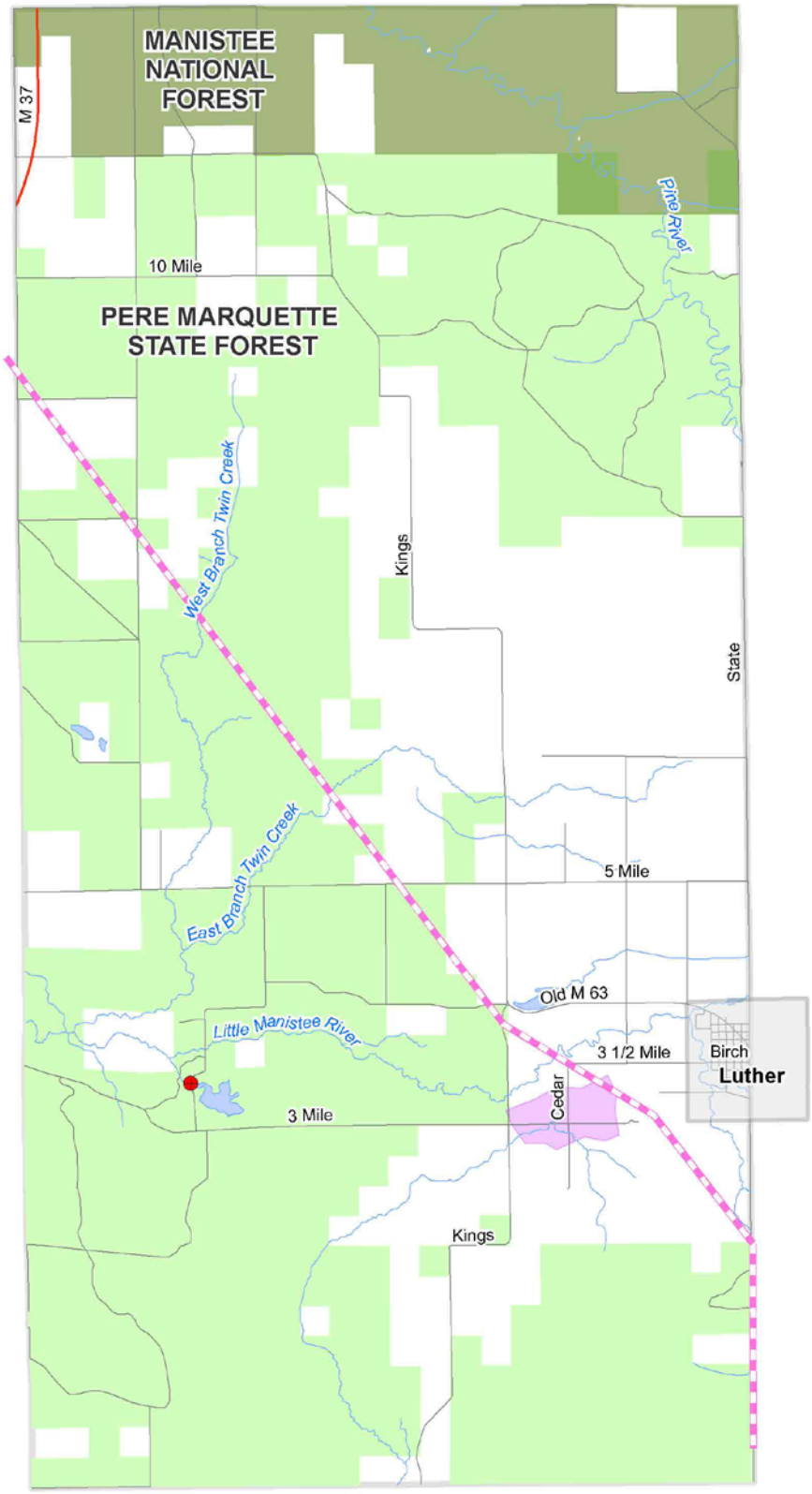
3.04 Public Health Emergencies: - None Identified.

3.05 Terrorism and Similar Criminal Activities: - None Identified.

	Newkirk Township Hazard Rating	Probability of Occurrence	Impact on People	Impact on Property	Impact on Economy	Impacts Total	Hazard Score
1.01	Celestial Impacts	1	2	0	2	8	8
1.02	Drought	2	2	2	3	13	26
1.03	Earthquake	0	-	-	-	-	-
1.04	Extreme Temperatures	3	2	1	2	10	30
1.05	Flooding: Riverine/Urban	2	1	1	1	6	12
1.06	Fog	2	1	0	1	4	8
1.07	Great Lakes Shoreline	0	-	-	-	-	-
1.08	Hail	3	1	2	1	8	24
1.09	Invasive Species	2	1	2	2	9	18
1.10	Lightning	3	1	2	1	8	24
1.11	Severe Winds	3	2	3	2	14	42
1.12	Subsidence	1	1	1	1	6	6
1.13	Tornadoes	2	1	2	2	9	18
1.14	Wildfire	3	2	2	2	12	36
1.15	Winter Storms	3	3	2	3	16	48
2.01	Dam failure	2	1	2	2	9	18
2.02	Energy Emergencies	2	2	0	3	9	18
2.03	Fire – Scrap Tires	1	1	1	1	6	6
2.04	Fire – Structural	3	1	1	2	7	21
2.05	HAZMAT – Fixed Site	2	1	1	2	7	14
2.06	HAZMAT – Transportation	2	1	1	2	7	14
2.07	Infrastructure Failures	3	3	1	2	13	39
2.08	Nuclear Power Emergencies	0	-	-	-	-	-
2.09	Oil/Natural Gas Well Accidents	2	2	1	1	9	18
2.10	Pipeline Accidents	0	-	-	-	-	-
2.11	Transportation Accidents	1	1	1	1	6	6
3.01	Catastrophic Incidents	1	3	3	3	18	18
3.02	Civil Disturbances	1	1	1	1	6	6
3.03	Nuclear Attack	0	-	-	-	-	-
3.04	Public Health Emergencies	2	2	0	3	9	18
3.05	Terrorism & Similar Criminal Acts	1	1	1	1	6	6

	Newkirk Township Hazard Ranking	Probability of Occurrence	X Impacts Total	= Hazard Score
1	Winter Storms	3	16	48
2	Severe Winds	3	14	42
3	Infrastructure Failures	3	13	39
4	Wildfire	3	12	36
5	Extreme Temperatures	3	10	30
6	Drought	2	13	26
7	Hail	3	8	24
7	Lightning	3	8	24
9	Fire – Structural	3	7	21
10	Catastrophic Incidents	1	18	18
10	Dam failure	2	9	18
10	Energy Emergencies	2	9	18
10	Invasive Species	2	9	18
10	Oil/Natural Gas Well Accidents	2	9	18
10	Public Health Emergencies	2	9	18
10	Tornadoes	2	9	18
17	HAZMAT – Fixed Site	2	7	14
17	HAZMAT – Transportation	2	7	14
19	Flooding: Riverine/Urban	2	6	12
20	Celestial Impacts	1	8	8
20	Fog	2	4	8
22	Civil Disturbances	1	6	6
22	Fire – Scrap Tires	1	6	6
22	Subsidence	1	6	6
22	Terrorism & Similar Criminal Acts	1	6	6
22	Transportation Accidents	1	6	6
	Earthquake	0	-	-
	Great Lakes Shoreline	0	-	-
	Nuclear Attack	0	-	-
	Nuclear Power Emergencies	0	-	-
	Pipeline Accidents	0	-	-

NEWKIRK TOWNSHIP
Critical Facilities and Potential Hazards



State Trunkline
Street
Power Line
Dam
Federal Land
State Land
Oil/Gas Field

0 0.5 1 2 Miles

Note: This jurisdiction is subject to many additional hazards; some of which tend to occur across wide areas and cannot be effectively shown on this map.Refer to **Appendix B- Hazard Identifications and Analyses** for more complete information about potential hazards in this community.

WMSRDC
WEST MICHIGAN SHORELINE REGIONAL DEVELOPMENT COMMISSION

Source: Michigan Geographic Data Library V 12b, Lake Co. Hazard Mitigation Plan Update 2014

Hazard Identification Profile

Peacock Township

1. NATURAL HAZARDS

1.01 Celestial Impacts: - None Identified.

1.02 Drought:

- Summer 1871: Prolonged drought over much of the Great Lakes region.
- May-September, 1891: Drought devastated Michigan's lumber industry.
- 12 recorded drought events in the area (including Lake, Mason, Muskegon, Newaygo, and Oceana counties) lasting eight months or greater: 1895-1896 (15 months), 1899-1900 (11 months), 1901-1902 (10 months), 1909-1911 (24 months), 1925-1926 (11 months), 1930-1931 (18 months), 1956-1957 (8 months), 1962-1963 (9 months), 1971-1972 (12 months), 1976-1977 (13 months), and 2002-2003 (12 months).

1.03 Earthquake: - None Identified.

1.04 Extreme Temperatures:

- July 1936: Heatwave. 570 deaths statewide, 364 in Detroit.
- Summer, 1988: 39 days with temperatures over 90 degrees, statewide.
- January 20, 1994: Record cold. $50m property damage across Michigan.
- March 2012: Anomalous temperatures. $209.8m crop damage across Michigan.

1.05 Flooding - Riverine/ Urban:

- September 10-19, 1986: Flooding. Declaration of disaster by Governor, Presidential disaster declaration, Lake County.
- ***August 6, 1998: Flash flood. $10k property damage, northwest Lake County.***
- February 10, 2001: Flooding. $100k property damage, western Michigan.
- May 21-23, 2004: Flooding. $25m property damage, $4.6m crop damage, western Lower Michigan.
- June 13, 2008: Flash flood. $2m property damage, $500k crop damage, Presidential disaster declaration, Lake County.
- May 3, 2012: Flash flood. $70k property damage, Lake County.
- April 17-23, 2013: Flood. $3m property damage, Lake County.
- April 2014: Flood. (details yet to come), Lake County.

1.06 Fog:

- January 11-13, 1995: Dense Fog. Four traffic accident fatalies, school closures, and flight delays across Lower Michigan.

1.07 Great Lakes Shoreline Hazards: - None Identified.

1.08 Hail:

- Severe hail events (1" or greater) recorded in Lake County since 1996: 9

1.09 Invasive Species:

- Invasive species exist in Lake County, however no significant events have been identified.

1.10 Lightning: - None Identified.

1.11 Severe Winds:

- April 6, 1997: High wind. $5m property damage across southwest Lower Michigan.
- May 31, 1998: Severe thunderstorm winds. Declaration of local of emergency and $1.1m property damage, Lake County.
- June 1, 2000: Severe thunderstorm winds. $25k property damage, Lake County.
- July 13, 2000: Severe thunderstorm winds. $25k property damage, Lake County.
- June 18, 2001: High wind. $100k property damage across central Lower Michigan.
- August 9, 2001: Severe thunderstorm winds. $25k property damage, Lake County.
- March 9, 2002: High wind. $485k property damage across southwest Lower Michigan.
- October 30, 2004: High wind. $1.15m property damage across southwest Lower Michigan.
- July 24, 2005: Severe thunderstorm winds. $25k property damage, Lake County.
- July 26, 2005: Severe thunderstorm winds. $25k property damage, Lake County.
- ***September 13, 2005: Severe thunderstorm winds. $20k property damage, Peacock Township.***
- ***April 25, 2005: Severe thunderstorm winds. $20k property damage, northwest Lake County.***
- May 3, 2012: Severe thunderstorm winds. $500k property damage, Lake County.
- August 7, 2013: Severe thunderstorm winds. $100k property damage, Lake County.
- November 17, 2013: High wind. $75k property damage, Lake County.

1.12 Subsidence: - None Identified.

1.13 Tornadoes:

- June 8, 1985: F1 tornado. No documented damages, unknown location in Lake County.

1.14 Wildfire:

- October 1871: Wildfires. 1.2m acres burned, 200 fatalities, Lower Peninsula.
- May-September, 1891: Uncontrollable wildfires across Michigan during the drought of 1891.
- 1981-2010: Approximately 11 wildfires and 43 acres burned per year on county lands under MDNR jurisdiction (315 total wildfires, 1,283.5 total acres burned).

1.15 Winter Storms:

- January 26, 1978: Blizzard, snowstorm. Declaration of statewide emergency by President, disaster by Governor.
- January 12, 1993: Heavy snow. $50k property damage, northern Lower Michigan.
- April 1, 1993: Heavy snow. $50k property damage, Lower Michigan.
- January 12-21, 1994: Heavy lake effect snow. $500k property damage across western Lower Michigan.
- January 27, 1994: Heavy snow and freezing rain. $5m property damage across region.
- March 9, 1998: Winter storm. $100k property damage across region.
- January 2-25, 1999: Blizzard, lake effect snow. "Blizzard of '99". southern Lower Michigan.
- April 3, 2003: Ice storm. $4.9m property damage throughout West Michigan.
- December 11-12, 2010: Winter storm. $250k property damage, west-central Lower Michigan.
- March 2-3, 2012: Heavy snow. $100k property damage, power outages, and shelters opened in Lake County.

2. TECHNOLOGICAL HAZARDS

2.01 Dam Failure: - None Identified.

2.02 Energy Emergencies: - None Identified.

2.03 Fire - Scrap Tire: - None Identified.

2.04 Fire - Structural:

- County fire rate per 1,000 population in 1998: 3.09

2.05 Hazard Material Incidents - Fixed Site (including industrial accidents): - None Identified.

2.06 Hazard Material Incidents - Transportation: - None Identified.

2.07 Infrastructure Failure:

- Number of NCDC events showing downed power lines or power outages in Lake County, 1997-2012: 18
- April 6-7,1997: 180,000-200,000 without power; 70,000 on second day (high wind event), statewide.
- March 9, 1998: 1,900 power outages (blizzard conditions), Lake, Clare, Oceana and Muskegon counties.
- February 9-10, 2001: Portions of M-37 closed (flooding), Lake County.
- April 3, 2003: Hundreds of thousands lose power (ice storm), Lower Michigan.
- October 10, 2004: 100,000 without power (high wind), statewide.
- September 13, 2005: Numerous trees and power lines blown down (thunderstorm winds), Peacock Township.
- June 28, 2008: Three-quarters of Lake County without power (thunderstorm winds), Lake County.
- May 3, 2012: Several roads flooded or washed out (flash flood), Lake County.

2.08 Nuclear Power Plant Emergencies: - None Identified.

2.09 Oil and Natural Gas Well Accidents:

- 56 oil and gas wells within Peacock Township, 1 of which is either "active" or "producing."
- 11 wells known to have detectable levels of hydrogen sulfide in Peacock Township.

2.10 Pipeline Accidents: - None Identified.

2.11 Transportation Accidents: - None Identified.

3. HUMAN -RELATED HAZARDS

3.01 Catastrophic Incidents (National Emergencies): - None Identified.

3.02 Civil Disturbances: - None Identified.

3.03 Nuclear Attack: - None Identified.

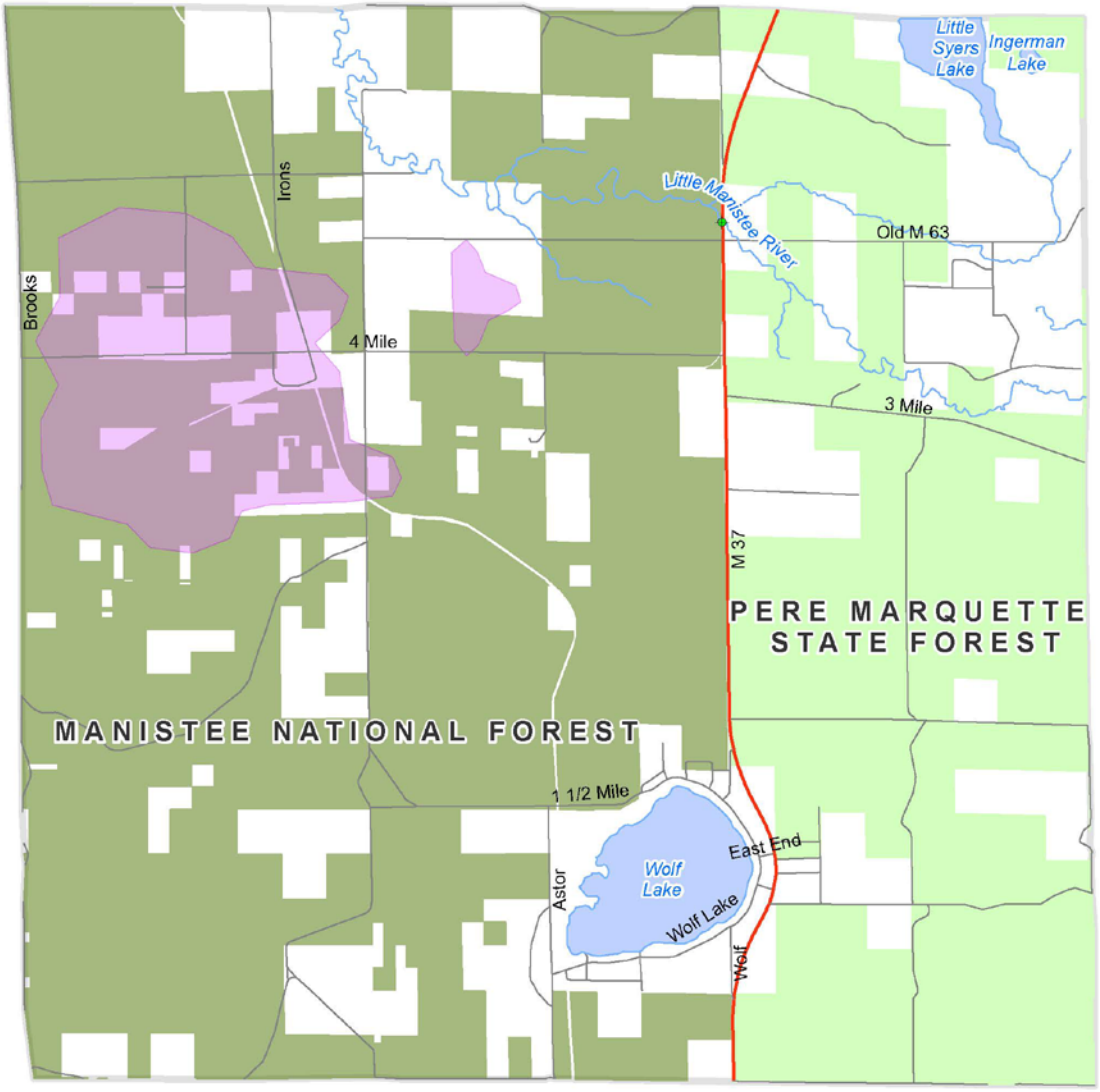
3.04 Public Health Emergencies: - None Identified.

3.05 Terrorism and Similar Criminal Activities: - None Identified.

	Peacock Township Hazard Rating	Probability of Occurrence	Impact on People	Impact on Property	Impact on Economy	Impacts Total	Hazard Score
1.01	Celestial Impacts	1	2	0	2	8	8
1.02	Drought	2	2	2	3	13	26
1.03	Earthquake	0	-	-	-	-	-
1.04	Extreme Temperatures	3	2	1	2	10	30
1.05	Flooding: Riverine/Urban	2	1	1	1	6	12
1.06	Fog	2	1	0	1	4	8
1.07	Great Lakes Shoreline	0	-	-	-	-	-
1.08	Hail	3	1	2	1	8	24
1.09	Invasive Species	2	1	2	2	9	18
1.10	Lightning	3	1	2	1	8	24
1.11	Severe Winds	3	2	3	2	14	42
1.12	Subsidence	1	1	1	1	6	6
1.13	Tornadoes	2	1	2	2	9	18
1.14	Wildfire	3	2	2	2	12	36
1.15	Winter Storms	3	3	2	3	16	48
2.01	Dam failure	2	1	1	1	6	12
2.02	Energy Emergencies	2	2	0	3	9	18
2.03	Fire – Scrap Tires	1	1	1	1	6	6
2.04	Fire – Structural	3	1	1	2	7	21
2.05	HAZMAT – Fixed Site	2	1	1	2	7	14
2.06	HAZMAT – Transportation	2	1	1	2	7	14
2.07	Infrastructure Failures	3	3	1	2	13	39
2.08	Nuclear Power Emergencies	0	-	-	-	-	-
2.09	Oil/Natural Gas Well Accidents	2	2	1	1	9	18
2.10	Pipeline Accidents	0	-	-	-	-	-
2.11	Transportation Accidents	1	1	1	1	6	6
3.01	Catastrophic Incidents	1	3	3	3	18	18
3.02	Civil Disturbances	1	1	1	1	6	6
3.03	Nuclear Attack	0	-	-	-	-	-
3.04	Public Health Emergencies	2	2	0	3	9	18
3.05	Terrorism & Similar Criminal Acts	1	1	1	1	6	6

	Peacock Township Hazard Ranking	Probability of Occurrence	X	Impacts Total	=	Hazard Score
1	Winter Storms	3		16		48
2	Severe Winds	3		14		42
3	Infrastructure Failures	3		13		39
4	Wildfire	3		12		36
5	Extreme Temperatures	3		10		30
6	Drought	2		13		26
7	Hail	3		8		24
7	Lightning	3		8		24
9	Fire – Structural	3		7		21
10	Catastrophic Incidents	1		18		18
10	Energy Emergencies	2		9		18
10	Invasive Species	2		9		18
10	Oil/Natural Gas Well Accidents	2		9		18
10	Public Health Emergencies	2		9		18
10	Tornadoes	2		9		18
16	HAZMAT – Fixed Site	2		7		14
16	HAZMAT – Transportation	2		7		14
18	Dam failure	2		6		12
18	Flooding: Riverine/Urban	2		6		12
20	Celestial Impacts	1		8		8
20	Fog	2		4		8
22	Civil Disturbances	1		6		6
22	Fire – Scrap Tires	1		6		6
22	Subsidence	1		6		6
22	Terrorism & Similar Criminal Acts	1		6		6
22	Transportation Accidents	1		6		6
	Earthquake	0		-		-
	Great Lakes Shoreline	0		-		-
	Nuclear Attack	0		-		-
	Nuclear Power Emergencies	0		-		-
	Pipeline Accidents	0		-		-

PEACOCK TOWNSHIP
Critical Facilities and Potential Hazards



0 0.75 1.5 Miles

Note: This jurisdiction is subject to many additional hazards; some of which tend to occur across wide areas and cannot be effectively shown on this map.Refer to **Appendix B- Hazard Identifications and Analyses** for more complete information about potential hazards in this community.

- State Trunkline
- Street
- Bridge
- Federal Land
- State Land
- Oil/Gas Field

WMSRDC
WEST MICHIGAN SHORELINE REGIONAL DEVELOPMENT COMMISSION

Source: Michigan Geographic Data Library V 12b, Lake Co. Hazard Mitigation Plan Update 2014

Hazard Identification Profile

Pinora Township

1. NATURAL HAZARDS

1.01 Celestial Impacts: - None Identified.

1.02 Drought:

- Summer 1871: Prolonged drought over much of the Great Lakes region.
- May-September, 1891: Drought devastated Michigan's lumber industry.
- 12 recorded drought events in the area (including Lake, Mason, Muskegon, Newaygo, and Oceana counties) lasting eight months or greater: 1895-1896 (15 months), 1899-1900 (11 months), 1901-1902 (10 months), 1909-1911 (24 months), 1925-1926 (11 months), 1930-1931 (18 months), 1956-1957 (8 months), 1962-1963 (9 months), 1971-1972 (12 months), 1976-1977 (13 months), and 2002-2003 (12 months).

1.03 Earthquake: - None Identified.

1.04 Extreme Temperatures:

- July 1936: Heatwave. 570 deaths statewide, 364 in Detroit.
- Summer, 1988: 39 days with temperatures over 90 degrees, statewide.
- January 20, 1994: Record cold. $50m property damage across Michigan.
- March 2012: Anomalous temperatures. $209.8m crop damage across Michigan.

1.05 Flooding - Riverine/ Urban:

- September 10-19, 1986: Flooding. Declaration of disaster by Governor, Presidential disaster declaration, Lake County.
- February 10, 2001: Flooding. $100k property damage, western Michigan.
- May 21-23, 2004: Flooding. $25m property damage, $4.6m crop damage, western Lower Michigan.
- June 13, 2008: Flash flood. $2m property damage, $500k crop damage, Presidential disaster declaration, Lake County.
- May 3, 2012: Flash flood. $70k property damage, Lake County.
- April 17-23, 2013: Flood. $3m property damage, Lake County.
- April 2014: Flood. (details yet to come), Lake County.

1.06 Fog:

- January 11-13, 1995: Dense Fog. Four traffic accident fatalies, school closures, and flight delays across Lower Michigan.

1.07 Great Lakes Shoreline Hazards: - None Identified.

1.08 Hail:

- Severe hail events (1" or greater) recorded in Lake County since 1996: 9

1.09 Invasive Species:

- Invasive species exist in Lake County, however no significant events have been identified.

1.10 Lightning: - None Identified.

1.11 Severe Winds:

- April 6, 1997: High wind. $5m property damage across southwest Lower Michigan.
- May 31, 1998: Severe thunderstorm winds. Declaration of local of emergency and $1.1m property damage, Lake County.
- June 1, 2000: Severe thunderstorm winds. $25k property damage, Lake County.
- July 13, 2000: Severe thunderstorm winds. $25k property damage, Lake County.
- June 18, 2001: High wind. $100k property damage across central Lower Michigan.
- August 9, 2001: Severe thunderstorm winds. $25k property damage, Lake County.
- March 9, 2002: High wind. $485k property damage across southwest Lower Michigan.
- October 30, 2004: High wind. $1.15m property damage across southwest Lower Michigan.
- July 24, 2005: Severe thunderstorm winds. $25k property damage, Lake County.
- July 26, 2005: Severe thunderstorm winds. $25k property damage, Lake County.
- May 3, 2012: Severe thunderstorm winds. $500k property damage, Lake County.
- August 7, 2013: Severe thunderstorm winds. $100k property damage, Lake County.
- November 17, 2013: High wind. $75k property damage, Lake County.

1.12 Subsidence: - None Identified.

1.13 Tornadoes:

- June 8, 1985: F1 tornado. No documented damages, unknown location in Lake County.

1.14 Wildfire:

- October 1871: Wildfires. 1.2m acres burned, 200 fatalities, Lower Peninsula.
- May-September, 1891: Uncontrollable wildfires across Michigan during the drought of 1891.
- 1981-2010: Approximately 11 wildfires and 43 acres burned per year on county lands under MDNR jurisdiction (315 total wildfires, 1,283.5 total acres burned).

1.15 Winter Storms:

- January 26, 1978: Blizzard, snowstorm. Declaration of statewide emergency by President, disaster by Governor.
- January 12, 1993: Heavy snow. $50k property damage, northern Lower Michigan.
- April 1, 1993: Heavy snow. $50k property damage, Lower Michigan.
- January 12-21, 1994: Heavy lake effect snow. $500k property damage across western Lower Michigan.
- January 27, 1994: Heavy snow and freezing rain. $5m property damage across region.
- March 9, 1998: Winter storm. $100k property damage across region.
- January 2-25, 1999: Blizzard, lake effect snow. "Blizzard of '99". southern Lower Michigan.
- April 3, 2003: Ice storm. $4.9m property damage throughout West Michigan.
- December 11-12, 2010: Winter storm. $250k property damage, west-central Lower Michigan.
- March 2-3, 2012: Heavy snow. $100k property damage, power outages, and shelters opened in Lake County.

2. TECHNOLOGICAL HAZARDS

2.01 Dam Failure: - None Identified.

2.02 Energy Emergencies: - None Identified.

2.03 Fire - Scrap Tire: - None Identified.

2.04 Fire - Structural:

- County fire rate per 1,000 population in 1998: 3.09

2.05 Hazard Material Incidents - Fixed Site (including industrial accidents): - None Identified.

2.06 Hazard Material Incidents - Transportation: - None Identified.

2.07 Infrastructure Failure:

- Number of NCDC events showing downed power lines or power outages in Lake County, 1997-2012: 18
- April 6-7,1997: 180,000-200,000 without power; 70,000 on second day (high wind event), statewide.
- March 9, 1998: 1,900 power outages (blizzard conditions), Lake, Clare, Oceana and Muskegon counties.
- April 3, 2003: Hundreds of thousands lose power (ice storm), Lower Michigan.
- October 10, 2004: 100,000 without power (high wind), statewide.
- June 13, 2008: Numerous roads washed out (flash flood), Lake County.
- June 28, 2008: Three-quarters of Lake County without power (thunderstorm winds), Lake County.
- May 3, 2012: Several roads flooded or washed out (flash flood), Lake County.

2.08 Nuclear Power Plant Emergencies: - None Identified.

2.09 Oil and Natural Gas Well Accidents:

- 45 oil and gas wells within Pinora Township, 26 of which are "active" or "producing."

2.10 Pipeline Accidents: - None Identified.

2.11 Transportation Accidents: - None Identified.

3. HUMAN -RELATED HAZARDS

3.01 Catastrophic Incidents (National Emergencies): - None Identified.

3.02 Civil Disturbances: - None Identified.

3.03 Nuclear Attack: - None Identified.

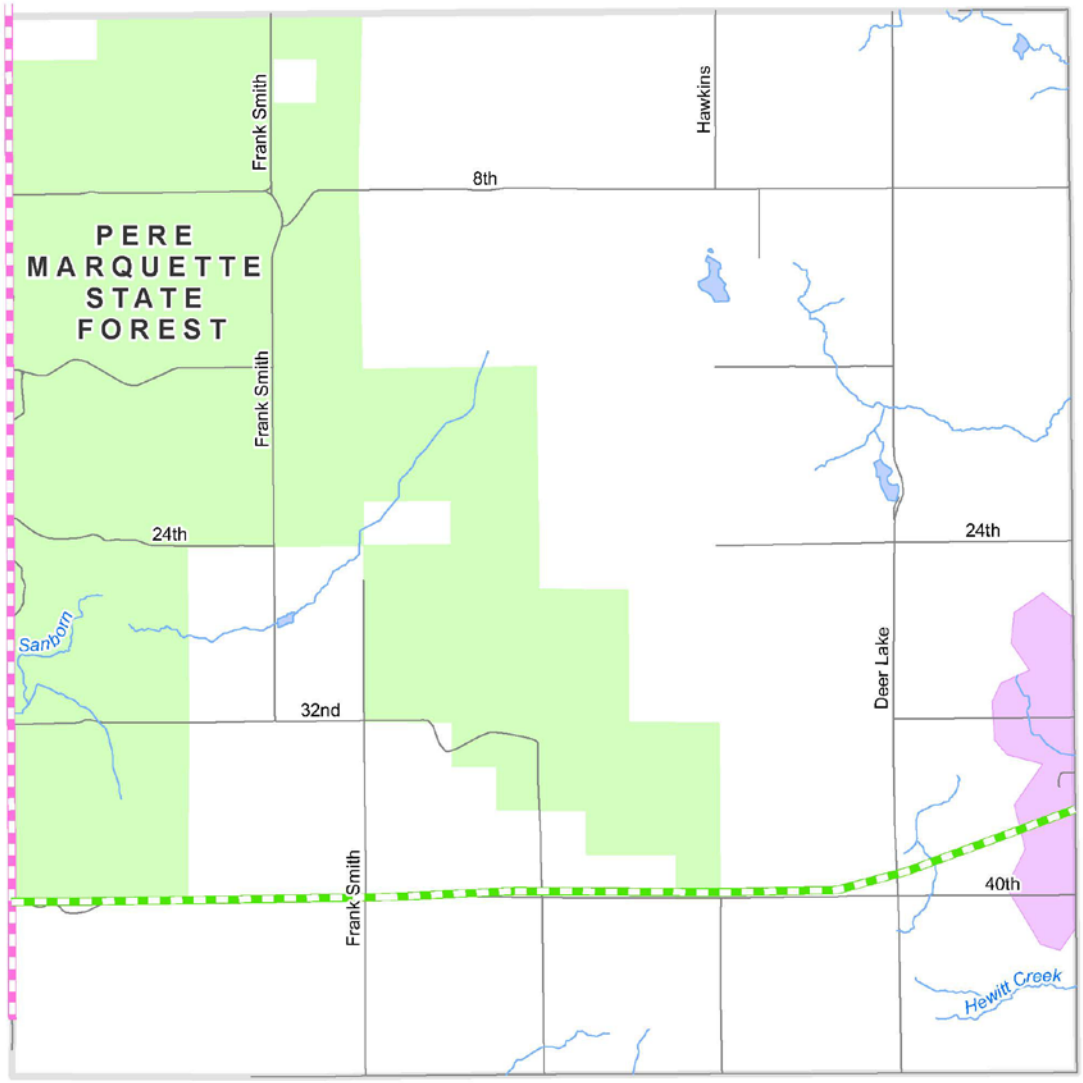
3.04 Public Health Emergencies: - None Identified.

3.05 Terrorism and Similar Criminal Activities: - None Identified.

	Pinora Township Hazard Rating	Probability of Occurrence	Impact on People	Impact on Property	Impact on Economy	Impacts Total	Hazard Score
1.01	Celestial Impacts	1	2	0	2	8	8
1.02	Drought	2	2	2	3	13	26
1.03	Earthquake	0	-	-	-	-	-
1.04	Extreme Temperatures	3	2	1	2	10	30
1.05	Flooding: Riverine/Urban	2	1	1	1	6	12
1.06	Fog	2	1	0	1	4	8
1.07	Great Lakes Shoreline	0	-	-	-	-	-
1.08	Hail	3	1	2	1	8	24
1.09	Invasive Species	2	1	2	2	9	18
1.10	Lightning	3	1	2	1	8	24
1.11	Severe Winds	3	2	3	2	14	42
1.12	Subsidence	1	1	1	1	6	6
1.13	Tornadoes	2	1	2	2	9	18
1.14	Wildfire	3	2	2	2	12	36
1.15	Winter Storms	3	3	2	3	16	48
2.01	Dam failure	2	1	1	1	6	12
2.02	Energy Emergencies	2	2	0	3	9	18
2.03	Fire – Scrap Tires	1	1	1	1	6	6
2.04	Fire – Structural	3	1	1	2	7	21
2.05	HAZMAT – Fixed Site	2	1	1	2	7	14
2.06	HAZMAT – Transportation	2	1	1	2	7	14
2.07	Infrastructure Failures	3	3	1	2	13	39
2.08	Nuclear Power Emergencies	0	-	-	-	-	-
2.09	Oil/Natural Gas Well Accidents	2	2	1	1	9	18
2.10	Pipeline Accidents	1	2	1	2	10	10
2.11	Transportation Accidents	1	1	1	1	6	6
3.01	Catastrophic Incidents	1	3	3	3	18	18
3.02	Civil Disturbances	1	1	1	1	6	6
3.03	Nuclear Attack	0	-	-	-	-	-
3.04	Public Health Emergencies	2	2	0	3	9	18
3.05	Terrorism & Similar Criminal Acts	1	1	1	1	6	6

	Pinora Township Hazard Ranking	Probability of Occurrence	X Impacts Total	= Hazard Score
1	Winter Storms	3	16	48
2	Severe Winds	3	14	42
3	Infrastructure Failures	3	13	39
4	Wildfire	3	12	36
5	Extreme Temperatures	3	10	30
6	Drought	2	13	26
7	Hail	3	8	24
7	Lightning	3	8	24
9	Fire – Structural	3	7	21
10	Catastrophic Incidents	1	18	18
10	Energy Emergencies	2	9	18
10	Invasive Species	2	9	18
10	Oil/Natural Gas Well Accidents	2	9	18
10	Public Health Emergencies	2	9	18
10	Tornadoes	2	9	18
16	HAZMAT – Fixed Site	2	7	14
16	HAZMAT – Transportation	2	7	14
18	Dam failure	2	6	12
18	Flooding: Riverine/Urban	2	6	12
20	Pipeline Accidents	1	10	10
21	Celestial Impacts	1	8	8
21	Fog	2	4	8
23	Civil Disturbances	1	6	6
23	Fire – Scrap Tires	1	6	6
23	Subsidence	1	6	6
23	Terrorism & Similar Criminal Acts	1	6	6
23	Transportation Accidents	1	6	6
	Earthquake	0	-	-
	Great Lakes Shoreline	0	-	-
	Nuclear Attack	0	-	-
	Nuclear Power Emergencies	0	-	-

PINORA TOWNSHIP
Critical Facilities and Potential Hazards



0 0.75 1.5 Miles

Note: This jurisdiction is subject to many additional hazards; some of which tend to occur across wide areas and cannot be effectively shown on this map.Refer to **Appendix B- Hazard Identifications and Analyses** for more complete information about potential hazards in this community.

- Street
- Gas Pipeline
- Power Line
- State Land
- Oil/Gas Field

WMSRDC
WEST MICHIGAN SHORELINE REGIONAL DEVELOPMENT COMMISSION

Source: Michigan Geographic Data Library V 12b, Lake Co. Hazard Mitigation Plan Update 2014

Hazard Identification Profile

Pleasant Plains Township

1. NATURAL HAZARDS

1.01 Celestial Impacts: - None Identified.

1.02 Drought:

- Summer 1871: Prolonged drought over much of the Great Lakes region.
- May-September, 1891: Drought devastated Michigan's lumber industry.
- 12 recorded drought events in the area (including Lake, Mason, Muskegon, Newaygo, and Oceana counties) lasting eight months or greater: 1895-1896 (15 months), 1899-1900 (11 months), 1901-1902 (10 months), 1909-1911 (24 months), 1925-1926 (11 months), 1930-1931 (18 months), 1956-1957 (8 months), 1962-1963 (9 months), 1971-1972 (12 months), 1976-1977 (13 months), and 2002-2003 (12 months).

1.03 Earthquake: - None Identified.

1.04 Extreme Temperatures:

- July 1936: Heatwave. 570 deaths statewide, 364 in Detroit.
- Summer, 1988: 39 days with temperatures over 90 degrees, statewide.
- January 20, 1994: Record cold. $50m property damage across Michigan.
- March 2012: Anomalous temperatures. $209.8m crop damage across Michigan.

1.05 Flooding - Riverine/ Urban:

- September 10-19, 1986: Flooding. Declaration of disaster by Governor, Presidential disaster declaration, Lake County.
- February 10, 2001: Flooding. $100k property damage, western Michigan.
- May 21-23, 2004: Flooding. $25m property damage, $4.6m crop damage, western Lower Michigan.
- June 13, 2008: Flash flood. $2m property damage, $500k crop damage, Presidential disaster declaration, Lake County.
- May 3, 2012: Flash flood. $70k property damage, Lake County.
- April 17-23, 2013: Flood. $3m property damage, Lake County.
- April 2014: Flood. (details yet to come), Lake County.

1.06 Fog:

- January 11-13, 1995: Dense Fog. Four traffic accident fatalies, school closures, and flight delays across Lower Michigan.

1.07 Great Lakes Shoreline Hazards: - None Identified.

1.08 Hail:

- Severe hail events (1" or greater) recorded in Lake County since 1996: 9
- ***June 8, 2003: .75 inch hail. $20k property damage and $20k crop damage, Pleasant Plains Township.***

1.09 Invasive Species:

- Invasive species exist in Lake County, however no significant events have been identified.

1.10 Lightning: - None Identified.

1.11 Severe Winds:

- April 6, 1997: High wind. $5m property damage across southwest Lower Michigan.
- May 31, 1998: Severe thunderstorm winds. Declaration of local of emergency and $1.1m property damage, Lake County.
- June 1, 2000: Severe thunderstorm winds. $25k property damage, Lake County.
- July 13, 2000: Severe thunderstorm winds. $25k property damage, Lake County.
- June 18, 2001: High wind. $100k property damage across central Lower Michigan.
- August 9, 2001: Severe thunderstorm winds. $25k property damage, Lake County.
- ***August 30, 2001: Severe thunderstorm winds. $100k property damage, Pleasant Plains and Yates Townships.***
- March 9, 2002: High wind. $485k property damage across southwest Lower Michigan.
- ***August 2, 2004: Severe thunderstorm winds. $10k property damage, Chase and Pleasant Plains townships.***
- October 30, 2004: High wind. $1.15m property damage across southwest Lower Michigan.
- July 24, 2005: Severe thunderstorm winds. $25k property damage, Lake County.
- July 26, 2005: Severe thunderstorm winds. $25k property damage, Lake County.
- May 3, 2012: Severe thunderstorm winds. $500k property damage, Lake County.
- August 7, 2013: Severe thunderstorm winds. $100k property damage, Lake County.
- November 17, 2013: High wind. $75k property damage, Lake County.

1.12 Subsidence: - None Identified.

1.13 Tornadoes:

- June 8, 1985: F1 tornado. No documented damages, unknown location in Lake County.

1.14 Wildfire:

- October 1871: Wildfires. 1.2m acres burned, 200 fatalities, Lower Peninsula.
- May-September, 1891: Uncontrollable wildfires across Michigan during the drought of 1891.
- ***1994: "County Line Fire." 900 acres burned, Pleasant Plains Township.***
- 1981-2010: Approximately 11 wildfires and 43 acres burned per year on county lands under MDNR jurisdiction (315 total wildfires, 1,283.5 total acres burned).

1.15 Winter Storms:

- January 26, 1978: Blizzard, snowstorm. Declaration of statewide emergency by President, disaster by Governor.
- January 12, 1993: Heavy snow. $50k property damage, northern Lower Michigan.
- April 1, 1993: Heavy snow. $50k property damage, Lower Michigan.
- January 12-21, 1994: Heavy lake effect snow. $500k property damage across western Lower Michigan.
- January 27, 1994: Heavy snow and freezing rain. $5m property damage across region.
- March 9, 1998: Winter storm. $100k property damage across region.
- January 2-25, 1999: Blizzard, lake effect snow. "Blizzard of '99". southern Lower Michigan.
- April 3, 2003: Ice storm. $4.9m property damage throughout West Michigan.
- December 11-12, 2010: Winter storm. $250k property damage, west-central Lower Michigan.
- March 2-3, 2012: Heavy snow. $100k property damage, power outages, and shelters opened in Lake County.

2. TECHNOLOGICAL HAZARDS

2.01 Dam Failure:

- September 1986: Floods triggered dam failures at Baldwin's Rearing Pond, Danaher Lake, and Luther Mill Pond.

2.02 Energy Emergencies: - None Identified.

2.03 Fire - Scrap Tire: - None Identified.

2.04 Fire - Structural:

- County fire rate per 1,000 population in 1998: 3.09

2.05 Hazard Material Incidents - Fixed Site (including industrial accidents): - None Identified.

2.06 Hazard Material Incidents - Transportation: - None Identified.

2.07 Infrastructure Failure:

- Number of NCDC events showing downed power lines or power outages in Lake County, 1997-2012: 18
- April 6-7,1997: 180,000-200,000 without power; 70,000 on second day (high wind event), statewide.
- March 9, 1998: 1,900 power outages (blizzard conditions), Lake, Clare, Oceana and Muskegon counties.
- February 9-10, 2001: Portions of M-37 closed (flooding), Lake County.
- April 3, 2003: Hundreds of thousands lose power (ice storm), Lower Michigan. .
- October 10, 2004: 100,000 without power (high wind), statewide.
- June 13, 2008: Numerous roads washed out (flash flood), Lake County.
- June 28, 2008: Three-quarters of Lake County without power (thunderstorm winds), Lake County.
- May 3, 2012: Several roads flooded or washed out (flash flood), Lake County.

2.08 Nuclear Power Plant Emergencies: - None Identified.

2.09 Oil and Natural Gas Well Accidents:

- 2 oil and gas wells within Pleasant Plains Township, none of which are "active" or "producing."

2.10 Pipeline Accidents:

- June 23, 1999: Broken gas main. Nearby residences evacuated, Pleasant Plains Township.

2.11 Transportation Accidents: - None Identified.

3. HUMAN -RELATED HAZARDS

3.01 Catastrophic Incidents (National Emergencies): - None Identified.

3.02 Civil Disturbances: - None Identified.

3.03 Nuclear Attack: - None Identified.

3.04 Public Health Emergencies: - None Identified.

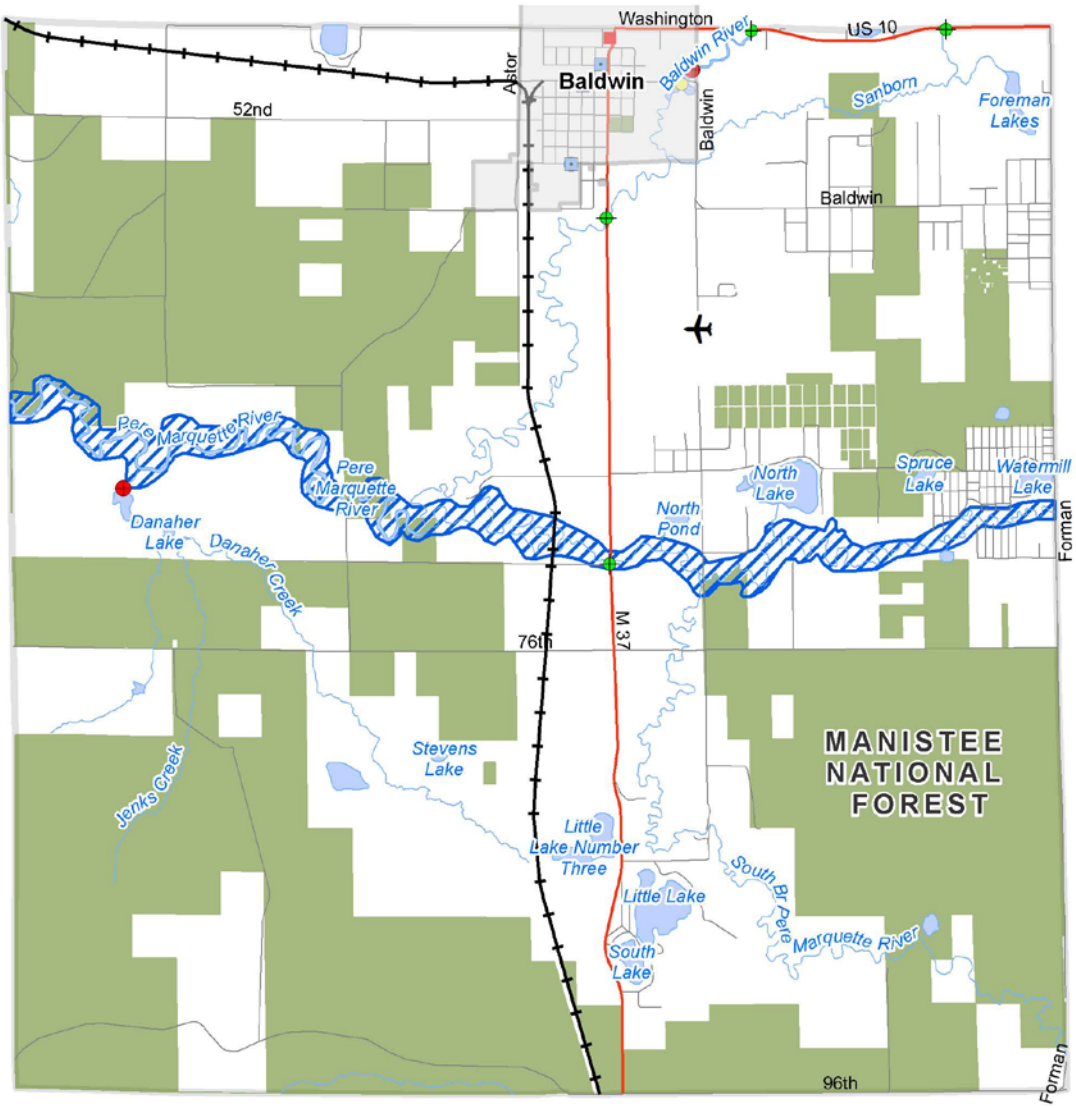
3.05 Terrorism and Similar Criminal Activities: - None Identified.

	Pleasant Plains Township Hazard Rating	Probability of Occurrence	Impact on People	Impact on Property	Impact on Economy	Impacts Total	Hazard Score
1.01	Celestial Impacts	1	2	0	2	8	8
1.02	Drought	2	2	2	3	13	26
1.03	Earthquake	0	-	-	-	-	-
1.04	Extreme Temperatures	3	2	1	2	10	30
1.05	Flooding: Riverine/Urban	2	1	1	1	6	12
1.06	Fog	2	1	0	1	4	8
1.07	Great Lakes Shoreline	0	-	-	-	-	-
1.08	Hail	3	1	2	1	8	24
1.09	Invasive Species	2	1	1	2	7	14
1.10	Lightning	3	1	2	1	8	24
1.11	Severe Winds	3	2	3	2	14	42
1.12	Subsidence	1	1	1	1	6	6
1.13	Tornadoes	2	1	2	2	9	18
1.14	Wildfire	3	2	2	2	12	36
1.15	Winter Storms	3	3	2	3	16	48
2.01	Dam failure	0	-	-	-	-	-
2.02	Energy Emergencies	2	2	0	3	9	18
2.03	Fire – Scrap Tires	1	1	1	1	6	6
2.04	Fire – Structural	3	1	1	2	7	21
2.05	HAZMAT – Fixed Site	2	1	1	2	7	14
2.06	HAZMAT – Transportation	2	1	1	2	7	14
2.07	Infrastructure Failures	3	3	1	2	13	39
2.08	Nuclear Power Emergencies	0	-	-	-	-	-
2.09	Oil/Natural Gas Well Accidents	2	2	1	1	9	18
2.10	Pipeline Accidents	0	-	-	-	-	-
2.11	Transportation Accidents	2	1	1	1	6	12
3.01	Catastrophic Incidents	1	3	3	3	18	18
3.02	Civil Disturbances	1	1	1	1	6	6
3.03	Nuclear Attack	0	-	-	-	-	-
3.04	Public Health Emergencies	2	2	0	3	9	18
3.05	Terrorism & Similar Criminal Acts	1	1	1	1	6	6

Pleasant Plains Township Hazard Ranking

		Probability of Occurrence	X Impacts Total	= Hazard Score
1	Winter Storms	3	16	48
2	Severe Winds	3	14	42
3	Infrastructure Failures	3	13	39
4	Wildfire	3	12	36
5	Extreme Temperatures	3	10	30
6	Drought	2	13	26
7	Hail	3	8	24
7	Lightning	3	8	24
9	Fire – Structural	3	7	21
10	Catastrophic Incidents	1	18	18
10	Energy Emergencies	2	9	18
10	Oil/Natural Gas Well Accidents	2	9	18
10	Public Health Emergencies	2	9	18
10	Tornadoes	2	9	18
15	HAZMAT – Fixed Site	2	7	14
15	HAZMAT – Transportation	2	7	14
15	Invasive Species	2	7	14
18	Flooding: Riverine/Urban	2	6	12
18	Transportation Accidents	2	6	12
20	Celestial Impacts	1	8	8
20	Fog	2	4	8
22	Civil Disturbances	1	6	6
22	Fire – Scrap Tires	1	6	6
22	Subsidence	1	6	6
22	Terrorism & Similar Criminal Acts	1	6	6
	Dam failure	0	-	-
	Earthquake	0	-	-
	Great Lakes Shoreline	0	-	-
	Nuclear Attack	0	-	-
	Nuclear Power Emergencies	0	-	-
	Pipeline Accidents	0	-	-

PLEASANT PLAINS TOWNSHIP
Critical Facilities and Potential Hazards



0 0.75 1.5 Miles

Note: This jurisdiction is subject to many additional hazards; some of which tend to occur across wide areas and cannot be effectively shown on this map.Refer to **Appendix B- Hazard Identifications and Analyses** for more complete information about potential hazards in this community.

- State Trunkline
- Street
- Railroad
- Bridge
- Airport
- Dam
- Federal Land
- Floodplain

WMSRDC
WEST MICHIGAN SHORELINE REGIONAL DEVELOPMENT COMMISSION

Source: Michigan Geographic Data Library V 12b, Lake Co. Hazard Mitigation Plan Update 2014

Hazard Identification Profile

Sauble Township

1. NATURAL HAZARDS

1.01 Celestial Impacts: - None Identified.

1.02 Drought:

- Summer 1871: Prolonged drought over much of the Great Lakes region.
- May-September, 1891: Drought devastated Michigan's lumber industry.
- 12 recorded drought events in the area (including Lake, Mason, Muskegon, Newaygo, and Oceana counties) lasting eight months or greater: 1895-1896 (15 months), 1899-1900 (11 months), 1901-1902 (10 months), 1909-1911 (24 months), 1925-1926 (11 months), 1930-1931 (18 months), 1956-1957 (8 months), 1962-1963 (9 months), 1971-1972 (12 months), 1976-1977 (13 months), and 2002-2003 (12 months).

1.03 Earthquake: - None Identified.

1.04 Extreme Temperatures:

- July 1936: Heatwave. 570 deaths statewide, 364 in Detroit.
- Summer, 1988: 39 days with temperatures over 90 degrees, statewide.
- January 20, 1994: Record cold. $50m property damage across Michigan.
- March 2012: Anomalous temperatures. $209.8m crop damage across Michigan.

1.05 Flooding - Riverine/ Urban:

- September 10-19, 1986: Flooding. Declaration of disaster by Governor, Presidential disaster declaration, Lake County.
- ***August 6, 1998: Flash flood. $10k property damage, northwest Lake County.***
- February 10, 2001: Flooding. $100k property damage, western Michigan.
- May 21-23, 2004: Flooding. $25m property damage, $4.6m crop damage, western Lower Michigan.
- June 13, 2008: Flash flood. $2m property damage, $500k crop damage, Presidential disaster declaration, Lake County.
- May 3, 2012: Flash flood. $70k property damage, Lake County.
- April 17-23, 2013: Flood. $3m property damage, Lake County.
- April 2014: Flood. (details yet to come), Lake County.

1.06 Fog:

- January 11-13, 1995: Dense Fog. Four traffic accident fatalies, school closures, and flight delays across Lower Michigan.

1.07 Great Lakes Shoreline Hazards: - None Identified.

1.08 Hail:

- Severe hail events (1" or greater) recorded in Lake County since 1996: 9

1.09 Invasive Species:

- Invasive species exist in Lake County, however no significant events have been identified.

1.10 Lightning: - None Identified.

1.11 Severe Winds:

- April 6, 1997: High wind. $5m property damage across southwest Lower Michigan.
- May 31, 1998: Severe thunderstorm winds. Declaration of local of emergency and $1.1m property damage, Lake County.
- June 1, 2000: Severe thunderstorm winds. $25k property damage, Lake County.
- July 13, 2000: Severe thunderstorm winds. $25k property damage, Lake County.
- June 18, 2001: High wind. $100k property damage across central Lower Michigan.
- August 9, 2001: Severe thunderstorm winds. $25k property damage, Lake County.
- March 9, 2002: High wind. $485k property damage across southwest Lower Michigan.
- October 30, 2004: High wind. $1.15m property damage across southwest Lower Michigan.
- July 24, 2005: Severe thunderstorm winds. $25k property damage, Lake County.
- July 26, 2005: Severe thunderstorm winds. $25k property damage, Lake County.
- ***April 25, 2005: Severe thunderstorm winds. $20k property damage, northwest Lake County.***
- May 3, 2012: Severe thunderstorm winds. $500k property damage, Lake County.
- August 7, 2013: Severe thunderstorm winds. $100k property damage, Lake County.
- November 17, 2013: High wind. $75k property damage, Lake County.

1.12 Subsidence: - None Identified.

1.13 Tornadoes:

- June 8, 1985: F1 tornado. No documented damages, unknown location in Lake County.

1.14 Wildfire:

- October 1871: Wildfires. 1.2m acres burned, 200 fatalities, Lower Peninsula.
- May-September, 1891: Uncontrollable wildfires across Michigan during the drought of 1891.
- 1981-2010: Approximately 11 wildfires and 43 acres burned per year on county lands under MDNR jurisdiction (315 total wildfires, 1,283.5 total acres burned).

1.15 Winter Storms:

- January 26, 1978: Blizzard, snowstorm. Declaration of statewide emergency by President, disaster by Governor.
- January 12, 1993: Heavy snow. $50k property damage, northern Lower Michigan.
- April 1, 1993: Heavy snow. $50k property damage, Lower Michigan.
- January 12-21, 1994: Heavy lake effect snow. $500k property damage across western Lower Michigan.
- January 27, 1994: Heavy snow and freezing rain. $5m property damage across region.
- March 9, 1998: Winter storm. $100k property damage across region.
- January 2-25, 1999: Blizzard, lake effect snow. "Blizzard of '99". southern Lower Michigan.
- April 3, 2003: Ice storm. $4.9m property damage throughout West Michigan.
- December 11-12, 2010: Winter storm. $250k property damage, west-central Lower Michigan.
- March 2-3, 2012: Heavy snow. $100k property damage, power outages, and shelters opened in Lake County.

2. TECHNOLOGICAL HAZARDS

2.01 Dam Failure: - None Identified.

2.02 Energy Emergencies: - None Identified.

2.03 Fire - Scrap Tire: - None Identified.

2.04 Fire - Structural:

- County fire rate per 1,000 population in 1998: 3.09

2.05 Hazard Material Incidents - Fixed Site (including industrial accidents): - None Identified.

2.06 Hazard Material Incidents - Transportation: - None Identified.

2.07 Infrastructure Failure:

- Number of NCDC events showing downed power lines or power outages in Lake County, 1997-2012: 18
- April 6-7,1997: 180,000-200,000 without power; 70,000 on second day (high wind event), statewide.
- March 9, 1998: 1,900 power outages (blizzard conditions), Lake, Clare, Oceana and Muskegon counties.
- April 3, 2003: Hundreds of thousands lose power (ice storm), Lower Michigan.
- October 10, 2004: 100,000 without power (high wind), statewide.
- June 13, 2008: Numerous roads washed out (flash flood), Lake County.
- June 28, 2008: Three-quarters of Lake County without power (thunderstorm winds), Lake County.
- May 3, 2012: Several roads flooded or washed out (flash flood), Lake County.

2.08 Nuclear Power Plant Emergencies: - None Identified.

2.09 Oil and Natural Gas Well Accidents:

- 27 oil and gas wells within Sauble Township, none of which are "active" or "producing."
- 1 well known to have detectable levels of hydrogen sulfide, Sauble Township.

2.10 Pipeline Accidents: - None Identified.

2.11 Transportation Accidents: - None Identified.

3. HUMAN -RELATED HAZARDS

3.01 Catastrophic Incidents (National Emergencies): - None Identified.

3.02 Civil Disturbances: - None Identified.

3.03 Nuclear Attack: - None Identified.

3.04 Public Health Emergencies: - None Identified.

3.05 Terrorism and Similar Criminal Activities: - None Identified.

	Sauble Township Hazard Rating	Probability of Occurrence	Impact on People	Impact on Property	Impact on Economy	Impacts Total	Hazard Score
1.01	Celestial Impacts	1	2	0	2	8	8
1.02	Drought	2	2	2	3	13	26
1.03	Earthquake	0	-	-	-	-	-
1.04	Extreme Temperatures	3	2	1	2	10	30
1.05	Flooding: Riverine/Urban	3	1	2	1	8	24
1.06	Fog	3	1	0	1	4	12
1.07	Great Lakes Shoreline	3	1	2	1	8	24
1.08	Hail	3	1	2	1	8	24
1.09	Invasive Species	2	1	2	1	8	16
1.10	Lightning	3	1	2	1	8	24
1.11	Severe Winds	3	2	3	2	14	42
1.12	Subsidence	1	1	1	1	6	6
1.13	Tornadoes	2	1	2	2	9	18
1.14	Wildfire	3	2	2	2	12	36
1.15	Winter Storms	3	3	2	3	16	48
2.01	Dam failure	2	2	2	2	12	24
2.02	Energy Emergencies	2	2	0	3	9	18
2.03	Fire – Scrap Tires	1	1	1	1	6	6
2.04	Fire – Structural	3	1	2	2	9	27
2.05	HAZMAT – Fixed Site	2	1	1	2	7	14
2.06	HAZMAT – Transportation	2	1	1	2	7	14
2.07	Infrastructure Failures	3	3	1	2	13	39
2.08	Nuclear Power Emergencies	0	-	-	-	-	-
2.09	Oil/Natural Gas Well Accidents	2	2	1	1	9	18
2.10	Pipeline Accidents	1	2	1	2	10	10
2.11	Transportation Accidents	2	1	1	1	6	12
3.01	Catastrophic Incidents	1	3	3	3	18	18
3.02	Civil Disturbances	1	1	1	1	6	6
3.03	Nuclear Attack	0	-	-	-	-	-
3.04	Public Health Emergencies	2	2	0	3	9	18
3.05	Terrorism & Similar Criminal Acts	1	1	1	1	6	6

	Sauble Township Hazard Ranking	Probability of Occurrence	X Impacts Total	= Hazard Score
1	Winter Storms	3	16	48
2	Severe Winds	3	14	42
3	Infrastructure Failures	3	13	39
4	Wildfire	3	12	36
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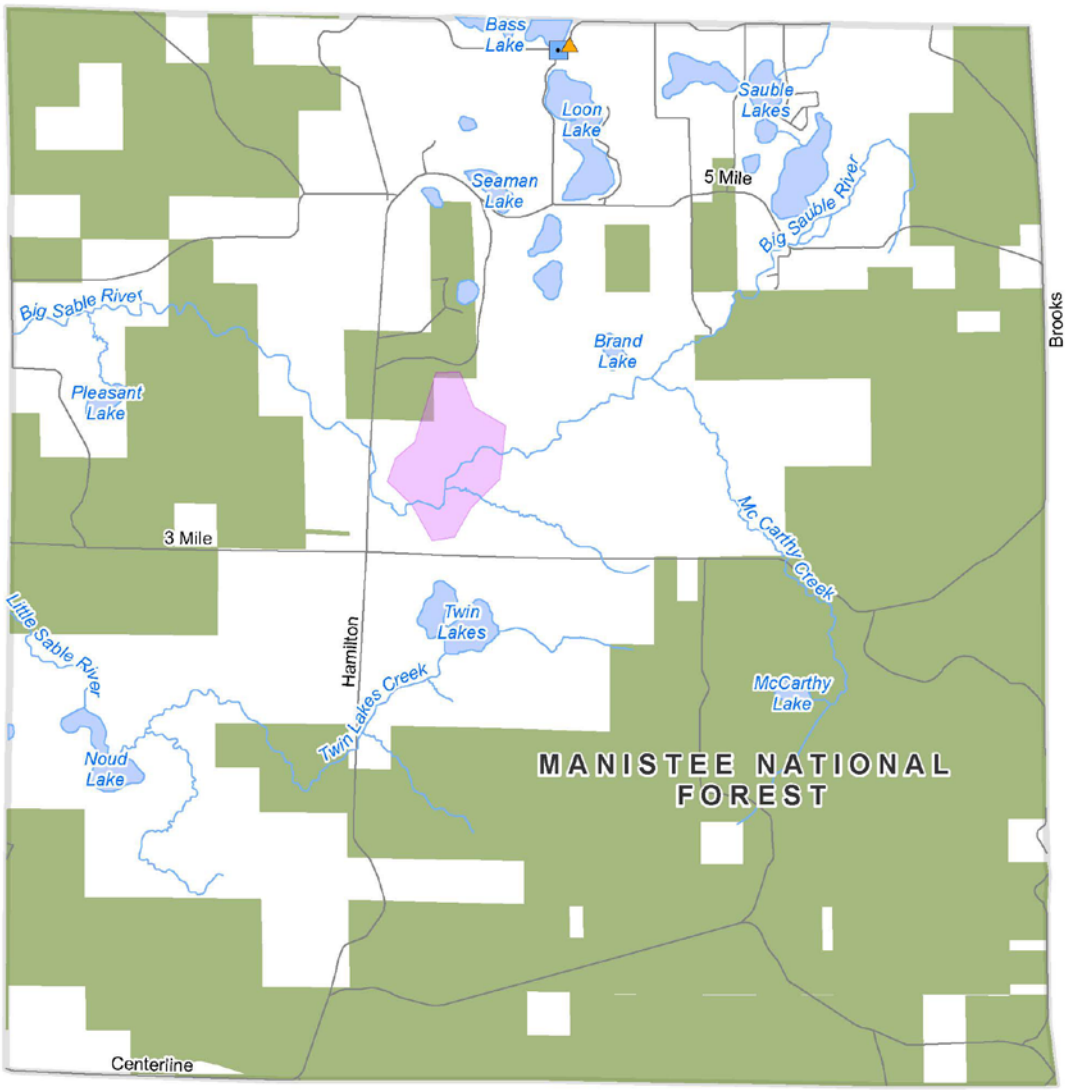
6	Fire – Structural	3	9	27
7	Drought	2	13	26
8	Dam failure	2	12	24
8	Flooding: Riverine/Urban	3	8	24
8	Great Lakes Shoreline	3	8	24
8	Hail	3	8	24
8	Lightning	3	8	24
13	Catastrophic Incidents	1	18	18
13	Energy Emergencies	2	9	18
13	Oil/Natural Gas Well Accidents	2	9	18
13	Public Health Emergencies	2	9	18
13	Tornadoes	2	9	18
18	Invasive Species	2	8	16
19	HAZMAT – Fixed Site	2	7	14
19	HAZMAT – Transportation	2	7	14
21	Fog	3	4	12
21	Transportation Accidents	2	6	12
23	Pipeline Accidents	1	10	10
24	Celestial Impacts	1	8	8
25	Civil Disturbances	1	6	6
25	Fire – Scrap Tires	1	6	6
25	Subsidence	1	6	6
25	Terrorism & Similar Criminal Acts	1	6	6
	Earthquake	0	-	-
	Nuclear Attack	0	-	-
	Nuclear Power Emergencies	0	-	-

SAUBLE TOWNSHIP
Critical Facilities and Potential Hazards



0 0.75 1.5 Miles

Note: This jurisdiction is subject to many additional hazards; some of which tend to occur across wide areas and cannot be effectively shown on this map.Refer to **Appendix B- Hazard Identifications and Analyses** for more complete information about potential hazards in this community.

- Street
- Fire/Police/911/EMS
- Shelter
- Federal Land
- Oil/Gas Field

WMSRDC
WEST MICHIGAN SHORELINE REGIONAL DEVELOPMENT COMMISSION

Source: Michigan Geographic Data Library V 12b, Lake Co. Hazard Mitigation Plan Update 2014

Hazard Identification Profile

Sweetwater Township

1. NATURAL HAZARDS

1.01 Celestial Impacts: - None Identified.

1.02 Drought:

- Summer 1871: Prolonged drought over much of the Great Lakes region.
- May-September, 1891: Drought devastated Michigan's lumber industry.
- 12 recorded drought events in the area (including Lake, Mason, Muskegon, Newaygo, and Oceana counties) lasting eight months or greater: 1895-1896 (15 months), 1899-1900 (11 months), 1901-1902 (10 months), 1909-1911 (24 months), 1925-1926 (11 months), 1930-1931 (18 months), 1956-1957 (8 months), 1962-1963 (9 months), 1971-1972 (12 months), 1976-1977 (13 months), and 2002-2003 (12 months).

1.03 Earthquake: - None Identified.

1.04 Extreme Temperatures:

- July 1936: Heatwave. 570 deaths statewide, 364 in Detroit.
- Summer, 1988: 39 days with temperatures over 90 degrees, statewide.
- January 20, 1994: Record cold. $50m property damage across Michigan.
- March 2012: Anomalous temperatures. $209.8m crop damage across Michigan.

1.05 Flooding - Riverine/ Urban:

- September 10-19, 1986: Flooding. Declaration of disaster by Governor, Presidential disaster declaration, Lake County.
- February 10, 2001: Flooding. $100k property damage, western Michigan.
- May 21-23, 2004: Flooding. $25m property damage, $4.6m crop damage, western Lower Michigan.
- June 13, 2008: Flash flood. $2m property damage, $500k crop damage, Presidential disaster declaration, Lake County.
- May 3, 2012: Flash flood. $70k property damage, Lake County.
- April 17-23, 2013: Flood. $3m property damage, Lake County.
- April 2014: Flood. (details yet to come), Lake County.

1.06 Fog:

- January 11-13, 1995: Dense Fog. Four traffic accident fatalies, school closures, and flight delays across Lower Michigan.

1.07 Great Lakes Shoreline Hazards: - None Identified.

1.08 Hail:

- Severe hail events (1" or greater) recorded in Lake County since 1996: 9

1.09 Invasive Species:

- Invasive species exist in Lake County, however no significant events have been identified.

1.10 Lightning: - None Identified.

1.11 Severe Winds:

- April 6, 1997: High wind. $5m property damage across southwest Lower Michigan.
- May 31, 1998: Severe thunderstorm winds. Declaration of local of emergency and $1.1m property damage, Lake County.
- June 1, 2000: Severe thunderstorm winds. $25k property damage, Lake County.
- July 13, 2000: Severe thunderstorm winds. $25k property damage, Lake County.
- June 18, 2001: High wind. $100k property damage across central Lower Michigan.
- August 9, 2001: Severe thunderstorm winds. $25k property damage, Lake County.
- March 9, 2002: High wind. $485k property damage across southwest Lower Michigan.
- October 30, 2004: High wind. $1.15m property damage across southwest Lower Michigan.
- July 24, 2005: Severe thunderstorm winds. $25k property damage, Lake County.
- July 26, 2005: Severe thunderstorm winds. $25k property damage, Lake County.
- May 3, 2012: Severe thunderstorm winds. $500k property damage, Lake County.
- August 7, 2013: Severe thunderstorm winds. $100k property damage, Lake County.
- November 17, 2013: High wind. $75k property damage, Lake County.

1.12 Subsidence: - None Identified.

1.13 Tornadoes:

- June 8, 1985: F1 tornado. No documented damages, unknown location in Lake County.

1.14 Wildfire:

- October 1871: Wildfires. 1.2m acres burned, 200 fatalities, Lower Peninsula.
- May-September, 1891: Uncontrollable wildfires across Michigan during the drought of 1891.
- 1981-2010: Approximately 11 wildfires and 43 acres burned per year on county lands under MDNR jurisdiction (315 total wildfires, 1,283.5 total acres burned).

1.15 Winter Storms:

- January 26, 1978: Blizzard, snowstorm. Declaration of statewide emergency by President, disaster by Governor.
- January 12, 1993: Heavy snow. $50k property damage, northern Lower Michigan.
- April 1, 1993: Heavy snow. $50k property damage, Lower Michigan.
- January 12-21, 1994: Heavy lake effect snow. $500k property damage across western Lower Michigan.
- January 27, 1994: Heavy snow and freezing rain. $5m property damage across region.
- March 9, 1998: Winter storm. $100k property damage across region.
- January 2-25, 1999: Blizzard, lake effect snow. "Blizzard of '99". southern Lower Michigan.
- April 3, 2003: Ice storm. $4.9m property damage throughout West Michigan.
- December 11-12, 2010: Winter storm. $250k property damage, west-central Lower Michigan.
- March 2-3, 2012: Heavy snow. $100k property damage, power outages, and shelters opened in Lake County.

2. TECHNOLOGICAL HAZARDS

2.01 Dam Failure: - None Identified.

2.02 Energy Emergencies: - None Identified.

2.03 Fire - Scrap Tire: - None Identified.

2.04 Fire - Structural:

- County fire rate per 1,000 population in 1998: 3.09

2.05 Hazard Material Incidents - Fixed Site (including industrial accidents): - None Identified.

2.06 Hazard Material Incidents - Transportation: - None Identified.

2.07 Infrastructure Failure:

- Number of NCDC events showing downed power lines or power outages in Lake County, 1997-2012: 18
- April 6-7,1997: 180,000-200,000 without power; 70,000 on second day (high wind event), statewide.
- March 9, 1998: 1,900 power outages (blizzard conditions), Lake, Clare, Oceana and Muskegon counties.
- ***July 13, 2000: Downed power lines (thunderstorm winds), Sweetwater Township.***
- April 3, 2003: Hundreds of thousands lose power (ice storm), Lower Michigan.
- October 10, 2004: 100,000 without power (high wind), statewide.
- June 13, 2008: Numerous roads washed out (flash flood), Lake County.
- June 28, 2008: Three-quarters of Lake County without power (thunderstorm winds), Lake County.
- May 3, 2012: Several roads flooded or washed out (flash flood), Lake County.

2.08 Nuclear Power Plant Emergencies: - None Identified.

2.09 Oil and Natural Gas Well Accidents:

- 7 oil and gas wells within SweetwaterTownship, none of which are "active" or "producing."

2.10 Pipeline Accidents: - None Identified.

2.11 Transportation Accidents: - None Identified.

3. HUMAN -RELATED HAZARDS

3.01 Catastrophic Incidents (National Emergencies): - None Identified.

3.02 Civil Disturbances: - None Identified.

3.03 Nuclear Attack: - None Identified.

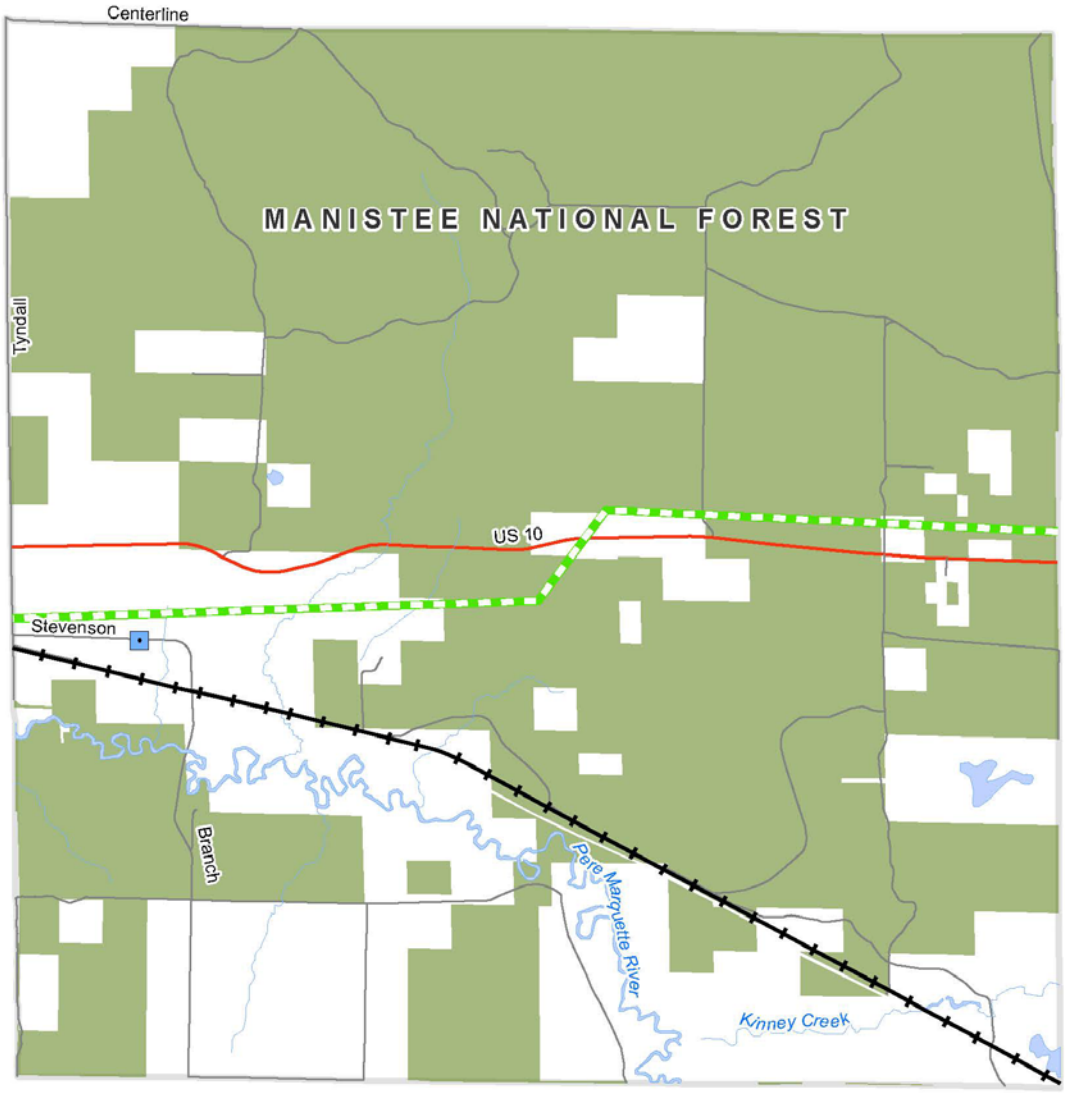
3.04 Public Health Emergencies: - None Identified.

3.05 Terrorism and Similar Criminal Activities: - None Identified.

	Sweetwater Township Hazard Rating	Probability of Occurrence	Impact on People	Impact on Property	Impact on Economy	Impacts Total	Hazard Score
1.01	Celestial Impacts	1	2	0	2	8	8
1.02	Drought	2	2	2	3	13	26
1.03	Earthquake	0	-	-	-	-	-
1.04	Extreme Temperatures	3	2	1	2	10	30
1.05	Flooding: Riverine/Urban	2	1	1	1	6	12
1.06	Fog	2	1	0	1	4	8
1.07	Great Lakes Shoreline	0	-	-	-	-	-
1.08	Hail	3	1	2	1	8	24
1.09	Invasive Species	2	1	2	2	9	18
1.10	Lightning	3	1	2	1	8	24
1.11	Severe Winds	3	2	3	2	14	42
1.12	Subsidence	1	1	1	1	6	6
1.13	Tornadoes	2	1	2	2	9	18
1.14	Wildfire	3	2	2	2	12	36
1.15	Winter Storms	3	3	2	3	16	48
2.01	Dam failure	0	-	-	-	-	-
2.02	Energy Emergencies	2	2	0	3	9	18
2.03	Fire – Scrap Tires	1	1	1	1	6	6
2.04	Fire – Structural	3	1	2	2	9	27
2.05	HAZMAT – Fixed Site	2	1	1	2	7	14
2.06	HAZMAT – Transportation	2	1	1	2	7	14
2.07	Infrastructure Failures	3	3	1	2	13	39
2.08	Nuclear Power Emergencies	0	-	-	-	-	-
2.09	Oil/Natural Gas Well Accidents	2	1	1	1	6	12
2.10	Pipeline Accidents	1	2	1	2	10	10
2.11	Transportation Accidents	2	1	1	1	6	12
3.01	Catastrophic Incidents	1	3	3	3	18	18
3.02	Civil Disturbances	1	1	1	1	6	6
3.03	Nuclear Attack	0	-	-	-	-	-
3.04	Public Health Emergencies	2	2	0	3	9	18
3.05	Terrorism & Similar Criminal Acts	1	1	1	1	6	6

	Sweetwater Township Hazard Ranking	Probability of Occurrence	X Impacts Total	= Hazard Score
1	Winter Storms	3	16	48
2	Severe Winds	3	14	42
3	Infrastructure Failures	3	13	39
4	Wildfire	3	12	36
5	Extreme Temperatures	3	10	30
6	Fire – Structural	3	9	27
7	Drought	2	13	26
8	Hail	3	8	24
8	Lightning	3	8	24
10	Catastrophic Incidents	1	18	18
10	Energy Emergencies	2	9	18
10	Invasive Species	2	9	18
10	Public Health Emergencies	2	9	18
10	Tornadoes	2	9	18
15	HAZMAT – Fixed Site	2	7	14
15	HAZMAT – Transportation	2	7	14
17	Flooding: Riverine/Urban	2	6	12
17	Oil/Natural Gas Well Accidents	2	6	12
17	Transportation Accidents	2	6	12
20	Pipeline Accidents	1	10	10
21	Celestial Impacts	1	8	8
21	Fog	2	4	8
23	Civil Disturbances	1	6	6
23	Fire – Scrap Tires	1	6	6
23	Subsidence	1	6	6
23	Terrorism & Similar Criminal Acts	1	6	6
	Dam failure	0	-	-
	Earthquake	0	-	-
	Great Lakes Shoreline	0	-	-
	Nuclear Attack	0	-	-
	Nuclear Power Emergencies	0	-	-

SWEETWATER TOWNSHIP
Critical Facilities and Potential Hazards



0 0.75 1.5 Miles

State Trunkline
Street
Railroad
Gas Pipeline
Shelter
Federal Land

Note: This jurisdiction is subject to many additional hazards; some of which tend to occur across wide areas and cannot be effectively shown on this map.Refer to **Appendix B- Hazard Identifications and Analyses** for more complete information about potential hazards in this community.

WMSRDC
WEST MICHIGAN SHORELINE REGIONAL DEVELOPMENT COMMISSION

Source: Michigan Geographic Data Library V 12b, Lake Co. Hazard Mitigation Plan Update 2014

Hazard Identification Profile

Webber Township

1. NATURAL HAZARDS

1.01 Celestial Impacts: - None Identified.

1.02 Drought:

- Summer 1871: Prolonged drought over much of the Great Lakes region.
- May-September, 1891: Drought devastated Michigan's lumber industry.
- 12 recorded drought events in the area (including Lake, Mason, Muskegon, Newaygo, and Oceana counties) lasting eight months or greater: 1895-1896 (15 months), 1899-1900 (11 months), 1901-1902 (10 months), 1909-1911 (24 months), 1925-1926 (11 months), 1930-1931 (18 months), 1956-1957 (8 months), 1962-1963 (9 months), 1971-1972 (12 months), 1976-1977 (13 months), and 2002-2003 (12 months).

1.03 Earthquake: - None Identified.

1.04 Extreme Temperatures:

- July 1936: Heatwave. 570 deaths statewide, 364 in Detroit.
- Summer, 1988: 39 days with temperatures over 90 degrees, statewide.
- January 20, 1994: Record cold. $50m property damage across Michigan.
- March 2012: Anomalous temperatures. $209.8m crop damage across Michigan.

1.05 Flooding - Riverine/ Urban:

- September 10-19, 1986: Flooding. Declaration of disaster by Governor, Presidential disaster declaration, Lake County.
- February 10, 2001: Flooding. $100k property damage, western Michigan.
- May 21-23, 2004: Flooding. $25m property damage, $4.6m crop damage, western Lower Michigan.
- June 13, 2008: Flash flood. $2m property damage, $500k crop damage, Presidential disaster declaration, Lake County.
- May 3, 2012: Flash flood. $70k property damage, Lake County.
- April 17-23, 2013: Flood. $3m property damage, Lake County.
- April 2014: Flood. (details yet to come), Lake County.

1.06 Fog:

- January 11-13, 1995: Dense Fog. Four traffic accident fatalies, school closures, and flight delays across Lower Michigan.

1.07 Great Lakes Shoreline Hazards: - None Identified.

1.08 Hail:

- Severe hail events (1" or greater) recorded in Lake County since 1996: 9

1.09 Invasive Species:

- Invasive species exist in Lake County, however no significant events have been identified.

1.10 Lightning: - None Identified.

1.11 Severe Winds:

- April 6, 1997: High wind. $5m property damage across southwest Lower Michigan.
- May 31, 1998: Severe thunderstorm winds. Declaration of local of emergency and $1.1m property damage, Lake County.
- June 1, 2000: Severe thunderstorm winds. $25k property damage, Lake County.
- July 13, 2000: Severe thunderstorm winds. $25k property damage, Lake County.
- June 18, 2001: High wind. $100k property damage across central Lower Michigan.
- August 9, 2001: Severe thunderstorm winds. $25k property damage, Lake County.
- March 9, 2002: High wind. $485k property damage across southwest Lower Michigan.
- October 30, 2004: High wind. $1.15m property damage across southwest Lower Michigan.
- July 24, 2005: Severe thunderstorm winds. $25k property damage, Lake County.
- July 26, 2005: Severe thunderstorm winds. $25k property damage, Lake County.
- May 3, 2012: Severe thunderstorm winds. $500k property damage, Lake County.
- August 7, 2013: Severe thunderstorm winds. $100k property damage, Lake County.
- November 17, 2013: High wind. $75k property damage, Lake County.

1.12 Subsidence: - None Identified.

1.13 Tornadoes:

- June 8, 1985: F1 tornado. No documented damages, unknown location in Lake County.

1.14 Wildfire:

- October 1871: Wildfires. 1.2m acres burned, 200 fatalities, Lower Peninsula.
- May-September, 1891: Uncontrollable wildfires across Michigan during the drought of 1891.
- 1981-2010: Approximately 11 wildfires and 43 acres burned per year on county lands under MDNR jurisdiction (315 total wildfires, 1,283.5 total acres burned).

1.15 Winter Storms:

- January 26, 1978: Blizzard, snowstorm. Declaration of statewide emergency by President, disaster by Governor.
- January 12, 1993: Heavy snow. $50k property damage, northern Lower Michigan.
- April 1, 1993: Heavy snow. $50k property damage, Lower Michigan.
- January 12-21, 1994: Heavy lake effect snow. $500k property damage across western Lower Michigan.
- January 27, 1994: Heavy snow and freezing rain. $5m property damage across region.
- March 9, 1998: Winter storm. $100k property damage across region.
- January 2-25, 1999: Blizzard, lake effect snow. "Blizzard of '99". southern Lower Michigan.
- April 3, 2003: Ice storm. $4.9m property damage throughout West Michigan.
- December 11-12, 2010: Winter storm. $250k property damage, west-central Lower Michigan.
- March 2-3, 2012: Heavy snow. $100k property damage, power outages, and shelters opened in Lake County.

2. TECHNOLOGICAL HAZARDS

2.01 Dam Failure: - None Identified.

2.02 Energy Emergencies: - None Identified.

2.03 Fire - Scrap Tire: - None Identified.

2.04 Fire - Structural:

- County fire rate per 1,000 population in 1998: 3.09

2.05 Hazard Material Incidents - Fixed Site (including industrial accidents): - None Identified.

2.06 Hazard Material Incidents - Transportation: - None Identified.

2.07 Infrastructure Failure:

- Number of NCDC events showing downed power lines or power outages in Lake County, 1997-2012: 18
- April 6-7,1997: 180,000-200,000 without power; 70,000 on second day (high wind event), statewide.
- March 9, 1998: 1,900 power outages (blizzard conditions), Lake, Clare, Oceana and Muskegon counties.
- ***February 9-10, 2001: Portions of M-37 closed (flooding), Lake County.***
- April 3, 2003: Hundreds of thousands lose power (ice storm), Lower Michigan. .
- October 10, 2004: 100,000 without power (high wind), statewide.
- June 13, 2008: Numerous roads washed out (flash flood), Lake County.
- June 28, 2008: Three-quarters of Lake County without power (thunderstorm winds), Lake County.
- May 3, 2012: Several roads flooded or washed out (flash flood), Lake County.

2.08 Nuclear Power Plant Emergencies: - None Identified.

2.09 Oil and Natural Gas Well Accidents:

- 2 oil and gas wells within Webber Township, none of which are "active" or "producing."

2.10 Pipeline Accidents: - None Identified.

2.11 Transportation Accidents: - None Identified.

3. HUMAN -RELATED HAZARDS

3.01 Catastrophic Incidents (National Emergencies): - None Identified.

3.02 Civil Disturbances: - None Identified.

3.03 Nuclear Attack: - None Identified.

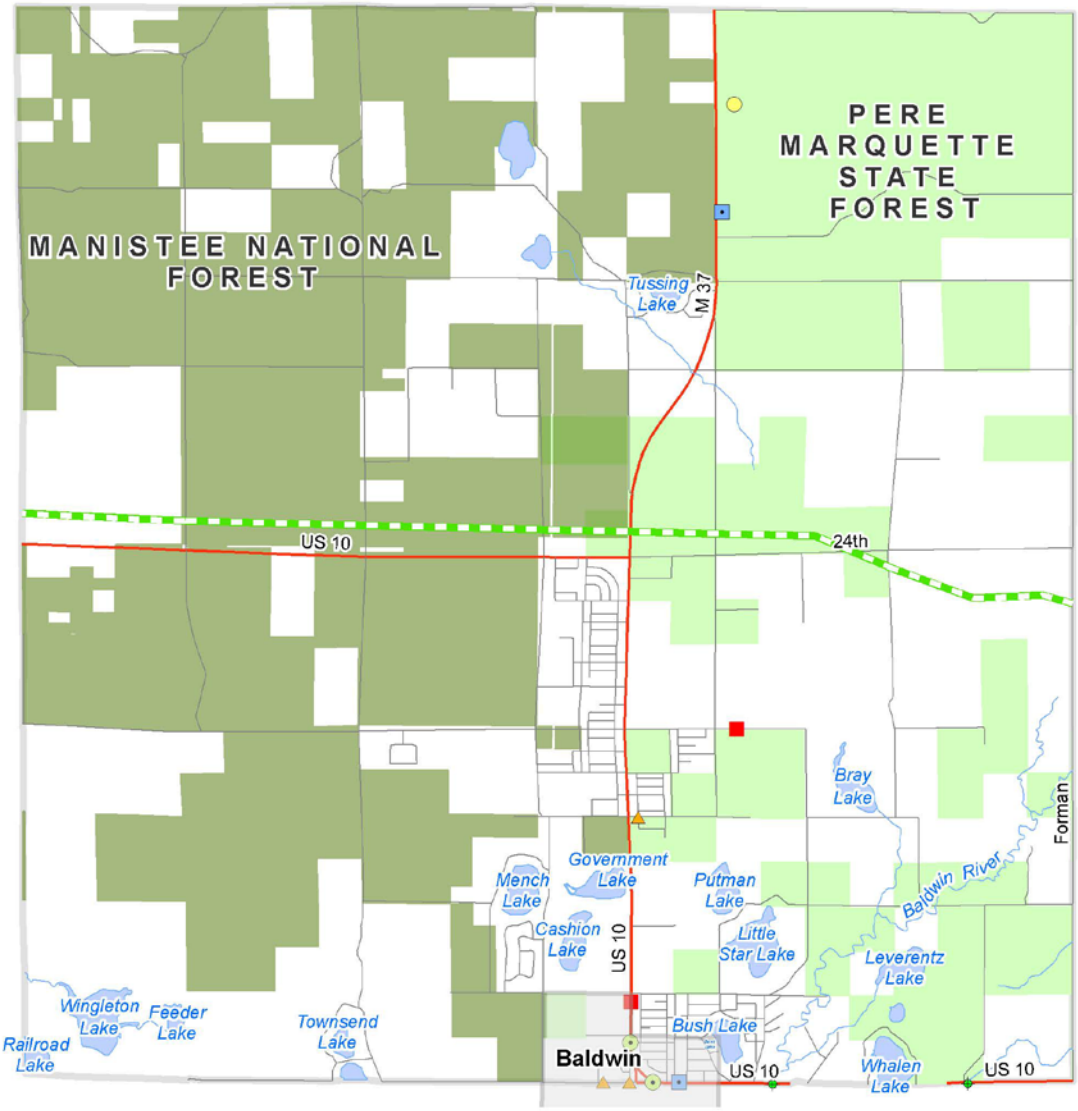
3.04 Public Health Emergencies: - None Identified.

3.05 Terrorism and Similar Criminal Activities: - None Identified.

	Webber Township Hazard Rating	Probability of Occurrence	Impact on People	Impact on Property	Impact on Economy	Impacts Total	Hazard Score
1.01	Celestial Impacts	1	2	0	2	8	8
1.02	Drought	2	2	2	3	13	26
1.03	Earthquake	0	-	-	-	-	-
1.04	Extreme Temperatures	3	2	1	2	10	30
1.05	Flooding: Riverine/Urban	3	1	2	1	8	24
1.06	Fog	2	1	0	1	4	8
1.07	Great Lakes Shoreline	0	-	-	-	-	-
1.08	Hail	3	1	2	1	8	24
1.09	Invasive Species	2	1	1	2	7	14
1.10	Lightning	3	1	2	1	8	24
1.11	Severe Winds	3	2	3	2	14	42
1.12	Subsidence	1	1	1	1	6	6
1.13	Tornadoes	2	1	2	2	9	18
1.14	Wildfire	3	2	2	2	12	36
1.15	Winter Storms	3	3	2	3	16	48
2.01	Dam failure	2	1	2	2	9	18
2.02	Energy Emergencies	2	2	0	3	9	18
2.03	Fire – Scrap Tires	1	1	1	1	6	6
2.04	Fire – Structural	3	1	1	2	7	21
2.05	HAZMAT – Fixed Site	2	1	1	2	7	14
2.06	HAZMAT – Transportation	2	1	1	2	7	14
2.07	Infrastructure Failures	3	3	1	2	13	39
2.08	Nuclear Power Emergencies	0	-	-	-	-	-
2.09	Oil/Natural Gas Well Accidents	1	1	1	1	6	6
2.10	Pipeline Accidents	1	1	1	2	7	7
2.11	Transportation Accidents	2	1	1	1	6	12
3.01	Catastrophic Incidents	1	3	3	3	18	18
3.02	Civil Disturbances	1	1	1	1	6	6
3.03	Nuclear Attack	0	-	-	-	-	-
3.04	Public Health Emergencies	2	2	0	3	9	18
3.05	Terrorism & Similar Criminal Acts	1	1	1	1	6	6

	Webber Township Hazard Ranking	Probability of Occurrence	X Impacts Total	= Hazard Score
1	Winter Storms	3	16	48
2	Severe Winds	3	14	42
3	Infrastructure Failures	3	13	39
4	Wildfire	3	12	36
5	Extreme Temperatures	3	10	30
6	Drought	2	13	26
7	Flooding: Riverine/Urban	3	8	24
7	Hail	3	8	24
7	Lightning	3	8	24
10	Fire – Structural	3	7	21
11	Catastrophic Incidents	1	18	18
11	Dam failure	2	9	18
11	Energy Emergencies	2	9	18
11	Public Health Emergencies	2	9	18
11	Tornadoes	2	9	18
16	HAZMAT – Fixed Site	2	7	14
16	HAZMAT – Transportation	2	7	14
16	Invasive Species	2	7	14
19	Transportation Accidents	2	6	12
20	Celestial Impacts	1	8	8
20	Fog	2	4	8
22	Pipeline Accidents	1	7	7
23	Civil Disturbances	1	6	6
23	Fire – Scrap Tires	1	6	6
23	Oil/Natural Gas Well Accidents	1	6	6
23	Subsidence	1	6	6
23	Terrorism & Similar Criminal Acts	1	6	6
	Earthquake	0	-	-
	Great Lakes Shoreline	0	-	-
	Nuclear Attack	0	-	-
	Nuclear Power Emergencies	0	-	-

WEBBER TOWNSHIP
Critical Facilities and Potential Hazards



0 0.75 1.5 Miles

- State Trunkline
- Street
- Gas Pipeline
- Bridge
- Fire/Police/EMS/911
- Correctional Facility
- Shelter
- Siren
- Federal Land
- State Land

Note: This jurisdiction is subject to many additional hazards; some of which tend to occur across wide areas and cannot be effectively shown on this map.Refer to **Appendix B- Hazard Identifications and Analyses** for more complete information about potential hazards in this community.

WMSRDC
WEST MICHIGAN SHORELINE REGIONAL DEVELOPMENT COMMISSION

Source: Michigan Geographic Data Library V 12b, Lake Co. Hazard Mitigation Plan Update 2014

Hazard Identification Profile

Yates Township

1. NATURAL HAZARDS

1.01 Celestial Impacts: - None Identified.

1.02 Drought:

- Summer 1871: Prolonged drought over much of the Great Lakes region.
- May-September, 1891: Drought devastated Michigan's lumber industry.
- 12 recorded drought events in the area (including Lake, Mason, Muskegon, Newaygo, and Oceana counties) lasting eight months or greater: 1895-1896 (15 months), 1899-1900 (11 months), 1901-1902 (10 months), 1909-1911 (24 months), 1925-1926 (11 months), 1930-1931 (18 months), 1956-1957 (8 months), 1962-1963 (9 months), 1971-1972 (12 months), 1976-1977 (13 months), and 2002-2003 (12 months).

1.03 Earthquake: - None Identified.

1.04 Extreme Temperatures:

- July 1936: Heatwave. 570 deaths statewide, 364 in Detroit.
- Summer, 1988: 39 days with temperatures over 90 degrees, statewide.
- January 20, 1994: Record cold. $50m property damage across Michigan.
- March 2012: Anomalous temperatures. $209.8m crop damage across Michigan.

1.05 Flooding - Riverine/ Urban:

- September 10-19, 1986: Flooding. Declaration of disaster by Governor, Presidential disaster declaration, Lake County.
- February 10, 2001: Flooding. $100k property damage, western Michigan.
- May 21-23, 2004: Flooding. $25m property damage, $4.6m crop damage, western Lower Michigan.
- June 13, 2008: Flash flood. $2m property damage, $500k crop damage, Presidential disaster declaration, Lake County.
- May 3, 2012: Flash flood. $70k property damage, Lake County.
- April 17-23, 2013: Flood. $3m property damage, Lake County.
- April 2014: Flood. Local state of emergency declared, Lake County.

1.06 Fog:

- January 11-13, 1995: Dense Fog. Four traffic accident fatalies, school closures, and flight delays across Lower Michigan.

1.07 Great Lakes Shoreline Hazards: - None Identified.

1.08 Hail:

- Severe hail events (1" or greater) recorded in Lake County since 1996: 9

1.09 Invasive Species:

- Invasive species exist in Lake County, however no significant events have been identified.

1.10 Lightning: - None Identified.

1.11 Severe Winds:

- April 6, 1997: High wind. $5m property damage across southwest Lower Michigan.
- May 31, 1998: Severe thunderstorm winds. Declaration of local of emergency and $1.1m property damage, Lake County.
- June 1, 2000: Severe thunderstorm winds. $25k property damage, Lake County.
- July 13, 2000: Severe thunderstorm winds. $25k property damage, Lake County.
- June 18, 2001: High wind. $100k property damage across central Lower Michigan.
- August 9, 2001: Severe thunderstorm winds. $25k property damage, Lake County.
- ***August 30, 2001: Severe thunderstorm winds. $100k property damage, Pleasant Plains and Yates Townships.***
- March 9, 2002: High wind. $485k property damage across southwest Lower Michigan.
- October 30, 2004: High wind. $1.15m property damage across southwest Lower Michigan.
- July 24, 2005: Severe thunderstorm winds. $25k property damage, Lake County.
- July 26, 2005: Severe thunderstorm winds. $25k property damage, Lake County.
- May 3, 2012: Severe thunderstorm winds. $500k property damage, Lake County.
- August 7, 2013: Severe thunderstorm winds. $100k property damage, Lake County.
- November 17, 2013: High wind. $75k property damage, Lake County.

1.12 Subsidence: - None Identified.

1.13 Tornadoes:

- June 8, 1985: F1 tornado. No documented damages, unknown location in Lake County.

1.14 Wildfire:

- October 1871: Wildfires. 1.2m acres burned, 200 fatalities, Lower Peninsula.
- May-September, 1891: Uncontrollable wildfires across Michigan during the drought of 1891.
- 1981-2010: Approximately 11 wildfires and 43 acres burned per year on county lands under MDNR jurisdiction (315 total wildfires, 1,283.5 total acres burned).

1.15 Winter Storms:

- January 26, 1978: Blizzard, snowstorm. Declaration of statewide emergency by President, disaster by Governor.
- January 12, 1993: Heavy snow. $50k property damage, northern Lower Michigan.
- April 1, 1993: Heavy snow. $50k property damage, Lower Michigan.
- January 12-21, 1994: Heavy lake effect snow. $500k property damage across western Lower Michigan.
- January 27, 1994: Heavy snow and freezing rain. $5m property damage across region.
- March 9, 1998: Winter storm. $100k property damage across region.
- January 2-25, 1999: Blizzard, lake effect snow. "Blizzard of '99". southern Lower Michigan.
- April 3, 2003: Ice storm. $4.9m property damage throughout West Michigan.
- December 11-12, 2010: Winter storm. $250k property damage, west-central Lower Michigan.
- March 2-3, 2012: Heavy snow. $100k property damage, power outages, and shelters opened in Lake County.

2. TECHNOLOGICAL HAZARDS

2.01 Dam Failure: - None Identified.

2.02 Energy Emergencies: - None Identified.

2.03 Fire - Scrap Tire: - None Identified.

2.04 Fire - Structural:

- County fire rate per 1,000 population in 1998: 3.09

2.05 Hazard Material Incidents - Fixed Site (including industrial accidents): - None Identified.

2.06 Hazard Material Incidents - Transportation: - None Identified.

2.07 Infrastructure Failure:

- Number of NCDC events showing downed power lines or power outages in Lake County, 1997-2012: 18
- April 6-7,1997: 180,000-200,000 without power; 70,000 on second day (high wind event), statewide.
- March 9, 1998: 1,900 power outages (blizzard conditions), Lake, Clare, Oceana and Muskegon counties.
- February 9-10, 2001: Portions of M-37 closed (flooding), Lake County.
- April 3, 2003: Hundreds of thousands lose power (ice storm), Lower Michigan.
- October 10, 2004: 100,000 without power (high wind), statewide.
- June 13, 2008: Numerous roads washed out (flash flood), Lake County.
- June 28, 2008: Three-quarters of Lake County without power (thunderstorm winds), Lake County.
- ***August 2, 2011: Road washout at 56th and Queens Highway (flash flood), Yates Township.***
- May 3, 2012: Several roads flooded or washed out (flash flood), Lake County.

2.08 Nuclear Power Plant Emergencies: - None Identified.

2.09 Oil and Natural Gas Well Accidents:

- 29 oil and gas wells within Yates Township, none of which are "active" or "producing."

2.10 Pipeline Accidents: - None Identified.

2.11 Transportation Accidents: - None Identified.

3. HUMAN -RELATED HAZARDS

3.01 Catastrophic Incidents (National Emergencies): - None Identified.

3.02 Civil Disturbances: - None Identified.

3.03 Nuclear Attack: - None Identified.

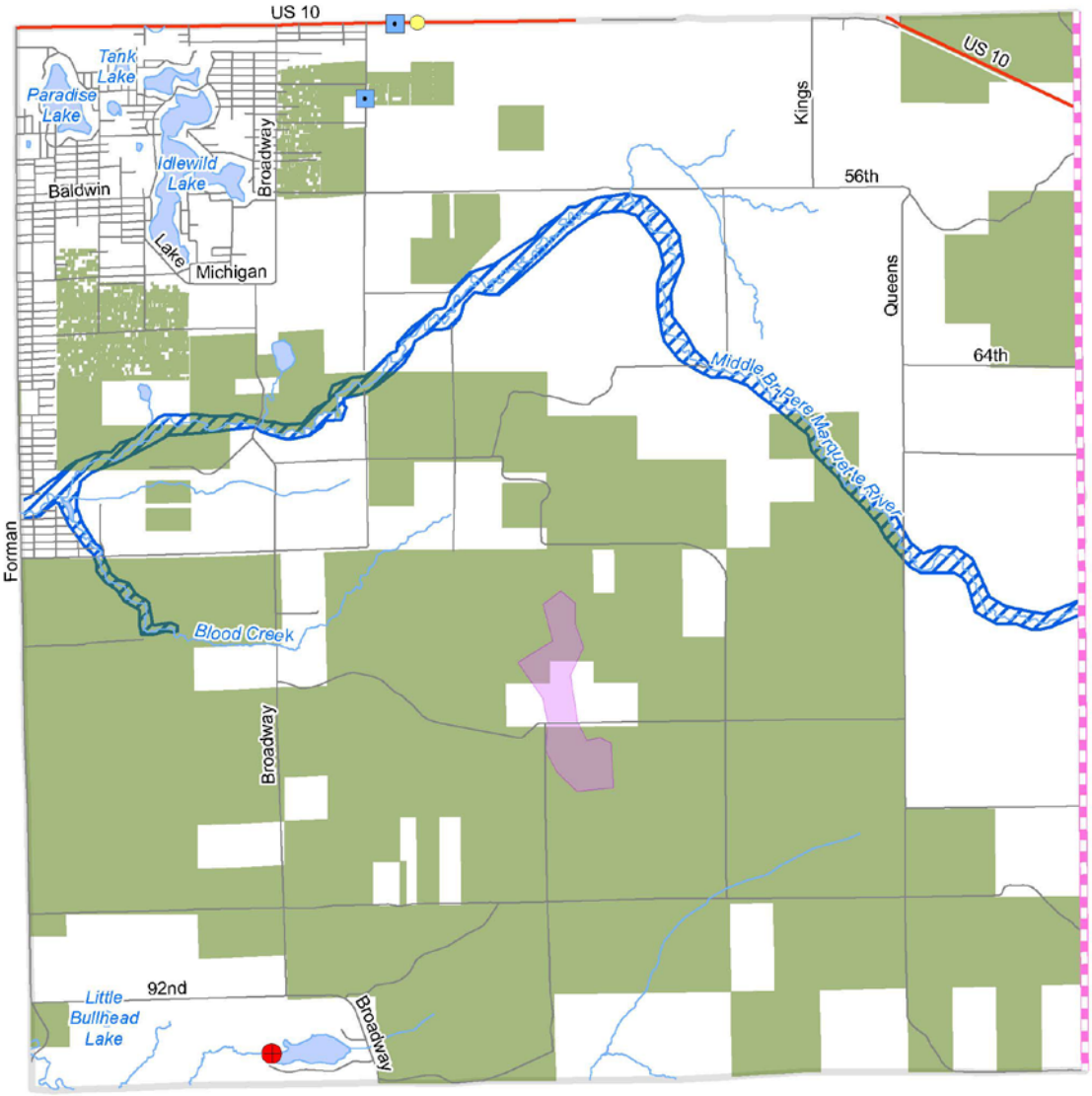
3.04 Public Health Emergencies: - None Identified.

3.05 Terrorism and Similar Criminal Activities: - None Identified.

	Yates Township Hazard Rating	Probability of Occurrence	Impact on People	Impact on Property	Impact on Economy	Impacts Total	Hazard Score
1.01	Celestial Impacts	1	2	0	2	8	8
1.02	Drought	2	2	2	3	13	26
1.03	Earthquake	0	-	-	-	-	-
1.04	Extreme Temperatures	3	2	1	2	10	30
1.05	Flooding: Riverine/Urban	2	1	2	1	8	16
1.06	Fog	2	1	0	1	4	8
1.07	Great Lakes Shoreline	0	-	-	-	-	-
1.08	Hail	3	1	2	1	8	24
1.09	Invasive Species	2	1	2	2	9	18
1.10	Lightning	3	1	2	1	8	24
1.11	Severe Winds	3	2	3	2	14	42
1.12	Subsidence	1	1	1	1	6	6
1.13	Tornadoes	2	1	2	2	9	18
1.14	Wildfire	3	2	2	2	12	36
1.15	Winter Storms	3	3	2	3	16	48
2.01	Dam failure	2	1	1	1	6	12
2.02	Energy Emergencies	2	2	0	3	9	18
2.03	Fire – Scrap Tires	1	1	1	1	6	6
2.04	Fire – Structural	3	1	1	2	7	21
2.05	HAZMAT – Fixed Site	2	1	1	2	7	14
2.06	HAZMAT – Transportation	2	1	1	2	7	14
2.07	Infrastructure Failures	3	3	1	2	13	39
2.08	Nuclear Power Emergencies	0	-	-	-	-	-
2.09	Oil/Natural Gas Well Accidents	2	1	1	1	6	12
2.10	Pipeline Accidents	1	2	1	2	10	10
2.11	Transportation Accidents	2	1	1	1	6	12
3.01	Catastrophic Incidents	1	3	3	3	18	18
3.02	Civil Disturbances	1	1	1	1	6	6
3.03	Nuclear Attack	0	-	-	-	-	-
3.04	Public Health Emergencies	2	2	0	3	9	18
3.05	Terrorism & Similar Criminal Acts	1	1	1	1	6	6

	Yates Township Hazard Ranking	Probability of Occurrence	X	Impacts Total	=	Hazard Score
1	Winter Storms	3		16		48
2	Severe Winds	3		14		42
3	Infrastructure Failures	3		13		39
4	Wildfire	3		12		36
5	Extreme Temperatures	3		10		30
6	Drought	2		13		26
7	Hail	3		8		24
7	Lightning	3		8		24
9	Fire – Structural	3		7		21
10	Catastrophic Incidents	1		18		18
10	Energy Emergencies	2		9		18
10	Invasive Species	2		9		18
10	Public Health Emergencies	2		9		18
10	Tornadoes	2		9		18
15	Flooding: Riverine/Urban	2		8		16
16	HAZMAT – Fixed Site	2		7		14
16	HAZMAT – Transportation	2		7		14
18	Dam failure	2		6		12
18	Oil/Natural Gas Well Accidents	2		6		12
18	Transportation Accidents	2		6		12
21	Pipeline Accidents	1		10		10
22	Celestial Impacts	1		8		8
22	Fog	2		4		8
24	Civil Disturbances	1		6		6
24	Fire – Scrap Tires	1		6		6
24	Subsidence	1		6		6
24	Terrorism & Similar Criminal Acts	1		6		6
	Earthquake	0		-		-
	Great Lakes Shoreline	0		-		-
	Nuclear Attack	0		-		-
	Nuclear Power Emergencies	0		-		-

YATES TOWNSHIP
Critical Facilities and Potential Hazards



0 0.75 1.5 Miles

Note: This jurisdiction is subject to many additional hazards; some of which tend to occur across wide areas and cannot be effectively shown on this map.Refer to **Appendix B- Hazard Identifications and Analyses** for more complete information about potential hazards in this community.

- State Trunkline
- Street
- Power Line
- Dam
- Shelter
- Siren
- Federal Land
- Floodplain
- Oil/Gas Field

WMSRDC
WEST MICHIGAN SHORELINE REGIONAL DEVELOPMENT COMMISSION

Source: Michigan Geographic Data Library V 12b, Lake Co. Hazard Mitigation Plan Update 2014

Appendix C:

Hazard Identification Data and Maps

National Climatic Data Center: Storm Events

(92 events involving Lake County between 01/01/1950 and 04/31/2004)

Location or County	Date	Time	Type	Magnitude	Death	Injury	Damage ($)	
							property	crop
1 LAKE	8/15/61	1200	Hail	0.75 in.	0	0	0	0
2 LAKE	8/31/76	1830	Tstm Wind	0 kts.	0	0	0	0
3 LAKE	7/26/78	1050	Tstm Wind	0 kts.	0	0	0	0
4 LAKE	8/15/78	2305	Hail	1.25 in.	0	0	0	0
5 LAKE	6/8/85	2240	Tornado	F1	0	0	0	0
6 LAKE	6/8/85	2300	Tstm Wind	0 kts.	0	0	0	0
7 LAKE	8/17/88	1720	Tstm Wind	0 kts.	0	0	0	0
8 LAKE	9/14/90	715	Tstm Wind	0 kts.	0	0	0	0
9 LAKE	6/17/92	1429	Tstm Wind	0 kts.	0	0	0	0
10 LAKE	6/17/92	1441	Tstm Wind	0 kts.	0	0	0	0
11 S Lower MI	1/3/93	2300	Flooding	N/A	0	0	5K	0
12 MIZ004	1/12/93	2300	Heavy Snow	N/A	0	0	50K	0
13 MIZ001	1/21/93	0	Ice Storm	N/A	0	0	0	0
14 MIZ004	3/23/93	300	Freezing Rain	N/A	0	0	0	0
15 MIZ011	4/1/93	0	Heavy Snow	N/A	0	0	50K	0
16 MIZ001	4/19/93	1200	Flood	N/A	0	0	5.0M	0
17 Upper and W MI	12/20/93	1000	Heavy Snow	N/A	0	0	0	0
19 Upper and W MI	12/25/93	700	Heavy Snow	N/A	0	0	0	0
20 Upper and W MI	12/29/93	0	Heavy Snow	N/A	0	0	0	0
21 Upper MI	1/12/94	0	Heavy Lake Snow	N/A	0	0	500K	0
22 Miz000	1/13/94	0	Record Cold	N/A	0	0	50.0M	0
23 Lower MI	1/27/94	0	Heavy Snow/freezing Rain	N/A	0	0	5.0M	0
24 W Lower MI	2/2/94	0	Heavy Snow	N/A	0	0	0	0
25 Central Upper MI	2/22/94	1900	Heavy Snow	N/A	0	0	0	0
26 N Lower MI	12/16/94	1900	Heavy Snow	N/A	0	0	0	0
27 Lower MI	1/11/95	1800	Dense Fog	N/A	0	0	0	0
28 MIZ001	2/3/95	1800	Heavy Lake Snow	N/A	0	0	0	0
29 MIZ001	2/11/95	0	Heavy Lake Snow	N/A	0	0	0	0
30 S Lower MI	2/27/95	100	Ice Storm	N/A	0	0	0	0
31 MIZ001	3/6/95	0	Heavy Snow	N/A	0	0	0	0
32 MIZ037	1/29/96	7:00 AM	Winter Storm	N/A	0	0	0	0
33 Baldwin	5/18/96	8:48 AM	Hail	1.75 in.	0	0	0	0
34 Luther	5/18/96	8:50 AM	Hail	0.75 in.	0	0	0	0
35 MIZ037	11/10/96	1:00 AM	Heavy Snow	N/A	0	0	0	0
36 Baldwin	2/21/97	10:15 AM	Flash Flood	N/A	0	0	0	0
37 MIZ037	4/6/97	4:00 PM	High Wind	0 kts.	0	0	5.0M	0
38 Baldwin	5/5/97	4:56 PM	Hail	0.88 in.	0	0	0	0
39 Idlewild	5/5/97	4:58 PM	Hail	0.75 in.	0	0	0	0
40 Chase	6/30/97	4:55 PM	Hail	0.75 in.	0	0	0	0
41 MIZ037	11/11/97	9:00 PM	Lake Effect Snow	N/A	0	0	0	0
42 MIZ037	12/4/97	7:00 PM	Lake Effect Snow	N/A	0	0	0	0
43 MIZ037	12/30/97	7:00 AM	Lake Effect Snow	N/A	0	0	0	0
44 MIZ037	1/4/98	12:00 AM	Freezing Rain	N/A	0	0	0	0
45 MIZ037	1/7/98	5:00 PM	Winter Storm	N/A	0	0	0	0
46 MIZ037	3/9/98	7:00 AM	Blizzard	N/A	0	0	0	0
47 MIZ037	3/13/98	3:00 PM	Heavy Snow	N/A	0	0	0	0

48 Baldwin	3/30/98	2:05 PM	Hail	1.00 in.	0	0	0	0
49 Baldwin	3/30/98	3:00 PM	Hail	1.75 in.	0	0	0	0
50 Baldwin	5/29/98	12:30 AM	Tstm Wind	0 kts.	0	0	1K	0
51 Irons	5/29/98	12:30 AM	Tstm Wind	0 kts.	0	0	10K	0
52 Countywide	5/31/98	4:05 AM	Tstm Wind	0 kts.	0	0	1.1M	0
53 NW MI	8/6/98	5:00 PM	Flash Flood	N/A	0	0	10K	0
54 Wolf Lake	9/26/98	4:20 AM	Hail	1.00 in.	0	0	0	0
55 Irons	9/26/98	7:50 AM	Tstm Wind/hail	60 kts.	0	0	0	0
56 MIZ037	11/10/98	10:00 AM	High Wind	87 kts.	1	0	0	0
57 MIZ037	12/21/98	1:00 PM	Lake Effect Snow	N/A	0	0	0	0
58 MIZ037	1/2/99	7:00 AM	Blizzard	N/A	0	0	0	0
59 MIZ037	1/4/99	12:00 AM	Snow	N/A	0	0	0	0
60 MIZ037	1/5/99	9:00 PM	Lake Effect Snow	N/A	0	0	0	0
61 MIZ037	2/5/99	7:00 PM	Freezing Rain	N/A	0	0	0	0
62 Baldwin	2/11/99	6:00 PM	Tstm Wind	0 kts.	0	0	10K	0
63 MIZ037	3/2/99	2:00 PM	Snow	N/A	0	0	0	0
64 Baldwin	6/6/99	9:42 PM	Tstm Wind	0 kts.	0	0	10K	0
65 Irons	7/23/99	10:45 AM	Tstm Wind	53 kts.	0	0	10K	0
66 Baldwin	10/13/99	2:41 AM	Hail	1.75 in.	0	0	10K	0
67 MIZ037	1/3/00	3:00 PM	Winter Storm	N/A	0	0	0	0
68 MIZ037	1/12/00	12:00 PM	Winter Storm	N/A	0	0	0	0
69 MIZ038	2/10/00	5:00 AM	Winter Storm	N/A	0	0	0	0
70 MIZ037	4/7/00	12:00 PM	Winter Storm	N/A	0	0	0	0
71 Baldwin	5/8/00	5:35 PM	Hail	1.00 in.	0	0	20K	0
72 Baldwin	6/1/00	9:05 PM	Tstm Wind	53 kts.	0	0	25K	0
73 Countywide	7/13/00	9:50 PM	Tstm Wind	53 kts.	0	0	25K	0
74 Luther	8/9/00	4:30 AM	Hail	1.75 in.	0	0	50K	25K
75 MIZ037	12/11/00	6:00 AM	Winter Storm	N/A	0	0	0	0
76 Countywide	2/9/01	9:00 AM	Flood	N/A	0	0	100K	0
77 Baldwin	5/23/01	6:15 PM	Hail	0.75 in.	0	0	10K	10K
78 MIZ038	6/18/01	8:13 PM	High Wind	62 kts.	0	0	100K	0
79 Baldwin	8/9/01	4:50 PM	Tstm Wind	53 kts.	0	0	25K	0
80 Baldwin	8/30/01	8:15 PM	Tstm Wind	60 kts.	0	0	100K	0
81 MIZ037	12/23/01	3:00 PM	Winter Storm	N/A	0	0	0	0
82 MIZ037	2/25/02	7:00 PM	Winter Storm	N/A	0	0	0	0
83 MIZ037	3/2/02	1:00 AM	Winter Storm	N/A	0	0	0	0
84 MIZ037	3/9/02	12:54 PM	High Wind	62 kts.	0	0	485K	0
85 Nirvana	4/18/02	7:50 PM	Tstm Wind	53 kts.	0	0	1K	0
86 MIZ037	12/1/02	10:00 AM	Heavy Snow	N/A	0	0	0	0
87 MIZ037	2/10/03	4:00 AM	Heavy Snow	N/A	0	0	0	0
88 MIZ037	4/3/03	10:00 AM	Ice Storm	N/A	0	0	4.9M	0
89 Bristol	5/11/03	12:05 AM	Hail	0.88 in.	0	0	10K	10K
90 Baldwin	6/8/03	4:35 PM	Hail	0.75 in.	0	0	20K	20K
91 MIZ037	1/14/04	4:00 AM	Heavy Snow	N/A	0	0	0	0
92 MIZ037	1/27/04	7:00 AM	Winter Storm	N/A	0	0	0	0

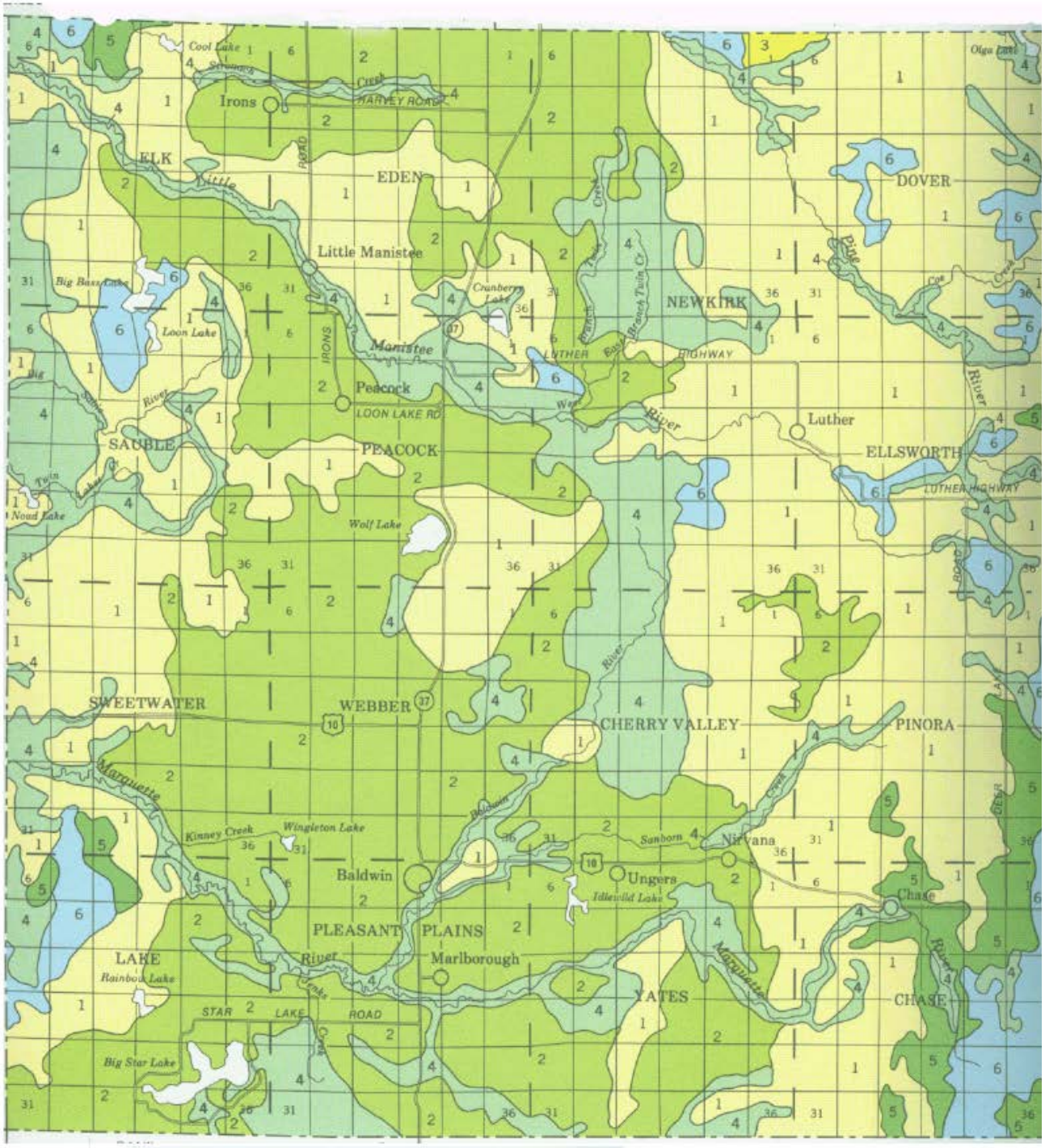
National Climatic Data Center: Storm Events

05/01/2004 through 02/28/2014 ♦ 61 events reported in Lake County

Location or Zone	Date	Duration	Type	Magnitude	Death	Injury	Damage ($)	
							property	crop
Lake Co. (Zone)	5/21/04	3 days	Flood	N/A	0	0	25M	4.6M
Irons	7/13/04	<1 day	Tstm Wind	61 mph	0	0	10K	0
Chase	8/02/04	<1 day	Tstm Wind	61 mph	0	0	10K	0
Lake Co. (Zone)	10/30/04	<1 day	High Wind	58-60 mph	0	0	1.15M	0
Lake Co. (Zone)	1/04/05	1 day	Heavy Snow	6-9” snow	0	0	0	0
Lake Co. (Zone)	1/18/05	1 day	Heavy Snow	6-7” snow	0	0	0	0
Lake Co. (Zone)	2/20/05	1 day	Heavy Snow	6-12” snow	0	0	0	0
Lake Co. (Zone)	2/27/50	1 day	Heavy Snow	6-11” snow	0	0	0	0
Baldwin	7/24/05	<1 day	Tstm Wind	61 mph	0	0	25K	0
Baldwin	7/26/05	4 miles	Tornado	EF-1	0	0	150K	50K
Baldwin	7/26/05	<1 day	Tstm Wind	61 mph	0	0	25K	0
Luther	8/18/05	<1 day	Tstm Wind	61 mph	0	0	4K	0
Peacock	9/13/05	<1 day	Tstm Wind	61 mph	0	0	20K	0
Lake Co. (Zone)	1/20/06	1 day	Heavy Snow	6-10” snow	0	0	0	0
Lake Co. (Zone)	2/16/06	1 day	Heavy Snow	6-8” snow	0	0	0	0
Lake Co. (Zone)	12/01/06	1 day	Heavy Snow	6-9” snow	0	0	0	0
Lake Co. (Zone)	12/04/06	1 day	Lake-Effect Snow	6-8” snow	0	0	0	0
Lake Co. (Zone)	12/06/06	1 day	Lake-Effect Snow	8-12” snow	0	0	0	0
Lake Co. (Zone)	2/02/07	2 days	Winter Storm	6” snow	0	0	0	0
Lake Co. (Zone)	2/24/07	2 days	Heavy Snow	10“ snow	0	0	0	0
Lake Co. (Zone)	3/01/07	1 day	Winter Storm	5” snow, .4” ice	0	0	25K	0
Chase	6/20/07	<1 day	Tstm Wind	58 mph	0	0	3K	0
Lake Co. (Zone)	12/01/07	1 day	Winter Storm	7” snow	0	0	0	0
Lake Co. (Zone)	12/28/07	1 day	Heavy Snow	6-8” snow	0	0	0	0
Lake Co. (Zone)	1/10/08	1 day	Winter Storm	6-7” snow	0	0	0	0
Lake Co. (Zone)	2/06/08	1 day	Winter Storm	12” snow	0	0	0	0
Lake Co. (Zone)	2/14/08	1 day	Winter Storm	12” snow	0	0	0	0
Irons	4/25/08	<1 day	Tstm Wind	60 mph	0	0	20K	0
Baldwin Muni. Arpt.	5/17/08	<1 day	Tstm Wind	60 mph	0	0	5K	0
Peacock	6/13/08	6-8 hr.	Flash Flood	5-11” rain	0	0	2M	500K
Idlewild	6/28/08	<1 day	Tstm Wind	60-70 mph	0	0	0	0
Baldwin	7/16/08	<1 day	Hail	1.00”	0	0	0	0
Lake Co. (Zone)	12/08/08	1 day	Winter Storm	10-16” snow	0	0	0	0
Lake Co. (Zone)	12/19/08	1 day	Winter Storm	6-9” snow	0	0	0	0
Lake Co. (Zone)	12/20/08	1 day	Winter Storm	4-8” snow	0	0	0	0
Lake Co. (Zone)	12/28/08	1 day	High Wind	60 mph	0	0	0	0
Lake Co. (Zone)	2/21/09	1 day	Winter Storm	7” snow	0	0	0	0
Lake Co. (Zone)	12/08/09	1 day	Winter Storm	8-10” snow	0	0	0	0
Lake Co. (Zone)	12/24/09	1 day	Winter Weather	.1-.25” ice	0	0	0	0
Lake Co. (Zone)	12/05/10	3 days	Lake-Effect Snow	15” snow	0	0	0	0
Lake Co. (Zone)	12/11/10	1 day	Winter Storm	6-12” snow	0	0	250K	0
Lake Co. (Zone)	1/03/11	1 day	Winter Weather	4.2” snow	0	0	0	0
Lake Co. (Zone)	1/06/11	3 days	Lake-Effect Snow	4-18” snow	0	0	0	0
Lake Co. (Zone)	1/22/11	1 day	Winter Weather	3-6” snow	0	0	0	0

Lake Co. (Zone)	2/01/11	1 day	Winter Storm	6-10” snow	0	0	0	0
Lake Co. (Zone)	2/20/11	1 day	Winter Storm	6-8” snow	0	0	0	0
Lake Co. (Zone)	3/04/11	<1 day	Winter Weather	.1-.125” ice	0	0	0	0
Lake Co. (Zone)	3/22/11	1 day	Winter Storm	6-10” snow	0	0	0	0
Wolf Lake	4/10/11	<1 day	Hail	1.00”	0	0	0	0
Lake Co. (Zone)	6/08/11	<1 day	Tstm Wind	60 mph, .88” hail	0	0	0	0
Nirvana	8/02/11	<1 day	Flash Flood	N/A	0	0	10K	0
Lake Co. (Zone)	1/01/12	2 days	Lake-Effect Snow	8” snow	0	0	0	0
Lake Co. (Zone)	1/12/12	2 days	Winter Storm	6-10” snow	0	0	0	0
Lake Co. (Zone)	3/02/12	1 day	Heavy Snow	6-10” snow	0	0	100K	0
Lake Co. (Zone)	5/03/12	<1 day	Strong Wind	52 mph	0	0	500K	0
Branch	5/03/12	<1 day	Flash Flood	5-7” rain	0	0	70K	0
Baldwin	7/0512	<1 day	Tstm Wind	60 mph	0	0	0	0
Lake Co. (Zone)	12/20/12	2 days	Heavy Snow	10-15” snow	0	0	0	0
Irons	4/17/13	6 days	Flood	70 mph	0	0	3M	0
Lake County	8/07/13	<1 day	Tstm Wind	70 mph	0	0	100K	0
Lake Co. (Zone)	11/17/13	<1 day	High Wind	70 mph	0	0	75K	0

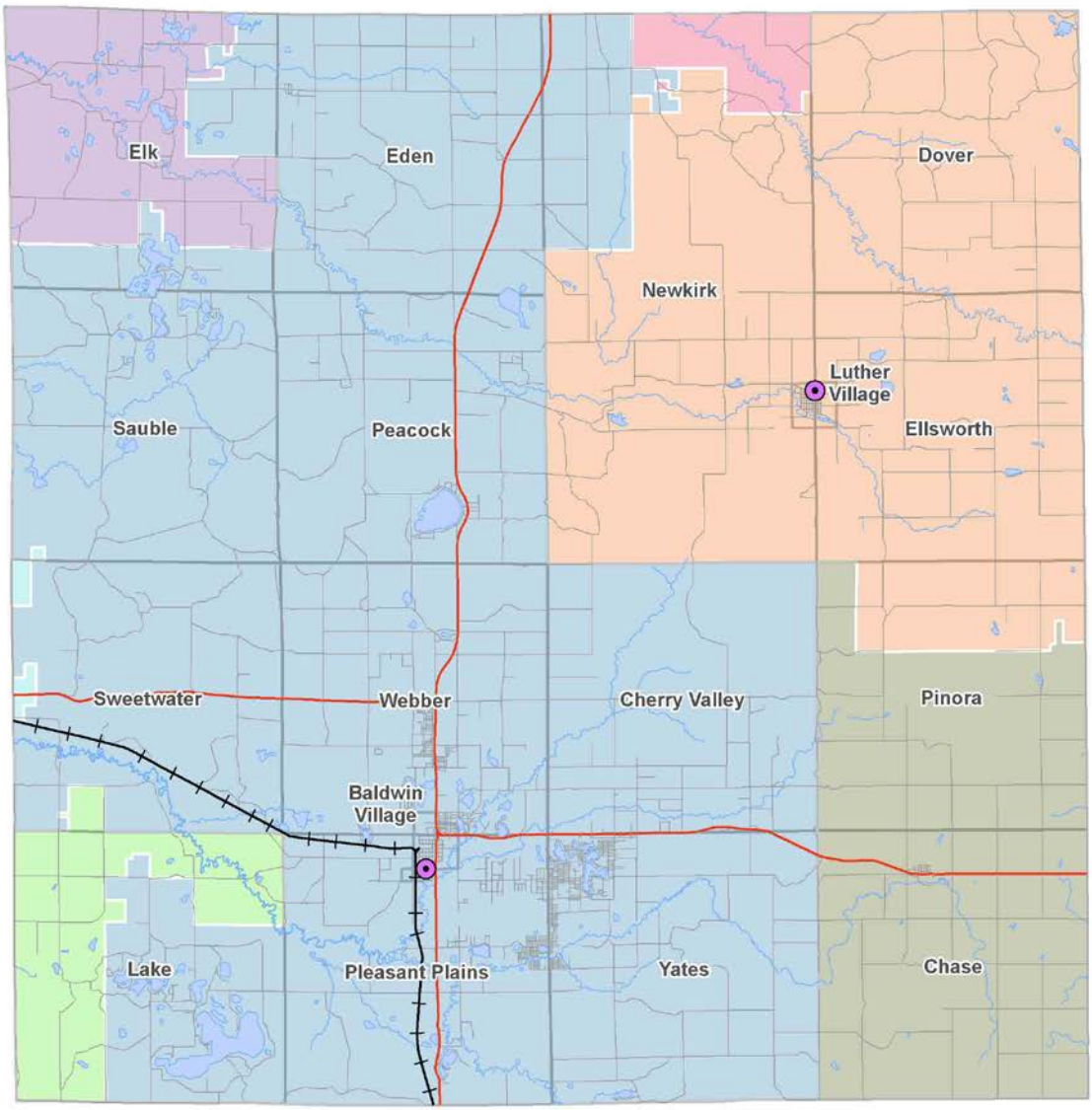
GENERAL SOILS MAP
Lake County



1	RUBICON-MONTCALM-GRAYCALM: Nearly level to steep, somewhat excessively drained and well drained sandy soils on moraines, till plains, and outwash plains
2	GRAYLING-GRAYCALM: Nearly level to moderately steep, excessively drained and somewhat excessively drained sandy soils on outwash plains, till plains, and low moraines
3	KALKASKA: Nearly level to steep, somewhat excessively drained and well drained sandy soils on outwash plains, till plains, and moraines
4	TAWAS-CROSWELL-LUPTON: Nearly level and undulating, very poorly drained and moderately well drained mucky and sandy soils in bogs, depressions, and drainageways and on low flats and bencher
5	EMMET-MONTCALM: Nearly level to steep, well drained loamy and sandy soils on till plains and moraines
6	NESTER-KAWKAWLIN-MANISTEE: Nearly level to steep, well drained and somewhat poorly drained loamy and sandy soils on till plains and moraines

Source: USDA/Mich.Dept.Agr.(issued Aug., 1985)

LAKE COUNTY
School Districts



- School
- Baldwin Community Schools
- Cadillac Area Public Schools
- Kaleva Norman Dickson S/D
- Mason County Central Schools
- Mason County Eastern Schools
- Pine River Area Schools
- Reed City Area Public Schools

WMSRDC
WEST MICHIGAN SHORELINE REGIONAL DEVELOPMENT COMMISSION

Source: Michigan Geographic Data Library V 12b, United States Geological Survey, Lake Co. Hazard Mitigation Update 2014

LAKE COUNTY DAMS

The National Inventory of Dams (NID) identifies 6 dams within Lake County. The NID consists of dams meeting at least one of the following criteria:

1) High hazard classification - loss of one human life is likely if the dam fails;
2) Significant hazard classification - possible loss of human life and likely significant property or environmental destruction;
3) Equal or exceed 25 feet in height and exceed 15 acre-feet in storage;
4) Equal or exceed 50 acre-feet storage and exceed 6 feet in height.

Dam hazard potential classes are defined as:

LOW HAZARD POTENTIAL

Dams assigned the low hazard potential classification are those where failure or misoperation results in no probable loss of human life and low economic and/or environmental losses. Losses are principally limited to the owner's property.

SIGNIFICANT HAZARD POTENTIAL

Dams assigned the significant hazard potential classification are those dams where failure or misoperation results in no probable loss of human life but can cause economic loss, environment damage, disruption of lifeline facilities, or impact other concerns. Significant hazard potential classification dams are often located in predominantly rural or agricultural areas but could be located in areas with population and significant infrastructure.

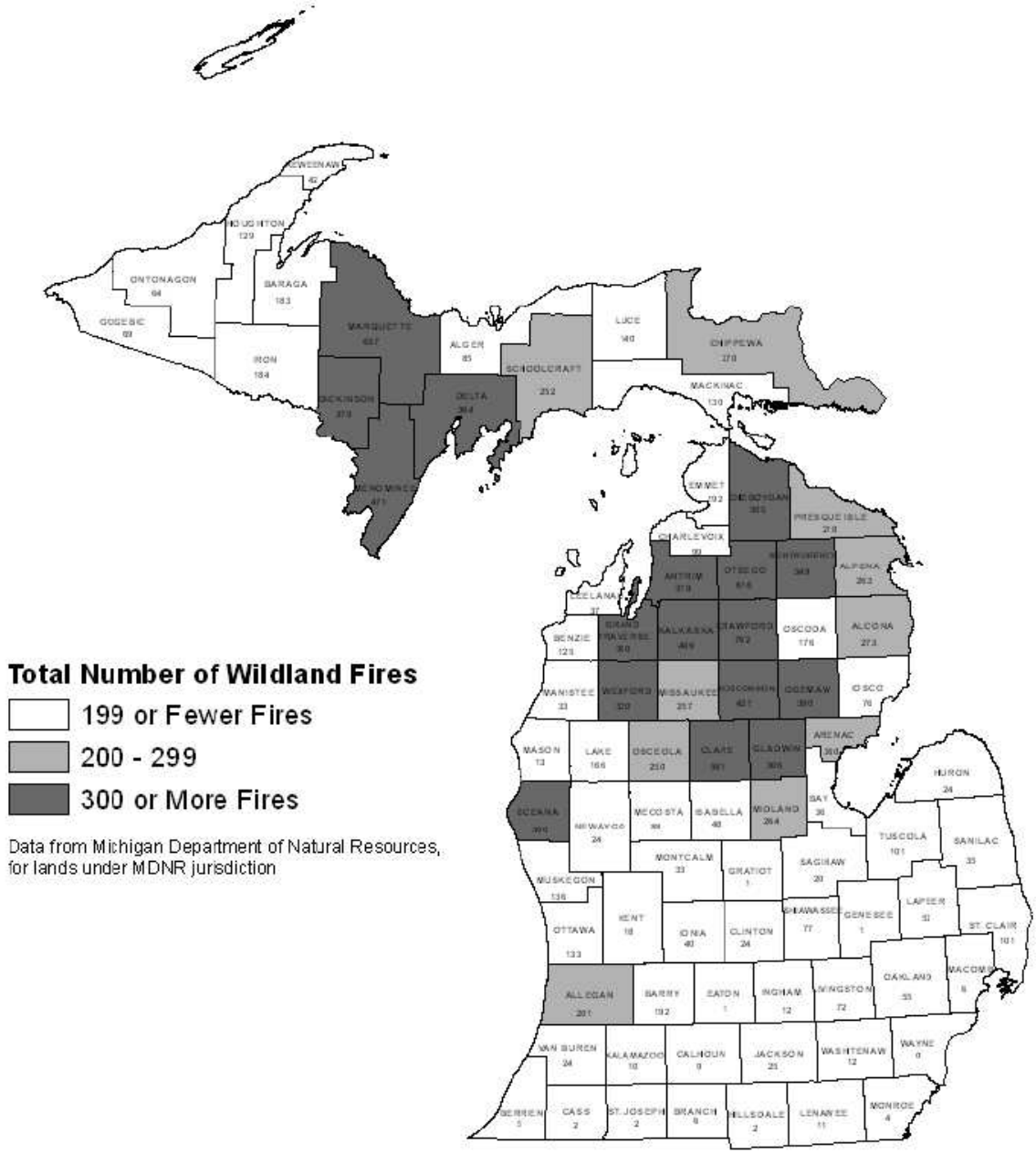
HIGH HAZARD POTENTIAL

Dams assigned the high hazard potential classification are those where failure or misoperation will probably cause loss of human life.

NAME	LOCATION	HAZARD POTENTIAL
Danaher Lake Dam	Pleasant Plains Township	Low
Lake Connamara Dam	Yates Township	
Little Widewaters Flooding Dam	Newkirk Township	
Olga Lake Dam	Dover Township	
Luther Pond Dam	Luther Village	Significant
Baldwin Fish Hatchery	Baldwin Village	
None	N/A	High

Source: National Inventory of Dams, US Army Corps of Engineers, September 26, 2012

Number of Wildland Fires
By County, 1981-2007



Michigan State Police
Emergency Management & Homeland Security Division
December 2010

Number of Wildfires and Acres Burned, by County: 1981-2010 (MDNR jurisdiction only)

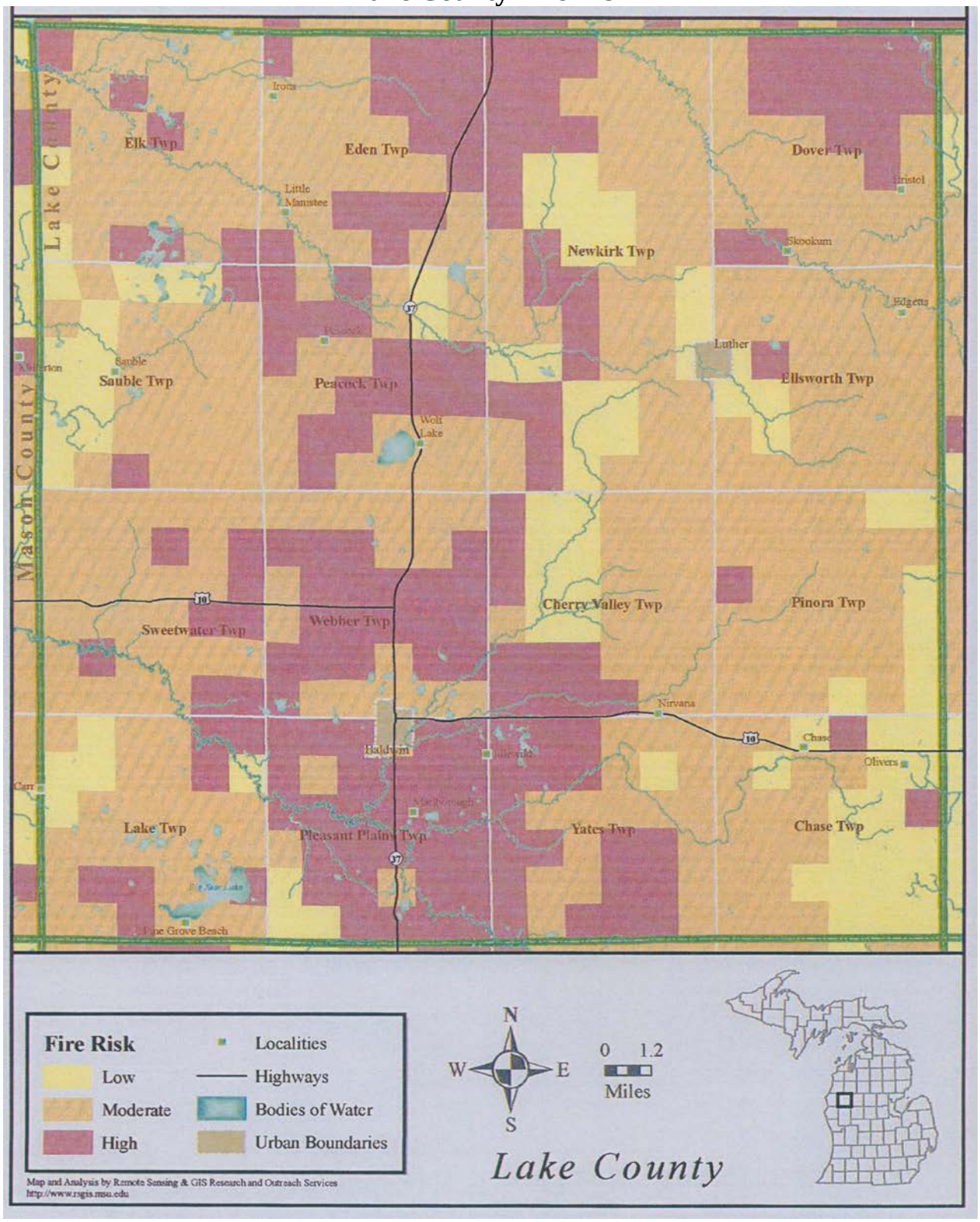
County	Number of Wildfires	Number of Wildfires/Year* (over 30 year period)	Number of Acres Burned	Number of Acres Burned/Year* (over 30 year period)
Alcona	119	4	843.8	28
Alger	41	1	123.0	4
Allegan	72	2	312.0	10
Alpena	156	5	267.2	9
Antrim	194	6	194.1	6
Arenac	127	4	418.8	14
Baraga	57	2	1897.6	63
Barry	99	3	447.3	15
Bay	16	1	142.2	5
Benzie	169	6	279.3	9
Berrien	8	0	24.4	1
Branch	6	0	19.3	1
Calhoun	9	0	41.2	1
Cass	3	0	27.0	1
Charlevoix	151	5	492.3	16
Cheboygan	737	25	1424.0	47
Chippewa	391	13	5108.2	170
Clare	822	27	2385.6	80
Clinton	27	1	138.9	5
Crawford	1142	38	25861.5	862
Delta	551	18	3213.8	107
Dickinson	506	17	2411.0	80
Eaton	3	0	0.3	0
Emmet	317	11	543.5	18
Genesee	1	0	0.1	0
Gladwin	484	16	1938.9	65
Gogebic	116	4	245.4	8
Grand Traverse	386	13	1296.9	43
Gratiot	2	0	40.0	1
Hillsdale	2	0	23.0	1
Houghton	181	6	1200.1	40
Huron	29	1	725.5	24
Ingham	14	0	474.7	16
Ionia	33	1	728.4	24
Iosco	112	4	1630.3	54
Iron	279	9	1953.9	65
Isabella	101	3	931.8	31
Jackson	35	1	520.5	17
Kalamazoo	14	0	74.3	2
Kalkaska	559	19	2953.4	98
Kent	20	1	125.9	4
Keweenaw	59	2	375.6	13
Lake	315	11	1283.5	43
Lapeer	60	2	533.8	18
Leelanau	56	2	212.0	7
Lenawee	16	1	224.2	7
Livingston	79	3	651.4	22
Luce	207	7	18679.9	623
Mackinac	197	7	1610.6	54
Macomb	7	0	15.4	1
Manistee	49	2	1041.6	35
Marquette	835	28	16087.6	536
Mason	32	1	154.6	5
Mecosta	169	6	844.9	28
Menominee	646	22	2353.4	78
Midland	412	14	1414.9	47
Missaukee	344	11	1772.0	59
Monroe	5	0	233.3	8
Montcalm	33	1	567.6	19
Montmorency	555	19	1271.5	42
Muskegon	251	8	2675.7	89
Newaygo	47	2	404.2	13
Oakland	54	2	368.5	12
Oceana	346	12	1766.0	59
Ogemaw	563	19	8296.1	277
Ontonagon	94	3	1438.1	48
Osceola	405	14	1085.2	36
Oscoda	268	9	8765.3	292
Otsego	970	32	1924.9	64
Ottawa	145	5	469.9	16
Presque Isle	330	11	838.4	28
Roscommon	613	20	4551.9	152
Saginaw	20	1	474.7	16
Sanilac	44	1	427.3	14
Schoolcraft	344	11	3210.5	107
Shiawassee	80	3	576.7	19
St. Clair	110	4	1642.8	55
St. Joseph	3	0	7.7	0
Tuscola	121	4	930.9	31
Van Buren	27	1	249.2	8
Washtenaw	17	1	217.5	7
Wayne	2	0	42.2	1
Wexford	428	14	1057.4	35
Total DNR fire events	17449	582	152228.3	5074

*rounded to nearest whole number

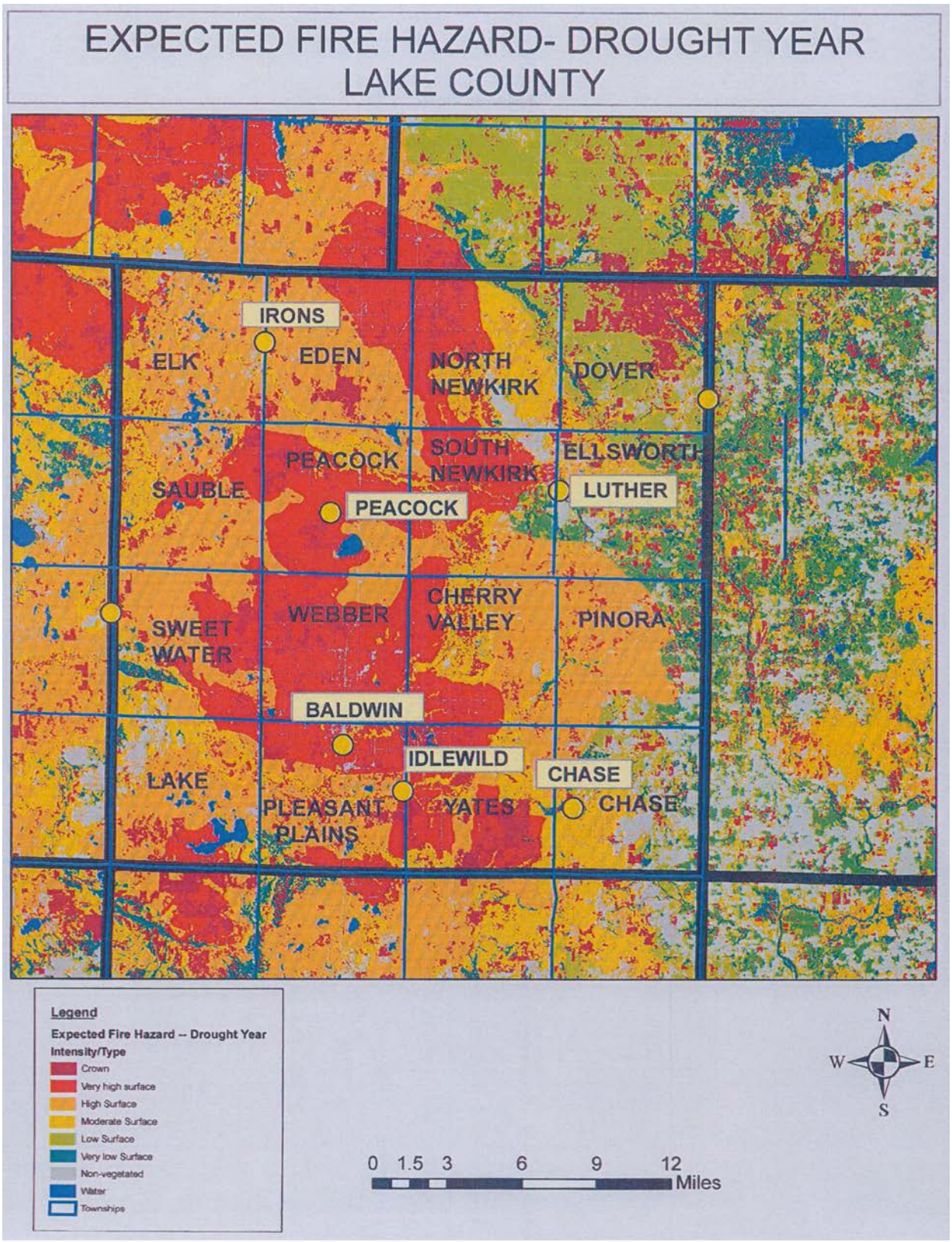
Source: Michigan Department of Natural Resources—Forest Management Division

Source: Michigan Hazard Mitigation Plan, 2011

Lake County Fire Risk

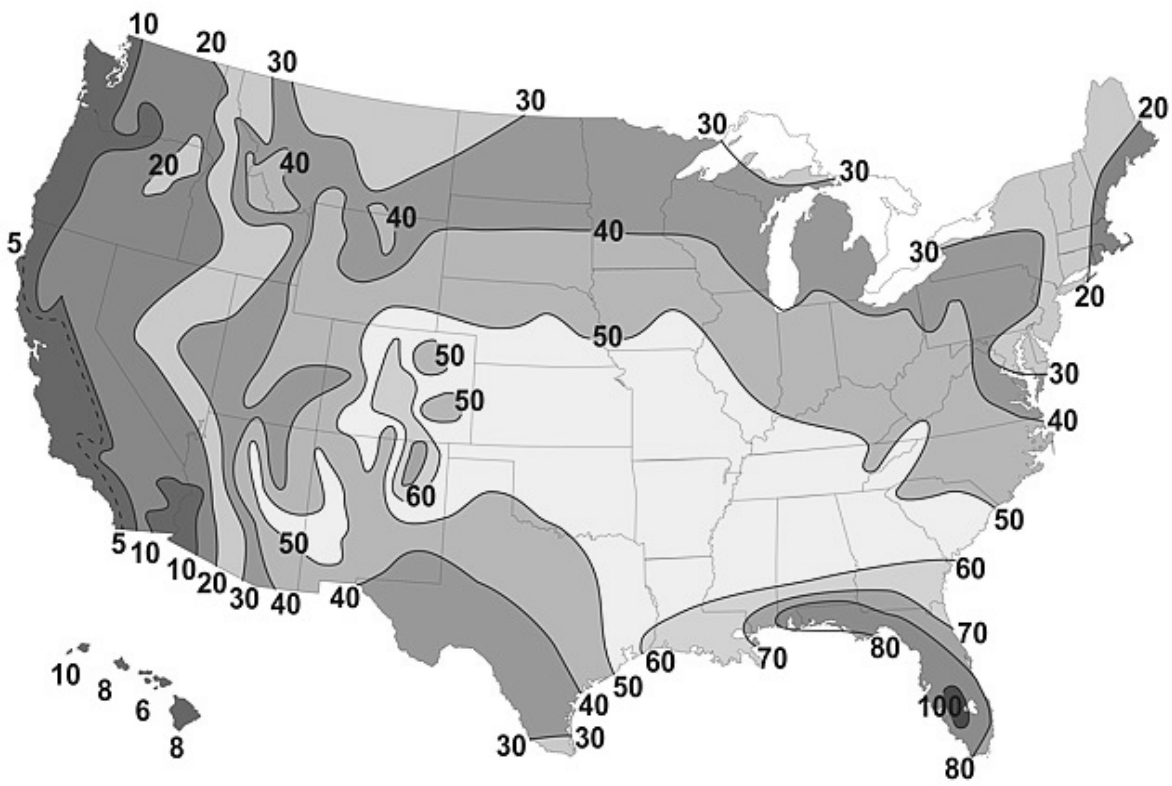


Source: Lake County Community Wildfire Protection Plan, 2011



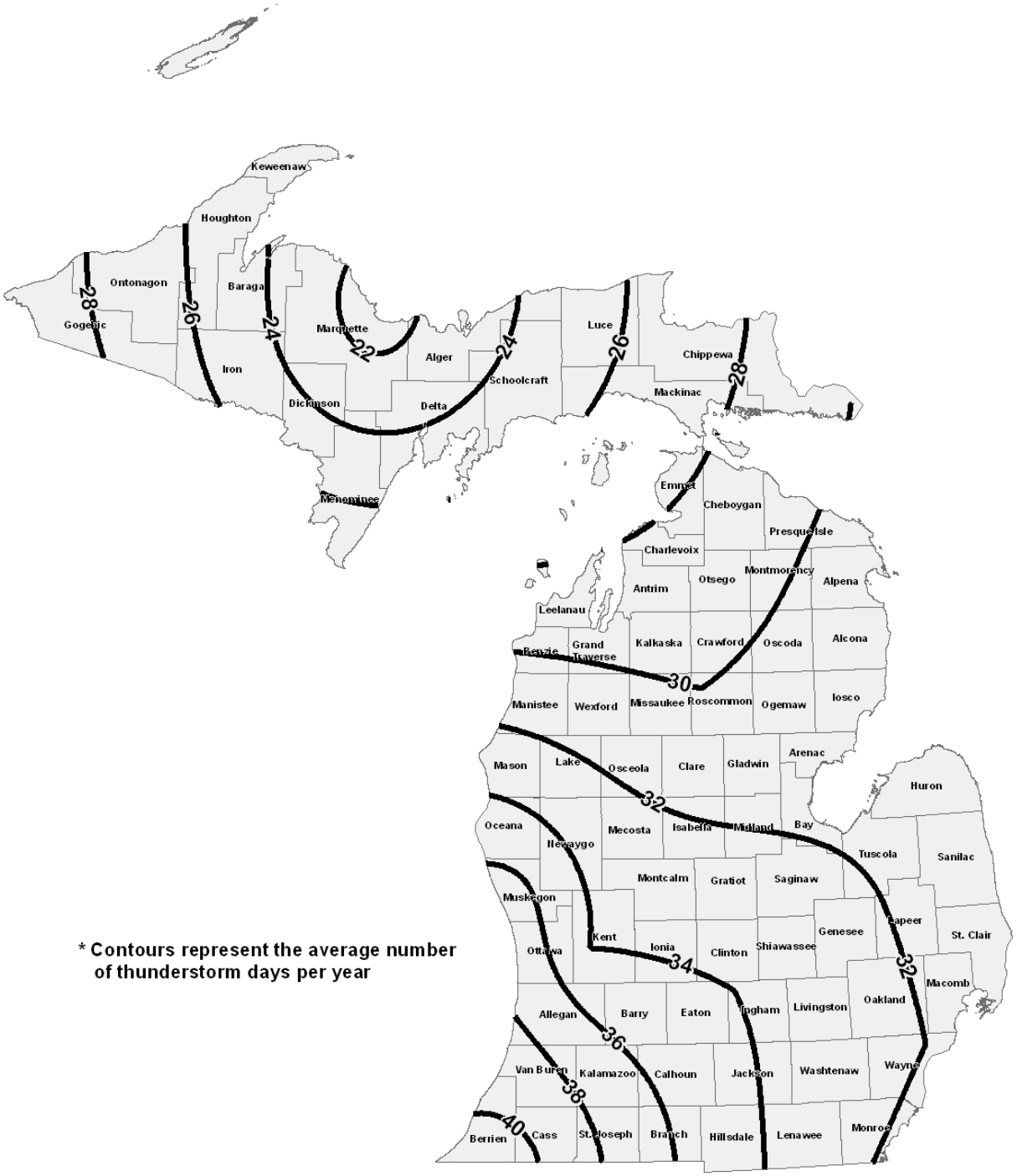
Source: Lake County Community Wildfire Protection Plan, 2011

Average Annual Thunderstorm Days



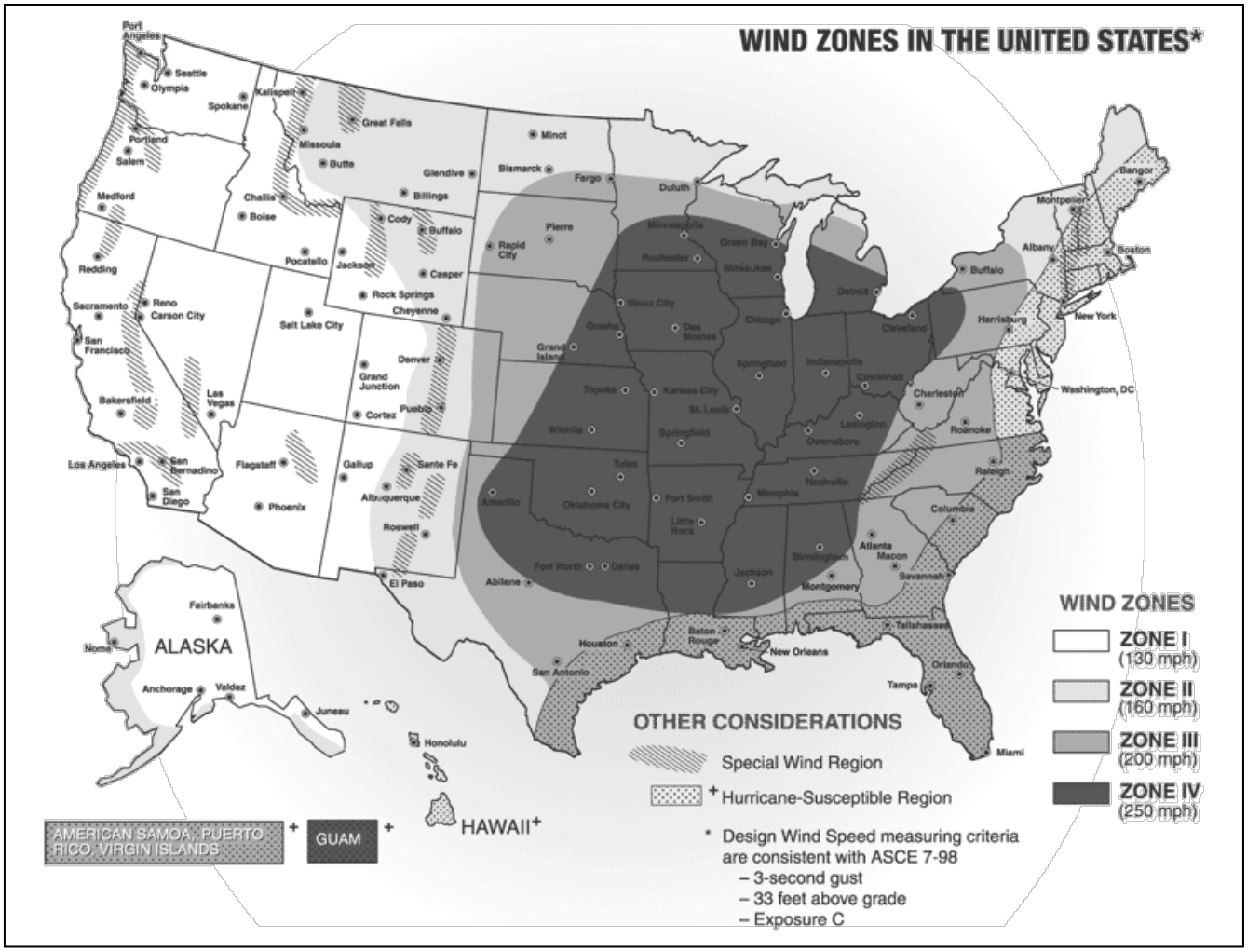
Source: NOAA National Weather Service

Thunderstorm Hazards



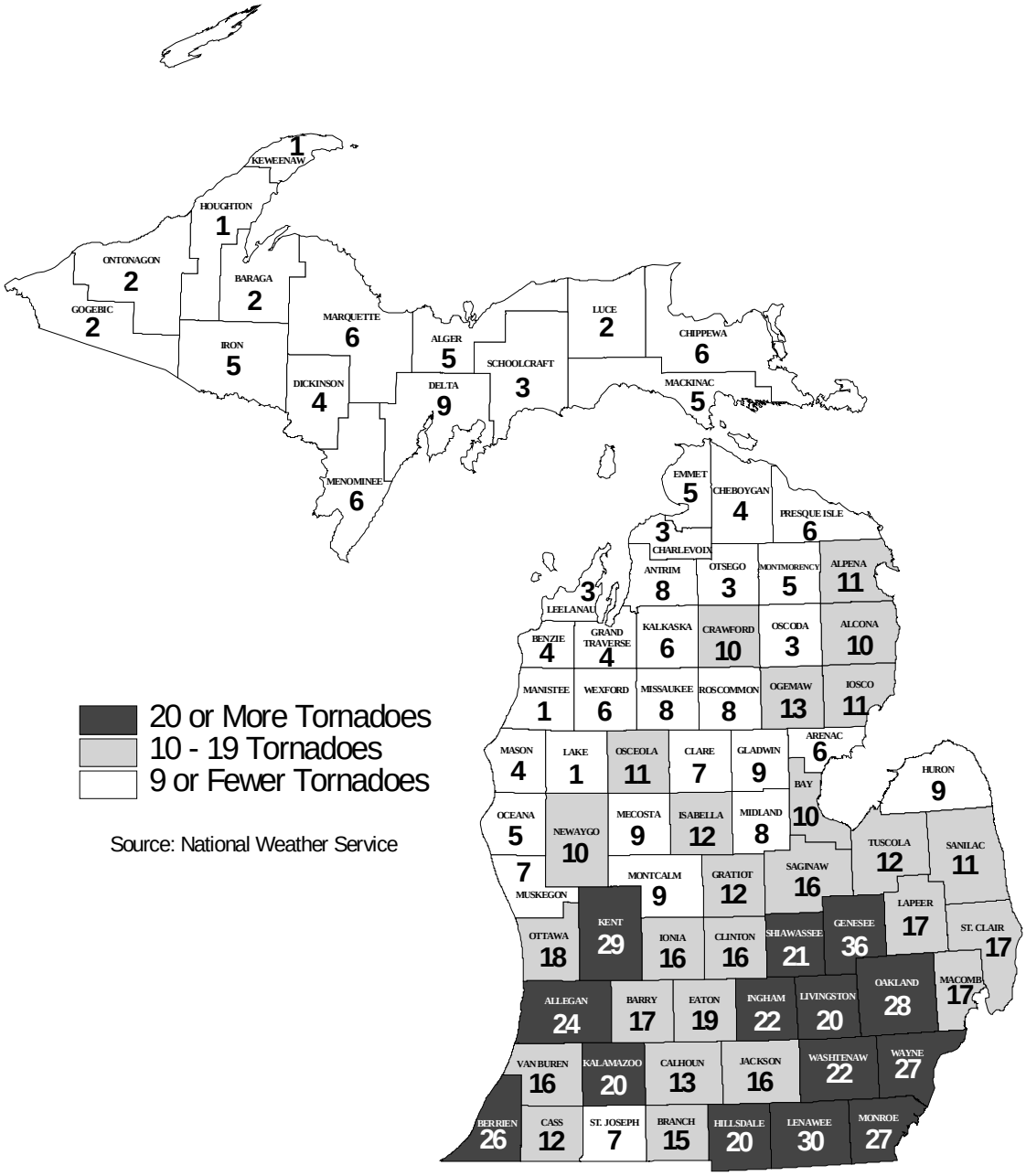
* Contours represent the average number of thunderstorm days per year

Produced by:
Michigan State Police
Emergency Management and Homeland Security Division
January 2011



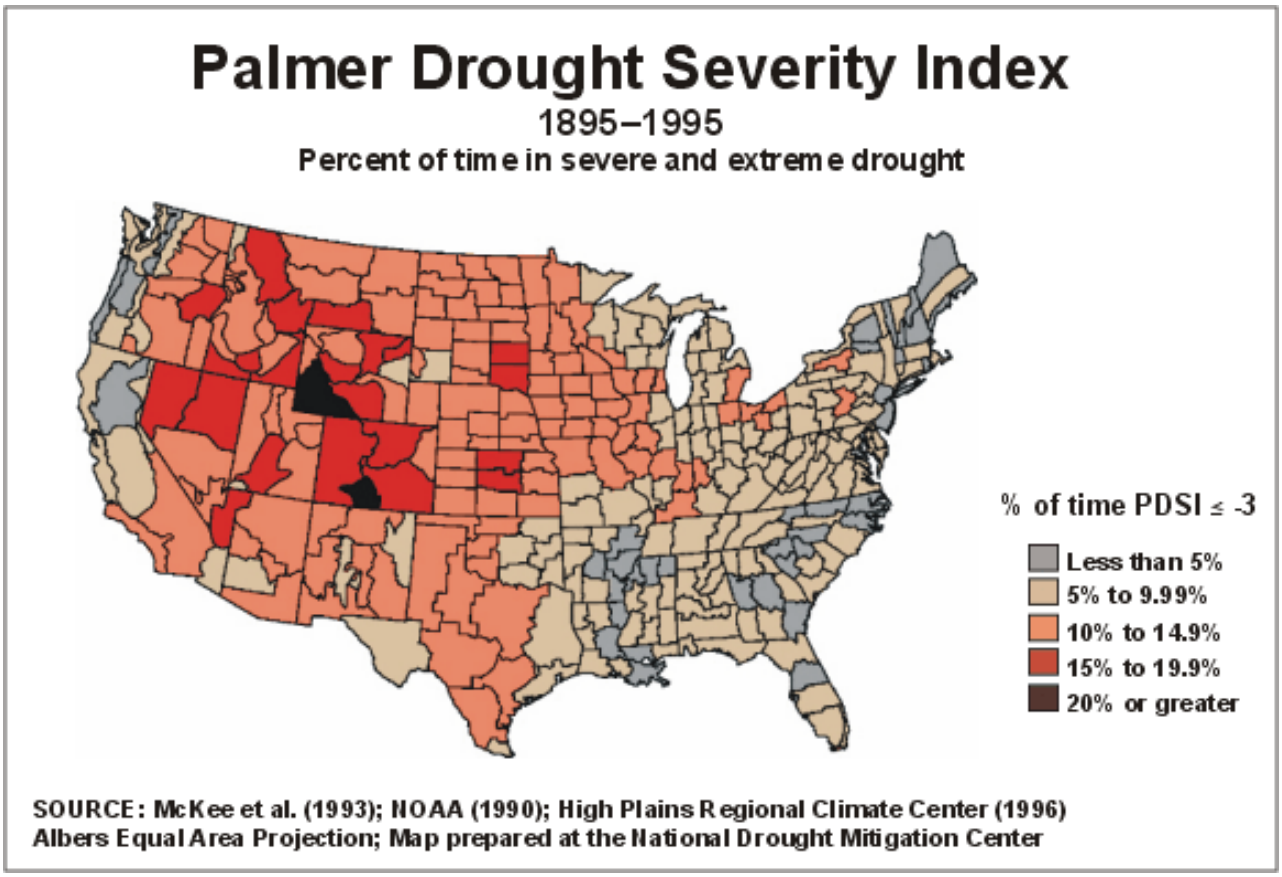
Source: Federal Emergency Management Agency

Number of Tornadoes in Michigan by County, 1950-2001



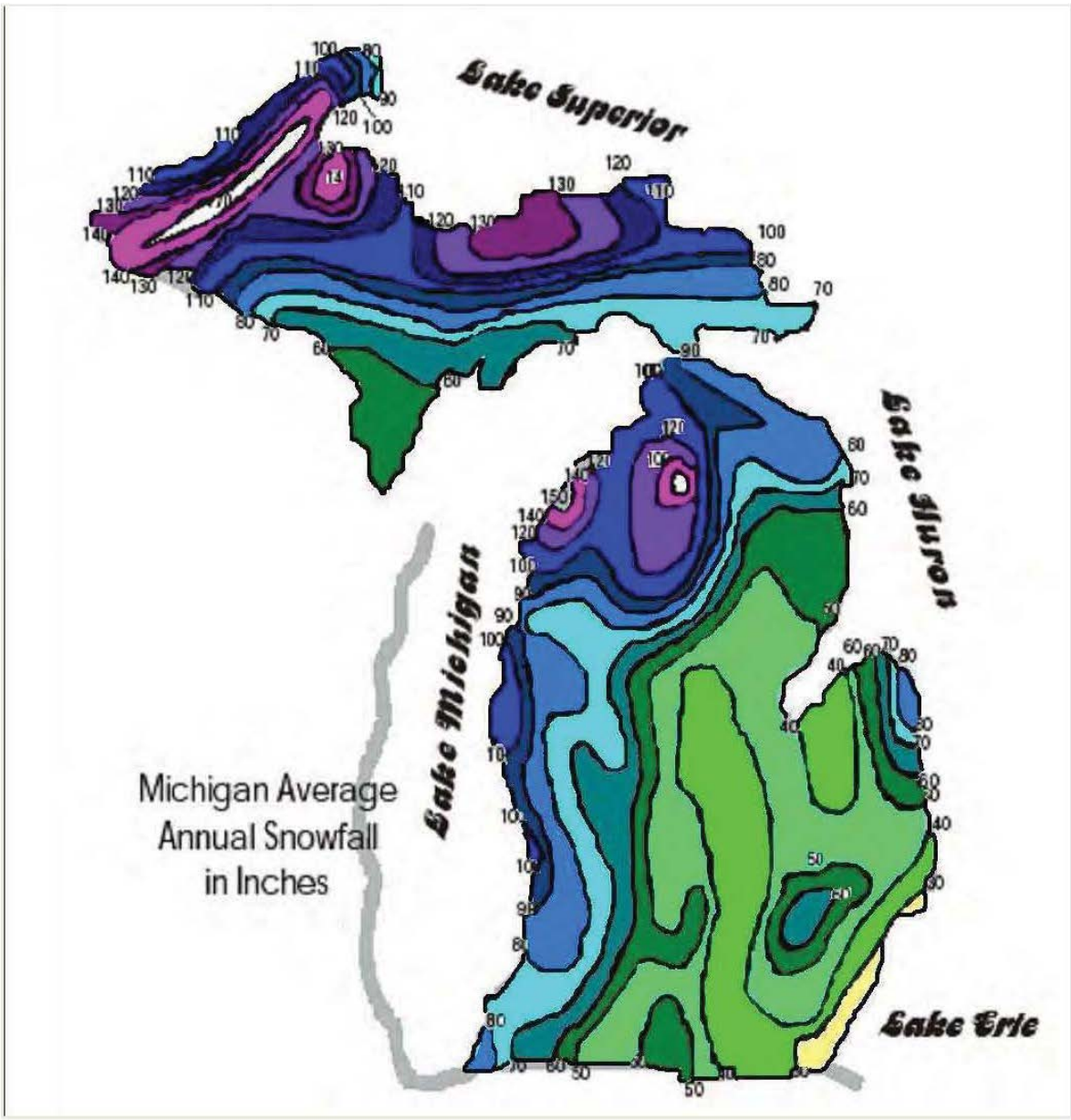
Source: National Weather Service

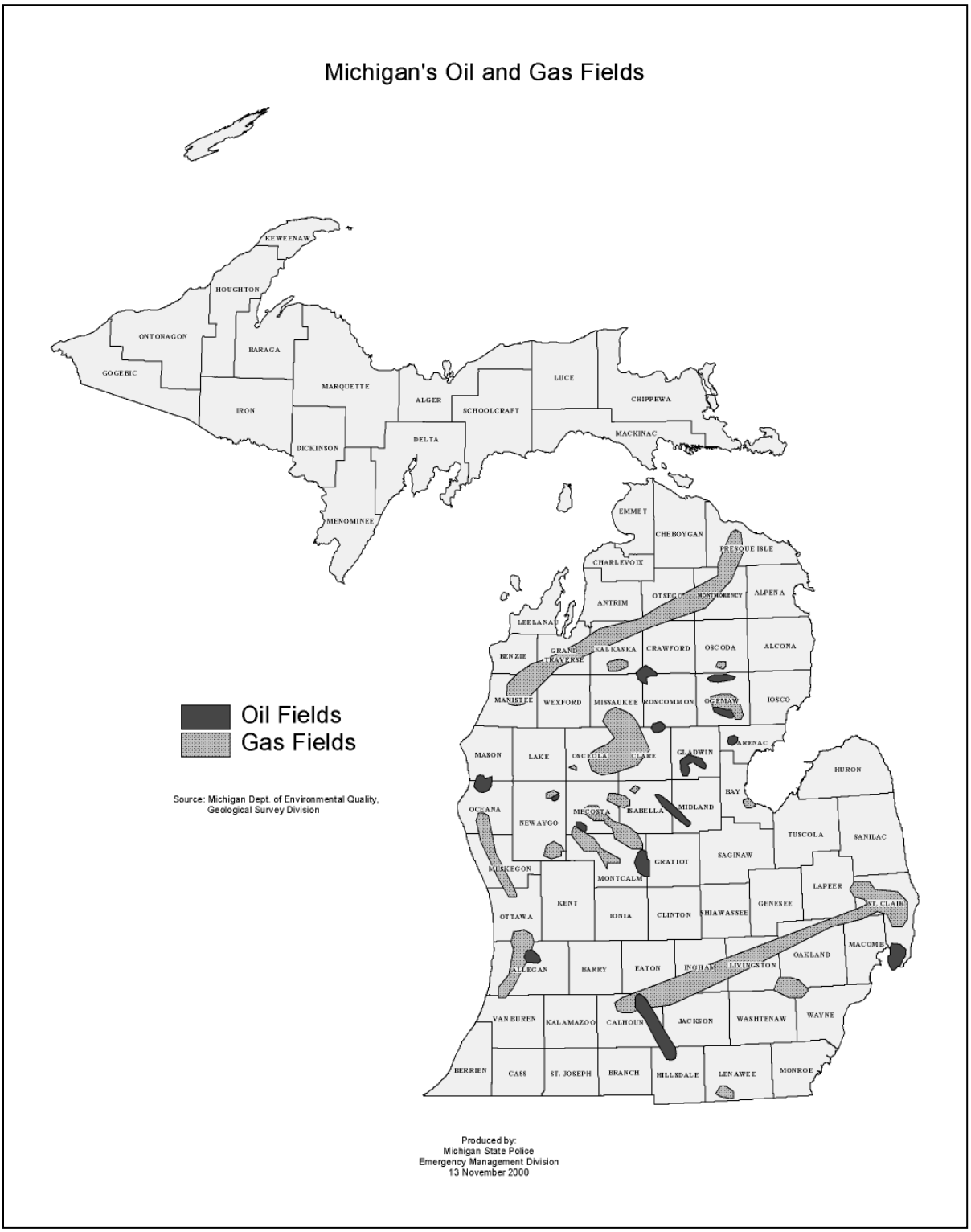
Produced by:
Michigan State Police
Emergency Management Division
12 December 2001


Palmer Drought Severity Index
1895–1995
Percent of time in severe and extreme drought
% of time PDSI ≤ -3
Less than 5%
5% to 9.99%
10% to 14.9%
15% to 19.9%
20% or greater
SOURCE: McKee et al. (1993); NOAA (1990); High Plains Regional Climate Center (1996)
Albers Equal Area Projection; Map prepared at the National Drought Mitigation Center

Michigan Average Annual Snowfall

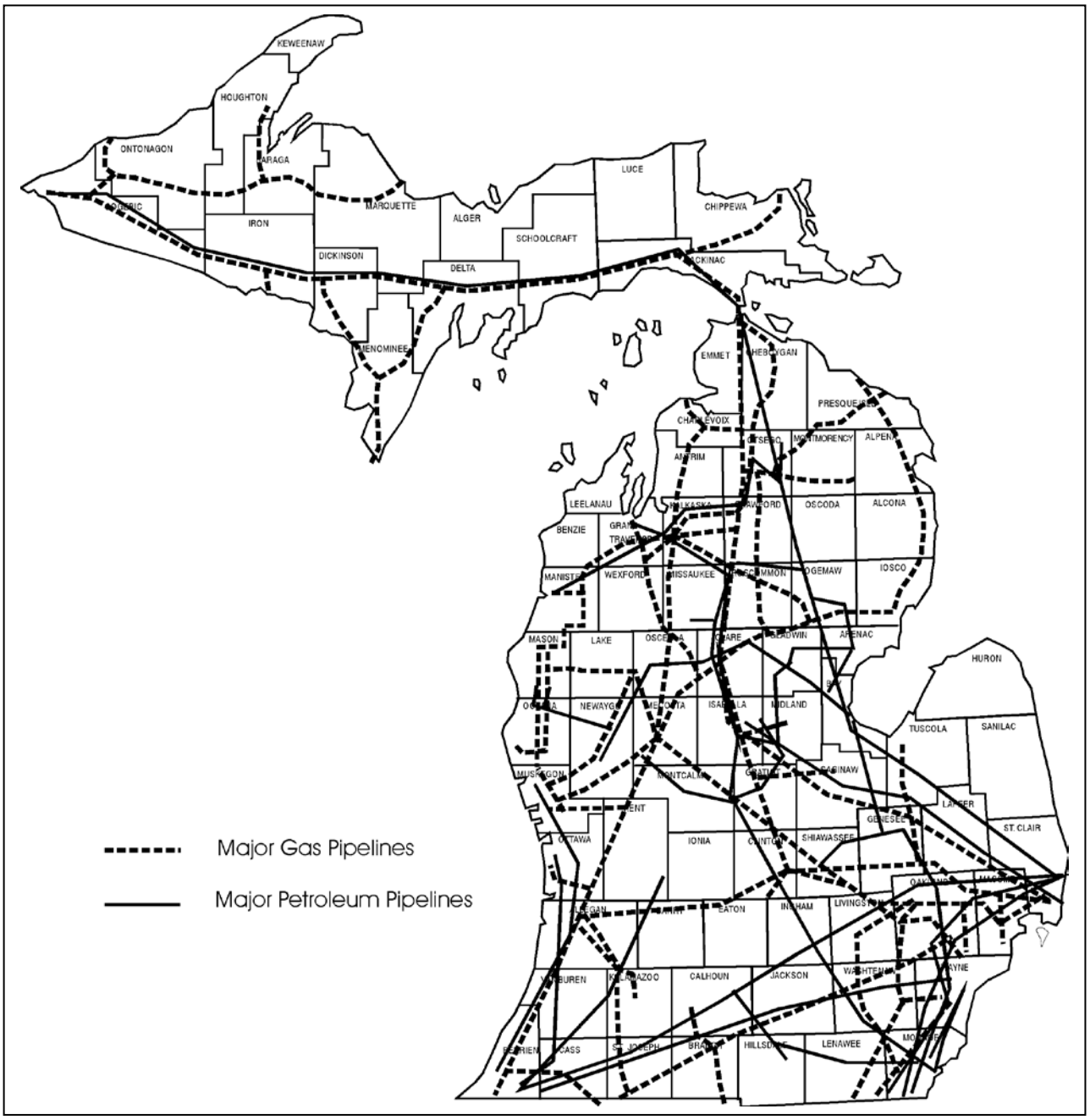
Source: Michigan Committee for Severe Weather Awareness

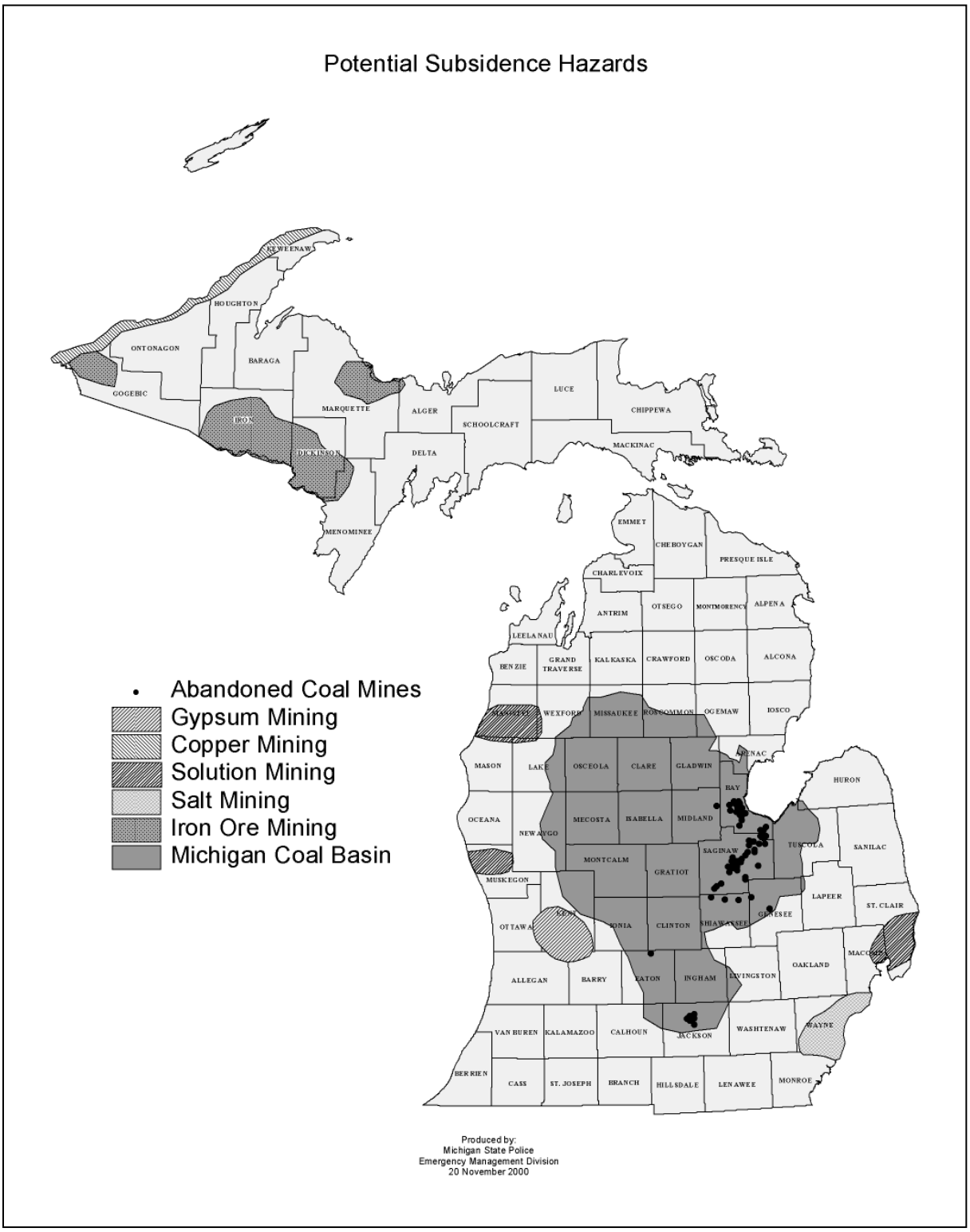



Michigan's Oil and Gas Fields
KEWEENAW
HOUGHTON
ONTONAGON
BARAGA
GOGEBIC
MARQUETTE
ALGER
LUCE
CHIPPEWA
IRON
SCHOOLCRAFT
DICKINSON
DELTA
MACKINAC
MENOMINEE
EMMET
CHEBOYGAN
PRESQUE ISLE
CHARLEVOIX
ANTRIM
OTSEGO
MONTMORENCY
ALPENA
LEELANAU
BENZIE
GRAND TRAVERSE
KALKASKA
CRAWFORD
OSCODA
ALCONA
MANISTEE
WEXFORD
MISSAUKEE
ROSCOMMON
OGEMAW
IOSCO
ARENAC
MASON
LAKE
OSCEOLA
CLARE
GLADWIN
HURON
BAY
OCEANA
NEWAYGO
MECOSTA
ISABELLA
MIDLAND
TUSCOLA
SANILAC
SAGINAW
MUSKEGON
GRATIOT
MONTCALM
LAPEER
KENT
GENESEE
ST. CLAIR
OTTAWA
IONIA
CLINTON
SHIAWASSEE
MACOMB
OAKLAND
ALLEGAN
BARRY
EATON
INGHAM
LIVINGSTON
VAN BUREN
KALAMAZOO
CALHOUN
JACKSON
WASHTENAW
WAYNE
BERRIEN
CASS
ST. JOSEPH
BRANCH
HILLSDALE
LENAWEE
MONROE
Oil Fields
Gas Fields
Source: Michigan Dept. of Environmental Quality, Geological Survey Division
Produced by:
Michigan State Police
Emergency Management Division
13 November 2000

Major Petroleum and Natural Gas Pipelines in Michigan

Source: Michigan Public Service Commission; pipeline company maps




Potential Subsidence Hazards
KEWEENAW
HOUGHTON
ONTONAGON
BARAGA
GOGEBIC
IRON
MARQUETTE
ALGER
SCHOOLCRAFT
LUCE
CHIPPEWA
MACKINAC
DICKINSON
DELTA
MENOMINEE
EMMET
CHEBOYGAN
PRESQUE ISLE
CHARLEVOIX
ANTRIM
OTSEGO
MONTMORENCY
ALPENA
LEELANAU
BENZIE
GRAND TRAVERSE
KALKASKA
CRAWFORD
OSCODA
ALCONA
MANISTEE
WEXFORD
MISSAUKEE
ROSCOMMON
OGEMAW
IOSCO
ALPENA
MASON
LAKE
OSCEOLA
CLARE
GLADWIN
HURON
BAY
OCEANA
NEWAYGO
MECOSTA
ISABELLA
MIDLAND
TUSCOLA
SANILAC
SAGINAW
MONTCALM
GRATIOT
MUSKEGON
LAPEER
ST. CLAIR
KENT
OTTAWA
IONIA
CLINTON
SHIAWASSEE
GENESEE
MACOMB
OAKLAND
ALLEGAN
BARRY
EATON
INGHAM
LIVINGSTON
VAN BUREN
KALAMAZOO
CALHOUN
JACKSON
WASHTENAW
WAYNE
BERRIEN
CASS
ST. JOSEPH
BRANCH
HILLSDALE
LENAWEE
MONROE
Abandoned Coal Mines
Gypsum Mining
Copper Mining
Solution Mining
Salt Mining
Iron Ore Mining
Michigan Coal Basin
Produced by:
Michigan State Police
Emergency Management Division
20 November 2000

Appendix D:

Hazard Mitigation Plan Update Survey

Survey – Cover Letter

February 10, 2012

Dear Interested Person,

The West Michigan Shoreline Regional Development Commission (WMSRDC) is seeking information about various hazards that might eventually affect people, property, or the environment in the area of Lake County.

The WMSRDC is beginning the research that is necessary to help fulfill federal requirements for updating a hazard mitigation plan, and thereby maintain the Lake County Hazard Mitigation Plan. Communities that wish to apply for funding for hazard mitigation projects from the Hazard Mitigation Grant Program are required (by the Federal Emergency Management Agency) to create, or participate in the creation of, an approved local hazard mitigation plan satisfying the requirements of the Disaster Mitigation Act of 2000 and 44 CFR 201.6. If your community intends to adopt the hazard mitigation plan once updated, you are strongly encouraged to participate in this survey.

Please take a moment to consider the enclosed questionnaire, and note any conditions which may bring harm to people or property, or interfere significantly with business or community infrastructure. If you need more room to respond, feel free to use additional sheets of paper. Completed surveys are requested by Monday, March 5, 2012.

A public hearing is scheduled for Thursday, March 8, 2012 to discuss the hazard mitigation project and receive comments and concerns from the public with regards to potential hazards to the community. The hearing will take place during the Lake County LEPC meeting at 11:00 A.M. in the Commission Room of the Lake County Courthouse.

Additional copies of the survey can be obtained at www.wmsrdc.org in the Special Projects section. If you have any questions about the questionnaire or the hazard mitigation project, please contact Stephen Carlson at (231) 722-7878 extension 11, or at scarlson@wmsrdc.org.

Respectfully,

Stephen Carlson
Associate Planner

LAKE COUNTY

Hazard Mitigation Plan Update Survey

PART 1 - Hazard Identification

Provided below is documentation of historical hazard events in Lake County, according to the Hazard Mitigation Plan for Lake County prepared in 2005.

Please take a moment to review the following events and provide additions, changes, and updates to this information.

Thunderstorm Hazards (severe winds, tornadoes, hail, lightning, heavy rain):

- Thunderstorm days per year: 40-50.
- May 31, 1998: Severe t-storm winds. Local state of emergency declaration and $1.1m property damage, Lake Co.
- May 8, 2000: 1 inch Hail. $20k property damage, Village of Baldwin.
- June 1, 2000: Severe thunderstorm winds. $25k property damage, Lake County.
- July 13, 2000: Severe thunderstorm winds. $25k property damage, Lake County.
- August 9, 2000: 1.75 inch hail. $50k property damage, $25k crop damage, Village of Luther.
- May 23, 2001: .75 inch hail. $10k property damage, $10k crop damage, Village of Baldwin.
- August 9, 2001: Severe thunderstorm winds. $25k property damage, Lake County.
- August 30, 2001: Severe thunderstorm winds. $100k property damage, Pleasant Plains and Yates Townships.
- June 8, 2003: .75 inch hail. $20k property damage and $20k crop damage, Pleasant Plains Township.

Severe Winter Weather (ice, sleet, snow storms):

- January 26, 1978: Blizzard, snowstorm. Declaration of statewide emergency by President, disaster by Governor.
- January 12, 1993: Heavy snow. $50k property damage, northern Lower Michigan.
- January 12-21, 1994: Heavy lake effect snow. $500k property damage across western Lower Michigan.
- January 27, 1994: Heavy snow and freezing rain. $5m property damage across region.
- March 9, 1998: Winter storm. $100k property damage across region.
- April 3, 2003, Ice storm. $4.9m property damage throughout West Michigan.

Floods (shoreline, riverine, urban):

- September 10-19, 1986: Flooding. Declaration of disaster by Governor, Declaration of major disaster by President.
- August 6, 1998: Flash flood. $10k property damage, Northwest Lake County.
- February 10, 2001: Flooding. $100k property damage across western Michigan.
- May 21-23, 2004: Flooding. $25m property damage, $4.6m crop damage across western Lower Michigan.

Extreme Temperatures:

- July 1936: Heatwave. 570 deaths statewide, 364 in Detroit.
- January 20, 1994: Record cold. $50m property damage across Michigan.
- Summer, 1988: 39 days with temperatures over 90 degrees, statewide.

Drought:

- Summer 1871: Prolonged drought over much of the Great Lakes regions.
- May-September, 1891: Drought devastated Michigan's lumber industry.
- Statewide: 1930-1937, 1960-1967, 1976-1980, 1986-1989.
- 1939-1942: Widespread crop failures, Lower Peninsula.

Wildfires:

- October 1871: Wildfires. 1.2m acres burned, 200 fatalities, Lower Peninsula.
- May-September, 1891: Uncontrollable wildfires across Michigan during the drought of 1891.
- 1994: "County Line Fire." 900 acres burned, Pleasant Plains Township.
- 1981-2000: Approximately 8 wildfires and 38 acres burned per year on county lands under MDNR jurisdiction (153 total wildfires, 769 total acres burned).

Structural and Scrap Tire Fires (including explosions, industrial accidents):

- County fire rate per 1,000 population in 1998: 3.09

Dam Failures:

- September 1986: Floods triggered dam failures at Baldwin's Rearing Pond, Danaher Lake, and Luther Mill Pond.

Infrastructure Failure (storm/sanitary sewers, water, electrical, and communications systems):

- April 6-7, 1997: 180,000-200,000 without power; 70,000 on second day, statewide. High wind.
- March 9, 1998: 1,900 power outages in Lake, Clare, Oceana and Muskegon Counties. Blizzard conditions.
- February 11, 1999: Baldwin. Power outages and downed power lines. Thunderstorm winds.
- July 13, 2000: Sweetwater Township. Downed power lines. Thunderstorm winds.
- August 9, 2001: Baldwin. Power outages, downed power lines and downed trees. Thunderstorm winds.
- August 30, 2001: Southern Lake County. Downed power lines and downed trees. Thunderstorm winds.
- April 3, 2003: Hundreds of thousands lose power in Lower Michigan. Ice storm.

Oil and Gas Well/Pipeline Accidents:

- 242 oil and gas wells within Lake County.
- June 23, 1999: Broken gas main. Nearby residences evacuated, Pleasant Plains Township.

Other Hazard Events:

- Earthquake
- Land Subsidence
- Hazard Material Incidents (fixed site and transportation related, nuclear material)
- Transportation Accidents
- Public Health Emergencies
- Civil Disturbances (riots, prison uprisings, etc.)
- Nuclear Attack/Civil Defense Emergency
- Weapons of Mass Destruction/Terrorism/Sabotage
- Any other vulnerabilities

Comments:

PART 2 – Hazard Ranking

Provided below is a prioritized list of hazards in Lake County, according to the Hazard Mitigation Plan for Lake County. Priorities were determined through a ranking system that scored the impact of each hazard in the following areas: Likelihood of Occurrence; Percent of Population Affected; Potential for Causing Casualties; Potential for Negative Effects; Corollary Effects; and Public Awareness of Hazard.

Please take a moment to consider these hazards and prioritize them, with #1 being the most important.

Priority	Hazard	Score (out of 10 possible points)	Your Priority
1st	Snow/Ice/Sleet Storms	7.85	
2nd	Infrastructure Failures	6.6	
3rd	Fire Hazards: Wildfire	6.55	
4th	Severe Winds	6.5	
5th	Fire Hazards: Structural	6.2	
6th	Extreme Temperatures	5.5	
7th	Lightning/Heavy Rain	5.2	
8th	Drought	4.85	
9th	Tornadoes	4.6	
10th	Dam Failures	4.35	
11th	Hail	4.2	
12th	Flooding: Riverine/Urban	3.95	
13th	Public Health Emergencies	3.8	
14th	Pipeline Accident	3.1	
15th	HAZMAT: Transportation	2.45	
16th	Transportation Accident	2.45	
17th	Fire Hazards: Scrap Tires	1.75	
18th	Oil/Gas Well Accident	1.4	
19th	Civil Disturbances	1.15	
20th	Land Subsidence	1	

PART 3 – Contact Information

Name _____ Date _____

Organization _____ Title _____

Email _____

Please remit survey to:	WMSRDC attention: Stephen Carlson PO Box 387 Muskegon, MI 49443-0387	OR	email: scarlson@wmsrdc.org fax: 231-722-9362

3

Summary of Survey Results

Part 1 – Hazard Identification

- 14" snow on March 1-2, 2012 caused power outages and led to shelter activations.
- May 9, 2011: Wilfire. "8th Street fire" burned 153 acres in southern Newkirk Township.

Part 2 – Hazard Ranking

Survey Responses

Hazard Mitigation Plan	Hazard	USDA Forest Service	MDNR - Fire	W. MI Community Mental Health	Newkirk Township	District Health Department #10	Peacock Township	Lake Co Emergency Management	SUBTTOAL	Average Survey Rating	Survey Average - Rank
1	Snow/Ice/Sleet Storms	1	1	1	1	1	1	1	7	1.0	1
2	Infrastructure Failure	9	2	2	2	2	2	2	21	3.0	3
3	Fire Hazards: Wildfire	2	3	3	3	3	3	3	20	2.9	2
4	Severe Winds	4	4	4	4	4	4	4	28	4.0	4
5	Fire Hazards: Structural	5	5	5	5	5	5	5	35	5.0	5
6	Extreme Temperatures	7	6	6	6	6	6	6	43	6.1	6
7	Lightning/Heavy Rain	3	7	7	7	7	7	7	45	6.4	7
8	Drought	6	8	8	8	8	8	8	54	7.7	8
9	Tornadoes	8	9	9	9	9	9	9	62	8.9	9
10	Dam Failures	10	10	10	10	10	10	10	70	10.0	10
11	Hail	11	11	11	11	11	11	11	77	11.0	11
12	Flooding: Rivering/Urban	12	12	12	12	12	12	12	84	12.0	12
13	Public Health Emergencies	13	13	13	13	13	13	13	91	13.0	13
14	Pipeline Accident	14	14	14	14	14	14	14	98	14.0	14
15	HAZMAT: Transportation	15	15	15	15	15	15	15	105	15.0	15
16	Transportation Accident	16	16	16	16	16	16	16	112	16.0	16
17	Fire Hazards: Scrap Tires	17	17	17	17	17	17	17	119	17.0	17
18	Oil/Gas Well Accident	18	18	18	18	18	18	18	126	18.0	18
19	Civil Disturbances	19	19	19	19	19	19	19	133	19.0	19
20	Land Subsidence	20	20	20	20	20	20	20	140	20.0	10

Appendix E:

Acknowledgments & Documentation

Lake County LEPC
2013 MEMBERSHIP ROSTER

LEPC OFFICER / MEMBER RECORD

YEAR 2013

LEPC NAME: Lake County

Complete the following information for the Chairperson, Information Coordinator, and Emergency Management Coordinator. if there's no change from the previous submission, please write "NO CHANGE" on the "Name" line.

CHAIRPERSON:
Name: No Change
Mailing Address:
City: State: Michigan Zip Code:
Phone Number:
E-Mail Address:

INFORMATION COORDINATOR:
Name: Chris Roy
Mailing Address: 1153 Mick Ave
City: Baldwin State: Michigan Zip Code:
Phone Number: 231 745 6201
E-Mail Address: jk4862@gmail.com

EMERGENCY MANAGEMENT COORDINATOR: *(AKA – Community Emergency Coordinator)*
Name: Michael Applewhite
Mailing Address: 800 E 10th st
City: Baldwin State: Michigan Zip Code: 49304
Phone Number: 231 745 2705
E-Mail Address: mapplewhite@co.lake.mi.us

MEMBER'S NAME	ADD (check box)	DELETE (check box)	CURRENT (check box)	GROUP REPRESENTED
Chris Roy	☐	☐	☒	Emergency Mgt.
Don Arquette	☐	☐	☒	Health Org.
Jim McCormick	☐	☐	☒	Health Org
Bret Haner	☐	☐	☒	Health Org
Mark Russo	☐	☐	☒	Law Enforcement
Lori Dewolf	☐	☐	☒	Emergency Mgt.
Susie Tripp	☐	☐	☒	Health Org
Lamont Johnson	☐	☐	☒	Transport
Mac McClellan	☐	☐	☒	Airport Mgr.
Shelly Myers	☐	☐	☒	Elected Official
Karen Ripke	☐	☐	☒	
Jeff Stockhill	☐	☐	☒	EMS

LEPC OFFICER / MEMBER RECORD Lake County **PAGE 2**

MEMBER'S NAME	ADD (check box)	DELETE (check box)	CURRENT (check box)	GROUP REPRESENTED
David Fowler	☐	☐	☒	Communition
Michael Applewhite	☐	☐	☒	Emergency Mgt.
Gus Motzer	☐	☒	☐	
Betty Dermyer	☐	☒	☐	
Mike Dermyer	☐	☒	☐	
Ken Wenzel	☐	☒	☐	
Larry Collier	☐	☒	☐	
Linda Shively	☐	☒	☐	
Kevin Thiel	☒	☐	☐	Fire Dept
Dwayne Dewyer	☒	☐	☐	Red Cross
Richard Perrin	☒	☐	☐	Law Enforcement
David Sanders	☒	☐	☐	Communition
Mike Curtis	☒	☐	☐	Fire Dept
Russ Kolski	☒	☐	☐	Health Dept
Marc Sales	☒	☐	☐	Health Dept
Dan Sloan	☒	☐	☐	Elected Off
Barb Stenger	☒	☐	☐	Elected Off
		☐	☐	
	☐	☐	☐	
	☐	☐	☐	
	☐	☐	☐	
	☐	☐	☐	
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	☐	☐	☐	
	☐	☐	☐	

(Please use additional forms as needed for members' names)

SUBMITTED BY: Chris Roy
TITLE: Lake Co LEPC Chair **DATE:** 1·29·13

Form available at: www.michigan.gov/emhsd

Lake County Hazard Mitigation Plan Update
2012 ADVISORY COMMITTEE

Mac McClellan
Emergency Management
mmcclellan@co.lake.mi.us

Michael Applewhite
Emergency Management
mapplewhite@co.lake.mi.us

Don Arquette
Department of Human Services
Doncooks2@hotmail.com

Russ Kolski
Family Health Care
Rkolski@familyhealthcare.org

Bret Haner
Dist. #10 Health Dept.
bhaner@dhd10.org

Mike Curtis
GEO Group
mcurtis@geogroup.com

Lamont Johnson
Yates Dial a Ride
Lamontjohnson_dart@yahoo.com

Brian Kessel
Lake Co Road Commission – Forman
roads@lcrc-roads.com

Jeannie Hall
Equalization
Jhall@co.lake.mi.us

Debbie Russell
Equalization – Mapping
drussell@co.lake.mi.us

Dave Fowler
911 – Director
dfowler@co.lake.mi.us

MEETINGS

Meetings attended by WMSRDC staff for the purpose of updating the Lake County Hazard Mitigation Plan; including lists of attendees and synopses of relevant comments and discussion.

December 8, 2011: Lake County LEPC Meeting

Attendees:

(Record unavailable)

Synopsis:

Introduction of Hazard Mitigation planning and a presentation of the anticipated planning process. Also discussed establishment of the Hazard Mitigation Advisory Team.

March 8, 2012: Lake County LEPC Meeting and Hazard Mitigation Public Hearing

Attendees:

Chris Roy	LEPC Chairperson	Emergency Management
Don Arquette	LEPC Vice Chairperson	Health Organization
Larry Collier	County Commissioner	Elected Official
Mike Curtis	GEO	Fire Department
Josh Lewis		
Russ Kolski	Baldwin Family Health Care	Health Department
Michael Applewhite	Lake County EM	Emergency Management
Rick Perrin	Sheriff's Dept	Law Enforcement
Mike Dermyer	Sheriff's Dept	Law Enforcement
Mac McClellan	Lake County EM	Emergency Management
Dave Fowler		Communication
Bruce Tower	Michigan DNR Forestry	
Lori DeWolf	Lake County	Emergency Management
Bret Haner	Health Dept. #10	Health Organization
Stephen Carlson	WMSRDC	(Guest)

Synopsis:

Public meeting to discuss hazard mitigation at the beginning of the planning process. It was noticed in the Lake County Star, discussed in the WMSRDC electronic newsletter, and announced in the February 2012 survey mailing. The meeting featured a presentation about the hazard mitigation planning process, and the public was invited to comment upon and discuss the survey that was distributed to 110 community individuals, and made available on the WMSRDC website.

The regular LEPC meeting included discussion of a recent snowstorm that led to the opening of the Emergency Shelter.

December 13, 2012: Lake County LEPC Meeting

Attendees:

(Record unavailable)

Synopsis:

An update was given regarding the status of th e Hazard Mitigation Plan Update. Discussed the medical resources (or lack thereof) in Lake County. Discussed the use of wildfire as a tool of terrorism. It was also mentioned that the NOAA tower at Wolf Lake may have been installed with assistance of Hazard Mitigation funds.

September 12, 2013: Lake County LEPC Meeting

Attendees:

Chris Roy	LEPC Chairperson	Emergency Management
Don Arquette	LEPC Vice Chairperson	Health Organization
Barb Stenger	County Commissioner	Elected Official
Russ Kolski	Baldwin Family Health Care	Health Department
Michael Applewhite	Lake County EM	Emergency Management
David Sanders	Lake County Central Dispatch	Communication
Bret Haner	Health Dept. #10	Health Organization
Dennis Robinson	Undersherrif	Law Enforcement
Stephen Carlson	WMSRDC	(Guest)
Joshua Croff	WMSRDC	(Guest)

Synopsis:

Discussed the Critical Facilities map, as well as the revised rating/ranking system for hazards in Lake County. Other items discussed at the meeting: There is a residential re-entry correctional facility in Baldwin; “Dam failure” at Syers Lake was likely the result of a culvert failure; Luther Elementary has been closed.

October 23, 2013: Water, Woods & Wetlands Regional Forum

Attendees:

ALISA	GONZALES-PENNINGTON	DEQ CZM	OFFICE OF GREAT LAKES-CZM
GARY	WILSON	Great Lks environmental	CHICAGO COMMENTATOR, GREAT LAKES ECHO
MATTHEW	CHILD	International JC	IJC - GREAT LAKES REGIONAL OFFICE
ANNA	KORNOELJE	Kzoo environmental	KALAMAZOO NATURE CENTER
STEPHANIE	SWART	MDEQ	MDEQ OFFICE OF THE GREAT LAKES
ROBERT	SWEET	MDEQ	MDEQ NON POINT SOURCE PROGRAM
JON	ALLAN	MDEQ	DIRECTOR, MICHIGAN OFFICE OF THE GREAT LAKES
SUZANNE	DIXON	MDNR	LEAGUE OF WOMEN VOTERS-DIRECTOR-DNR
SHAUN	HOWARD	MI environmental	NATURE CONSERVANCY IN MICHIGAN
JEAN	WEIRICH	MI environmental	WILDFLOWER ASSOCIATION OF MICHIGAN
STEPHANIE	BARRETT	Mkg Co. elected	MUSKEGON COUNTY INTERIM DRAIN COMMISSION
SUSIE	HUGHES	Mkg Co. elected	MUSKEGON COUNTY COMMISSIONER
LUPE	ALVIAR	Mkg Co. Veterans	MUSKEGON COUNTY VETERANS BOARD
KIM	ARTER	Mkg local elected	LAKETON TOWNSHIP SUPERVISOR
LEA	MARKOWSKI	Mkg local official	CITY OF MUSKEGON COMMISSIONER
DAVID	SHEEHY	Mkg local official	LAKETON TOWNSHIP ZONING ADMINISTRATOR
RON	BROWN	Mkg Non-Profit	MUSKEGON ENVIRONMENTAL RESEARCH & EDUCATION SOCIETY
DARLENE	DEHUDY	Mkg resident	MUSKEGON COUNTY RESIDENT
TOM	MATYCH	Mkg resident	MUSKEGON COUNTY RESIDENT
BILLIE	HOLMES	MLWP	JACKSON HILL NEIGHBORHOOD ASSOC. & MLWP
CATHERINE	SWIATEK	MLWP	MUSKEGON LAKE WATERSHED PARTNERSHIP
THERESA	BERNHARDT	MLWP	MUSKEGON LAKE WATERSHED PARTNERSHIP
WAYNE	GROESBECK	MLWP	MUSKEGON LAKE WATERSHED PARTNERSHIP & MRWA
NANCY	BURMEISTER	MRWA	MUSKEGON RIVER WATERSHED ASSEMBLY
GARY	NOBLE	MRWA	MUSKEGON RIVER WATERSHED ASSEMBLY
DENNIS	DONAHUE	NOAA	NOAA GLERL LAKE MICHIGAN FIELD STATION
TERRY	HEATLIE	NOAA	NOAA FISHERIES
JOEL	DARLING	Non-Profit	DARLING CETACEANS
LISA	DUTCHER	Oceana Co. RC	RSX CONSULTANT - OCEANA COUNTY ROAD COMMISSION
TOM	BOOM	Private Business	BARR ENGINEERING
ERIC	JOHNSON	Private Business	WEST SHORE CONSULTANTS
BOB	KRENN	Private Business	TIMBER BRIDGES
KELLY	RICE	Private Business	CARDNO JF NEW
CHRIS	WARREN	Private Business	BARR ENGINEERING COMPANY
ELAINE	ISELY	Regional environmental	WEST MICHIGAN ENVIRONMENTAL ACTION COUNCIL
JENNIFER	MCKAY	Regional environmental	TIP OF THE MITT WATERSHED COUNCIL
CAROLYN	ULSTAD	Regional environmental	MACATAWA AREA COORDINATING COUNCIL
RICK	WESTERHOF	USFWS	US FISH & WILDLIFE SERVICE
CHARLES	BYERS	USGS	US GEOLOGICAL SURVEY
JOE	DURIS	USGS	USGS - MICHIGAN WATER SCIENCE CENTER
RYAN	OSTER	USGS	USGS MICHIGAN WATER SCIENCE CENTER
DENNIS	MARVIN	utilities	CMS ENERGY
TANYA	CABALA	Wh. Lk. PAC	WHITE LAKE PUBLIC ADVISORY COUNCIL
GREG	MUND	Wh. Lk. PAC	WHITE LAKE PUBLIC ADVISORY COUNCIL
THOMAS	TISUE	Wh. Lk. PAC	WHITE LAKE PUBLIC ADVISORY COUNCIL
TOM	HAMILTON	Wh. R. WP	WHITE RIVER WATERSHED PARTNERSHIP
STEPHEN	CARLSON	WMSRDC	WMSRDC SENIOR PLANNER
JOSHUA	CROFF	WMSRDC	WMSRDC PLANNER
SANDEEP	DEY	WMSRDC	WMSRDC EXECUTIVE DIRECTOR
KATHY	EVANS	WMSRDC	WMSRDC ENVIRONMENTAL PROGRAM MANAGER
JOEL	FITZPATRICK	WMSRDC	WMSRDC TRANSPORTATION PLANNER
AMY	HAACK	WMSRDC	WMSRDC
ERIN	KUHN	WMSRDC	WMSRDC ECONOMIC DEVELOPMENT PROGRAM MGR
BRIAN	MULNIX	WMSRDC	WMSRDC TRANSPORTATION PROGRAM MGR
MARY	SEEGER	WMSRDC	WMSRDC
RUTH	OLSEN		
VIRGINIA	O'TOOLE		

Synopsis:

WMSRDC staff discussed hazard mitigation at the "Water, Woods, & Wetlands" regional forum on October 23, 2013 in Muskegon, Michigan. The hazard mitigation session addressed the potential for coordination between hazard mitigation and a variety of environmental initiatives. Examples of successful mitigation projects in Michigan highlighted many common interests, such as culvert improvements, flood control, and stream bank stabilization.

December 12, 2013: Lake County LEPC Meeting

Attendees:

Chris Roy	LEPC Chairperson	Emergency Management
Don Arquette	LEPC Vice Chairperson	Health Organization
Dan Sloan	County Commissioner	Elected Official
Michael Applewhite	Lake County EM	Emergency Management
Bret Haner	Health Dept. #10	Health Organization
Barb Stenger	County Commissioner	Elected Official
James Anderlohr	Lake County Central Dispatch	Communication
Jim VanBendegom		
Stephen Carlson	WMSRDC	(Guest)

Synopsis:

Reviewed progress made towards hazard mitigation action items and other mitigation-related activities, including: Lake County 911 installed a repeater near Luther to improve communications in northern reaches of the county; there are only 5 HAM radio operators in the county, however there is a network of amateur radio operators in neighboring counties that could be called upon if needed; Lake County is changing warning system from CityWatch to Code Red. Suggestions for mitigation projects include: seasonally appropriate public hazard awareness campaigns; review/monitor hazard mitigation plan annually. Also reviewed and discussed the hazard mitigation Goals & Objectives.

March 13, 2014: Lake County LEPC Meeting

Attendees:

Chris Roy	LEPC Chairperson	Emergency Management
George Supernois	Cherry Valley Twp Clerk	Elected Official
Michael Applewhite	Lake County EM	Emergency Management
Bret Haner	Health Dept. #10	Health Organization
Mark Russo	Michigan State Police	Law Enforcement
Stephen Carlson	WMSRDC	(Guest)

Synopsis:

Reviewed and discussed a revised Action Agenda. Low attendance at the meeting, but the Action Agenda was distributed to the entire committee prior to the meeting and no comments were submitted.

September 11, 2014: Lake County LEPC Meeting and Public Meeting

Attendees:

Chris Roy	LEPC Chairperson	Emergency Management
Don Arquette	LEPC Vice Chairperson	Health Organization
Dan Sloan	County Commissioner	Elected Official
Michael Applewhite	Lake County EM	Emergency Management
Bret Haner	Health Dept. #10	Health Organization
Steve Hatting	USDA Forest Service	
Dave Sanders	Lake County Central Dispatch	Communication
Stephen Carlson	WMSRDC	(Guest)

Synopsis:

The LEPC hosted a public meeting to offer the public an opportunity to participate during the drafting process. There were no comments from the public at the meeting, and no comments were submitted to WMSRDC prior to the meeting. The meeting was noticed in the Lake County Star on August 28.

Following the public meeting, the LEPC discussed the proposed Action Agenda. Helpful comments were received from the 911 Dispatch representative. The committee decided to add another action item to establish an amateur radio club. There was also some concern expressed about Action Item #9 (zoning). There was concern that anything with zoning on it will meet resistance in Lake County.

November 19, 2014: Lake County Board of Commissioners Meeting

Attendees:

Karl Walls	Board Chairman	Lake County Commissioner
Barb Stenger		Lake County Commissioner
Colleen Carrington-Atkins		Lake County Commissioner
John Fairbanks		Lake County Commissioner
Bob Myers		Lake County Commissioner
Dan Sloan		Lake County Commissioner
Lori DeWolf	Deputy Clerk	Lake County
Michael Applewhite	Emergency Management	Lake County
Erin Kuhn	Executive Director	WMSRDC
Stephen Carlson	Senior Planner	WMSRDC
Craig Cooper	Prosecuting Attorney	Lake County

Synopsis:

Staff from the West Michigan Shoreline Regional Development Commission attended the Lake County Board of Commissioners meeting to present the first draft of the Lake County Hazard Mitigation Plan Update, and answer the Boards questions regarding hazard mitigaiton. The Board gave its consent have the draft transmitted to MSP-EMHSD to initiate the review process.

RESOURCES

Many resources, documents, and websites were researched and referenced during the development of this plan. The following were most helpful during this process:

Lake County Land Use Plan (2012)

Lake County Emergency Action Guidelines (January 2004)

Lake County Community Wildfire Protection Plan (January 2011)

Michigan Hazard Analysis (July 2012)

Michigan Hazard Mitigation Plan (updated March 2011)

Michigan Department of Agriculture Food and Agricultural Systems Profiles (2009)

Hazard Mitigation Plan for Kent and Ottawa Counties (revised 2012)

United States 2010 Census

Flood Insurance Rate Maps from the National Flood Insurance Program

USGS topographic maps

Plat maps

USDA Soil Survey of Lake and Wexford Counties, Michigan (1985)

Web sites:

- National Climatic Data Center: http://www.ncdc.noaa.gov/
- FEMA www.fema.gov
- Michigan Geographic Data Library: www.mcgi.state.mi.us/mgdl/
- Local media
    - MLIVE: www.mlive.com
    - Shoreline Media: www.shorelinemedia.net

ARTICLES & PUBLIC NOTICES

Articles and public notices published during the Lake County Hazard Mitigation Plan Update planning process.

June / July 2011 – WMSRDC print newsletter

Expected Hazard Mitigation Plan Updates

Hazard mitigation is sustained action taken to reduce or eliminate long-term risk to people and their property from hazards. Mitigation Plans form the foundation for a community's long-term strategy to reduce disaster losses and break the cycle of disaster damage, reconstruction, and repeated damage.

Five years ago, WMSRDC authored Hazard Mitigation Plans for the counties of Lake, Mason, Muskegon, Newaygo, and Oceana. All five plans attained Federal Emergency Management Agency (FEMA) approval, helping the counties become eligible for certain types of non-emergency disaster assistance, including funding for mitigation projects.

These plans are now in need of a formal update to maintain this condition for mitigation funding eligibility. The Commission recently partnered with Oceana County to apply for a FEMA Hazard Mitigation Planning Grant to update existing Hazard Mitigation plans for the five counties.

This two-year project is expected to commence in August 2011. WMSRDC will coordinate with each county's Emergency Manager to assemble an advisory committee, identify local hazards, and educate local communities and citizens about local hazards and how to mitigate their effects. This planning process is as important as the plan itself, because it creates a framework for risk-based decision-making to reduce damages to lives, property, and the economy from future disasters.

For more information, check out the Hazard Mitigation Planning section at wmsrdc.org under "Special Projects." You may also contact Stephen Carlson, Associate Planner, at (231) 722-7878 extension 11 or scarlson@wmsrdc.org.

Novemer 8, 2011 – WMSRDC e-newsletter

WMSRDC Initiates Updates of Hazard Mitigation Plans

Five years ago, WMSRDC authored Hazard Mitigation Plans for the counties of Lake, Mason, Muskegon, Newaygo, and Oceana. All five plans attained Federal Emergency Management Agency (FEMA) approval, helping the counties become eligible for certain types of non-emergency disaster assistance, including funding for mitigation projects. WMSRDC is now in the process of updating the plans to maintain this condition for mitigation funding eligibility. As a part of the planning process, WMSRDC will coordinate with each county's emergency manager to identify local hazards and educate local communities and citizens about local hazards and how to mitigate their effects. This two-year project is expected conclude in October 2013.

December 2011 / January/February 2012 – WMSRDC print newsletter

Spotlight on… Hazard Mitigation Planning

In October of 2011, Oceana County with assistance from the WMSRDC secured a Federal Emergency Management Agency (FEMA) Pre-Disaster Mitigation Planning Grant for the update of Hazard Mitigation Plans for the five counties of Lake, Mason, Muskegon, Newaygo and Oceana. WMSRDC will be responsible for performing these FEMA-required five-year updates over a two-year period.

The primary objective of hazard mitigation is to reduce or eliminate long-term risk to people and property. These plans are helpful in identifying a community's risks, prioritizing those risks, and identifying actions to mitigate those risks. The plans, once approved by FEMA, also help communities qualify for certain types of non-emergency disaster assistance, including funding for mitigation projects.

Community and stakeholder involvement in the preparation of a hazard mitigation plan is essential to the planning process and has a direct influence on a plan's effectiveness. Therefore, Advisory Teams have been established in each county to help guide the update of the plans. Each team is lead by their county's Emergency Manager, and includes representatives from an array of sectors involved with emergency planning.

The first major task in the update planning process is to invite participation from the public. In the month of February WMSRDC will distribute a hazard mitigation survey questionnaire to a wide range of organizations such as local officials and agencies, public utilities, and emergency responders via mail and e-mail. This survey will also be available to the public on the WMSRDC website under Special Projects. In March and April, WMSRDC will organize a public meeting in each county to discuss the hazard mitigation project, and to receive public comments and concerns associated with hazard mitigation.

For more information regarding the Hazard Mitigation project or to receive a survey, visit www.wmsrc.org, or contact Stephen Carlson, Associate Planner at (231) 722-7878 extension 11 or at scarlson@wmsrdc.org.

February 23, 2012 – Lake County Star

NOTICE OF PUBLIC HEARING REGARDING HAZARD MITIGATION

The West Michigan Shoreline Regional Development Commission (WMSRDC), in cooperation with Lake County, has begun the process of updating the Lake County Hazard Mitigation Plan. Public input is requested regarding natural and man-made hazards that pose a threat to people and property in Lake County. A public hearing to discuss Hazard Mitigation and receive input from the community will take place at 11:00 AM on March 8, 2012 at the Lake County Courthouse located at 800 10th St., Baldwin, MI 49304. Additional information about the Lake County Hazard Mitigation Plan Update is available at www.wmsrdc.org. Please direct any questions to Mr. Stephen Carlson, Associate Planner, at (231) 722-7878, extension 11 or at scarlson@wmsrdc.org.

March 2012 – WMSRDC e-newsletter

Participate in Hazard Mitigation Planning in Your Community Through Surveys and Public Hearings

WMSRDC recently distributed over 700 hazard mitigation questionnaires to community leaders and stakeholders via mail and e-mail. This survey is an important component of the process to update the Hazard Mitigation plans for Lake, Mason, Muskegon, Newaygo, and Oceana counties. It is intended to encourage respondents to provide valuable input from a local perspective, as well as increase awareness of the hazard mitigation update process which is underway. The surveys are open to the public, and can be viewed and downloaded here..

This spring, WMSRDC and partners will hold hazard mitigation public hearings in each of the five counties. Hazard mitigation will be discussed and opportunities will be provided for attendees to comment on natural and man-made threats to their community. Dates, times, and locations of the public hearings are listed below. For more information, please contact Stephen Carlson, associate planner at (231) 722-7878 ext. 11 or scarlson@wmsrdc.org.

Public Hearings

- Lake County, March 8, 11:00 AM, Lake County Courthouse
- Mason County, May 15, 4:00 PM, Mason County Sheriff's Office
- Muskegon County, April 10, 10:30 AM, Norton Shores City Hall
- Newaygo County, March 20, 2:00 PM, Newaygo County Emergency Operations Center
- Oceana County, March 27. 12:00, Oceana County Courthouse

March / April 2012 – WMSRDC print newsletter

Hazard Mitigation Update

Efforts are in full-swing to update the Hazard Mitigation Plans for the counties of Lake, Mason, Muskegon, Newaygo, and Oceana. In February and March, surveys were mailed or emailed to over 700 individuals throughout the five counties in order to gather information, as well as increase awareness of hazard mitigation planning.

In addition, research is underway to identify natural and manmade hazards. Once the research is complete, hazards will be ranked prioritized for each county and strategies will be identified to prevent or lessen future damages to people, structures, and property from disasters. The public is invited to participate throughout the project, which on schedule to conclude in the fall of 2013.

For more information or to partake in the Hazard Mitigation Survey, visit the Hazard Mitigation Planning page at www.WMSRDC.org, or contact Stephen Carlson, Associate Planner, at (231) 722-7878 extension 11 or at scarlson@wmsrdc.org.

December 2012 Annual Report – WMSRDC print newsletter

Spotlight on Hazard Mitigation

In 2011, Oceana County with the assistance of WMSRDC received a $225,000 Pre-Disaster Mitigation (PDM) grant from the Federal Emergency Management Agency (FEMA) to update the hazard mitigation plans for Lake, Mason, Muskegon, Newaygo and Oceana counties. Each county, as well as WMSRDC, combined to contribute local match for the grant. In 2012, WMSRDC made great progress towards accomplishing the updates, a process which is expected to span two years.

Hazard mitigation aims to reduce or eliminate long-term risk to people and property from hazards. Mitigation plans (like the ones prepared by WMSRDC) form the foundation for a community's long-term strategy to reduce disaster losses and break the cycle of disaster damage, reconstruction, and repeated damage. In addition, the plans help communities qualify for certain Hazard Mitigation Assistance (HMA) funding for pre-disaster and post-disaster mitigation. The relocation or demolition of a structure located within a floodplain is example of a mitigation project.

Community and stakeholder involvement in the preparation of a hazard mitigation plan is essential to the planning process and has a direct influence on a plan's effectiveness. Once a plan is completed, it must be approved by FEMA and then adopted locally. The goals, objectives, and action items should then be incorporated into the community's planning for such things as capital improvements, transportation, and future land use.

Hazards addressed in WMSRDC's hazard mitigation plans are organized into three areas and include, but are not limited to, the following hazards:

- Natural Hazards such as thunderstorms, flooding, winter weather, wildfires, etc;
- Technological Hazards such as structural fires, infrastructure failures, and transportation accidents; and
- Human-Related Hazards such as public health emergencies, civil disturbances, and terrorism.

June 2013 – WMSRDC e-newsletter

Hazard Mitigation Planning Update

WMSRDC is continuing the process of updating Hazard Mitigation Plans for Lake, Mason, Muskegon, Newaygo, and Oceana counties. The first phase of the project is nearly complete for all five plans. This has included extensive research of demographics, critical facilities, infrastructure, and so forth; as well as the identification of potential hazards and documentation of historical hazardous events. A survey was also mailed and/or emailed to over seven hundred individuals and agencies within the five-county region. The survey is still available and open to the public at www.wmsrdc.org on the Hazard Mitigation page. The next step for the Hazard Mitigation Plan updates will be to prioritize the identified hazards with a ranking system that takes into account each hazard's frequency and propensity to impact people, property, and the economy.

August / September 2013 – WMSRDC print newsletter

Hazard Mitigation Update

WMSRDC continues working to update the Hazard Mitigation plans for the counties of Lake, Mason, Muskegon, Newaygo, and Oceana. Each plan includes analysis of 31 natural, technological, and human-related hazards. The latest milestone of this effort was the revision of the method used to rate and rank these hazards. The new system assesses four metrics for each hazard. These metrics include:
- Probability of Occurrence;
- Impact on the Population;
- Impact on Property; and
- Impact on the Economy.

A weighting system is then applied to help rank the hazards in order of importance. "Probability of Occurrence" and "Impact on the Population" are the two most important factors in this ranking system.

The resulting list of hazards will be used in the next phase of the planning process to help identify hazard mitigation priorities and to select feasible mitigation projects for each county.

For more information about Hazard Mitigation, please contact Stephen Carlson, Senior Planner, at (231) 722-7878 ext. 11 or at scarlson@wmsrdc.org.

February / March 2014 – WMSRDC print newsletter

Hazard Mitigation Update

Hazard mitigation is a relatively unknown concept. Yet upon closer inspection, one realizes that hazard mitigation is virtually everywhere. It encompasses any action taken to eliminate or reduce damages and losses to property and life. Seemingly endless policies and practices are already in place with that goal in mind.

Having a Federal Emergency Management Agency (FEMA)-approved hazard mitigation plan helps a community qualify for certain types of hazard mitigation assistance. Projects in Michigan that have received such assistance include acquisition of flood-prone properties, stream bank stabilization, and culvert replacements.

WMSRDC continues working to update the Hazard Mitigation plans for the counties of Lake, Mason, Muskegon, Newaygo, and Oceana. Once the updates are complete, financial and/or technical help might be available to further hazard mitigation in those areas. The plan updates are on track to be complete in second half of 2014.

For more information about Hazard Mitigation, please contact Stephen Carlson, Senior Planner, at (231) 722-7878 ext. 11 or at scarlson@wmsrdc.org.

April / May 2014 – WMSRDC print newsletter

Hazard Mitigation

WMSRDC continues to make progress toward updating the Hazard Mitigation plans for Lake, Mason, Muskegon, Newaygo, and Oceana counties. The project is funded through a grant awarded to Oceana County by the Michigan State Police – Emergency Management and Homeland Security Division. Oceana County is the fiduciary for the grant, while WMSRDC is responsible for fulfilling the grant obligations.

The project is scheduled to end July 31, 2014, however a one-year extension has been requested to accommodate the potentially lengthy approval and adoption process. Each county's hazard mitigation plan must be reviewed by MSP, approved by FEMA, and locally adopted. The plans are "multi-jurisdictional," meaning that each municipality in addition to the county may adopt the plan to become eligible for certain types of hazard mitigation funds.

August / September 2014 – WMSRDC print newsletter

Hazard Mitigation Public Review Opportunity

ATTENTION LAKE AND OCEANA COUNTIES! The public is invited to review the Hazard Analysis and Goals & Objectives sections of the Lake County and Oceana County plans. These sections are freely accessible at www.wmsrdc.org.

A public meeting will be held in each county during September to receive comments regarding these sections at the following times and locations:

- Lake County public meeting - September 11, 2014 at 11:00 AM in the Commission Room of the Lake County Courthouse, 800 10th Street, Baldwin.
- Oceana County public meeting - September 23, 2014 at 12:00 PM in the Board Conference Room in the County Building, 100 State Street, Hart.

Public comments may also be emailed to Stephen Carlson, scarlson@wmrdc.org, prior to the meetings.

August 28, 2014 – Lake County Star

HAZARD MITIGATION PUBLIC MEETING

Public input is requested for the Lake County Hazard Mitigation Plan, which is being developed by Lake County Emergency Management with assistance from the West Michigan Shoreline Regional Development Commission (WMSRDC). The "Hazard Analysis" and "Goals & Objectives" of the plan are currently available for public review at www.wmsrdc.org. The public will have an opportunity to comment on these sections at 11:00 AM on September 11, 2014 at the Lake County Courthouse, 800 10th St, Baldwin. Written comments may be emailed to scarlson@wmsrdc.org prior to the meeting. Please direct any questions to Mr. Stephen Carlson, Senior Planner, at (231) 722-7878.

Appendix F:

Potential Hazard Mitigation Funding Sources

Source: Michigan Hazard Mitigation Plan (Updated March 2011)

STATE AGENCY MITIGATION FUNDING PROGRAMS

Funding Sources for Hazard-Specific Measures	Drought	Earthquake	Extreme Temperatures	Wildfire	Dam Failure	Riverine Flooding	Great Lakes Shoreline Flooding	Subsidence	Hail	Lightning	Severe Wind	Tornadoes	Ice and Sleet Storms	Snowstorms	FINANCIAL ASSISTANCE	TECHNICAL ASSISTANCE
MICHIGAN DEPARTMENT OF AGRICULTURE																
Conservation Reserve Enhancement Program						X					X				X	X
Intercounty Drain Program (available to drain commissioners only)					X	X										X
MICHIGAN DEPT. OF ENVIRONMENTAL QUALITY																
Coastal Management Program							X								X	X
Michigan Great Lakes Protection Fund							X								X	
State Revolving Fund (Loan)						X									X	
Wetland Program Development (also see 66.461 in CFDA)						X	X								X	
MICHIGAN DEPT. OF NATURAL RESOURCES																
Land & Water Conservation Fund						X	X								X	
Michigan Habitat Improvement Fund Project Grants						X									X	
Michigan Natural Resources Trust Fund				X		X									X	
Michigan Volunteer Fire Assistance				X											X	
Recreational Trails Program Grants						X	X								X	
Community Forestry Program											X	X	X		X	X
MICHIGAN DEPARTMENT OF STATE POLICE																
Emergency Management Performance Grants (also see 97.042 in CFDA)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Flood Mitigation Assistance (also see 97.029 in CFDA)						X	X								X	
Hazard Mitigation Grant Program (also see 97.039 in CFDA)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Federal Disaster Assistance to Individuals and Households in Presidential Declared Disaster Areas (also see 97.048 in CFDA)		X		X		X	X	X			X	X			X	
Presidential Declared Disaster Assistance - Disaster Housing Operations For Individuals And Households (also see 97.049 in CFDA)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Presidential Declared Disaster Assistance To Individuals And Households - Other Needs (also see 97.050 in CFDA)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Disaster Grants-Public Assistance (Presidentially Declared Disasters) (also see 97.036 in CFDA)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Pre-Disaster Mitigation (also see 97.047 in CFDA)			X	X		X	X				X	X			X	
Severe Loss Repetitive Program (also see 97.110 in CFDA)						X	X								X	
Repetitive Flood Claims (also see 97.092 in CFDA)						X	X								X	
MICHIGAN DEPARTMENT OF TRANSPORTATION																
Transportation Economic Development Fund						X	X								X	
MICHIGAN ECONOMIC DEVELOPMENT CORP																
Community Development Block Grant Program (also see 14.218,14.219, 14.228 in CFDA)						X	X								X	
Urban Land Assembly						X	X								X	
MICHIGAN STATE HOUSING DEVELOPMENT AUTHORITY																
CDBG Housing Resource Fund (Inc HOME) (also see 14.239 in CFDA)						X	X		X		X	X			X	
Home/Property Improvement Loans						X	X		X		X	X			X	
MICHIGAN DEPARTMENT OF TREASURY																
Michigan Finance Authority-Local Gov't Loan Program	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Michigan Finance Authority-State Aid Note	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	

FEDERAL HAZARD MITIGATION FUNDING SOURCES

Funding Sources for Hazard-Specific Measures	Drought	Earthquake	Temperatures	Wildfire	Dam Failure	Riverine Flooding	Shoreline Flooding and Erosion	Subsidence	Hail	Lightning	Severe Wind	Tornadoes	Ice and Sleet	Storms	Snowstorms	FINANCIAL ASSISTANCE	TECHNICAL ASSISTANCE
10.054 Emergency Conservation Program	X					X					X	X				X	
10.069 Conservation Reserve Program						X					X	X				X	X
10.072 Wetlands Reserve Program						X	X									X	X
10.202 Cooperative Forestry Research				X							X	X				X	
10.410 Very Low to Moderate Income Housing Loans			X	X		X	X	X	X	X	X	X				X	
10.411 Rural Housing Site Loans and Self Help Housing and Development Loans						X	X									X	
10.417 Very Low Income Housing Repair Loans/Grants			X	X		X	X	X	X	X	X	X				X	
10.445 Direct Housing Natural Disaster (Very Low/Low Income Loans)				X		X	X		X	X	X	X				X	
10.652 Forestry Research						X	X				X	X				X	
10.664 Cooperative Forestry Assistance				X												X	
10.760 Water & Waste Disposal Sys. for Rural Comm.						X	X									X	
10.763 Emergency Community Water Assistance Grants	X					X	X									X	
10.766 Community Facilities Loans & Grants	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	
10.768 Business and Industry Loans	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	
10.770 Water/Waste Disposal Loans/Grants						X	X									X	
10.773 Rural Business Opportunity Grants						X	X									X	
10.850 Rural Electrification Loans and Loan Guarntees										X	X	X	X	X		X	
10.901 Resource Conservation and Development	X	X	X	X		X	X										X
10.902 Soil and Water Conservation	X	X	X	X		X	X										X
10.904 Watershed Protection and Flood Prevention					X	X	X									X	X
10.913 Farm and Ranch Land Protection Program						X	X									X	
10.914 Wildlife Habitat Incentive Program						X	X									X	
11.300 Investments for Public Works and Economic Development Facilities					X	X	X									X	
11.303 Economic Development Technical Assistance						X	X									X	X
11.307 Economic Adjustment Assistance					X	X	X				X	X				X	
11.419 Coastal Zone Mgmt. Administration Awards							X										X
11.462 Hydrologic Research	X				X	X	X									X	
11.463 Habitat Conservation							X									X	
11.477 Fisheries Disaster Relief	X			X	X	X	X									X	
11.478 Center for Coastal Ocean Research_Coastal Ocean Program							X									X	
11.550 Public Telecommunication Facilities-Planning & Construction												X				X	
12.101 Beach Erosion Control Projects							X									X	
12.102 Emergency Rehabilitation of Flood Control Works or Federally Authorized Coastal Protection Works					X	X	X									X	
12.103 Emergency Operations Flood Response & Post-Flood Response					X	X	X									X	
12.104 Flood Plain Management Services					X	X	X										X
12.105 Protection of Essential Highways, Highway Bridge Approaches, and Public Works					X	X	X									X	
12.106 Flood Control Projects					X	X	X									X	
12.108 Snagging and Clearing for Flood Control					X	X	X									X	
12.109 Protection, Clearing and Straightening Channels						X	X									X	
12.111 Emergency Advance Measures for Flood Protection					X	X	X									X	
14.218 Community Development Block Grants/Entitlement Grants	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	
14.228 Community Development Block Grants-State's Program	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	

FEDERAL HAZARD MITIGATION FUNDING SOURCES (CONT.)

Funding Sources for Hazard-Specific Measures	Drought	Earthquake	Temperatures	Wildfire	Dam Failure	Riverine Flooding	Shoreline Flooding and Erosion	Subsidence	Hail	Lightning	Severe Wind	Tornadoes	Ice and Sleet	Storms	Snowstorms	FINANCIAL ASSISTANCE	TECHNICAL ASSISTANCE
14.218 Community Development Block Grants/Entitlement Grants	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
14.219 Community Development Block Grants -Small Cities Program	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
14.228 Community Development Block Grants-State's Program	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
14.239 HOME Investment Partnerships Program						X	X		X	X	X	X				X	
14.246 Community Development Block Grant/Brownfileds Economic Development Initiative						X	X				X	X				X	
14.250 Rural Housing and Economic Development	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
14.511 Community Outreach Partnership Center Program	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
15.623 North American Wetlands Conservation Fund						X	X									X	
15.904 Historic Preservation Fund Grants-In-Aid						X	X	X	X	X	X	X	X	X	X		X
15.916 Outdoor Recreation-Acquisition, Development and Planning (Land and Water Conservation Fund Grants)						X	X									X	
15.918 Disposal of Federal Surplus Real Property for Parks, Recreation, and Historic Monuments						X	X										
15.921 Rivers, Trails, and Conservation Assistance						X	X										X
47.041 Engineering Grants	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
59.008 Disaster Assistance Loans		X		X		X	X	X	X	X	X	X	X	X	X	X	
66.461 Regional Wetlands Program Development Grants						X	X									X	
66.469 Great Lakes Program							X									X	
81.042 Weatherization Assistance for Low-Income Persons			X													X	
97.018 National Fire Academy Training Assistance				X													X
97.022 Flood Insurance						X	X										X
97.023 Community Assistance Program - State Support Services Element (NFIP)						X	X										X
97.024 Emergency Food and Shelter National Board Program	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
97.026 Emergency Management Institute-Training Assistance	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X
97.028 Emergency Management Institute-Resident Education Program	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X
97.029 Flood Mitigation Assistance						X	X									X	
97.030 Community Disaster Loans	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
97.031 Cora Brown Fund	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
97.036 Disaster Grants - Public Assistance (Presidentially Declared Disasters)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
97.037 Disaster Housing Program	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
97.039 Hazard Mitigation Grant Program	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
97.041 National Dam Safety Program					X												X
97.042 Emergency Management Performance Grants	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
97.044 Assistance to Firefighters Grant				X												X	
97.045 Cooperating Techincal Partners						X	X									X	
97.046 Fire Management Assistance Grant				X												X	
97.047 Pre-Disaster Mitigation		X		X		X	X	X			X	X				X	
97.048 Disaster Housing Assistance to Individuals and Households in Presidential Declared Disaster Areas	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
97.049 Presidential Declared Disaster Assistance - Disaster Housing Operations for Individuals and Housholds	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
97.050 Presidential Declared Disaster Assistance to Individual and Households - Other Needs	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
97.092 Repetitive Flood Claims						X	X									X	
97.110 Severe Repetitive Loss Program						X	X									X	

316 Morris Avenue - Suite 340 - Muskegon, MI 49440-1140
Telephone: 231-722-7878 - Fax: 231-722-9362
www.wmsrdc.org