Hazard Mitigation Plan
for
Oceana County
and
Constituent Local Governments

Adopted by Oceana County
March 12, 2015

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

Susie Hughes, Chairperson
Evelyn Kolbe, Vice-Chairperson
James Rynberg, Secretary

Erin Kuhn, Executive Director

Project Staff:

Stephen Carlson, Senior Planner
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Prepared by WMSRDC in conjunction with the
Oceana County Local Emergency Planning Committee and the
Oceana County Department of Emergency Management

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OCEANA COUNTY
EMERGENCY MANAGEMENT DEPARTMENT

314 S. State Street
Hart, Michigan 49420
Phone: 231-873-4473
Email: oceanaem@hotmail.com

(Organization Name
and Address)

Date

Dear

Please find enclosed the most recent version of the Oceana County Hazard Mitigation Plan. The plan, originally written in 2005, has just undergone a complete update and has been reviewed and accepted by FEMA, Michigan State Police, Emergency Management and Homeland Security Department, and the Oceana County Board of Commissioners. The plan was developed and updated using input from members of our communities, affected agencies, units of government, business, and other stakeholders. Several public hearings were part of this update process. The plan is intended to be a tool for local governments to use to help minimize risks associated with development, activities and natural processes. The plan is by no means intended to restrict development but rather to provide tools and information such that future developments consider and address natural and man-made hazards in such a way that risk to human life and safety and to property is reduced to the extent practicable.

The Oceana County Board of Commissioners adopted this updated version of the Oceana County Hazard Mitigation Plan at its March 12, 2015 meeting. We are now asking that each local unit of government also adopt this plan to demonstrate our county's commitment to protecting our citizens' lives and property. We are requesting that (______________ township, village, city) consider and review the enclosed plan and adopt it by resolution.
Tom Osborn, the Oceana County Emergency Management Coordinator, would be happy to talk and/or meet with you to answer any questions you may have and to support the plan's adoption.

Thank you very much for your cooperation.

Sincerely,

Dennis Powers

Dennis Powers, Chairman
Oceana County Board of Commissioners

Thomas Osborn

Thomas Osborn, Coordinator
Oceana County Emergency Management

Oceana County
BOARD OF COMMISSIONERS
County Building
100 S. State Street, Suite M-4
Hart, Michigan 49420

COPY

RESOLUTION ADOPTION THE HAZARD MITIGATION PLAN FOR OCEANA COUNTY

Moved by Mr. Walker and seconded by Ms. Kolbe to adopt the following Resolution:

WHEREAS, Oceana 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 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 the *Hazard Mitigation Plan* is hereby adopted as an official plan of the County of Oceana.

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

BE IT FURTHER RESOLVED: that the Oceana County Office of Emergency Management Coordinator, or designee, is charged with supervising the implementation of the Plan's recommendations within the funding limitations as provided by the Oceana County Board of Commissioners or other sources.

BE IT FINALLY RESOLVED: The Oceana County Office of Emergency Management Coordinator, or designee, shall convene the LEPC at least quarterly. The LEPC shall monitor implementation of the plan and shall submit a written progress report to Oceana 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 calendar 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 Oceana County Board of Commissioners.

Roll call vote: Walker, yes; Kolbe, yes; Brown, yes; Gustafson, yes; Byl, yes; Sebolt, yes; and, Powers, yes. Motion carried.

CERTIFICATION:

The undersigned, being the Clerk of Oceana County, does hereby certify that on the 12th day of March, 2015, the Oceana County Board of Commissioners did adopt the above Resolution at its Regular Meeting.

Rebecca J. Griffin, Clerk
Oceana County
Board of Commissioners

HAZARD MITIGATION PLAN

Part A
PURPOSE AND PLANNING PROCESS

Purpose

The Oceana 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 carry out 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 Oceana County Hazard Mitigation Plan was adopted by Oceana County in 2006, and fully approved by FEMA in 2007. Of the 23 jurisdictions in Oceana County (1 city, 6 villages, and 16 townships), 20 were successful in adopting the county's multi-jurisdictional hazard mitigation plan at the local level. Only Hesperia Village, Greenwood Township, and Hart Township did not adopt the plan.

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 Oceana County Hazard Mitigation Plan examines a wide array of hazards and mitigation activities on a multi-jurisdictional level (county, city, 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 Oceana County. Hart Township was the only municipality out of 23 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 Oceana County Hazard Mitigation Plan Update 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 Oceana County Hazard Mitigation Plan was developed by the West Michigan Shoreline Regional Development Commission (WMSRDC) under the guidance of the Oceana County Local Emergency Planning Committee (LEPC), the Oceana County Hazard Mitigation Advisory Team, and Oceana County 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 Oceana County LEPC is a thirty-member committee appointed by the county board. It is comprised of individuals representing elected officials, emergency management, community groups, law enforcement, fire services, health organizations, transportation, amateur radio, agriculture, drain office, SARA Title III sites, animal control, public works, and 911 dispatch. 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 Oceana County Emergency Coordinator to aid the process of reviewing and updating the Oceana County Hazard Mitigation Plan. All LEPC members were invited to join the team, which was eventually comprised of twenty-two individuals representing Oceana County Emergency Management, Oceana County Administration, Oceana County Board of Commissioners, Oceana County Road Commission, Oceana County Sheriff's Department, Oceana County Animal Control, Senior Resources, Lakeshore Hospital, Northwest Michigan Health Services, Oceana EMS, Department of Human Services, District #10 Health Department, Michigan DNR-Forest Resources, Michigan State Police, Pentwater Police Department, Hart Fire Department, Walkerville Fire & Rescue, Grant Township Fire Department, Mason-Oceana 911, and Shelby Department of Public Works. 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 appointees (as of October 2, 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

Oceana 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 147 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
- Oceana County Administration
- Oceana County Road Commission
- Oceana County Drain Commission
- Oceana County Equalization
- Oceana County Council on Aging
- Oceana County Building Official
- Oceana County EMS

- Oceana County Airport
- Oceana County Department of Human Services
- District #10 Health Department
- Senior Resources
- West Michigan Community Mental Health System
- American Red Cross – Lakeshore & West Shore Chapter
- Lakeshore Hospital
- Oceana Intermediate School District
- Mason-Oceana 911 Dispatch
- Oceana County MSU Extension
- Oceana Conservation District
- Michigan DNR Forest Resources
- Michigan DNR State Parks
- Huron-Manistee National Forest Fire Management

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 Oceana 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 Oceana 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 Oceana County Emergency Management, Oceana County Administration, Oceana County Commissioners, County Building Inspector, Oceana Department of Human Services, Mason-Oceana 911, Lakeshore Hospital, West Michigan Community Mental Health, District #10 Health Department, USDA Forest Service, Shelby Township Zoning, Golden Township Zoning, Pentwater Fire Department, Pentwater Township Planning Commission, Grant Township, Hart Township, and Village of New Era. Survey feedback was used to help identify hazards, establish goals and objectives, recommend activities and prioritize actions. Although the survey produced a meager 10.8% response rate, it was successful in increasing awareness of hazard mitigation throughout Oceana 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 the plan was approved in 2006. These efforts provided information about hazard mitigation and invited individuals to participate in the Plan Update.

The following chart shows the hazard mitigation participation status of each local jurisdiction in Oceana 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.

Oceana County Hazard Mitigation Plan Jurisdiction Participation					
Jurisdiction	**Adopted 2006 Oceana Co HazMit Plan***	**2006 HazMit Plan Participant**	**2011 Letter to Participate**	**HazMit Plan Update Participant**	**Participation Status**
Oceana County	✓	✓	✓	✓	Continuing
Benona Twp	✓	✓	✓	✓	Continuing
Claybanks Twp	✓		✓		
Colfax Twp	✓		✓		
Crystal Twp	✓	✓	✓	✓	Continuing
Elbridge Twp	✓		✓	✓	**New Participant**
Ferry Twp	✓	✓	✓	✓	Continuing
Golden Twp	✓	✓	✓	✓	Continuing
Grant Twp	✓		✓	✓	**New Participant**
Greenwood Twp			✓	✓	**New Participant**
Hart City	✓	✓	✓		
Hart Twp		✓		✓	Non-Participant
Hesperia Village			✓		
Leavitt Twp	✓		✓		
New Era Village	✓		✓	✓	**New Participant**
Newfield Twp	✓		✓	✓	**New Participant**
Otto Twp	✓		✓		
Pentwater Village	✓		✓	✓	**New Participant**
Pentwater Twp	✓	✓	✓	✓	Continuing
Rothbury Village	✓		✓	✓	**New Participant**
Shelby Village	✓		✓	✓	**New Participant**
Shelby Twp	✓	✓	✓	✓	Continuing
Walkerville Village	✓		✓	✓	**New Participant**
Weare Twp	✓	✓	✓	✓	Continuing

** Approved by FEMA in 2007*

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 Oceana County, and vice versa. Oceana County is bounded by Lake and Mason counties to the north; Muskegon County to the south; and Newaygo County to the east. All were given the option of reviewing drafts of this document.

Public Engagement

The Oceana County LEPC hosted a public meeting to discuss hazard mitigation at the beginning of the planning process at its March 27, 2012 meeting. It was noticed in the Oceana Herald-Journal, 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 regular meeting on September 23, 2014. The meeting was noticed in the Oceana Herald-Journal; 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 Oceana County, and members of the Oceana County Board and Oceana County Planning Commission. 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 written comments to WMSRDC staff prior to the meeting. One set of comments was received prior to the public meeting, which included a description of gas pipeline and electric transmission lines that traverse Oceana County. Those comments were incorporated into the appropriate hazard descriptions contained within Part C of this document. The meeting also featured a work session, whereas a proposed set of hazard mitigation action items were reviewed, discussed, and prioritized utilizing interactive polling technology.

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. 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, Oceana 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 Oceana County

Oceana County is located in the west-central part of Michigan's Lower Peninsula. The county borders Mason County to the north, Newaygo County to the east, Muskegon County to the south, and Lake Michigan to the west. The county has a land area of 512.07 squares miles, which notably includes sections of the Manistee National Forest and coastal sand dunes. The county has a total water area of 3,245 acres and about 30 miles of Lake Michigan coastline. Around 38 percent is farmland, while the majority of the remaining land is forested. There are numerous recreational opportunities in the Manistee National Forest, as well as other outdoor recreation opportunities such as canoeing, fishing, sightseeing, and fruit picking. The county had a U.S. Census population in 1970 of 17,984 persons. Population has grown significantly in recent years to a 2000 population of 26,873, with a summer population estimated as high as double that. As of the 2010 U.S. Census, the population had slightly decreased to 26,570. In terms of ethnicity, the 2010 population consisted of 23,952 White, 119 African American, 285 American Indian or Alaskan Native, 3,629 Hispanic or Latino, 531 "two or more" races, and 1,618 "some other" race. In 2010, there were 15,944 total housing units with 10,174 occupied and 5,770 vacant. The large number of vacant housing units consisted of seasonal dwellings and temporary migrant worker dwellings. Per capita income in 2010 was $18,065 and median household income was $39,043.

1.02 History and Development

The first settlers in Oceana County arrived at the mouth of Whiskey Creek in the late 1840's, in what is now Claybanks Township. They chose the area because it had very fertile clay loam soil and several acres had been cleared by Indians. By the 1850's, there were 36 people living in the settlement. The earliest settlers included Reverend William M. Ferry and his son Thomas. Together they bought 1,300 acres of woodland along Stony Creek and opened the area's first sawmill. Another settler was Charles Mears, who founded present-day Pentwater. He built a sawmill in the mid-1850's and improved the channel between Pentwater Lake and Lake Michigan.

Officially organized on May 31, 1855, Oceana County was named after its long shoreline on Lake Michigan. The first county seats were Stony Creek and Whiskey Creek. In 1864, the county seat was moved to Hart in the northwestern part of the County. An influx of new settlers and lumbermen increased the county's population from 7,000 in 1870 to 12,000 in 1880. The best timber had been cut by the 1880's, and the residents by that time found the cut over areas provided excellent locations for farming special crops and orchards. In the early 1860's, apple and peach trees were planted near Little Point Sable. In 1867, peaches, plums, and pears were brought to Pentwater, marketed, and shipped to Chicago.

Today, Oceana County is one of Michigan's leading horticultural producers. According to the Michigan Department of Agriculture in 2009, the county ranks first in acres of asparagus and tart cherries, and second in acres of all vegetables and revenue from Christmas tree sales. It also ranks third in number of controlled atmosphere storage facilities and fifth in number of food processing plants. The county is the site of the National Asparagus Festival and is known as the "Asparagus Capital" of the world.

1.03 Climate

The major climatic variations in the county, even among areas that are near one another, are mainly the result of differences in topography and the proximity to Lake Michigan. Between 1981 and 2010, the average winter (December through February) temperature is 25.1 degrees F at Hart on the west side of the county and 24.4 degrees at Hesperia on the east side. The average daily minimum temperatures are 18.3 degrees at Hart and 16.3 degrees at Hesperia. The lowest temperature on record is -35 degrees at Hart on February 11, 1899. In summer (June through August), the average temperatures are 67.0 degrees at Hart and 67.1 degrees at Hesperia. The average daily maximum temperatures are 77.7 degrees at Hart and 79.7 degrees at Hesperia. The highest recorded temperatures were 104 degrees at Hart on July 13, 1936 and 100 degrees at Hesperia on August 21, 1955.

The total average annual precipitation is 36.75 inches at Hart and 35.02 inches at Hesperia. On average, over half of the total precipitation falls in April through September. The growing season for most crops falls within this period. The heaviest 1-day rainfalls during the period of record were 5.43 inches at Hart and 6.56 inches at Hesperia, all on September 11, 1986. Thunderstorms occur between 30 and 34 days each year, mostly in June, July, or August. The average annual snowfall between 1981 and 2010 was 81.6 inches at Hart and 71.1 inches at Hesperia. Maximum snow depths generally occur in the month of January. On the average, 98 days of the year at Hart and 97 days of the year at Hesperia have at least 1 inch of snow on the ground. The number of such days can vary greatly from year to year. The heaviest 1-day snowfalls between 1981 and 2010 were 15.0 inches at Hart and 12.3 inches at Hesperia. The greatest monthly snowfalls were 88.7 inches at Hart in December 2008 and 78.9 inches at Hesperia in December 2008. The greatest annual snowfalls were 201.4 inches at Hart in 2008 and 144.4 inches at Hesperia in 2008. The least annual snowfalls were 27.6 inches at Hart in 1998 and 30.0 inches at Hesperia in 1993. The average relative humidity in mid-afternoon is about 64 percent. Humidity is higher at night, and the average at dawn is about 81 percent. Based on data recorded in Grand Rapids, the sun shines 62 percent of the time possible in summer and 30 percent in winter. The prevailing wind is from the south-southwest. Average wind-speed is highest, at 12.5 miles per hour, in January.

1.04 Agriculture

A variety of soils and relief in Oceana County and the moderating effects of Lake Michigan on the climate have resulted in a variety of agricultural products. According to a 2009 Michigan Department of Agriculture report, 123,384 acres in the county, or 37.7 percent of the total land area, is farmland. Corn, soy and wheat crops were grown on 20,619 acres (16.7% of cropland). About 13,122 acres were used for vegetables (10.6% of cropland). In northeastern areas of the county, vegetables and corn have recently become the major crops and corn production has increased. Fruit and tree nuts accounted for 16,061 acres (11.4% of cropland). Oceana County leads the State in acreage of asparagus and tart cherries. Asparagus is grown mainly on coarse textured, excessively drained soils. Other vegetables, such as cucumbers and squash, generally are grown on coarse textured to medium textured, well-drained soils. Sweet cherries, apples, peaches, pears, prunes, and plums are the major fruits grown in the county. They are generally grown in the higher areas, such as Elbridge Township, where frost damage is minimized. Many of the fruit-producing areas are in the western half of the county, where the proximity of Lake Michigan reduces the effects of frost. The production of fruit tree nursery stock and Christmas tree plantations are important enterprises. Oceana County is second in the State in revenue from Christmas tree sales. Some of the farmland in the county is used for livestock enterprises and hay crops. The livestock are mainly hogs, beef, and dairy cows, while alfalfa is the primary hay crop.

1.05 Industry and Transportation

The main industry in Oceana County is farming. Specialty crops are marketed fresh, frozen, or canned. The other main industries are tourism; the production of lumber for pallets, crates, and baskets; and machine tooling and casting. Tourism is a vital part of the economy along the County's coastline. Pentwater and the Silver Lake area are major summer attractions. The main highway in the county is U.S. Route 31, which runs north and south through the western half of the county. The major State roadways are M-20, which runs east and west through the south-central part of the county; and M-120, which runs along the Newaygo County line to Hesperia. Residents and visitors to Oceana County depend upon a system of county roads that are mainly two-lanes. The county's largest airport is the Oceana County Airport in Shelby Township. Two privately operated airports are the Double JJ Ranch Airport in Grant Township, and the Silver Lake Airport in Benona Township.

1.06 Physiography

The bedrock beneath Oceana County is covered by a thick layer of glacial deposits, which formed through the complex action of the Lake Michigan Lobe of the Wisconsin glacial ice sheet. Glacial action resulted in five dominant features; moraines, till plains, lake plains, outwash plains, and drainageways. Other geological features in the county are sand dunes and beach ridges. The thickness of the glacial drift (unconsolidated sediment) over bedrock ranges from 600 feet in the northern part of the county to 200 feet in the southern part. The bedrock is sedimentary and has been downwarped toward the center of the State to form the edge of a huge bowl-like structure called the Michigan basin. This bedrock formed during the Mississippian Period. It consists of the Coldwater shale formation in the western part of the county, the Napoleon-Marshall sandstone formation in the central part, and the Michigan gypsum formation in the eastern part. Part of a major moraine is in the county. The Port Huron moraine is a large morainic system that extends around the State, roughly parallel with the coast. Within the county, it generally extends in a northeasterly direction from the area of New Era to east of Crystal Valley. The dominant features of the moraine are three distinct ridges that reach the highest elevations in the county. The ridges are dissected by outwash channels. The till plains are on the eastern and western sides of the end moraine. The largest till plain is in Leavitt Township. Other areas of till are in Weare, Hart, and Claybanks townships. The major areas of lake plains are directly east of the sand dunes in the county. The lake plains include a small area around Stony Lake in Benona Township, and a larger area extending from the Silver Lake area north into Mason County. An area near the southeast corner of the county was part of a glacial lake. The outwash plains are mainly in the south-central and southeastern parts of the county. The largest outwash area is in the eastern part of Otto Township and the western part of Greenwood Township. Other areas of outwash are smaller and are mainly on the eastern sides of moraines. The major drainageways are the north and south branches of the Pentwater River in the northern part of the county; South Branch of the Pere Marquette River in the northeast; Stony Creek in the southwest; and the north and south branches of the White River in the southeast. The General Soil Map-Oceana County, Michigan is contained in the appendices.

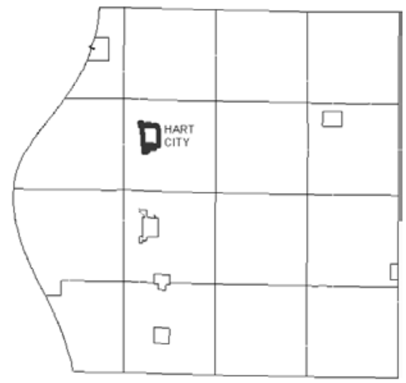
1.07 Lakes and Rivers

Oceana County has about 65 lakes and 4 major rivers. The largest lakes are Silver Lake (690 acres), Pentwater Lake (430 acres), Stony Lake (278 acres), McLaren Lake (271 acres), and Hart Lake (240 acres). Bodies of water that are more than 40 acres in size make up a total of about 3,245 acres in the county. The major rivers are the North and South Branches of the Pentwater River and the North and South Branches of the White River. The North Branch of the Pentwater River flows in a southwest direction through Weare Township and into Pentwater Lake. The South Branch of the Pere Marquette River also clips the northeastern corner of the county. The South Branch of the Pentwater River flows in a northwest direction through Elbridge and Hart Townships and into the North Branch of the Pentwater River. The North Branch of the White River flows in a south-southwest direction through Newfield, Ferry, and Otto townships and into the South Branch of the White River. The South Branch of the White River flows in a southwest direction from Hesperia through Greenwood Township and into Muskegon County.*

**Extracted, with revisions, from "Oceana County Soil Survey", Natural Resources Conservation Service, USDA, 1996.*

2.0 CITY PROFILE SUMMARIES

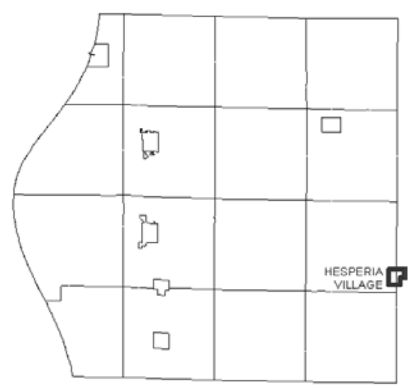
2.01 Hart City



Hart, the county seat, is located along US-31 in the western portion of the county about seven miles from Lake Michigan. This scenic town is situated adjacent to Hart Lake, formed by a dam on the Pentwater River. Hart was founded by several early pioneers, including Nelson Grove, the first to arrive in 1856. Another early settler was Wellington Hart, whom the city was named after a couple of years later. In 1862, Lyman Corbin built a sawmill and gristmill here, giving the area some permanence. Later, he built additional structures and helped officially plat the area in 1864, naming it after the township. It became the county seat in 1865, was incorporated into a village in 1885 and was later incorporated as a city in 1946. The 2010 population of the city was 2,126 persons, with an estimated 2,180 persons during the summer seasonal period. A total of 582 persons commuted to work, with an average commute of 15.1 minutes. In 2010, there were 849 total housing units, of which 757 were occupied and 21 were seasonal or occasional use. Major critical public or private facilities in the city consist of four schools, two medical care facilities, three group homes, two senior housing facilities, the County Building, Annex and Jail, police and fire departments, the County fairgrounds, a public water system, a public wastewater system, a hydro-electric plant, a linear State Park, and around eight major employers. Major natural terrain features are Hart Lake, Russell Creek and Pentwater River.

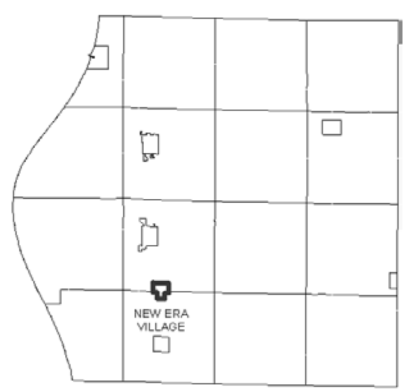
3.0 VILLAGE PROFILE SUMMARIES

3.01 Hesperia Village



Hesperia Village is located in Newfield Township on the South Branch of the White River in the southeast corner of Oceana County. Its eastern portion is in Denver Township in Newaygo County. The 2010 population of the village was 954 persons, with an estimated 969 persons during the summer seasonal period. A total of 387 persons commuted to work, mostly outside of the village, with an average commute of 26 minutes. In 2010, there were 431 total housing units in the village, of which 382 were occupied and six were seasonal or occasional use. Major critical public or private facilities in the village consist of four schools, a medical center, three apartment buildings, the Village Hall, police and fire departments, a public water system, and one dam. Besides Hesperia Community Schools, there is one other major employer. Major natural terrain features are the South Branch of the White River and the Hesperia Pond.

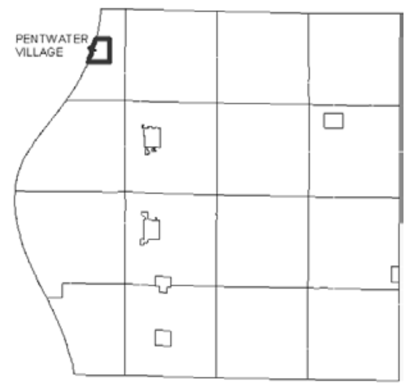
3.02 New Era Village



New Era Village is located on the border between Grant and Shelby townships in the southwest quadrant of Oceana County. Gilbert B. Goble and Dr. Spaulding founded this village in 1870. Mr. Goble became the first postmaster on May 15, 1872, with the office in the depot of the Chicago & Western Michigan Railroad. On November 6, 1877 Joseph Zeck took office. This village was incorporated in 1948. The 2010 population of the village was 451 persons, with an estimated 456 persons during the summer seasonal period.

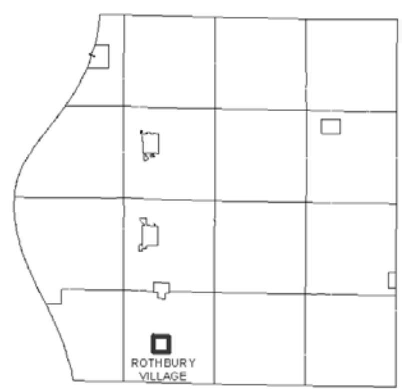
A total of 271 persons commuted to work, mostly outside of the village, with an average commute of 21.1 minutes. In 2010, there were 188 total housing units in the village, of which 173 were occupied and two were seasonal or occasional use. Major critical public or private facilities in the village consist of the Hart-Montague Trail, two schools, the Village Hall, and one major employer (outside of the schools).

3.03 <u>Pentwater Village</u>



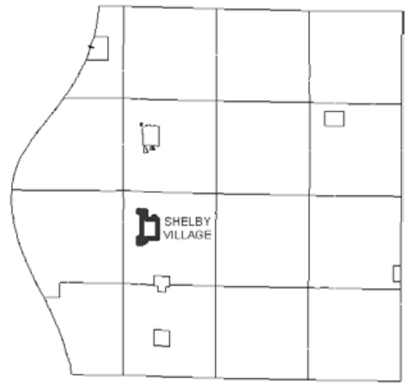
Pentwater Village is located in Pentwater Township in the northwest corner of Oceana County at the mouth of the Pentwater River along the channel at Lake Michigan. This town is truly one of the gems of the Great Lakes, situated along a clean, white sandy shoreline, with resorts, stores, shops, inns, bed-and-breakfasts, and restaurants that each reflect a balance of past and present. Pentwater comes alive in summer as boats and recreational vessels bring visitors to enjoy the sun, water, food and festivities the town offers. First called Middlesex, the town was founded by Charles Mears who built a sawmill in 1856. The following year it was incorporated as a village and officially named Pent Water, later changed to Pentwater in 1894. It was either named after the narrow openings to the river from Pentwater Lake or possibly misnamed from "paintwater" after the dark color of Pentwater Lake. The State Park beach on the north side of town bears the name of Charles Mears. The 2010 population of the village was 857 persons, with an estimated 1,772 persons during the summer seasonal period. A total of 316 persons commuted to work, mostly outside of the village, with an average commute of 19.9 minutes. In 2010, there were 997 total housing units in the village, of which 450 were occupied and 484 were seasonal or occasional use. Major critical public or private facilities in the village consist of three schools, one group home, one apartment building, the Village Hall, police and fire departments, a public water system, a state park, channel access to Lake Michigan, and one major employer (outside of the schools). Major natural terrain features are the Lake Michigan shoreline with sand dunes and Pentwater Lake.

3.04 <u>Rothbury Village</u>



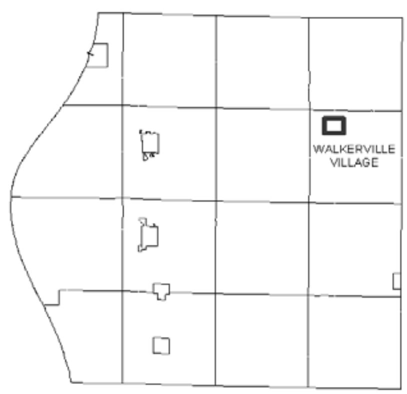
Rothbury is located in southern Oceana County in Grant Township. This small town functions primarily as a commuter city to the greater Muskegon area, and is also supported by a large iron foundry on the east side of town. Rothbury was first established around 1865 when its first settler, Nelson Green moved here. It became known as Greenwood after Green gave the Chicago & Northwestern Railroad right of way to his property. In 1879, the name was changed to Rothbury by the village, naming it after the post office station, as there was already another Greenwood in another county. The 2010 population of the village was 432 persons, with an estimated 432 persons (the same number) during the summer seasonal period. A total of 152 persons commuted to work, mostly outside of the village, with an average commute of 24.9 minutes. In 2010, there were 162 total housing units in the village, of which 124 were occupied. Major critical public or private facilities in the village consist of the Hart-Montague Trail, one school, one group home, the Village Hall, the police department, and two major employers.

3.05 Shelby Village



Shelby is located in west/central Oceana County and is easily accessed from US-31, which runs a mile west of town. Shelby's economy is supported by tourism, local stores and businesses, many of which are located in an industrial park located at the north end of town. Shelby is also located on the Hart-Montague Bicycle Trail, a popular attraction and one of the first "rail-to trail" projects in the state. Surrounding agriculture also plays a significant role, as Shelby is located in the middle of a rich fruit-growing region. Shelby was originally established as Churchill's Corners in 1866, named after Walter H. Churchill who was the first postmaster. It was renamed Shelby in 1885 when it was incorporated as a village – after General Isaac Shelby, who along with his famous Kentucky Rangers, took back Detroit from the British in the War of 1812. The 2010 population of the village was 2,065 persons, with an estimated 2,068 persons during the summer seasonal period. A total of 877 persons commuted to work, with an average commute of 16.2 minutes. In 2010, there were 772 total housing units in the village, of which 689 were occupied and one was seasonal or occasional use. Major critical public or private facilities in the village consist of the Hart-Montague Trail, four schools, one hospital, one group home, four apartment and senior housing buildings, the Village Hall, police and fire departments, a public water system, and three major employers (outside of the schools).

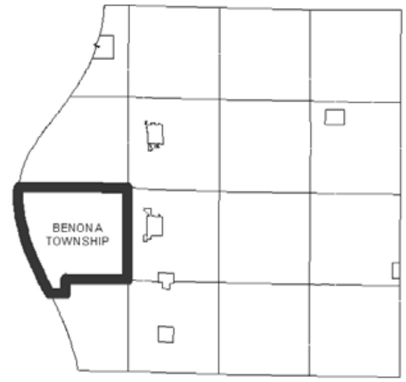
3.06 Walkerville Village



Walkerville is located in Leavitt Township in the northeastern quadrant of Oceana County. This small community is supported mainly by agriculture and tourism, being adjacent to several lakes and fishing streams located in the surrounding Manistee National Forest. Walkerville was named after Fayette Walker, who officially platted the land in 1883. At that time, it was also a station on the short-lived Mason & Oceana Railroad, which had a 27-mile line in the area during its brief existence. The town was officially incorporated as a village in 1908. The 2010 population of the village was 247 persons, with an estimated 259 persons during the summer seasonal period. A total of 89 persons commuted to work, mostly outside of the village, with an average commute of 28.4 minutes. In 2010, there were 103 total housing units in the village, of which 84 were occupied and four were seasonal or occasional use. Major critical public or private facilities in the village consist of three schools, the Village Hall, police and fire departments, a county road commission garage, a power transmission line, and a Wolverine Power transmission line and substation. The major employer in the village is Walkerville Public Schools.

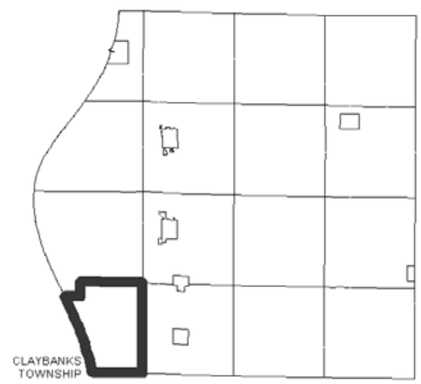
4.0 TOWNSHIP PROFILE SUMMARIES

4.01 Benona Township



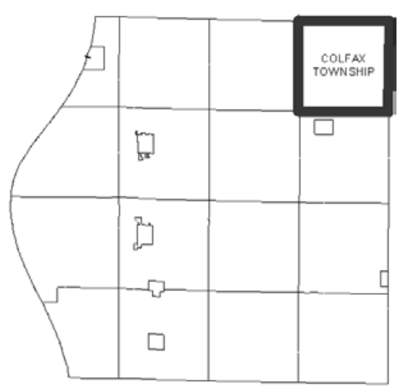
Benona Township is located in the west-central part of Oceana County along the shoreline of Lake Michigan. The terrain is mostly forested with rolling hills and sand dunes along Lake Michigan. Cultivated agricultural lands and scattered rural and seasonal housing are interspersed throughout the terrain. A major feature is Stony Lake and area in the southwestern corner of the township. This is a significant residential, resort, and recreational location with several camps, campgrounds, parks, and golf course. The 2010 population of the township was 1,437 persons, with an estimated 2,092 persons during the summer seasonal period. A total of 568 persons commuted to work, mostly outside of the township, with an average commute of 21.5 minutes. In 2010, there were 1,320 total housing units in the township of which 600 were occupied and 653 were seasonal or occasional use. Major critical public or private facilities in the township consist of the Township Hall and the privately operated Silver Lake Airport.

4.02 Claybanks Township



Claybanks Township is located in the southwest corner of Oceana County along the shoreline of Lake Michigan. The terrain is somewhat forested with rolling hills and sand dunes along Lake Michigan. Cultivated agricultural lands and scattered rural and seasonal housing are interspersed throughout the terrain. Besides the sand dunes, major natural terrain features are Jakes and Park lakes and Flower Creek. The township is a significant residential, resort, and recreational location with several camps, campgrounds, and parks in the area. The 2010 population of the township was 777 persons, with an estimated 1,196 persons during the summer seasonal period. A total of 395 persons commuted to work, mostly outside of the township, with an average commute of 28.8 minutes. In 2010, there were 529 total housing units in the township of which 322 were occupied and 176 were seasonal or occasional use. The only identified critical public or private facility in the township is the Township Hall.

4.03 Colfax Township

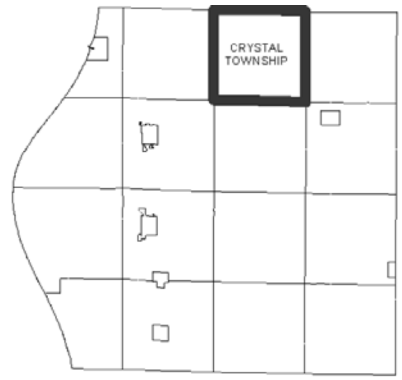


Colfax Township is located in the northeast corner of Oceana County. The terrain is mostly forested with rolling hills. Major natural terrain features are School Section Lake, Ruby Creek, South Branch Pere Marquette River, and about 8,700 acres of the Manistee National Forest. Cultivated agricultural lands and scattered rural/seasonal housing are interspersed throughout the terrain. The township is a residential, resort, and recreational location with several camps and campgrounds. There is also a major modern sawmill and a large hog farming operation. The 2010 population of the township was 462 persons, with an estimated 1,061 persons during the summer seasonal period. A total of 194 persons commuted to work, mostly outside of the township, with an average commute of 30.9 minutes. In 2010, there were 511 total housing units in the township of which 196 were occupied and 254 were seasonal or occasional use.

Identified critical public or private facilities consist of the Township Hall, one dam, a Wolverine Power transmission line, and three major employers.

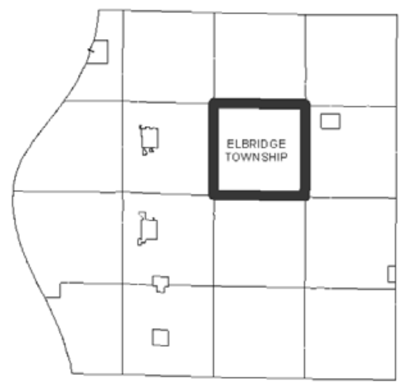
4.04 Crystal Township

Crystal Township is located in north-central Oceana County. The terrain is mostly forested with rolling hills. Major natural terrain features are Crystal and Cleveland creeks, and about 6,400 acres of the Manistee National Forest. Cultivated agricultural lands and scattered rural and seasonal housing are interspersed throughout the terrain. The 2010 population of the township was 838 persons, with an estimated 927 persons during the summer seasonal period. A total of 576 persons commuted to work, mostly outside of the township, with an average commute of 25.8 minutes. In 2010, there were 404 total housing units in the township of which 281 were occupied and 30 were seasonal or occasional use. Identified critical public or private facilities in the township include the Township Hall, fire department, one dam, and a power transmission line.



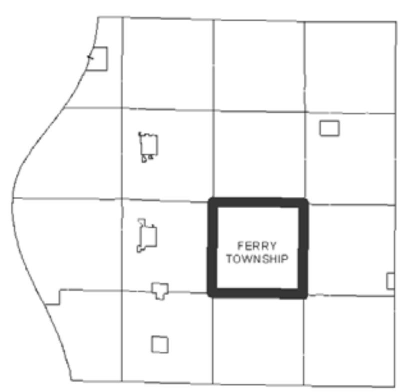
4.05 Elbridge Township

Elbridge Township is located in the center of Oceana County. The terrain is mostly forested with rolling hills. Major natural features are the Pentwater River, Routley Creek, Reunions Creek, Swinton Creek, Osborn Creek, Cobmoosa and Evans lakes, and the Manistee National Forest. The township is a rural community characterized by agriculture with scattered rural housing and natural land cover. The 2010 population of the township was 971 persons, with an estimated 1,058 persons during the summer seasonal period. A total of 464 persons commuted to work, mostly outside of the township, with an average commute of 33.5 minutes. In 2010, there were 482 total housing units in the township, of which 332 were occupied and 30 were seasonal or occasional use. Identified critical public or private facilities in the township include the Township Hall, one dam, a natural gas pipeline, two power transmission lines.

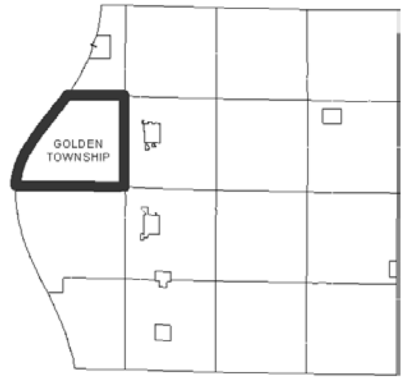


4.06 Ferry Township

Ferry Township is located in the center of Oceana County. The terrain is mostly forested with rolling hills. Major natural features include Knox Swamp, Robinson Creek, Swinton Creek, the North Branch of the White River, and the Manistee National Forest. Cultivated agricultural lands and scattered rural and seasonal housing are interspersed throughout the terrain. The 2010 population of the township was 1,292 persons, with an estimated 1,495 persons during the summer seasonal period. A total of 581 persons commuted to work, mostly outside of the township, with an average commute of 31 minutes. In 2010, there were 637 total housing units in the township, of which 496 were occupied and 78 were seasonal or occasional use. Identified critical public or private facilities include the Township Hall, fire department, county road commission building, county transfer station, DNR field office, and a power transmission line.

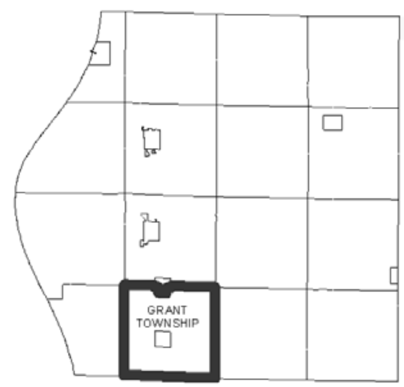


4.07 Golden Township



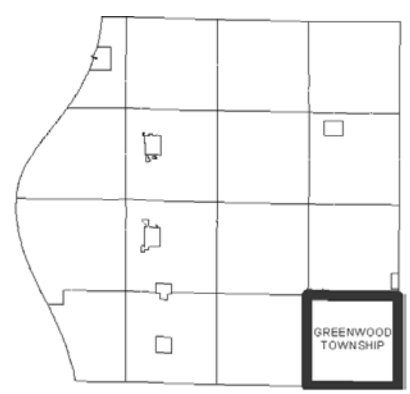
Golden Township is located in west-central Oceana County along the shoreline of Lake Michigan. The terrain is mostly forested with rolling hills and sand dunes along Lake Michigan. Other major natural features include Silver Lake, Upper Silver Lake, Silver Lake State Park, and Pere Marquette State Forest. There are floodplains along the Lake Michigan shoreline, Silver Creek, Hunter Creek, Lambricks Creek, Golden drainage ditch, and around Silver Lake. Cultivated agricultural lands and scattered rural and seasonal housing are interspersed throughout the terrain. The Silver Lake area is a significant residential, resort, and recreational location with several camps, campgrounds, parks, a golf course, and the Hart-Montague Trail. The 2010 population of the township was 1,742 persons, with an estimated 5,031 persons during the summer seasonal period. A total of 563 persons commuted to work with an average commute of 17.2 minutes. In 2010, there were 2,366 total housing units in the township, of which 781 were occupied and 1,475 were seasonal or occasional use. Identified critical public or private facilities include the Township Hall, three dams, and a propane distribution system near Upper Silver Lake.

4.08 Grant Township



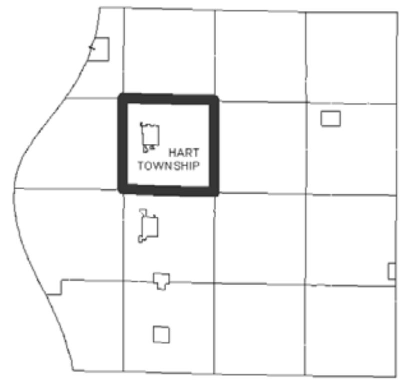
Grant Township is located in south-central Oceana County. The terrain is mostly forested with rolling hills. Major natural features are Mud Lake, Carlton Creek, and the Manistee National Forest. Cultivated agricultural lands and scattered rural and seasonal housing are interspersed throughout the terrain. A significant feature is the Double JJ Resort nearby and Rothbury Village area which contains various residential, resort, and recreational locations. The township also encompasses part of New Era Village, as well as the Hart-Montague Trail. The 2010 population of the township was 2,976 persons, with an estimated 3,131 persons during the summer seasonal period. A total of 1,354 persons commuted to work, mostly outside of the township, with an average commute of 25.3 minutes. In 2010, there were 1,290 total housing units in the township, of which 1,103 were occupied and 58 were seasonal or occasional use. Identified critical public or private facilities include the Township Hall, fire department, a natural gas pipeline, and a privately operated airport. The Double JJ Resort typically employs over 300 people.

4.09 Greenwood Township



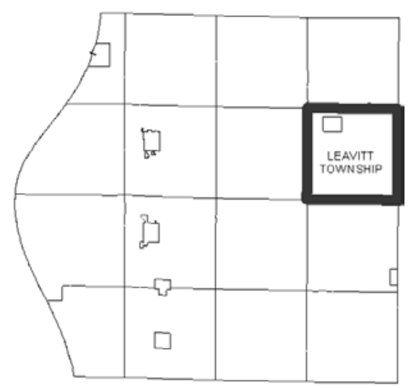
Greenwood Township is located in the southeastern corner of Oceana County. The terrain is mostly forested with rolling hills. Natural features include the South Branch of the White River, Cushman Creek, Skeels Creek, Brayton Creek, Horseshoe Lake, and the Manistee National Forest. Cultivated agricultural lands and scattered rural and seasonal housing are interspersed throughout the terrain. The 2010 population of the township was 1,184 persons, with an estimated 1,346 persons during the summer seasonal period. A total of 450 persons commuted to work, mostly outside of the township, with an average commute of 26 minutes. In 2010, there were 497 total housing units in the township, of which 403 were occupied and 55 were seasonal or occasional use. Identified critical public or private facilities include the Township Hall and a power transmission line.

4.10 Hart Township



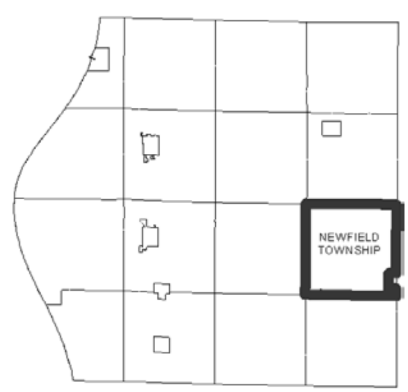
Hart Township is located in the northwest quadrant of Oceana County. The terrain is mostly farmed or forested with rolling hills. Natural features include Hart Lake, Crystal Lake, and the South Branch of the Pentwater River. Agricultural lands and scattered rural and seasonal housing are interspersed throughout the terrain. The 2010 population of the township was 1,853 persons, with an estimated 2,069 persons during the summer seasonal period. A total of 796 persons commuted to work, with an average commute of 18.7 minutes. In 2010, there were 865 total housing units in the township, of which 699 were occupied and 82 were seasonal or occasional use. Identified critical public or private facilities in the township are the Township Hall, a school, a natural gas pipeline, a power transmission line, a sewage treatment plant, a dam, a State Police Post, a county road commission garage, and various county agencies. Peterson Farms is a major employer.

4.11 Leavitt Township



Leavitt Township is located in the northwest quadrant of Oceana County. The terrain is mostly forested with rolling hills. Major natural features are Gilbert, Campbell, and Mud lakes; Beaver Creek; and about 5,400 acres of the Manistee National Forest. The township lies within the Pere Marquette River watershed and is characterized by Walkerville Village, agricultural lands, dense forests, and scattered rural housing. The 2010 population of the township was 891 persons, with an estimated 1,134 persons during the summer seasonal period. A total of 303 persons commuted to work, mostly outside of the township, with an average commute of 37.3 minutes. In 2010, there were 461 total housing units in the township, of which 310 were occupied and 86 were seasonal or occasional use. Critical public or private facilities identified include the Township Hall, a natural gas pipeline, a power transmission line, and a Wolverine Power transmission line.

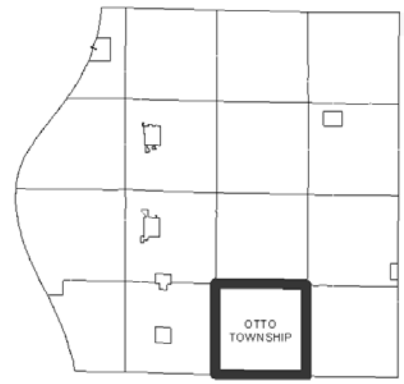
4.12 Newfield Township



Newfield Township is located in the southeast quadrant of Oceana County. Major natural features consist of McLaren Lake, the North and South Branches of the White River, and the Manistee National Forest. The terrain is mostly forested with rolling hills. Agricultural lands and scattered rural and seasonal housing are interspersed throughout the terrain. Greater concentrations of development have occurred near the Village of Hesperia and around many lakes. The 2010 population of the township was 2,401 persons, with an estimated 3,238 persons during the summer seasonal period. A total of 837 persons commuted to work, mostly outside of the township, with an average commute of 27.7 minutes. In 2010, there were 1,366 total housing units in the township, of which 946 were occupied and 322 were seasonal or occasional use. Identified critical public or private facilities in the township are the Township Hall, a fire department, and a power transmission line.

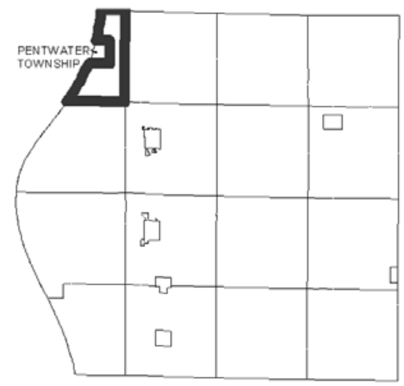
4.13 Otto Township

Otto Township is located in the southeast quadrant of Oceana County. The terrain is densely forested with rolling hills. Major natural features include the White River; Bear, Knutson, and Sand creeks; and the Manistee National Forest. Scattered rural and seasonal housing are interspersed throughout, with some agriculture along the north and northwest periphery of the township. The 2010 population of the township was 826 persons, with an estimated 946 persons during the summer seasonal period. A total of 346 persons commuted to work, mostly outside of the township, with an average commute of 27 minutes. In 2010, there were 394 total housing units in the township, of which 311 were occupied and 45 were seasonal or occasional use. The only identified critical public or private facility in the township is the Township Hall.



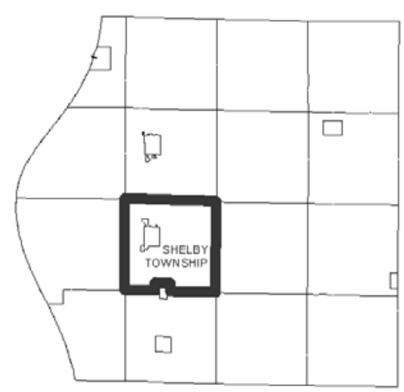
4.14 Pentwater Township

Pentwater Township is located in the northwest corner of Oceana County along Lake Michigan. The terrain is mostly forested with rolling hills and sand dunes along Lake Michigan. Major natural features are Pentwater Lake, Pentwater River, the Pentwater State Game Area, and the Pere Marquette State Forest. Development in the township is mainly focused around the Village of Pentwater and along the shores of lakes Michigan and Pentwater. This is a significant residential, resort, and recreational area with a camp, campgrounds and parks. The 2010 population of the township was 1,515 persons, with an estimated 3,362 persons during the summer seasonal period. A total of 467 persons commuted to work, with an average commute of 19.9 minutes. In 2010, there were 1,812 total housing units in the township, of which 771 were occupied and 947 were seasonal or occasional use. Other than a sewage disposal pond, there are no identified critical public or private facilities in the township outside of the Village of Pentwater.



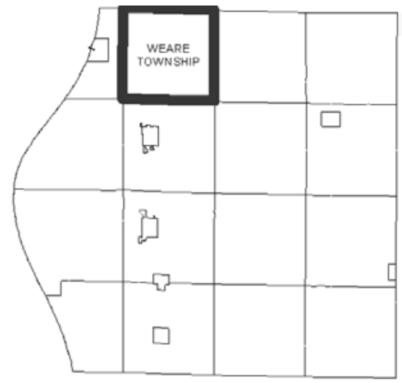
4.15 Shelby Township

Shelby Township is located near the center of Oceana County. The terrain is mainly characterized by agriculture with areas of forest and scattered rural residences. Development is typically confined to areas around the villages of New Era and Shelby, as well as along major transportation routes M-20 and Oceana Drive. Major natural features include Round Lake, Browns Pond, and the Manistee National Forest. The 2010 population of the township was 4,069 persons, with an estimated 4,124 persons during the summer seasonal period. A total of 1,687 persons commuted to work, with an average commute of 19.1 minutes. In 2010, there were 1,584 total housing units in the township, of which 1,409 were occupied and 19 were seasonal or occasional use. Critical public or private facilities found outside of the villages include the Oceana County Airport, a natural gas pipeline, a sewage treatment lagoon, and a county road commission yard.

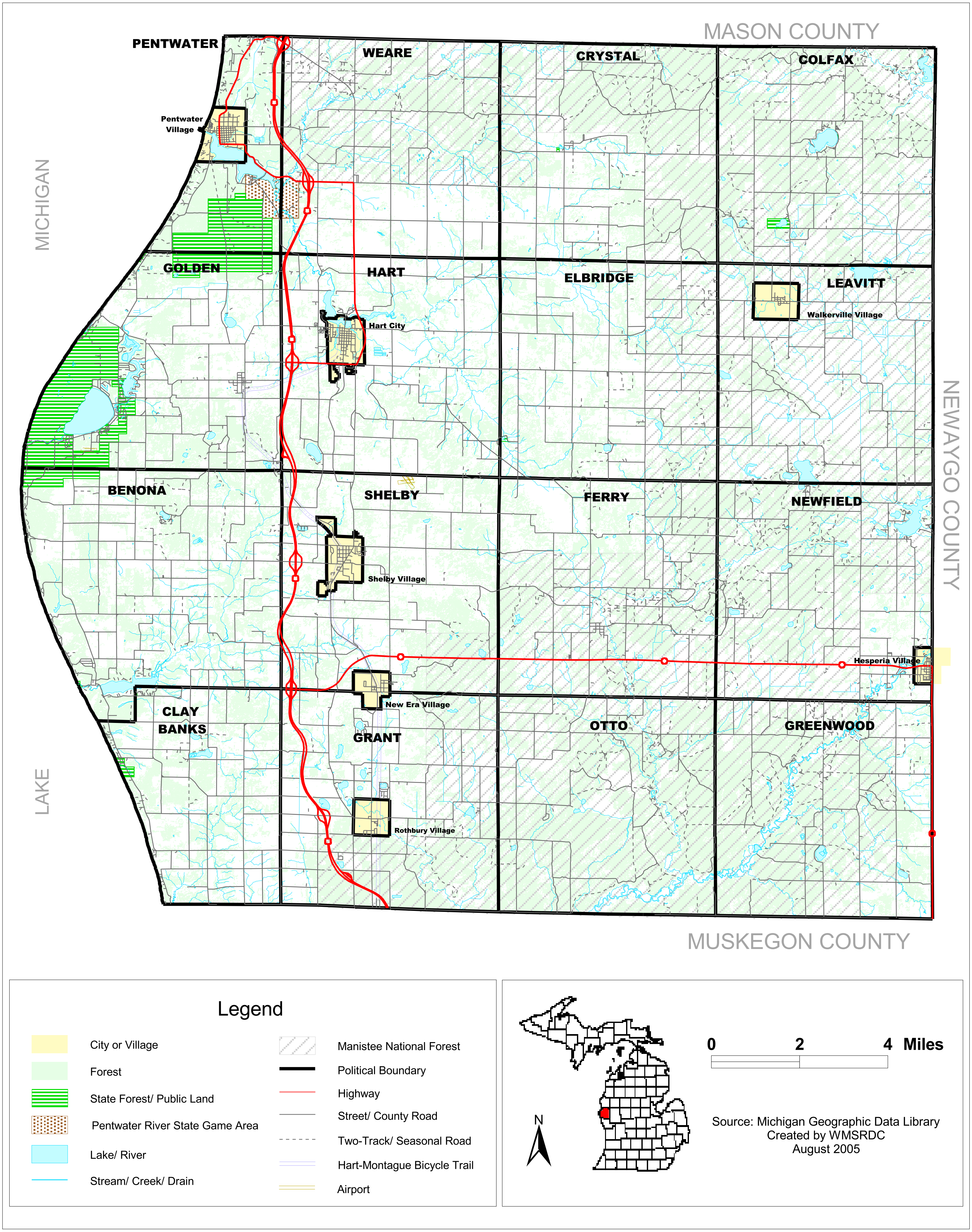


4.16 Weare Township

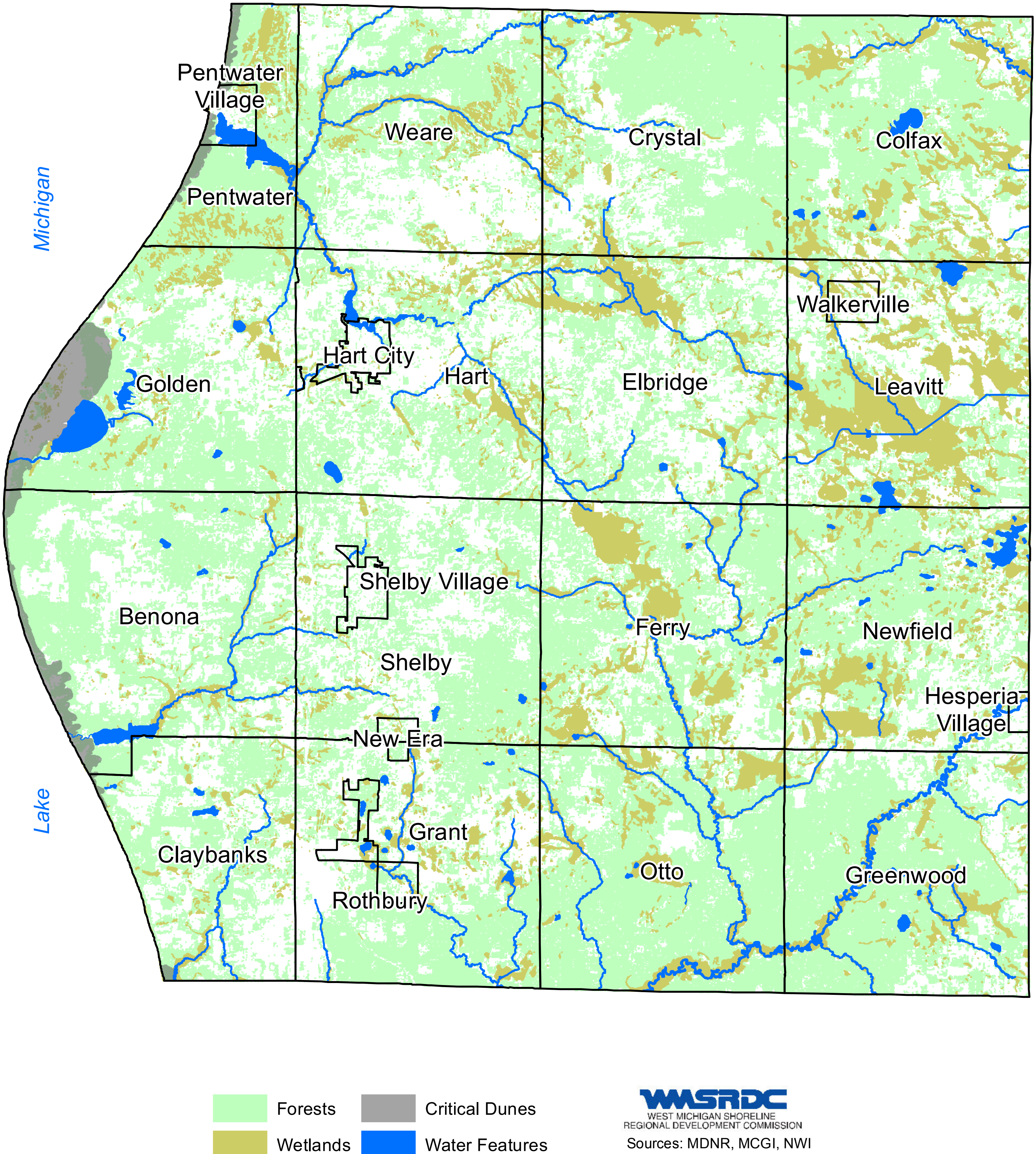
Weare Township located in the northwest quadrant of Oceana County. The terrain is characterized by forested areas, farms, and rolling hills. Major natural features are the Pentwater River; Dumaw, Cedar, Crystal, Mud, and Watson creeks; and the Manistee National Forest. Agricultural lands and scattered rural and seasonal housing are interspersed throughout the terrain. The 2010 population of the township was 1,210 persons, with an estimated 1,342 persons during the summer seasonal period. A total of 550 persons commuted to work, mostly outside of the township, with an average commute of 25 minutes. In 2010, there were 577 total housing units in the township, of which 457 were occupied and 50 were seasonal or occasional use. Critical public or private facilities include the Township Hall, a power transmission line, a natural gas pipeline, and the Mason-Oceana 911 Central Dispatch facility.



Oceana County
BASE MAP



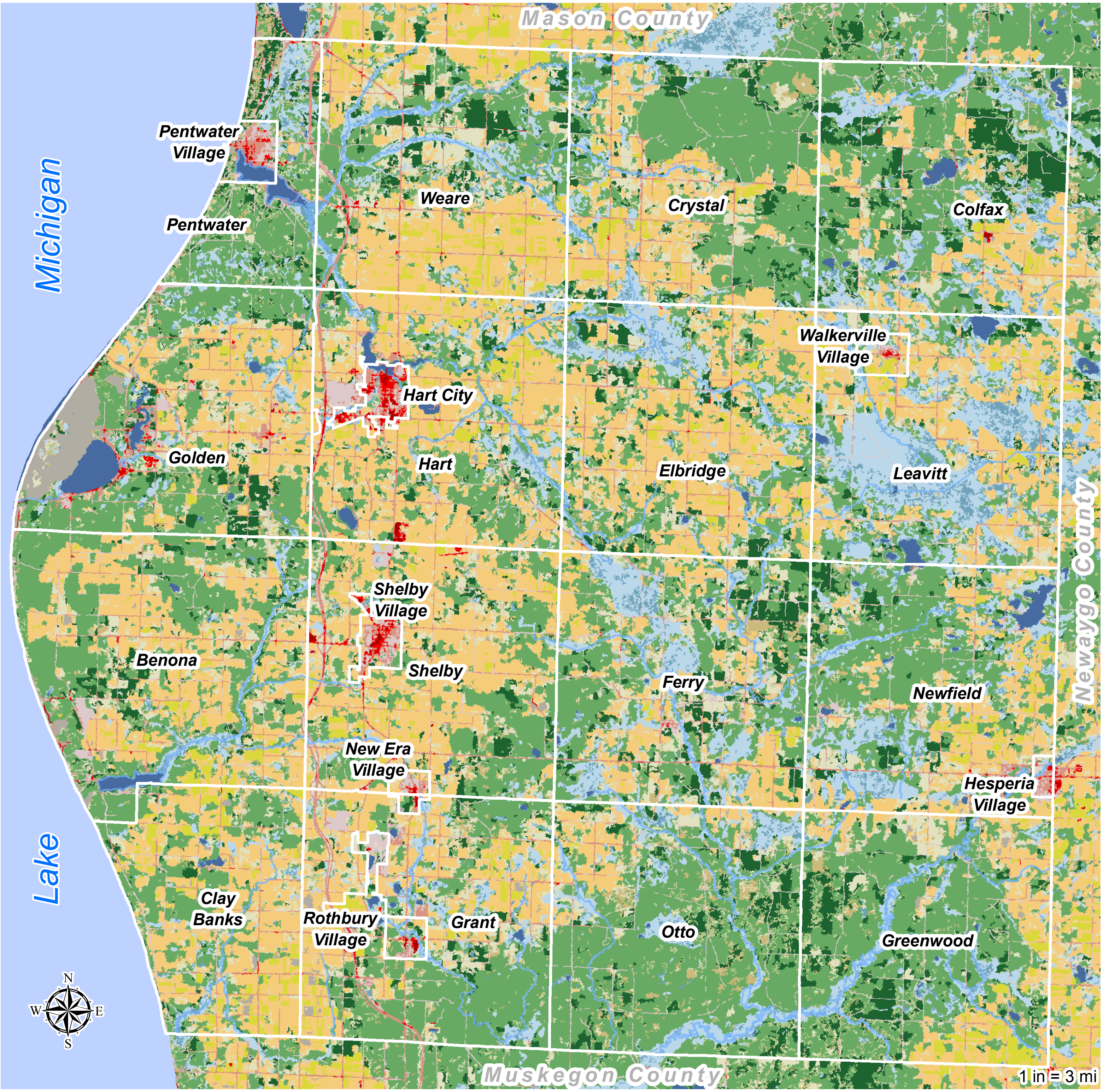
OCEANA COUNTY
Natural Features



WMSRDC
WEST MICHIGAN SHORELINE REGIONAL DEVELOPMENT COMMISSION

Sources: MDNR, MCGI, NWI
Created June 13th, 2013

Oceana County
Existing Land Cover



NLCD Classifications

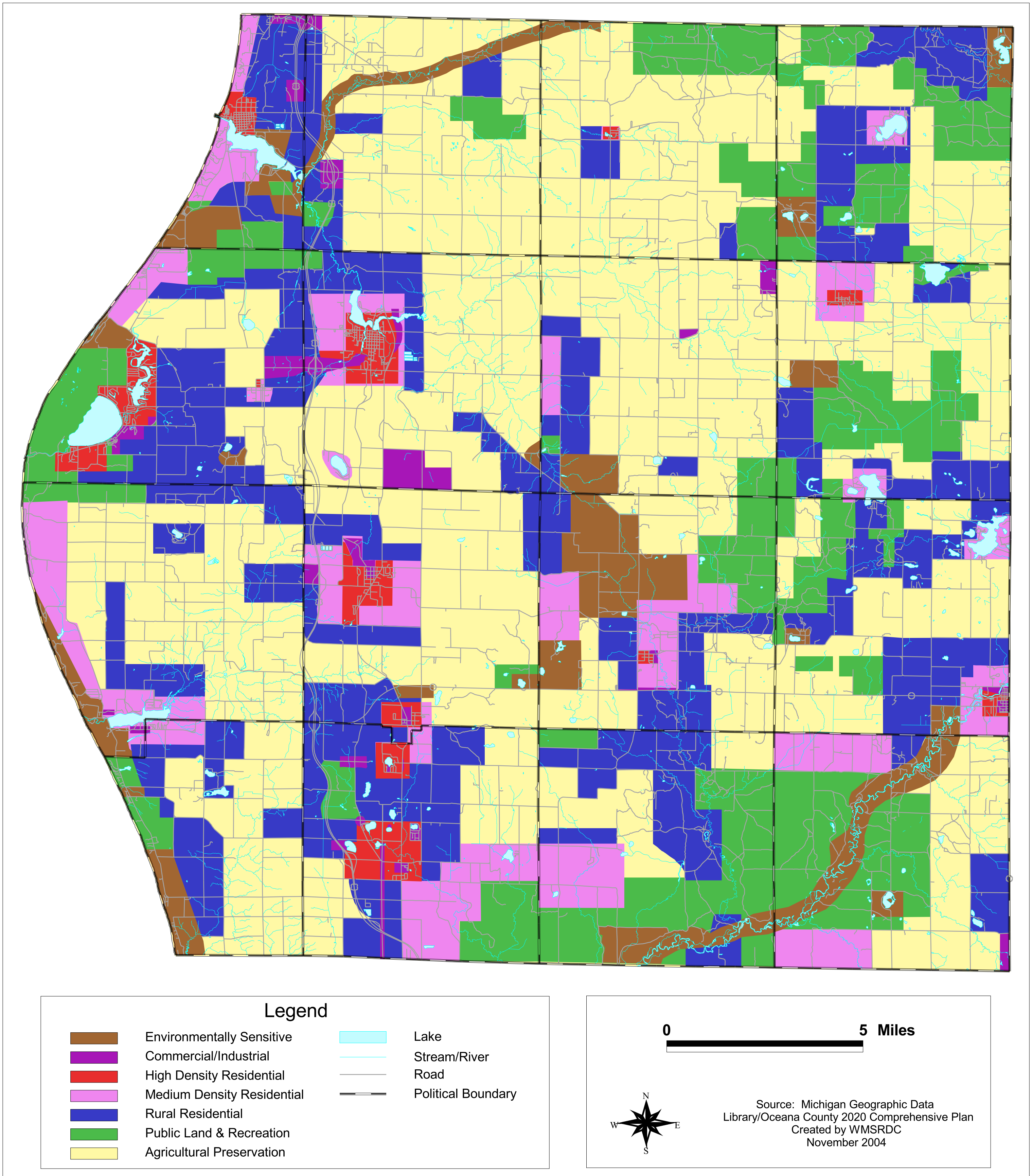
- Barren Land
- Cultivated Crops
- Deciduous Forest
- Developed, High Intensity
- Developed, Low Intensity
- Developed, Medium Intensity
- Developed, Open Space
- Emergent Herbaceuous Wetlands
- Evergreen Forest
- Hay/Pasture
- Herbaceuous
- Mixed Forest
- Open Water
- Shrub/Scrub
- Woody Wetlands

WMSRDC WEST MICHIGAN SHORELINE REGIONAL DEVELOPMENT COMMISSION

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

OCEANA COUNTY

FUTURE LAND USE MAP



Source: Michigan Geographic Data Library/Oceana County 2020 Comprehensive Plan
Created by WMSRDC
November 2004

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 Oceana 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. Oceana 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.”

<u>Significant Updates</u>

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:
- July 1936: Heat wave. 570 deaths statewide.
- Summer 1988: 39 days in Michigan with temperatures over 90 degrees Fahrenheit.
- May 16, 1997: Record cold temperatures. $2m crop damage, Oceana County.
- March 2012: Record warmth. Early growing season led to $209.8m crop losses in Michigan.

Floods (riverine, urban):
- September 10-19, 1986: Flooding. Declaration of major disaster by President.
- April 19-27, 1993: Flooding. $5m property damage across Lower Michigan.
- May 15-16, 2001: Flash flooding from severe t-storms. $550k property damage and $250k crop damage in Oceana County.
- May 21-23, 2004: Flooding. $25m property damage and $4.6m crop damage in 23 county area.
- April 17-23, 2013: Flooding. $3m property damage across Oceana County.

Great Lakes Shoreline:
- 1986: Record high water level on Lake Michigan.
- 2013: Record low water level on Lake Michigan.

Severe Winds & Thunderstorm Hazards (winds, tornadoes, hail, lightning):
- July 11, 1967: Tornado (F1). $25k property damage, Ferry Township.
- August 20 - September 6, 1975: Rainstorms, high winds. Declaration of major disaster by President.
- March 30, 1977: Tornado (F1). $25k property damage, Weare Township.
- August 12, 1978: Tornado (F2). $250k property damage.
- September 14, 1990: Tornado (F1). $25k property damage, Ferry Township.
- May 28, 1991: Tornado (F2). $250k property damage, Hart Township.
- May 31, 1998: Thunderstorms & high winds. Declaration of major disaster by President. $4m public property damage in Oceana County.
- May 12, 2000: Severe thunderstorm winds. $50k property damage, Shelby Township.
- June 1, 2000: Severe thunderstorm winds. $50k property damage, Golden Township.
- July 13, 2000: 1.75 inch hail. $50k property and $25k crop damage, Village of Walkerville.
- July 17, 2006: Severe thunderstorm winds. $250k property damage and $50k crop damage throughout Oceana County.

Severe Winter Weather (ice, sleet, snow storms):
- March 2-7, 1976: Ice storms. Declaration of major disaster by President.
- January 26-31, 1977: Blizzard, snowstorm. Declaration of emergency by President.
- January 26-27, 1978: Blizzard, snowstorm. Declaration of statewide emergency by President.
- 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 2-15, 1999: Blizzard, snowstorm. Declaration of emergency by President.
- April 3, 2003: Ice storm. $4.9m property damage throughout West Michigan.
- February 16, 2006: Ice storm. $1m property damage across Lower Michigan.

Wildfires:
- October 1871: Wildfires. 1.2m acres burned, 200 fatalities, Lower Peninsula.
- May-September, 1891: Uncontrollable wildfires across Michigan during the drought of 1891.

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 Oceana 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 Oceana County appears to be "space weather" generated by the sun. This is considered relevant to Oceana 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.

<u>Asteroids</u>: 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: Oceana County is located adjacent to 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. Oceana County is grouped with Lake, Mason, Muskegon, and Newaygo 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 Oceana 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 Oceana 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 Oceana 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, Oceana 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 Oceana 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.

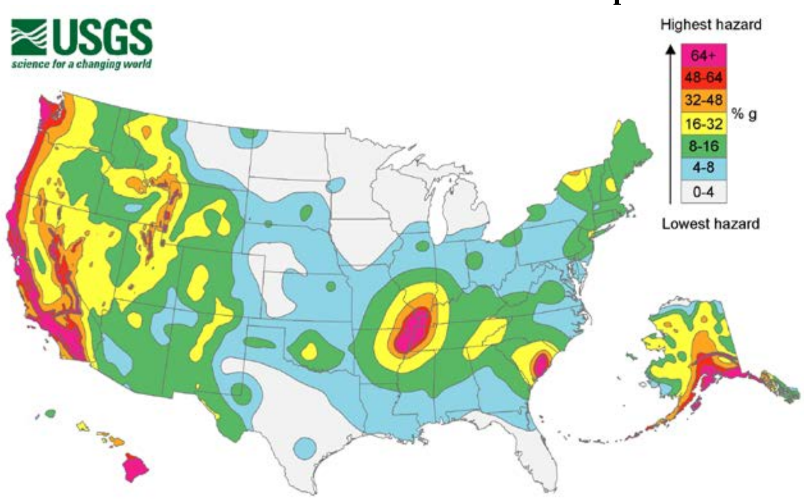
1.03 EARTHQUAKE

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 Oceana 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



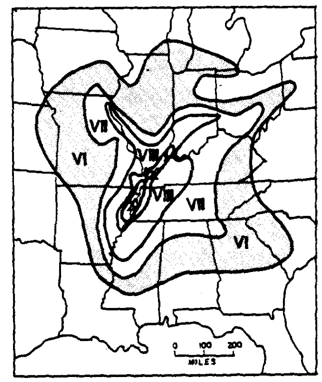
Source: http://earthquake.usgs.gov/hazards/products/

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 Oceana 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 reported across southern 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 Oceana 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.

New Madrid Seismic Zone



Regional map of maximum intensities that would result from a magnitude Ms=7.6, maximum intensity earthquake anywhere along the New Madrid Seismic Zone.

Frequency of Occurrence: According to U.S. Geological Survey maps, Oceana 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 Oceana County.

1.04 EXTREME TEMPERATURES

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

Summary: Oceana County enjoys a relatively stable and comfortable climate year-round, thanks to the moderating influence of nearby Lake Michigan. Even so, significant temperature extremes are realized every year. From 1981 to 2010, the City of Hart averaged 2 days with a high temperature of 90 degrees or more and 6 days with a minimum temperature of 0 degrees or less. Further inland away from Lake Michigan, the Village of Hesperia averaged 6 days with a high temperature of 90 degrees or more and 11 days with a minimum temperature of 0 degrees or less.

High humidity in summer and high winds in winter exacerbate the effects of temperature extremes and increase the risk of harm on human health and property, while prolonged periods of extreme temperatures can pose life-threatening problems for residents. Public education about 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. 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). Each type of extreme temperature is addressed separately 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 be possible.

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	Actual Temperature (degrees Fahrenheit)									
Humidity	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. The table below reveals the monthly average number of days with maximum temperature of 90 degrees or greater in Hart and Hesperia between 1981 and 2010.

Average Number of Days => 90°F
1981-2010

	May	June	July	August	September	Annual
Hart	0.1	0.6	1.2	0.5	0	2.3
Hesperia	0.1	1.7	2.4	1.6	0.4	6.1

Source: Michigan State Climatologist's Office

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. Building and infrastructure damage can also occur in bitter cold conditions, potentially causing expensive repairs and 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. The table below reveals the monthly average number of days with minimum temperature of 0 degrees or less in Hart and Hesperia between 1981 and 2010.

Average Number of Days <= 0°F
1981-2010

	January	February	March	April	November	December	Annual
Hart	2.2	2.3	0.9	0.0	0.0	0.7	6.1
Hesperia	4.4	3.3	1.7	0.4	0.4	1.6	11

Source: Michigan State Climatologist's Office

Historically Significant and Related Events: While Oceana 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 moderated temperature extremes throughout the year. The Oceana County Soil Survey of 1996 states that record high temperatures in the county include 104 degrees at Hart and 100 degrees at Hesperia; while the record low is -35 degrees at both Hart and Hesperia. Due to heat index and wind chill factors, the effect of these extreme temperatures on county residents was surely greater than the stand-alone temperatures would indicate.

The National Climatic Data Center (NCDC) has documentation of two cold events for Oceana County since January 1994. The record cold of January 13, 1994 warranted a Presidential Declaration of Major Disaster (Underground Freeze) for counties primarily in the Upper Peninsula. Although Oceana was not included in the declaration, it was mentioned in the NCDC list of 32 counties suffering a combined $50 million in property damages and frozen water and sewer lines from the event. The second event was for May 16's record low, which occurred in 1997 when temperatures unseasonably dropped into the 20's. The untimely cold spell caused a hard frost, which wiped out approximately 20 percent of Oceana County's annual asparagus crop and caused an estimated $2 million in damages, but would not normally be considered extreme.

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 Oceana 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 Oceana 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. Oceana 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 Oceana County and are possible any given day of the year. 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 Oceana County is likely to experience more days of severe cold than severe heat.

In the climatological period from 1981 to 2010, the City of Hart experienced a high temperature of 90 degrees or more at least once per year 66% of the time, and averaged 2.3 days per year overall. The city experienced a minimum temperature of 0 degrees or less at least once per year 93% of the time, and averaged 6.1 days per year overall. During the same period, the Village of Hesperia experienced a high temperature of 90 degrees or more at least once per year in four of every five years, and averaged 6.1 days per year overall. The village experienced a minimum temperature of 0 degrees or less at least once per year, and averaged 11 days per year overall.

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.

There are a number of rivers and streams in Oceana County whose flows occasionally exceed their banks. The county is drained a number of watercourses, most notably Lake Michigan, Pentwater River, Pere Marquette River, and White River. Ten communities in the county participate in the National Flood Insurance Program (NFIP). Flood hazard areas, delineated on flood insurance rate maps (FIRM), are primarily located along Lake Michigan, Pentwater River, and White River. There is also a flood-prone area, not identified through the NFIP, along the Pere Marquette River.

In addition, Oceana County has watercourses that are prized for their natural scenery, historic sites, and outstanding recreational attributes such as paddling and fishing. The Pere Marquette River is a National Wild and Scenic River System, while the White River is a Michigan Natural River and is under consideration for inclusion into the national system. The recreational nature of the theses waters 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 Oceana County currently participating in the CRS.

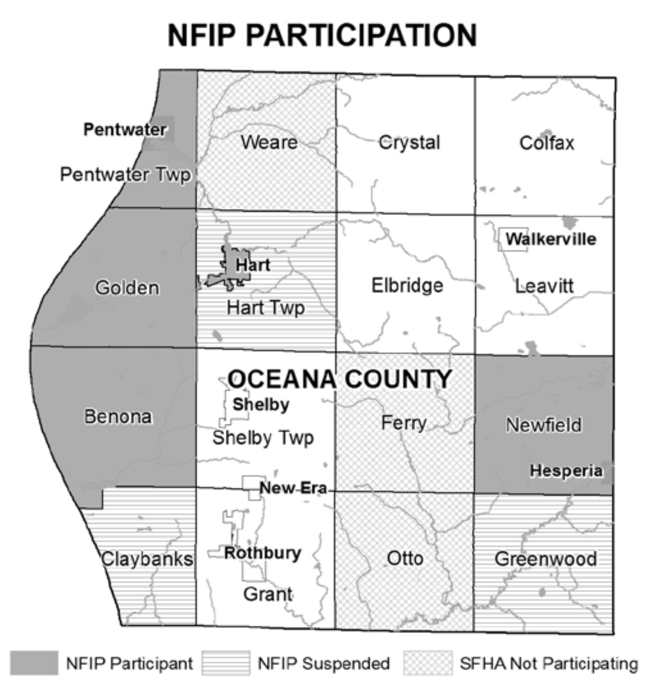
One goal of the NFIP is to reduce the number of "repetitive loss properties." A repetitive loss property is any property receiving two or more flood insurance claim payments for at least $1,000 within any 10-year period since 1978. Repetitive loss properties are a high priority because they account for approximately 33% of the total NFIP claim payments. As of October 2013, there had been no repetitive losses in Oceana County. The table below summarizes current NFIP flood insurance policies, as well as 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*
Benona Township	$13,653	12	$2,796,200	1	$0
Claybanks Township	$0	0	$0	1	$0
Golden Township	$15,480	20	$4,244,400	12	$25,602
Greenwood Township	$334	1	$175,000	2	$2,658
Hart City	$886	2	$490,000	2	$0
Hart Township	$454	1	$280,000	0	$0
Hesperia Village	$3,494	3	$327,700	2	$12,904
Newfield Township	$9,713	12	$1,674,300	2	$36,442
Pentwater Township	$5,505	8	$2,243,100	1	$0
Pentwater Village	$18,336	31	$4,044,100	4	$18,212
Oceana County Total	**$67,855**	**90**	**$16,274,800**	**27**	**$95,818**

Source: *Federal Emergency Management Agency*
http://www.fema.gov/policy-claim-statistics-flood-insurance/policy-claim-statistics-flood-insurance/policy-claim-13

As of November 2014, there were seven communities in Oceana County participating in the NFIP: City of Hart; villages of Hesperia and Pentwater; and townships of Benona, Golden, Newfield, and Pentwater. The townships of Ferry, Otto, and Weare have "special flood hazard areas" identified, but were not yet participating in the program. In addition, three townships were suspended from the NFIP: Claybanks, Greenwood, and Hart. Lastly, community members have noted that areas along the Pere Marquette River in Colfax Township have development and are known to be flood-prone. The map to the right shows NFIP participation in the county.



NFIP participation as of November 2014

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 or frozen 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 much of Oceana County is undeveloped, sources of flooding other than rivers and streams are mitigated somewhat by natural vegetation. Even so, roads, bridges, and culverts in Oceana County are susceptible to flash flooding produced by torrential rainfall.

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: Since 1975, there was one Declaration of Disaster by the Governor (October 28, 1986) and one Declaration of Major Disaster by the President (September 1986) due to flooding. Details of these events, however, are not available through the NCDC as it only maintains flood event records since 1993. In response to the 1986 flood, 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. Federal and state grants received in Oceana County for repairs are summarized in the table below.

September 1986 Flood Disaster (FEMA-0774):
State and Federally Assisted Flood Mitigation Projects

City of Hart	Acquired land for construction of emergency spillway for Hart Lake Dam; constructed emergency access road to dam; automated floodgates for dam; stabilized stream bank.
Village of Pentwater	Replaced and relocated lift station within floodplain.

Source: Michigan Hazard Analysis, December 2001

NCDC lists eight additional flooding events between 1993 and 2013, six of which caused damage. One of these occurred on April 19-27, 1993, when communities across southern Lower Michigan incurred approximately $5 million in property damages. Another event on May 15-16, 2001, saw thunderstorms dump up to 8" of rain on Oceana County, washing Pentwater's 6th Street storm drain into Pentwater Lake and causing $550 thousand in property damage and $250 million in crop damage across Oceana County. One of the worst floods since 1986 came in May-June 2004. Oceana County was not included in the state or federal declarations of disaster, but was included in the NCDC report of $25 million of property damage and $4.6 million of crop damage across 23 counties in Lower Michigan. More recently, the flood of April 2013 lead to about $3 million in property damage in Oceana County.

Frequency of Occurrence: At the very least, minor flooding is likely to naturally occur every year in Oceana County. The northwestern and southeastern areas of the county are more likely to experience a higher degree of riverine flooding due to watercourses and drainage basins of the White and Pentwater rivers. In addition, riverine flooding is more likely to occur when Lake Michigan is at or near record levels, as it was in 1986. The levels of the Great Lakes are cyclic, but impossible to predict at this point.

There are floodplains identified in eight out of the ten municipalities in Oceana County currently participating in the National Flood Insurance Program. By definition, these areas have at least a 1% chance per year of flooding. Refer to the Hazard/Risk Profile maps in Appendix B for approximate delineations of floodplain areas in the county.

Recent history suggests that a major flooding event might occur as often as once every 10 to 15 years in Oceana County. Two such events (1986, 2004) occurred in 28 years from 1986 through 2013. It is likely that less-significant floods will occur at the rate of about once every two to three years. There are eight such events documented by NCDC in 20 years from 1993 through 2013.

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 Oceana 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 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 Oceana County.

Historically Significant and Related Events: There is one fog or freezing fog event listed in the NCDC for Oceana 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 nearby 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 Oceana 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.

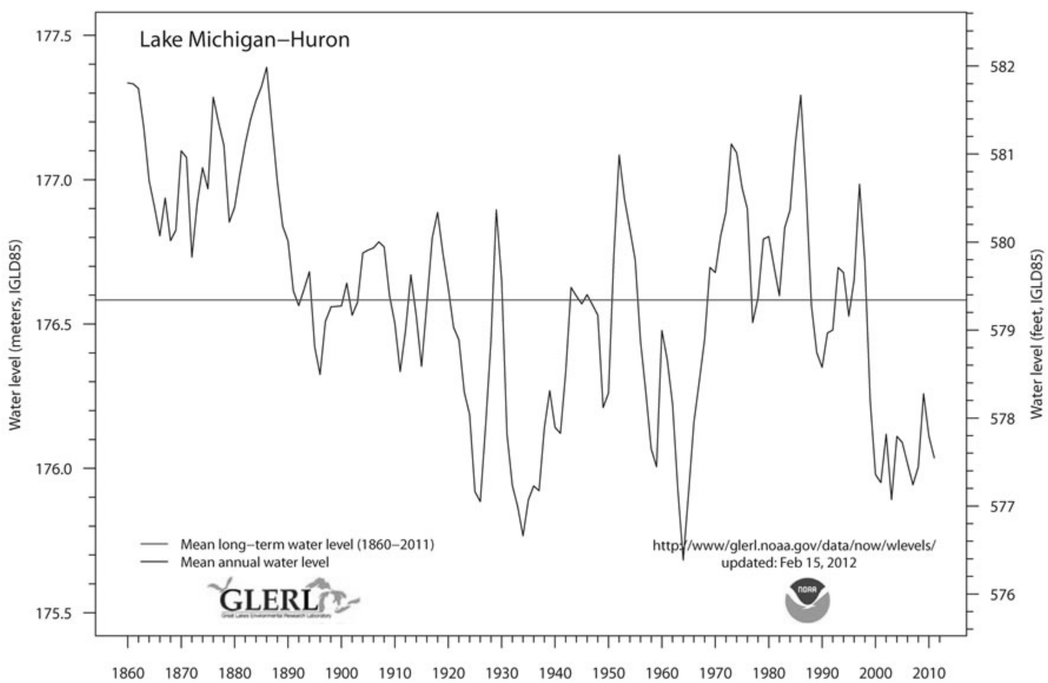
Summary: With about 30 miles of Lake Michigan coastline, Oceana County is at risk from Great Lakes shoreline hazards. Approximately 21% of the county's population resides within the shoreline communities of Pentwater (village and township), Benona Township, Claybanks Township, and Golden Township. Each community has at least one public access point for recreation. In addition, Oceana County has one recreational harbor on Lake Michigan located in Pentwater, complete with piers on the north and south side of the Pentwater Lake Channel.

Shoreline flooding and erosion are natural processes that occur constantly, regardless of 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 water levels can also present hazards, such as shallow shipping and recreation channels or increased exposure of polluted lake-bottom debris.

Other shoreline hazards include severe winds, seiches, and rip currents. These conditions can be life-threatening for boaters and swimmers, and are often exacerbated by the presence of structures, such as breakwalls, and river mouths.

Hazard Description: The Great Lakes occupy an area of 95,000 square miles and drain an amount of land twice that size. They hold nearly one-fifth of the world's fresh surface water. Because the Great Lakes' watershed is so vast, seasonal changes in precipitation within the basin have a direct effect on water levels. However, this relationship is not immediately evident because of the delay between the time precipitation falls within the drainage basin and the time that runoff waters enter the lakes.

Long-term and seasonal variations in precipitation and evaporation rates primarily determine the fluctuation of water levels on the Great Lakes. Over one hundred years of record keeping have not indicated a simple, easily-predictable cycle of water levels on the Great Lakes. 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.



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 wind 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.

Under Part 323, Shorelands Protection and Management, the Michigan Department of Environmental Quality (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 erosion can be caused from one or several factors, including high water levels, storms, wind, ground water seepage, surface water runoff, and frost. The high risk erosion area regulations require a setback distance oto protect new structures from erosion for a period of 30 to 60 years, depending on the size, number of living units, and type of constructions. All four shoreline townships of Oceana County contain one or more sections of high-risk erosion areas. These areas can be viewed on the Hazard/Risk maps found within Appendix B. In addition, the MDEQ also designated flood risk areas along Michigan's shoreline, meaning that they have floodplain-like areas with a 1% annual chance of a designated flood level being exceeded. The entire coastline of Oceana County has received this designation. In general, low-lying lands along the coastline are prone to shoreline flooding during both high and low lake water periods. For more information about flooding, see section "1.05 Flooding: Riverine/Urban."

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 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 Oceana County's character is defined by Lake Michigan, 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. 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.

While high water levels generally increase the risk of flooding and erosion, low water levels can cause significant economic impacts as well. Among those most affected by the low water levels are the shipping companies that operate massive, 1,000-foot-long iron ore and coal carriers on the Great Lakes. Low water levels can force these cargo ships to lighten their loads by as much as 6,000 tons to reduce their drafts and avoid running aground in channels and ports. Also, ferry services that transport people to and from islands may be forced to shut down because of low water depths. Significant drops in water levels can also result in an increase in demand for dredging projects, which can be very expensive. In addition to the high cost of the dredging itself, homeowners and marina operators are faced with the cost of safely disposing of sediments that have been contaminated with heavy metals, pesticides, diesel fuel and other toxic substances. Under strict environmental laws, such dredged material must be deposited in confined disposal facilities.

Aside from precipitation rates and human influences, weather-related events can also cause water level fluctuations lasting 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. Seiches can produce dangerous shoreline conditions called rip currents.

A rip current is a strong flow of water returning seaward from the shore. When wind and waves push water towards the shore, the previous backwash is often pushed sideways. This water streams along the shoreline until it finds an exit back to the sea. The resulting rip current is usually narrow and located between sandbars, under piers, or along jetties. The current is strongest at the surface, and can dampen incoming waves, leading to the illusion of a particularly calm area. Rip currents cause approximately 100 deaths annually in the United States, more than all other natural hazards except excessive heat.

From 2002 through 2012, Lake Michigan has the highest number of rip current-related fatalities and rescues of all the Great Lakes, with 77 fatalities and at least 230 rescues. The majority of these incidents occurred along the eastern and southern shoreline. There are numerous factors, but the primary explanation is that the prevailing wind direction is westerly, or onshore, across the eastern shore of Lake Michigan, making it more prone to rip current development. Secondly, there are a higher number of recreational locations on the Michigan side of the lake; therefore more people are at risk. Rip currents occur less frequently on the western side of Lake Michigan. The main type of rip current on Lake Michigan is the structural rip current, where the longshore current interacts with a pier or breakwall extending out into the lake, such as the pier at Pentwater Lake. The typical weather pattern for the development of these rip currents is any that involves onshore flow or flow parallel to the shore, which enhances the longshore current. This typically manifests itself as an approaching or exiting cold front, where onshore winds are either southwesterly (ahead of the front) or northwesterly (behind the front). Lastly, seiches can cause uneven distributions of water in the nearshore environment, leading to rip current development.

In May 2012, the National Weather Service began testing a new warning product, called a Beach Hazards Statement, in certain areas of the United States. Oceana County is located within one of those areas. This warning informs beach goers and local authorities about a multitude of hazards in a single statement and provides safety information on these hazards. Some examples of the types of hazards (but not limited to) which may be included in the Beach Hazards Statement are…dangerous currents in the surf zone or unusual surf/wave/water conditions. In coordination with other agencies (as needed), the product may also inform users of various types of environmental hazards such as chemical spills, harmful algal blooms, and other unusual hazards.

For swimmers experiencing a rip current, the most important action is to conserve one's strength so as to stay afloat (rather than expending one's strength in an over-desperate struggle to "fight the current"). Once out of the rip current's pull, head back to shore at a pace that is appropriate to one's strength. In some circumstances, a swimmer may have been observed by beach lifeguards while being pulled by the current, and in such a case, if waves and weather are not too severe to allow a rescue, a swimmer may simply need to stay afloat until the lifeguards can bring aid.

Another Great Lakes hazard is the potential effect of severe winds upon boating activities. Although some discussion of marine accidents can be found in the Transportation Accidents section of this chapter, it must be noted here that severe winds tend to be felt more strongly on open waters (winds from an approaching storm front often strike in advance of the storm itself, by 5 minutes or even more). Waterspouts (which are like a tornado involving contact with water instead of land) are a common occurrence posing a great threat to marine traffic and recreation.

Historically Significant and Related Events: According to the Michigan Hazard Mitigation Plan, there have been 10 major periods of flooding/erosion on the Great Lakes since 1918. Extremely high water level peaks occurred in 1929, 1952, 1973, 1986, and 1997. During one of these periods in 1972-1973, 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 in damage to shoreline communities. The record high water levels in 1986, when Oceana County was granted a Presidential Disaster Declaration for Riverine and Shoreline Flooding, caused severe erosion that required the relocation of homes away from Lake Michigan. In 1997-1998, high Great Lakes water levels occurred again, approaching the record levels set in the 1980's.

Low water levels are also cyclical and can have severe economic impacts in the form of dredging and sediment disposal costs and marine transportation hazards. Extreme low water levels occurred in 1926, 1934, 1964, and 2003. The low water levels in lakes Michigan, Huron and Erie between 1998 and 2004 were the fastest decline in water levels in the Great Lakes in nearly a century and a half. Between the summer of 1997 and the spring of 2003, the lakes Michigan, Huron, and Erie each dropped by almost five feet. In December 2012, the water level on Lake Michigan was the lowest ever recorded for that month. The following January, a new all-time recorded low level was achieved, eclipsing the previous record low established in March 1964.

From 2002 through 2012, there were 77 rip current fatalities and 230 rescues (307 incidents) on Lake Michigan. On August 3, 2011, a 13 year old girl was caught up in the rip current along the northern pier near Charles Mears State Park in Pentwater. She went under, but a 29 year old man was able to reach her near the south pier. A few days later, the girl died at a hospital in Grand Rapids, MI. Winds at the time were from the northwest at 10 to 20 miles per hour, though for the evening prior to the incident, the winds were 15 to 25 miles per hour. Waves were in the 3 to 5 feet range at the time of the incident, though witnesses indicated that the waves may have been more like 6 to 8 feet.

Finally, a seiche caused a massive storm surge that stretched from Holland to Pentwater on July 13, 1938. According to an article in Hope College's Joint Archives Quarterly, waves triggered by the seiche drowned three people at Holland State Park. It also caused "freak high waves" that drowned a swimmer in Muskegon and another man canoeing in Lake Michigan near Pentwater.

Frequency of Occurrence: Though water levels on the Great Lakes are known to be cyclical, the timing, extent, and duration of high and low periods can only be estimated. According to the Michigan Hazard Mitigation Plan, about 10 major periods of flooding/erosion have occurred on the Great Lakes since 1918, or approximately once per decade.

In the 11-year period 2002-2012, there was an annual average of seven fatalities and 21 rescues (28 total incidents) on the shores of Lake Michigan related to rip currents. Most of these incidents occurred on the southern and eastern shores of Lake Michigan due in part to prevailing onshore or longshore winds.

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. Oceana County experiences between 32 and 36 thunderstorms annually, many of which produce hail. There are numerous records of golf ball-sized (1¾") hail in the county, as well as approximately $435,000 in total damages to property and crops associated with hail events documented by the National Climatic Data Center.

The impacts of hail on humans and property are somewhat mitigated by Oceana County's relatively low population density and scattered nature of development. On the other hand, crops in the county are certainly susceptible to damage from hail. 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.

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

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.

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: Oceana County is no stranger to hailstorms. The NCDC lists 34 hail events since 1955, 13 of which meet today's criteria for "severe" hail. All events occurred in the months of March through October. May was the most common month with 26% of the reported events. Severe hail reports were confided to the months of April, May, June, and July. May was also the most common month when severe hail was reported.

Between 1996 and 2012, there are 27 documented hail events, 11 of which were severe. Damages from hail (both sub-severe and severe) have been recorded 21 times since 1996, totaling $260,000 in reported property damages and $175,000 in reported crop damages.

A notable severe hail event was observed in July 2000, when 1.75 inch hailstones caused $50,000 in property damages and $25,000 in crop damages in the Village of Walkerville. Another significant hail event took place in Oceana County on May 6, 2004. Although this event failed to reach "severe" criteria, .88-inch hailstones caused approximately $20,000 in property damages and $20,000 in crop damages across the county. This instance shows that hail need not be severe to cause damage.

Severe Hail in Oceana County
1955 - 2012

Date	Location	Size
5-14-68	n/a	1.75 in.
6-20-79	n/a	1.75 in.
4-12-96	Shelby	1.75 in.
7-30-00	Walkerville	1.75 in.
4-18-02	Pentwater	1.00 in.
5-6-02	Mears	1.00 in.
5-6-02	Shelby	1.00 in.
5-10-03	New Era	1.00 in.
6-26-06	Ferry	1.00 in.
7-9-06	Walkerville	1.00 in.
6-14-08	Mears	1.00 in.
6-08-11	Shelby	1.75 in.
5-3-12	Hart & Shelby	1.00 in.

Source: National Climatic Data Center

Frequency of Occurrence: With between 32 and 36 thunderstorm days per year (Michigan Hazard Mitigation Plan), it is highly likely that Oceana County will experience multiple sub-severe hail events annually. There are 13 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 four to five 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 27 reported events, 11 of which were severe. Therefore, based on recent trends, Oceana 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 Oceana 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 Oceana County is covered by agriculture, 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. Invasive aquatic species also pose a threat to water features in the county. In addition, Oceana 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 Oceana County appear to be from agricultural and forest pests, as well as 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 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: There are hundreds of known invasive species in Michigan and the Great Lakes. There are hundreds of potential threats as well. The effects of these invaders are often a mere nuisance; however, cases exist where effects are costly and damaging. The discussion below provides a small sample of the overall invasive species threat.

Though not a significant issue in Oceana County, the Emerald Ash Borer has caused extensive damage to trees in parts of Michigan. 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 Oceana 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 nine miles north of Oceana 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.

The character of Oceana County is closely tied to, and influenced by, the presence of Lake Michigan. The Great Lakes provide a potential conduit for the transportation of exotic and invasive species from other regions in North America and worldwide. Below is a list of invasive species in the Great Lakes, according to the Great Lakes Information Network.

Invasive Species in the Great Lakes Region

Current Invaders	
Crustaceans:	Rusty Crayfish, Spiny Water Flea
Fish:	Round Goby, Tubenose Goby, Rudd, Ruffe, Sea Lamprey, White Perch
Mollusks:	Quagga Mussel, Zebra Mussel
Plants:	Curly-leaf Pondweed, Eurasian Waterfoil, Phragmites, Purple Loosestrife
Viruses:	Viral Hemorrhagic Septicemia Virus (VHSv)
Potential Invaders	
Fish:	Asian Carp

Source: Great Lakes Information Network
http://www.great-lakes.net/envt/flora-fauna/invasive/invasive.html

Frequency of Occurrence: The effects of invasive species are inherently unpredictable. Insufficient data exists regarding significant impacts incurred as a result of invasive species in Oceana County. However, it should be recognized that invasive and exotic species are a constant threat, including those that occur in agricultural, 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. Oceana County experiences between 32 and 36 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 Oceana 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, about 2,000 thunderstorms are occurring at any given time, producing 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

Gender of Victims
· 84% male; 16% female

Months of Most Strikes
· July (30%); August (22%); June (21%)

Most Likely Time Period of Reported Strikes
· 2:00 PM – 6:00 PM

Number of Victims
· 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 Oceana County. There are, however, statewide statistics derived from NCDC data that lend historical credence to the risk of lightning in Oceana County. The tables at the end of this section detail lightning-related injuries and deaths in Michigan from 1959 to 2005.

Frequency of Occurrence: Although Oceana County typically experiences between 32 and 36 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 Oceana County. Statistics show that individuals engaged in outdoor activities are generally at a higher risk from lightning during a thunderstorm.

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

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 to cause damage in Oceana County and may occur simultaneously with other hazards such as lightning, hail, tornadoes, and heavy rains. Oceana County annually experiences between 32 and 36 thunderstorms, 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 2007-2011 American Community Survey 5-year Estimates, mobile homes alone make up nearly 20% of Oceana's housing. This type of housing may either be concentrated in mobile home parks 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 at the end of this section for information on mobile home densities and distribution in Oceana County.

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.

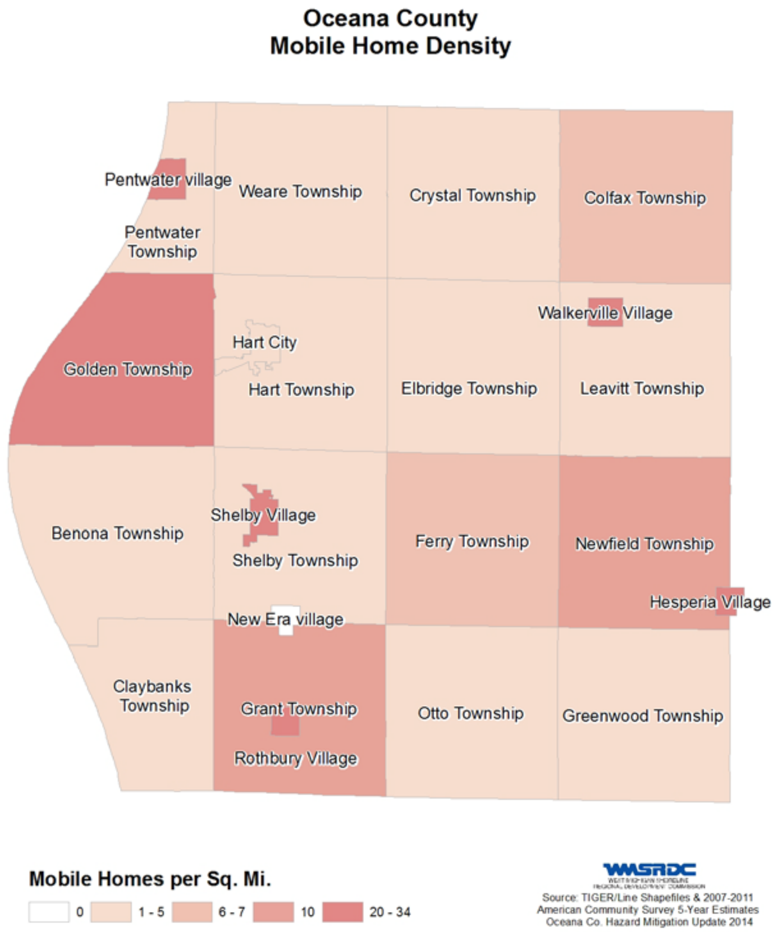
The Federal Emergency Management Agency (FEMA) has produced a wind zone classification map for the United States that divides the country into four winds zones and identifies areas that are susceptible to hurricanes and special wind regions (see map in Appendix C). The zones range from I – IV, with IV having the highest potential winds. According to the map, Oceana 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.

Mobile Homes in Oceana County

Community	# Mobile Homes	% of Homes in Municipality
Oceana County *	3,108	19.4
Hart City	5	0.6
Hesperia Village	18	4.1
New Era Village	0	0.0
Pentwater Village	38	4.1
Rothbury Village	20	14.2
Shelby Village	58	7.3
Walkerville Village	24	25.0
Benona Township	114	8.2
Claybanks Township	31	5.6
Colfax Township	260	**46.2**
Crystal Township	114	31.1
Elbridge Township	124	24.5
Ferry Township	200	**34.1**
Golden Township	**731**	31.9
Grant Township	**364**	27.2
Greenwood Township	110	19.4
Hart Township	110	11.9
Leavitt Township	165	**37.6**
Newfield Township	**359**	25.1
Otto Township	98	28.0
Pentwater Township	47	2.7
Shelby Township	131	8.3
Weare Township	145	24.2

** total of city and townships only; village totals already included within township totals*

Source: American Community Survey 2007-2011 5-year Estimates



Historically Significant and Related Events: Severe winds are a fairly common occurrence in Oceana 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 warm months in the spring, summer, and fall. The county has received two Presidential Disaster Declarations related to winds. The first was the result of rainstorms and high winds from August 20 – September 6, 1975. The second followed the passage of an intense derecho on May 31, 1998.

The NCDC has documented 59 wind events in Oceana County between 1955 and 2013, of which 51 were attributed to thunderstorms. About two-thirds of all recorded wind events occurred in July (all resulting from thunderstorms), which is more than any other month. In the 21-year period from 1993 through 2013, 34 thunderstorm wind events were observed in Oceana County, causing $4.55 million in damage to property and $50 thousand in damage to crops.

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, Oceana County sustained $4,018,760 in public damage costs, 37 injuries, 26 homes destroyed, 1415 homes damaged, 6 businesses destroyed, and 109 businesses damaged. Across Michigan, the derecho killed four people, injured 146 people, and caused an estimated $166 million worth of damages. With over 600,000 of its customers without power, 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. Oceana County declared a local state of emergency following this event and was granted a Governor's Disaster Declaration to activate state assistance for the county on June 3-5, 1998. On June 24th, President Clinton granted a Major

Disaster Declaration for "winds from thunderstorms" for thirteen west Michigan counties, including Oceana, making federal disaster assistance available. This particular derecho formed in South Dakota on the evening of May 30 and raced across Minnesota, Iowa and Wisconsin, before striking the Lower Peninsula around 4:30 a.m. An in-depth analysis and maps of this derecho, along with documented wind strengths can be found at:
http://www.spc.noaa.gov/misc/AbtDerechos/casepages/may30-311998page.htm.

Another notable severe thunderstorm event caused significant wind damage across the county on July 17, 2006. The storm caused $250,000 worth of property damage and $50,000 damage to crops. For lists of other recent severe thunderstorm and high wind events in Oceana County documented by the NCDC, see the "Hazard Identification Profile" tables in Appendix B and "National Climatic Data Center: Storm Events" tables in Appendix C.

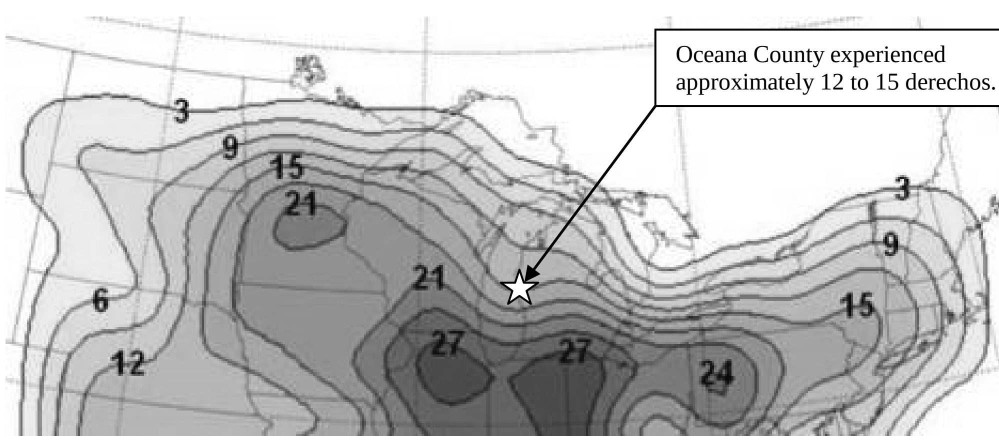
In addition to thunderstorms, Oceana County has experienced numerous severe wind events associated with strong weather systems. These damaging events are often characterized by constant strong winds, with occasionally severe gusts, affecting large areas for hours or even days. Nine "high wind" events listed by the NCDC have involved Oceana County from 1993 through 2013. One of these events happened 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: Oceana County is subject to between 32 and 36 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 Oceana County is at risk of experiencing this phenomenon.

Long-term data from 1955 through 2013 suggest that Oceana County averages about one severe wind event every year (59 events in 59 years). However, increased consistency of storm documentation since the 1990's suggests that Oceana County will experience wind events more frequently. Observations from 1993 through 2013 yield 42 events over 21 years, demonstrating that severe wind events are documented about twice per year within Oceana County.

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

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



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

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: Overall, subsidence is not considered a significant threat in Oceana County. In Michigan, the primary cause of subsidence is underground mining. Mining, however, is not a part of Oceana County's history. 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 Oceana County. The use of groundwater for agriculture may also contribute to this threat.

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 table below:

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.

There is a network of infrastructure in Oceana County which includes water, wastewater, and stormwater pipes and culverts. Failure of any of these has the potential to cause erosion-related subsidence hazards. Currently, broken water pipes and the improper discharge of rainwater are the most common causes of water-related subsidence in Michigan. It primarily occurs when 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: There are no documented incidences of subsidence related to mining or groundwater withdrawal in Oceana County, however the risks associated with excessive groundwater withdrawal, as well as water-induced erosion along roads and Lake Michigan, warrant a cursory analysis of subsidence as a potential hazard.

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

1.13 TORNADOES

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

Summary: Although just five tornadoes have been observed in Oceana County between 1950 and 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, Oceana 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, and 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 eight levels of damage to 28 different indicators.

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. Regardless of any amount of preparation, ample warning is the best way to save lives in the event of a tornado.

There is a concern for mobile and manufactured homes just as there is for mobile homes undergoing severe winds. Every community in Oceana County is susceptible to tornados and 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 20% of Oceana County's housing is comprised of mobile homes. There are 3,108 mobile homes in the county according to the 2007-2011 ACS 5-Year Estimates. The townships with the highest number of mobile homes include Golden (731), Grant (364), and Newfield (359). In addition, mobile homes make up over 30% of the housing stock in five townships: Colfax (46.2%), Leavitt (37.6%), Ferry (34.1%), Golden (31.9%), and Crystal (31.1%).

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

Historically Significant and Related Events: According to NCDC storm data, there have been five tornadoes in Oceana County since 1950. Three tornadoes (1967, 1977, 1990) were classified "F1" and caused approximately $25,000 in property damages each. The remaining two (1978, 1991) were classified "F2" and caused approximately $250,000 in property damages each.

The surrounding counties of Lake, Mason, Muskegon, and Newaygo have seen 26 tornadoes (31 including Oceana) over the same 63-year period. Therefore the total number of observed tornadoes in Oceana County, as it relates to the county's overall tornado risk, is misleading. With exception of two unrated tornadoes in Muskegon County, all of these tornadoes were F0, F1, EF1, or F2.

Tornado Touchdowns by Month
- 1950 through 2012 -

Oceana County and Adjacent Counties*									
Month	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.
Tornadoes	2	8	4	5	3	4	4	0	1
Percentage	6.5%	25.8%	12.9%	16.1%	9.7%	12.9%	12.9%	0.0%	3.2%

**Includes Lake, Mason, Muskegon, Newaygo and Oceana counties*
Source: Storm Data, National Climatic Data Center

Frequency of Occurrence: In 63 years from 1950 through 2012, there have been five tornadoes in Oceana County reported to the NCDC. However, since Oceana County and its adjacent counties have seen 31 tornadoes over that span, the actual chance of tornado activity in the area is somewhat greater. With 62% of tornadoes occurring between March and June, observations in this area reflect the statewide tendency of tornadoes to be most common in the spring and early summer. April has the greatest frequency of tornadoes around Oceana County, claiming 25.8 percent of all tornado touchdowns in the area. Recent history shows that Oceana County and its neighbors average one tornado every two years somewhere in the area.

1.14 WILDFIRE

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

Summary: 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.

Forests cover approximately half of Oceana County's land area. The forest cover is a boon for both industry and recreation. However, it also makes many areas of the county potentially vulnerable to wildfires; including portions of the Manistee National Forest, State of Michigan-owned forests, and around the county's many camping areas. Throughout the county, private developed lands can be found adjacent to or scattered within forested lands. In addition to these "wildland-urban interface" areas, there are also wooded areas of higher risk where fairly steep slopes exist (see the topographic maps in Appendix B). Of particular concern are the high dwelling density areas located in the wooded areas of the shoreline townships, many of which lack proper access for fire equipment because of narrow drives and extreme topography.

In 2014, Oceana County completed a Community Wildfire Protection Plan with a grant from the Michigan Department of Natural Resources. That document complements and expands upon the wildfire description and analysis contained within this Hazard Mitigation Plan. For example the CWPP identifies wildland-urban interface (WUI) areas where human development intermixes or abuts natural vegetation and fuels, and estimates potential wildfire severity according to the types of vegetation and other factors.

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 (poor visibilities and air quality), closed roadways, and infrastructure impacts that may interfere with ordinary life, the economy, and planned tourism-based events; and
- Structural fires, particularly near outdoor recreation areas and wildland-urban interfaces.

The threat of wildfire may be elevated in times of drought, high heat, high wind, and/or low humidity. Unfortunately these conditions often coincide with attractive conditions for outdoor activity and recreation. This only compounds the fact that most wildfires are 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; wind storms and frost/freeze damage, increasing the availability of dead fuels; and slow/late green-up in the spring. Conversely, a harsh winter with a heavy deep snowpack can mitigate wildfire risk in the spring. Such conditions compact dead fuels, reducing their surface-to-mass ratio and allowing them to retain moisture longer.

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.

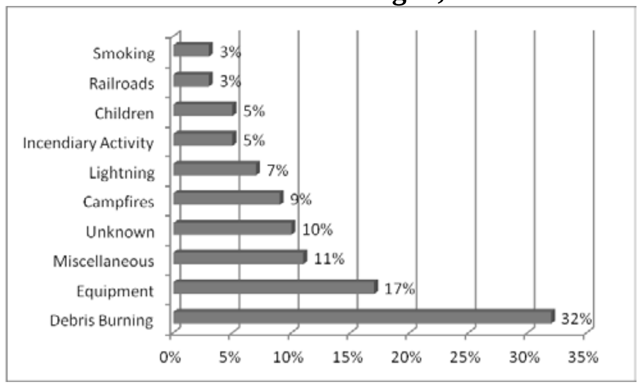
Perhaps the greatest wildfire concern in Oceana County is along the Lake Michigan shore, including the townships of Benona, Claybanks, Golden, and Pentwater. Development there is often characterized by dwellings tucked away on wooded lots. Adding to this concern is the prevalence of poor or inadequate access for first responders, such as narrow drives, extreme topography, and abundant fuels. This environment hinders fire suppression efforts and puts emergency responders at risk. The potential for significant loss is compounded by the presence of large homes and higher property values in these areas.

State and federally-owned forestlands are another variable of the wildfire equation in Oceana County. Inadequate or non-existent motorized vehicle access to densely forested areas owned by state and federal agencies is commonly cited as an issue of public safety. At least a small portion of the Manistee National Forest can be found in the townships of Colfax, Crystal, Elbridge, Ferry, Grant, Greenwood, Leavitt, Newfield, Otto, Shelby, and Weare. Colfax, Crystal, Greenwood, and Otto townships have the greatest acreage of national forest. State-owned lands in the county are highlighted by larger tracts in Golden and Pentwater townships; the Pentwater River State Game Area in Pentwater and Weare townships; and state parks in the Village of Pentwater and Golden Township.

Additional wildfire concerns in Oceana County include potential economic impacts of wildfire on agriculture, tourism, and recreation. Even a small fire could disrupt local commerce given the right circumstance. Other factors that contribute to wildfire risk in Oceana County include blight (associated with trash burning), pine stands and plantations, and oil / gas wells (specifically those with known detectable levels of hydrogen sulfide).

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, placing both people and property at risk.

Causes of Wildfire in Michigan, 2001-2011



Source: Michigan Hazard Mitigation Plan, 2011

Wildfires occur annually in Oceana County, and have had significant effects on the 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 Oceana's economy.

Wildfire incidents have continued to occur in Oceana County and nearby areas since the late 1800's despite advances in firefighting technology and methodology. These advances 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. With nearly 20 percent of Oceana County's land area owned by state or federal entities, the county has state and federal assistance for wildfire response in and around those areas.

In June 2012, a lightning-induced wildfire in Luce County in the Upper Peninsula (known as the Duck Lake fire) proved that wildfires are still a significant threat in Michigan. It burned over 21,000 acres and destroyed 136 structures including 47 homes and cabins, one hotel and one store. It was the third largest wildfire in Michigan history. A total of 300 personnel served on the Duck Lake Fire from agencies including Michigan State Police, Luce County Sheriff's Department, Red Cross, Luce County Emergency Management, Wisconsin DNR, American Red Cross, and Salvation Army.

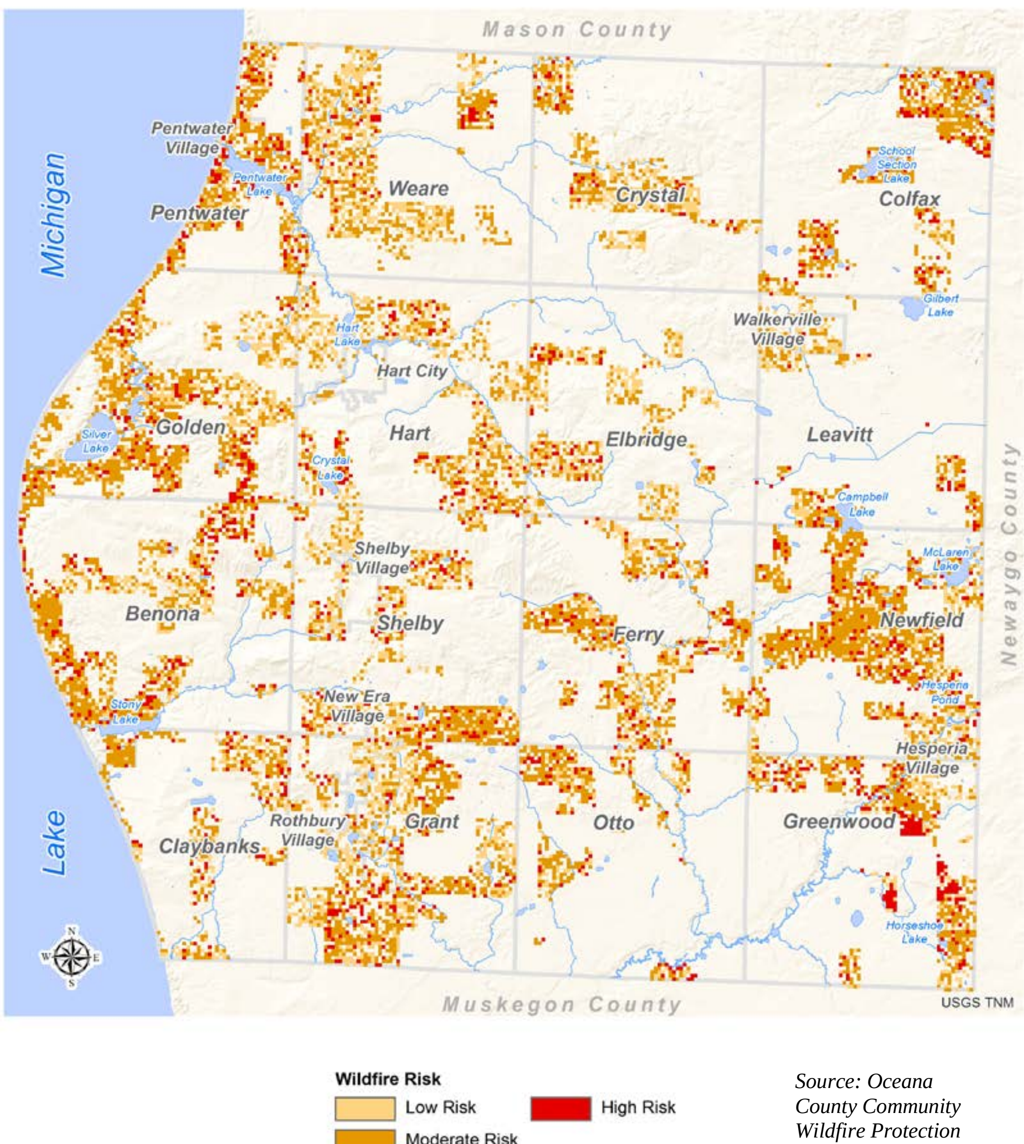
While Oceana County has not experienced a wildfire of that magnitude in recent memory, smaller scale wildfires happen numerous times each year. In 2005, a notable wildfire in Benona Township spread across 17 acres destroying 2 houses and 16 walkways, and damaging 5 other homes. Two examples of human-caused wildfires happened in Golden Township in 2012. In June, a gust of wind caused a campfire to spread to nearby dune grass along the Lake Michigan shoreline. The fire scorched 2.4 acres of land, damaged a number of residential decks, and required special equipment to maneuver around the dunes and beach sand to quell the flames. The other instance happened in July, when a fire resulted from fireworks being ignited in the area. This fire also occurred along the Lake Michigan shoreline and burned one acre of dune grass.

There were a total of 249 wildfires **reported** by the MDNR in Oceana County that burned 1,308 acres between 1981 and 2000. However, between 1981 and 2010, the number of reported wildfires under MDNR jurisdiction increased to 346, with a total of 1,766.0 acres burned. Over this 30-year period, the county annually averaged about 12 wildfires and nearly 60 burned acres per year. Since many minor wildfires over Oceana'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 Oceana 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 Oceana County has a permanent population of just 26,570, 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 Oceana County. The severity of each occurrence will depend greatly upon the time of year, climatological conditions, geographic location of the fire, as well as the response efforts and capabilities of federal, state, and local fire suppression resources.

Oceana County
WUI Wildfire Risk Map



Source: Oceana County Community Wildfire Protection Plan (2014)

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 Oceana 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, Oceana 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 Oceana County and may be exacerbated due to the county's 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 and local municipalities, such as salting, de-icing and plowing, help maintain safe road conditions in order to reduce hazardous impacts of winter weather. However, rural areas such as northeast Oceana County may be subjected to longer durations of impacts on transportation routes; depending on the road clearing strategies employed by the county road commission. 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 Oceana 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 Oceana County, there have been declarations of Major Disaster and Emergency by both the President and the Governor for snowstorms, blizzards, and ice storms. These include the President's Declarations for ice storms on March 2-7, 1976, and for blizzards and snowstorms on January 26-31, 1977; January 26-27, 1978; and January 2-15, 1999. NCDC has no information available on the amount of snowfall or damages from the 1976, 1977, and 1978 storms because snowstorm details were not collected in its database before 1993. However, local reports indicate that the 1976 event experienced long power outages and tree damage from ice. The Oceana County Hazard Analysis states that the 1978 storm brought 34" of snow and winds of 50 miles per hour. An estimated 90% of county roads were closed for an extended time. Back roads were closed for several weeks. Similar storms, though not as intense, occurred in 1967 and 1983, and resulted in similar effects.

Major Winter Storms in Oceana County

Date	Event	Details	Location
March 2-7, 1976	Ice storm	Presidential Declaration of Disaster	29 counties in Southern Lower MI
January 26-31, 1977	Blizzard, snowstorm	Presidential Declaration of Emergency	15 counties in Upper MI & Western Lower MI
January 26-27, 1978	Blizzard, snowstorm	34" snow with 50 mph winds. Presidential Declaration of Emergency	Statewide
January 2-15, 1999	Blizzard, lake effect snow	"Blizzard of '99"; worst since 1978. Presidential Declaration of Emergency	Central & Southern Lower Michigan

Source: Michigan State Police Emergency Management Division

The NCDC lists 120 severe winter weather events in the 21 years from 1993 through 2013 in Oceana County, most of which occurred in December and January. Significant ice/freezing rain was reported 14 times; and although ice/freezing rain was observed in each month from December through April, over 85% of the events were in January, February, or March.

Six of the NCDC events from 1993 through 2013 resulted in reported damages ranging from $50 thousand to $5 million across Oceana County's zone (typically west-central or southwest Michigan). The most recent damaging winter storm to affect Oceana occurred on February 16, 2006, when a major ice storm developed across much of Lower Michigan. The storm produced around ¼ to ½ inch of ice accumulation between Route 10 and I-96; caused thousands of homes to lose power from just north of Grand Rapids to Lansing north to Route 10 for up to five days; and was blamed for $1 million in property damage in Lower Michigan.

Frequency of Occurrence: There is little doubt that winter hazards will typically occur a handful of times every year in Oceana County. A graphic within the Michigan Hazard Mitigation Plan (included in Appendix C) shows that the county annually receives anywhere from 70 inches of snow over the eastern reaches of the county, to over 100 inches near the Lake Michigan shoreline. In addition, the "Annual Snowfall" table gives statistics for three weather stations in and near Oceana County for the 30-year period from 1981 to 2010. All accumulating snow at these stations occurred between the months of October through April. Each station received over 60% of its average annual snowfall in December and January.

Based on 120 severe winter weather reports collected by the NCDC from 1993 through 2013, Oceana County should expect approximately six notable winter storms every year. Though winter-like storms can happen from October through April, the most likely time for a severe winter weather event appears to be during the months of December through February. Significant ice/ freezing rain events are less frequent (occurring once every one to two years), and are most likely in the months of January through March.

Annual Snowfall
- 1981 through 2010 -

	Hart *Northwest Oceana Co.*	**Hesperia** *Southeast Oceana Co.*	**Montague** *3 mi. south of Oceana Co.*
Mean	81.65”	71.14”	74.55”
30-year Low	27.6” (1998)	39.0” (1993)	39.2” (2001)
30-year High	201.4” (2008)	144.4” (2008)	150.2” (1985)
# years over 100”	5	3	4

Source: Michigan State Climatologist’s Office

Severe Winter Events
- 1993 through 2012 -

	Nov.	Dec.	Jan.	Feb.	Mar.	Apr
# of Events	5	33	38	23	15	3
Percentage	4.3%	28.2%	32.5%	19.7%	12.8%	2.6%

Source: Storm Data, National Climatic Data Center

In the last 40 years, Oceana County has been affected by four major storms resulting in Presidential Declarations; or once every 10 years. Less significant, yet still damaging, storms should be expected more frequently. In the last 20 years, NCDC records indicate the county experienced six storms with documented property damages; or once every three to four 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 eight dams in Oceana County listed in the U.S. Army Corps of Engineers, National Inventory of Dams (NID). The hazard potential of these dams range from low to high.

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.

Oceana County has eight 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 Oceana County dams, two are rated high, two are rated significant, and four are rated low. The high hazard potential dams are located in Golden Township. The dams rated significant hazard potential are in the village of Hesperia and Colfax Township. The four low hazard potential dams are located in the townships of Crystal, Elbridge, Golden, and Hart.

Oceana County is fortunate that it is not especially vulnerable to dam failures from adjacent communities. However, failure of the Ludington Pumped Storage Plant in Mason County could impact the northwest corner of Oceana County in the Pentwater area should the banks fail on the eastern or southern sides of the impoundment.

Historically Significant and Related Events: The MDEQ has documented approximately 287 dam failures in Michigan since 1888. Since 1970, there have been nine documented in Oceana County; however specific dates, reasons, and locations for all of the failures are not available. Known failures have occurred at the Hart Hydro-Electric Dam, the Hesperia Pond Dam Spillway, and the Crystal Lake Dam Spillway (erosion). Each of these occurred in September of 1986, when Oceana County received a record 7”-10” of rainfall between September 9 and September 11. The Hart Dam collapsed under the weight of the rainwater and the 250-acre Hart Lake emptied into the Pentwater River in a matter of a few hours. Damage from the collapse included: downed trees, flooding of parking lots and backyards with corresponding erosion, and washed out roads and bridges. The State Street Bridge over Hart Lake in downtown Hart sustained damages as did the southbound bridge on US-31 over the Pentwater River, while the northbound bridge collapsed. Widespread flooding downstream from the dam was expected, but property damage in Pentwater was minimal. Evacuation of residents close to threatened areas was undertaken for safety purposes but no one was seriously injured.

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 Oceana County are believed to be in good shape and are monitored constantly (two dams have been repaired within recent years). However future failures in the county are still expected. With nine known failures between 1970 and 2012, the county averaged up to one failure every four to five years. However, since the inception of record keeping for dam failures is unknown, this estimated frequency might be too high. In addition, it is possible that all of the mentioned dam failures were the direct or indirect result of one weather event (floods of 1986). 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 Oceana 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 Oceana 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 Oceana 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 Oceana 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 Oceana 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 extinguish. In addition, scrap tire piles pose a threat to public health by providing shelter and breeding grounds for mosquitoes and small animals.

Small concentrations of scrap tires may currently exist in the eastern reaches of Oceana County. Many of these tires may have been cleaned up, thanks to two scrap tire grants awarded to land owners in Oceana County in 2012. Even so, the threat remains for 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/.

In Oceana County, it is doubtful that a fire involving scrap tires would in itself cause a severe emergency or disaster. Rather, scrap tires are more likely to add problems to an already existing fire. Although there were an estimated 44,000 scrap tires in Oceana County in 2001, many likely were cleaned up with a FEMA 2000 grant. In 2012, the Michigan Department of Environmental Quality estimated 11,000 total scrap tires at two “Registration Non-Compliant” sites in Oceana County. Two scrap tire cleanup grants totaling $13,826 were awarded in Oceana County in Fiscal Year 2012 to dispose the passenger tire equivalent (PTE) of 10,875 tires. It is possible that other, undocumented concentrations exist within the county, such as a pile that exists near Black Lake in Colfax Township.

To prevent the scrap tire fire hazard, as well as threats to public health from scrap tire piles, mitigation measures must involve the prevention of indiscriminate scrap tire dumping and include proper disposal, recycling, and reuse practices. Various “junk days,” such as the yearly Spring Clean-Up Day in Newfield Township, are held at various places throughout the county to encourage the disposal of garbage, such as scrap tires. This type of service helps to control mass accumulations of scrap tires within the county. In addition, Oceana County Transfer Station/Recycling Center accepts tires on a fee basis, and transfers them out of the county.

Historically Significant and Related Events: Although research for this document was unable to reveal a history of scrap tire fires in Oceana County, the possibility of one cannot be ignored. Because automobiles are the primary mode of transportation in Oceana County, there is a constant potential for accumulation of discarded tires. Therefore this hazard should be monitored as a potential threat to public health and safety.

Oceana County received a state grant in 2000 for scrap tire cleanup. In 2012, there were an estimated 11,000 scrap tires in Oceana County, though it is likely they have been or will be cleaned up thanks to grants awarded in fiscal year 2012.

The nearby counties of Mecosta and Osceola have experienced the following 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.

Frequency of Occurrence: Although there is no record of a serious scrap tire fire in Oceana County, the possibility of one cannot be entirely discounted as a threat in the future. 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 Oceana 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 all 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, Oceana County has relatively less risk of experiencing widespread structural fires. However, communities across the county have concentrations of historic buildings that would not meet today's standards for fire protection. Therefore, in addition to the risk of residential and wildland fires, there is a risk of conflagration in many Oceana County communities.

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. A special concern for many rural homes is the fact that emergency personnel cannot adequately respond to emergencies due to complications such as: 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." These complications may be more common within coastal dune areas along Lake Michigan and in densely wooded areas.

Many structural fire hazards may be mitigated in part through enforcement of local zoning ordinances. Oceana County does not have a county-wide zoning ordinance, and the townships of Leavitt and Colfax are the only municipalities within the County that do not maintain zoning ordinances. "Key Policies" in the Oceana County 2020 Master Plan reveal the county's intent to review local master plans and zoning ordinances to ensure their consistency with the countywide Master Plan and other county regulations.

Despite the predominately rural nature of Oceana County, another concern according to the Oceana County Hazard Analysis is the potential for large structural fires in the "core" of the county's old commercial districts. Aging wooden framed multi-story commercial buildings with common walls, substandard electrical systems and remodeled 2nd and 3rd floors, done with little or no regard for fire code, present a fire chief with his worst nightmare, especially if the higher stories are tenant occupied. Mobile home fires also present a significant threat to life. There are many mobile home concentrations scattered throughout the county; including rural areas where there are no fire hydrants. See the "Severe Winds" hazard section for mobile home statistics in Oceana County.

Historically Significant and Related Events: Structural fires are a common occurrence in Oceana County. Statistics from the Michigan State Police, Fire Marshal Division estimated that the county's fire incident rate was relatively high at 6.37 fires per 1,000 in population in 1998. In fact, it was the 9th highest out of Michigan's 83 counties, rivaling Wayne County's rate of 7.46/1,000 persons. If this rate held true for the 2010 county population (26,570), Oceana would have experienced approximately 169 fire incidents in that year. It should be noted that this estimate includes all types of fire incidents and it is not known how many of these fires would be structural.

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." The remaining fires are listed as "outside/other" (15,285) or "mobile properties" (9,475). 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. There were 171 fires in Oceana County in 2003 which caused property and contents losses of $557,300. Based on the proportion of structural fires to all types of fire in Michigan, it is likely that approximately 73 (43%) of the reported fires involved structures.

Structural fires have been a reality in Oceana County since the area was settled. In May of 1891, a major fire destroyed over half of the Village of Walkerville. More recently, a number of significant fires took place in Oceana County in 2012; each requiring the assistance and cooperation of multiple fire departments. In June, a structural fire ravaged through historic buildings in downtown Shelby, destroying four businesses and some apartments. In October a major fire destroyed a 400 ft barn at a pig farm in Leavitt Township. Both fires caused property damage but no fatalities.

Frequency of Occurrence: There will certainly be structural fires each year in Oceana 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 169-171 fires per year), Oceana County should expect to average some sort of fire once every 2 to 3 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.

As of 2012, there were 83 SARA Title III sites in Oceana County (known to store potentially dangerous amounts of hazardous materials). The vast majority of these sites are associated with agricultural practices.

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 2012, there were 83 sites in Oceana 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 is one identified hazardous material release from a fixed site in Oceana County. The incident involved the release of an unknown amount of anhydrous ammonia in the Village of Shelby on October 18, 2011. The release was caused by a cracked pipe in a compressor room at a private enterprise. There were no reported damages from the event.

In December 2012, an explosion at a pig farm in the northeast portion of the county may have been caused by a buildup of methane gas. The event damaged the barn and caused no fatalities or injuries.

Frequency of Occurrence: The limited amount of documented fixed site hazardous materials incidents prohibits the prediction of its frequency. Because there is a significant number of SARA Title III sites in Oceana County, the possibility of an illicit or accidental release cannot be overlooked.

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: The transportation of hazardous materials along roadways is a common occurrence in Oceana County; both passing through the area along highways, and directly to sites within the county. As of 2012, there were 83 SARA Title III sites in Oceana County (see discussion in 2.05 Hazardous Material Incidents: Fixed Site); most of which host industrial or agricultural activities. Therefore, the hazardous materials may be transported to developed or rural areas of the county. The most likely incident involving the transportation of hazardous materials would occur along a roadway, with the risk of such an event increasing during inclement driving conditions.

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.

There have been many minor petroleum and hazardous materials spills throughout the years on highway systems in Michigan. Although there is no record of a serious hazardous materials incident occurring on Oceana County transportation routes, there have been minor incidents. All highways within the county, with the exception of US-31, are primarily two lanes. These routes may be congested in the summer months, and are often icy or impassable in the winter. Most of the SARA Title III sites in Oceana County are associated with either agriculture or industry. In addition, many areas of the county depend upon liquefied petroleum (LP) gas, which is often delivered along rural routes. Therefore, the transportation of hazardous substances to rural locations throughout the county puts much of the area at risk of an accidental spill. Because many rural roads in Oceana County are in disrepair, there exists an increased possibility of an accident involving any hazardous material in transit.

The Hart-Shelby County Airport can accommodate twin engine aircraft and small cargo planes. It has a 3,500 foot runway and automatic lighting to allow for 24 hour service. The county also lies beneath the "fly-over" zone for aircraft plying its way back and forth between the "air hubs" of Minneapolis, Grand Rapids, Detroit and New York. At times, there may be anywhere from 12-18 aircraft flying above the county.

Similarly, the county is in a "pass-by" zone for commercial shipping on Lake Michigan. Although there are no commercial ports in Oceana County, there is one to the north in Ludington and one to the south in Muskegon. Because of this, one of the most dangerous hazardous material transportation accident scenarios that could occur in Oceana County would be a spill or release of oil, petroleum or other harmful materials from a marine cargo vessel. Such an incident, if it involved a large quantity of material, could cause environmental contamination of unprecedented proportions. Fortunately, the Great Lakes states, working in partnership with oil and petroleum companies and other private industry, have taken significant steps to ensure that a spill of significant magnitude is not likely to occur on the Great Lakes. Low water levels may increase the possibility of a ship running aground and releasing harmful amounts of contaminants into the environment.

A significant portion of incidents involving the release of hazardous materials in Michigan have involved trains. There are no active rails in Oceana County at this time, so this is not a concern.

Historically Significant and Related Events: There have been no documented incidences involving the transportation of hazardous materials in Oceana County. A significant hazardous materials incident may occur on a county roadway, airway, or bordering waterway.

Frequency of Occurrence: Since the county has no documented incidences involving the transportation of hazardous materials, frequency of this hazard cannot be determined for Oceana County. An accidental release of hazardous materials appears to be most likely along a roadway due to the significant number of SARA Title III sites within the 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: 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."

Power loss is the most common form of infrastructure failure in Oceana County, often occurring as a result of natural hazards. Isolated residences in rural areas may be exceptionally vulnerable to extended power loss events, especially during the winter months. Food processing operations and certain agriculture in the county may also be especially affected by an outage lasting for an extended period of time.

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.

In Oceana County, sewer systems are available in the City of Hart and the villages of Pentwater, Shelby, New Era, Walkerville and Hesperia. Municipal water systems are available in the City of Hart and the villages of Pentwater, Shelby and Hesperia. The age of city/village water systems presents vulnerability, since several are about 100 years of age (Hart, Shelby, Pentwater and Hesperia). Pubic wastewater systems in Hart, Shelby and Pentwater were built in the late 60’s and early 70’s and are in better condition.

There also exist electric transmission lines that traverse the county. According to local knowledge, four 135kva transmission lines owned by ITC pass through Oceana County between the Ludington Pumped Storage Plant and the Midwest Grid System. All four pass through the Walkerville Area Fire and Rescue protection area. There is concern that a loss of any one of these transmissions lines could be a major problem especially in a major blackout event. In addition, the main Wolverine Power transmission line that powers the Oceana County Great Lakes Energy system comes to the Walkerville Substation from the northeast. This line connects to a substation north of Hart, a substation in Golden Township, and then passes into Muskegon County. Problems with this transmission line could lead to a major power loss in Oceana County.

Widespread Power Outages Affecting Oceana County

Date	Event	Number of Outages	Area Affected
April 6-7, 1997	Windstorm	180,000-200,000	Michigan
March 9, 1998	Blizzard	Over 23,000; 1,900	Southwest Michigan; Lake, Clare, Oceana, and Muskegon counties
May 29, 1998	Thunderstorms	90,000	Lower Michigan
May 31, 1998	Thunderstorms	Over 861,000	Lower Michigan
November 10, 1998	Windstorm	167,000	West Michigan
April 3, 2003	Ice Storm	Hundreds of thousands	Southwest Lower Michigan
October 30, 2004	Windstorm	100,000	Michigan
December 28, 2008	Windstorm	Hundreds of thousands	Michigan

Source: NCDC Storm Events Database, Local Reports

Historically Significant and Related Events: Infrastructure failures are common in Oceana County, with power loss as the most significant and frequent failure. The NCDC Storm Events Database mentions downed power lines 32 times for Oceana County between 1993 and 2012; most of which were the result of thunderstorms, high wind events, or winter weather. Notable power outages that affected Oceana County to some degree are listed in the table below.

Transportation infrastructure in Oceana County is also susceptible to failure or interruption. There are numerous examples within the NCDC Storm Data documenting road closures, most of which were the result of severe winter weather. Excessive rains and flash flooding also have a propensity to render roads impassable; or even washout roads completely.

There are a number of municipal water and sewer systems in the county that may experience failure or service interruption. For example in 2012, routine tests of the water system in the Village of Shelby revealed an increased level of coliform bacteria, which may indicate the presence of potentially harmful substances. The village issued a Boil Water Warnings in August and September for precaution. The system was subsequently treated, and the warning was lifted within a few days in both instances. Although no citizens are known to have been afflicted by the condition of the water system, this example demonstrates how the presence of harmful substances in a water system may threaten the general public, and that water systems in the county are continually monitored.

Site-based water and septic utilities, which are common in Oceana 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. In addition, extremely low water levels and drought conditions may cause some water wells to go dry.

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

NCDC Storm Data includes 32 instances of downed power lines or outages in Oceana County between 1993 and 2012. At this rate, the county experienced one to two incidents per year. Widespread power failure events were less common, occurring every two to three years.

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 plants are more than 50 miles away from Oceana County, well beyond the facilities' Emergency Planning Zones. Nuclear power plant emergencies are therefore not considered a significant threat to Oceana 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 training to handle radioactive materials, training to control personal radiation exposure, and who have specialized equipment to detect and monitor radiation.

The previous edition of this plan stated that the closest nuclear facility was the Palisades, located about 80 miles to the south in Van Buren County. However, it has since been realized that the Point Beach Nuclear Power Plant in Wisconsin is about 65 miles to the northwest of Little Sauble Point. Because both plants are more than 50 miles away from Oceana County, and beyond the facilities Emergency Planning Zones, they are not considered to be a threat in Oceana County. The impacts of a major emergency at Point Beach may have long-term effects on Oceana County by virtue of potential impacts on Lake Michigan. Regarding the Palisades plant, it is believed that even if a major plume cloud were to be released, most radioactive materials would probably disperse into relatively harmless quantities over the long distance separating the county and that site.

History: Oceana County has never experienced damage resulting from a nuclear power emergency.

Frequency of Occurrence: Nuclear power plant emergencies are not considered a significant threat in Oceana 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. Oceana County contains the Gilbert Lake and Pentwater Oil fields, and although oil and gas wells are fairly common, there are no known incidents that have happened in Oceana County.

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 in October 2012, there are 1,188 total oil and gas wells in Oceana County. While a vast majority of these wells are inactive or capped, 50 of them were “active” or “producing.” Seventy-four total wells are known to have detectable levels of hydrogen sulfide in the following Oceana County townships: Benona (3), Claybanks (20), Colfax (1), Crystal (1), Elbridge (4), Golden (1), Grant (1), Pentwater (12), and Weare (31). 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.

A cursory analysis of well locations in Oceana County shows that some are located fairly close to major roads, homes, or developed areas. This in itself is not cause for undue alarm, but the locations merit increased precautions and awareness. Continued monitoring and investigation should ensure that these wells do not pose any threat to any nearby developments. Field investigation may determine that these wells and processing plants are far enough from other developments that the risks of harmful incidents are minimal. The Michigan Department of Environmental Quality has information on all permitted wells in the state.
An additional concern in Oceana County 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 Oceana 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.

Historically Significant and Related Events: There are no identified oil or gas well incidents in Oceana County. However, the nearby 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 Oceana 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 Oceana 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 Oceana County's residents and vacationers rely upon site-based liquefied petroleum (LP) gas, some parts of the county have access to natural gas and propane gas utilities offered by MichCon and Shell Gas Bulk LLC. Utility natural gas is the second most common source of heating fuel in Oceana County (following LP gas). There are numerous natural gas transmission lines throughout Oceana County, as well as sour gas pipelines that connect to a sweetening plant in Manistee 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.

A major MichCon natural gas transmission line runs through Oceana County, and natural gas service from MichCon is limited to developed areas along Oceana Drive and along the southeastern area of the county. According to the Michigan Public Service Commission, these communities include the City of Hart, villages of Hesperia, New Era, Pentwater, Rothbury, and Shelby, and townships of Grant, Greenwood, Hart, Newfield, Pentwater, Shelby and Weare. In addition, there are a number of small-scale propane distribution systems throughout the county, such as the one that serves residences around Upper Silver Lake in Golden Township.

According to the Oceana County 2020 Master Plan (2010), some wells producing sour gas are connected to a pipeline to processing facilities to the north in Manistee County. There is a sour gas pipeline that runs north through Hart and Weare townships, with possible sour gas gathering lines in Elbridge and Leavitt townships. According to local knowledge of the system, there is a collector line from a well in Hart Township, and collector lines in the Claybanks Township area that go all the way to the compressor Facility in Elbridge Township. From Elbridge, a high pressure line (1,200 psi) runs north into Manistee County. It is possible that other small sour gas pipelines exist within the county; however their locations and current status are unknown.

Historically Significant and Related Events: While there are no incidents known to have a significant impact on Oceana County, research for this hazard revealed one related incident. A natural gas leak on March 5, 2010 caused some disruption in the Village of Shelby. Though no one was injured, a small number of residents were evacuated to a nearby shelter and elementary students were moved to a separate school facility as a precaution. The leak occurred after a resident backed his truck into a gas meter.

There have been a number of more significant incidents in neighboring counties in recent years. The following records provide examples of events that are possible in Oceana County.

June 23, 1999 – Lake County

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.

October 21, 2000 – Newaygo County

A propane explosion in the unincorporated community of Woodland Park 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.

August 28, 2007 – Muskegon County

A house exploded in Muskegon County after a contractor accidentally struck a natural gas line. Fortunately, no one was inside the home when the incident occurred. The explosion also caused damage to a neighbor's house.

Frequency of Occurrence: With only one minor incident and no significant pipeline accidents identified in Oceana County, the frequency of this hazard cannot be determined. However, pipeline accidents in neighboring counties of Lake, Muskegon, and Newaygo have demonstrated how similar accidents may affect Oceana County in the future.

2.11 TRANSPORTATION ACCIDENTS

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

Summary: Minor transportation accidents along the county's road network are frequent and inevitable; especially during inclement weather and along roads that are in disrepair. The primary emphasis this hazard description, however, is placed upon commercial and larger-scale modes of transportation.

Possible accidents involving commercial passenger transportation in Oceana County are primarily limited to school buses and the occasional tour bus travelling along the county's highways. Natural weather hazards, as well as high traffic volumes, occasionally increase the risk of accident involving any of these modes of transportation. There are no other public transportation agencies or commercial water or air transportation carriers within the county.

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. In addition, a marine transportation accident could require a water rescue operation, possibly under dangerous conditions on Lake Michigan.

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 buses 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.

According to the Oceana County Hazard Analysis, the county is under-served by upgraded transportation facilities and paved roads. There is no commercial bus service; but there are school buses and occasional tourist buses. Tour buses may occasionally traverse the county along highways US-31, M-120, and M-20. School buses travel routes throughout the county, often along rural routes that are easily impacted by inclement weather. There are concerns that a major transportation accident could cause many injuries or deaths and might occupy all area responders. Although the 2-lane highways in Oceana 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. Major land transportation accidents are more likely to occur in areas of heavy traffic, industrial activity, and during periods of inclement weather.

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 probability of a crash or accident increases as the number of landings and takeoffs increase. 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.

Oceana County has a very low risk of commercial air, water, or rail transportation accident. Major hazards from commercial air transportation would likely be the result of flights between regional destinations such as Minneapolis, Grand Rapids, Detroit, and New York. At times, there may be anywhere from 12-18 aircraft flying above the county. The Oceana County Airport, classified as "General Utility," is the county's main airport, and does not offer commercial passenger services. It has a 3,500 foot runway and automatic lighting to allow for 24 hour service, and can accommodate twin engine aircraft and small cargo planes. The Double JJ Ranch Airport and the Silver Lake Airport are privately operated. Great Lakes port facilities in the county are limited to recreation at Pentwater and Stony Lake. While there are marinas and small-scale fishing charters are available in the Pentwater area, the nearest commercial port is located in Ludington, about 10 miles from the county's northern border. There are no active railroads within the county.

Historically Significant and Related Events: There are no identified major transportation accidents in Oceana County for commercial passenger carriers. However, there have been a number of minor incidents in recent years which highlight the possibility of a serious incident.

July 14, 2011 – Hart Township

A school bus carrying migrant students lost control along a narrow rural road. The bus tipped over in a ditch, injuring two children and requiring several pieces of heavy equipment to retrieve the bus. There was no apparent cause for the accident.

December 1, 2012 – Leavitt Township

A private helicopter crashed in a swampy area of the Manistee National Forest, killing the pilot and injuring the passenger. Emergency responders had a difficult time locating and accessing the crash site due to the remote location and rugged terrain. The location of the crash also complicated the retrieval of the wreckage as well.

December 21, 2012 – Claybanks Township

A snow-induced whiteout caused a school bus to collide with a downed tree. Though the bus was likely totaled in the accident, there were no injuries reported.

Frequency of Occurrence: Even though there are no documented incidences of major transportation accidents in Oceana County, the possibility of a land, air, or marine transportation accident can't be overlooked. Although the incidents detailed above demonstrate the potential for transportation-related accidents, major incidents are considered to have a low potential or possibility of occurrence according to the Oceana County Hazard Analysis.

Minor traffic accidents are a common, daily occurrence in Oceana County. Heavy traffic volumes are most likely around holidays and 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 <u>HUMAN RELATED HAZARDS</u>

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 Oceana 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 Michigan 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 Oceana 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 major civil disturbances are known to have happened in Oceana County. Although future incidents are certainly possible, civil disturbance is not considered to be a significant hazard. A civil disturbance in the county would most likely stem from a festival or similar gathering at a single location.

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.

<u>Types of civil disturbance</u>

- *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. It is also important for correctional facilities to plan for disruptions.

The county has only one jail, located in the City of Hart. In addition, there is an annual county-wide fair, several festivals, museums, and many campgrounds. Although large groups gather at these places and events, they generally are not groups that cause disturbances. A notable annual event is the Electric Forest Festival (formerly Rothbury Festival), which is held at the Double JJ Ranch in Grant Township. This multi-day music festival takes place around late June to early July, and has attracted up to 30,000 visitors. Political protests are not a concern in the rural communities within Oceana County because most of the controversial political issues that could generate violent protest do not originate from the local or county-level government.

Historically Significant and Related Events: No major civil disturbance has been documented in Oceana County in recent history. However, over the past several decades there have been two incidents in the Silver Lake area which required additional support (resources from surrounding counties and communities). Both happened when exceptionally large weekend or holiday crowds concentrated for an event or celebration. While no serious labor-industrial relations have occurred, good labor-industrial relations are helpful in preventing incidents of labor unrest.

Frequency of Occurrence: Although there have only been a couple of minor civil disturbances in Oceana County, the chance of a more significant event cannot be entirely discounted. The threat of a minor civil disturbance appears to be more likely than a major incident.

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 Oceana 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 Oceana 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 Oceana 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.

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. In the event of a widespread public health emergency, Oceana County's medical facilities may be strained, requiring the assistance of resources from outside the county.

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). The Health Department continually monitors health threats and enforces strict regulations for septic systems in resort and summer-surge population areas.

Oceana County has a fairly limited amount of medical resources, which could be especially stressed either during a public health emergency, or during a disaster event. The county's only hospital is the Mercy Health Partners Lakeshore Campus in Shelby. Larger regional hospitals are located to the north in Ludington and to the south in Muskegon. If a large health emergency occurs, especially during "surge" population seasons, medical resources may become overwhelmed and unable to deal with any additional needs. Generally speaking, 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). Close cooperation with medical resources from outside the county may be needed. Even a public health emergency on a local scale would have potential to strain existing medical resources, and interrupt businesses and services.

Lastly, it is worth noting that there are a number of hydraulic fracturing operations in Oceana County. This method, also known as fracking, is used for the extraction of natural gas and petroleum products. According to the U.S. Environmental Protection Agency (EPA), hydraulic fracturing involves a five-step process which may have impacts on groundwater resources. At the request of Congress, EPA is conducting a study to better understand any potential impacts of hydraulic fracturing on drinking water resources. The scope of the research includes the full lifespan of water in hydraulic fracturing. A draft report is expected to be released for public comment and peer review in 2014.

The Hydraulic Fracturing Water Cycle	*Potential Impacts on Drinking Water Resources*
Stage 1: Water Acquisition Large volumes of water are withdrawn from ground water and surface water resources to be used in the HF process.	• Change in the quantity of water available for drinking • Change in drinking water quality
Stage 2: Chemical Mixing Once delivered to the well site, the acquired water is combined with chemical additives and proppant to make the HF fluid.	• Release to surface and ground water through on-site spills and/or leaks
Stage 3: Well Injection Pressurized HF fluid is injected into the well, creating cracks in the geological formation that allow oil or gas to escape through the well to be collected at the surface.	• Release of HF fluids to ground water due to inadequate well construction or operation • Movement of HF fluids from the target formation to drinking water aquifers through local man-made or natural features (e.g., abandoned wells and existing faults) • Movement into drinking water aquifers of natural substances found underground, such as metals or radioactive materials, which are mobilized during HF activities
Stage 4: Flowback and Produced Water (HF Wastewaters) When pressure in the well is released, HF fluid, formation water, and natural gas begin to flow back up the well. This combination of fluids, containing HF chemical additives and naturally occurring substances, must be stored on-site—typically in tanks or pits—before treatment, recycling, or disposal.	• Release to surface or ground water through spills or leakage from on-site storage
Stage 5: Wastewater Treatment and Waste Disposal Wastewater is dealt with in one of several ways, including but not limited to: disposal by underground injection, treatment followed by disposal to surface water bodies, or recycling (with or without treatment) for use in future HF operations.	• Contaminants reaching drinking water due to surface water discharge and inadequate treatment of wastewater • Byproducts formed at drinking water treatment facilities by reaction of HF contaminants with disinfectants

Source: U.S. EPA, http://www2.epa.gov/hfstudy/hydraulic-fracturing-water-cycle, 7-15-13

Historically Significant and Related Events: There are no recorded public health emergencies in Oceana County within recent history. However, like the rest of the United States and the world, Oceana 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 are known to 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 Oceana County. Influenza pandemics have occurred with regularity every 20-30 years and could occur more frequently with modern day travel and migration.

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 Oceana 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 it might appear Oceana County is an unlikely target for terrorism, it cannot be totally discounted. A more detailed study may be performed by Oceana County Emergency Management to ascertain whether the county’s preparedness matches the estimated risk from these unfortunate threats. Consequently, 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 Oceana 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 Oceana 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 Oceana 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.

OCEANA 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	2	3
1.03 Earthquake	0	-	-	-
1.04 Extreme Temperatures	3	2	1	2
1.05 Flooding: Riverine/Urban	3	1	2	1
1.06 Fog	3	1	0	1
1.07 Great Lakes Shoreline	3	1	2	1
1.08 Hail	3	1	2	1
1.09 Invasive Species	2	1	2	2
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	2	1	1	2
2.06 HAZMAT – Transportation	2	1	1	2
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	2
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	3
3.05 Terrorism & Similar Criminal Acts	1	1	1	1

OCEANA COUNTY
Hazard Vulnerability Rankings

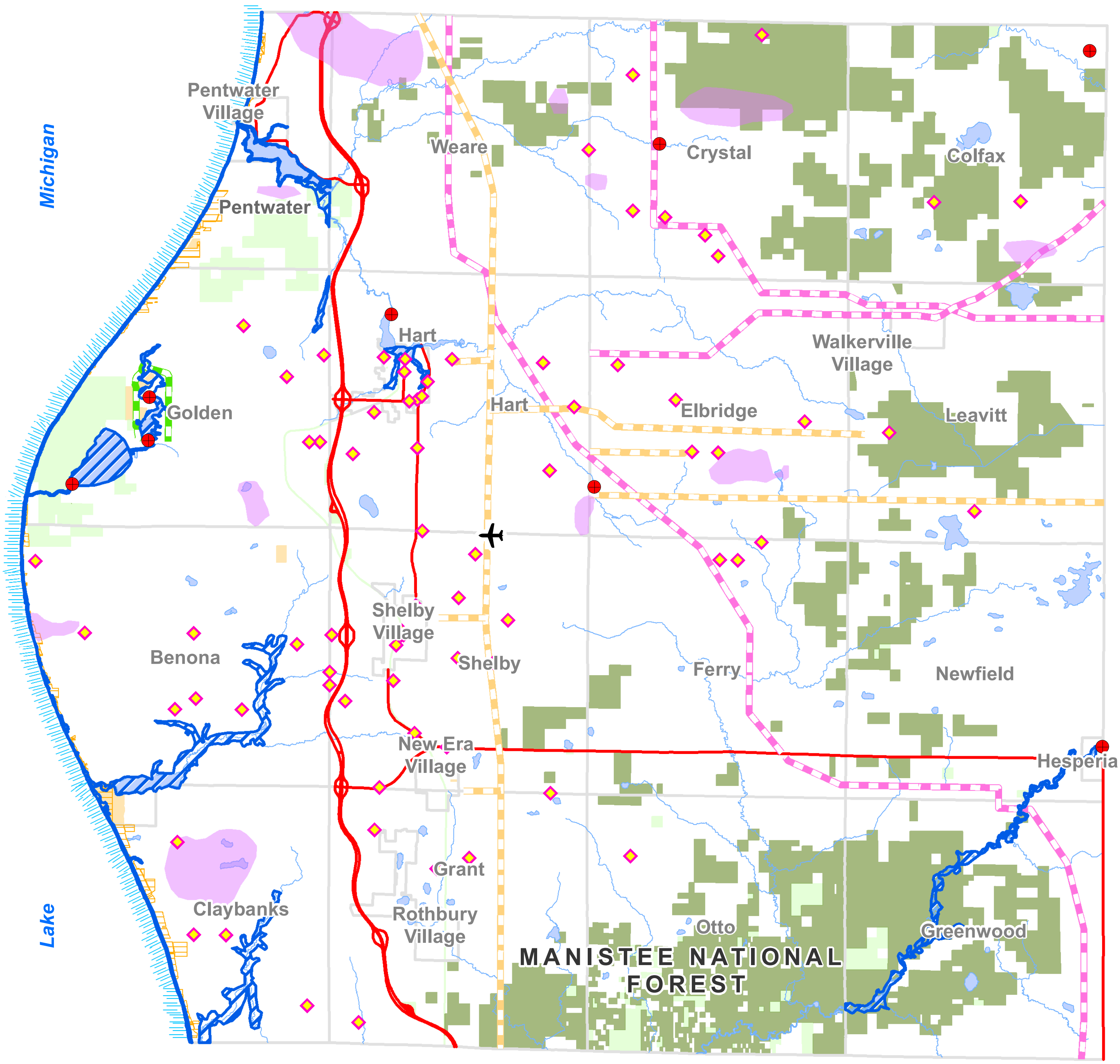
Rank	Hazard	Probability of Occurrence	x Sum of Weighted Impacts	= Hazard Vulnerability Ranking
1	Winter Storms	3	15	45
2	Severe Winds	3	12	36
3	Wildfire	3	11	33
4	Extreme Temperatures	3	10	30
4	Infrastructure Failures	3	10	30
6	Fire – Structural	3	9	27
7	Drought	2	13	26
8	Flooding: Riverine/Urban	3	8	24
8	Great Lakes Shoreline	3	8	24
8	Hail	3	8	24
8	Lightning	3	8	24
12	Catastrophic Incidents	1	18	18
12	Dam failure	2	9	18
12	Invasive Species	2	9	18
12	Public Health Emergencies	2	9	18
12	Tornadoes	2	9	18
17	Energy Emergencies	2	8	16
18	HAZMAT – Fixed Site	2	7	14
18	HAZMAT – Transportation	2	7	14
18	Pipeline Accidents	2	7	14
21	Fog	3	4	12
21	Oil/Natural Gas Well Accidents	2	6	12
21	Transportation Accidents	2	6	12
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
n/a	Earthquake	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 Oceana County Hazard Mitigation Plan. The county's top six hazards remain the same, but somewhat re-ordered. W*inter storms* remains in the #1 slot, followed by s*evere winds*, *wildfire*, *infrastructure failures*, *extreme temperatures*, *and structural fire*. The largest change in ranking for any hazard was the promotion of *Great Lake Shoreline* (formerly known as *Flooding: Shoreline*) from #14 to #8. This dramatic increase in priority is partly because the scope of the hazard analysis was broadened to include additional aspects, such as "rip currents" and the impacts of low water levels on the Great Lakes.

The individual community level hazard rankings, located in Appendix B, are similar to the county rankings. For the city and villages, the top three priority hazards are *winter storms*, *severe winds*, and *infrastructure failures*. For all townships, the top three hazards are *winter storms*, *severe winds*, *and wildfire*. Beyond 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	3	**↑1**
3	Wildfire	4	**↑1**
4	Infrastructure Failures	5	**↑1**
4	Extreme Temperatures	2	**↓2**
6	Fire – Structural	6	*- no change -*
7	Drought	8	**↑1**
8	Flooding: Riverine/Urban	10	**↑2**
8	Great Lakes Shoreline	14	**↑6**
8	Hail	11	**↑3**
8	Lightning	12	**↑4**
12	Catastrophic Incidents	-	**new hazard**
12	Dam Failure	13	**↑1**
12	Invasive Species	-	**new hazard**
12	Public Health Emergencies	9	**↓3**
12	Tornadoes	7	**↓5**
17	Energy Emergencies	-	**new hazard**
18	HAZMAT – Fixed Site	17	**↓1**
18	HAZMAT – Transportation	19	*- no change -*
18	Pipeline Accidents	15	**↓3**
21	Fog	-	**new hazard**
21	Oil/Natural Gas Well Accidents	18	**↓3**
21	Transportation Accidents	16	**↓5**
24	Celestial Impacts	-	**new hazard**
25	Civil Disturbances	21	**↓4**
25	Fire – Scrap Tires	*not ranked*	-
25	Subsidence	20	**↓5**
25	Terrorism & Similar Criminal Acts	*not ranked*	**-**
not ranked	Earthquake	*not ranked*	**-**
not ranked	Nuclear Attack	*not ranked*	**-**
not ranked	Nuclear Power Emergencies	*not ranked*	**-**

OCEANA COUNTY
Potential Hazards

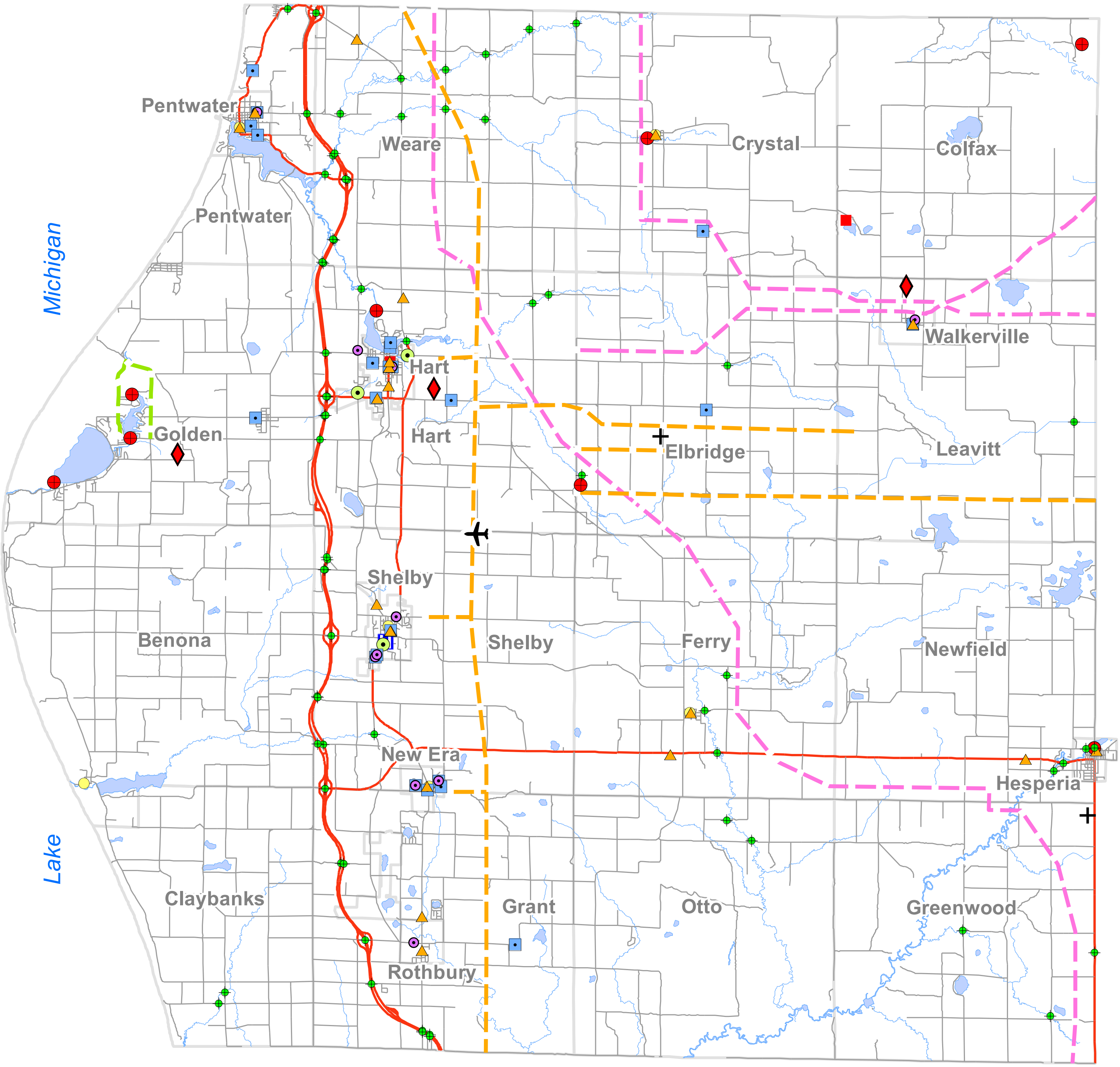


State Trunkline
Gas Pipeline
Power Line
Propane Pipeline
Great Lakes Shoreline Hazard
SARA Title III Sites
Dam
Airport
Oil/Gas Field
High Risk Erosion Area
Federal Land
State Land
Municipal Parks
Floodplain

WMSRDC WEST MICHIGAN SHORELINE REGIONAL DEVELOPMENT COMMISSION

Source: Michigan Geographic Data Library
Michigan Department of Environmental Quality, Oceana
Co. Hazard Mitigation Plan Update 2014

OCEANA COUNTY
Critical Facilities



- State Trunkline
- Street
- Gas Pipeline
- Power Line
- Propane Pipeline
- Bridge
- Wastewater Treatment
- Communications Tower
- Airport
- Fire/Police/EMS/911
- School
- Shelter
- Dam
- Hospital
- Medical Facility
- Correctional Facility
- Siren

WMSRDC
WEST MICHIGAN SHORELINE REGIONAL DEVELOPMENT COMMISSION

Source: Michigan Geographic Data Library
United States Geological Survey, Oceana Co. Hazard Mitigation 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 Oceana County. They are based on 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 Oceana County LEPC prior to, and then discussed at its December 10, 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 from them.
- 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 Oceana 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 Oceana 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 where there is an abundance of undeveloped land, such as in Oceana County. Planning, zoning, and code-enforcement officials 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 or not done properly, the building code may essentially 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.

Oceana County currently abides by the 2009 Michigan Residential Code, 2009 Michigan Building Code, 2012 Michigan Plumbing Code, 2012 Michigan Mechanical Code, 2012 International Fuel Gas Code and the 2011 Michigan Electrical Code (with NEC & Part 8 Rules). These codes are constantly being evaluated and updated to reflect new information and recommended practices.

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. Oceana County employs a building inspector, an electrical inspector, and a mechanical & plumbing inspector to handle code enforcement in most areas of the county. The only exceptions are Newfield & Otto townships, who have their own inspectors; and Grant Township, who has its own building inspector.

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.

Recent figures show that mobile homes account for about 19.4% of the housing stock in Oceana County. Mobile home parks in the county include: Evergreen Village Mobile Home Park, Green Lawn Mobile Home Court, Hylander Valley Estates, Lakewood Mobile Home Park, Pines Mobile Home Park, and Orchard Terrace Manufactured Community Homes.

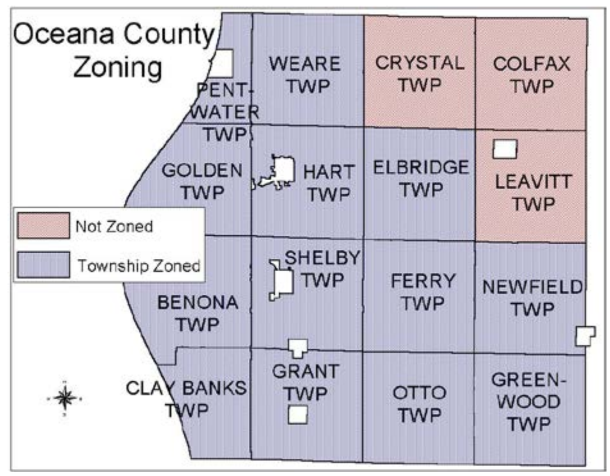
C. Planning, Zoning, and Capital Improvements. While building codes provide guidance on *how* to build in hazardous areas, planning and zoning activities direct development *away* from these areas, especially floodplains and wetlands. They do this by designating land uses that are compatible to the natural 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 Oceana County 2020 Comprehensive Plan, authored in 2004 and updated in 2010, describes a "Vision-based, Compact Future Land Use Pattern" that considers "Sensitive Environment Protection Areas"; such as wetlands, steep slopes, dunes, floodplains, streams, rivers and lakeshores. The following statements are made regarding these areas:

1. Floodplains and wetlands would not be developed.
2. Shoreline areas of streams, rivers and lakes would have waterside buffer plantings to filter storm water and provide shade and wildlife habitat.
3. Steep slopes would not be built upon, or limited development would employ special design and construction approaches to prevent erosion and limit scenic impact.
4. Dunes with special habitat would have no, or limited, development.

It also contains an objective that it be accepted as the guide for future land use, zoning and infrastructure decisions of local and county government and agencies and a key policy that it be used as the general guide for preparing plans of various county agencies, local plans, capital improvement programs, land division and zoning regulations within the county. It should be noted that zoning ordinances in Oceana County are adopted and enforced by local jurisdictions; excepting Colfax, Crystal and Leavitt Townships which are not zoned.



Source: Oceana County 2020 Comprehensive Plan

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 potentially hazardous areas; such as in flood plains. 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.

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. 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 firefighting 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 firefighting.

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 Oceana County Master Plan helps set the table for open space preservation in the county. For example, the document recommends that "townships should develop an Agriculture and Open Space Preservation Plan for the preservation of farmland and open space."

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.

In Oceana County, two rivers are currently designated by the Michigan Natural Rivers Program: the Pere Marquette River and the White River. The Pere Marquette also happens to be a National Wild and Scenic 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 its 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. As of November 2014, seven communities in Oceana County were participating in the National Flood Insurance Program (NFIP): the City of Hart; the villages of Hesperia and Pentwater; and the townships of Benona, Golden, Newfield, and Pentwater. In addition the townships of Claybanks, Greenwood, and Hart were "Suspended" from the NFIP; and initial flood insurance rate maps (FIRM) were identified for the townships Ferry, Otto, and Weare in August 2014.

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. Officially, the code "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."

Stormwater runoff regulations add to these efforts to regulate development by requiring developers to build retention or detention basins to minimize the increases in the run-off rate caused by impervious surfaces and new drainage systems. Generally, each development must not let stormwater leave at a rate higher than it did under pre-development conditions. In Oceana County, stormwater runoff can be mitigated through the Oceana County Drain Commissioner Subdivision Drainage Rules and Storm Water Design Criteria, effective October 1, 2004. The rules laid out within this edict are to be followed in the processing of all subdivision plats and all other land developments which impact established county or intercounty drains, or for which the Oceana County Drain Commissioner provides support to other state, county, or local reviewing agencies.

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.

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 (berm or levee), or concrete or steel (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.

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-EMSHD mitigation funding programs. As of October 2013, there had not been any repetitive losses in Oceana

County. 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;
- Farmland protection;
- Sand dune protection and management; and
- Shorelands protection and management.

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 sedimentation 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. In Oceana County, the County Enforcing Agent is the Oceana County Drain Commissioner, the Authorized Public Agencies are the Oceana County Drain Office and the Oceana County Road Commission, and the Conservation District is the Oceana 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 numerous watershed groups that include Oceana County within their borders, including: Pere Marquette River Watershed Council and White River Watershed Partnership.

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.

The Pentwater Lake Association is one example of an organization in Oceana County that promotes BMP's around Pentwater Lake.

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.

H. Sand Dune and Shorelands Protection and Management. According to MDEQ, Michigan's sand dunes are a resource of global significance since they are the largest assemblage of fresh water dunes in the world. The Michigan Legislature has found that critical dune areas of this state are "unique, irreplaceable, and fragile resources that provide significant recreational, economic, scientific, geological, scenic, botanical, educational, agricultural, and ecological benefits to the people of this state and to people from other states and countries who visit this resource."

Construction in these areas is carefully controlled. In addition to the required local building permits, MDEQ permits are required for all proposed new uses in designated areas of Oceana County, as contained in its "Atlas of Critical Dune Areas" (www.michigan.gov/deq under "sand dunes"). There are designated areas in the townships of Benona, Claybanks, Golden, and Pentwater (including Pentwater Village).

In addition, Michigan's Shorelands Protection and Management legislation determines if a high-risk erosion area shall be regulated to prevent property loss or if suitable methods of protection shall be installed to prevent property loss. A permit is required for the erection, installation, or moving of a permanent structure on a parcel of land where any portion is a designated high risk erosion area. Examples include homes, porches, septic systems, additions, substantial improvements of existing structures, and out buildings. With the exception of Alcona, Charlevoix, Macomb, Monroe, and Wayne Counties, all coastal counties in Michigan have some designated high risk erosion areas.

This careful control of development can assist in the prevention of hazards such as increased wildfire risk (caused by the wildland/urban interface and increased erosion potential. It can also assist in assuring fire-fighting access to development.

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 Oceana County Emergency Management. 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. However, there are no AHPS gauges in Oceana 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 a relay transmitter located south of Hesperia to reach receivers in in Oceana County. It was installed on high ground to re-broadcast transmission from the Grand Rapids tower, thereby assuring that marine radios and the entire county have contact. 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 Oceana County Office of Emergency Management and the NWS.

The NWS is also the prime agency for predicting winter storms. Severe snow storms can often be forecasted days in advance of the expected event, which allows time for warning and preparation. The NWS can also forecast ice storms, issue dense fog advisories, and give notice when conditions are conducive for rip currents in Lake Michigan.

In summation, Oceana 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, the Oceana County Office of 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 continually evaluated, updated to include new technologies, and expanded to include warnings to people with "special needs" 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 most effective. If people do not hear one warning, they may still get the message from another. Also more effective are warnings that 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.

There are eight sirens currently operational in Oceana County, all of which can be activated from 911 dispatch. Municipalities that own and maintain sirens include: City of Hart; villages of New Era, Pentwater, Shelby and Walkerville; and townships of Crystal and Ferry. Another siren is located at Camp Miniwanca at Stony Lake. In areas not serviced by existing sirens, the most effective means of warning are radio, television, and cable systems (EAS), EARS tone alert radios, NOAA Weather Radios, and mobile device alerts. The Oceana County Office of Emergency Management may provide emergency and disaster early warning information on a request basis to special needs populations.

In areas not serviced by existing sirens, the most effective means of warning are radio, television, and cable systems (EAS); the EARS tone alert radios; and NOAA Weather Radios. Mason-Oceana 911 maintains and operates three Homeland Security Region 6-funded emergency communication systems.

1. *CityWatch*- a reverse 911 system that allows the general public of geographical based emergencies through land-line telephones.
2. *EMnet*- Secure, satellite based communication and warning system soon to interface with various media (TV, radio) outlets.
3. *Codespear*- Mobile radio system that allows connecting various radio bands to each other and the internet.

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. Mears State Park in Pentwater and Silver Lake State Park in Golden Township have both achieved StormReady status.

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 Oceana County Emergency Operations Plan is designed to present a common platform for coordination of major response activities for all types of natural and technological hazards. It establishes the Incident Command System that assigns responsibilities during a disaster, such as communications, evacuation and public health. Implementation of the plan relies on the combined effort of Oceana County departments and local communities. The Emergency Operations Plan is augmented with annexes (including terrorism), 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. There are only a few additional documents that provide specific guidance for responding to natural hazards on an individual basis (Site Emergency Response Plans and Standard Operating Procedures or road closures, etc.).

The Incident Command System is required for Oceana 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 computerized layers of mapped 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 firefighting 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. 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 "Storm Ready" and "Turn Around Don't Drown" programs, 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. Oceana 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.

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 Oceana. In addition, many of Oceana 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, and 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, soil type and topography; 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. Enforce Michigan's Sand Dune and Shorelands Protection and Management Programs that control development in high-risk erosion areas and protect dunes.

Action Item 14. 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 15. 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 16. Develop, adopt, and enforce a Nuisance Ordinance to prevent dumping "objectionable" solid matter into channels and wetlands and Waterway Dumping Regulations to prevent dumping "non-objectionable" waste.

Action Item 17. 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 18. 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.

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 19. Assess the capacity of storm water systems to handle both storm waters and high water tables and make necessary improvements and expansions to assure the protection of property and infrastructure.

Action Item 20. Raise or relocate buildings above the 100-year flood level, and/or acquire properties in flood and high-risk erosion areas for demolition and re-use of the land as open space.

Action Item 21. Identify 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 22. Identify 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 23. Employ "Firewise" principles of proper grounds maintenance, equipment storage, vegetation clearance, and other techniques.

Action Item 24. Create firebreaks, wherein brush and other fuel is cleared away, in wildland areas.

Action Item 25. Maintain the Oceana County Community Wildfire Protection Plan (CWPP), and work to implement its recommendations to reduce the frequency and severity of wildfires.

Action Item 26. Adopt and enforce local ordinances that require burn permits and restrict campfires and outdoor burning.

Action Item 27. 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 28. Encourage property owners and public facility operators to increase their property's resilience and resistance to hazards.

Action Item 29. 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 30. 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 31. 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 32. 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 33. Assure insurance coverage on properties and obtain additional insurance coverage as appropriate (sump pump failure, sewer back-up, wildfire, dam failure, etc.).

Action Item 34. 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 35. 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 36. 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 37. 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 38. 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 39. 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 40. 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 41. 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 42. Assess the need for and use of state and federal funding and technical assistance for dam / spillway repairs.

Action Item 43. Investigate the availability of resources and need for creating firebreaks and the availability of resources for acquiring land, as necessary, to achieve continuity of needed firebreak areas.

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 44. 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 45. Implement improvements to the warning system as deemed necessary for improving coverage and effectiveness.

Action Item 46. Maintain a description of the public warning process and coordinate actions in a section of the Emergency Action Guidelines (EAG).

Action Item 47. 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 and encourage upkeep of the radio tower south of Hesperia.

Action Item 48. 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 49. 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 50. 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 51. Encourage electrical utilities to place power lines underground wherever possible, but especially when upgrading them or running power to new developments.

Action Item 52. 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 53. Install back-up generators, as needed for short-term relief from power failures, at critical facilities such as sewage pump stations, road commissions, hospitals and medical centers, nursing home facilities, schools, shelters, and government facilities.

Action Item 54. Bury water/sewer lines below the frost line or insulate and maintain lines to protect against ground freeze.

Action Item 55. Establish safe and appropriate locations for temporary debris disposal sites.

Action Item 56. 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 57. Continue to refine state, county and local road, bridge and culvert maintenance / vegetation management programs to maintain visibilities, provide for living snow fences, reduce erosion, slow stormwater runoff, and maintain 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 58. 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, Flood Mitigation Assistance Program, and Hazard Mitigation Grant Program.

Action Item 59. 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 60. 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 61. 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 62. 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 63. Design and plan for water supply infrastructure systems that include a consideration of, and are more resistant to, drought events.

Action Item 64. Continue to maintain, and acquire as necessary, fire-fighting and rescue equipment, including specialized equipment for limited access areas, thermal imaging devices, and special equipment for water and ice rescues.

Action Item 65. 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 66. Coordinate with the Conservation District, local watershed councils, and lake improvement boards to maintain healthy, free-flowing watercourses with minimal erosion and sedimentation, and to restore / preserve wetlands.

Action Item 67. 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 68. Meet the criteria to become a NWS-approved "Storm Ready" community.

Objective 3.4. Enlist support of committed volunteers to safeguard the community before, during, and after a disaster.

Action Item 69. Continue relationship with and support of the Oceana County RACES amateur radio group to assure communication capability with the state EOC, state police, NWS, 911 dispatch, neighboring jurisdictions and others during extreme communication disruption events.

Action Item 70. Designate amateur radio operators to relay information on "immediately dangerous" weather situations and storm damage reports to the NWS, 911 Dispatch, and/or Oceana County Emergency Management.

Action Item 71. Create a volunteer outreach program, whereby a network of amateur radio operators and others regularly check on the needs and conditions of elderly, disabled, homebound, and other special-needs groups during and after severe weather conditions; deliver goods / assistance to them; and / or disseminate information about emergency shelters.

Action Item 72. Utilize NWS-trained weather spotters to watch for developing storms, take flood water measurements, and monitor stream conditions.

Action Item 73. 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 74. 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 75. Produce and distribute local emergency preparedness and safety information 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 76. 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 77. 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.

Action Item 78. Provide local schools with information for the classroom regarding severe weather hazards and how families can prepare for and respond to them.

Action Item 79. Incorporate safety strategies for severe weather events in driver education classes and materials.

Action Item 80. 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 81. 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 82. Research availability of local and Michigan-based recovery “vendors” for post-disaster goods and services to support disaster recovery efforts.

Action Item 83. 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 84. 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 85. 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 86. Participate in programs such as NFIP, CRS, Firewise, Tree City USA, StormReady, etc. and respond to concerns regarding program requirements and obstacles to participation.

Action Item 87. Develop model hazard mitigation and contingency plans and regulations (such as stormwater ordinance, nuisance ordinance, waterway dumping regulations, community forestry program, drought plan and ordinance, etc.) and provide them to interested communities.

Action Item 88. 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 89. Notify communities of hazard mitigation funds, as they become available, and assist them in applying for funds.

Action Item 90. 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 91. 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 92. Assist the LEPC in its activities relating to the development and review of SARA Title III Section 302 site emergency plans, including assistance in updating SARA site plans, and in the appointment of qualified members to the committee.

Action Item 93. Assist the LEPC in its activities related to developing and continually revising Emergency Action Guidelines detailing the response requirements of emergency responders (emergency management, damage assessment, communications, medical services, fire services, public health services, human services, law enforcement, public works, and public information).

Action Item 94. 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 95. 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 96. Coordinate with American Red Cross to ensure the county-wide availability of designated and accessible emergency shelters 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 included 20 action items that were recommended for implementation and then assigned to the appropriate jurisdictions within Oceana County. This chapter contains a review of the 2006 Action Agenda, as well as a revised Action Agenda for the 2014 update.

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 Oceana 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 2006 Action Agenda items remain priorities in 2014.
3) 2006 action items #39 (involving firebreaks) and #54 (hazard mitigation coordinator) are no longer considered priority action items and will not be included on the 2014 Action Agenda.

Eight local units of government in Oceana County responded to the questionnaire. Six LEPC / Advisory Team members took part in the exercise; including Oceana County Emergency Management, Oceana County Road Commission, Oceana-Mason 911 Dispatch, Lakeshore Hospital, Oceana Conservation District, and District #10 Health Department. At least some progress was reported for 17 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 Oceana 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	
#7 - Incorporate mitigation provisions into comprehensive plans and land use plans, especially as they address open space preservation and development restrictions (particularly in floodplains and hydraulic shadows of dams).	X	X			**Oceana Co. Em. Mgmt. –** Ongoing via county Planning Commission and county Road Commission.
#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, etc.) are considered.	X	X	X		**Ferry Twp –** Nearly every culvert prone to back-up and upstream impounding has been removed. Few roads remain where over-topping due to high-water events might occur. **Shelby Village –** Capital Improvements Planning has just begun in the Village. In the past, hazard mitigation has been considered for capital improvements. Going forward those concerns will be more seriously addressed and noted as part of a comprehensive CIP. **District #10 Health Dept. –** reviews proposed sites for possible environmental impacts on soils and water resources (debris storage, retention pond placement, etc).

#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 (PUD).	X	X			**Oceana Co. Em. Mgmt. –** This is part of the zoning process. **District #10 Health Dept –** reviews proposed sites for possible environmental impacts on soils and water resources (debris storage, retention pond placement, etc)
#14 - Consider regulation of development in the hydraulic shadows of dams (where flooding would occur if there was a severe dam failure).		X			**Oceana Co. Em. Mgmt. –** Too late for the Upper Silver Lake area.
#30 - Encourage municipalities to join the National Flood Insurance Program (NFIP) so that residents can obtain flood insurance.		X	X		**Oceana Co. Em. Mgmt. –** Some have consciously not joined (Elbridge Twp), and some are considering joining (Ferry Twp). **Shelby Village –** Greater training and understanding of the importance of this action item would help the Village in determining the best route to take. **Ferry Twp –** Passed a resolution several years ago to join NFIP via OCEM. Have not been provided an update on what needs to occur next, or the status of the Program as it relates to the Township.
#31 - Encourage municipalities to join the NFIP's Community Rating System (CRS), implement the CRS minimum standards, and implement additional flood loss reduction activities (such as the adoption of this plan) to reduce the cost of NFIP flood insurance.				X	
#38 - Assess the need for and use of state and federal funding for dam/spillway repairs.	X				**Oceana Co. Em. Mgmt. –** Most have been assessed (Hart, Hesperia, Holiday, Gales Pond dams). Upper Silver Lake in need, but privately owned. **Oceana Co. Road Commission –** Gales Pond County Park Dam (Elbridge Twp), along with Fillmore Rd over the dam and through the Park, recently experienced major improvements. Repairs as ordered by the DEQ Dam Inspection Unit have also been completed.
#39 - Investigate the availability of resources and need for creating firebreaks in forested areas to help protect them and nearby properties from forest fires and the availability of resources for acquiring land necessary to achieve continuity of needed firebreaks.		X			**Oceana Co. Em. Mgmt. –** CWPP to be completed by August 1, 2014.
#40 - Evaluate the effectiveness of the public warning system including the threat detection process, management system, communications links, and methods of dissemination. Consider warning for slow and short onset hazards, new technologies, public views of the warning system (especially confusion about fire station sirens) and the effect this has on response to warnings, disseminating warnings to people with "special needs", redundancies, and effective methods of risk communication.	X	X			**Oceana Co. Em. Mgmt. –** Sirens all tested and synched; new siren in Ferry; EMnet system; and special needs weather radios acquired. **Mason-Oceana 911 –** Multiple systems are in place, but solutions are constantly evolving. **Shelby Village –** Have been in talks of ways to improve this system for the village. Date of completion is unknown; anticipate further coordination with countywide public warning system in the first quarter of 2014. **Walkerville Village –** There is no plan to expand the system and no scheduled testing of the existing siren warning systems.
#41 - Improve warning system coverage and effectiveness and implement improvements to the warning system as deemed necessary.	X	X			**Oceana Co. Em. Mgmt. –** Improved warning dissemination through cell phones, EMNet and IPAWS. **Walkerville Village –** There is no plan to expand the system and no scheduled testing of the existing siren warning systems. **Ferry Twp –** Ferry Township spent funds to upgrade the Fire Barn's siren, receiving additional capabilities.
#49 - Install back-up generators, as needed for short-term relief from power failures, at critical facilities such as sewage pump stations, road commissions, hospitals and medical centers, nursing home facilities, schools, shelters, governmental facilities, and correctional facilities.	X				**Mason-Oceana 911 –** Complete for 911 Dispatch. **Walkerville Village –** Fire station has generator. No generators at schools/shelters. **Lakeshore Hospital –** Installed diesel generator as backup to their propane generator.

#52 - 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**			**Oceana Co. Road Commission –** Road Commission does not have adequate manpower or equipment to deal with long-term, widespread weather events. The OCRC and local townships have partnered financially to reopen roads, repair bridges and replace many inadequate road/stream crossings, reducing property damage, threats to motoring public and aiding emergency responders. Additional funding/resources are needed. **Walkerville Village –** Village is responsible for own roads and handles local problems unless very severe snow and ice. Assistance from county Road Commission would take additional time.
#54 - 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**	**Oceana Co. Em. Mgmt. –** Low probability with grants shrinking and higher priorities.
#55 - Develop and review coordinated response plans and programs across service providers and agencies and assure both mutual aid and the ability to communicate during emergencies (compatibility of radio frequencies, impact of adverse weather on warning systems, etc.).	**X**	**X**			**Oceana Co. Em. Mgmt. –** Communication capabilities improved greatly. All 800 MHz throughout county; radios rebanded, new equipment acquired, and equipment training (mainly through Homeland Security funding). **Walkerville Village –** Fire Service has automatic/ mutual aid plans. No other coordinated service plans. There is the 911 Dispatch communication plan. Walkerville Area Fire & Rescue has backup communication system.
#59 - Obtain extra fire-fighting equipment, including specialized equipment for limited access (WUI areas and residential/dune intermix areas) and snow-blocked areas and thermal imaging devices to help detect or mitigate lightning-related fires.	**X**	**X**			**Oceana Co. Em. Mgmt. –** CWPP under development will address acquisition of fire equipment. Have acquired thermal imaging equipment and new law enforcement imagers. **Walkerville Village –**Walkerville Area Fire & Rescue has an ATV for offroad wildfires; 4x4 trucks equipped for structural fires; and a thermal imaging camera. Funds needed to replace 24-year-old pumper with an official 4x4 wildland interface engine. **Ferry Twp –** Ferry Township FD purchased a newer fire truck in 2013. Recently, new fire suits and a defibrillator also were purchased.
#65 - Create a volunteer outreach program 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**			**Oceana Co. Em. Mgmt. –** RACES are active; more so with disaster-related communications than outreach to special populations. **Mason-Oceana 911 –** Amateur radio operators are available through RACES/ARES and 911 has radio equipment at the EOC in 911. But there is no outreach program in place or being pursued. **Shelby Village –** The village is in the process of becoming more active in this endeavor. **Newfield Twp –** Oceana County 911 works with amateur radio operators.
#68 - Distribute already produced information on hazards and cost-effective mitigation actions individuals can implement to residents and/or targeted groups most at risk to experience significant impacts due to natural hazards.		**X**			**Pentwater FD –** Hazard preparedness and information pamphlet. **Walkerville Village –** Fire prevention programs by the Walkerville Fire Department.
#69 - Produce and distribute local emergency preparedness and safety information concerning all natural hazards to the general public and/or targeted groups (seasonal population, floodplain residents, developers and builders, farm owners and operators, decision makers, Spanish speaking, etc.).		**X**			**Pentwater FD –** Hazard preparedness and information pamphlet. **Walkerville Village –** Fire prevention programs by the Walkerville Fire Department. **Oceana Conservation District –** Assists farms on a voluntary basis with emergency farm plans as a part of a Farmstead Environmental Risk Assessment, and implementation of practices to address those risks. Also assists farms in meeting SARA Title III regulations.
#70 - 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.	**X**				**Mason-Oceana 911 –** (no details available for completed actions).

2006 Action Agenda

PROGRESS BY JURISDICTION

GOVERNMENT UNIT	2 B.C.E.G.S.	7 COMP/LAND-USE PLANS	8 CAPITAL IMPROVEMENT	9 ZONING ORDINANCE	14 HYDRAULIC SHADOWS	30 N.F.I.P.	31 C.R.S.	38 DAM REPAIRS	39 FIREBREAKS	40 WARNING SYSTEM EVAL.	41 WARNING SYSTEM IMPLEMENTATION	49 GENERATORS	52 ROAD/BRIDGE MAINTENANCE	54 MITIGATION COORDINATOR	55 COORDINATED RESPONSE	59 FIRE-FIGHTING EQUIPMENT	65 VOLUNTEERS	68 HAZARD AWARENESS	69 PREPAREDNESS INFORMATION	70 MITIGATION EFFORTS
Oceana Co.	●	●	●			●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
CITIES																				
Hart		●	●	●			●			●	●	●	●		●	●				
VILLAGES																				
Hesperia		●	●	●	●		●	●				●	●		●	●				
New Era		●	●	●						●	●	●								
Pentwater		●	●	●			●			●	●	●	●		●	●				
Rothbury		●	●	●						●	●	●								
Shelby		●	●	●						●	●	●	●		●	●				
Walkerville		●	●	●						●	●	●			●	●				
TOWNSHIPS																				
Benona		●	●	●			●		●	●	●				●	●				
Claybanks		●	●	●			●		●											
Colfax		●	●		●			●	●											
Crystal		●	●		●			●	●	●	●				●	●				
Elbridge		●	●	●	●			●	●											
Ferry		●	●	●		●	●		●	●	●				●	●				
Golden		●	●	●	●		●	●	●											
Grant	●	●	●	●		●	●		●						●	●				
Greenwood		●	●	●			●		●											
Hart		●	●	●	●		●	●	●						●	●				
Leavitt		●	●			●	●		●											
Newfield		●	●	●			●		●						●	●				
Otto		●	●	●		●	●		●											
Pentwater		●	●	●			●		●											
Shelby		●	●	●					●	●	●				●	●				
Weare		●	●	●		●	●		●											

● *Action Item applicable to municipal jurisdiction*

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 2014 Action Agenda. The selection process was guided by criteria described in Part H. <u>All items on the 2014 Action Agenda are considered to be of the highest priority.</u> 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 Oceana County. Each action item includes the following information to help facilitate implementation:

<u>Priority Level</u>

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.

<u>Timeframe</u>

Generally identifies when an action item might begin. Where appropriate, prerequisite activities are discussed.

<u>Applicable Governmental Unit(s) / Responsible Person (s)</u>

Identifies key players for initiating and implementing each action. Often the work will be shared by a number of individuals and agencies.

<u>Potential Technical / Financial Assistance</u>

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.**

<u>Comments</u>

Additional details or helpful information about the action item. This feature was added for the 2014 edition of this plan.

2014 Action Agenda

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):
Oceana County Building Official; Grant Township; Newfield Township; Otto Township.

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 enforcement. 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 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, and etc.

Priority Level: Low

Timeframe: To be completed when land use plans are written or updated

Applicable Governmental Unit(s)/Responsible Person(s):
Local units of government; Oceana County Planning Commission.

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 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.

Priority Level: High

Timeframe: To be completed during planning for capital improvements

Applicable Governmental Unit(s)/Responsible Person(s):
Local units of government; Oceana County (e.g. Planning Commission, Road Commission, Drain Commission, etc.).

Potential Technical/Financial Assistance Sources:
Local resources.

Comments:
Local adoption of this plan is the first step towards completing this measure. Oceana County Emergency Management (OCEM) will then promote the utilization of this plan to local governments and county departments to help coordinate hazard mitigation activities across county departments and local governments.

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, soil type and topography; and as they allow flexibility in lot sizes and locations, such as in Planned Unit Developments (PUD).

Priority Level: High

Timeframe: To be completed when zoning ordinances are written or updated

Applicable Governmental Unit(s)/Responsible Person(s):
Local units of government that engage in zoning.

Potential Technical/Financial Assistance Sources:
Local resources.

Comments:
Following adoption of this plan, local units of government and the county will be encouraged to consider the contents of this plan when writing or updating local ordinances. 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. Resources such as the IBHS suite of FORTIFIED programs can provide additional guidance for increasing the resistance of new and existing structures to hazards.

Action Item 14. Consider regulation of development in the hydraulic shadows of dams (where flooding would occur if there was a severe dam failure).

Priority Level: Medium

Timeframe: 2016

Applicable Governmental Unit(s)/Responsible Person(s):
Hesperia Village; Townships of Crystal, Colfax, Elbridge, Golden, Greenwood, Hart, Newfield, and Weare.

Potential Technical/Financial Assistance Sources:
OCEM; Michigan MDEQ.

Comments:
OCEM will coordinate with local governments to identify areas that would be at a high risk in the event of a severe dam failure; and local governments will be recommended to regulate development of structures and infrastructure in those areas. This action is intended to lessen the impacts of dam failure upon new development.

Action Item 25. Maintain the Oceana County Community Wildfire Protection Plan (CWPP), and work to implement its recommendations to reduce the frequency and severity of wildfires.

Priority Level: Low

Timeframe: Review CWPP Action Plan annually; Implement CWPP Action Plan as funding allows

Applicable Governmental Unit(s)/Responsible Person(s):
OCEM; Local fire departments; Local units of government.

Potential Technical/Financial Assistance Sources:
USDA – Forest Service; Michigan DNR; MSU Extension.

Comments:
The CWPP will need to be updated by August 2019 (5-year update). This action item is new for the 2014 Action Agenda.

Action Item 34. 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: Immediately following adoption of this plan

Applicable Governmental Unit(s)/Responsible Person(s):
OCEM.

Potential Technical/Financial Assistance Sources:
MSP-Emergency Management and Homeland Security Division (MSP-EMHSD); MDEQ NFIP Coordinator.

Comments:
All municipalities are eligible to participate in the program, so long as the minimum requirements are met. NFIP flood insurance can only be acquired in communities that participate in the program. Municipalities to target for NFIP participation include the townships of Claybanks, Colfax, Ferry, Greenwood, Hart, Otto, and Weare.

Action Item 35. 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.

Priority Level: Low

Timeframe: 2015-2016

Applicable Governmental Unit(s)/Responsible Person(s):
OCEM.

Potential Technical/Financial Assistance Sources:
MSP-EMHSD; MDEQ NFIP Coordinator.

Comments:
Current NFIP participants include: City of Hart; villages of Hesperia and Pentwater; and townships of Benona, Golden, Newfield, and Pentwater.

Action Item 42. Assess the need for and use of state and federal funding and technical assistance for dam / spillway repairs.

Priority Level: Medium

Timeframe: Annually

Applicable Governmental Unit(s)/Responsible Person(s):
OCEM.

Potential Technical/Financial Assistance Sources:
Michigan DEQ.

Comments:
OCEM will coordinate with local governments to monitor dam conditions, and maintain communication with state and federal agencies that may be able to provide funding or assistance for dam maintenance and repairs.

Action Item 44. 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.

Priority Level: Medium

Timeframe: Annually

Applicable Governmental Unit(s)/Responsible Person(s):
OCEM; Mason-Oceana 911.

Potential Technical/Financial Assistance Sources:
Local resources.

Comments:
Protecting public health and safety is one of the four main goals of this plan. Maintaining an effective and reliable public warning system is one of the best ways to accomplish that goal.

Action Item 45. Implement improvements to the warning system as deemed necessary for improving coverage and effectiveness.

Priority Level: Medium

Timeframe: Annually; following evaluation of public warning system (Action Item 44)

Applicable Governmental Unit(s)/Responsible Person(s):
OCEM; Mason-Oceana 911.

Potential Technical/Financial Assistance Sources:
Federal Emergency Management Agency (FEMA); MSP-EMHSD.

Comments:
Protecting public health and safety is one of the four main goals of this plan. Maintaining an effective and reliable public warning system is one of the best ways to accomplish that goal.

Action Item 53. Install back-up generators, as needed for short-term relief from power failures, at critical facilities such as sewage pump stations, road commissions, hospitals and medical centers, nursing home facilities, schools, shelters, and government facilities.

Priority Level: Medium

Timeframe: 2015

Applicable Governmental Unit(s)/Responsible Person(s):
OCEM; Critical facility managers.

Potential Technical/Financial Assistance Sources:
MSP-EMHSD; Local resources.

Comments:
Though many facilities in Oceana County currently have generators, the some remain in need of backup power. OCEM may consider developing an inventory of the critical facilities that are in need of back-up power.

Action Item 56. 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: High

Timeframe: Annually

Applicable Governmental Unit(s)/Responsible Person(s):
OCEM; Oceana 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. This is action item is new for the 2014 Action Agenda.

Action Item 57. Continue to refine state, county and local road, bridge and culvert maintenance / vegetation management programs to maintain visibilities, provide for living snow fences, reduce erosion, slow stormwater runoff and maintain the structural integrity of transportation infrastructure.

Priority Level: High

Timeframe: Ongoing

Applicable Governmental Unit(s)/Responsible Person(s):
OCEM; Oceana County Road Commission.

Potential Technical/Financial Assistance Sources:
MDOT; Oceana County Conservation District.

Comments:
OCEM, through the Oceana County LEPC will work to identify opportunities to incorporate hazard mitigation provisions into management programs to protect new and existing infrastructure. This is action item is new for the 2014 Action Agenda.

Action Item 60. 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.

Priority Level: High

Timeframe: Annually

Applicable Governmental Unit(s)/Responsible Person(s):
OCEM; Local fire departments.

Potential Technical/Financial Assistance Sources:
Local resources.

Comments:
This task is the responsibility of Oceana County Emergency Management with support from the Oceana County LEPC.

Action Item 64. Continue to maintain, and acquire as necessary, fire-fighting and rescue equipment, including specialized equipment for limited access areas, thermal imaging devices, and special equipment for water and ice rescues.

Priority Level: Medium

Timeframe: Annually

Applicable Governmental Unit(s)/Responsible Person(s):
OCEM; Local fire departments.

Potential Technical/Financial Assistance Sources:
MSP-EMHSD; Homeland Security Grant Program (HSGP)..

Comments:
Improving the capabilities of first responders will provide a way to lessen or perhaps shorten the duration of a disaster's impacts.

Action Item 69. Continue relationship with and support of the Oceana County RACES amateur radio group to assure communication capability with the state EOC, state police, NWS, 911 dispatch, neighboring jurisdictions and others during extreme communication disruption events.

Priority Level: Medium

Timeframe: Ongoing

Applicable Governmental Unit(s)/Responsible Person(s):
Oceana County RACES; Mason-Oceana 911; OCEM.

Potential Technical/Financial Assistance Sources:
HSGP; Voluntary contributions.

Comments:
OCEM will maintain a relationship with the Oceana County RACES and Mason-Oceana 911 through monthly LEPC meetings.

Action Item 74. 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: Low

Timeframe: Seasonally

Applicable Governmental Unit(s)/Responsible Person(s):
OCEM; Local units of government.

Potential Technical/Financial Assistance Sources:
MSP-EMHSD; FEMA; MSUE; NFIP; Red Cross; Salvation Army.

Comments:
Mitigation and disaster recovery information may be distributed via social media, public meetings, newsletters, etc. OCEM will consider distributing such 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 75. Produce and distribute local emergency preparedness and safety information 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: Low

Timeframe: Ongoing

Applicable Governmental Unit(s)/Responsible Person(s):
OCEM; Oceana County Departments.

Potential Technical/Financial Assistance Sources:
HMGP; HSGP; MSP-EMHSD; Utilities.

Comments:
Many county departments are constantly implementing this action item. It is stated here to support efforts that are currently in effect, and to encourage OCEM to distribute pertinent information through 211, social media, public meetings, etc.

Action Item 76. 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.

Priority Level: Low

Timeframe: Annually

Applicable Governmental Unit(s)/Responsible Person(s):
OCEM.

Potential Technical/Financial Assistance Sources:
Local resources.

Comments:
This action item will help to incorporate hazard mitigation into local government authorities, policies, programs, and resources within Oceana County.

2014 Action Agenda

List of Hazard Mitigation Actions Applicable to Governmental Units

ACTION AGENDA

APPLICABLE LOCAL GOVERNMENT

Action Item	BCEGS	LAND USE PLANNING	CAPITAL IMPROVEMENTS	ZONING ORDINANCES	HYDRAULIC SHADOW	IMPLEMENT CWPP	NFIP	CRS	DAM REPAIR FUNDING	WARNING SYSTEM EVALUATION	WARNING SYSTEM IMPROVEMENTS	GENERATORS	DISASTER RESPONSE CAPABILITIES	ROAD MAINTENANCE	COORDINATED RESPONSE PLANS	EMERGENCY RESPONSE EQUIPMENT	AMATEUR RADIO	HAZARD AND MITIGATION INFO.	PREPAREDNESS AND SAFETY INFORMATION	MITIGATION OUTREACH
Action Item #	**2**	**7**	**8**	**9**	**14**	**25**	**34**	**35**	**42**	**44**	**45**	**53**	**56**	**57**	**60**	**64**	**69**	**74**	**75**	**76**
Oceana County	•	•	•			•	•		•	•	•	•	•	•	•	•	•	•	•	•
Hart City		•	•	•		•		•							•	•		•		
Hesperia Vil.		•	•	•	•	•		•							•	•		•		
New Era Vil.		•	•	•		•												•		
Pentwater Vil.		•	•	•		•		•							•	•		•		
Rothbury Vil.		•	•	•		•												•		
Shelby Vil.		•	•	•		•									•	•		•		
Walkerville Vil.		•	•	•		•									•	•		•		
Benona T.		•	•	•		•		•							•	•		•		
Claybanks T.		•	•	•		•												•		
Colfax T.		•	•		•	•	•											•		
Crystal T.		•	•		•	•									•	•		•		
Elbridge T.		•	•	•	•	•												•		
Ferry T.		•	•	•		•	•								•	•		•		
Golden T.		•	•	•	•	•		•										•		
Grant T.	•	•	•	•		•	•								•	•		•		
Greenwood T.		•	•	•	•	•	•											•		
Hart T.		•	•	•	•	•	•								•	•		•		
Leavitt T.		•	•			•												•		
Newfield T.	•	•	•	•	•	•		•							•	•		•		
Otto T.	•	•	•	•		•	•											•		
Pentwater T.		•	•	•		•		•										•		
Shelby T.		•	•	•		•									•	•		•		
Weare 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 Oceana County Emergency Management Coordinator 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 Coordinator with assistance from the LEPC.

Monitoring

The Oceana County Emergency Management Coordinator 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 Coordinator 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 Coordinator 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 done by the Emergency Management Coordinator, 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 Coordinator who will receive all other forms of correspondence. The Office of Emergency Management 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. Most communities in Oceana 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

OCEANA COUNTY

1.	**major geographic features:**	- 51.9 persons per square mile - 31.0 housing units per square mile - Pentwater River, Pere Marquette River, White River - Lake Michigan, Silver Lake, Pentwater Lake, Hart Lake, Stony Lake - Lake Michigan shoreline and beach - Coastal sand dunes - Manistee National Forest - Hart-Montague Bicycle Trail
2.	**Population Concentrations**	
a.	**group homes:**	- A New Beginning, 298 Hawley, Hesperia, MI (6 capacity) - Cherry Blossom Manor, 611 E. Main St., Hart, MI (39 capacity) - Country Acres AFC, 2649 W. Woodrow Rd., Shelby, MI (11 capacity) - Fessenden Adult Foster Care, 412 S. Hart, Hart, MI (12 capacity) - Michigan Street Home, 7880 S. Michigan Ave., Rothbury, MI (6 capacity) - King Home, 7212 S. Oceana Drive, Rothbury, MI (6 capacity) - Morningside, 3871 Melody Lane, Hart, MI (6 capacity) - Rose AFC Home, 1318 S. Oceana Dr. (12 capacity) - Oceana Seniors INC., 6699 N. Oceana Dr., Hart, MI (12 capacity) - Pine Cone Grove, 68 S. Oceana Drive, Shelby, MI (6 capacity) - The River AFC, LLC, 397 W. Michigan Ave., Hesperia, MI (15 capacity) - Willowbrook AFC, 5275 S. 68th Ave., New Era, MI (6 capacity) - White Oak, 566 S. Clymer St., Pentwater, MI (8 capacity)
b.	**large apartment buildings:**	- Barnett Station Village, 64 S. Michigan Ave., Shelby, MI (32 units) - Chapita Hills, 52 Chapita Hills Dr., Shelby, MI (24 family units) - Chippewa Creek, 450 Griswold, Hart, MI (18 Elderly Units) - Park View Manor, 710 E. Main St, Hart, MI (28 Elderly and 20 Family Units) - Park Place Apartments, 415-417 N. State St., Shelby, MI(32 family units) - Rosewood, 182 W. 6th St., Shelby, MI (24 elderly units) - Summerview Apartments, 360 N. 3rd Ave., Pentwater, MI (16 family units) - Silverwood Manor Apartments, 140 Town Place Ct., Hesperia, MI (16 units) - Town Place Apartments, 120 Town Place Ct., Hesperia, MI (16 units) - White River Estates, 23 S. Winter St., Hesperia, MI (31 family units)
c.	**schools:**	- Hart High School, 300 W. Johnson St. (340 students, 32 staff) - Hart Middle School, 308 W. Johnson St. (364 students, 36 staff) - Spitler Elementary School (Hart Public Schools), 302 W. Johnson St. (459 students, 45 staff) - Diman-Wolf Early Childhood Center, 306 W. Johnson St. (88 students, 16 staff) - New Era Christian Preschool, 1901 Oak Ave. (15 capacity) - New Era Elementary (Shelby Public Schools), 2752 Hillcrest Dr. (187 students, 21 staff) - Oceana Christian School, 3258 N. 72nd Ave. (102 students, 12 staff) - Oceana High School (Shelby Public Schools), 2930 Winston Rd. (60 students, 7 staff) - Pentwater Public School (Elementary, Middle, and High School), 600 E. Park (292 students, 31 staff) - Shelby High School, 641 N. State St. (400 students, 35 staff) - Shelby Middle School, 525 N. State St. (280 students, 25 staff) - Thomas Read Elementary (Shelby Public Schools), 155 6th St. (425 students, 42 staff) - Shelby Early Childhood Center, 155 6th St. (105 Students, 15 staff) - Walkerville Elementary/Middle/High School, 180 E. Main St. (270 students, 17 staff)
d.	**large office buildings:**	- See 4.h.

e.	**other:** (such as stadiums, concert halls, amusement parks, fairgrounds, correctional facilities, nursing homes, other special populations or large crowd assembly areas)	**Refer to individual city, village or township profiles**
f.	**major employers:**	- Arbre Farms, 6362 N. 192nd Ave. (300 employees) - Burnett Foods, 4856 First (265 employees) - Ed's Thrif-T Shopping Center, 75 W. Michigan (61 employees) - GHSP – Hart, 1500 N. Industrial Park Drive (250 employees) - Gray & Co., 3325 W. Polk Rd. (144 employees) - Gales IGA, 710 S. State (50 employees) - Hart Area Schools, 300 W. Johnson St. (175 employees) - Kurdziel Iron, 2625 W. Winston Rd. (250 employees) - Kysor of Cadillac (50 employees) - Lakeshore Community Hospital, 725 S. State St. (155 employees) - Michigan Freeze Pack, 835 S. Griswold (200 employees) - Oceana County Medical Facility, 701 E. Main (227 employees) - Oceana County, 100 N State St (80 employees) - Oceana County FIA, 4081 W. Polk Rd. (42 employees) - Oceana Foods, 168 W. Lincoln (50 employees) - Pentwater School District, 600 E. Park (31 employees) - Pentwater Wire Products, 474 Carroll (100 employees) - Peterson Farms, 226 Oceana Dr. (600 employees) - Seventh Day Adventist Church, 79 6th (72 employees) - Shelby Public Schools, 641 N. State St. (220 employees) - Shelby Manufacturing, 925 N. Industrial Park Dr. (50 employees) - Walkerville Public Schools, 180 E. Main St. (17 educators)
3.	**Population Shifts**	
a.	**daily:**	- 10,713 commute with an average commuting time of 23.8 minutes - 5,529 school-aged children
b.	**seasonal:**	- 15,944 total housing units: 10,174 occupied/ 5,770 vacant - Of the vacant, 4,381 (75.9%) are seasonal recreational or occasional use
4.	**Important or Critical Public and Private Facilities**	
a.	**police precincts:**	- Hart Police Department, 427 State St. - Hesperia Village Police Dept, 33 E. Michigan Ave. (Newaygo County) - Michigan State Police/Hart Post 66, 3720 W. Polk Rd. - Mason-Oceana 911 Central Dispatch, 9160 N. Oceana Drive - New Era Police Department, 2580 Ray St. - Oceana County Sheriff Department, 216 Lincoln St. - Pentwater Village Police Department, 326 Hancock St. - Rothbury Police Department, 7752 Michigan Ave. - Shelby Police Department, 189 Maple St. - Walkerville Police Department, 121 S. East St.
b.	**fire stations:**	- Crystal Township Fire Department, 1503 E Hammett Rd. - DNR - Oceana Field Office, 1757 E. Hayes Rd. (M-20) - Ferry Township Fire Department, 2140 E. Main St. - Grant Township Fire Department, 7140 S. Oceana Dr. - Hart Fire Department, 808 S. State - Hesperia Area Fire Department, 8320 E. M-20 - Pentwater Fire Department, 486 E. Park - Shelby-Benona Fire Department, 430 Industrial Park Dr. - Walkerville Area Fire/Rescue, 134 S. East St.
c.	**public works yards:**	- Department of Public Works, 6th St. (Village of Shelby) - Oceana County Road Commission, 3501 W. Polk Rd. - Pentwater Village Public Works Department, W. Madison Rd.

		- Public Works Department, 1010 S. State St. (City of Hart)
d.	**pumping stations:**	- City of Hart Water System - Village of Hesperia Water System - Village of Pentwater Water System - Village of Shelby Water System
e.	**community shelters:**	- Congregational United Church of Christ, 408 S. State Rd., Hart, MI 49420 - Elbridge Community Church, 2370 N 136th Ave., Hart, MI 49420 - Elbridge Township Hall, 2266 E. Polk Rd., Hart, MI 49420 - Golden Elementary School, 5527 W. Fox Rd, Mears, MI 49436 - Hart High School, 300 W. Johnson St., Hart, MI 49420 - Hart Middle School, 308 W. Johnson St., Hart, MI 49420 - Hart United Methodist Church, 308 State St., Hart, MI 49420 - Hart VFW, 802 State St., Hart, MI 49420 - Hart Wesleyan Church, 3400 Polk Rd., Hart, MI 49420 - New Era Christian, 1901 Oak, New Era, MI 49446 - New Era Elementary, 2752 Hillcrest, New Era, MI 49446 - New Era Reformed Church, 4775 First St., New Era, MI 49446 - Pentwater Friendship Center, 310 Rush St., Pentwater, MI 49449 - Pentwater Public Schools, 600 E. Park St., Pentwater, MI 49449 - Pentwater VFW Hall, 8440 N. US 31, Pentwater, MI 49449 - Rothbury Community Church, 2440 Winston Rd., Rothbury, MI 49452 - Shelby High School, 641 N. State St., Shelby, MI 49455 - Shelby Middle School, 525 N. State St., Shelby, MI 49455 - Shelby United Methodist Church, 68 E. Third St., Shelby, MI 49455 - St. Gregory's Church, 316 Peach St., Hart, MI 49420 - St. Joseph Catholic Church Hall, 2349 Jackson Rd., Hart, MI 49420 - St. Vincent Catholic Church, 637 E. Sixth St., Pentwater, MI 49449 - Walkerville High School, 145 Lathrop, Walkerville, MI 49459
f.	**community medical facilities, hospitals:**	- Hart Family Medical Center, 611 E. Main St. - Memorial Family Care Center, 2481 N. 72nd Ave. - Emergency Medical Services, 3966 N. Oceana Dr., Hart Twp (ambulance) - Mercy Health Partners- Lakeshore Campus, 72 S. State St. - Northwest Michigan Health Services, 119 S. State St. - Emergency Medical Services, 23 E. Third St (ambulance)
g.	**historic sites:**	- Hart Historic Industrial District, 215-216 Lincoln St. & 109 Union St. (Hart) - US-31 (Old) Pentwater River Bridge, Oceana Dr. over Pentwater River (Hart) - Weaver, Daniel, House, 84 S. Cook St. (Hesperia, Newago County) - Benona Township Hall, 5400 W. Woodrow (Benona Twp) - Little Point Sable Light Station, Little Sable Point (Benona Twp) - Charles Mears, Silver Lake Boardinghouse, SE Corner of Lighthouse & Silver Lake Channel rds. (Golden Twp) - Veterans Day Storm-Graveyard of Ships Informational Designation, 421 S. Hancock St. (Pentwater)
h.	**other:** (such as government buildings, record center, major construction companies, warehouses, demolition companies, heavy equipment rental, emergency equipment and vehicle storage areas, etc.)	**Refer to individual city, village or township profiles**
5.	**Vital or Critical Infrastructure**	
a.	**roads, railroads, and bridges:**	- Oceana Drive - B-15, B-86 - M-20, M-82, M-86, M-120 - US-31 - Bridges: M-20 over White River North Branch, M-20 over White River South Branch, M-20 over US-31, US-31 over Pentwater

		River South Branch, US-31 Business Route over Bass Lake, B-15 over Bass Lake, Oceana drive over Pentwater River South Branch, Oceana drive over Pentwater River North Branch
b.	**dams, power stations, water treatment plants, sanitary lift stations, etc.:**	- Consumers Energy Power Line (Crystal Township, Elbridge Township, Ferry Township, Grant Township, Greenwood Township, Hart Township, Leavitt Township, Newfield Township, Weare Township) - Hart Lake Dam, Foster Lake Dam, Crystal Valley Dam, Gales Pond Dam, Upper Silver Lake Dam, Lake Holiday Dam, Pond Dam (Mill St, Hesperia) - Silver Lake Level Control Structure - City of Hart Wastewater Treatment Plant - City of Hart Wastewater Collection System - Sewage disposal pond, Madison Rd. (Pentwater Township) - Sewage Lagoon, Pierce Rd. (Shelby Township) - Oceana County Trash, Transfer, and Recycling, 1600 E Hayes Rd (M-20, Ferry Township)
c.	**other:** (such as airports, pipelines, bus terminals, train stations, military bases, marine passenger ferry services, etc.)	- Double JJ Resort Ranch Airport, Water Rd. (Open from April-October) - Oceana County Airport (Hart-Shelby), 1805 W. Baseline Rd. - Silver Lake Airport, 6094 Weaver Rd. - MichCon Gas Pipeline (Grant Township, Hart Township, Shelby Township, Weare Township) - Great Lakes Energy Gas Services natural gas pipeline - Great Lakes Energy Gas Services storage tank, 2100 N. Ridge Rd. (30,000 gallons)

6. Socio-Economic Profile of Sector

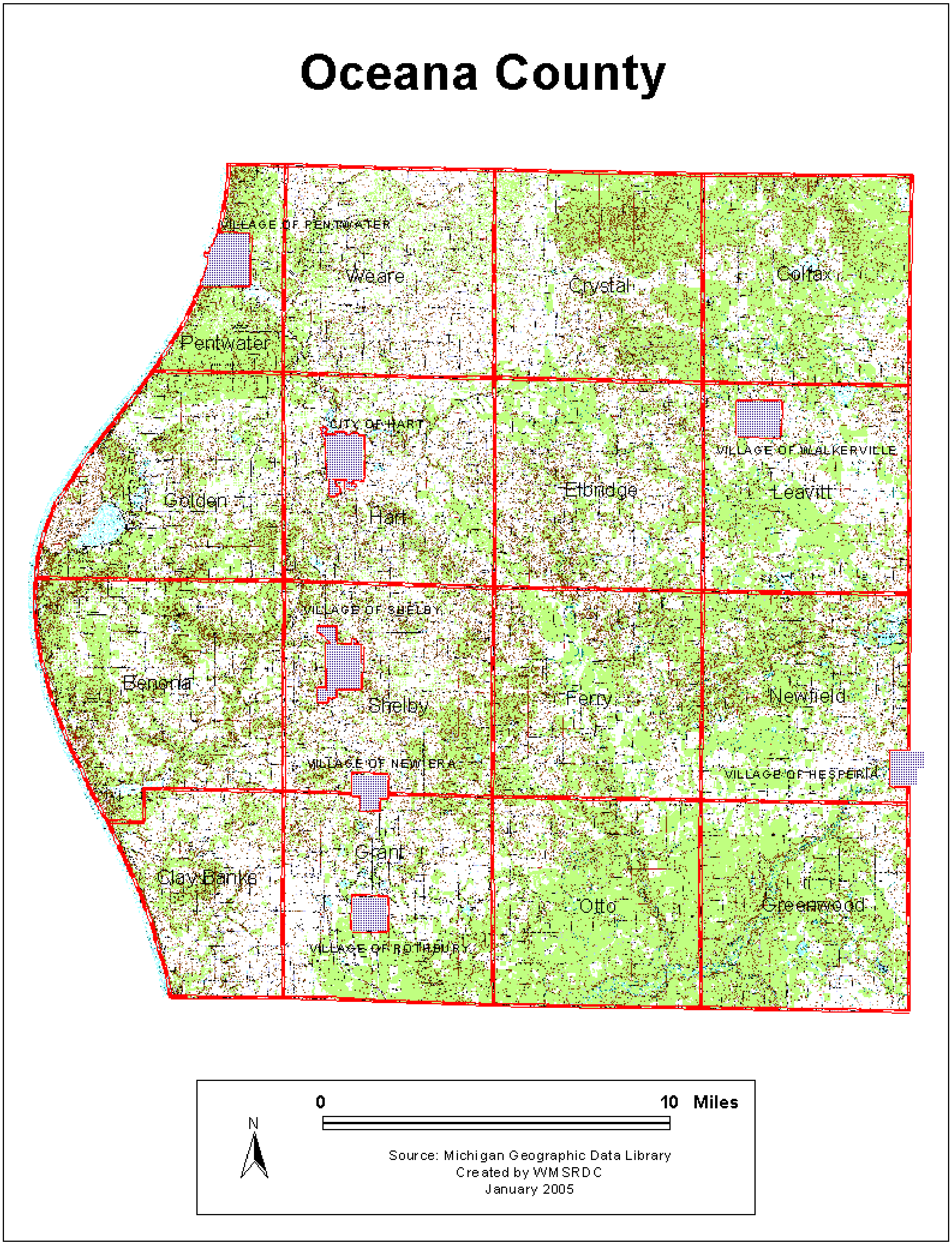
a.	**total population (night):**		26,570
b.	**peak population (seasonal):**		37,873
c.	**percent over 65:**		17
d.	**percent under 18:**		24.9
e.	**percent that are homeowners:**		81.3
f.	**percent below poverty level:**		12.4
g.	**percent with disability or mobility limitation:**		21.4
h.	**estimated property insurance coverage:** **(Real and Personal Equalized Valuations):**	Agricultural: Commercial: Industrial: Residential: Total Personal: Total:	$184,507,517 $97,499,014 $35,208,501 $1,154,828,294 $81,023,930 $1,553,067,256
j.	**flood insurance coverage:**	Total Losses since 01/01/78: Total Payments since 01/01/78: Policies In-Force: Total Insurance In-Force:	23 $82,914 86 $12,890,000
j.	**location of floodplains:**	**Refer to individual city, village or township profiles.**	

7. Emergency Warning System Coverage

a.	**siren locations and/or description of warning system:**	- Camp Miniwanca, 8845 W. Garfield, Stony Lake - Hart Siren, just east of Hart Post Office, 135 S. State St. - Crystal Valley Siren, Crystal Township Fire Department, 1499 E. Hammett Rd. - Ferry Siren, Ferry Township Fire Department, 2140 E. Main St. - New Era Siren, Village Hall, 2589 W. Garfield Rd. - Pentwater Siren, Village Hall, 327 S. Hancock

		- Shelby Siren, Village Center, Near Michigan Ave. and E. 4th St. - Walkerville Siren, Walkerville Area Fire/Rescue, 134 S. East St. - National Weather Service Relay Tower, Greenwood Township
b.	**percent of population covered by warning sirens or system:**	All cover a ½ to 2 mile radius depending on wind and humidity
(Note: Map showing warning siren locations and system coverage is included in Part D.)		

Land Use and Natural Features Map (USGS Quad.)



CITY OF HART

1.	**major geographic features:**	- 1,113.1 persons per square mile - 444.5 housing units per square mile - Hart Lake - Pentwater River - Hart-Montague Bicycle Trail
2.	**Population Concentrations**	
a.	**group homes:**	- Fessenden Adult Foster Care, 412 S. Hart (12 capacity) - Cherry Blossom Manor, 611 E. Main St. (39 capacity) - Morningside, 3871 Melody Lane, Hart, MI (6 capacity)
b.	**large apartment buildings:**	- Park View Manor, 710 E. Main St (28 Elderly and 20 Family Units) - Chippewa Creek, 450 Griswold (18 Elderly Units)
c.	**schools:**	- Hart High School, 300 W. Johnson St. (340 students, 32 staff) - Hart Middle School, 308 W. Johnson St. (364 students, 36 staff) - Diman-Wolf Early Childhood Center (Hart Area Schools), 306 W. Johnson St. (88 students, 16 staff) - Spitler Elementary (Hart Area Schools), 302 W. Johnson St. (459 students, 45 staff)
d.	**large office buildings:**	- Refer to 4.h.
e.	**other:** (such as stadiums, concert halls, amusement parks, fairgrounds, correctional facilities, nursing homes, other special populations or large crowd assembly areas)	- Hart High School Football Stadium, 300 W. Johnson St. - Oceana County Medical Care Facility, 701 E. Main St. (nursing home, 113 beds) - John Gurney Park, 300 N. Griswold St. (80 camp-sites) - Oceana County Fairgrounds, 1025 S. State (3rd week in August) - Oceana County Jail, 216 Lincoln St. (66 capacity) - Hart Migrant Program, 300 W. Johnson St. (22 capacity) - National Asparagus Festival (every other year) - Hart Heritage Days (Labor Day weekend) - Hart Motel, 715 S. State (16 units) - John Gurney Park, 300 N. Griswold (105 campsites)
f.	**major employers:**	- Gray & Co., 3325 W. Polk Rd. (144 employees) - Oceana County Medical Facility, 701 E. Main (227 employees) - Hart Area Schools, 300 W. Johnson St. (175 employees) - GHSP – Hart, 1500 N. Industrial Park Drive (250 employees) - Oceana County, 100 N State St (80 employees) - Michigan Freeze Pack, 835 S. Griswold (200 employees) - Gales IGA, 710 S. State (50 employees) - Oceana County FIA, 4081 W. Polk Rd. (42 employees)
3.	**Population Shifts**	
a.	**daily:**	- 582 commute with an average commuting time of 15.1 minutes - 432 school-aged children
b.	**seasonal:**	- 849 total housing units: 757 occupied/ 92 vacant - Of the vacant, 21 (22.8%) are for seasonal, recreational or occasional use
4.	**Important or Critical Public and Private Facilities**	
a.	**police precincts:**	- Hart Police Department, 427 State St. - Oceana County Sheriff Department, 216 Lincoln St.

		- Michigan State Police Post, 3720 W. Polk Rd.
b.	**fire stations:**	- Hart Fire Department, 808 S. State
c.	**public works yards:**	- Public Works Department, 1010 S. State St.
d.	**pumping stations:**	- City of Hart Water System
e.	**community shelters:**	- Congregational United Church of Christ, 408 S. State - Hart High School, 300 W. Johnson St. - Hart Middle School, 308 W. Johnson St. - Hart United Methodist Church, 308 S. State St. - Hart VFW, 802 S. State St. - St. Gregory's Church, 316 S. Peach Ave.
f.	**community medical facilities, hospitals:**	- Hart Family Medical Center, 611 E. Main St. - Memorial Family Care Center, 2481 N. 72nd Ave.
g.	**historic sites:**	- Hart Historic Industrial District, 215 Lincoln St., 216 Lincoln St., &109 Union St. - US-31 (Old) Pentwater River Bridge, Oceana Dr. over Pentwater River
h.	**other:** (such as government buildings, record center, major construction companies, warehouses, demolition companies, heavy equipment rental, emergency equipment and vehicle storage areas, etc.)	- Oceana County Building, 100 N. State and Annex, 314 S. State St. (20 employees) - City of Hart, 407 State St. - Hart Public Library, 407 S. State St. - Oceana County FIA, 4081 W. Polk Rd.

5. Vital or Critical Infrastructure

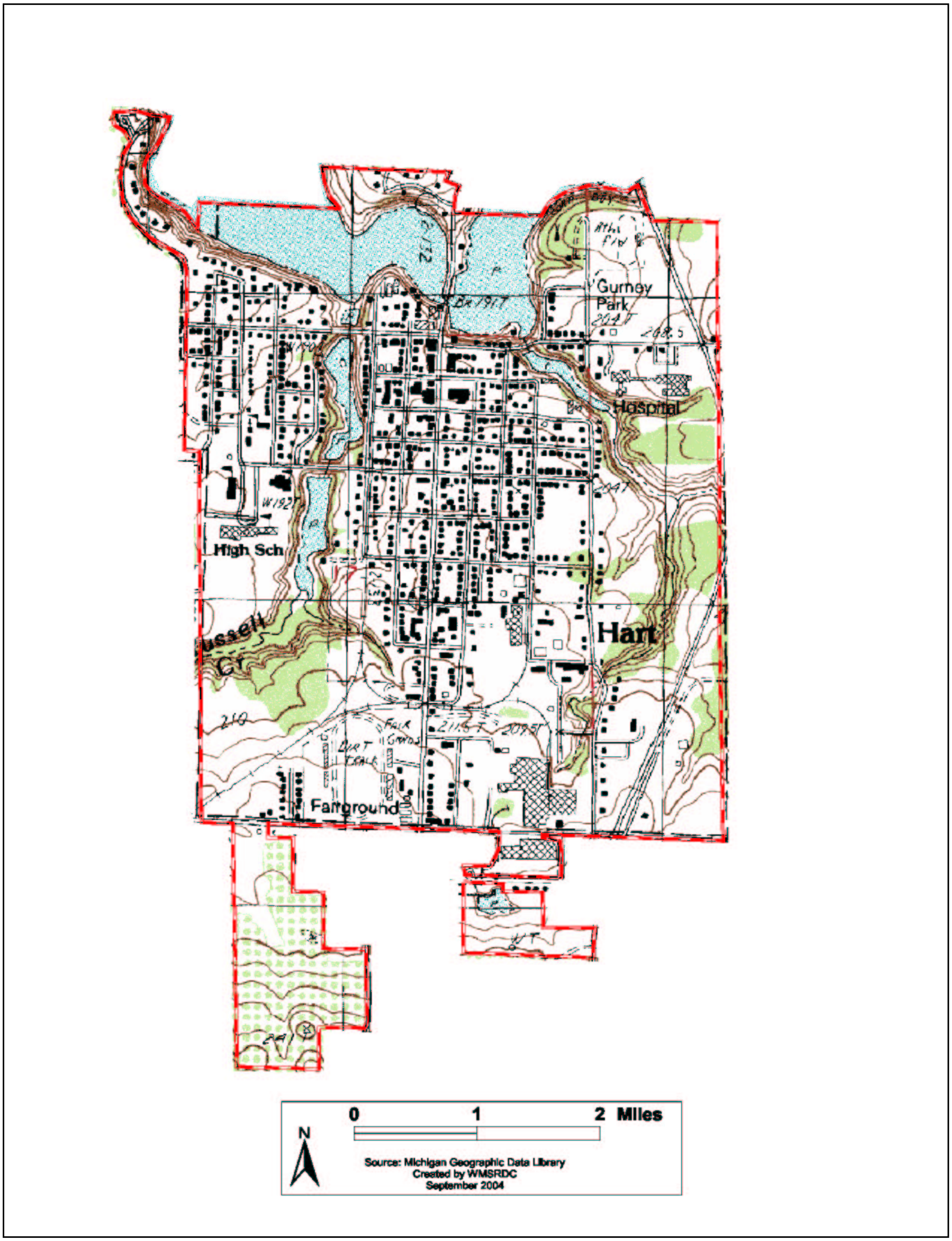
a.	**roads, railroads, and bridges:**	- Oceana Drive
b.	**dams, power stations, water treatment plants, sanitary lift stations, etc.:**	- Hart Hydro-Electric - City of Hart Wastewater Treatment Plant - City of Hart Wastewater Collection System
c.	**other:** (such as airports, pipelines, bus terminals, train stations, military bases, marine passenger ferry services, etc.)	- None Identified

6. Socio-Economic Profile of Sector

a.	**total population (night):**		2,126
b.	**peak population (seasonal):**		2,180
c.	**percent over 65:**		19.9
d.	**percent under 18:**		26.4
e.	**percent that are homeowners:**		55.5
f.	**percent below poverty level:**		23.5
g.	**percent with disability or mobility limitation:**		22.8
h.	**estimated property insurance coverage:** **(Real and Personal Equalized Valuations)**	Agricultural: Commercial: Industrial: Residential: Total Personal: Total:	$0 $19,312,000 $8,848,400 $22,486,400 $8,848,400 $59,495,200
i.	**flood insurance coverage:**	Total Losses since 01/01/78: Total Payments since 01/01/78: Policies In-Force: Total Insurance In-Force:	2 $0 2 $490,000
j.	**location of floodplains:**	- Floodplains around Hart Lake and along Russell and Chippewa creeks	

7.	**Emergency Warning System Coverage**	
a.	**siren locations or description of warning system:**	- Siren located just east of post office
b.	**percent of population covered by warning sirens or system:**	- Covers a ½ to 2 mile radius depending on wind and humidity
(Note: Map showing warning siren locations and system coverage is included in Part D.)		

Land Use and Natural Features Map (USGS Quad.)
CITY OF HART



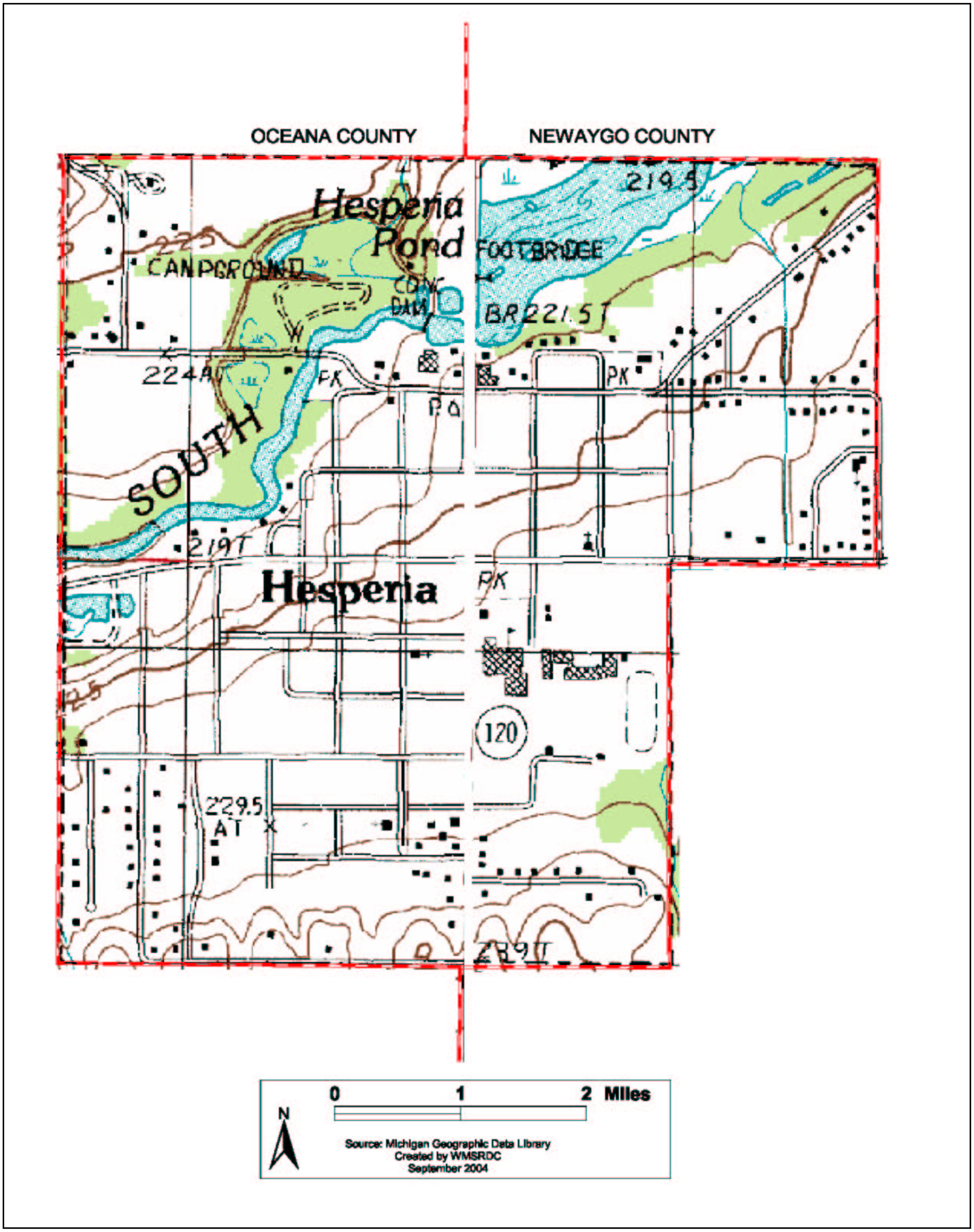
VILLAGE OF HESPERIA

1.	**major geographic features:**	- 1,207.6 persons per square mile - 545.6 housing units per square mile - White River - Hesperia Pond
2.	**Population Concentrations**	
a.	**group homes:**	- The River AFC, LLC, 397 W. Michigan Ave. (15 capacity) - A New Beginning, 298 Hawley St. (6 capacity)
b.	**large apartment buildings:**	- White River Estates, 23 S. Winter St. (31 family units) - Town Place Apartments, 120 Town Place Ct. (16 units) - Silverwood Manor Apartments, 140 Town Place Ct. (16 units)
c.	**schools:**	- Hesperia Community Schools (1,130 students, 127 staff) - Hesperia High School, 96 S Division (330 students, 23 staff, Newaygo County) - Hesperia Middle School, 96 S Division (323 students, 22 staff, Newaygo County) - Patricia St. Clair Elementary, 96 S Division (443 students, 41 staff, Newaygo County) - Hesperia Community Education (34 student, 8 staff adult education), 232 S Cook St (Newaygo County)
d.	**large office buildings:**	- See 4.g.
e.	**other:** (such as stadiums, concert halls, amusement parks, fairgrounds, correctional facilities, nursing homes, other special populations or large crowd assembly areas)	- Building Bridges Hesperia MSRP, 96 S Division (day care, capacity 32, Newaygo County) - Hesperia High School Football Stadium, 96 S Division (Newaygo County) - All Seasons Inn, 287 S. Division - Rivers Edge Lodging, 315 W. South, M-20 (Newaygo County) - Evergreen Village Mobile Home Park, 146 North Smith - Old Mill Camp, 155 W. Michigan (25 campsites)
f.	**major employers:**	- Hesperia Community Schools (127 employees) (Newaygo County) - Ed's Thrif-T Shopping Center, 75 W. Michigan (61 employees)
3.	**Population Shifts** *(also included in Newfield Township and Denver Township [Newaygo])*	
a.	**daily:**	- 387 commute with an average commuting time of 26 minutes - 227 school-aged children
b.	**seasonal:**	- 431 total housing units: 382 occupied/ 49 vacant - Of the vacant, 6 (12.2%) are for seasonal recreational or occasional use
4.	**Important or Critical Public and Private Facilities**	
a.	**police precincts:**	- Hesperia Village Police Department, 33 E. Michigan Ave. (Newaygo County)
b.	**fire stations:**	- None Identified
c.	**public works yards:**	- Hesperia Department of Public Works, 33 E. Michigan Ave. (Newaygo County)
d.	**pumping stations:**	- Village of Hesperia Water System
e.	**community shelters:**	- None Identified
f.	**community medical facilities, hospitals:**	- Hesperia Medical Center, 78 N Division (Newaygo County)

g.	**historic sites:**	- Weaver, Daniel, House, 84 S. Cook St. (Newago County)
h.	**other:** (such as government buildings, record center, major construction companies, warehouses, demolition companies, heavy equipment rental, emergency equipment and vehicle storage areas, etc.)	- Village of Hesperia, 33 E. Michigan Ave. (Newaygo County) - Hesperia Library & Civic Center, 80 S. Division St. (Newaygo County) - United States Post Office, Hesperia, 205 N Division
5.	**Vital or Critical Infrastructure**	
a.	**roads, railroads, and bridges:**	- M20 - M82/120
b.	**dams, power stations, water treatment plants, sanitary lift stations, etc.:**	- Pond Dam, Mill St. - Hesperia Water Department
c.	**other:** (such as 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 Newfield Township and Denver Township [Newaygo])* 954
b.	**peak population (seasonal):**	*(also included in Newfield Township and Denver Township [Newaygo])* 969
c.	**percent over 65:**	16.1
d.	**percent under 18:**	27
e.	**percent that are homeowners:**	67.8
f.	**percent below poverty level:**	20.3
g.	**percent with disability or mobility limitation:**	26
h.	**estimated property insurance coverage:** **(Real Equalized Valuations)** Agricultural: Commercial: Industrial: Residential: Total:	*See Newfield Township*
i.	**flood insurance coverage:** Total Losses since 01/01/78: Total Payments since 01/01/78: Policies In-Force: Total Insurance In-Force:	2 $12,904 3 $327,700
j.	**location of floodplains:**	- Floodplain along White 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

Land Use and Natural Features Map (USGS Quad.)

VILLAGE OF HESPERIA



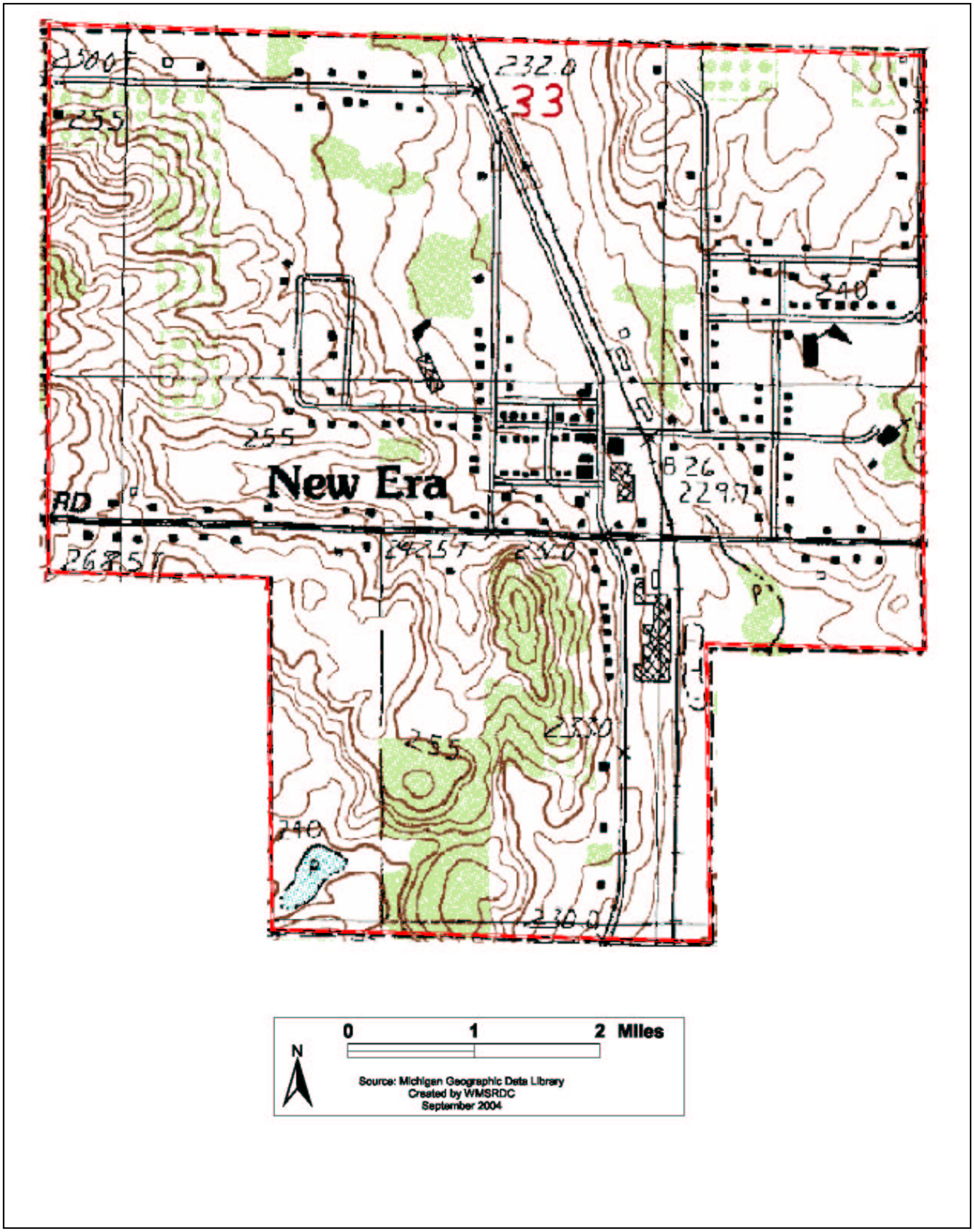
VILLAGE OF NEW ERA

1.	**major geographic features:**	- 536.9 persons per square mile - 223.8 housing units per square mile - 1 small pond - Hart-Montague Bicycle Trail
2.	**Population Concentrations**	
a.	**group homes:**	- None Identified
b.	**large apartment buildings:**	- None Identified
c.	**schools:**	- New Era Elementary (Shelby Public Schools), 2752 Hillcrest Dr. (187 students, 21 staff) - New Era Christian Preschool, 1901 Oak Ave. (15 capacity)
d.	**large office buildings:**	- See 4.h.
e.	**other:** (such as stadiums, concert halls, amusement parks, fairgrounds, correctional facilities, nursing homes, other special populations or large crowd assembly areas)	- None Identified
f.	**major employers:**	- Burnett Foods, 4856 First (265 employees) - New Era Elementary (Shelby Public Schools), 2752 Hillcrest Dr. (21 employees)
3.	**Population Shifts** *(also included in Grant and Shelby townships)*	
a.	**daily:**	- 271 commute with an average commuting time of minutes 21.1 - 98 school-aged children
b.	**seasonal:**	- 188 total housing units: 173 occupied / 15 vacant - Of the vacant, 2 (13.3%) are for seasonal recreational or occasional use
4.	**Important or Critical Public and Private Facilities**	
a.	**police precincts:**	- New Era Police Department, 2580 Ray St.
b.	**fire stations:**	- None Identified
c.	**public works yards:**	- None Identified
d.	**pumping stations:**	- None Identified
e.	**community shelters:**	- New Era Christian Reformed Church, 1820 E. Ray Ave. - New Era Christian School, 1901 Oak Ave. - New Era Elementary School, 2752 Hillcrest Dr. - New Era Reformed Church, 4775 S. First
f.	**community medical facilities, hospitals:**	- None Identified
g.	**historic sites:**	- None Identified
h.	**other:** (such as government buildings, record center, major construction companies, warehouses, demolition companies, heavy equipment rental, emergency equipment and vehicle storage areas, etc.)	- New Era Village Hall, PO Box 85
5.	**Vital or Critical Infrastructure**	
a.	**roads, railroads, and bridges:**	- US-31 - Oceana Drive

b.	**dams, power stations, water treatment plants, sanitary lift stations, etc.:**	- None Identified
c.	**other:** (such as 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 Grant and Shelby Townships)* 451
b.	**peak population (seasonal):**	*(also included in Grant and Shelby Townships)* 456
c.	**percent over 65:**	17.7
d.	**percent under 18:**	27.1
e.	**percent that are homeowners:**	87.3
f.	**percent below poverty level:**	10.4
g.	**percent with disability or mobility limitation:**	18.6
h.	**estimated property insurance coverage:** **(Real Equalized Valuations)** Agricultural: Commercial: Industrial: Residential: Total:	*See Grant and Shelby Townships*
i.	**flood insurance coverage:** Total Losses since 01/01/78: Total Payments since 01/01/78: Policies In-Force: Total Insurance In-Force:	*Not Participating in the NFIP*
j.	**location of floodplains:**	- None Identified
7.	**Emergency Warning System Coverage**	
a.	**siren locations and/or description of warning system:**	- Village Hall, 2589 W. Garfield Rd.
b.	**percent of population covered by warning sirens or system:**	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.)	

Land Use and Natural Features Map (USGS Quad.)

VILLAGE OF NEW ERA



VILLAGE OF PENTWATER

1.	**major geographic features:**	- 669.5 persons per square mile - 778.9 housing units per square mile - Lake Michigan shoreline and beach - Coastal sand dunes - Pentwater Lake
2.	**Population Concentrations**	
a.	**group homes:**	- White Oaks, 566 S. Clymer St. (8 capacity)
b.	**large apartment buildings:**	- Summer View Apartments, 360 N. 3rd Ave. (16 family units)
c.	**schools:**	- Pentwater Public School (Elementary, Middle, and High School), 600 E. Park (292 students, 31 staff)
d.	**large office buildings:**	- See 4.h.
e.	**other:** (such as stadiums, concert halls, amusement parks, fairgrounds, correctional facilities, nursing homes, other special populations or large crowd assembly areas)	- Pentwater High School Football Stadium, 600 E. Park - Charles Mears State Park, 400 W. Lowell St. (126 campsites) - Pentwater Childrens Nursery, 110 N. Rush St. (18 capacity) - Channel Lane Inn Motel, 10 Channel Lane - The Pentwater Inn, 180 E Lowell (5 rooms) - Charlie's Marina, 240 6th St (5 transient slips) - Pentwater Municipal Marina, 500 Hancock St (18 transient slips) - Pentwater Yacht Club, 205 Dover St - Pentwater Pointe Marina, 1 E. Lake St. (60 slips) - Snug Harbor Marina, 616 S. Hancock (54 slips) - Lakewood Mobile Home Park, 3241 72nd Street
f.	**major employers:**	- Pentwater Wire Products, 474 Carroll (100 employees) - Pentwater School District, 600 E. Park (45 employees)
3.	**Population Shifts** *(also included in Pentwater Township)*	
a.	**daily:**	- 316 commute with an average commuting time of 19.9 minutes - 89 school-aged children
b.	**seasonal:**	- 997 total housing units: 450 occupied/ 547 vacant - Of the vacant, 484 (88.5%) are for seasonal recreational or occasional use
4.	**Important or Critical Public and Private Facilities**	
a.	**police precincts:**	- Pentwater Village Police Department, 326 Hancock St.
b.	**fire stations:**	- Pentwater Fire Department, 486 E. Park
c.	**public works yards:**	- Pentwater Village Public Works Department, W. Madison Rd.
d.	**pumping stations:**	- Village of Pentwater Water System
e.	**community shelters:**	- Pentwater Public Schools, 600 E. Park - St. Vincent Catholic Church, 637 E. 6th St. - Pentwater Friendship Center, 310 Rush St.
f.	**community medical facilities, hospitals:**	- None Identified
g.	**historic sites:**	- None Identified

h.	**other:** (such as government buildings, record center, major construction companies, warehouses, demolition companies, heavy equipment rental, emergency equipment and vehicle storage areas, etc.)	- Village of Pentwater, 327 S. Hancock - Pentwater Township Library, 402 Park St. - Village of Pentwater Public Works Department, W. Madison Rd.

5.	**Vital or Critical Infrastructure**	
a.	**roads, railroads, and bridges:**	- US-31 Business Route - B-15
b.	**dams, power stations, water treatment plants, sanitary lift stations, etc.:**	- None Identified
c.	**other:** (such as 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 Pentwater Township)* 857
b.	**peak population (seasonal):**	*(also included in Pentwater Township)* 1,772
c.	**percent over 65:**	38.3
d.	**percent under 18:**	11.2
e.	**percent that are homeowners:**	82.7
f.	**percent below poverty level:**	1.9
g.	**percent with disability or mobility limitation:**	22
h.	**estimated property insurance coverage:** **(Real Equalized Valuations)** Agricultural: Commercial: Industrial: Residential: Total:	*See Pentwater Township*
i.	**flood insurance coverage:** Total Losses since 01/01/78: Total Payments since 01/01/78: Policies In-Force: Total Insurance In-Force:	4 $18,212 31 $ 4,044,100
j.	**location of floodplains:**	- Floodplain around Pentwater Lake and a tributary from the north end of Pentwater Lake

7.	**Emergency Warning System Coverage**	
a.	**siren locations and/or description of warning system:**	- Village Hall, 327 S. Hancock
b.	**percent of population covered by warning sirens or system:**	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.)

Land Use and Natural Features Map (USGS Quad.)
VILLAGE OF PENTWATER

VILLAGE OF ROTHBURY

1.	**major geographic features:**	- 480 persons per square mile - 180 housing units per square mile - 1 to 2 small creeks - Hart Montague Bicycle Trail
2.	**Population Concentrations** (including special facilities)	
a.	**group homes:**	- Michigan Street Home, 7880 S. Michigan Ave. (6 capacity) - King Home, 7212 S. Oceana Dr. (6 capacity)
b.	**large apartment buildings:**	- None Identified
c.	**schools:**	- Oceana High School (Shelby Public Schools), 2930 Winston Rd. (60 students, 7 staff)
d.	**large office buildings:**	- See 4.h.
e.	**other:** (such as stadiums, concert halls, amusement parks, fairgrounds, correctional facilities, nursing homes, other special populations or large crowd assembly areas)	- Green Lawn Mobile Home Court, 2725 Forest Street - Back Forty Ranch, 3300 Wilke Rd (59 campsites)
f.	**major employers:**	- Rothbury Steel Inc., 2625 W. Winston Rd. (50-100 employees) - Kysor of Cadillac (50 employees) - Oceana High School (Shelby Public Schools), 2930 Winston Rd. (7 employees)
3.	**Population Shifts** location; time, date or season of shift; extent of shift *(also included in Grant Township)*	
a.	**daily:**	- 152 commute with an average commuting time of 24.9 minutes - 98 school-aged children
b.	**seasonal:**	- 162 total housing units: 124 occupied/ 12 vacant - Of the vacant, 0 are for seasonal recreational or occasional use
4.	**Important or Critical Public and Private Facilities**	
a.	**police precincts:**	- Rothbury Police Department, 7752 Michigan Ave.
b.	**fire stations:**	- None Identified
c.	**public works yards:**	- None Identified
d.	**pumping stations:**	- None Identified
e.	**community shelters:**	- Rothbury Community Church, 2440 Winston Rd.
f.	**community medical facilities, hospitals:**	- None Identified
g.	**historic sites:**	- None Identified
h.	**other:** (such as government buildings, record center, major construction companies, warehouses, demolition companies, heavy equipment rental, emergency equipment and vehicle storage areas, etc.)	- Village of Rothbury, 7804 S. Michigan Ave.
5.	**Vital or Critical Infrastructure**	

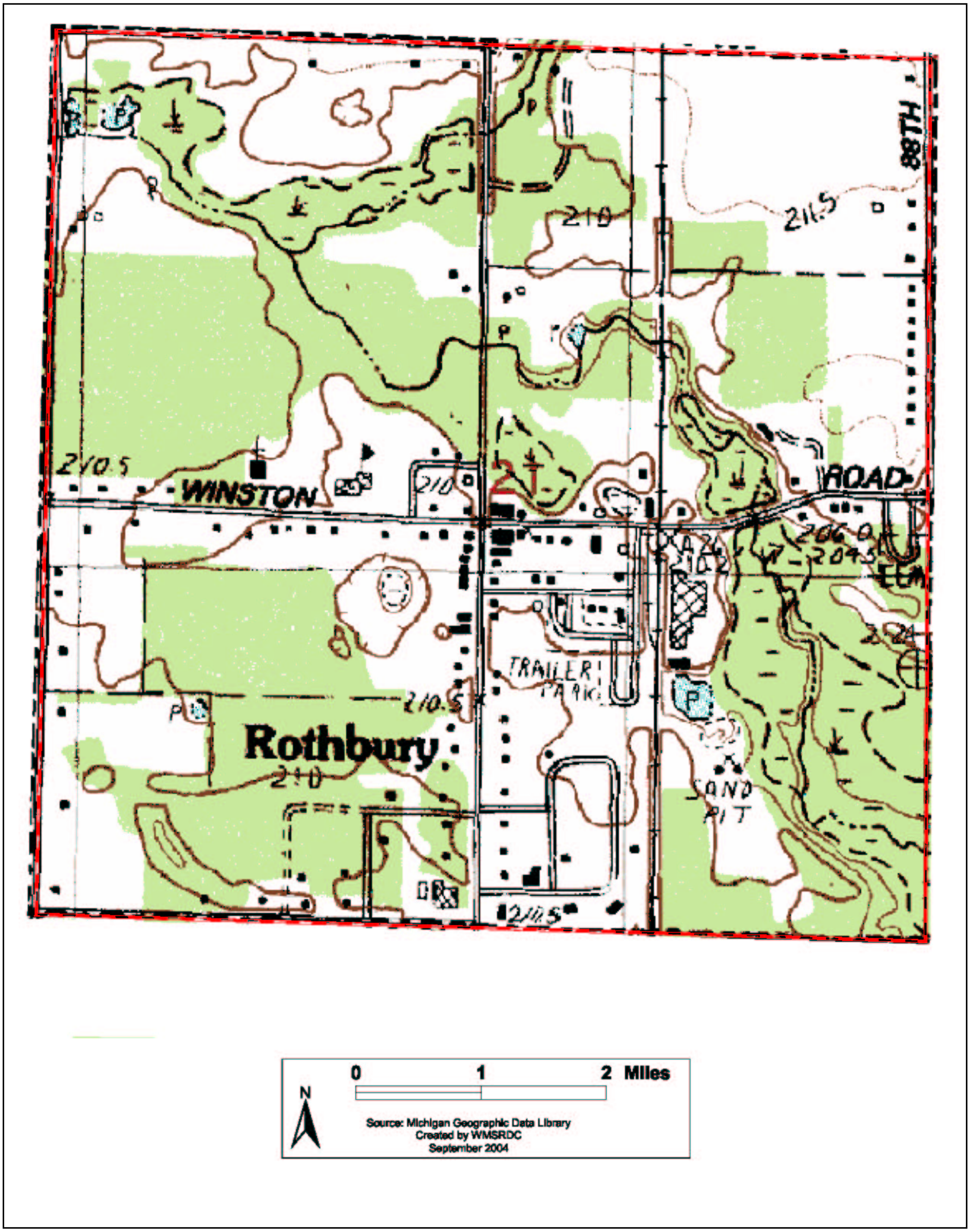
a.	**roads, railroads, and bridges:**	- US-31 - B-15
b.	**dams, power stations, water treatment plants, sanitary lift stations, etc.:**	- None Identified
c.	**other:** (such as airports, pipelines, bus terminals, train stations, military bases, marine passenger ferry services, etc.)	- None Identified

6.	**Socio-Economic Profile of Sector**		
a.	**total population (night):**	*(also included in Grant Township)*	432
b.	**peak population (seasonal):**	*(also included in Grant Township)*	432
c.	**percent over 65:**		11.8
d.	**percent under 18:**		27.5
e.	**percent that are homeowners:**		76.5
f.	**percent below poverty level:**		8.7
g.	**percent with disability or mobility limitation:**		20.4
h.	**estimated property insurance coverage:** **(Real Equalized Valuations)**	Agricultural: Commercial: Industrial: Residential: Total:	*See Grant Township*
i.	**flood insurance coverage:**	Total Losses since 01/01/78: Total Payments since 01/01/78: Policies In-Force: Total Insurance In-Force:	*Not Participating in the NFIP*
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:**	- None Identified

Land Use and Natural Features Map (USGS Quad.)

VILLAGE OF ROTHBURY

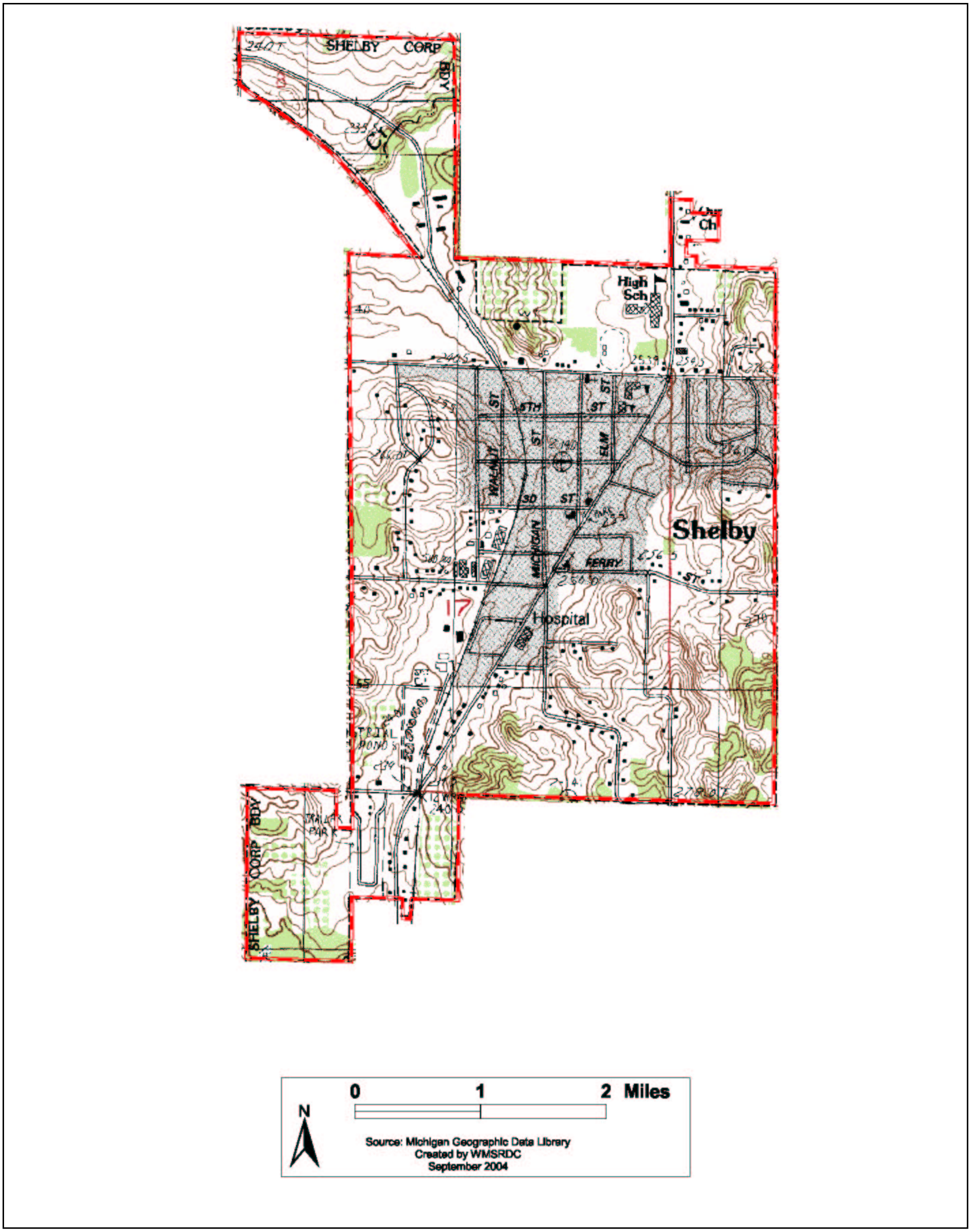


VILLAGE OF SHELBY

1.	**major geographic features:**	- 1,214.7 persons per square mile - 454.1 housing units per square mile - Hart-Montague Bicycle Trail
2.	**Population Concentrations**	
a.	**group homes:**	- Rose AFC Home, 1318 S. Oceana Dr. (12 capacity)
b.	**large apartment buildings:**	- Chapita Hills, 52 Chapita Hills Dr. (24 family units) - Park Place Apartments, 415-417 N. State St. (32 family units) - Rosewood, 182 W. 6th St. (24 elderly units) - Barnett Station Village, 64 S. Michigan Ave. (32 units)
c.	**schools:**	- Shelby High School, 641 N. State St. (400 students, 35 staff) - Shelby Middle School, 525 N. State St. (280 students, 25 staff) - Thomas Read Elementary (Shelby Public Schools), 155 6th St. (425 students, 42 staff) - Shelby Early Childhood Center, 155 6th St. (105 Students, 15 staff)
d.	**large office buildings:**	- See 4.h.
e.	**other:** (such as stadiums, concert halls, amusement parks, fairgrounds, correctional facilities, nursing homes, other special populations or large crowd assembly areas)	- Shelby High School Football Stadium, 641 N. State St. - Adventure Center Day Care, 525 N. State St. (21 capacity) - National Asparagus Festival (every other year)
f.	**major employers:**	- Shelby Public Schools, 641 N. State St. (220 employees) - Lakeshore Community Hospital, 725 S. State St. (155 employees) - Shelby Manufacturing, 925 N. Industrial Park Dr. (50 employees) - Oceana Foods, 168 W. Lincoln (50 employees)
3.	**Population Shifts** *(also included in Shelby Township)*	
a.	**daily:**	- 877 commute with an average commuting time of 16.2 minutes - 550 school-aged children
b.	**seasonal:**	- 772 total housing units: 689 occupied/ 83 vacant - Of the vacant, 1 (1.2%) is for seasonal recreational or occasional use
4.	**Important or Critical Public and Private Facilities**	
a.	**police precincts:**	- Shelby Police Department, 189 Maple St.
b.	**fire stations:**	- Shelby-Benona Fire Department, 430 Industrial Park Dr.
c.	**public works yards:**	- Department of Public Works, 6th St.
d.	**pumping stations:**	- Village of Shelby Water System
e.	**community shelters:**	- Shelby High School, 641 N. State St. (no power generator) - Shelby Middle School, 525 N. State St. (no power generator) - United Methodist Church, 68 E. 3rd St.
f.	**community medical facilities, hospitals:**	- Mercy Health Partners- Lakeshore Campus, 72 S. State St. - Northwest Michigan Health Services, 119 S. State St. - Emergency Medical Services, 23 E. Third St (ambulance)
g.	**historic sites:**	- None Identified

h.	**other:** (such as government buildings, record center, major construction companies, warehouses, demolition companies, heavy equipment rental, emergency equipment and vehicle storage areas, etc.)	- Village of Shelby, 189 N. Maple St. - Shelby Public Library, 189 N. Maple St. - Shelby Village Garage, 6th St.
5.	**Vital or Critical Infrastructure**	
a.	**roads, railroads, and bridges:**	- Oceana Drive
b.	**dams, power stations, water treatment plants, sanitary lift stations, etc.:**	- None Identified
c.	**other:** (such as 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 Shelby Township)* 2,065
b.	**peak population (seasonal):**	*(also included in Shelby Township)* 2,068
c.	**percent over 65:**	12.5
d.	**percent under 18:**	33.2
e.	**percent that are homeowners:**	62.7
f.	**percent below poverty level:**	16
g.	**percent with disability or mobility limitation:**	21.9
h.	**estimated property insurance coverage:** **(Real Equalized Valuations)** Agricultural: Commercial: Industrial: Residential: Total:	*See Shelby Township*
i.	**flood insurance coverage:** Total Losses since 01/01/78: Total Payments since 01/01/78: Policies In-Force: Total Insurance In-Force:	*Not Participating in the NFIP*
j.	**location of floodplains:**	- None Identified
7.	**Emergency Warning System Coverage**	
a.	**siren locations and/or description of warning system:**	- Village Center, Near Michigan Ave. And e. 4th St.
b.	**percent of population covered by warning sirens or system:**	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.)		

Land Use and Natural Features Map (USGS Quad.)
VILLAGE OF SHELBY



VILLAGE OF WALKERVILLE

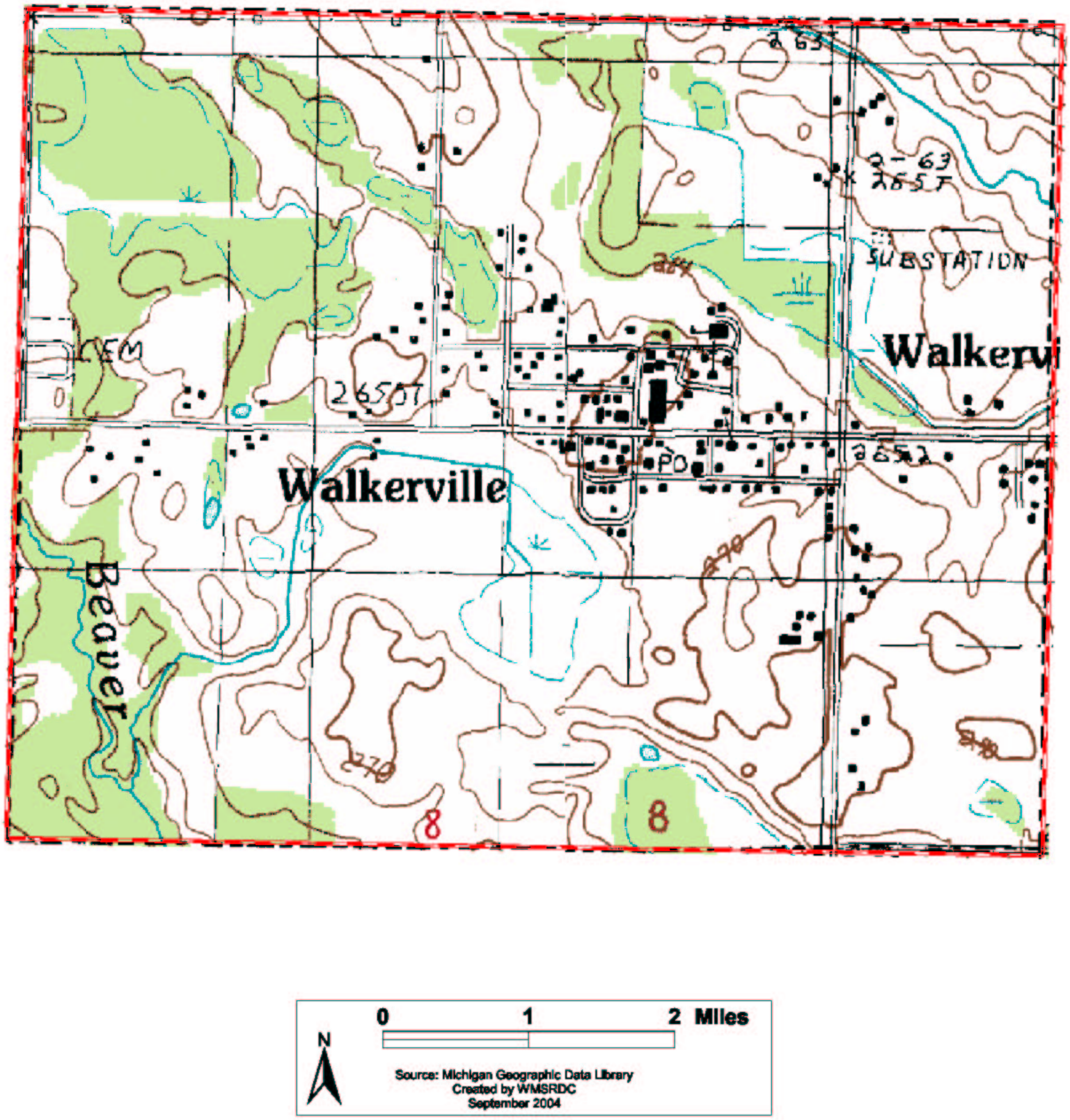
1.	**major geographic features:**	- 228.7 persons per square mile - 95.6 housing units per square mile
2.	**Population Concentrations**	
a.	**group homes:**	- None Identified
b.	**large apartment buildings:**	- None Identified
c.	**schools:**	- Walkerville Elementary/Middle/High School, 180 E. Main St. (270 students, 17 staff)
d.	**large office buildings:**	- See 4.h.
e.	**other:** (such as stadiums, concert halls, amusement parks, fairgrounds, correctional facilities, nursing homes, other special populations or large crowd assembly areas)	- Black Lake Campground, 176th Ave. (15 campsites)
f.	**major employers:**	- Walkerville Public Schools, 180 E. Main St. (17 employees)
3.	**Population Shifts** *(also included in Leavitt Township)*	
a.	**daily:**	- 89 commute with an average commuting time of 28.4 minutes - 53 school-aged children
b.	**seasonal:**	-103 total housing units: 84 occupied/ 19 vacant - Of the vacant, 4 (21.1%) are for seasonal recreational or occasional use
4.	**Important or Critical Public and Private Facilities**	
a.	**police precincts:**	- Walkerville Police Department, 121 S. East St.
b.	**fire stations:**	- Walkerville Area Fire/Rescue, 134 S. East St.
c.	**public works yards:**	- None Identified
d.	**pumping stations:**	- None Identified
e.	**community shelters:**	- Walkerville High School, 145 E. Lathrop St.
f.	**community medical facilities, hospitals:**	- None Identified
g.	**historic sites:**	- None Identified
h.	**other:** (such as government buildings, record center, major construction companies, warehouses, demolition companies, heavy equipment rental, emergency equipment and vehicle storage areas, etc.)	- Village of Walkerville, 1215 S. East St. - Oceana County Road Commission Garage, 209 Michigan St.
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 Transmission Line - Wolverine Power Transmission Line and Substation
c.	**other:** (such as 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 Leavitt Township)* 247
b.	**peak population (seasonal):**	*(also included in Leavitt Township)* 259
c.	**percent over 65:**	11.7
d.	**percent under 18:**	27.5
e.	**percent that are homeowners:**	79.3
f.	**percent below poverty level:**	8.7
g.	**percent with disability or mobility limitation:**	18.1
h.	**estimated property insurance coverage:** **(Real Equalized Valuations)** Agricultural: Commercial: Industrial: Residential: Total:	*See Leavitt Township*
i.	**flood insurance coverage:** Total Losses since 01/01/78: Total Payments since 01/01/78: Policies In-Force: Total Insurance In-Force:	*Not Participating in the NFIP*
j.	**location of floodplains:**	- None Identified

7.	Emergency Warning System Coverage	
a.	**siren locations and/or description of warning system:**	- Walkerville Area Fire/Rescue, 134 S. East St.
b.	**percent of population covered by warning sirens or system:**	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.)

Land Use and Natural Features Map (USGS Quad.)
VILLAGE OF WALKERVILLE



BENONA TOWNSHIP

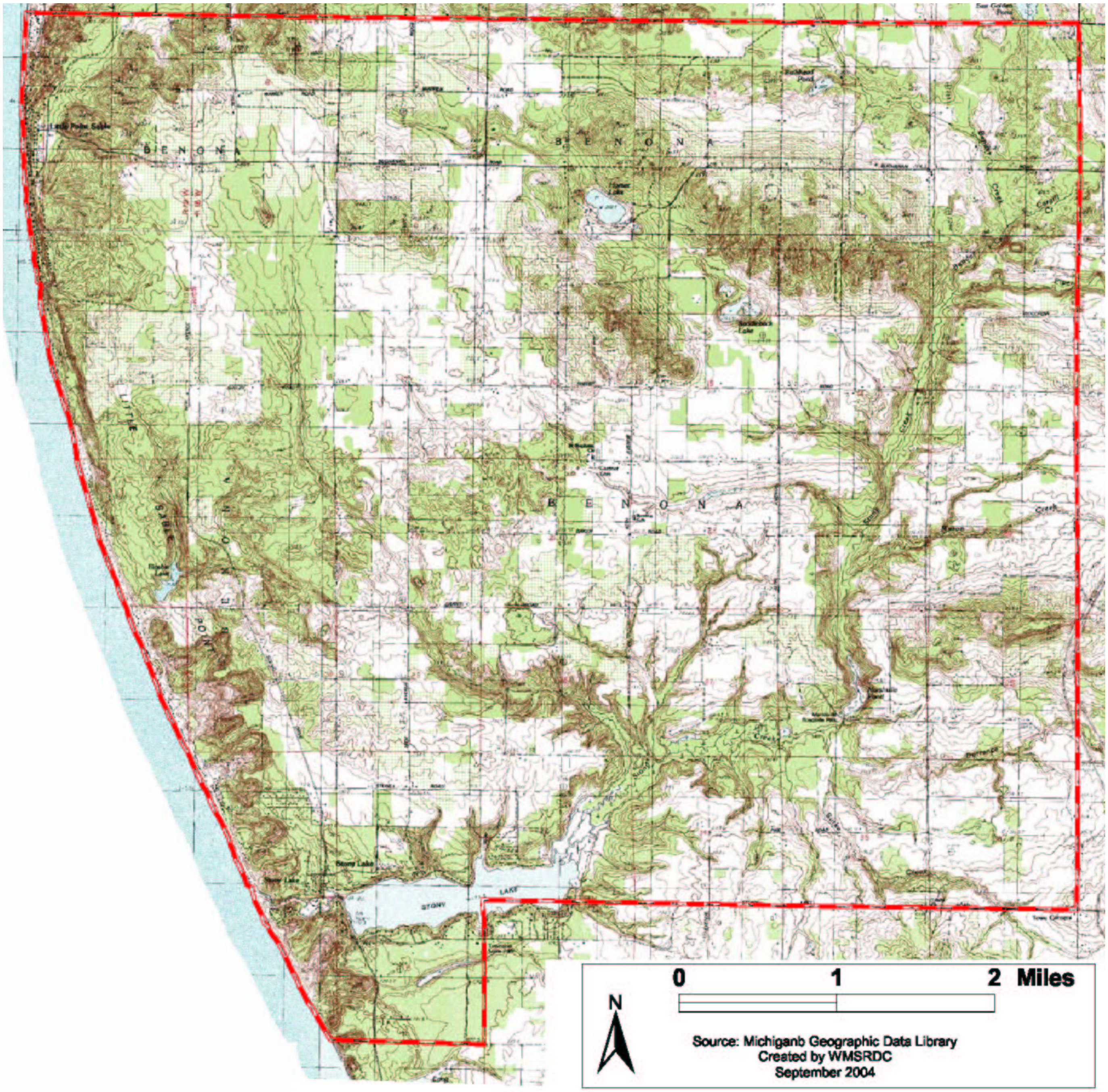
1.	**major geographic features:**	- 35.2 persons per square mile - 32.4 housing units per square mile - Lake Michigan shoreline and beach - Coastal sand dunes - Stony Lake - 4 small lakes and ponds, 4 to 5 small creeks
2.	**Population Concentrations**	
a.	**group homes:**	- None Identified
b.	**large apartment buildings:**	- None Identified
c.	**schools:**	- None Identified
d.	**large office buildings:**	- See 4.h.
e.	**other:** (such as stadiums, concert halls, amusement parks, fairgrounds, correctional facilities, nursing homes, other special populations or large crowd assembly areas)	- Benona Township Park - Stony Lake County Park - Benona Preschool, 2750 S. 40th St. (16 capacity) - Camp Al-Wa-Kiwa, 8401 W. Thomas - Camp Miniwanca/American Youth Foundation, 8845 W. Garfield (950 capacity) - Stony Haven Campground, 8079 W. Stony Lake Rd. (70 campsites) - Holiday Camping Resort, 5483 W. Stony Lake Rd. (80 campsites) - Benona Shores Golf Course, 3410 Scenic Dr. (18 holes)
f.	**major employers:**	- None Identified
3.	**Population Shifts**	
a.	**daily:**	- 568 commute with an average commuting time of 21.5 minutes - 266 school-aged children
b.	**seasonal:**	-1,320 total housing units: 600 occupied/ 720 vacant - Of the vacant, 653 (90.7%) 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:**	- Benona Township Hall, 5400 W. Woodrow - Little Point Sable Light Station, Little Sable Point
h.	**other:** (such as government buildings, record center, major construction companies, warehouses, demolition companies, heavy equipment rental, emergency equipment and vehicle storage areas, etc.)	- Township of Benona, 7169 W. Baker Rd

5.	**Vital or Critical Infrastructure**	
a.	**roads, railroads, and bridges:**	- B-15
b.	**dams, power stations, water treatment plants, sanitary lift stations, etc.:**	- None Identified
c.	**other:** (such as airports, pipelines, bus terminals, train stations, military bases, marine passenger ferry services, etc.)	- Silver Lake Airport, 6094 Weaver Rd.

6.	**Socio-Economic Profile of Sector**		
a.	**total population (night):**		1,437
b.	**peak population (seasonal):**		2,092
c.	**percent over 65:**		20.3
d.	**percent under 18:**		20.1
e.	**percent that are homeowners:**		90.3
f.	**percent below poverty level:**		9.2
g.	**percent with disability or mobility limitation:**		12.9
h.	**estimated property insurance coverage:** **(Real and Personal Equalized Valuations)**	Agricultural: Commercial: Industrial: Residential: Total Personal: Total:	$16,682,400 $1,880,800 $12,300 $194,439,400 $2,062,200 $215,077,100
i.	**flood insurance coverage:**	Total Losses since 01/01/78: Total Payments since 01/01/78: Policies In-Force: Total Insurance In-Force:	1 $0 12 $ 2,796,200
j.	**location of floodplains:**	- Floodplain along Lake Michigan Shoreline, Stony Lake shoreline, and Stony Creek	

7.	**Emergency Warning System Coverage**	
a.	**siren locations and/or description of warning system:**	- Outdoor warning siren at Camp Miniwanca, 8845 W. Garfield
b.	**percent of population covered by warning sirens or system:**	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.)		

Land Use and Natural Features Map (USGS Quad.)
BENONA TOWNSHIP

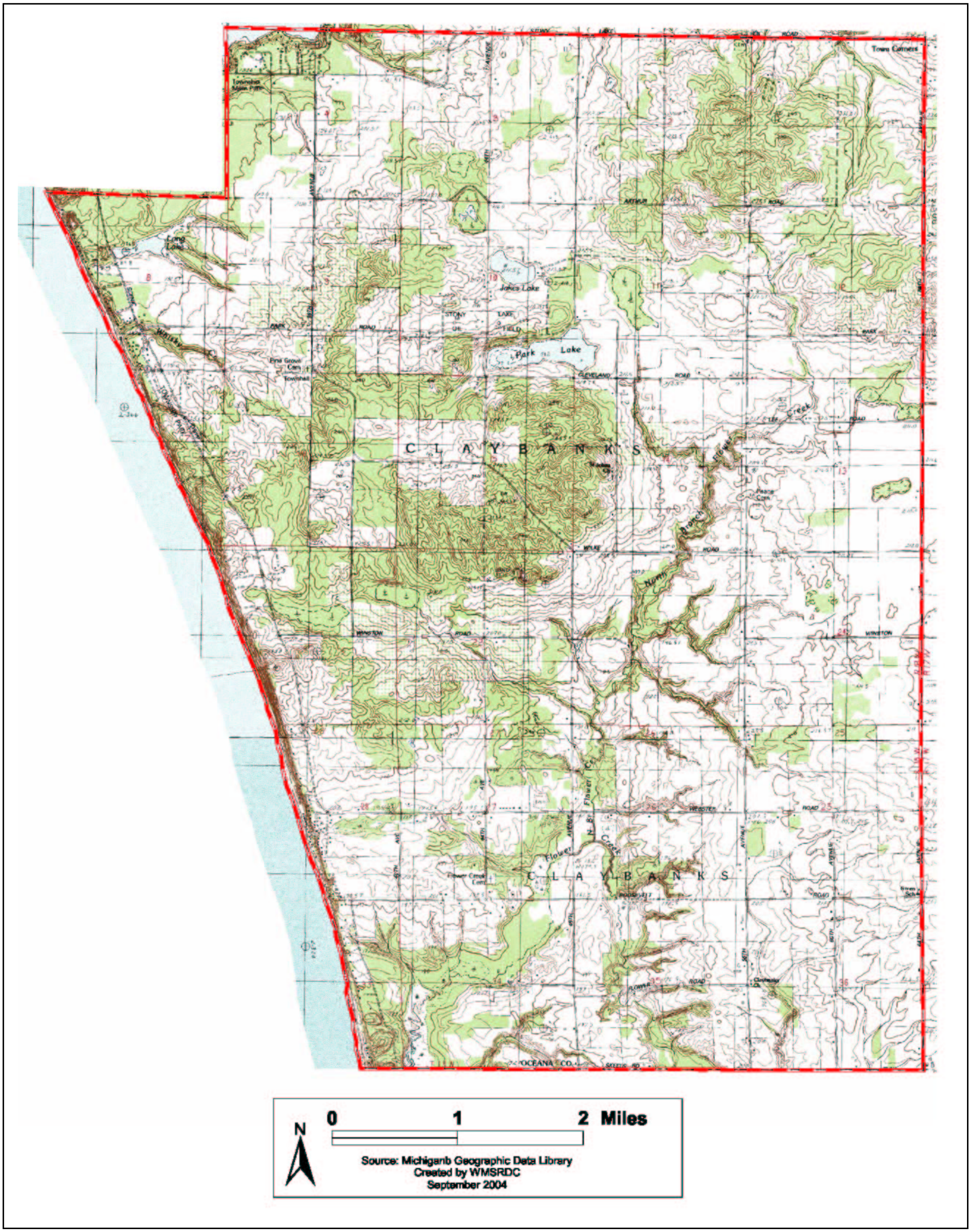


CLAYBANKS TOWNSHIP

1.	**major geographic features:**	- 32.5 persons per square mile - 22.1 housing units per square mile - Lake Michigan shoreline and beach - Coastal sand dunes - Stony Lake - 3 small lakes and ponds, 2 to 3 small creeks
2.	**Population Concentrations**	
a.	**group homes:**	- None Identified
b.	**large apartment buildings:**	- None Identified
c.	**schools:**	- None Identified
d.	**large office buildings:**	- See 4.h.
e.	**other:** (such as stadiums, concert halls, amusement parks, fairgrounds, correctional facilities, nursing homes, other special populations or large crowd assembly areas)	- Claybanks Township Park, 6407 Scenic Dr. (75 campsites) - Holiday Camping Resort, 5483 W. Stony Lake Rd. (110 campsites) - Lutheran Outdoor & Retreat Ministries of MI, Stony Lake, 7898 W. Stony Lake Rd.
f.	**major employers:**	- None Identified
3.	**Population Shifts**	
a.	**daily:**	- 395 commute with an average commuting time of 28.8 minutes - 139 school-aged children
b.	**seasonal:**	- 529 total housing units: 322 occupied/207 vacant - Of the vacant, 176 (85.0%) 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:** (such as government buildings, record center, major construction companies, warehouses, demolition companies, heavy equipment rental, emergency equipment and vehicle storage areas, etc.)	- Township of Claybanks, 7577 W. Cleveland
5.	**Vital or Critical Infrastructure**	
a.	**roads, railroads, and bridges:**	- B-15
b.	**dams, power stations, water treatment plants, sanitary lift**	- None Identified

	stations, etc.:	
c.	**other:** (such as 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):**	777
b.	**peak population (seasonal):**	1,196
c.	**percent over 65:**	19.8
d.	**percent under 18:**	20.3
e.	**percent that are homeowners:**	88.8
f.	**percent below poverty level:**	9.5
g.	**percent with disability or mobility limitation:**	19.5
h.	**estimated property insurance coverage:** **(Real and Personal Equalized Valuations)** Agricultural: Commercial: Industrial: Residential: Total Personal: Total:	$19,363,200 $260,200 $16,800 $63,994,800 $1,198,862 $84,833,862
i.	**flood insurance coverage:** Total Losses since 01/01/78: Total Payments since 01/01/78: Policies In-Force: Total Insurance In-Force:	1 $0 0 $0
j.	**location of floodplains:**	- Floodplain along Lake Michigan Shoreline and Flower Creek
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

Land Use and Natural Features Map (USGS Quad.)
CLAYBANKS TOWNSHIP



COLFAX TOWNSHIP

1.	**major geographic features:**	- 13.1 persons per square mile - 14.4 housing units per square mile - Densely forested (Manistee National Forest) - South Branch Pere Marquette River - 7 to 10 small lakes and ponds, several small creeks
2.	**Population Concentrations**	
a.	**group homes:**	- None Identified
b.	**large apartment buildings:**	- None Identified
c.	**schools:**	- None Identified
d.	**large office buildings:**	- See 4.h.
e.	**other:** (such as stadiums, concert halls, amusement parks, fairgrounds, correctional facilities, nursing homes, other special populations or large crowd assembly areas)	- Colfax Township Park - Black Lake County Park - Matt's Pine Haven Campground and Grocery, 7792 186th. Ave (60 campsites) - Swihart's Camp Car-O-Van, 5727 N. 168th Ave. - Sunrise Campground, 7612 N. 186th Ave. (25 campsites) - Misti Pines Campground, 8311 E. Washington (24 campsites) - Michigan Womyn's Music Festival (up to 10,000 visitors in Mid-August)
f.	**major employers:**	- Arbre Farms, 6362 N. 192nd Ave. (300 employees) - Valley View Pork (60 employees) - Willow Cold Storage, 6280 N. 192nd Ave (40 employees)
3.	**Population Shifts**	
a.	**daily:**	- 194 commute with an average commuting time of 30.9 minutes - 77 school-aged children
b.	**seasonal:**	- 511 total housing units: 196 occupied/ 315 vacant - Of the vacant, 254 (80.6%) 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:** (such as government buildings, record center, major construction companies, warehouses, demolition companies, heavy equipment rental, emergency equipment and vehicle storage areas, etc.)	- Township of Colfax, 5594 N. 192nd Ave
5.	**Vital or Critical Infrastructure**	
a.	**roads, railroads, and bridges:**	- None Identified

b.	**dams, power stations, water treatment plants, sanitary lift stations, etc.:**	- Foster Lake Dam - Wolverine Power Transmission Line
c.	**other:** (such as airports, pipelines, bus terminals, train stations, military bases, marine passenger ferry services, etc.)	- None Identified

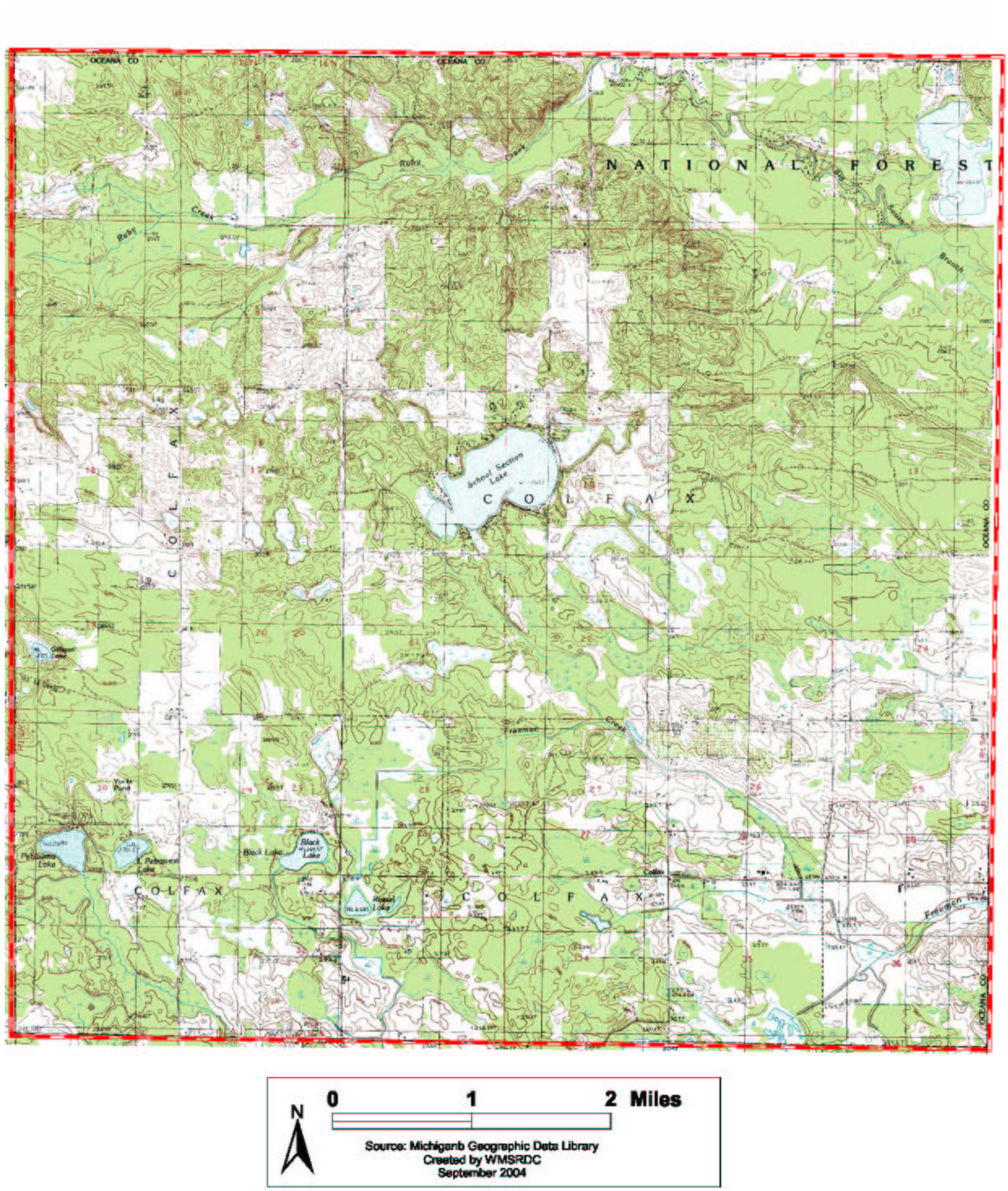
6. Socio-Economic Profile of Sector

a.	**total population (night):**		462
b.	**peak population (seasonal):**		1,061
c.	**percent over 65:**		20.3
d.	**percent under 18:**		19.3
e.	**percent that are homeowners:**		83.7
f.	**percent below poverty level:**		13.6
g.	**percent with disability or mobility limitation:**		21.7
h.	**estimated property insurance coverage:** **(Real and Personal Equalized Valuations)**	Agricultural: Commercial: Industrial: Residential: Total Personal: Total:	$8,479,600 $628,700 $5,363,900 $25,138,100 $7,114,500 $46,724,800
i.	**flood insurance coverage:**	Total Losses since 01/01/78: Total Payments since 01/01/78: Policies In-Force: Total Insurance In-Force:	*Not Participating in the NFIP*
j.	**location of floodplains:**	- None identified through the NFIP - Flood-prone areas exist along the 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

Land Use and Natural Features Map (USGS Quad.)
COLFAX TOWNSHIP



CRYSTAL TOWNSHIP

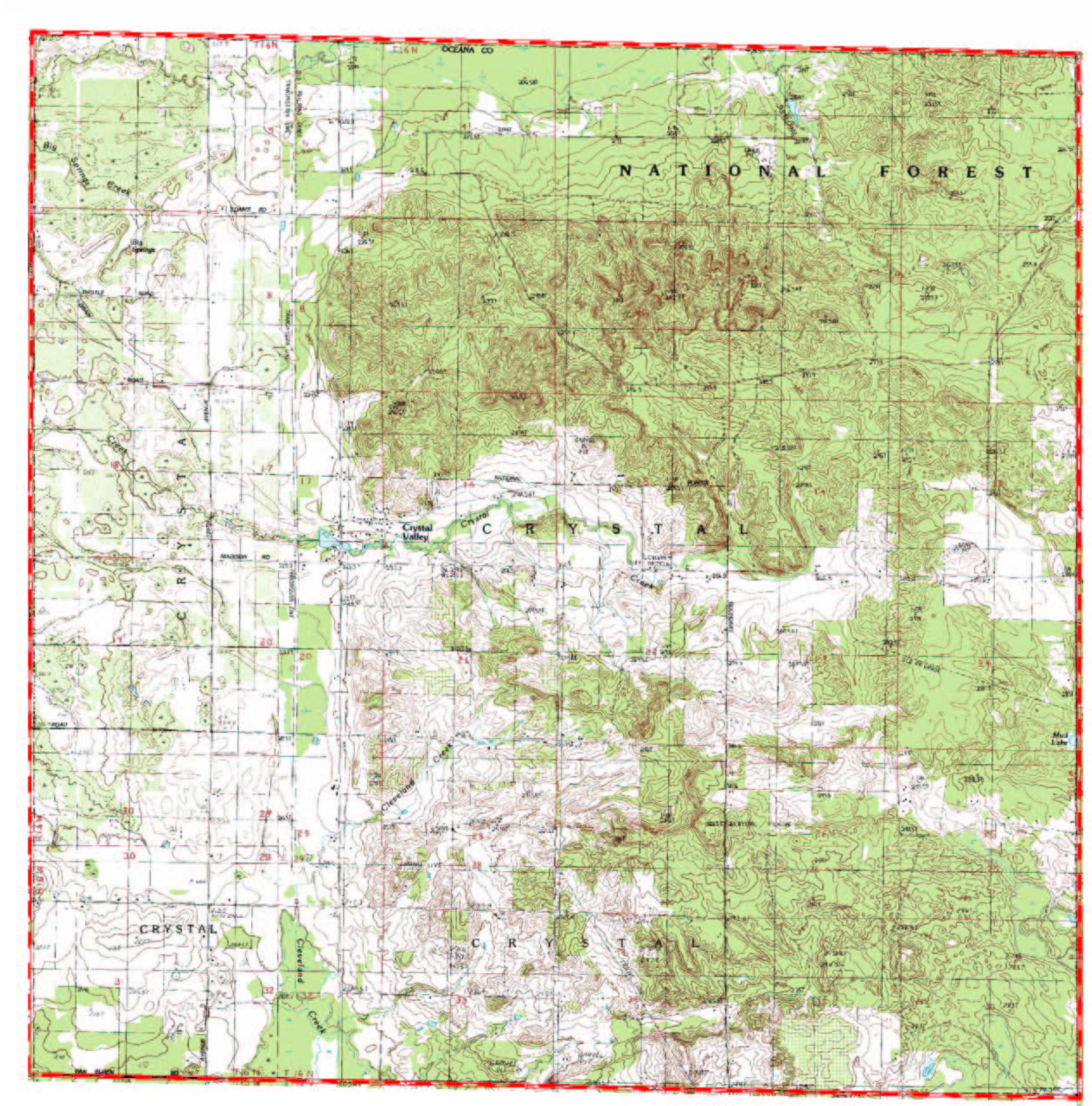
1.	**major geographic features:**	- 23.3 persons per square mile - 11.2 housing units per square mile - Densely forested (Manistee National Forest) - Pere Marquette River - 3 to 4 small creeks
2.	**Population Concentrations**	
a.	**group homes:**	- None Identified
b.	**large apartment buildings:**	- None Identified
c.	**schools:**	- None Identified
d.	**large office buildings:**	- See 4.h.
e.	**other:** (such as stadiums, concert halls, amusement parks, fairgrounds, correctional facilities, nursing homes, other special populations or large crowd assembly areas)	- Crystal Valley County Park - Northern Retreat, 3030 E. Jackson Rd (5 campsites)
f.	**major employers:**	- None Identified
3.	**Population Shifts**	
a.	**daily:**	- 576 commute with an average commuting time of 25.8 minutes - 218 school-aged children
b.	**seasonal:**	- 404 total housing units: 281 occupied/ 123 vacant - Of the vacant, 30 (24.4%) are for seasonal recreational or occasional use
4.	**Important or Critical Public and Private Facilities**	
a.	**police precincts:**	- None Identified
b.	**fire stations:**	- Crystal Township Fire Department, 1503 E. Hammett 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:**	- Gay, Jared H., House, Route 2, 128th Ave
h.	**other:** (such as government buildings, record center, major construction companies, warehouses, demolition companies, heavy equipment rental, emergency equipment and vehicle storage areas, etc.)	- Township of Crystal, 1499 E. Hammett
5.	**Vital or Critical Infrastructure**	
a.	**roads, railroads, and bridges:**	- None Identified
b.	**dams, power stations, water treatment plants, sanitary lift stations, etc.:**	- Crystal Valley Dam, 124th St along Crystal Creek - Consumers Energy Transmission Line
c.	**other:** (such as 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):**		838
b.	**peak population (seasonal):**		927
c.	**percent over 65:**		12.2
d.	**percent under 18:**		33
e.	**percent that are homeowners:**		79.7
f.	**percent below poverty level:**		31.9
g.	**percent with disability or mobility limitation:**		18.1
h.	**estimated property insurance coverage:** **(Real and Personal Equalized Valuations)**	Agricultural: Commercial: Industrial: Residential: Total Personal: Total:	$11,483,500 $97,450 $317,750 $17,649,450 $673,410 $30,221,560
i.	**flood insurance coverage:**	Total Losses since 01/01/78: Total Payments since 01/01/78: Policies In-Force: Total Insurance In-Force:	*Not Participating in the NFIP*
j.	**location of floodplains:**	- None Identified	

7.	Emergency Warning System Coverage
a.	**siren locations and/or description of warning system:**	- Crystal Township Fire Department, 1499 E. Hammett Rd.
b.	**percent of population covered by warning sirens or system:**	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.)

Land Use and Natural Features Map (USGS Quad.)
CRYSTAL TOWNSHIP



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Source: Michigan Geographic Data Library
Created by WMSRDC
September 2004

ELBRIDGE TOWNSHIP

1.	**major geographic features:**	- 26.8 persons per square mile - 13.3 housing units per square mile - Manistee National Forest in SE corner of township - Pentwater River - 6 to 8 small lakes and ponds, 8 to 10 small creeks

2.	**Population Concentrations**	
a.	**group homes:**	- None Identified
b.	**large apartment buildings:**	- None Identified
c.	**schools:**	- None Identified
d.	**large office buildings:**	- See 4.h.
e.	**other:** (such as stadiums, concert halls, amusement parks, fairgrounds, correctional facilities, nursing homes, other special populations or large crowd assembly areas)	- Doolittle Park - Gales Pond Park
f.	**major employers:**	- None Identified

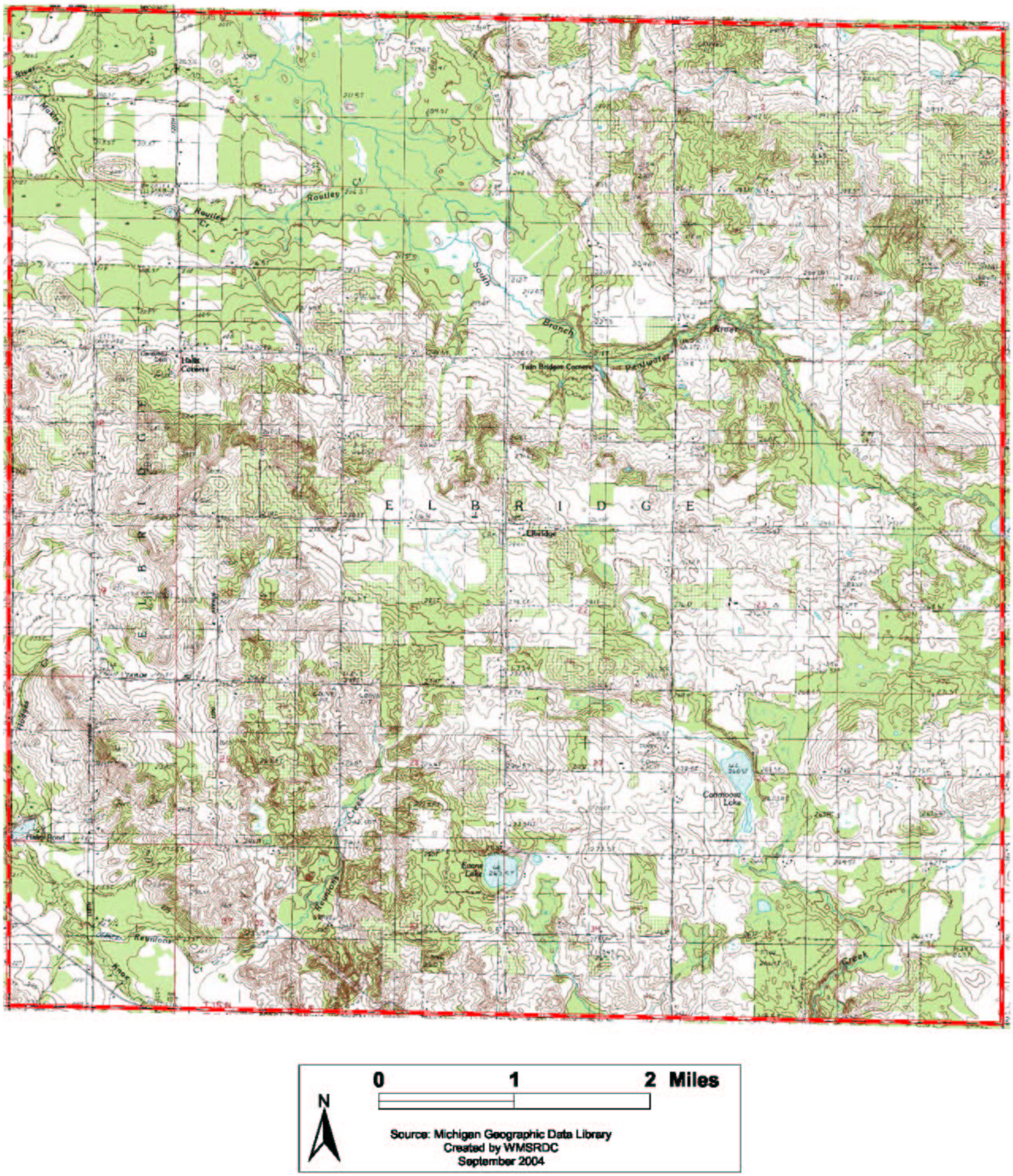
3.	**Population Shifts**	
a.	**daily:**	- 464 commute with an average commuting time of 33.5 minutes - 237 school-aged children
b.	**seasonal:**	- 482 total housing units: 332 occupied/ 150 vacant - Of the vacant, 30 (20%) are seasonal recreational or occasional use

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:**	- Elbridge Community Church, 2370 N. 136th Ave. - Elbridge Township Hall, 2266 E. Polk Rd.
f.	**community medical facilities, hospitals:**	- None Identified
g.	**historic sites:**	- None Identified
h.	**other:** (such as government buildings, record center, major construction companies, warehouses, demolition companies, heavy equipment rental, emergency equipment and vehicle storage areas, etc.)	- Township of Elbridge, 2396 E. Polk 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 Transmission Line - Gales Pond Dam - Wolverine Power Transmission Line
c.	**other:** (such as airports, pipelines, bus terminals, train stations, military bases, marine passenger ferry services, etc.)	- Natural Gas Transmission Pipeline

6.	**Socio-Economic Profile of Sector**		
a.	**total population (night):**		971
b.	**peak population (seasonal):**		1,058
c.	**percent over 65:**		12.3
d.	**percent under 18:**		29.6
e.	**percent that are homeowners:**		83.4
f.	**percent below poverty level:**		17.1
g.	**percent with disability or mobility limitation:**		30.0
h.	**estimated property insurance coverage:** **(Real and Personal Equalized Valuations)**	Agricultural: Commercial: Industrial: Residential: Total Personal: Total:	$20,395,057 $185,944 $331,901 $16,701,100 $1,342,876 $38,956,878
i.	**flood insurance coverage:**	Total Losses since 01/01/78: Total Payments since 01/01/78: Policies In-Force: Total Insurance In-Force:	*Not Participating in the NFIP*
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	

Land Use and Natural Features Map (USGS Quad.)
ELBRIDGE TOWNSHIP



FERRY TOWNSHIP

1.	**major geographic features:**	- 36 persons per square mile - 17.7 housing units per square mile - Scattered rural housing, moderately dense residential area in Ferry - Small portions of Manistee National Forest in SW and NE corners of township - White River - 8 to 10 small lakes and ponds, 5 to 7 small creeks

2.	**Population Concentrations**	
a.	**group homes:**	- None Identified
b.	**large apartment buildings:**	- None Identified
c.	**schools:**	- None Identified
d.	**large office buildings:**	- See 4.h.
e.	**other:** (such as stadiums, concert halls, amusement parks, fairgrounds, correctional facilities, nursing homes, other special populations or large crowd assembly areas)	- Ferry County Park - Ferry Ghost Town Day (Late July) - Leisure Haven Campground, 3056 E. M-20 (50 campsites) - Timberview Campground, 979 E. Shelby Rd. (92 campsites)
f.	**major employers:**	- None Identified

3.	**Population Shifts**	
a.	**daily:**	- 581 commute with an average commuting time of 31 minutes - 252 school-aged children
b.	**seasonal:**	- 637 total housing units: 496 occupied/ 141 vacant - of the vacant, 78 (55.3%) are for seasonal recreational or occasional use

4.	**Important or Critical Public and Private Facilities**	
a.	**police precincts:**	- None Identified
b.	**fire stations:**	- Ferry Township Fire Department, 2140 E. Main St. - DNR - Oceana Field Office, 1757 E. Hayes Rd. (M-20)
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:** (such as government buildings, record center, major construction companies, warehouses, demolition companies, heavy equipment rental, emergency equipment and vehicle storage areas, etc.)	- Township of Ferry, 2154 E. Main St. - Oceana County Road Commission, 110 E. M-20

5.	**Vital or Critical Infrastructure**	
a.	**roads, railroads, and bridges:**	- M-20 - M-20 bridge over White River North Branch
b.	**dams, power stations, water treatment plants, sanitary lift stations, etc.:**	- Consumers Energy Power Line - Oceana County Trash, Transfer, and Recycling, 1600 E Hayes Rd (M-20)

c.	**other:** (such as 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):**		1,292
b.	**peak population (seasonal):**		1,495
c.	**percent over 65:**		13.4
d.	**percent under 18:**		23.4
e.	**percent that are homeowners:**		85.9
f.	**percent below poverty level:**		1.5
g.	**percent with disability or mobility limitation:**		22.8
h.	**estimated property insurance coverage:** **(Real and Personal Equalized Valuations)**	Agricultural: Commercial: Industrial: Residential: Total Personal: Total:	$5,986,000 $485,400 $368,400 $27,806,800 $1,257,800 $35,904,400
i.	**flood insurance coverage:**	Total Losses since 01/01/78: Total Payments since 01/01/78: Policies In-Force: Total Insurance In-Force:	*Not Participating in the NFIP*
j.	**location of floodplains:**	N/A	

7.	**Emergency Warning System Coverage**	
a.	**siren locations and/or description of warning system:**	- Ferry Township Fire Department, 2140 E. Main St.
b.	**percent of population covered by warning sirens or system:**	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.)

Land Use and Natural Features Map (USGS Quad.)
FERRY TOWNSHIP

0 1 2 Miles
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Source: Michigan Geographic Data Library
Created by WMSRDC
September 2004

GOLDEN TOWNSHIP

1.	**major geographic features:**	- 52 persons per square mile - 70.6 housing units per square mile - Dense residential around Silver and Upper Silver Lake, Somewhat dense residential in Mears, scattered rural throughout the rest of township - Lake Michigan shoreline and beach - Coastal sand dunes - Silver Lake - Pere Marquette State Forest in Northern edge of township - 2 to 3 small lakes and ponds, 2 to 3 small creeks - Little Sable Lighthouse - Hart-Montague Bicycle Trail
2.	**Population Concentrations**	
a.	**group homes:**	- None Identified
b.	**large apartment buildings:**	- None Identified
c.	**schools:**	- None identified
d.	**large office buildings:**	- See 4.h.
e.	**other:** (such as stadiums, concert halls, amusement parks, fairgrounds, correctional facilities, nursing homes, other special populations or large crowd assembly areas)	- Golden Township Park - Cedar Point County Park, Ridge Ave - Val-Du-Lakes Amphitheatre (Mears) - Golden Sands Golf Course, 2501 Wilson Ave. (9 holes) - Grace Youth Camp, 2100 N. Ridge Rd. - Silver Lake State Park, 9679 W. State Park Rd. (200 campsites) - Silver Lake Resort & Campground, 1786 N. 34th Ave. (217 campsites) - Hideaway Campground & Resort, 9671 W. Silver Lake Rd. (215 campsites) - Sandy Shores Campground & Resort, 8595 W. Silver Lake Rd. (212 campsites) - Yogi Bear's Jellystone Park, 8239 W. Hazel Rd. (200 campsites) - Timber Lake Resort & RV Club, 4370 N. Ridge Rd. (176 campsites) - Silver Creek RV Resort, 1441 N. 34th Ave. (129 sites) - Silver Hills Camp/Resort, 7594 W. Hazel Rd. (105 campsites) - Holiday Shores, 7980 W. Village Rd. (54 campsites) - Val Du Lakes Campgrounds, 1533 Wilson Rd. (87 campsites) - Dunes Waterfront Resort, 1180 N. Shore Rd. (72 rooms) - Sierra Sands Resort/Motel, 7990 W. Hazel Rd. (40 rooms) - Silver Lake Apple & BBQ Cook-Off Festival (September) - Silver Sands Resort, 8446 W. Hazel Rd. (36 rooms) - West Michigan Sand Dragway, N. 40th Ave and W. Deer Rd. - Mac Woods Dune Scooter Rides, 629 N 18th Ave
f.	**major employers:**	- None identified
3.	**Population Shifts**	
a.	**daily:**	- 563 commute with an average commuting time of 17.2 minutes - 235 school-aged children
b.	**seasonal:**	- 2,366 total housing units: 781 occupied/ 1,585 vacant - Of the vacant, 1,475 (93.1%) 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:**	- Golden Elementary School, 5527 W. Fox Rd.
f.	**community medical facilities,:**	- None Identified
g.	**historic sites:**	- Charles Mears Silver Lake Boardinghouse, SE Corner of Lighthouse & Silver Lake Channel rds.
h.	**other:** (such as government buildings, record center, major construction companies, warehouses, demolition companies, heavy equipment rental, emergency equipment and vehicle storage areas, etc.)	- Township of Golden, 5698 W. 4th St.

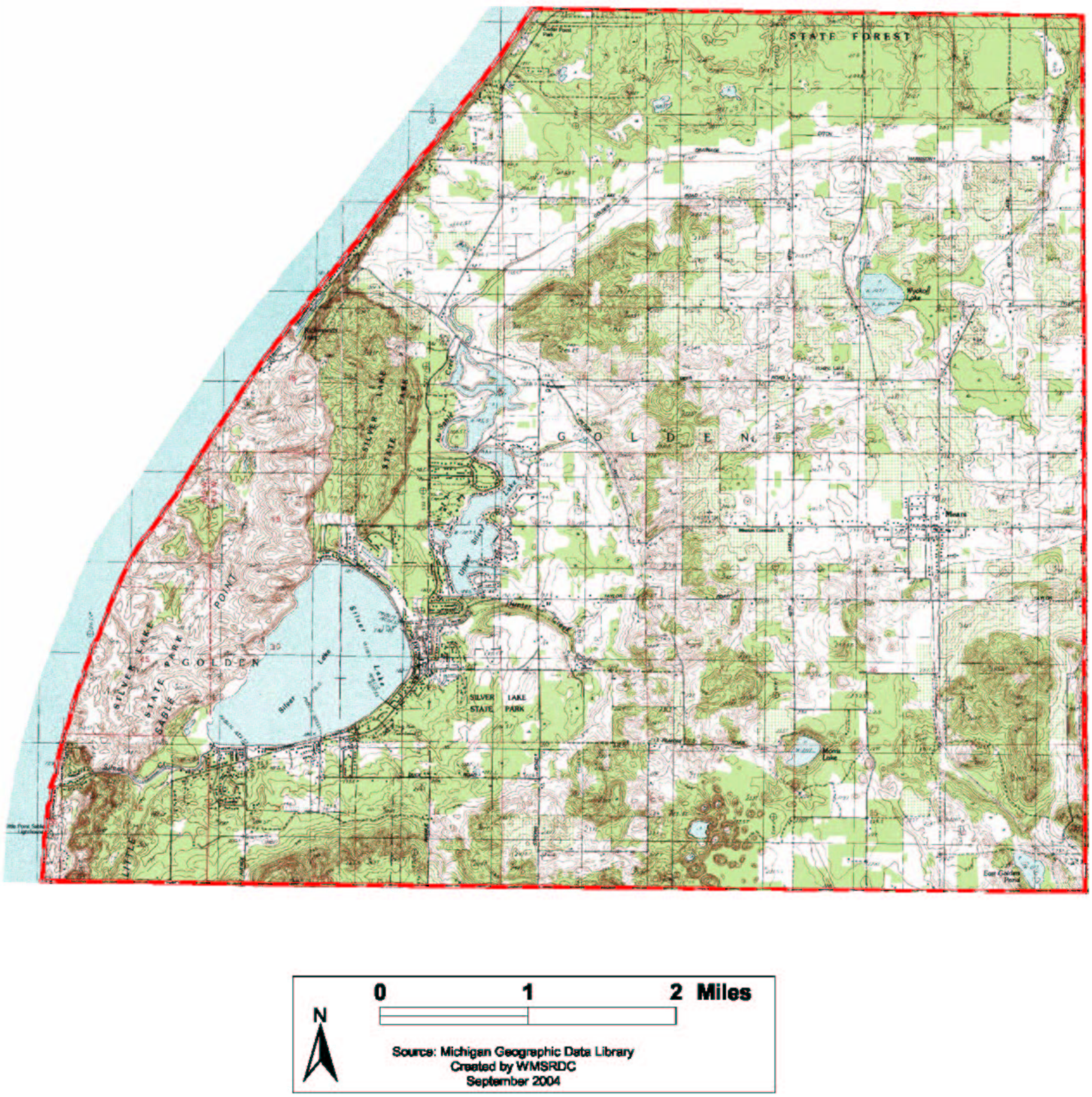
5.	**Vital or Critical Infrastructure**	
a.	**roads, railroads, and bridges:**	- B-15
b.	**dams, power stations, water treatment plants, sanitary lift stations, etc.:**	- Upper Silver Lake Dam - Lake Holiday Dam - Silver Lake Level Control Structure
c.	**other:** (such as airports, pipelines, bus terminals, train stations, military bases, marine passenger ferry services, etc.)	- Shell Gas Bulk LLC propane pipeline - Shell Gas Bulk LLC storage tank, 2100 N. Ridge Rd. (30,000 gallons)

6.	**Socio-Economic Profile of Sector**		
a.	**total population (night):**		1,742
b.	**peak population (seasonal):**		5,031
c.	**percent over 65:**		25
d.	**percent under 18:**		16.5
e.	**percent that are homeowners:**		85
f.	**percent below poverty level:**		17.4
g.	**percent with disability or mobility limitation:**		19.6
h.	**estimated property insurance coverage:** **(Real and Personal Equalized Valuations)**	Agricultural: Commercial: Industrial: Residential: Total Personal: Total:	$10,510,150 $18,669,200 $69,350 $197,165,729 $2,648,868 $229,063,297
i.	**flood insurance coverage:**	Total Losses since 01/01/78: Total Payments since 01/01/78: Policies In-Force: Total Insurance In-Force:	12 $25,602 20 $4,244,400
j.	**location of floodplains:**	- Floodplains along Lake Michigan, Silver Creek, Hunter Creek, Lambricks Creek, Golden drainage ditch, and around Silver Lake	

7.	**Emergency Warning System Coverage**	
a.	**siren locations and/or warning system:**	- None Identified
b.	**percent of population covered by warning sirens or system:**	N/A

Land Use and Natural Features Map (USGS Quad.)

GOLDEN TOWNSHIP



GRANT TOWNSHIP

1.	**major geographic features:**	- 84.1 persons per square mile - 36.4 housing units per square mile - Scattered rural housing, somewhat dense residential around Oceana Lake and Lake Tahoe - Manistee National Forest in SE corner of township - 13 to 15 small lakes and ponds, 10 to 12 small creeks - Hart-Montague Bicycle Trail

2.	**Population Concentrations**	
a.	**group homes:**	- Willowbrook AFC, 5275 S. 68^{th} Ave.
b.	**large apartment buildings:**	- None Identified
c.	**schools:**	- None Identified
d.	**large office buildings:**	- See 4.h.
e.	**other:** (such as stadiums, concert halls, amusement parks, fairgrounds, correctional facilities, nursing homes, other special populations or large crowd assembly areas)	- Double JJ Resort, 5900 Water Rd. (9 cabins, 2 lofts, 2 homesteads, RV park, 50 campsites, and employee housing) - Karner Blue Campground, 9228 S. 88^{th} Ave. (24 campsites) - Lucky Lake Campground, 3977 W. Wilke Rd. (250 campsites) - Grand View Golf Course, 5464 S. 68^{th} Ave. (18 holes) - Thoroughbred Golf Club, 5900 Water Rd (18 holes) - Electric Forest Festival at Double JJ Ranch (up to 30,000 attendees, late-June/early-July)
f.	**major employers:**	- Double JJ Resort, 5900 Water Rd. (310 employees)

3.	**Population Shifts** *(numbers include Village of Rothbury and part of Village of New Era)*	
a.	**daily:**	- 1,354 commute with an average commuting time of 25.3 minutes - 658 school-aged children
b.	**seasonal:**	-1,290 total housing units: 1,103 occupied/ 187 vacant - Of the vacant, 58 (31.0%)are seasonal recreational or occasional use

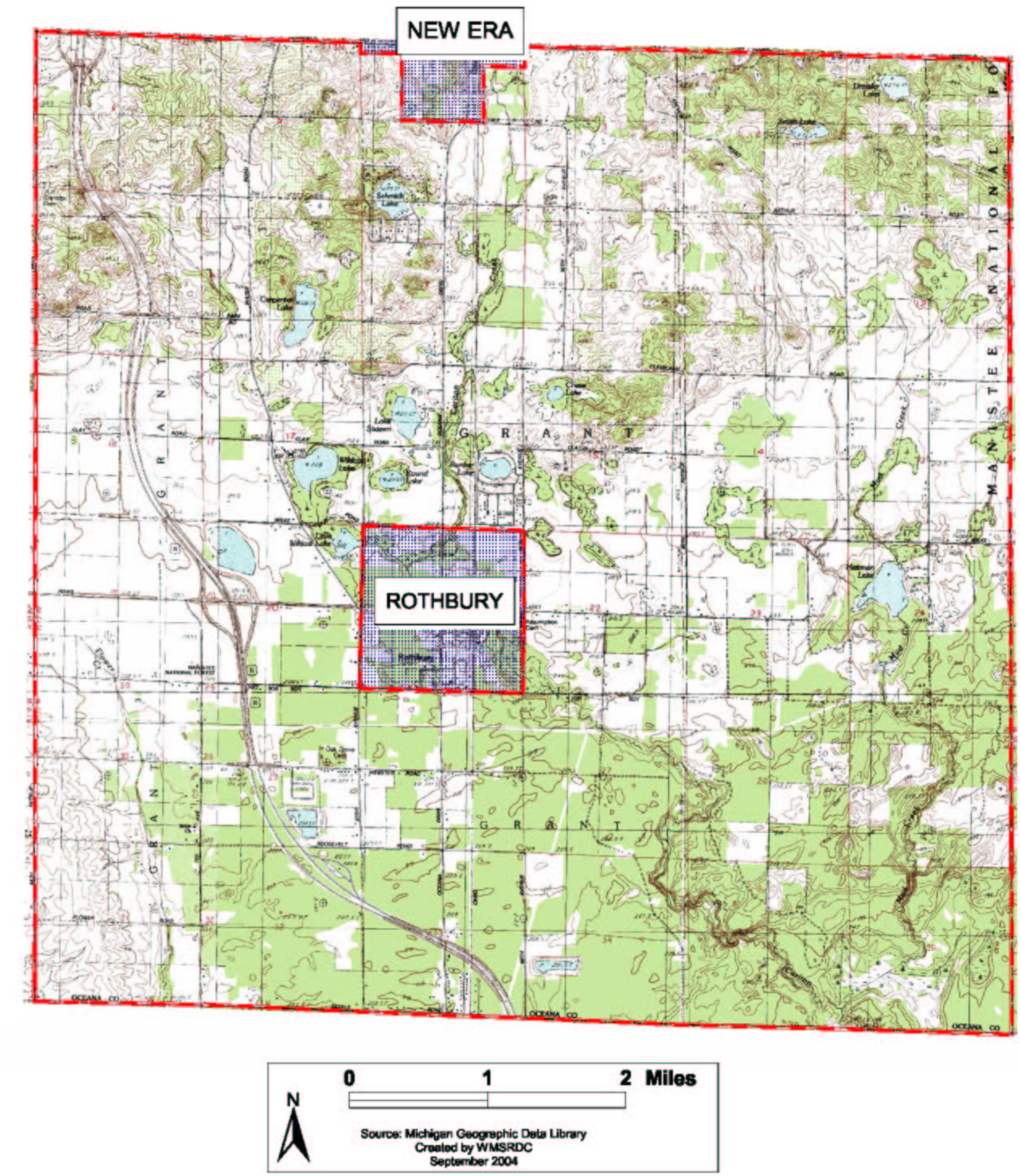
4.	**Important or Critical Public and Private Facilities**	
a.	**police precincts:**	- None Identified
b.	**fire stations:**	- Grant Township Fire Department, 7140 S. Oceana Dr.
c.	**public works yards:**	- None Identified
d.	**pumping stations:**	- None Identified
e.	**community shelters:**	- None Identified
f.	**community medical facilities, hospitals:**	- None Identified
g.	**historic sites:**	- None Identified
h.	**other:** (such as government buildings, record center, major construction companies, warehouses, demolition companies, heavy equipment rental, emergency equipment and vehicle storage areas, etc.)	- Township of Grant, 7140 S. Oceana Dr. - West Michigan Power & Equipment Inc., 3651 W. M-20

5.	**Vital or Critical Infrastructure**	
a.	**roads, railroads, and bridges:**	- US-31 - M-20 - M-20 bridge over US-31

b.	**dams, power stations, water treatment plants, sanitary lift stations, etc.:**	- None Identified
c.	**other:** (such as airports, pipelines, bus terminals, train stations, military bases, marine passenger ferry services, etc.)	- Double JJ Resort Ranch Airport, Water Rd. (Open from April-October) - MichCon Gas Pipeline
6.	**Socio-Economic Profile of Sector**	
a.	**total population (night):**	*(numbers include Village of Rothbury and part of Village of New Era)* 2,976
b.	**peak population (seasonal):**	*(numbers include Village of Rothbury and part of Village of New Era)* 3,131
c.	**percent over 65:**	12.4
d.	**percent under 18:**	26.6
e.	**percent that are homeowners:**	80.9
f.	**percent below poverty level:**	13.2
g.	**percent with disability or mobility limitation:**	24.6
h.	**estimated property insurance coverage:** **(Real and Personal Equalized Valuations)** Agricultural: Commercial: Industrial: Residential: Total Personal: Total:	$9,705,300 $7,944,420 $3,830,000 $54,476,300 $6,482,941 $82,438,961
i.	**flood insurance coverage:** Total Losses since 01/01/78: Total Payments since 01/01/78: Policies In-Force: Total Insurance In-Force:	*Not Participating in the NFIP*
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

Land Use and Natural Features Map (USGS Quad.)

GRANT TOWNSHIP



GREENWOOD TOWNSHIP

1.	**major geographic features:**	- 33.1 persons per square mile - 13.9 housing units per square mile - Scattered rural housing, somewhat dense residential around Acker Lake and St. Hubert's Subdivision - Heavily forested (Manistee National Forest) - White River - 8 to 10 small lakes and ponds, 8 to 10 small creeks

2.	**Population Concentrations**	
a.	**group homes:**	- None Identified
b.	**large apartment buildings:**	- None Identified
c.	**schools:**	- None Identified
d.	**large office buildings:**	- See 4.h.
e.	**other:** (such as stadiums, concert halls, amusement parks, fairgrounds, correctional facilities, nursing homes, other special populations or large crowd assembly areas)	- Pines Point National Forest Campground (32 campsites) - 4B's Campground, 5414 E. Garfield (20 campsites)
f.	**major employers:**	- None Identified

3.	**Population Shifts**	
a.	**daily:**	- 450 commute with an average commuting time of 26 minutes - 282 school-aged children
b.	**seasonal:**	- 497 total housing units: 403 occupied/ 94 vacant - Of the vacant, 55 (58.5%) 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:** (such as government buildings, record center, major construction companies, warehouses, demolition companies, heavy equipment rental, emergency equipment and vehicle storage areas, etc.)	- Township of Greenwood, 5589 S. 200th Ave.

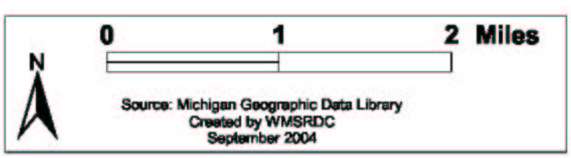
5.	**Vital or Critical Infrastructure**	
a.	**roads, railroads, and bridges:**	- B86 - M82/120
b.	**dams, power stations, water treatment plants, sanitary lift stations, etc.:**	- Consumers Energy Power Line

c.	**other:** (such as 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):**	1,184
b.	**peak population (seasonal):**	1,346
c.	**percent over 65:**	12.1
d.	**percent under 18:**	28.8
e.	**percent that are homeowners:**	84.6
f.	**percent below poverty level:**	13
g.	**percent with disability or mobility limitation:**	28.3
h.	**estimated property insurance coverage:** **(Real and Personal Equalized Valuations)** Agricultural: Commercial: Industrial: Residential: Total Personal: Total:	$6,226,500 $404,300 $413,200 $25,315,300 $1,188,900 $33,548,200
i.	**flood insurance coverage:** Total Losses since 01/01/78: Total Payments since 01/01/78: Policies In-Force: Total Insurance In-Force:	2 $2,658 1 $175,000
j.	**location of floodplains:**	- Floodplain along White 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

Land Use and Natural Features Map (USGS Quad.)
GREENWOOD TOWNSHIP



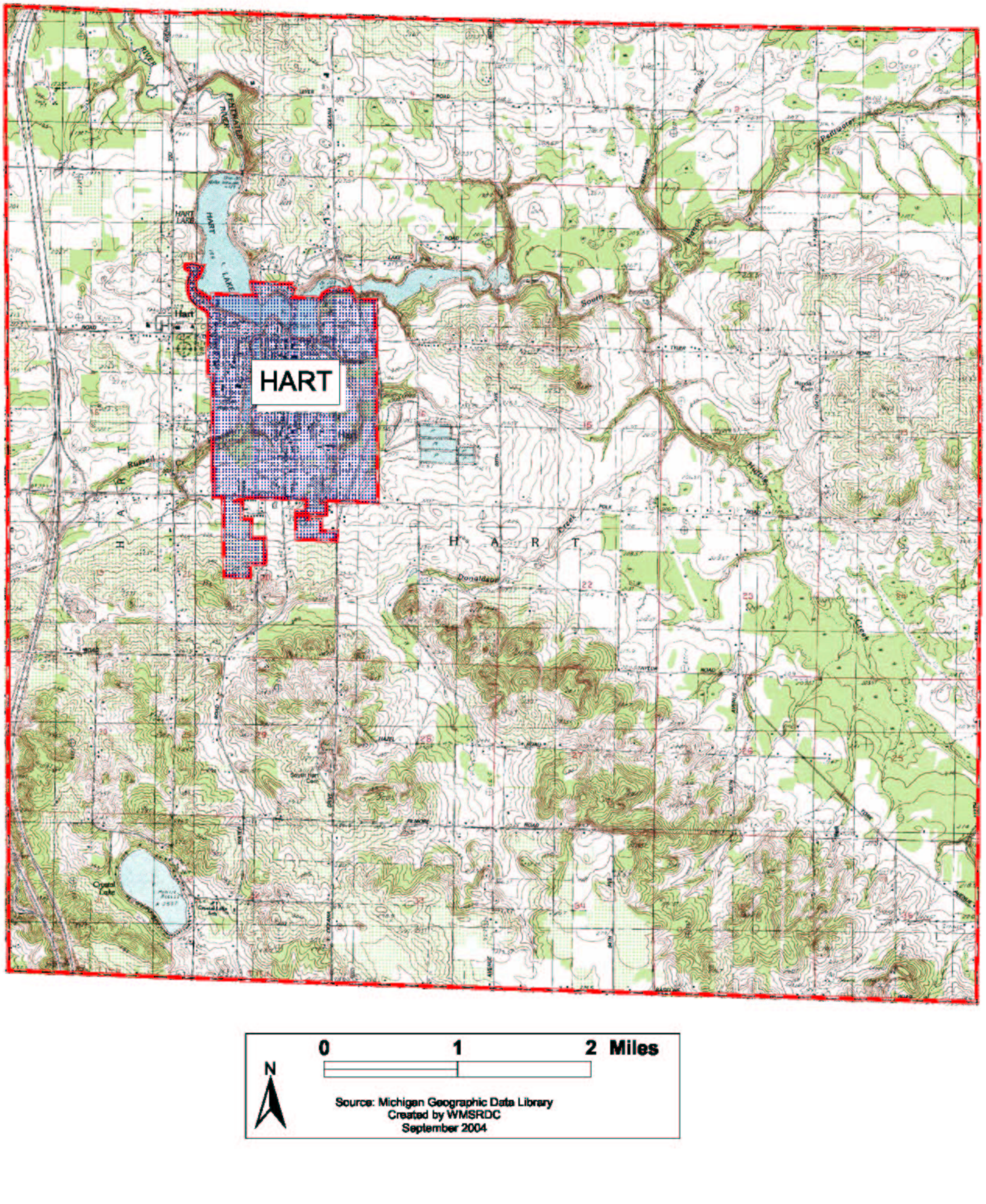
HART TOWNSHIP

1.	**major geographic features:**	- 54.7 persons per square mile - 25.5 housing units per square mile - Scattered rural housing, somewhat dense residential around Crystal Lake - Pentwater River - Hart Lake - 3 to 4 small lakes and ponds, 5 to 8 small creeks - Hart-Montague Bicycle Trail
2.	**Population Concentrations**	
a.	**group homes:**	- None Identified
b.	**large apartment buildings:**	- None Identified
c.	**schools:**	- Oceana Christian School, 3258 N. 72nd Ave. (102 students, 12 staff)
d.	**large office buildings:**	- See 4.h.
e.	**other:** (such as stadiums, concert halls, amusement parks, fairgrounds, correctional facilities, nursing homes, other special populations or large crowd assembly areas)	- The Colonial Golf Course, 2763 N. 72nd Ave. (18 holes) - Comfort Inn, 2248 N. Comfort Dr. (61 rooms) - Budget Host Hart Motel, 4143 Polk Rd. (20 rooms) - Gateway Motel, 3781 N. Oceana Dr. (19 units) - Pines Mobile Home Park, 3241 72nd Street
f.	**major employers:**	- Peterson Farms, 226 Oceana Dr. (600 employees)
3.	**Population Shifts**	
a.	**daily:**	- 796 commute with an average commuting time of 18.7 minutes - 410 school-aged children
b.	**seasonal:**	- 865 total housing units: 699 occupied/ 166 vacant - Of the vacant, 82 (49.4%) are for seasonal recreational or occasional use
4.	**Important or Critical Public and Private Facilities**	
a.	**police precincts:**	- Michigan State Police/Hart Post 66, 3793 W. Polk Rd.
b.	**fire stations:**	- None Identified
c.	**public works yards:**	- Oceana County Road Commission, 3501 W. Polk Rd.
d.	**pumping stations:**	- None Identified
e.	**community shelters:**	- Hart Wesleyan Church, 3400 Polk Rd.
f.	**community medical facilities, hospitals:**	- Emergency Medical Services, 3966 N. Oceana Dr
g.	**historic sites:**	- US-31 (Old)/Pentwater River Bridge, Over Pentwater River
h.	**other:** (such as government buildings, record center, major construction companies, warehouses, demolition companies, heavy equipment rental, emergency equipment and vehicle storage areas, etc.)	- Township of Hart, 3437 W. Polk Rd. - Oceana County Health Department, 3896 N. Oceana Dr. - Oceana County Family Independence Agency, 4081W. Polk Rd. - Oceana County Road Commission, 3501 W. Polk Rd. - Hart Concrete, 3653 N. State St.
5.	**Vital or Critical Infrastructure**	
a.	**roads, railroads, and bridges:**	- US-31 - Oceana Drive

b.	**dams, power stations, water treatment plants, sanitary lift stations, etc.:**	- Consumers Energy Power Line - Hart Lake Dam
c.	**other:** (such as 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):**	1,853
b.	**peak population (seasonal):**	2,069
c.	**percent over 65:**	17.6
d.	**percent under 18:**	25.9
e.	**percent that are homeowners:**	83
f.	**percent below poverty level:**	10.4
g.	**percent with disability or mobility limitation:**	19.2
h.	**estimated property insurance coverage:** **(Real and Personal Equalized Valuations)** Agricultural: Commercial: Industrial: Residential: Total Personal: Total:	$14,349,900 $2,897,000 $2,184,300 $34,113,300 $7,725,000 $61,263,500
i.	**flood insurance coverage:** Total Losses since 01/01/78: Total Payments since 01/01/78: Policies In-Force: Total Insurance In-Force:	*Suspended from NFIP Participation*
j.	**location of floodplains:**	- Pentwater 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

Land Use and Natural Features Map (USGS Quad.)

HART TOWNSHIP



LEAVITT TOWNSHIP

1.	**major geographic features:**	- 25.2 persons per square mile - 13.1 housing units per square mile - Scattered rural housing, somewhat dense residential around Campbell and Little Campbell Lake - Heavily Forested (Manistee National Forest) - Campbell Lake - 7 to 10 small lakes and ponds, 8 to 10 small creeks - Tanner and Sippy Swamp

2.	**Population Concentrations**	
a.	**group homes:**	- None Identified
b.	**large apartment buildings:**	- None Identified
c.	**schools:**	- None Identified
d.	**large office buildings:**	- See 4.h.
e.	**other:** (such as stadiums, concert halls, amusement parks, fairgrounds, correctional facilities, nursing homes, other special populations or large crowd assembly areas)	- Camp Tall Turf, 6947 E. Scout Rd. (16 cabins, approximately 150 campers)
f.	**major employers:**	- None Identified

3.	**Population Shifts** *(numbers include Village of Walkerville)*	
a.	**daily:**	- 303 commute with an average commuting time of 37.3 minutes - 202 school-aged children
b.	**seasonal:**	- 461 total housing units: 310 occupied/ 151 vacant - Of the vacant, 86 (57.0%) 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:** (such as government buildings, record center, major construction companies, warehouses, demolition companies, heavy equipment rental, emergency equipment and vehicle storage areas, etc.)	- Township of Leavitt, 2401 N. 184th Ave.

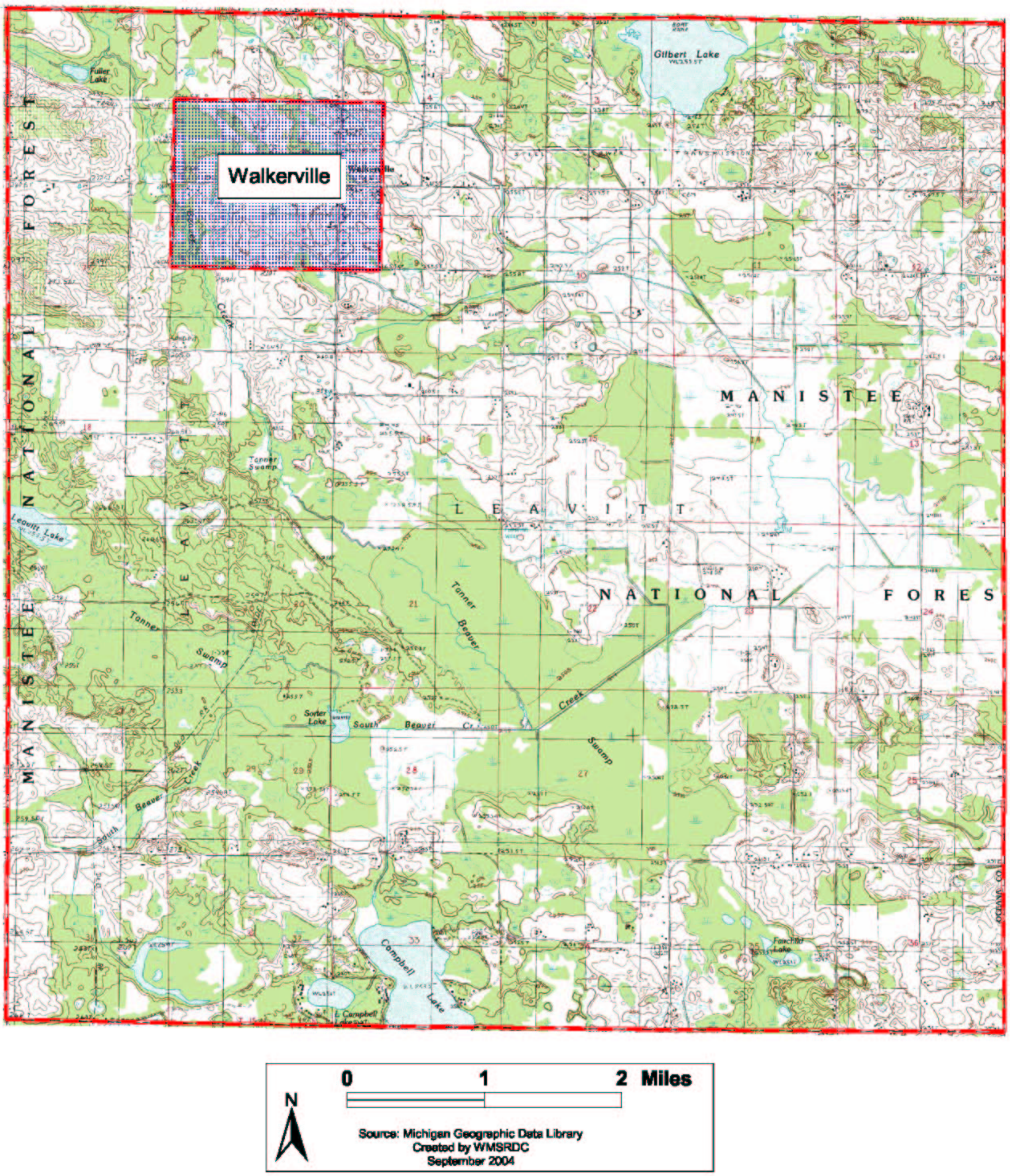
5.	**Vital or Critical Infrastructure**	
a.	**roads, railroads, and bridges:**	- None Identified
b.	**dams, power stations, water treatment plants, sanitary lift stations, etc.:**	- Consumers Energy Transmission Line - Wolverine Power Transmission Line

c.	**other:** (such as airports, pipelines, bus terminals, train stations, military bases, marine passenger ferry services, etc.)	- Natural Gas Transmission Pipeline

6.	**Socio-Economic Profile of Sector**		
a.	**total population (night):**	*(numbers include Village of Walkerville)*	891
b.	**peak population (seasonal):**	*(numbers include Village of Walkerville)*	1,134
c.	**percent over 65:**		13.9
d.	**percent under 18:**		26.6
e.	**percent that are homeowners:**		78.1
f.	**percent below poverty level:**		10.7
g.	**percent with disability or mobility limitation:**		19
h.	**estimated property insurance coverage:** **(Real and Personal Equalized Valuations)**	Agricultural:	$12,284,400
		Commercial:	$584,400
		Industrial:	$312,700
		Residential:	$16,551,300
		Total Personal:	$914,400
		Total:	$30,647,200
i.	**flood insurance coverage:**	Total Losses since 01/01/78: Total Payments since 01/01/78: Policies In-Force: Total Insurance In-Force:	*Not Participating in the NFIP*
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

Land Use and Natural Features Map (USGS Quad.)
LEAVITT TOWNSHIP



NEWFIELD TOWNSHIP

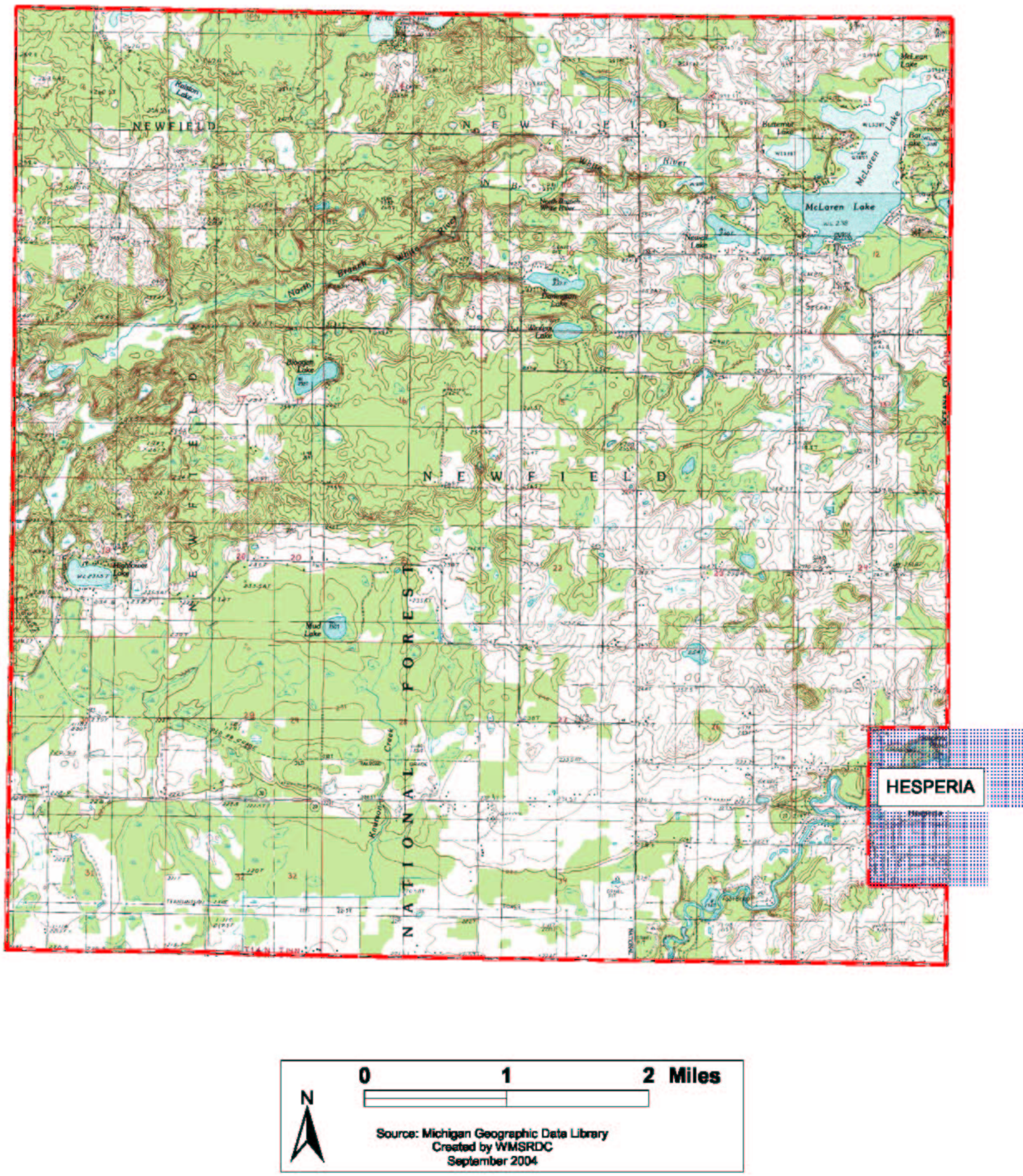
1.	**major geographic features:**	- 68.4 persons per square mile - 38.9 housing units per square mile - Scattered rural housing, somewhat dense residential around McLaren, Campbell, and High Tower Lakes - Heavily forested (Manistee National Forest) - White River - McLaren Lake - 12 to 15 small lakes and ponds, 2 to 3 small creeks
2.	**Population Concentrations**	
a.	**group homes:**	- None Identified
b.	**large apartment buildings:**	- None Identified
c.	**schools:**	- None Identified
d.	**large office buildings:**	- See 4.h.
e.	**other:** (such as stadiums, concert halls, amusement parks, fairgrounds, correctional facilities, nursing homes, other special populations or large crowd assembly areas)	- Newfield Township Park - Five Lakes Resort, 8790 E. Buchanan Rd. (17 units) - Oakwood Resort Condominium, 45 S. 180th Ave. (39 campsites) - TTCM Hesperia, 6777 E. M-20 (80 campsites)
f.	**major employers:**	- None Identified
3.	**Population Shifts** *(numbers include portions of Village of Hesperia in Oceana County)*	
a.	**daily:**	- 837 commute with an average commuting time of 27.7 minutes - 541 school-aged children
b.	**seasonal:**	- 1,366 total housing units: 946 occupied/ 420 vacant - Of the vacant, 322 (76.7%) are for seasonal recreational or occasional use
4.	**Important or Critical Public and Private Facilities**	
a.	**police precincts:**	- None Identified
b.	**fire stations:**	- Hesperia Area Fire Department, 8320 E. M-20
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:** (such as government buildings, record center, major construction companies, warehouses, demolition companies, heavy equipment rental, emergency equipment and vehicle storage areas, etc.)	- Township of Newfield, 3890 198th Ave.
5.	**Vital or Critical Infrastructure**	
a.	**roads, railroads, and bridges:**	- M-20 - M-82/120 - M-20 bridge over White River South Branch

b.	**dams, power stations, water treatment plants, sanitary lift stations, etc.:**	- Consumers Energy Power Line
c.	**other:** (such as 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 portions of Village of Hesperia in Oceana County)*	2,401
b.	**peak population (seasonal):**	*(numbers include portions of Village of Hesperia in Oceana County)*	3,238
c.	**percent over 65:**		16.7
d.	**percent under 18:**		24.6
e.	**percent that are homeowners:**		85.4
f.	**percent below poverty level:**		16.5
g.	**percent with disability or mobility limitation:**		23.8
h.	**estimated property insurance coverage:** **(Real and Personal Equalized Valuations)**	Agricultural: Commercial: Industrial: Residential: Total Personal: Total:	$7,835,510 $4,536,800 $350,900 $59,039,515 $1,566,300 $73,329,025
i.	**flood insurance coverage:**	Total Losses since 01/01/78: Total Payments since 01/01/78: Policies In-Force: Total Insurance In-Force:	2 $36,442 12 $1,674,300
j.	**location of floodplains:**	- Floodplain along White 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

Land Use and Natural Features Map (USGS Quad.)
NEWFIELD TOWNSHIP



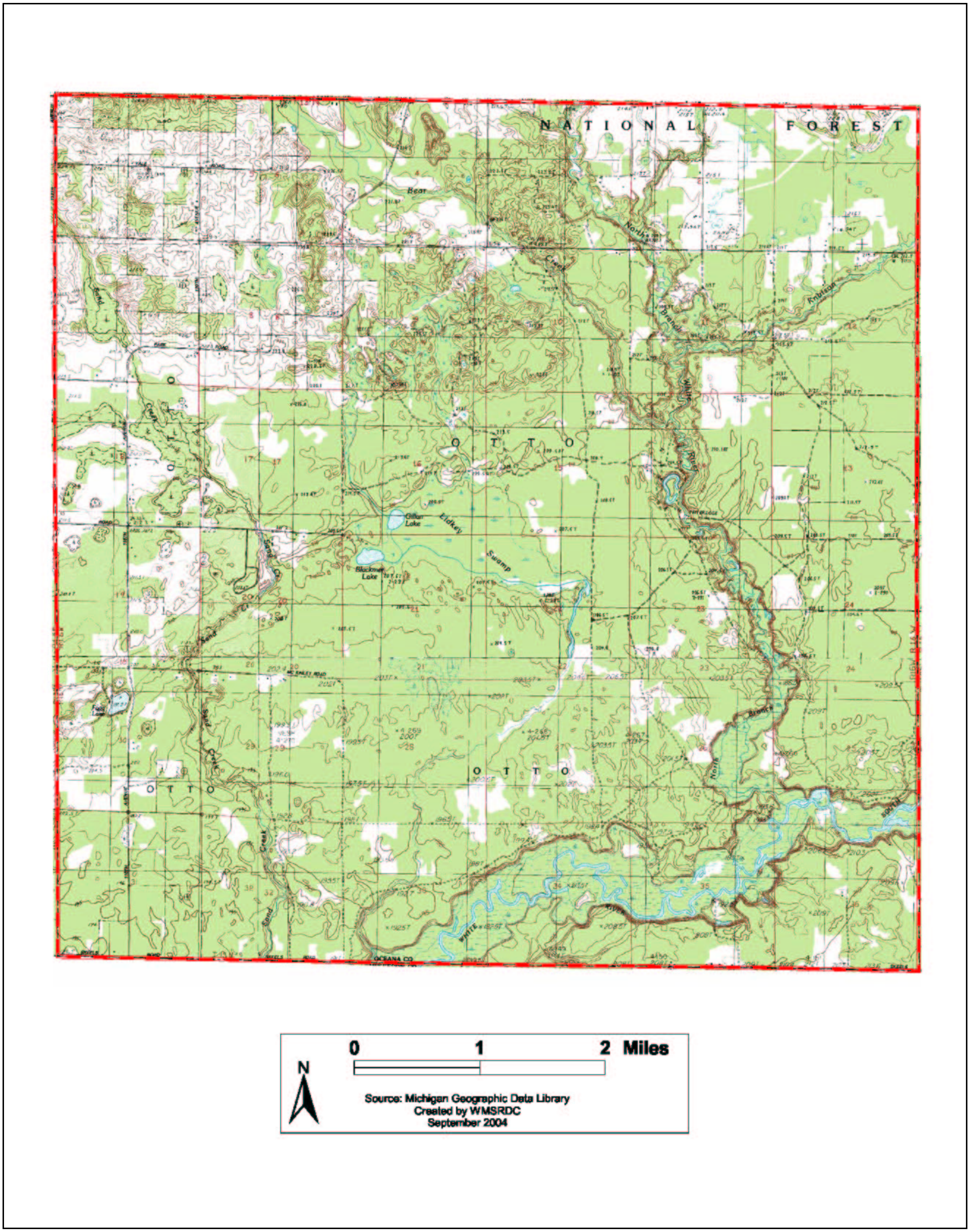
OTTO TOWNSHIP

1.	**major geographic features:**	- 23 persons per square mile - 11 housing units per square mile - Heavily forested (Manistee National Forest) - White River - 4 to 5 small lakes and ponds, 5 to 7 small creeks
2.	**Population Concentrations**	
a.	**group homes:**	- None Identified
b.	**large apartment buildings:**	- None Identified
c.	**schools:**	- None Identified
d.	**large office buildings:**	- See 4.h.
e.	**other:** (such as 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**	
a.	**daily:**	- 346 commute with an average commuting time of 27 minutes - 183 school-aged children
b.	**seasonal:**	- 394 total housing units: 311 occupied/ 83 vacant - Of the vacant, 45 (54.2%) 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:** (such as government buildings, record center, major construction companies, warehouses, demolition companies, heavy equipment rental, emergency equipment and vehicle storage areas, etc.)	- Township of Otto, 5458 S. 128th Ave.
5.	**Vital or Critical Infrastructure**	
a.	**roads, railroads, and bridges:**	- B-86
b.	**dams, power stations, water treatment plants, sanitary lift stations, etc.:**	- None Identified
c.	**other:** (such as 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):**	826
b.	**peak population (seasonal):**	946
c.	**percent over 65:**	10.3
d.	**percent under 18:**	26.6
e.	**percent that are homeowners:**	90
f.	**percent below poverty level:**	10.5
g.	**percent with disability or mobility limitation:**	21.6
h.	**estimated property insurance coverage:** **(Real and Personal Equalized Valuations)** Agricultural: Commercial: Industrial: Residential: Total Personal: Total:	$2,846,700 $48,800 $13,600 $19,316,200 $754,600 $22,979,900
i.	**flood insurance coverage:** Total Losses since 01/01/78: Total Payments since 01/01/78: Policies In-Force: Total Insurance In-Force:	*Not Participating in the NFIP*
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

Land Use and Natural Features Map (USGS Quad.)

OTTO TOWNSHIP



PENTWATER TOWNSHIP

1.	**major geographic features:**	- 113.1 persons per square mile - 135.2 housing units per square mile - Dense residential along Lake Michigan Shoreline and Pentwater Lake, somewhat dense residential near Bass Lake at northern edge of township - Lake Michigan shoreline and beach - Coastal sand dunes - Pentwater Lake - Pentwater River - 1 to 2 small creeks - Heavy forest in southern portion of township (Pere Marquette State Forest) - Pentwater River State Game Area

2.	**Population Concentrations**	
a.	**group homes:**	- None Identified
b.	**large apartment buildings:**	- None Identified
c.	**schools:**	- None Identified
d.	**large office buildings:**	- See 4.h.
e.	**other:** (such as stadiums, concert halls, amusement parks, fairgrounds, correctional facilities, nursing homes, other special populations or large crowd assembly areas)	- River Farm Campground, 5480 N. Wayne Rd. (25 campsites) - Hill & Hollow Campground, 8915 N. Business US-31 (150 sites) - Lake Michigan United Methodist Camp, 5807 N. Ridge Rd. (65 sites) - Pines Motel, 8228 N. Business US-31
f.	**major employers:**	- None Identified

3.	**Population Shifts** *(numbers include Village of Pentwater)*	
a.	**daily:**	- 467 commute with an average commuting time of 19.9 minutes - 157 school-aged children
b.	**seasonal:**	- 1,812 total housing units: 771 occupied/ 1,041 vacant - Of the vacant, 947 (91.0%) 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:**	- Pentwater VFW Hall, 8440 N. US 31
f.	**community medical facilities, hospitals:**	- None Identified
g.	**historic sites:**	- Veterans Day Storm-Graveyard of Ships Informational Designation, 421 S. Hancock St.
h.	**other:** (such as government buildings, record center, major construction companies, warehouses, demolition companies, heavy equipment rental, emergency equipment and vehicle storage areas, etc.)	- None Identified

5.	**Vital or Critical Infrastructure**

a.	**roads, railroads, and bridges:**	- B-15 - B-15 Bridge over Bass Lake - US-31 - US-31 Business Route - US-31 Business Route bridge over Bass Lake
b.	**dams, power stations, water treatment plants, sanitary lift stations, etc.:**	- Sewage disposal pond, Madison Rd.
c.	**other:** (such as airports, pipelines, bus terminals, train stations, military bases, marine passenger ferry services, etc.)	- None Identified

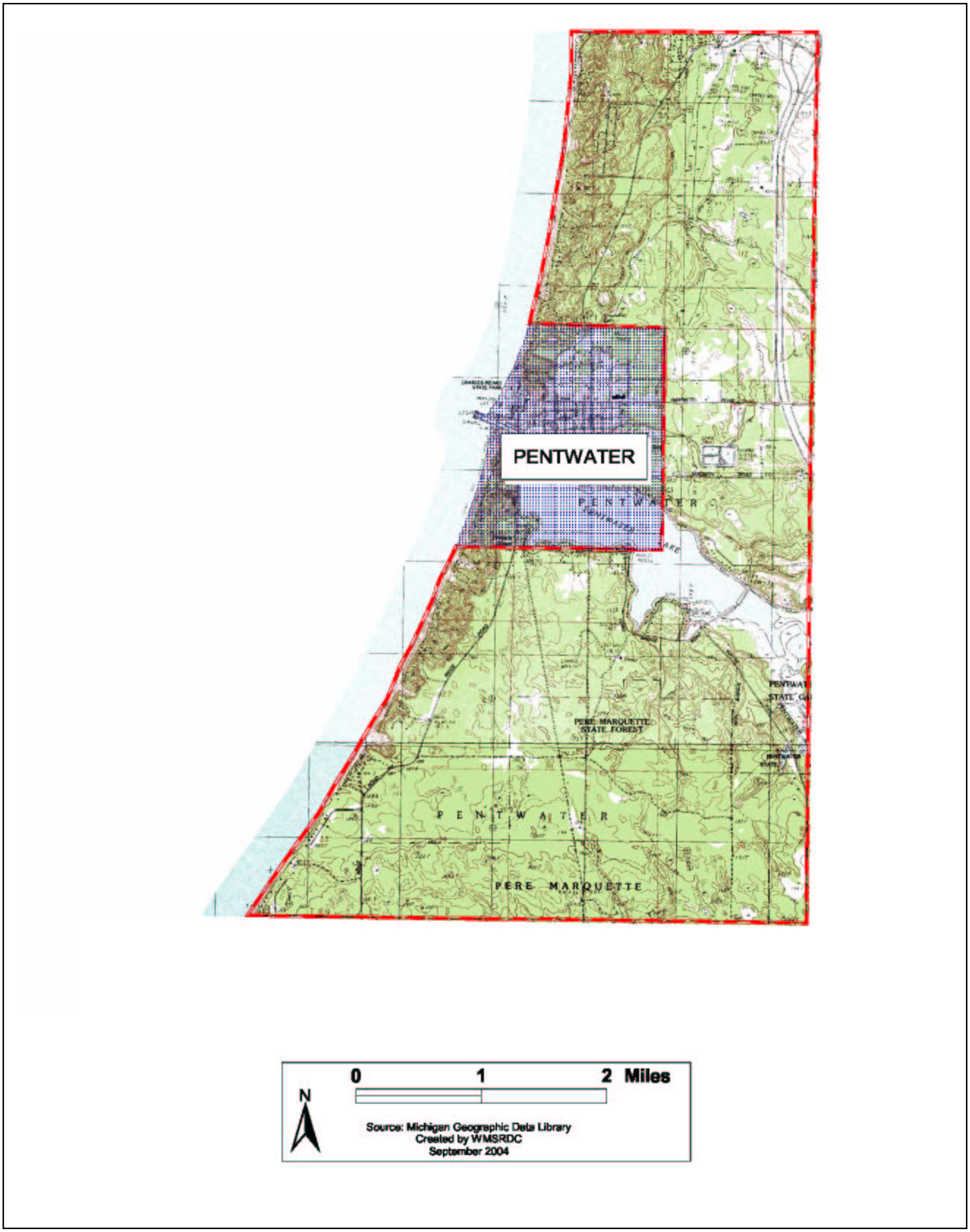
6.	**Socio-Economic Profile of Sector**

a.	**total population (night):**	*(numbers include Village of Pentwater)*	1,515
b.	**peak population (seasonal):**	*(numbers include Village of Pentwater)*	3,362
c.	**percent over 65:**		35.8
d.	**percent under 18:**		11.6
e.	**percent that are homeowners:**		86.4
f.	**percent below poverty level:**		3.2
g.	**percent with disability or mobility limitation:**		19.9
h.	**estimated property insurance coverage:** **(Real and Personal Equalized Valuations)**	Agricultural: Commercial: Industrial: Residential: Total Personal: Total:	$0 $15,966,100 $247,100 $273,796,300 $2,400,500 $292,410,000
i.	**flood insurance coverage:**	Total Losses since 01/01/78: Total Payments since 01/01/78: Policies In-Force: Total Insurance In-Force:	1 $0 4 $2,243,100
j.	**location of floodplains:**	- Floodplain around Pentwater Lake and along Pentwater River (excluding Pentwater State Game Area)	

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

Land Use and Natural Features Map (USGS Quad.)
PENTWATER TOWNSHIP



SHELBY TOWNSHIP

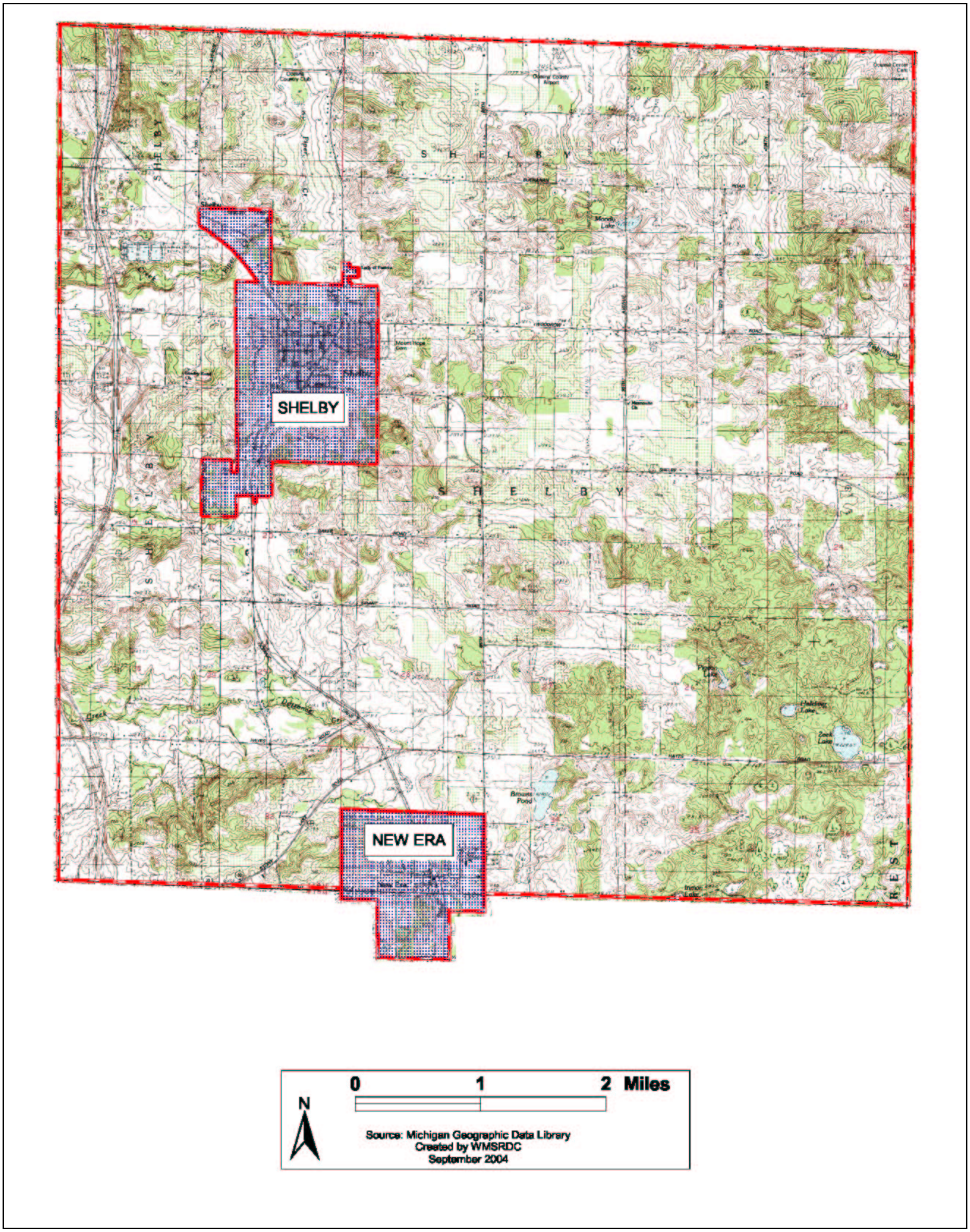
1.	**major geographic features:**	- 113 persons per square mile - 44 housing units per square mile - Scattered rural housing, somewhat dense along Oceana Dr. and Woodrow Rd. east of Village of Shelby - Manistee National Forest in SE corner of township - 5 to 7 small lakes and ponds, 4 to 5 small creeks - Hart-Montague Bicycle Trail
2.	**Population Concentrations**	
a.	**group homes:**	- Country Acres AFC, 2649 W. Woodrow Rd. (11 capacity) - Pine Cone Grove, 68 S. Oceana Drive (6 capacity)
b.	**large apartment buildings:**	- None Identified
c.	**schools:**	- None Identified
d.	**large office buildings:**	- See 4.h.
e.	**other:** (such as stadiums, concert halls, amusement parks, fairgrounds, correctional facilities, nursing homes, other special populations or large crowd assembly areas)	- Oceana Golf Club, 3333 W. Weaver Rd. (18 holes)
f.	**major employers:**	- None Identified
3.	**Population Shifts** *(numbers include Village of Shelby and parts of New Era)*	
a.	**daily:**	- 1,687 commute with an average commuting time of 19.1 minutes - 1,002 school-aged children
b.	**seasonal:**	- 1,584 total housing units: 1,409 occupied/ 175 vacant - Of the vacant, 19 (10.9%) 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:** (such as government buildings, record center, major construction companies, warehouses, demolition companies, heavy equipment rental, emergency equipment and vehicle storage areas, etc.)	- Township of Shelby, 198 N. Michigan Ave.
5.	**Vital or Critical Infrastructure**	
a.	**roads, railroads, and bridges:**	- US-31 - M-20 - Oceana Drive - M-20 bridge over US-31

b.	**dams, power stations, water treatment plants, sanitary lift stations, etc.:**	- Sewage Lagoon, Pierce Rd.
c.	**other:** (such as airports, pipelines, bus terminals, train stations, military bases, marine passenger ferry services, etc.)	- Oceana County Airport (Hart-Shelby), 1805 W. Baseline Rd. - MichCon Gas Pipeline

6.	**Socio-Economic Profile of Sector**		
a.	**total population (night):**	*(includes Village of Shelby and part of Village of New Era)*	4,069
b.	**peak population (seasonal):**	*(includes Village of Shelby and part of Village of New Era)*	4,124
c.	**percent over 65:**		13.4
d.	**percent under 18:**		30
e.	**percent that are homeowners:**		75.4
f.	**percent below poverty level:**		11.5
g.	**percent with disability or mobility limitation:**		20.2
h.	**estimated property insurance coverage:** **(Real and Personal Equalized Valuations)**	Agricultural: Commercial: Industrial: Residential: Total Personal: Total:	$16,477,800 $21,918,800 $3,978,500 $64,387,800 $2,400,500 $109,163,400
i.	**flood insurance coverage:**	Total Losses since 01/01/78: Total Payments since 01/01/78: Policies In-Force: Total Insurance In-Force:	*Not Participating in the NFIP*
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

Land Use and Natural Features Map (USGS Quad.)
SHELBY TOWNSHIP



Weare Township

1.	**major geographic features:**	- 33.5 persons per square mile - 15.4 housing units per square mile - N Branch Pentwater River - S Branch Pentwater River - 8 to 10 small creeks - Manistee National Forest - Pentwater River State Game Area

2.	**Population Concentrations**	
a.	**group homes:**	- Oceana Seniors INC., 6699 N. Oceana Dr. (12 capacity)
b.	**large apartment buildings:**	- None Identified
c.	**schools:**	- None Identified
d.	**large office buildings:**	- See 4.h.
e.	**other:** (such as stadiums, concert halls, amusement parks, fairgrounds, correctional facilities, nursing homes, other special populations or large crowd assembly areas)	- Hylander Valley Estates Mobile Home Community 231 North Eastwood
f.	**major employers:**	- None Identified

3.	**Population Shifts**	
a.	**daily:**	- 550 commute with an average commuting time of 25 minutes - 238 school-aged children
b.	**seasonal:**	- 577 total housing units: 457 occupied/ 120 vacant - Of the vacant, 50 (41.7%) are for seasonal recreational or occasional use

4.	**Important or Critical Public and Private Facilities**	
a.	**police precincts:**	- Mason-Oceana 911 Central Dispatch, 9160 N. Oceana Drive
b.	**fire stations:**	- None Identified
c.	**public works yards:**	- None Identified
d.	**pumping stations:**	- None Identified
e.	**community shelters:**	- St. Joseph's Parish, 2349 Jackson Rd.
f.	**community medical facilities, hospitals:**	- None Identified
g.	**historic sites:**	- None Identified
h.	**other:** (such as government buildings, record center, major construction companies, warehouses, demolition companies, heavy equipment rental, emergency equipment and vehicle storage areas, etc.)	- Weare Township Hall, 6506 N. Oceana Dr.

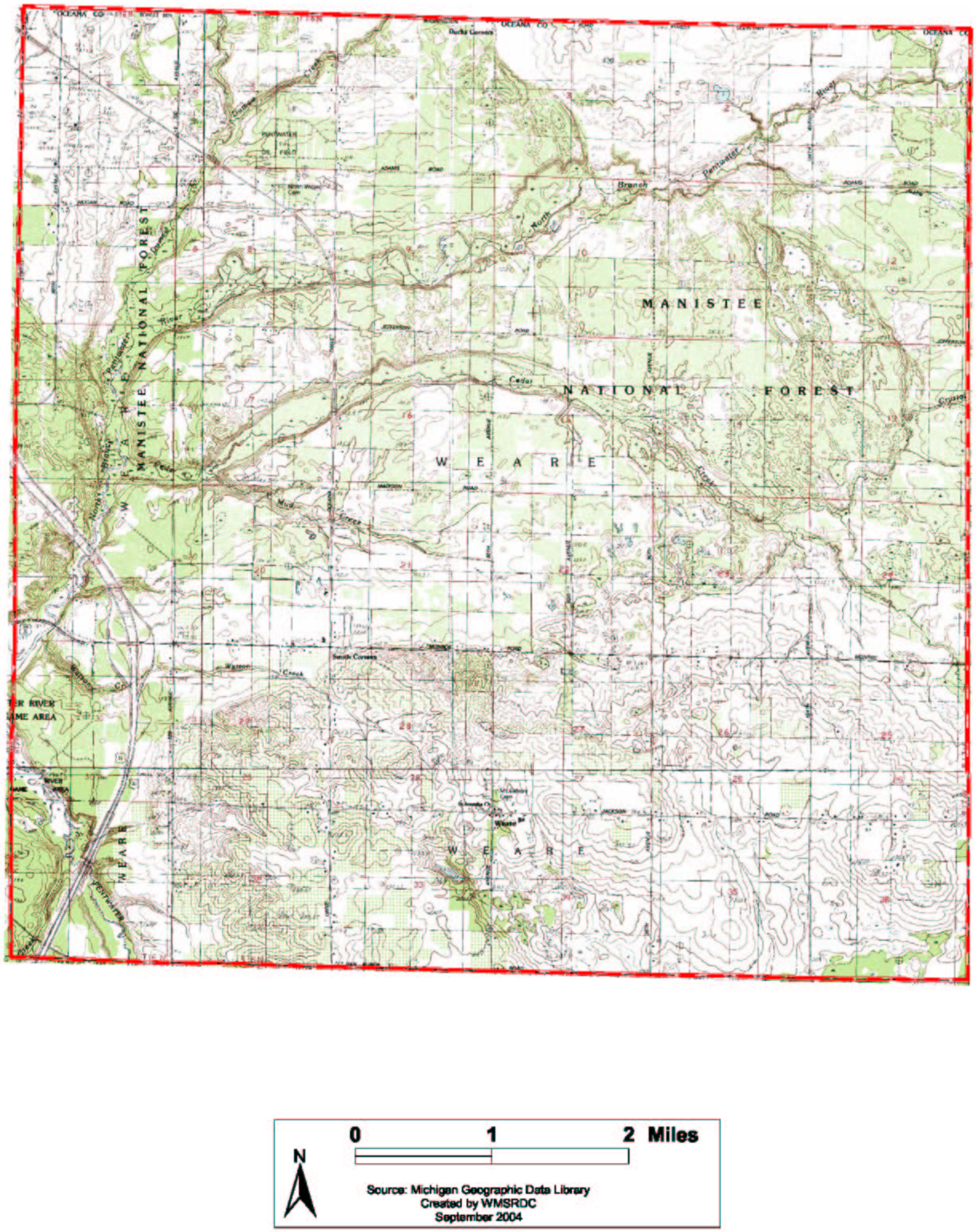
5.	**Vital or Critical Infrastructure**	
a.	**roads, railroads, and bridges:**	- US-31, US-31 Business Route - Oceana Drive - US-31 bridge over Pentwater River South Branch - Oceana Drive bridge over Pentwater River South and North Branches

b.	**dams, power stations, water treatment plants, sanitary lift stations, etc.:**	- Consumers Energy Power Line
c.	**other:** (such as 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):**		1,210
b.	**peak population (seasonal):**		1,342
c.	**percent over 65:**		16.2
d.	**percent under 18:**		24.3
e.	**percent that are homeowners:**		86.7
f.	**percent below poverty level:**		15.2
g.	**percent with disability or mobility limitation:**		19
h.	**estimated property insurance coverage:** **(Real and Personal Equalized Valuations)**	Agricultural: Commercial: Industrial: Residential: Total Personal: Total:	$16,419,300 $2,044,000 $415,800 $29,473,300 $1,592,400 $49,944,800
i.	**flood insurance coverage:**	Total Losses since 01/01/78: Total Payments since 01/01/78: Policies In-Force: Total Insurance In-Force:	*Not Participating in the NFIP*
j.	**location of floodplains:**	- None Identified	

7.	**Emergency Warning System Coverage**	
a.	**siren location(s) and description of system:**	- None Identified
b.	**percent of population covered by warning sirens or system:**	N/A

Land Use and Natural Features Map (USGS Quad.)
WEARE TOWNSHIP



Appendix B:
HAZARD IDENTIFICATIONS AND ANALYSES

Hazard Identification Profile
Oceana County

1. NATURAL HAZARDS

1.01 Celestial Impacts: - None Identified.

1.02 Drought:

- 12 recorded drought events in the area (including Lake, Mason, Muskegon, Newaygo, and Oceana counties) lasting eight months or greater: 1895-1896, 1899-1900, 1901-1902, 1909-1911, 1925-1926, 1930-1931, 1956-1957, 1962-1963, 1971-1972, 1976-1977, and 2002-2003.
- Summer 1871: Prolonged drought over much of the Great Lakes region.
- May-September, 1891: Drought devastated Michigan's lumber industry.
- 2013: Record "low" Lake Michigan water levels.

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.
- May 16, 1997: Record cold temperatures. $2m crop damage, Oceana County.
- March 2012: Record warm temperatures triggered early growing season. $209.8m crop damage across Michigan.

1.05 Flooding - Riverine/ Urban:

- September 10-19, 1986: Flooding. Declaration of major disaster by President.
- October 28, 1986: Flooding & heavy rain. Declaration of disaster by Governor.
- April 19, 1993: Flooding. $5m property damage across southern Lower Michigan.
- February 9-10, 2001: Flooding. $100k property damage, Oceana County.
- February 24-28, 2001: Flooding. $190k property damage across West Michigan.
- May 15-16, 2001: Flash flooding from severe thunderstorms. $550k property damage, $250k crop damage, Oceana Co.
- May 21-23, 2004: Flooding. $25m property damage and $4.6m crop damage across 23 counties in Lower Michigan.
- April 17-23, 2013: Flooding. $3m property damage, Oceana County.

1.06 Fog:

- January 11-13, 1995: Dense Fog. 4 traffic accident fatalities, school closures, and flight delays across Lower Michigan.

1.07 Great Lakes Shoreline Hazards:

- June 1986: Record high water level on Lake Michigan.
- Extreme high water levels in the Great Lakes: 1929, 1952, 1973, 1986, and 1997.
- 2013: Record low water level on Lake Michigan.
- Extreme low water levels in the Great Lakes: 1926, 1934, 1964, 2003, and 2013.
- Rip current incidents on Lake Michigan, 2002-2012: 77 fatalities, 230 rescues.
- July 13, 1938: Seiche/storm surge on Lake Michigan. 3 drowned in Holland, 1 in Muskegon, and 1 near Pentwater.
- April 6, 1997: Beach erosion due to high winds reported at Stony Lake, Benona Twp.
- August 3, 2011: 13-year old girl died in a hospital after being swept away by a rip current near the north pier in Pentwater.

1.08 Hail:

- Severe hail events (1" or greater) recorded in Oceana County, 1996-2012: 11
- July 13, 2000: 1.75 inch hail. $50k property damage, $25k crop damage, Walkerville Village (Leavitt Twp).
- May 10, 2003: 1.00 inch hail. $20k property damage, $10k crop damage, New Era Village (Grant Twp and Shelby Twp).
- May 6, 2004: 0.88 inch hail. $20k property damage, $20k crop damage, Oceana County.
- May 23, 2004: 0.75 inch hail. $15k property damage, $15k crop damage, New Era Village (Grant Twp and Shelby Twp).

1.09 Invasive Species: - Invasive species exist in Oceana County; No significant events identified.

1.10 Lightning: - None Identified.

1.11 Severe Winds:

- August 20 - September 6, 1975: Rainstorms, high winds. Declaration of major disaster by President.
- July 15, 1995: Severe thunderstorms. $15k property damage, Walkerville Village (Leavitt Twp).
- April 6, 1997: High wind. $5m property damage across southwest Lower Michigan.
- May 31, 1998: Severe thunderstorms. Local, Gubernatorial, and Presidential disaster declarations. $4.m public damage, 37 injuries, 26 homes and 6 businesses destroyed, 1415 homes and 109 businesses damaged in Oceana Co.
- July 8, 1999: Severe thunderstorms. $20k property damage across Oceana County.
- May 12, 2000: Severe thunderstorms. $50k property damage, Shelby Twp.
- June 1, 2000: Severe thunderstorms. $50k property damage, Golden Twp.
- 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 26, 2005: Severe thunderstorms. $15k property damage, Pentwater Village (Pentwater Twp).
- July 17, 2006: Severe thunderstorms. $250k property damage, $50k crop damage, across Oceana County.
- August 1, 2006: Severe thunderstorms. $20k property damage across northwest Oceana County.
- November 17, 2013: High wind. $75k property damage and power outages across Oceana County.

1.12 Subsidence: - None Identified.

1.13 Tornadoes:

- July 11, 1967: Tornado (F1). $25k property damage, Ferry Township.

- March 30, 1977: Tornado (F1). $25k property damage, Weare Township.
- August 12, 1978: Tornado (F2). $250k property damage.
- September 14, 1990: Tornado (F1). $25k property damage, Ferry Township.
- May 28, 1991: Tornado (F2). $250k property damage, Hart 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 12 wildfires and 60 acres burned per year on county lands under MDNR jurisdiction (346 total wildfires, 1,766.0 total acres burned).
- April 11, 2005: Wildfire. 17 acres burned, 2 houses/ 16 walkways destroyed, 5 houses damaged. Benona Township.

1.15 Winter Storms:
- March 2-7, 1976: Ice storms. Declaration of major disaster by President.
- January 26-31, 1977: Blizzard, snowstorm. Declaration of emergency by President.
- January 26-27, 1978: Blizzard, snowstorm. Declaration of statewide emergency by President.
- 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.
- January 2-15, 1999: Blizzard, snowstorm. Declaration of emergency by President.
- April 3, 2003: Ice storm. $4.9m property damage throughout West Michigan.
- February 16, 2006: Ice storm. $1m property damage across Lower Michigan.

2. TECHNOLOGICAL HAZARDS

2.01 Dam Failure:
- September 1986: Hart Hydro-Electric Dam, Hesperia Dam spillway erosion, Crystal Valley Dam spillway erosion.

2.02 Energy Emergencies: - None Identified.

2.03 Fire - Scrap Tire: - None Identified; Approximate scrap tire inventory in Oceana County in 2012: 11,000.

2.04 Fire - Structural:
- County fire rate per 1,000 population in 1998: 6.37
- Major fires in the Village of Walkerville: May 1891, 1914, and in the 1940"s.
- June 12, 2012: Fire destroyed historic buildings in downtown Shelby, including apartment units and 4 businesses.
- October 16, 2012: Major fire destroyed a 400 ft barn at a pork farm in Leavitt Township; unknown cause.

2.05 Hazard Material Incidents - Fixed Site (including industrial accidents):
- SARA Title III Sites in Oceana County in 2012: 83.
- December 12, 2012: Explosion in a pig farm barn in Crystal Township; possibly caused by methane gas buildup.

2.06 Hazard Material Incidents - Transportation: - None Identified.

2.07 Infrastructure Failure:
- Number of NCDC with mention of downed power lines or power outages in Oceana County, 1993-2012: 32
- January 20, 1994: Frozen sewer/water lines and downed power lines (extreme cold), statewide.
- 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: 90,000 without power statewide (thunderstorm winds). Power lines downed in Pentwater.
- May 31, 1998: over 861,000 without power (thunderstorm winds), statewide.
- November 10, 1998: 167,000 power outages (high wind), West Michigan.
- April 3, 2003: Hundreds of thousands lose power (ice storm), Lower Michigan.
- October 10, 2004: 100,000 without power (high wind), statewide.
- December 28, 2008: Hundreds of thousands lose power (high wind), statewide.

2.08 Nuclear Power Plant Emergencies: - None Identified.

2.09 Oil and Natural Gas Well Accidents: - No accidents identified.
- Oil and gas wells in Oceana County in 2012: 1,188
- 74 wells with known detectable levels of hydrogen sulfide.

2.10 Pipeline Accidents:
- March 5, 2010: Damage to residential gas meter causing natural gas leak. Minor neighborhood evacuations and temporary relocation of schoolchildren, Shelby Village.

2.11 Transportation Accidents:
- July 14, 2001: School bus rolled into a ditch. 2 children injured, Hart Township.
- December 1, 2012: Private helicopter crashed into Manistee National Forest. 1 fatality and 1 injury, Leavitt Township.

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.

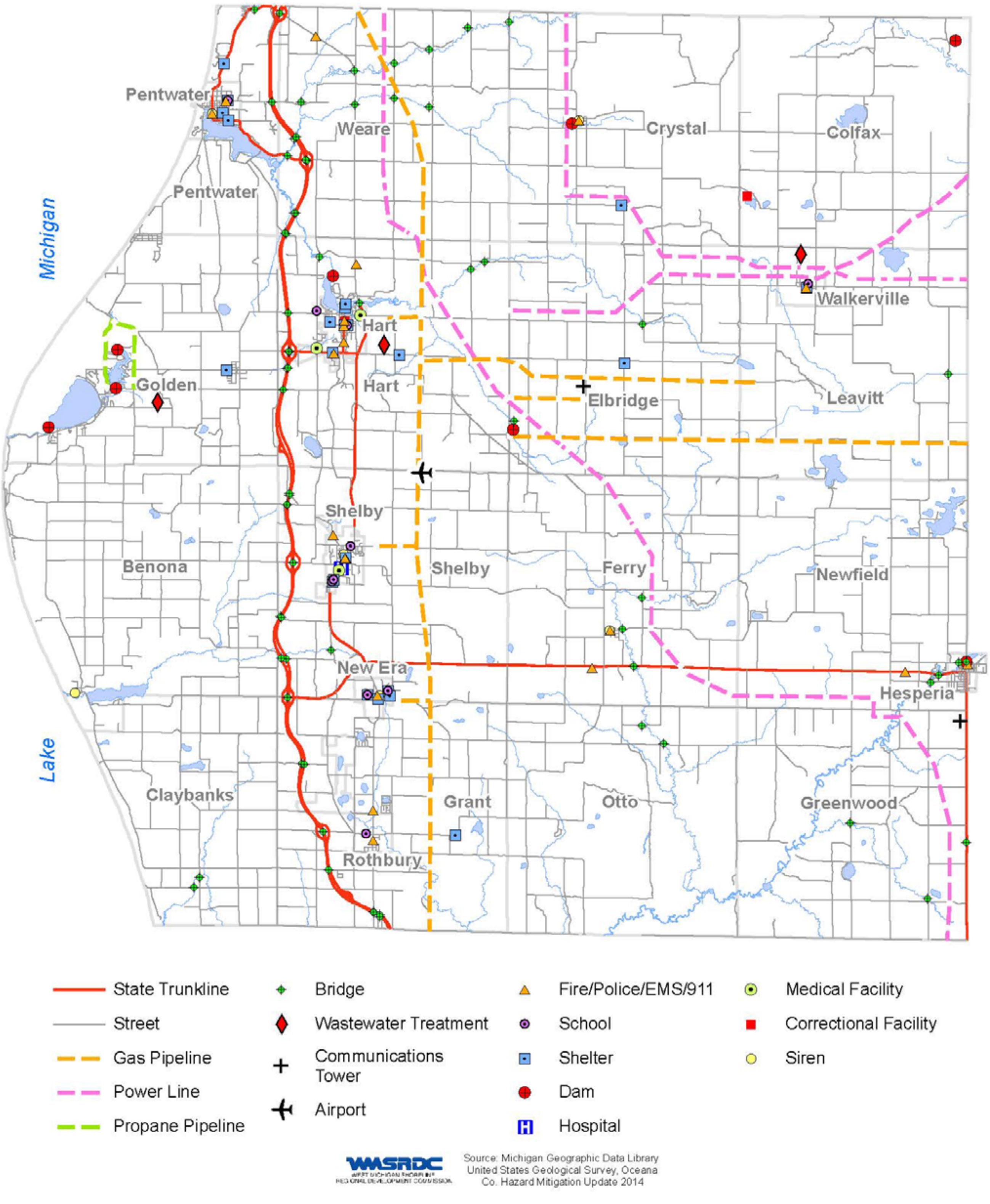
OCEANA COUNTY
Hazard Assessment
Ratings

Natural Hazards	Probability of Occurrence	Population Affected	Property Damaged	Economic Impacts
1.01 Celestial Impacts	1	2	0	2
1.02 Drought	2	2	2	3
1.03 Earthquake	0	-	-	-
1.04 Extreme Temperatures	3	2	1	2
1.05 Flooding: Riverine/Urban	3	1	2	1
1.06 Fog	3	1	0	1
1.07 Great Lakes Shoreline	3	1	2	1
1.08 Hail	3	1	2	1
1.09 Invasive Species	2	1	2	2
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	2	1	1	2
2.06 HAZMAT – Transportation	2	1	1	2
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	2
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	3
3.05 Terrorism & Similar Criminal Acts	1	1	1	1

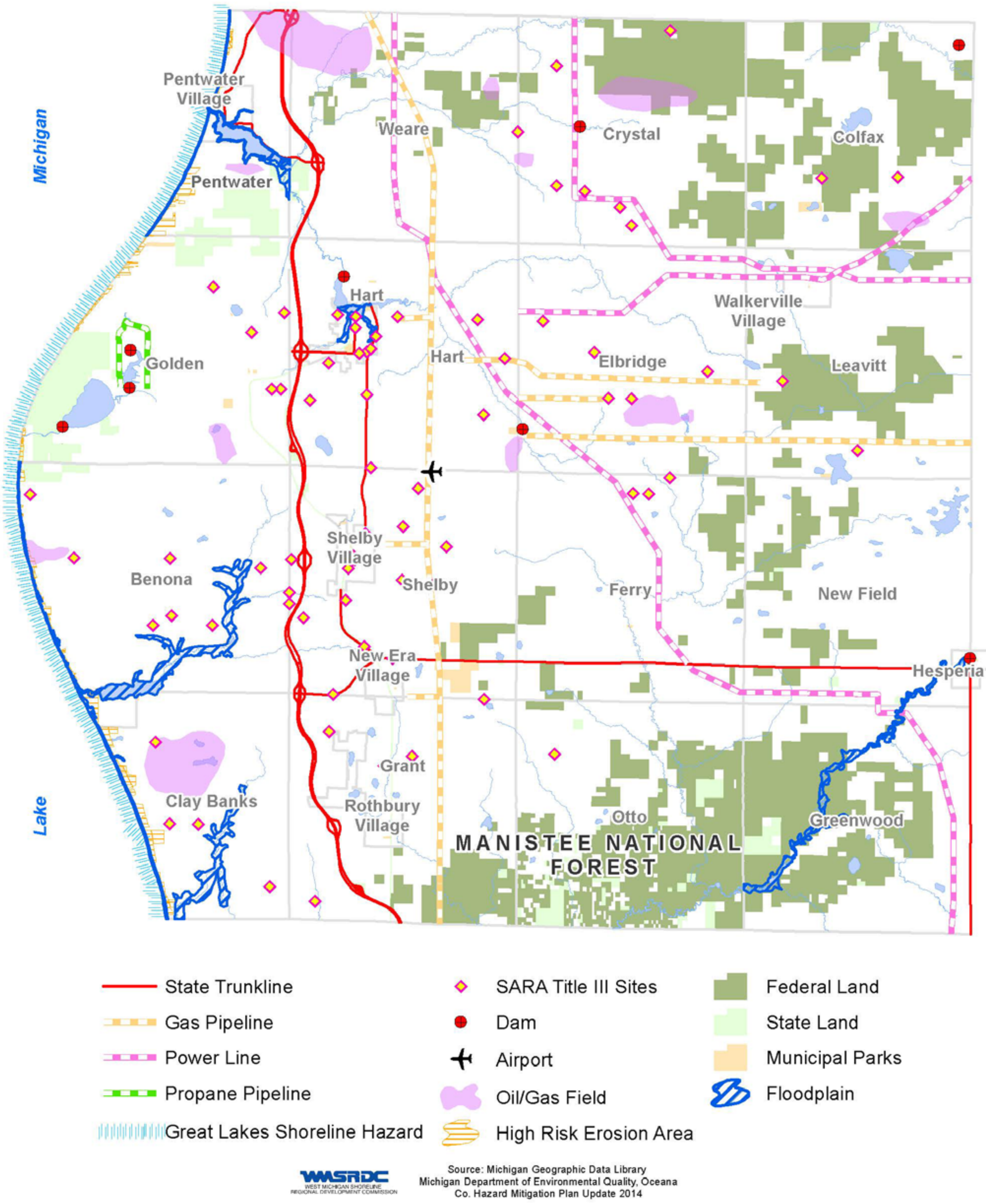
OCEANA COUNTY
Hazard Vulnerability
Rankings

Ranking	Hazard	Probability of Occurrence	X	Weighted Impacts	=	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
4	Extreme Temperatures	3		10		30
6	Fire – Structural	3		9		27
7	Drought	2		13		26
8	Flooding: Riverine/Urban	3		8		24
8	Great Lakes Shoreline	3		8		24
8	Hail	3		8		24
8	Lightning	3		8		24
12	Catastrophic Incidents	1		18		18
12	Dam Failure	2		9		18
12	Invasive Species	2		9		18
12	Public Health Emergencies	2		9		18
12	Tornadoes	2		9		18
17	Energy Emergencies	2		8		16
18	HAZMAT – Fixed Site	2		7		14
18	HAZMAT – Transportation	2		7		14
18	Pipeline Accidents	2		7		14
21	Fog	2		6		12
21	Oil/Natural Gas Well Accidents	2		6		12
21	Transportation Accidents	2		6		12
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
n/a	Earthquake	0		-		-
n/a	Nuclear Attack	0		-		-
n/a	Nuclear Power Emergencies	0		-		-

OCEANA COUNTY
Critical Facilities



OCEANA COUNTY
Potential Hazards



Hazard Identification Profile
City of Hart

1. NATURAL HAZARDS

1.01 Celestial Impacts: - None Identified.

1.02 Drought:
- 12 recorded drought events in the area (including Lake, Mason, Muskegon, Newaygo, and Oceana counties) lasting eight months or greater: 1895-1896, 1899-1900, 1901-1902, 1909-1911, 1925-1926, 1930-1931, 1956-1957, 1962-1963, 1971-1972, 1976-1977, and 2002-2003.
- Summer 1871: Prolonged drought over much of the Great Lakes region.
- May-September, 1891: Drought devastated Michigan's lumber industry.
- 2013: Record "low" Lake Michigan water levels.

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.
- May 16, 1997: Record cold temperatures. $2m crop damage, Oceana County.
- March 2012: Record warm temperatures triggered early growing season. $209.8m crop damage across Michigan.

1.05 Flooding - Riverine/ Urban:
- September 10-19, 1986: Flooding. Declaration of major disaster by President.
- October 28, 1986: Flooding & heavy rain. Declaration of disaster by Governor.
- April 19, 1993: Flooding. $5m property damage across southern Lower Michigan.
- February 9-10, 2001: Flooding. $100k property damage, Oceana County.
- February 24-28, 2001: Flooding. $190k property damage across West Michigan.
- May 15-16, 2001: Flash flooding from severe thunderstorms. $550k property damage, $250k crop damage, Oceana Co.
- May 21-23, 2004: Flooding. $25m property damage and $4.6m crop damage across 23 counties in Lower Michigan.
- April 17-23, 2013: Flooding. $3m property damage, Oceana County.

1.06 Fog:
- January 11-13, 1995: Dense Fog. 4 traffic accident fatalities, 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 Oceana County, 1996-2012: 11
- May 6, 2004: 0.88 inch hail. $20k property damage, $20k crop damage, Oceana County.

1.09 Invasive Species: - Invasive species exist in Oceana County; No significant events identified.

1.10 Lightning: - None Identified.

1.11 Severe Winds:
- August 20 - September 6, 1975: Rainstorms, high winds. Declaration of major disaster by President.
- April 6, 1997: High wind. $5m property damage across southwest Lower Michigan.
- May 31, 1998: Severe thunderstorms. Local, Gubernatorial, and Presidential disaster declarations. $4.m public damage, 37 injuries, 26 homes and 6 businesses destroyed, 1415 homes and 109 businesses damaged in Oceana Co.
- July 8, 1999: Severe thunderstorms. $20k property damage across Oceana 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 17, 2006: Severe thunderstorms. $250k property damage, $50k crop damage, across Oceana County.
- ***August 1, 2006: Severe thunderstorms. $20k property damage across northwest Oceana County.***
- November 17, 2013: High wind. $75k property damage and power outages across Oceana County.

1.12 Subsidence: - None Identified.

1.13 Tornadoes: - None Identified.

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 12 wildfires and 60 acres burned per year on county lands under MDNR jurisdiction (346 total wildfires, 1,766.0 total acres burned).

1.15 Winter Storms:
- March 2-7, 1976: Ice storms. Declaration of major disaster by President.
- January 26-31, 1977: Blizzard, snowstorm. Declaration of emergency by President.
- January 26-27, 1978: Blizzard, snowstorm. Declaration of statewide emergency by President.
- 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.
- January 2-15, 1999: Blizzard, snowstorm. Declaration of emergency by President.
- April 3, 2003: Ice storm. $4.9m property damage throughout West Michigan.
- February 16, 2006: Ice storm. $1m property damage across Lower Michigan.

2. TECHNOLOGICAL HAZARDS

2.01 Dam Failure:

- September 1986: Hart Hydro-Electric Dam, Hesperia Pond spillway erosion, Crystal Valley Dam spillway erosion.

2.02 Energy Emergencies: - None Identified.

2.03 Fire - Scrap Tire: - None Identified; Approximate scrap tire inventory in Oceana County in 2012: 11,000.

2.04 Fire - Structural:

- County fire rate per 1,000 population in 1998: 6.37

2.05 Hazard Material Incidents - Fixed Site (including industrial accidents):

- No incidents identified; SARA Title III Sites in Oceana County in 2012: 83.

2.06 Hazard Material Incidents - Transportation: - None Identified.

2.07 Infrastructure Failure:

- Number of NCDC with mention of downed power lines or power outages in Oceana County, 1993-2012: 32
- January 20, 1994: Frozen sewer/water lines and downed power lines (extreme cold), statewide.
- 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: 90,000 without power statewide (thunderstorm winds).
- May 31, 1998: over 861,000 without power (thunderstorm winds), statewide.
- November 10, 1998: 167,000 power outages (high wind), West Michigan.
- April 3, 2003: Hundreds of thousands lose power (ice storm), Lower Michigan.
- October 10, 2004: 100,000 without power (high wind), statewide.
- December 28, 2008: Hundreds of thousands lose power (high wind), statewide.

2.08 Nuclear Power Plant Emergencies: - None Identified.

2.09 Oil and Natural Gas Well Accidents: - No accidents identified.

- Oil and gas wells in Oceana County in 2012: 1,188

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.

CITY OF HART

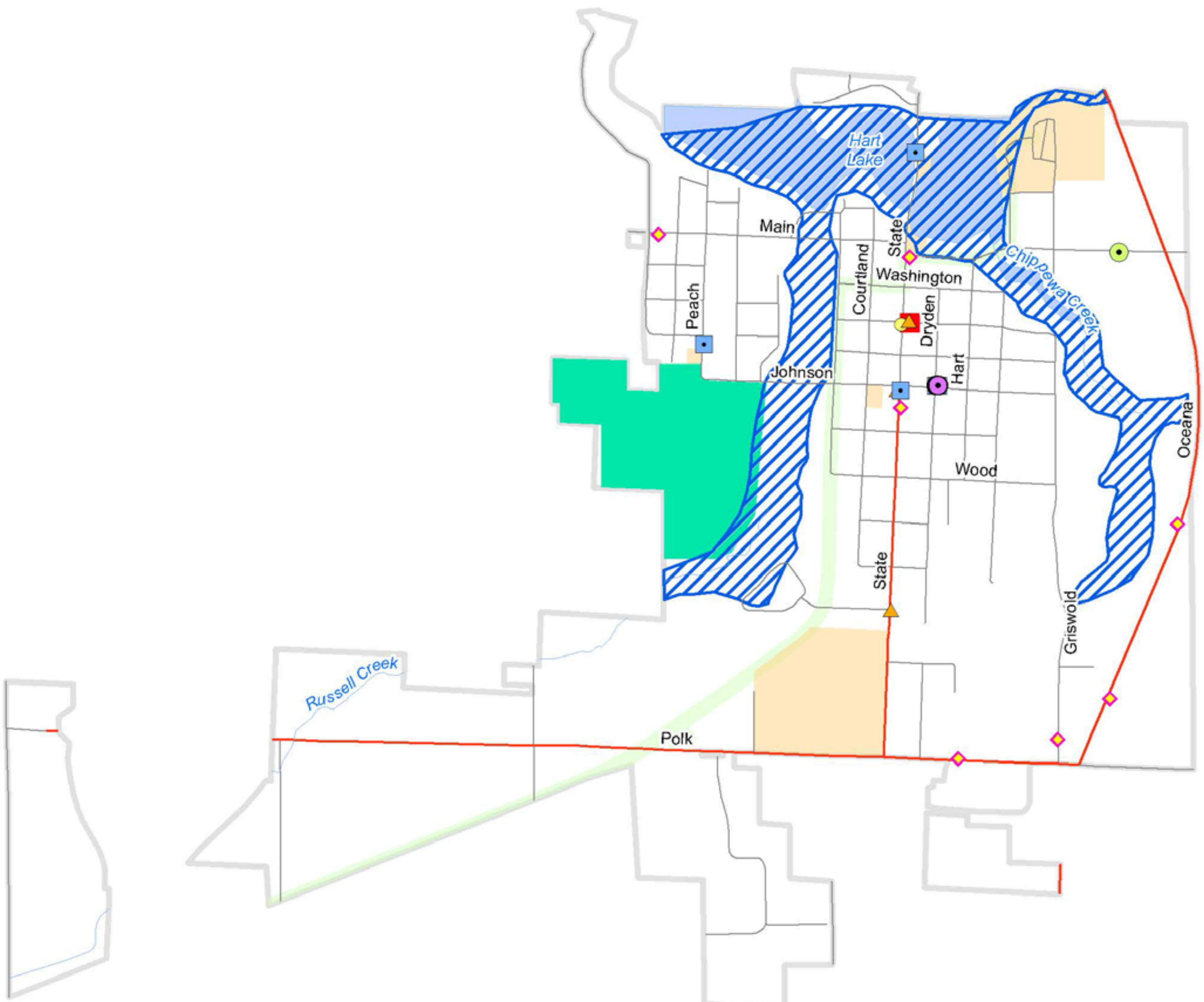
Hazard Assessment
Ratings

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

CITY OF HART
Hazard Vulnerability
Rankings

Ranking	Hazard	Probability of Occurrence	X	Weighted Impacts	=	Hazard Score
1	Winter Storms	3		15		45
2	Severe Winds	3		14		42
3	Infrastructure Failures	3		13		39
4	Extreme Temperatures	3		10		30
5	Wildfire	3		9		27
6	Fire – Structural	2		13		26
7	Hail	3		8		24
7	Drought	3		8		24
7	Energy Emergencies	2		12		24
10	Flooding: Riverine/Urban	2		11		22
11	Lightning	1		18		18
11	Catastrophic Incidents (National Emergencies)	2		9		18
11	Dam Failure	2		9		18
11	Great Lakes Shoreline	2		9		18
15	Invasive Species	1		15		15
16	Public Health Emergencies	2		7		14
16	Tornadoes	2		7		14
16	HAZMAT – Transportation	2		7		14
19	Fog	2		6		12
20	HAZMAT – Fixed Site	1		8		8
20	Oil/Natural Gas Well Accidents	1		8		8
20	Transportation Accidents	2		4		8
23	Celestial Impacts	1		7		7
24	Pipeline Accidents	1		6		6
24	Civil Disturbances	1		6		6
24	Fire – Scrap Tires	1		6		6
n/a	Subsidence	0		-		-
n/a	Terrorism & Similar Criminal Acts	0		-		-
n/a	Earthquake	0		-		-
n/a	Nuclear Attack	0		-		-
n/a	Nuclear Power Emergencies	0		-		-

CITY OF HART
Critical Facilities and Potential Hazards



- State Trunkline
- Street
- School
- Shelter
- SARA Title III Site
- Fire/Police/EMS/911
- Medical Facility
- Siren
- Correctional Facility
- State Land
- Municipal Land
- School Property
- Floodplain

0 0.25 0.5 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.

WMSRDC
WEST MICHIGAN SHORELINE REGIONAL DEVELOPMENT COMMISSION

Source: Michigan Geographic Data Library V 12b, Oceana Co. Hazard Mitigation Plan Update 2014

Hazard Identification Profile
Village of Hesperia

1. NATURAL HAZARDS

1.01 Celestial Impacts: - None Identified.

1.02 Drought:
- 12 recorded drought events in the area (including Lake, Mason, Muskegon, Newaygo, and Oceana counties) lasting eight months or greater: 1895-1896, 1899-1900, 1901-1902, 1909-1911, 1925-1926, 1930-1931, 1956-1957, 1962-1963, 1971-1972, 1976-1977, and 2002-2003.
- Summer 1871: Prolonged drought over much of the Great Lakes region.
- May-September, 1891: Drought devastated Michigan's lumber industry.
- 2013: Record "low" Lake Michigan water levels.

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.
- May 16, 1997: Record cold temperatures. $2m crop damage, Oceana County.
- March 2012: Record warm temperatures triggered early growing season. $209.8m crop damage across Michigan.

1.05 Flooding - Riverine/ Urban:
- September 10-19, 1986: Flooding. Declaration of major disaster by President.
- October 28, 1986: Flooding & heavy rain. Declaration of disaster by Governor.
- April 19, 1993: Flooding. $5m property damage across southern Lower Michigan.
- February 9-10, 2001: Flooding. $100k property damage, Oceana County.
- February 24-28, 2001: Flooding. $190k property damage across West Michigan.
- May 15-16, 2001: Flash flooding from severe thunderstorms. $550k property damage, $250k crop damage, Oceana Co.
- May 21-23, 2004: Flooding. $25m property damage and $4.6m crop damage across 23 counties in Lower Michigan.
- April 17-23, 2013: Flooding. $3m property damage, Oceana County.

1.06 Fog:
- January 11-13, 1995: Dense Fog. 4 traffic accident fatalities, 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 Oceana County, 1996-2012: 11

1.09 Invasive Species: - Invasive species exist in Oceana County; No significant events identified.

1.10 Lightning: - None Identified.

1.11 Severe Winds:
- August 20 - September 6, 1975: Rainstorms, high winds. Declaration of major disaster by President.
- April 6, 1997: High wind. $5m property damage across southwest Lower Michigan.
- May 31, 1998: Severe thunderstorms. Local, Gubernatorial, and Presidential disaster declarations. $4.m public damage, 37 injuries, 26 homes and 6 businesses destroyed, 1415 homes and 109 businesses damaged in Oceana Co.
- July 8, 1999: Severe thunderstorms. $20k property damage across Oceana 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 17, 2006: Severe thunderstorms. $250k property damage, $50k crop damage, across Oceana County.
- November 17, 2013: High wind. $75k property damage and power outages across Oceana County.

1.12 Subsidence: - None Identified.

1.13 Tornadoes: - None Identified.

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 12 wildfires and 60 acres burned per year on county lands under MDNR jurisdiction (346 total wildfires, 1,766.0 total acres burned).

1.15 Winter Storms:
- March 2-7, 1976: Ice storms. Declaration of major disaster by President.
- January 26-31, 1977: Blizzard, snowstorm. Declaration of emergency by President.
- January 26-27, 1978: Blizzard, snowstorm. Declaration of statewide emergency by President.
- 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.
- January 2-15, 1999: Blizzard, snowstorm. Declaration of emergency by President.
- April 3, 2003: Ice storm. $4.9m property damage throughout West Michigan.
- February 16, 2006: Ice storm. $1m property damage across Lower Michigan.

2. TECHNOLOGICAL HAZARDS

2.01 Dam Failure:
- September 1986: Hart Hydro-Electric Dam, ***Hesperia Dam spillway erosion***, Crystal Valley Dam spillway erosion.

2.02 Energy Emergencies: - None Identified.

2.03 Fire - Scrap Tire: - None Identified; Approximate scrap tire inventory in Oceana County in 2012: 11,000.

2.04 Fire - Structural:
- County fire rate per 1,000 population in 1998: 6.37

2.05 Hazard Material Incidents - Fixed Site (including industrial accidents):
- No incidents identified; SARA Title III Sites in Oceana County in 2012: 83.

2.06 Hazard Material Incidents - Transportation: - None Identified.

2.07 Infrastructure Failure:
- Number of NCDC with mention of downed power lines or power outages in Oceana County, 1993-2012: 32
- January 20, 1994: Frozen sewer/water lines and downed power lines (extreme cold), statewide.
- 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: 90,000 without power statewide (thunderstorm winds).
- May 31, 1998: over 861,000 without power (thunderstorm winds), statewide.
- November 10, 1998: 167,000 power outages (high wind), West Michigan.
- April 3, 2003: Hundreds of thousands lose power (ice storm), Lower Michigan.
- October 10, 2004: 100,000 without power (high wind), statewide.
- December 28, 2008: Hundreds of thousands lose power (high wind), statewide.

2.08 Nuclear Power Plant Emergencies: - None Identified.

2.09 Oil and Natural Gas Well Accidents: - No accidents identified.
- Oil and gas wells in Oceana County in 2012: 1,188

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.

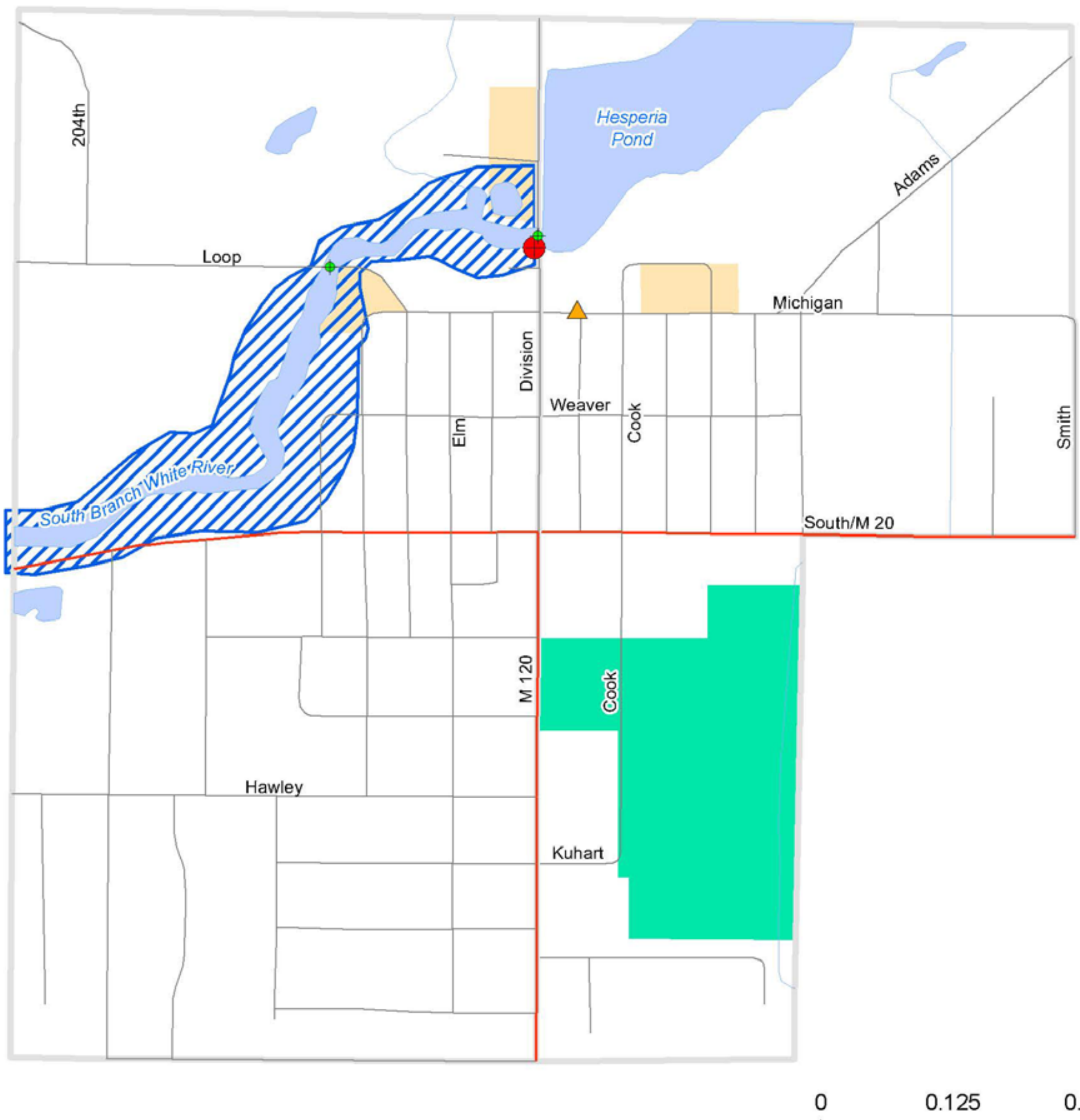
HESPERIA VILLAGE
Hazard Assessment
Ratings

Natural Hazards	Probability of Occurrence	Population Affected	Property Damaged	Economic Impacts
1.01 Celestial Impacts	1	2	0	2
1.02 Drought	2	2	2	3
1.03 Earthquake	0	-	-	-
1.04 Extreme Temperatures	3	2	1	2
1.05 Flooding: Riverine/Urban	3	1	2	1
1.06 Fog	2	1	0	1
1.07 Great Lakes Shoreline	0	-	-	-
1.08 Hail	2	2	2	1
1.09 Invasive Species	2	1	1	2
1.10 Lightning	3	1	2	1
1.11 Severe Winds	3	2	3	2
1.12 Subsidence	1	1	1	1
1.13 Tornadoes	1	3	2	2
1.14 Wildfire	2	2	2	2
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	3
2.03 Fire – Scrap Tires	1	1	1	1
2.04 Fire – Structural	3	1	2	2
2.05 HAZMAT – Fixed Site	2	1	1	2
2.06 HAZMAT – Transportation	2	1	1	2
2.07 Infrastructure Failures	3	3	1	2
2.08 Nuclear Power Emergencies	0	-	-	-
2.09 Oil/Natural Gas Well Accidents	0	-	-	-
2.10 Pipeline Accidents	1	1	1	2
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	3
3.05 Terrorism & Similar Criminal Acts	1	1	1	1

HESPERIA VILLAGE
Hazard Vulnerability Rankings

Ranking	Hazard	Probability of Occurrence	X	Weighted Impacts	=	Hazard Score
1	Winter Storms	3		15		45
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
n/a	Earthquake	0		-		-
n/a	Great Lakes Shoreline	0		-		-
n/a	Nuclear Attack	0		-		-
n/a	Nuclear Power Emergencies	0		-		-
n/a	Oil/Natural Gas Well Accidents	0		-		-

HESPERIA VILLAGE
Critical Facilities and Potential Hazards



- State Trunkline
- Street
- Dam
- Bridge
- Fire/Police/EMS/911
- Municipal Land
- School Property
- Floodplain

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, Oceana Co. Hazard Mitigation Plan Update 2014

Hazard Identification Profile
Village of New Era

1. NATURAL HAZARDS

1.01 Celestial Impacts: - None Identified.

1.02 Drought:

- 12 recorded drought events in the area (including Lake, Mason, Muskegon, Newaygo, and Oceana counties) lasting eight months or greater: 1895-1896, 1899-1900, 1901-1902, 1909-1911, 1925-1926, 1930-1931, 1956-1957, 1962-1963, 1971-1972, 1976-1977, and 2002-2003.
- Summer 1871: Prolonged drought over much of the Great Lakes region.
- May-September, 1891: Drought devastated Michigan's lumber industry.
- 2013: Record "low" Lake Michigan water levels.

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.
- May 16, 1997: Record cold temperatures. $2m crop damage, Oceana County.
- March 2012: Record warm temperatures triggered early growing season. $209.8m crop damage across Michigan.

1.05 Flooding - Riverine/ Urban:

- September 10-19, 1986: Flooding. Declaration of major disaster by President.
- October 28, 1986: Flooding & heavy rain. Declaration of disaster by Governor.
- April 19, 1993: Flooding. $5m property damage across southern Lower Michigan.
- February 9-10, 2001: Flooding. $100k property damage, Oceana County.
- February 24-28, 2001: Flooding. $190k property damage across West Michigan.
- May 15-16, 2001: Flash flooding from severe thunderstorms. $550k property damage, $250k crop damage, Oceana Co.
- May 21-23, 2004: Flooding. $25m property damage and $4.6m crop damage across 23 counties in Lower Michigan.
- April 17-23, 2013: Flooding. $3m property damage, Oceana County.

1.06 Fog:

- January 11-13, 1995: Dense Fog. 4 traffic accident fatalities, 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 Oceana County, 1996-2012: 11
- ***May 10, 2003: 1.00 inch hail. $20k property damage, $10k crop damage, New Era Village (Grant and Shelby Twps).***
- May 6, 2004: 0.88 inch hail. $20k property damage, $20k crop damage, Oceana County.
- ***May 23, 2004: 0.75 inch hail. $15k property damage, $15k crop damage, New Era Village (Grant and Shelby Twps).***

1.09 Invasive Species: - Invasive species exist in Oceana County; No significant events identified.

1.10 Lightning: - None Identified.

1.11 Severe Winds:

- August 20 - September 6, 1975: Rainstorms, high winds. Declaration of major disaster by President.
- April 6, 1997: High wind. $5m property damage across southwest Lower Michigan.
- May 31, 1998: Severe thunderstorms. Local, Gubernatorial, and Presidential disaster declarations. $4.m public damage, 37 injuries, 26 homes and 6 businesses destroyed, 1415 homes and 109 businesses damaged in Oceana Co.
- July 8, 1999: Severe thunderstorms. $20k property damage across Oceana 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 17, 2006: Severe thunderstorms. $250k property damage, $50k crop damage, across Oceana County.
- November 17, 2013: High wind. $75k property damage and power outages across Oceana County.

1.12 Subsidence: - None Identified.

1.13 Tornadoes: - None Identified.

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 12 wildfires and 60 acres burned per year on county lands under MDNR jurisdiction (346 total wildfires, 1,766.0 total acres burned).

1.15 Winter Storms:

- March 2-7, 1976: Ice storms. Declaration of major disaster by President.
- January 26-31, 1977: Blizzard, snowstorm. Declaration of emergency by President.
- January 26-27, 1978: Blizzard, snowstorm. Declaration of statewide emergency by President.
- 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.

- January 2-15, 1999: Blizzard, snowstorm. Declaration of emergency by President.
- April 3, 2003: Ice storm. $4.9m property damage throughout West Michigan.
- February 16, 2006: Ice storm. $1m property damage across Lower Michigan.

2. TECHNOLOGICAL HAZARDS

2.01 Dam Failure: - None Identified.

2.02 Energy Emergencies: - None Identified.

2.03 Fire - Scrap Tire: - None Identified; Approximate scrap tire inventory in Oceana County in 2012: 11,000.

2.04 Fire - Structural:

- County fire rate per 1,000 population in 1998: 6.37

2.05 Hazard Material Incidents - Fixed Site (including industrial accidents):

- No incidents identified; SARA Title III Sites in Oceana County in 2012: 83.

2.06 Hazard Material Incidents - Transportation: - None Identified.

2.07 Infrastructure Failure:

- Number of NCDC with mention of downed power lines or power outages in Oceana County, 1993-2012: 32
- January 20, 1994: Frozen sewer/water lines and downed power lines (extreme cold), statewide.
- 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: 90,000 without power statewide (thunderstorm winds).
- May 31, 1998: over 861,000 without power (thunderstorm winds), statewide.
- November 10, 1998: 167,000 power outages (high wind), West Michigan.
- April 3, 2003: Hundreds of thousands lose power (ice storm), Lower Michigan.
- October 10, 2004: 100,000 without power (high wind), statewide.
- December 28, 2008: Hundreds of thousands lose power (high wind), statewide.

2.08 Nuclear Power Plant Emergencies: - None Identified.

2.09 Oil and Natural Gas Well Accidents: - No accidents identified.

- Oil and gas wells in Oceana County in 2012: 1,188

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.

NEW ERA VILLAGE

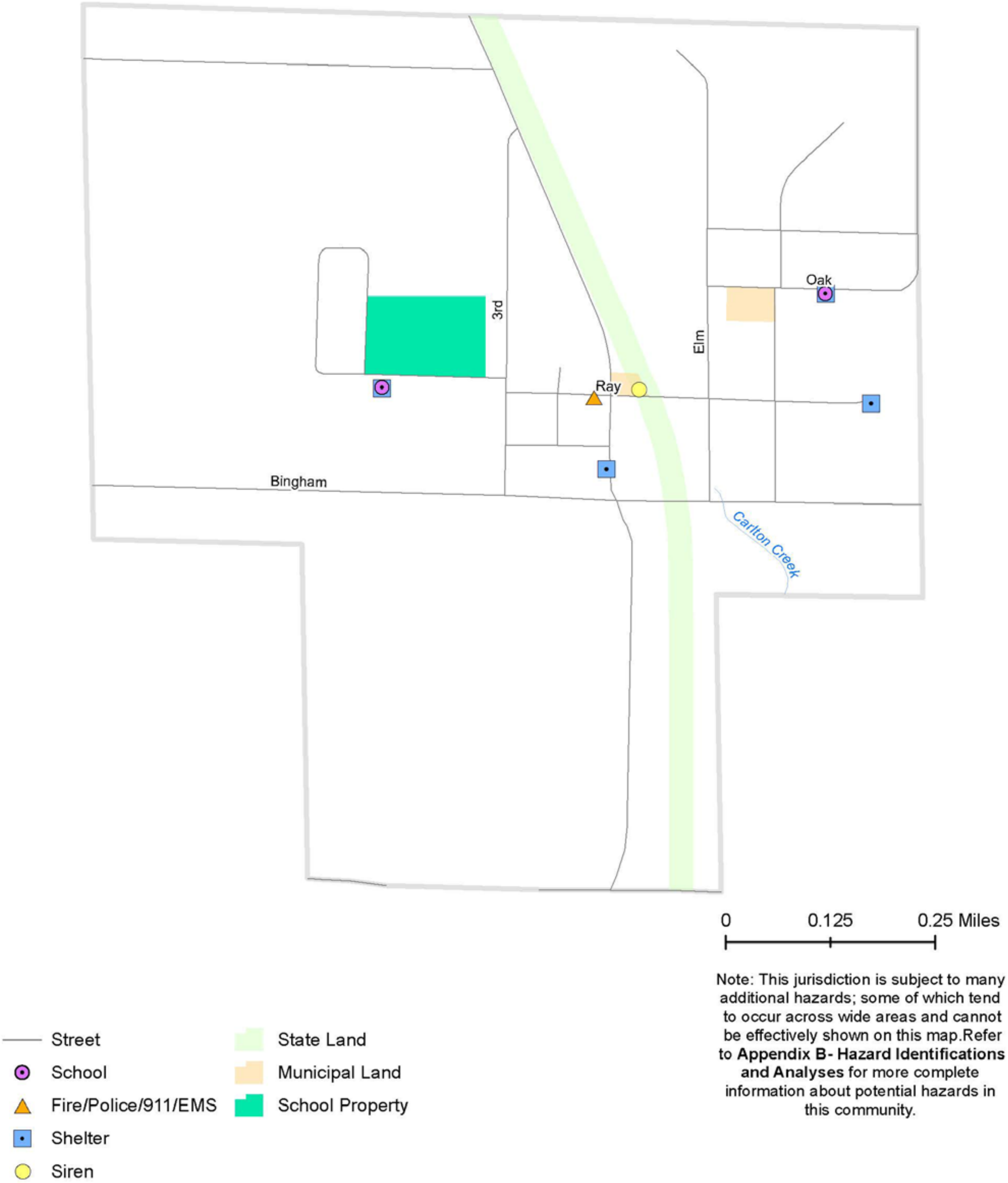
Hazard Assessment
Ratings

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

NEW ERA VILLAGE
Hazard Vulnerability Rankings

Ranking	Hazard	Probability of Occurrence	X	Weighted Impacts	=	Hazard Score
1	Winter Storms	3		15		45
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
n/a	Dam Failure	0		-		-
n/a	Earthquake	0		-		-
n/a	Great Lakes Shoreline	0		-		-
n/a	Nuclear Attack	0		-		-
n/a	Nuclear Power Emergencies	0		-		-
n/a	Oil/Natural Gas Well Accidents	0		-		-

NEW ERA VILLAGE
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.

WMSRDC
WEST MICHIGAN SHORELINE REGIONAL DEVELOPMENT COMMISSION

Source: Michigan Geographic Data Library V 12b, Oceana Co. Hazard Mitigation Plan Update 2014

Hazard Identification Profile

Village of Pentwater

1. NATURAL HAZARDS

1.01 Celestial Impacts: - None Identified.

1.02 Drought:

- 12 recorded drought events in the area (including Lake, Mason, Muskegon, Newaygo, and Oceana counties) lasting eight months or greater: 1895-1896, 1899-1900, 1901-1902, 1909-1911, 1925-1926, 1930-1931, 1956-1957, 1962-1963, 1971-1972, 1976-1977, and 2002-2003.
- Summer 1871: Prolonged drought over much of the Great Lakes region.
- May-September, 1891: Drought devastated Michigan's lumber industry.
- 2013: Record "low" Lake Michigan water levels.

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.
- May 16, 1997: Record cold temperatures. $2m crop damage, Oceana County.
- March 2012: Record warm temperatures triggered early growing season. $209.8m crop damage across Michigan.

1.05 Flooding - Riverine/ Urban:

- September 10-19, 1986: Flooding. Declaration of major disaster by President.
- October 28, 1986: Flooding & heavy rain. Declaration of disaster by Governor.
- April 19, 1993: Flooding. $5m property damage across southern Lower Michigan.
- February 9-10, 2001: Flooding. $100k property damage, Oceana County.
- February 24-28, 2001: Flooding. $190k property damage across West Michigan.
- May 15-16, 2001: Flash flooding from severe thunderstorms. $550k property damage, $250k crop damage, Oceana Co.
- May 21-23, 2004: Flooding. $25m property damage and $4.6m crop damage across 23 counties in Lower Michigan.
- April 17-23, 2013: Flooding. $3m property damage, Oceana County.

1.06 Fog:

- January 11-13, 1995: Dense Fog. 4 traffic accident fatalities, school closures, and flight delays across Lower Michigan.

1.07 Great Lakes Shoreline Hazards:

- June 1986: Record high water level on Lake Michigan.
- Extreme high water levels in the Great Lakes: 1929, 1952, 1973, 1986, and 1997.
- 2013: Record low water level on Lake Michigan.
- Extreme low water levels in the Great Lakes: 1926, 1934, 1964, 2003, and 2013.
- Rip current incidents on Lake Michigan, 2002-2012: 77 fatalities, 230 rescues.
- ***July 13, 1938: Seiche/storm surge on Lake Michigan. 3 drowned in Holland, 1 in Muskegon, and 1 near Pentwater.***
- ***August 3, 2011: 13-year old girl died after being swept away by a rip current near the north pier in Pentwater.***

1.08 Hail:

- Severe hail events (1" or greater) recorded in Oceana County, 1996-2012: 11
- May 6, 2004: 0.88 inch hail. $20k property damage, $20k crop damage, Oceana County.

1.09 Invasive Species: - Invasive species exist in Oceana County; No significant events identified.

1.10 Lightning: - None Identified.

1.11 Severe Winds:

- August 20 - September 6, 1975: Rainstorms, high winds. Declaration of major disaster by President.
- April 6, 1997: High wind. $5m property damage across southwest Lower Michigan.
- May 31, 1998: Severe thunderstorms. Local, Gubernatorial, and Presidential disaster declarations. $4.m public damage, 37 injuries, 26 homes and 6 businesses destroyed, 1415 homes and 109 businesses damaged in Oceana Co.
- July 8, 1999: Severe thunderstorms. $20k property damage across Oceana 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 26, 2005: Severe thunderstorms. $15k property damage, Pentwater Village (Pentwater Twp).***
- July 17, 2006: Severe thunderstorms. $250k property damage, $50k crop damage, across Oceana County.
- ***August 1, 2006: Severe thunderstorms. $20k property damage across northwest Oceana County.***
- November 17, 2013: High wind. $75k property damage and power outages across Oceana County.

1.12 Subsidence: - None Identified.

1.13 Tornadoes: - None Identified.

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 12 wildfires and 60 acres burned per year on county lands under MDNR jurisdiction (346 total wildfires, 1,766.0 total acres burned).

1.15 Winter Storms:

- March 2-7, 1976: Ice storms. Declaration of major disaster by President.
- January 26-31, 1977: Blizzard, snowstorm. Declaration of emergency by President.
- January 26-27, 1978: Blizzard, snowstorm. Declaration of statewide emergency by President.
- 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.
- January 2-15, 1999: Blizzard, snowstorm. Declaration of emergency by President.
- April 3, 2003: Ice storm. $4.9m property damage throughout West Michigan.
- February 16, 2006: Ice storm. $1m property damage across Lower Michigan.

2. TECHNOLOGICAL HAZARDS

2.01 Dam Failure: - None Identified.

2.02 Energy Emergencies: - None Identified.

2.03 Fire - Scrap Tire: - None Identified; Approximate scrap tire inventory in Oceana County in 2012: 11,000.

2.04 Fire - Structural:

- County fire rate per 1,000 population in 1998: 6.37

2.05 Hazard Material Incidents - Fixed Site (including industrial accidents):

- No incidents identified; SARA Title III Sites in Oceana County in 2012: 83.

2.06 Hazard Material Incidents - Transportation: - None Identified.

2.07 Infrastructure Failure:

- Number of NCDC with mention of downed power lines or power outages in Oceana County, 1993-2012: 32
- January 20, 1994: Frozen sewer/water lines and downed power lines (extreme cold), statewide.
- 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:*** 90,000 without power statewide (thunderstorm winds). ***Power lines downed in Pentwater.***
- May 31, 1998: over 861,000 without power (thunderstorm winds), statewide.
- November 10, 1998: 167,000 power outages (high wind), West Michigan.
- April 3, 2003: Hundreds of thousands lose power (ice storm), Lower Michigan.
- October 10, 2004: 100,000 without power (high wind), statewide.
- December 28, 2008: Hundreds of thousands lose power (high wind), statewide.

2.08 Nuclear Power Plant Emergencies: - None Identified.

2.09 Oil and Natural Gas Well Accidents: - No accidents identified.

- Oil and gas wells in Oceana County in 2012: 1,188

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.

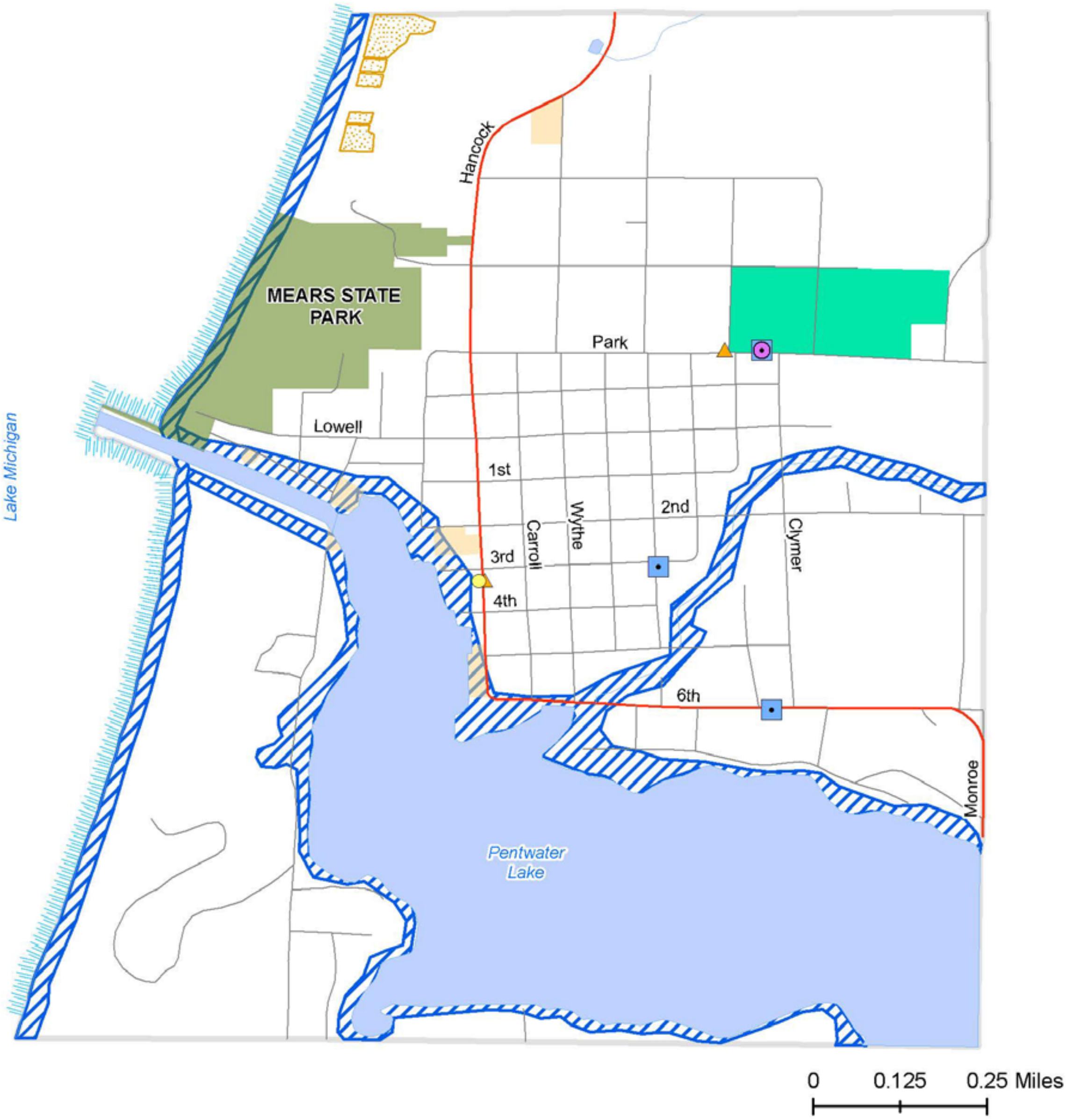
PENTWATER VILLAGE
Hazard Assessment
Ratings

Natural Hazards	Probability of Occurrence	Population Affected	Property Damaged	Economic Impacts
1.01 Celestial Impacts	1	2	0	2
1.02 Drought	2	2	2	3
1.03 Earthquake	0	-	-	-
1.04 Extreme Temperatures	3	2	1	2
1.05 Flooding: Riverine/Urban	3	1	2	1
1.06 Fog	3	1	0	1
1.07 Great Lakes Shoreline	3	1	2	1
1.08 Hail	2	2	2	1
1.09 Invasive Species	2	1	1	1
1.10 Lightning	3	1	2	1
1.11 Severe Winds	3	2	3	2
1.12 Subsidence	1	1	1	1
1.13 Tornadoes	1	3	2	2
1.14 Wildfire	2	2	2	2
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	3
2.03 Fire – Scrap Tires	1	1	1	1
2.04 Fire – Structural	3	1	2	2
2.05 HAZMAT – Fixed Site	1	1	1	2
2.06 HAZMAT – Transportation	1	1	1	2
2.07 Infrastructure Failures	3	3	1	2
2.08 Nuclear Power Emergencies	0	-	-	-
2.09 Oil/Natural Gas Well Accidents	0	-	-	-
2.10 Pipeline Accidents	1	1	1	2
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	3
3.05 Terrorism & Similar Criminal Acts	1	1	1	1

PENTWATER VILLAGE
Hazard Vulnerability Rankings

Ranking	Hazard	Probability of Occurrence	X	Weighted Impacts	=	Hazard Score
1	Winter Storms	3		15		45
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
n/a	Earthquake	0		-		-
n/a	Nuclear Attack	0		-		-
n/a	Nuclear Power Emergencies	0		-		-
n/a	Oil/Natural Gas Well Accidents	0		-		-

PENTWATER VILLAGE
Critical Facilities and Potential Hazards



- State Trunkline
- Street
- Great Lakes Shoreline Hazard
- Fire/Police/EMS/911
- School
- Shelter
- Siren
- State Land
- Municipal Land
- School Property
- High Risk Erosion Area
- Floodplain

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.

WEST MICHIGAN SHORELINE REGIONAL DEVELOPMENT COMMISSION

Source: Michigan Geographic Data Library V 12b, Oceana Co. Hazard Mitigation Plan Update 2014

Hazard Identification Profile

Village of Rothbury

1. NATURAL HAZARDS

1.01 Celestial Impacts: - None Identified.

1.02 Drought:

- 12 recorded drought events in the area (including Lake, Mason, Muskegon, Newaygo, and Oceana counties) lasting eight months or greater: 1895-1896, 1899-1900, 1901-1902, 1909-1911, 1925-1926, 1930-1931, 1956-1957, 1962-1963, 1971-1972, 1976-1977, and 2002-2003.
- Summer 1871: Prolonged drought over much of the Great Lakes region.
- May-September, 1891: Drought devastated Michigan's lumber industry.
- 2013: Record "low" Lake Michigan water levels.

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.
- May 16, 1997: Record cold temperatures. $2m crop damage, Oceana County.
- March 2012: Record warm temperatures triggered early growing season. $209.8m crop damage across Michigan.

1.05 Flooding - Riverine/ Urban:

- September 10-19, 1986: Flooding. Declaration of major disaster by President.
- October 28, 1986: Flooding & heavy rain. Declaration of disaster by Governor.
- April 19, 1993: Flooding. $5m property damage across southern Lower Michigan.
- February 9-10, 2001: Flooding. $100k property damage, Oceana County.
- February 24-28, 2001: Flooding. $190k property damage across West Michigan.
- May 15-16, 2001: Flash flooding from severe thunderstorms. $550k property damage, $250k crop damage, Oceana Co.
- May 21-23, 2004: Flooding. $25m property damage and $4.6m crop damage across 23 counties in Lower Michigan.
- April 17-23, 2013: Flooding. $3m property damage, Oceana County.

1.06 Fog:

- January 11-13, 1995: Dense Fog. 4 traffic accident fatalities, 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 Oceana County, 1996-2012: 11
- May 6, 2004: 0.88 inch hail. $20k property damage, $20k crop damage, Oceana County.

1.09 Invasive Species: - Invasive species exist in Oceana County; No significant events identified.

1.10 Lightning: - None Identified.

1.11 Severe Winds:

- August 20 - September 6, 1975: Rainstorms, high winds. Declaration of major disaster by President.
- April 6, 1997: High wind. $5m property damage across southwest Lower Michigan.
- May 31, 1998: Severe thunderstorms. Local, Gubernatorial, and Presidential disaster declarations. $4.m public damage, 37 injuries, 26 homes and 6 businesses destroyed, 1415 homes and 109 businesses damaged in Oceana Co.
- July 8, 1999: Severe thunderstorms. $20k property damage across Oceana 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 17, 2006: Severe thunderstorms. $250k property damage, $50k crop damage, across Oceana County.
- November 17, 2013: High wind. $75k property damage and power outages across Oceana County.

1.12 Subsidence: - None Identified.

1.13 Tornadoes: - None Identified.

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 12 wildfires and 60 acres burned per year on county lands under MDNR jurisdiction (346 total wildfires, 1,766.0 total acres burned).

1.15 Winter Storms:

- March 2-7, 1976: Ice storms. Declaration of major disaster by President.
- January 26-31, 1977: Blizzard, snowstorm. Declaration of emergency by President.
- January 26-27, 1978: Blizzard, snowstorm. Declaration of statewide emergency by President.
- 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.

- January 2-15, 1999: Blizzard, snowstorm. Declaration of emergency by President.
- April 3, 2003: Ice storm. $4.9m property damage throughout West Michigan.
- February 16, 2006: Ice storm. $1m property damage across Lower Michigan.

2. TECHNOLOGICAL HAZARDS

2.01 Dam Failure: - None Identified.

2.02 Energy Emergencies: - None Identified.

2.03 Fire - Scrap Tire: - None Identified; Approximate scrap tire inventory in Oceana County in 2012: 11,000.

2.04 Fire - Structural:

- County fire rate per 1,000 population in 1998: 6.37

2.05 Hazard Material Incidents - Fixed Site (including industrial accidents):

- No incidents identified; SARA Title III Sites in Oceana County in 2012: 83.

2.06 Hazard Material Incidents - Transportation: - None Identified.

2.07 Infrastructure Failure:

- Number of NCDC with mention of downed power lines or power outages in Oceana County, 1993-2012: 32
- January 20, 1994: Frozen sewer/water lines and downed power lines (extreme cold), statewide.
- 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: 90,000 without power statewide (thunderstorm winds).
- May 31, 1998: over 861,000 without power (thunderstorm winds), statewide.
- November 10, 1998: 167,000 power outages (high wind), West Michigan.
- April 3, 2003: Hundreds of thousands lose power (ice storm), Lower Michigan.
- October 10, 2004: 100,000 without power (high wind), statewide.
- December 28, 2008: Hundreds of thousands lose power (high wind), statewide.

2.08 Nuclear Power Plant Emergencies: - None Identified.

2.09 Oil and Natural Gas Well Accidents: - No accidents identified.

- Oil and gas wells in Oceana County in 2012: 1,188

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.

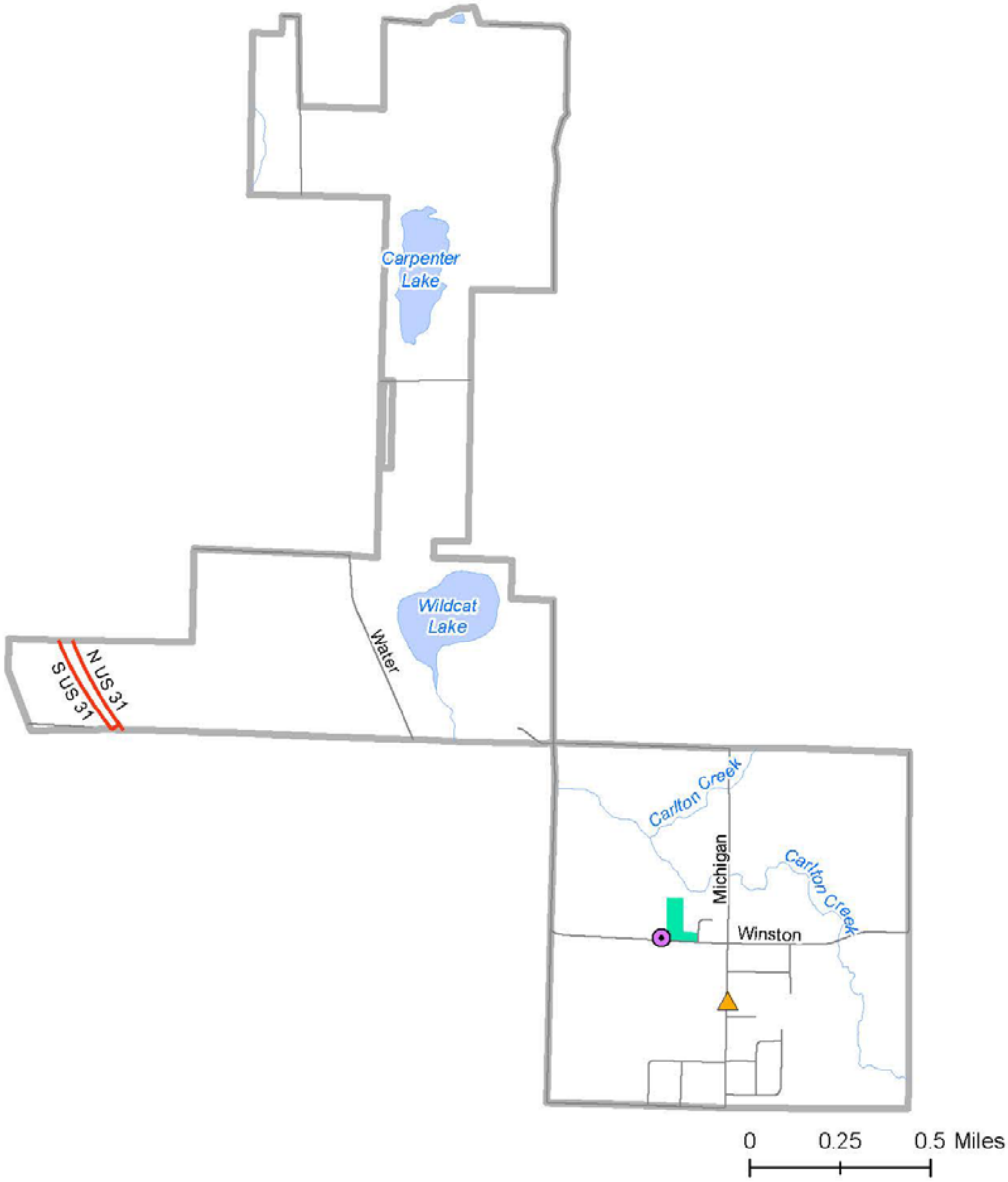
ROTHBURY VILLAGE
Hazard Assessment
Ratings

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

ROTHBURY VILLAGE
Hazard Vulnerability
Rankings

Ranking	Hazard	Probability of Occurrence	X	Weighted Impacts	=	Hazard Score
1	Winter Storms	3		15		45
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
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
n/a	Dam Failure	0		-		-
n/a	Earthquake	0		-		-
n/a	Great Lakes Shoreline	0		-		-
n/a	Nuclear Attack	0		-		-
n/a	Nuclear Power Emergencies	0		-		-

ROTHBURY VILLAGE
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
- Fire/Police/EMS/911
- School
- School Property

WMSRDC
WEST MICHIGAN SHORELINE REGIONAL DEVELOPMENT COMMISSION

Source: Michigan Geographic Data Library V 12b, Oceana Co. Hazard Mitigation Plan Update 2014

Hazard Identification Profile
Village of Shelby

1. NATURAL HAZARDS

1.01 Celestial Impacts: - None Identified.

1.02 Drought:
- 12 recorded drought events in the area (including Lake, Mason, Muskegon, Newaygo, and Oceana counties) lasting eight months or greater: 1895-1896, 1899-1900, 1901-1902, 1909-1911, 1925-1926, 1930-1931, 1956-1957, 1962-1963, 1971-1972, 1976-1977, and 2002-2003.
- Summer 1871: Prolonged drought over much of the Great Lakes region.
- May-September, 1891: Drought devastated Michigan's lumber industry.
- 2013: Record "low" Lake Michigan water levels.

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.
- May 16, 1997: Record cold temperatures. $2m crop damage, Oceana County.
- March 2012: Record warm temperatures triggered early growing season. $209.8m crop damage across Michigan.

1.05 Flooding - Riverine/ Urban:
- September 10-19, 1986: Flooding. Declaration of major disaster by President.
- October 28, 1986: Flooding & heavy rain. Declaration of disaster by Governor.
- April 19, 1993: Flooding. $5m property damage across southern Lower Michigan.
- February 9-10, 2001: Flooding. $100k property damage, Oceana County.
- February 24-28, 2001: Flooding. $190k property damage across West Michigan.
- May 15-16, 2001: Flash flooding from severe thunderstorms. $550k property damage, $250k crop damage, Oceana Co.
- May 21-23, 2004: Flooding. $25m property damage and $4.6m crop damage across 23 counties in Lower Michigan.
- April 17-23, 2013: Flooding. $3m property damage, Oceana County.

1.06 Fog:
- January 11-13, 1995: Dense Fog. 4 traffic accident fatalities, 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 Oceana County, 1996-2012: 11
- May 6, 2004: 0.88 inch hail. $20k property damage, $20k crop damage, Oceana County.

1.09 Invasive Species: - Invasive species exist in Oceana County; No significant events identified.

1.10 Lightning: - None Identified.

1.11 Severe Winds:
- August 20 - September 6, 1975: Rainstorms, high winds. Declaration of major disaster by President.
- April 6, 1997: High wind. $5m property damage across southwest Lower Michigan.
- May 31, 1998: Severe thunderstorms. Local, Gubernatorial, and Presidential disaster declarations. $4.m public damage, 37 injuries, 26 homes and 6 businesses destroyed, 1415 homes and 109 businesses damaged in Oceana Co.
- July 8, 1999: Severe thunderstorms. $20k property damage across Oceana 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 17, 2006: Severe thunderstorms. $250k property damage, $50k crop damage, across Oceana County.
- November 17, 2013: High wind. $75k property damage and power outages across Oceana County.

1.12 Subsidence: - None Identified.

1.13 Tornadoes: - None Identified.

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 12 wildfires and 60 acres burned per year on county lands under MDNR jurisdiction (346 total wildfires, 1,766.0 total acres burned).

1.15 Winter Storms:
- March 2-7, 1976: Ice storms. Declaration of major disaster by President.
- January 26-31, 1977: Blizzard, snowstorm. Declaration of emergency by President.
- January 26-27, 1978: Blizzard, snowstorm. Declaration of statewide emergency by President.
- 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.
- January 2-15, 1999: Blizzard, snowstorm. Declaration of emergency by President.

- April 3, 2003: Ice storm. $4.9m property damage throughout West Michigan.
- February 16, 2006: Ice storm. $1m property damage across Lower Michigan.

2. TECHNOLOGICAL HAZARDS

2.01 Dam Failure:
- September 1986: Hart Hydro-Electric Dam, Hesperia Pond Dam spillway, Crystal Valley Dam spillway erosion.

2.02 Energy Emergencies: - None Identified.

2.03 Fire - Scrap Tire: - None Identified; Approximate scrap tire inventory in Oceana County in 2012: 11,000.

2.04 Fire - Structural:
- County fire rate per 1,000 population in 1998: 6.37
- ***June 12, 2012: Fire destroyed historic buildings in downtown Shelby, including apartment units and businesses.***

2.05 Hazard Material Incidents - Fixed Site (including industrial accidents):
- No incidents identified; SARA Title III Sites in Oceana County in 2012: 83.

2.06 Hazard Material Incidents - Transportation: - None Identified.

2.07 Infrastructure Failure:
- Number of NCDC with mention of downed power lines or power outages in Oceana County, 1993-2012: 32
- January 20, 1994: Frozen sewer/water lines and downed power lines (extreme cold), statewide.
- 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: 90,000 without power statewide (thunderstorm winds).
- May 31, 1998: over 861,000 without power (thunderstorm winds), statewide.
- November 10, 1998: 167,000 power outages (high wind), West Michigan.
- April 3, 2003: Hundreds of thousands lose power (ice storm), Lower Michigan.
- October 10, 2004: 100,000 without power (high wind), statewide.
- December 28, 2008: Hundreds of thousands lose power (high wind), statewide.

2.08 Nuclear Power Plant Emergencies: - None Identified.

2.09 Oil and Natural Gas Well Accidents: - No accidents identified.
- Oil and gas wells in Oceana County in 2012: 1,188

2.10 Pipeline Accidents:
- ***March 5, 2010: Damage to residential gas meter causing natural gas leak. Minor neighborhood evacuations and temporary relocation of schoolchildren, Shelby Village.***

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.

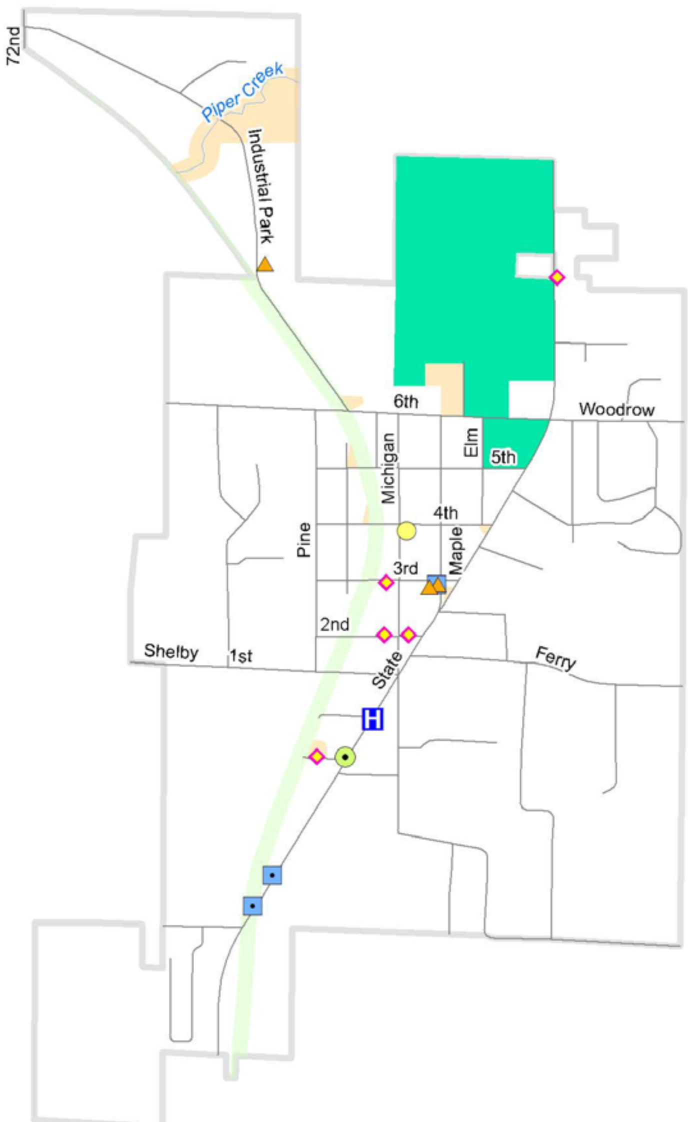
3.05 Terrorism and Similar Criminal Activities: - None Identified.

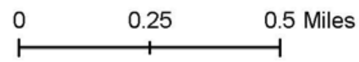
SHELBY VILLAGE
Hazard Assessment
Ratings

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

SHELBY VILLAGE Hazard Vulnerability Rankings				
Ranking	Hazard	Probability of Occurrence X	Weighted Impacts =	Hazard Score
1	Winter Storms	3	15	45
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
n/a	Dam Failure	0	-	-
n/a	Earthquake	0	-	-
n/a	Great Lakes Shoreline	0	-	-
n/a	Nuclear Attack	0	-	-
n/a	Nuclear Power Emergencies	0	-	-
n/a	Oil/Natural Gas Well Accidents	0	-	-

SHELBY VILLAGE
Critical Facilities and Potential Hazards





- Street
- SARA Title III Site
- Fire/Police/EMS/911
- Shelter
- Hospital
- Medical Facility
- Siren
- State Land
- Municipal Land
- School Property

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, Oceana County Hazard Mitigation Plan Update 2014

Hazard Identification Profile

Village of Walkerville

1. NATURAL HAZARDS

1.01 Celestial Impacts: - None Identified.

1.02 Drought:

- 12 recorded drought events in the area (including Lake, Mason, Muskegon, Newaygo, and Oceana counties) lasting eight months or greater: 1895-1896, 1899-1900, 1901-1902, 1909-1911, 1925-1926, 1930-1931, 1956-1957, 1962-1963, 1971-1972, 1976-1977, and 2002-2003.
- Summer 1871: Prolonged drought over much of the Great Lakes region.
- May-September, 1891: Drought devastated Michigan's lumber industry.
- 2013: Record "low" Lake Michigan water levels.

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.
- May 16, 1997: Record cold temperatures. $2m crop damage, Oceana County.
- March 2012: Record warm temperatures triggered early growing season. $209.8m crop damage across Michigan.

1.05 Flooding - Riverine/ Urban:

- September 10-19, 1986: Flooding. Declaration of major disaster by President.
- October 28, 1986: Flooding & heavy rain. Declaration of disaster by Governor.
- April 19, 1993: Flooding. $5m property damage across southern Lower Michigan.
- February 9-10, 2001: Flooding. $100k property damage, Oceana County.
- February 24-28, 2001: Flooding. $190k property damage across West Michigan.
- May 15-16, 2001: Flash flooding from severe thunderstorms. $550k property damage, $250k crop damage, Oceana Co.
- May 21-23, 2004: Flooding. $25m property damage and $4.6m crop damage across 23 counties in Lower Michigan.
- April 17-23, 2013: Flooding. $3m property damage, Oceana County.

1.06 Fog:

- January 11-13, 1995: Dense Fog. 4 traffic accident fatalities, 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 Oceana County, 1996-2012: 11
- ***July 13, 2000: 1.75 inch hail. $50k property damage, $25k crop damage, Walkerville Village (Leavitt Twp).***
- May 6, 2004: 0.88 inch hail. $20k property damage, $20k crop damage, Oceana County.

1.09 Invasive Species: - Invasive species exist in Oceana County; No significant events identified.

1.10 Lightning: - None Identified.

1.11 Severe Winds:

- August 20 - September 6, 1975: Rainstorms, high winds. Declaration of major disaster by President.
- ***July 15, 1995: Severe thunderstorms. $15k property damage, Walkerville Village (Leavitt Twp).***
- April 6, 1997: High wind. $5m property damage across southwest Lower Michigan.
- May 31, 1998: Severe thunderstorms. Local, Gubernatorial, and Presidential disaster declarations. $4.m public damage, 37 injuries, 26 homes and 6 businesses destroyed, 1415 homes and 109 businesses damaged in Oceana Co.
- July 8, 1999: Severe thunderstorms. $20k property damage across Oceana 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 17, 2006: Severe thunderstorms. $250k property damage, $50k crop damage, across Oceana County.
- November 17, 2013: High wind. $75k property damage and power outages across Oceana County.

1.12 Subsidence: - None Identified.

1.13 Tornadoes: - None Identified.

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 12 wildfires and 60 acres burned per year on county lands under MDNR jurisdiction (346 total wildfires, 1,766.0 total acres burned).

1.15 Winter Storms:

- March 2-7, 1976: Ice storms. Declaration of major disaster by President.
- January 26-31, 1977: Blizzard, snowstorm. Declaration of emergency by President.
- January 26-27, 1978: Blizzard, snowstorm. Declaration of statewide emergency by President.
- 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.
- January 2-15, 1999: Blizzard, snowstorm. Declaration of emergency by President.
- April 3, 2003: Ice storm. $4.9m property damage throughout West Michigan.
- February 16, 2006: Ice storm. $1m property damage across Lower Michigan.

2. TECHNOLOGICAL HAZARDS

2.01 Dam Failure: - None Identified.

2.02 Energy Emergencies: - None Identified.

2.03 Fire - Scrap Tire: - None Identified; Approximate scrap tire inventory in Oceana County in 2012: 11,000.

2.04 Fire - Structural:

- County fire rate per 1,000 population in 1998: 6.37
- ***Major fires in the Village of Walkerville: May 1891, 1914, and in the 1940"s.***

2.05 Hazard Material Incidents - Fixed Site (including industrial accidents):

- No incidents identified; SARA Title III Sites in Oceana County in 2012: 83.

2.06 Hazard Material Incidents - Transportation: - None Identified.

2.07 Infrastructure Failure:

- Number of NCDC with mention of downed power lines or power outages in Oceana County, 1993-2012: 32
- January 20, 1994: Frozen sewer/water lines and downed power lines (extreme cold), statewide.
- 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: 90,000 without power statewide (thunderstorm winds).
- May 31, 1998: over 861,000 without power (thunderstorm winds), statewide.
- November 10, 1998: 167,000 power outages (high wind), West Michigan.
- April 3, 2003: Hundreds of thousands lose power (ice storm), Lower Michigan.
- October 10, 2004: 100,000 without power (high wind), statewide.
- December 28, 2008: Hundreds of thousands lose power (high wind), statewide.

2.08 Nuclear Power Plant Emergencies: - None Identified.

2.09 Oil and Natural Gas Well Accidents: - No accidents identified.

- Oil and gas wells in Oceana County in 2012: 1,188

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.

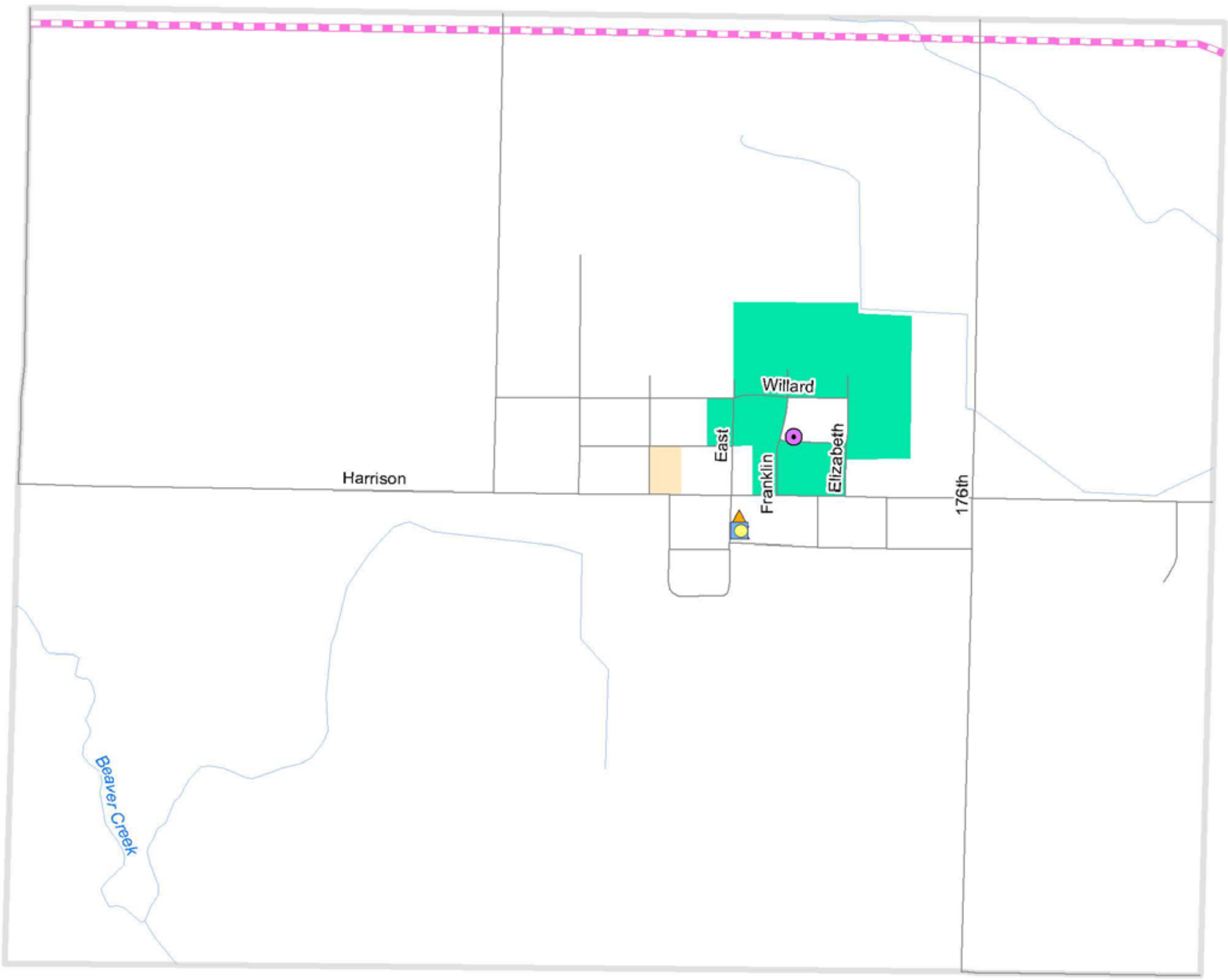
3.05 Terrorism and Similar Criminal Activities: - None Identified.

WALKERVILLE VILLAGE
Hazard Assessment
Ratings

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

WALKERVILLE VILLAGE Hazard Vulnerability Rankings				
Ranking	Hazard	Probability of Occurrence X	Weighted Impacts =	Hazard Score
1	Winter Storms	3	15	45
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
n/a	Dam Failure	0	-	-
n/a	Earthquake	0	-	-
n/a	Great Lakes Shoreline	0	-	-
n/a	Nuclear Attack	0	-	-
n/a	Nuclear Power Emergencies	0	-	-
n/a	Pipeline Accidents	0	-	-

WALKERVILLE VILLAGE
Critical Facilities 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
Power Line
Shelter
School
Fire/Police/EMS/911
Siren
Municipal Land
School Property

WEST MICHIGAN SHORELINE REGIONAL DEVELOPMENT COMMISSION

Source: Michigan Geographic Data Library V 12b, Oceana Co. Hazard Mitigation Plan Update 2014

Hazard Identification Profile
Benona Township

1. NATURAL HAZARDS

1.01 Celestial Impacts: - None Identified.

1.02 Drought:
- 12 recorded drought events in the area (including Lake, Mason, Muskegon, Newaygo, and Oceana counties) lasting eight months or greater: 1895-1896, 1899-1900, 1901-1902, 1909-1911, 1925-1926, 1930-1931, 1956-1957, 1962-1963, 1971-1972, 1976-1977, and 2002-2003.
- Summer 1871: Prolonged drought over much of the Great Lakes region.
- May-September, 1891: Drought devastated Michigan's lumber industry.
- 2013: Record "low" Lake Michigan water levels.

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.
- May 16, 1997: Record cold temperatures. $2m crop damage, Oceana County.
- March 2012: Record warm temperatures triggered early growing season. $209.8m crop damage across Michigan.

1.05 Flooding - Riverine/ Urban:
- September 10-19, 1986: Flooding. Declaration of major disaster by President.
- October 28, 1986: Flooding & heavy rain. Declaration of disaster by Governor.
- April 19, 1993: Flooding. $5m property damage across southern Lower Michigan.
- February 9-10, 2001: Flooding. $100k property damage, Oceana County.
- February 24-28, 2001: Flooding. $190k property damage across West Michigan.
- May 15-16, 2001: Flash flooding from severe thunderstorms. $550k property damage, $250k crop damage, Oceana Co.
- May 21-23, 2004: Flooding. $25m property damage and $4.6m crop damage across 23 counties in Lower Michigan.
- April 17-23, 2013: Flooding. $3m property damage, Oceana County.

1.06 Fog:
- January 11-13, 1995: Dense Fog. 4 traffic accident fatalities, school closures, and flight delays across Lower Michigan.

1.07 Great Lakes Shoreline Hazards:
- June 1986: Record high water level on Lake Michigan.
- Extreme high water levels in the Great Lakes: 1929, 1952, 1973, 1986, and 1997.
- 2013: Record low water level on Lake Michigan.
- Extreme low water levels in the Great Lakes: 1926, 1934, 1964, 2003, and 2013.
- Rip current incidents on Lake Michigan, 2002-2012: 77 fatalities, 230 rescues.
- ***April 6, 1997: Beach erosion due to high winds reported at Stony Lake, Benona Twp.***

1.08 Hail:
- Severe hail events (1" or greater) recorded in Oceana County, 1996-2012: 11
- May 6, 2004: 0.88 inch hail. $20k property damage, $20k crop damage, Oceana County.

1.09 Invasive Species: - Invasive species exist in Oceana County; No significant events identified.

1.10 Lightning: - None Identified.

1.11 Severe Winds:
- August 20 - September 6, 1975: Rainstorms, high winds. Declaration of major disaster by President.
- April 6, 1997: High wind. $5m property damage across southwest Lower Michigan.
- May 31, 1998: Severe thunderstorms. Local, Gubernatorial, and Presidential disaster declarations. $4.m public damage, 37 injuries, 26 homes and 6 businesses destroyed, 1415 homes and 109 businesses damaged in Oceana Co.
- July 8, 1999: Severe thunderstorms. $20k property damage across Oceana 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 17, 2006: Severe thunderstorms. $250k property damage, $50k crop damage, across Oceana County.
- November 17, 2013: High wind. $75k property damage and power outages across Oceana County.

1.12 Subsidence: - None Identified.

1.13 Tornadoes: - None Identified.

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 12 wildfires and 60 acres burned per year on county lands under MDNR jurisdiction (346 total wildfires, 1,766.0 total acres burned).
- ***April 11, 2005: Wildfire. 17 acres burned, 2 houses/ 16 walkways destroyed, 5 houses damaged. Benona Twp.***

1.15 Winter Storms:

- March 2-7, 1976: Ice storms. Declaration of major disaster by President.
- January 26-31, 1977: Blizzard, snowstorm. Declaration of emergency by President.
- January 26-27, 1978: Blizzard, snowstorm. Declaration of statewide emergency by President.
- 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.
- January 2-15, 1999: Blizzard, snowstorm. Declaration of emergency by President.
- April 3, 2003: Ice storm. $4.9m property damage throughout West Michigan.
- February 16, 2006: Ice storm. $1m property damage across Lower Michigan.

2. TECHNOLOGICAL HAZARDS

2.01 Dam Failure: - None Identified.

2.02 Energy Emergencies: - None Identified.

2.03 Fire - Scrap Tire: - None Identified; Approximate scrap tire inventory in Oceana County in 2012: 11,000.

2.04 Fire - Structural:

- County fire rate per 1,000 population in 1998: 6.37

2.05 Hazard Material Incidents - Fixed Site (including industrial accidents):

- No incidents identified; SARA Title III Sites in Oceana County in 2012: 83.

2.06 Hazard Material Incidents - Transportation: - None Identified.

2.07 Infrastructure Failure:

- Number of NCDC with mention of downed power lines or power outages in Oceana County, 1993-2012: 32
- January 20, 1994: Frozen sewer/water lines and downed power lines (extreme cold), statewide.
- 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: 90,000 without power statewide (thunderstorm winds).
- May 31, 1998: over 861,000 without power (thunderstorm winds), statewide.
- November 10, 1998: 167,000 power outages (high wind), West Michigan.
- April 3, 2003: Hundreds of thousands lose power (ice storm), Lower Michigan.
- October 10, 2004: 100,000 without power (high wind), statewide.
- December 28, 2008: Hundreds of thousands lose power (high wind), statewide.

2.08 Nuclear Power Plant Emergencies: - None Identified.

2.09 Oil and Natural Gas Well Accidents: - No accidents identified.

- Oil and gas wells in Oceana County in 2012: 1,188
- ***3 wells with known detectable levels of hydrogen sulfide in Benona 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.

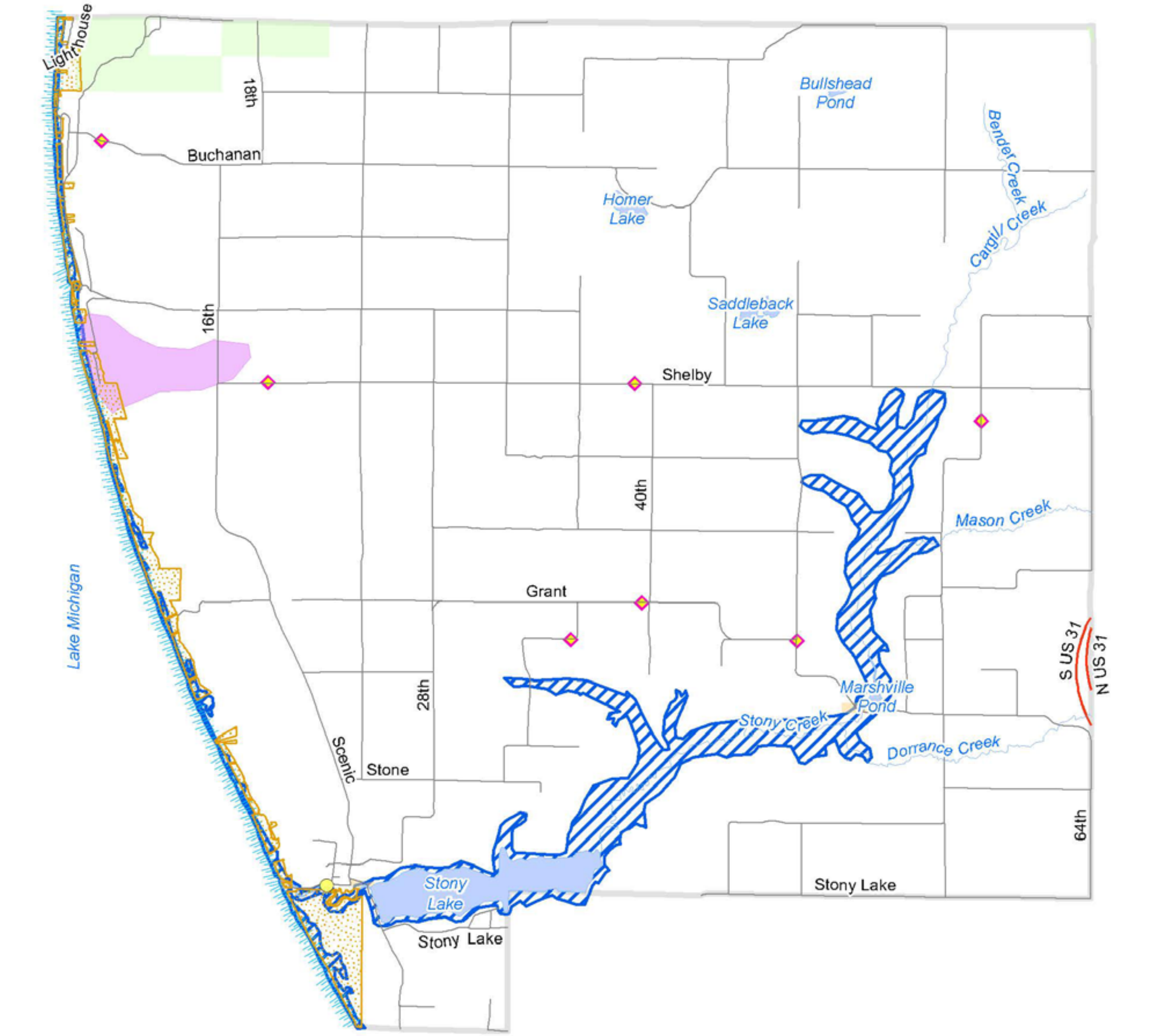
BENONA TOWNSHIP
Hazard Assessment
Ratings

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

BENONA TOWNSHIP
Hazard Vulnerability
Rankings

Ranking	Hazard	Probability of Occurrence	X	Weighted Impacts	=	Hazard Score
1	Winter Storms	3		15		45
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	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
n/a	Dam failure	0		-		-
n/a	Earthquake	0		-		-
n/a	Nuclear Attack	0		-		-
n/a	Nuclear Power Emergencies	0		-		-
n/a	Pipeline Accidents	0		-		-

BENONA TOWNSHIP
Critical Facilities and Potential Hazards



0 0.5 1 2 Miles

- State Trunkline
- Street
- Great Lakes Shoreline Hazard
- SARA Title III Site
- Siren
- State Land
- Municipal Land
- Oil/Gas Field
- High-Risk Erosion Area
- Floodplain

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, Oceana Co. Hazard Mitigation Plan Update 2014

Hazard Identification Profile
Claybanks Township

1. NATURAL HAZARDS

1.01 Celestial Impacts: - None Identified.

1.02 Drought:
- 12 recorded drought events in the area (including Lake, Mason, Muskegon, Newaygo, and Oceana counties) lasting eight months or greater: 1895-1896, 1899-1900, 1901-1902, 1909-1911, 1925-1926, 1930-1931, 1956-1957, 1962-1963, 1971-1972, 1976-1977, and 2002-2003.
- Summer 1871: Prolonged drought over much of the Great Lakes region.
- May-September, 1891: Drought devastated Michigan's lumber industry.
- 2013: Record "low" Lake Michigan water levels.

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.
- May 16, 1997: Record cold temperatures. $2m crop damage, Oceana County.
- March 2012: Record warm temperatures triggered early growing season. $209.8m crop damage across Michigan.

1.05 Flooding - Riverine/ Urban:
- September 10-19, 1986: Flooding. Declaration of major disaster by President.
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- April 19, 1993: Flooding. $5m property damage across southern Lower Michigan.
- February 9-10, 2001: Flooding. $100k property damage, Oceana County.
- February 24-28, 2001: Flooding. $190k property damage across West Michigan.
- May 15-16, 2001: Flash flooding from severe thunderstorms. $550k property damage, $250k crop damage, Oceana Co.
- May 21-23, 2004: Flooding. $25m property damage and $4.6m crop damage across 23 counties in Lower Michigan.
- April 17-23, 2013: Flooding. $3m property damage, Oceana County.

1.06 Fog:
- January 11-13, 1995: Dense Fog. 4 traffic accident fatalities, school closures, and flight delays across Lower Michigan.

1.07 Great Lakes Shoreline Hazards:
- June 1986: Record high water level on Lake Michigan.
- Extreme high water levels in the Great Lakes: 1929, 1952, 1973, 1986, and 1997.
- 2013: Record low water level on Lake Michigan.
- Extreme low water levels in the Great Lakes: 1926, 1934, 1964, 2003, and 2013.
- Rip current incidents on Lake Michigan, 2002-2012: 77 fatalities, 230 rescues.

1.08 Hail:
- Severe hail events (1" or greater) recorded in Oceana County, 1996-2012: 11
- May 6, 2004: 0.88 inch hail. $20k property damage, $20k crop damage, Oceana County.

1.09 Invasive Species: - Invasive species exist in Oceana County; No significant events identified.

1.10 Lightning: - None Identified.

1.11 Severe Winds:
- August 20 - September 6, 1975: Rainstorms, high winds. Declaration of major disaster by President.
- April 6, 1997: High wind. $5m property damage across southwest Lower Michigan.
- May 31, 1998: Severe thunderstorms. Local, Gubernatorial, and Presidential disaster declarations. $4.m public damage, 37 injuries, 26 homes and 6 businesses destroyed, 1415 homes and 109 businesses damaged in Oceana Co.
- July 8, 1999: Severe thunderstorms. $20k property damage across Oceana 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 17, 2006: Severe thunderstorms. $250k property damage, $50k crop damage, across Oceana County.
- November 17, 2013: High wind. $75k property damage and power outages across Oceana County.

1.12 Subsidence: - None Identified.

1.13 Tornadoes: - None Identified.

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 12 wildfires and 60 acres burned per year on county lands under MDNR jurisdiction (346 total wildfires, 1,766.0 total acres burned).

1.15 Winter Storms:
- March 2-7, 1976: Ice storms. Declaration of major disaster by President.
- January 26-31, 1977: Blizzard, snowstorm. Declaration of emergency by President.

- January 26-27, 1978: Blizzard, snowstorm. Declaration of statewide emergency by President.
- 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.
- January 2-15, 1999: Blizzard, snowstorm. Declaration of emergency by President.
- April 3, 2003: Ice storm. $4.9m property damage throughout West Michigan.
- February 16, 2006: Ice storm. $1m property damage across Lower Michigan.

2. TECHNOLOGICAL HAZARDS

2.01 Dam Failure: - None Identified.

2.02 Energy Emergencies: - None Identified.

2.03 Fire - Scrap Tire: - None Identified; Approximate scrap tire inventory in Oceana County in 2012: 11,000.

2.04 Fire - Structural:

- County fire rate per 1,000 population in 1998: 6.37

2.05 Hazard Material Incidents - Fixed Site (including industrial accidents):

- No incidents identified; SARA Title III Sites in Oceana County in 2012: 83.

2.06 Hazard Material Incidents - Transportation: - None Identified.

2.07 Infrastructure Failure:

- Number of NCDC with mention of downed power lines or power outages in Oceana County, 1993-2012: 32
- January 20, 1994: Frozen sewer/water lines and downed power lines (extreme cold), statewide.
- 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: 90,000 without power statewide (thunderstorm winds).
- May 31, 1998: over 861,000 without power (thunderstorm winds), statewide.
- November 10, 1998: 167,000 power outages (high wind), West Michigan.
- April 3, 2003: Hundreds of thousands lose power (ice storm), Lower Michigan.
- October 10, 2004: 100,000 without power (high wind), statewide.
- December 28, 2008: Hundreds of thousands lose power (high wind), statewide.

2.08 Nuclear Power Plant Emergencies: - None Identified.

2.09 Oil and Natural Gas Well Accidents: - No accidents identified.

- Oil and gas wells in Oceana County in 2012: 1,188
- ***20 wells with known detectable levels of hydrogen sulfide in Claybanks 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.

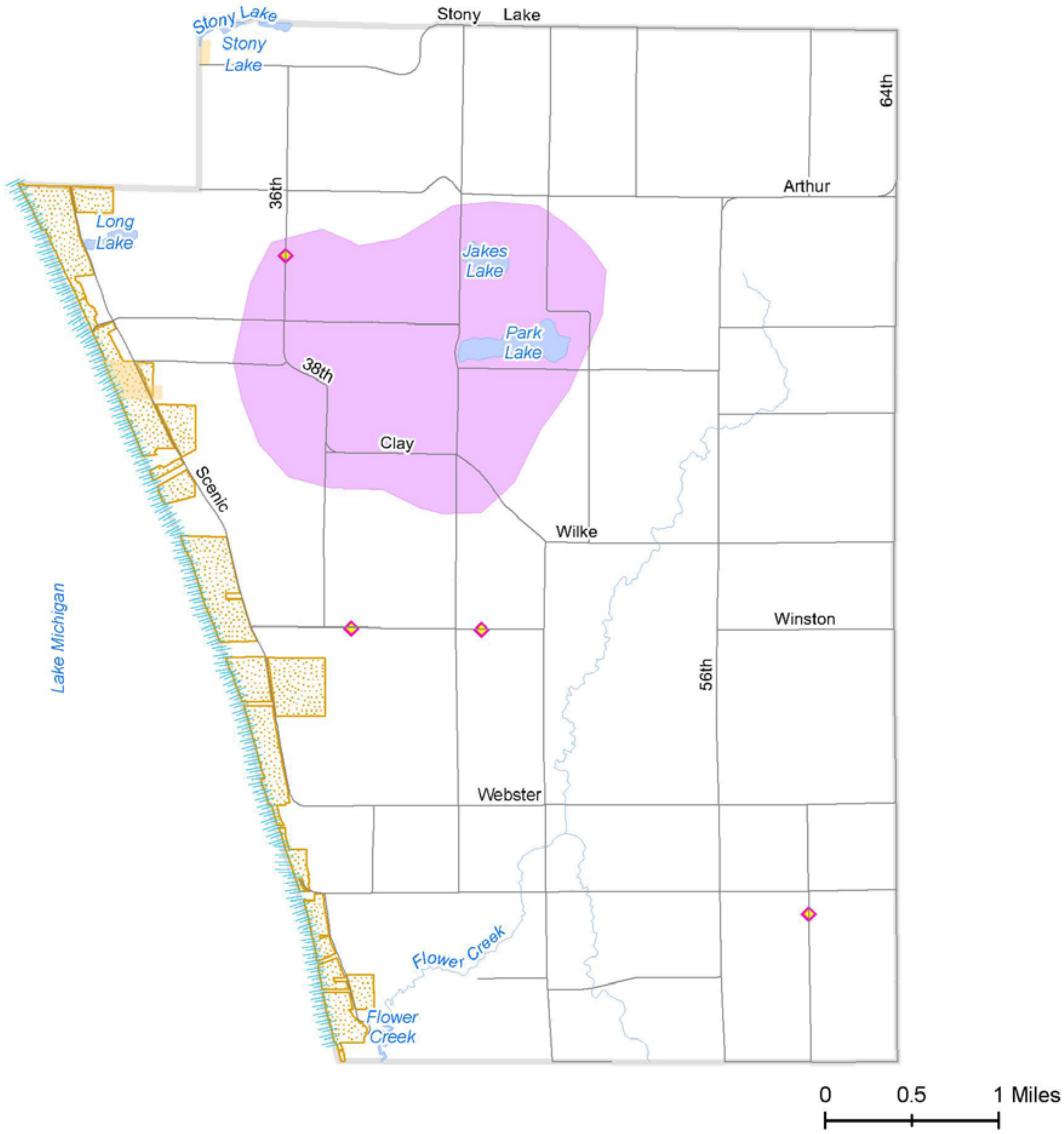
3.05 Terrorism and Similar Criminal Activities: - None Identified.

CLAYBANKS TOWNSHIP
Hazard Assessment Ratings

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

CLAYBANKS TOWNSHIP Hazard Vulnerability Rankings				
Ranking	Hazard	Probability of Occurrence X	Weighted Impacts =	Hazard Score
1	Winter Storms	3	15	45
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	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
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
n/a	Dam failure	0	-	-
n/a	Earthquake	0	-	-
n/a	Nuclear Attack	0	-	-
n/a	Nuclear Power Emergencies	0	-	-
n/a	Pipeline Accidents	0	-	-

CLAYBANKS TOWNSHIP
Critical Facilities and Potential Hazards



- Street
- Great Lakes Shoreline Hazard
- SARA Title III Sites
- Municipal Land
- Oil/Gas Field
- High-Risk Erosion Area

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, Oceana Co. Hazard Mitigation Plan Update 2014

Hazard Identification Profile
Colfax Township

1. NATURAL HAZARDS

1.01 Celestial Impacts: - None Identified.

1.02 Drought:
- 12 recorded drought events in the area (including Lake, Mason, Muskegon, Newaygo, and Oceana counties) lasting eight months or greater: 1895-1896, 1899-1900, 1901-1902, 1909-1911, 1925-1926, 1930-1931, 1956-1957, 1962-1963, 1971-1972, 1976-1977, and 2002-2003.
- Summer 1871: Prolonged drought over much of the Great Lakes region.
- May-September, 1891: Drought devastated Michigan's lumber industry.
- 2013: Record "low" Lake Michigan water levels.

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.
- May 16, 1997: Record cold temperatures. $2m crop damage, Oceana County.
- March 2012: Record warm temperatures triggered early growing season. $209.8m crop damage across Michigan.

1.05 Flooding - Riverine/ Urban:
- September 10-19, 1986: Flooding. Declaration of major disaster by President.
- October 28, 1986: Flooding & heavy rain. Declaration of disaster by Governor.
- April 19, 1993: Flooding. $5m property damage across southern Lower Michigan.
- February 9-10, 2001: Flooding. $100k property damage, Oceana County.
- February 24-28, 2001: Flooding. $190k property damage across West Michigan.
- May 15-16, 2001: Flash flooding from severe thunderstorms. $550k property damage, $250k crop damage, Oceana Co.
- May 21-23, 2004: Flooding. $25m property damage and $4.6m crop damage across 23 counties in Lower Michigan.
- April 17-23, 2013: Flooding. $3m property damage, Oceana County.

1.06 Fog:
- January 11-13, 1995: Dense Fog. 4 traffic accident fatalities, 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 Oceana County, 1996-2012: 11
- May 6, 2004: 0.88 inch hail. $20k property damage, $20k crop damage, Oceana County.

1.09 Invasive Species: - Invasive species exist in Oceana County; No significant events identified.

1.10 Lightning: - None Identified.

1.11 Severe Winds:
- August 20 - September 6, 1975: Rainstorms, high winds. Declaration of major disaster by President.
- April 6, 1997: High wind. $5m property damage across southwest Lower Michigan.
- May 31, 1998: Severe thunderstorms. Local, Gubernatorial, and Presidential disaster declarations. $4.m public damage, 37 injuries, 26 homes and 6 businesses destroyed, 1415 homes and 109 businesses damaged in Oceana Co.
- July 8, 1999: Severe thunderstorms. $20k property damage across Oceana 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 17, 2006: Severe thunderstorms. $250k property damage, $50k crop damage, across Oceana County.
- November 17, 2013: High wind. $75k property damage and power outages across Oceana County.

1.12 Subsidence: - None Identified.

1.13 Tornadoes: - None Identified.

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 12 wildfires and 60 acres burned per year on county lands under MDNR jurisdiction (346 total wildfires, 1,766.0 total acres burned).

1.15 Winter Storms:
- March 2-7, 1976: Ice storms. Declaration of major disaster by President.
- January 26-31, 1977: Blizzard, snowstorm. Declaration of emergency by President.
- January 26-27, 1978: Blizzard, snowstorm. Declaration of statewide emergency by President.
- 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.
- January 2-15, 1999: Blizzard, snowstorm. Declaration of emergency by President.

- April 3, 2003: Ice storm. $4.9m property damage throughout West Michigan.
- February 16, 2006: Ice storm. $1m property damage across Lower Michigan.

2. TECHNOLOGICAL HAZARDS

2.01 Dam Failure: - None Identified.

2.02 Energy Emergencies: - None Identified.

2.03 Fire - Scrap Tire: - None Identified; Approximate scrap tire inventory in Oceana County in 2012: 11,000.

2.04 Fire - Structural:
- County fire rate per 1,000 population in 1998: 6.37

2.05 Hazard Material Incidents - Fixed Site (including industrial accidents):
- No incidents identified; SARA Title III Sites in Oceana County in 2012: 83.

2.06 Hazard Material Incidents - Transportation: - None Identified.

2.07 Infrastructure Failure:
- Number of NCDC with mention of downed power lines or power outages in Oceana County, 1993-2012: 32
- January 20, 1994: Frozen sewer/water lines and downed power lines (extreme cold), statewide.
- 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: 90,000 without power statewide (thunderstorm winds).
- May 31, 1998: over 861,000 without power (thunderstorm winds), statewide.
- November 10, 1998: 167,000 power outages (high wind), West Michigan.
- April 3, 2003: Hundreds of thousands lose power (ice storm), Lower Michigan.
- October 10, 2004: 100,000 without power (high wind), statewide.
- December 28, 2008: Hundreds of thousands lose power (high wind), statewide.

2.08 Nuclear Power Plant Emergencies: - None Identified.

2.09 Oil and Natural Gas Well Accidents: - No accidents identified.
- Oil and gas wells in Oceana County in 2012: 1,188
- ***1 well with known detectable levels of hydrogen sulfide in Colfax 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.

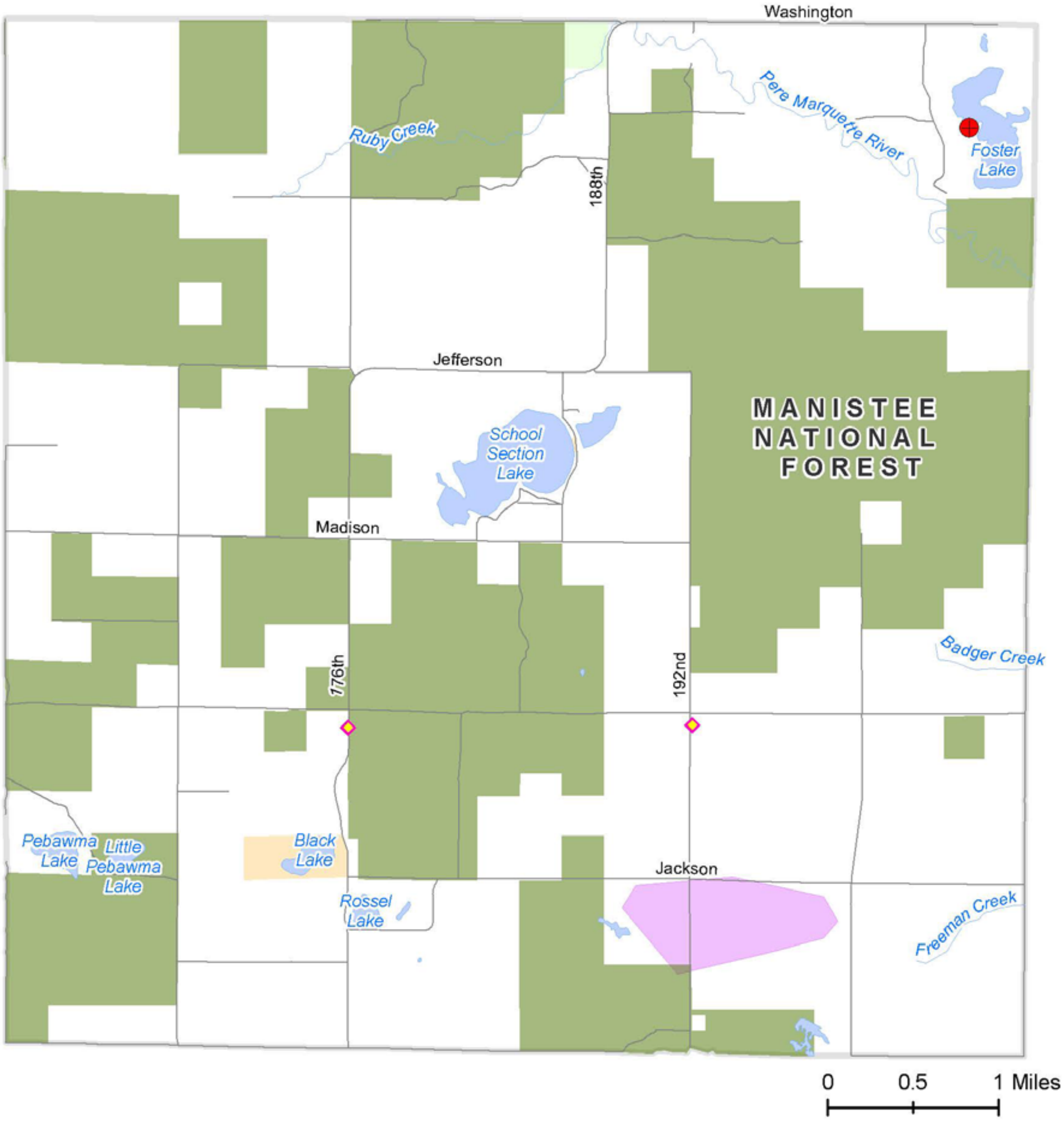
COLFAX TOWNSHIP
Hazard Assessment
Ratings

Natural Hazards	Probability of Occurrence	Population Affected	Property Damaged	Economic Impacts
1.01 Celestial Impacts	1	2	0	2
1.02 Drought	2	2	2	3
1.03 Earthquake	0	-	-	-
1.04 Extreme Temperatures	3	2	1	2
1.05 Flooding: Riverine/Urban	2	1	1	1
1.06 Fog	2	1	0	1
1.07 Great Lakes Shoreline	0	-	-	-
1.08 Hail	3	1	2	1
1.09 Invasive Species	2	1	2	2
1.10 Lightning	3	1	2	1
1.11 Severe Winds	3	2	3	2
1.12 Subsidence	1	1	1	1
1.13 Tornadoes	2	1	2	2
1.14 Wildfire	3	2	2	2
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	3
2.03 Fire – Scrap Tires	1	1	1	1
2.04 Fire – Structural	3	1	1	2
2.05 HAZMAT – Fixed Site	2	1	1	2
2.06 HAZMAT – Transportation	2	1	1	2
2.07 Infrastructure Failures	3	3	1	2
2.08 Nuclear Power Emergencies	0	-	-	-
2.09 Oil/Natural Gas Well Accidents	2	2	1	1
2.10 Pipeline Accidents	0	-	-	-
2.11 Transportation Accidents	1	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	3
3.05 Terrorism & Similar Criminal Acts	1	1	1	1

COLFAX TOWNSHIP
Hazard Vulnerability Rankings

Ranking	Hazard	Probability of Occurrence	X	Weighted Impacts	=	Hazard Score
1	Winter Storms	3		15		45
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
n/a	Earthquake	0		-		-
n/a	Great Lakes Shoreline	0		-		-
n/a	Nuclear Attack	0		-		-
n/a	Nuclear Power Emergencies	0		-		-
n/a	Pipeline Accidents	0		-		-

COLFAX TOWNSHIP
Critical Facilities and Potential Hazards



Street
Dam
Federal Land
State Land
Municipal 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, Oceana County Hazard Mitigation Plan Update 2014

Hazard Identification Profile
Crystal Township

1. NATURAL HAZARDS

1.01 Celestial Impacts: - None Identified.

1.02 Drought:
- 12 recorded drought events in the area (including Lake, Mason, Muskegon, Newaygo, and Oceana counties) lasting eight months or greater: 1895-1896, 1899-1900, 1901-1902, 1909-1911, 1925-1926, 1930-1931, 1956-1957, 1962-1963, 1971-1972, 1976-1977, and 2002-2003.
- Summer 1871: Prolonged drought over much of the Great Lakes region.
- May-September, 1891: Drought devastated Michigan’s lumber industry.
- 2013: Record “low” Lake Michigan water levels.

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.
- May 16, 1997: Record cold temperatures. $2m crop damage, Oceana County.
- March 2012: Record warm temperatures triggered early growing season. $209.8m crop damage across Michigan.

1.05 Flooding - Riverine/ Urban:
- September 10-19, 1986: Flooding. Declaration of major disaster by President.
- October 28, 1986: Flooding & heavy rain. Declaration of disaster by Governor.
- April 19, 1993: Flooding. $5m property damage across southern Lower Michigan.
- February 9-10, 2001: Flooding. $100k property damage, Oceana County.
- February 24-28, 2001: Flooding. $190k property damage across West Michigan.
- May 15-16, 2001: Flash flooding from severe thunderstorms. $550k property damage, $250k crop damage, Oceana Co.
- May 21-23, 2004: Flooding. $25m property damage and $4.6m crop damage across 23 counties in Lower Michigan.
- April 17-23, 2013: Flooding. $3m property damage, Oceana County.

1.06 Fog:
- January 11-13, 1995: Dense Fog. 4 traffic accident fatalities, 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 Oceana County, 1996-2012: 11
- May 6, 2004: 0.88 inch hail. $20k property damage, $20k crop damage, Oceana County.

1.09 Invasive Species: - Invasive species exist in Oceana County; No significant events identified.

1.10 Lightning: - None Identified.

1.11 Severe Winds:
- August 20 - September 6, 1975: Rainstorms, high winds. Declaration of major disaster by President.
- April 6, 1997: High wind. $5m property damage across southwest Lower Michigan.
- May 31, 1998: Severe thunderstorms. Local, Gubernatorial, and Presidential disaster declarations. $4.m public damage, 37 injuries, 26 homes and 6 businesses destroyed, 1415 homes and 109 businesses damaged in Oceana Co.
- July 8, 1999: Severe thunderstorms. $20k property damage across Oceana 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 17, 2006: Severe thunderstorms. $250k property damage, $50k crop damage, across Oceana County.
- November 17, 2013: High wind. $75k property damage and power outages across Oceana County.

1.12 Subsidence: - None Identified.

1.13 Tornadoes: - None Identified.

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 12 wildfires and 60 acres burned per year on county lands under MDNR jurisdiction (346 total wildfires, 1,766.0 total acres burned).

1.15 Winter Storms:
- March 2-7, 1976: Ice storms. Declaration of major disaster by President.
- January 26-31, 1977: Blizzard, snowstorm. Declaration of emergency by President.
- January 26-27, 1978: Blizzard, snowstorm. Declaration of statewide emergency by President.
- 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.
- January 2-15, 1999: Blizzard, snowstorm. Declaration of emergency by President.

- April 3, 2003: Ice storm. $4.9m property damage throughout West Michigan.
- February 16, 2006: Ice storm. $1m property damage across Lower Michigan.

2. TECHNOLOGICAL HAZARDS

2.01 Dam Failure:

- September 1986: Hart Hydro-Electric Dam, Hesperia Dam spillway erosion, ***Crystal Valley Dam spillway erosion***.

2.02 Energy Emergencies: - None Identified.

2.03 Fire - Scrap Tire: - None Identified; Approximate scrap tire inventory in Oceana County in 2012: 11,000.

2.04 Fire - Structural:

- County fire rate per 1,000 population in 1998: 6.37

2.05 Hazard Material Incidents - Fixed Site (including industrial accidents):

- SARA Title III Sites in Oceana County in 2012: 83.
- ***December 12, 2012: Explosion in a pig farm barn in Crystal Township; possibly caused by methane gas buildup.***

2.06 Hazard Material Incidents - Transportation: - None Identified.

2.07 Infrastructure Failure:

- Number of NCDC with mention of downed power lines or power outages in Oceana County, 1993-2012: 32
- January 20, 1994: Frozen sewer/water lines and downed power lines (extreme cold), statewide.
- 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: 90,000 without power statewide (thunderstorm winds).
- May 31, 1998: over 861,000 without power (thunderstorm winds), statewide.
- November 10, 1998: 167,000 power outages (high wind), West Michigan.
- April 3, 2003: Hundreds of thousands lose power (ice storm), Lower Michigan.
- October 10, 2004: 100,000 without power (high wind), statewide.
- December 28, 2008: Hundreds of thousands lose power (high wind), statewide.

2.08 Nuclear Power Plant Emergencies: - None Identified.

2.09 Oil and Natural Gas Well Accidents: - No accidents identified.

- Oil and gas wells in Oceana County in 2012: 1,188
- ***1 well with known detectable levels of hydrogen sulfide in Crystal 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.

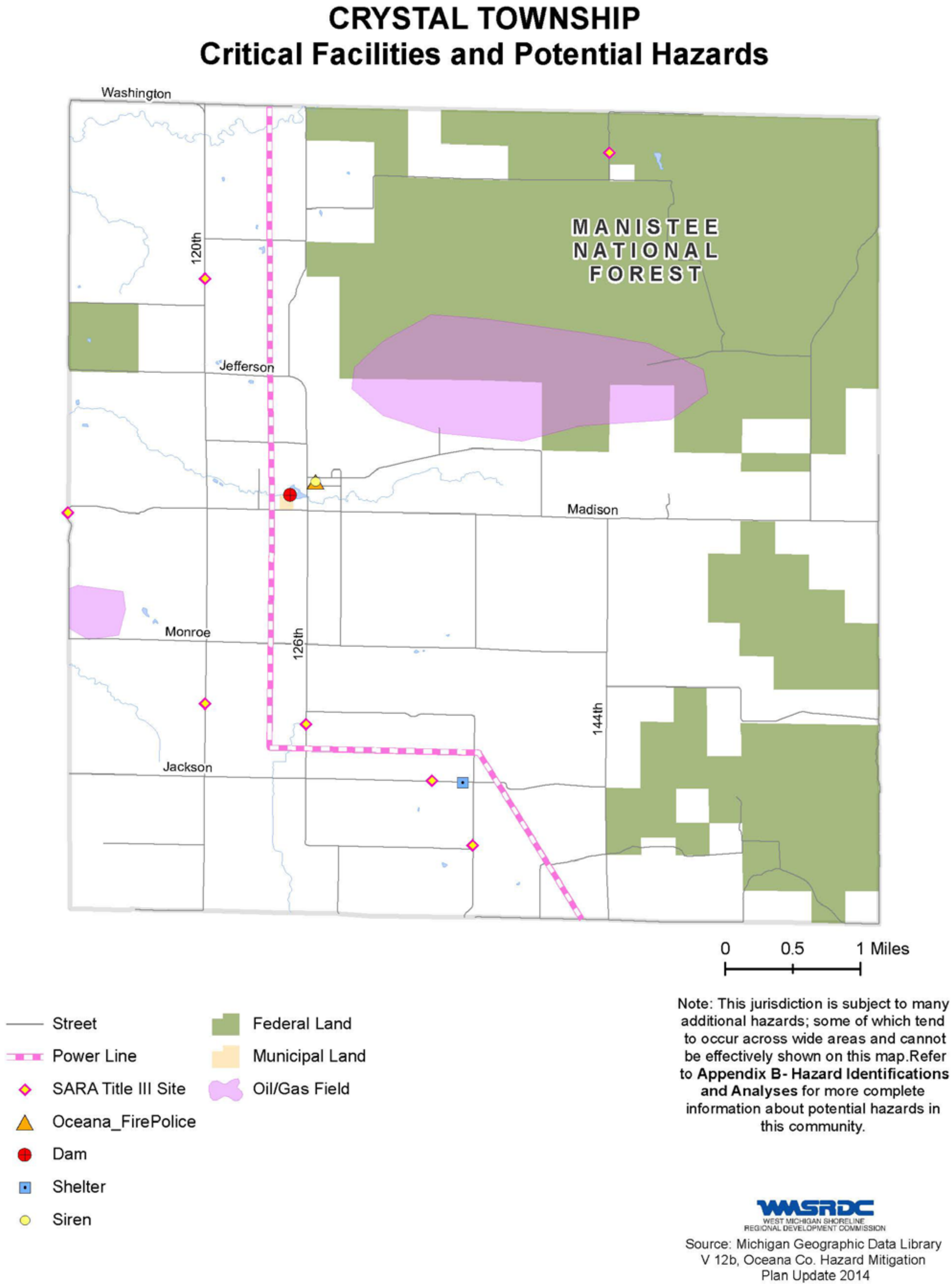
CRYSTAL TOWNSHIP

Hazard Assessment Ratings

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

CRYSTAL TOWNSHIP
Hazard Vulnerability Rankings

Ranking	Hazard	Probability of Occurrence	X	Weighted Impacts	=	Hazard Score
1	Winter Storms	3		15		45
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
n/a	Earthquake	0		-		-
n/a	Great Lakes Shoreline	0		-		-
n/a	Nuclear Attack	0		-		-
n/a	Nuclear Power Emergencies	0		-		-
n/a	Pipeline Accidents	0		-		-


CRYSTAL TOWNSHIP
Critical Facilities and Potential Hazards
Washington
120th
Jefferson
MANISTEE NATIONAL FOREST
Madison
Monroe
126th
144th
Jackson
0 0.5 1 Miles
Street
Power Line
SARA Title III Site
Oceana_FirePolice
Dam
Shelter
Siren
Federal Land
Municipal 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, Oceana Co. Hazard Mitigation Plan Update 2014

Hazard Identification Profile
Elbridge Township

1. NATURAL HAZARDS

1.01 Celestial Impacts: - None Identified.

1.02 Drought:

- 12 recorded drought events in the area (including Lake, Mason, Muskegon, Newaygo, and Oceana counties) lasting eight months or greater: 1895-1896, 1899-1900, 1901-1902, 1909-1911, 1925-1926, 1930-1931, 1956-1957, 1962-1963, 1971-1972, 1976-1977, and 2002-2003.
- Summer 1871: Prolonged drought over much of the Great Lakes region.
- May-September, 1891: Drought devastated Michigan's lumber industry.
- 2013: Record "low" Lake Michigan water levels.

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.
- May 16, 1997: Record cold temperatures. $2m crop damage, Oceana County.
- March 2012: Record warm temperatures triggered early growing season. $209.8m crop damage across Michigan.

1.05 Flooding - Riverine/ Urban:

- September 10-19, 1986: Flooding. Declaration of major disaster by President.
- October 28, 1986: Flooding & heavy rain. Declaration of disaster by Governor.
- April 19, 1993: Flooding. $5m property damage across southern Lower Michigan.
- February 9-10, 2001: Flooding. $100k property damage, Oceana County.
- February 24-28, 2001: Flooding. $190k property damage across West Michigan.
- May 15-16, 2001: Flash flooding from severe thunderstorms. $550k property damage, $250k crop damage, Oceana Co.
- May 21-23, 2004: Flooding. $25m property damage and $4.6m crop damage across 23 counties in Lower Michigan.
- April 17-23, 2013: Flooding. $3m property damage, Oceana County.

1.06 Fog:

- January 11-13, 1995: Dense Fog. 4 traffic accident fatalities, 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 Oceana County, 1996-2012: 11
- May 6, 2004: 0.88 inch hail. $20k property damage, $20k crop damage, Oceana County.

1.09 Invasive Species: - Invasive species exist in Oceana County; No significant events identified.

1.10 Lightning: - None Identified.

1.11 Severe Winds:

- August 20 - September 6, 1975: Rainstorms, high winds. Declaration of major disaster by President.
- April 6, 1997: High wind. $5m property damage across southwest Lower Michigan.
- May 31, 1998: Severe thunderstorms. Local, Gubernatorial, and Presidential disaster declarations. $4.m public damage, 37 injuries, 26 homes and 6 businesses destroyed, 1415 homes and 109 businesses damaged in Oceana Co.
- July 8, 1999: Severe thunderstorms. $20k property damage across Oceana 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 17, 2006: Severe thunderstorms. $250k property damage, $50k crop damage, across Oceana County.
- November 17, 2013: High wind. $75k property damage and power outages across Oceana County.

1.12 Subsidence: - None Identified.

1.13 Tornadoes: - None Identified.

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 12 wildfires and 60 acres burned per year on county lands under MDNR jurisdiction (346 total wildfires, 1,766.0 total acres burned).

1.15 Winter Storms:

- March 2-7, 1976: Ice storms. Declaration of major disaster by President.
- January 26-31, 1977: Blizzard, snowstorm. Declaration of emergency by President.
- January 26-27, 1978: Blizzard, snowstorm. Declaration of statewide emergency by President.
- 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.
- January 2-15, 1999: Blizzard, snowstorm. Declaration of emergency by President.
- April 3, 2003: Ice storm. $4.9m property damage throughout West Michigan.
- February 16, 2006: Ice storm. $1m property damage across Lower Michigan.

2. TECHNOLOGICAL HAZARDS

2.01 Dam Failure: - None Identified.

2.02 Energy Emergencies: - None Identified.

2.03 Fire - Scrap Tire: - None Identified; Approximate scrap tire inventory in Oceana County in 2012: 11,000.

2.04 Fire - Structural:
- County fire rate per 1,000 population in 1998: 6.37

2.05 Hazard Material Incidents - Fixed Site (including industrial accidents):
- No incidents identified; SARA Title III Sites in Oceana County in 2012: 83.

2.06 Hazard Material Incidents - Transportation: - None Identified.

2.07 Infrastructure Failure:
- Number of NCDC with mention of downed power lines or power outages in Oceana County, 1993-2012: 32
- January 20, 1994: Frozen sewer/water lines and downed power lines (extreme cold), statewide.
- 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: 90,000 without power statewide (thunderstorm winds).
- May 31, 1998: over 861,000 without power (thunderstorm winds), statewide.
- November 10, 1998: 167,000 power outages (high wind), West Michigan.
- April 3, 2003: Hundreds of thousands lose power (ice storm), Lower Michigan.
- October 10, 2004: 100,000 without power (high wind), statewide.
- December 28, 2008: Hundreds of thousands lose power (high wind), statewide.

2.08 Nuclear Power Plant Emergencies: - None Identified.

2.09 Oil and Natural Gas Well Accidents: - No accidents identified.
- Oil and gas wells in Oceana County in 2012: 1,188
- ***4 wells with known detectable levels of hydrogen sulfide in Elbridge 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.

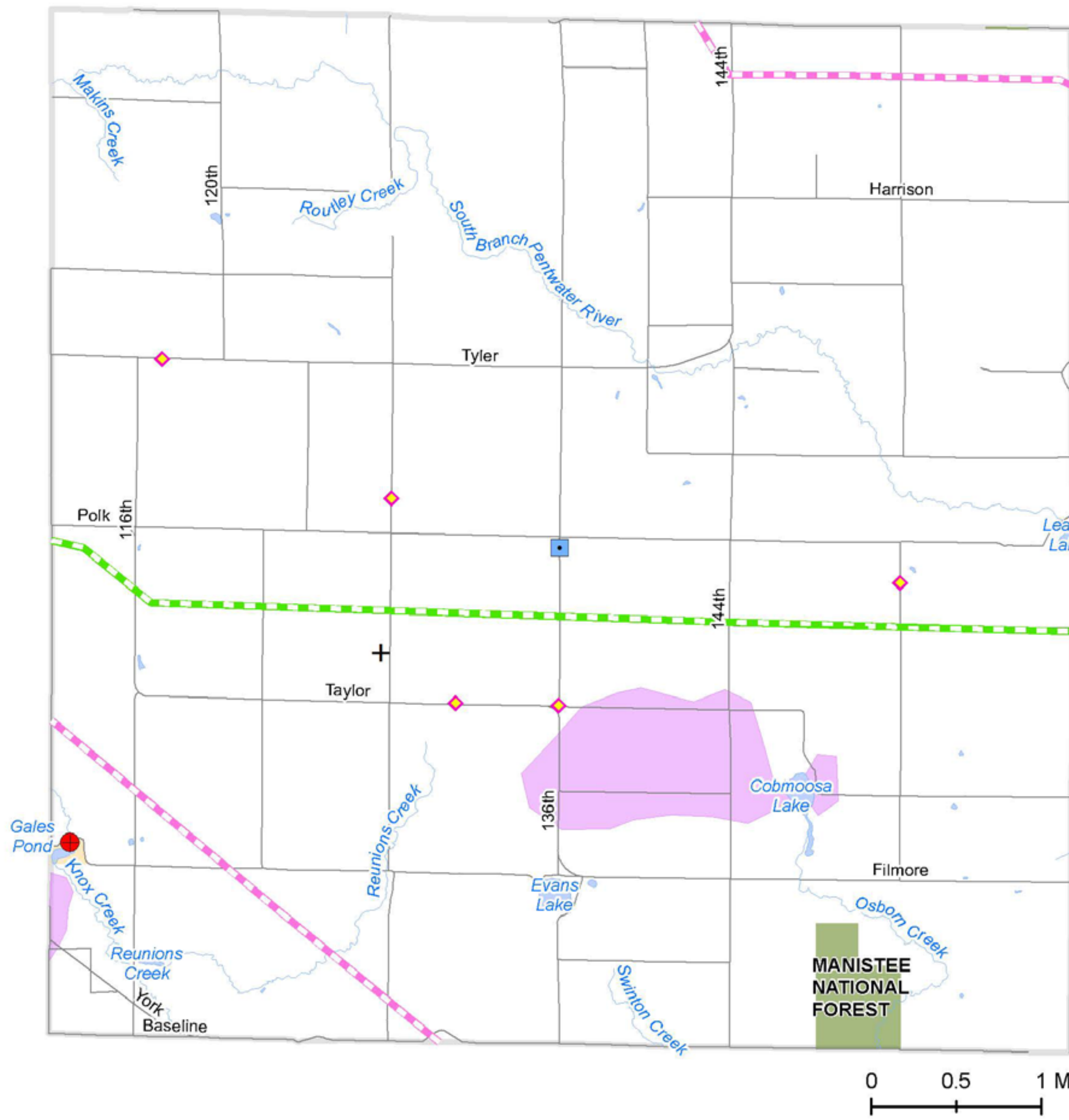
ELBRIDGE TOWNSHIP
Hazard Assessment
Ratings

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

ELBRIDGE TOWNSHIP
Hazard Vulnerability
Rankings

Ranking	Hazard	Probability of Occurrence X	Weighted Impacts =	Hazard Score
1	Winter Storms	3	15	45
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
n/a	Earthquake	0	-	-
n/a	Great Lakes Shoreline	0	-	-
n/a	Nuclear Attack	0	-	-
n/a	Nuclear Power Emergencies	0	-	-

ELBRIDGE TOWNSHIP
Critical Facilities and Potential Hazards



- Street
- Gas Pipeline
- Power Line
- SARA Title III Site
- Dam
- Shelter
- Federal Land
- Municipal 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, Oceana Co. Hazard Mitigation Plan Update 2014

Hazard Identification Profile

Ferry Township

1. NATURAL HAZARDS

1.01 Celestial Impacts: - None Identified.

1.02 Drought:

- 12 recorded drought events in the area (including Lake, Mason, Muskegon, Newaygo, and Oceana counties) lasting eight months or greater: 1895-1896, 1899-1900, 1901-1902, 1909-1911, 1925-1926, 1930-1931, 1956-1957, 1962-1963, 1971-1972, 1976-1977, and 2002-2003.
- Summer 1871: Prolonged drought over much of the Great Lakes region.
- May-September, 1891: Drought devastated Michigan's lumber industry.
- 2013: Record "low" Lake Michigan water levels.

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.
- May 16, 1997: Record cold temperatures. $2m crop damage, Oceana County.
- March 2012: Record warm temperatures triggered early growing season. $209.8m crop damage across Michigan.

1.05 Flooding - Riverine/ Urban:

- September 10-19, 1986: Flooding. Declaration of major disaster by President.
- October 28, 1986: Flooding & heavy rain. Declaration of disaster by Governor.
- April 19, 1993: Flooding. $5m property damage across southern Lower Michigan.
- February 9-10, 2001: Flooding. $100k property damage, Oceana County.
- February 24-28, 2001: Flooding. $190k property damage across West Michigan.
- May 15-16, 2001: Flash flooding from severe thunderstorms. $550k property damage, $250k crop damage, Oceana Co.
- May 21-23, 2004: Flooding. $25m property damage and $4.6m crop damage across 23 counties in Lower Michigan.
- April 17-23, 2013: Flooding. $3m property damage, Oceana County.

1.06 Fog:

- January 11-13, 1995: Dense Fog. 4 traffic accident fatalities, 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 Oceana County, 1996-2012: 11
- May 6, 2004: 0.88 inch hail. $20k property damage, $20k crop damage, Oceana County.

1.09 Invasive Species: - Invasive species exist in Oceana County; No significant events identified.

1.10 Lightning: - None Identified.

1.11 Severe Winds:

- August 20 - September 6, 1975: Rainstorms, high winds. Declaration of major disaster by President.
- April 6, 1997: High wind. $5m property damage across southwest Lower Michigan.
- May 31, 1998: Severe thunderstorms. Local, Gubernatorial, and Presidential disaster declarations. $4.m public damage, 37 injuries, 26 homes and 6 businesses destroyed, 1415 homes and 109 businesses damaged in Oceana Co.
- July 8, 1999: Severe thunderstorms. $20k property damage across Oceana 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 17, 2006: Severe thunderstorms. $250k property damage, $50k crop damage, across Oceana County.
- November 17, 2013: High wind. $75k property damage and power outages across Oceana County.

1.12 Subsidence: - None Identified.

1.13 Tornadoes:

- ***July 11, 1967: Tornado (F1). $25k property damage, Ferry Township.***
- ***September 14, 1990: Tornado (F1). $25k property damage, Ferry 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 12 wildfires and 60 acres burned per year on county lands under MDNR jurisdiction (346 total wildfires, 1,766.0 total acres burned).

1.15 Winter Storms:

- March 2-7, 1976: Ice storms. Declaration of major disaster by President.
- January 26-31, 1977: Blizzard, snowstorm. Declaration of emergency by President.
- January 26-27, 1978: Blizzard, snowstorm. Declaration of statewide emergency by President.
- 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.
- January 2-15, 1999: Blizzard, snowstorm. Declaration of emergency by President.
- April 3, 2003: Ice storm. $4.9m property damage throughout West Michigan.
- February 16, 2006: Ice storm. $1m property damage across Lower Michigan.

2. TECHNOLOGICAL HAZARDS

2.01 Dam Failure: - None Identified.

2.02 Energy Emergencies: - None Identified.

2.03 Fire - Scrap Tire: - None Identified; Approximate scrap tire inventory in Oceana County in 2012: 11,000.

2.04 Fire - Structural:

- County fire rate per 1,000 population in 1998: 6.37

2.05 Hazard Material Incidents - Fixed Site (including industrial accidents):

- No incidents identified; SARA Title III Sites in Oceana County in 2012: 83.

2.06 Hazard Material Incidents - Transportation: - None Identified.

2.07 Infrastructure Failure:

- Number of NCDC with mention of downed power lines or power outages in Oceana County, 1993-2012: 32
- January 20, 1994: Frozen sewer/water lines and downed power lines (extreme cold), statewide.
- 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: 90,000 without power statewide (thunderstorm winds).
- May 31, 1998: over 861,000 without power (thunderstorm winds), statewide.
- November 10, 1998: 167,000 power outages (high wind), West Michigan.
- April 3, 2003: Hundreds of thousands lose power (ice storm), Lower Michigan.
- October 10, 2004: 100,000 without power (high wind), statewide.
- December 28, 2008: Hundreds of thousands lose power (high wind), statewide.

2.08 Nuclear Power Plant Emergencies: - None Identified.

2.09 Oil and Natural Gas Well Accidents: - No accidents identified.

- Oil and gas wells in Oceana County in 2012: 1,188

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.

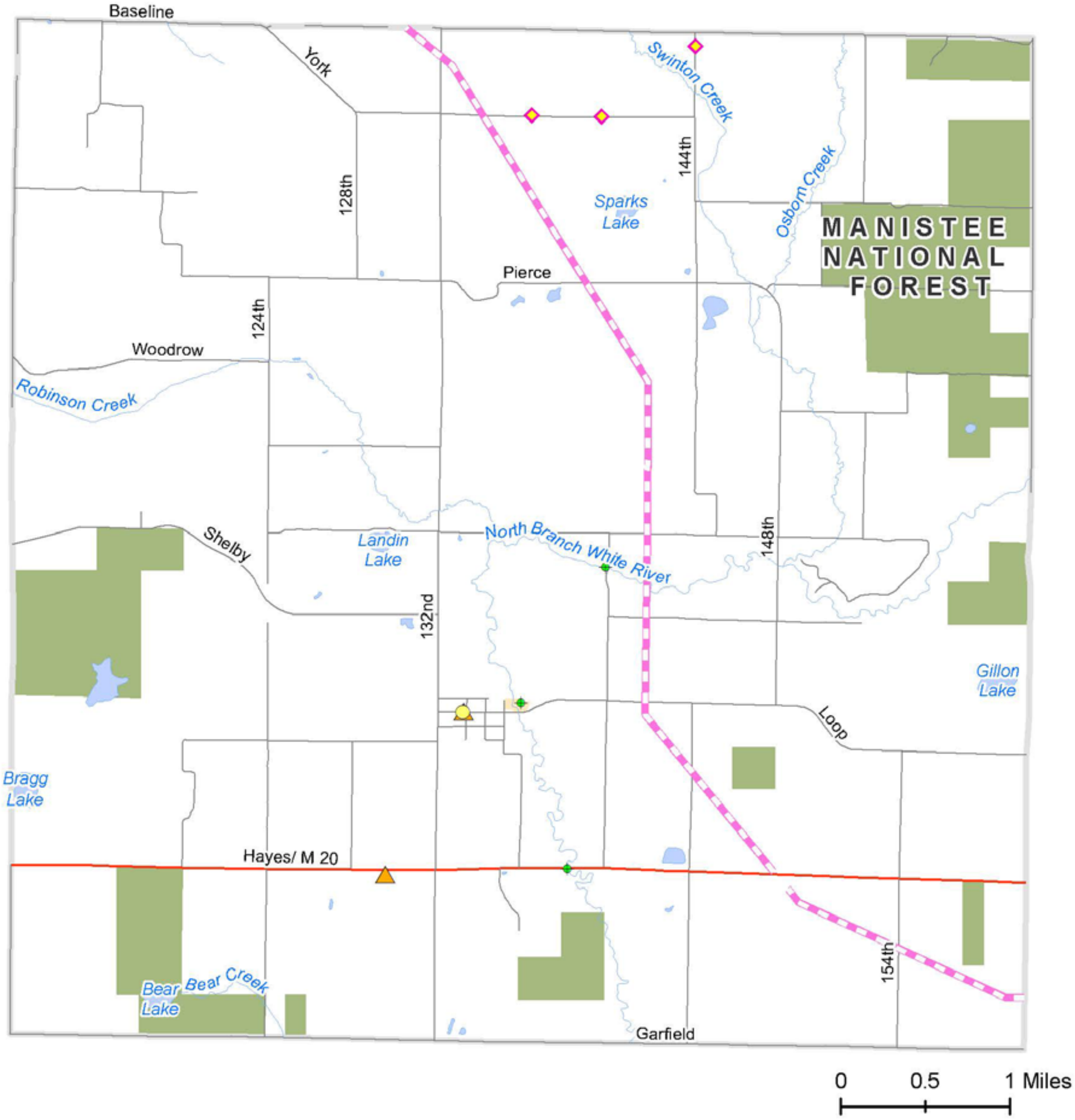
FERRY TOWNSHIP
Hazard Assessment
Ratings

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

FERRY TOWNSHIP
Hazard Vulnerability
Rankings

Ranking	Hazard	Probability of Occurrence	X	Weighted Impacts	=	Hazard Score
1	Winter Storms	3		15		45
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
n/a	Dam failure	0		-		-
n/a	Earthquake	0		-		-
n/a	Great Lakes Shoreline	0		-		-
n/a	Nuclear Attack	0		-		-
n/a	Nuclear Power Emergencies	0		-		-
n/a	Pipeline Accidents	0		-		-

FERRY TOWNSHIP
Critical Facilities and Potential Hazards



- State Trunkline
- Street
- Power Line
- SARA Title III Site
- Bridge
- Fire/Police/EMS/911
- Siren
- Federal Land
- Municipal 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, Oceana Co. Hazard Mitigation Plan Update 2014

Hazard Identification Profile
Golden Township

1. NATURAL HAZARDS

1.01 Celestial Impacts: - None Identified.

1.02 Drought:

- 12 recorded drought events in the area (including Lake, Mason, Muskegon, Newaygo, and Oceana counties) lasting eight months or greater: 1895-1896, 1899-1900, 1901-1902, 1909-1911, 1925-1926, 1930-1931, 1956-1957, 1962-1963, 1971-1972, 1976-1977, and 2002-2003.
- Summer 1871: Prolonged drought over much of the Great Lakes region.
- May-September, 1891: Drought devastated Michigan's lumber industry.
- 2013: Record "low" Lake Michigan water levels.

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.
- May 16, 1997: Record cold temperatures. $2m crop damage, Oceana County.
- March 2012: Record warm temperatures triggered early growing season. $209.8m crop damage across Michigan.

1.05 Flooding - Riverine/ Urban:

- September 10-19, 1986: Flooding. Declaration of major disaster by President.
- October 28, 1986: Flooding & heavy rain. Declaration of disaster by Governor.
- April 19, 1993: Flooding. $5m property damage across southern Lower Michigan.
- February 9-10, 2001: Flooding. $100k property damage, Oceana County.
- February 24-28, 2001: Flooding. $190k property damage across West Michigan.
- May 15-16, 2001: Flash flooding from severe thunderstorms. $550k property damage, $250k crop damage, Oceana Co.
- May 21-23, 2004: Flooding. $25m property damage and $4.6m crop damage across 23 counties in Lower Michigan.
- April 17-23, 2013: Flooding. $3m property damage, Oceana County.

1.06 Fog:

- January 11-13, 1995: Dense Fog. 4 traffic accident fatalities, school closures, and flight delays across Lower Michigan.

1.07 Great Lakes Shoreline Hazards:

- June 1986: Record high water level on Lake Michigan.
- Extreme high water levels in the Great Lakes: 1929, 1952, 1973, 1986, and 1997.
- 2013: Record low water level on Lake Michigan.
- Extreme low water levels in the Great Lakes: 1926, 1934, 1964, 2003, and 2013.
- Rip current incidents on Lake Michigan, 2002-2012: 77 fatalities, 230 rescues.

1.08 Hail:

- Severe hail events (1" or greater) recorded in Oceana County, 1996-2012: 11
- May 6, 2004: 0.88 inch hail. $20k property damage, $20k crop damage, Oceana County.

1.09 Invasive Species: - Invasive species exist in Oceana County; No significant events identified.

1.10 Lightning: - None Identified.

1.11 Severe Winds:

- August 20 - September 6, 1975: Rainstorms, high winds. Declaration of major disaster by President.
- April 6, 1997: High wind. $5m property damage across southwest Lower Michigan.
- May 31, 1998: Severe thunderstorms. Local, Gubernatorial, and Presidential disaster declarations. $4.m public damage, 37 injuries, 26 homes and 6 businesses destroyed, 1415 homes and 109 businesses damaged in Oceana Co.
- July 8, 1999: Severe thunderstorms. $20k property damage across Oceana County.
- ***June 1, 2000: Severe thunderstorms. $50k property damage, Golden Twp.***
- 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 17, 2006: Severe thunderstorms. $250k property damage, $50k crop damage, across Oceana County.
- ***August 1, 2006: Severe thunderstorms. $20k property damage across northwest Oceana County.***
- November 17, 2013: High wind. $75k property damage and power outages across Oceana County.

1.12 Subsidence: - None Identified.

1.13 Tornadoes: - None Identified.

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 12 wildfires and 60 acres burned per year on county lands under MDNR jurisdiction (346 total wildfires, 1,766.0 total acres burned).

1.15 Winter Storms:

- March 2-7, 1976: Ice storms. Declaration of major disaster by President.
- January 26-31, 1977: Blizzard, snowstorm. Declaration of emergency by President.
- January 26-27, 1978: Blizzard, snowstorm. Declaration of statewide emergency by President.
- 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.
- January 2-15, 1999: Blizzard, snowstorm. Declaration of emergency by President.
- April 3, 2003: Ice storm. $4.9m property damage throughout West Michigan.
- February 16, 2006: Ice storm. $1m property damage across Lower Michigan.

2. <u>TECHNOLOGICAL HAZARDS</u>

2.01 Dam Failure: - None Identified.

2.02 Energy Emergencies: - None Identified.

2.03 Fire - Scrap Tire: - None Identified; Approximate scrap tire inventory in Oceana County in 2012: 11,000.

2.04 Fire - Structural:

- County fire rate per 1,000 population in 1998: 6.37

2.05 Hazard Material Incidents - Fixed Site (including industrial accidents):

- No incidents identified; SARA Title III Sites in Oceana County in 2012: 83.

2.06 Hazard Material Incidents - Transportation: - None Identified.

2.07 Infrastructure Failure:

- Number of NCDC with mention of downed power lines or power outages in Oceana County, 1993-2012: 32
- January 20, 1994: Frozen sewer/water lines and downed power lines (extreme cold), statewide.
- 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: 90,000 without power statewide (thunderstorm winds).
- May 31, 1998: over 861,000 without power (thunderstorm winds), statewide.
- November 10, 1998: 167,000 power outages (high wind), West Michigan.
- April 3, 2003: Hundreds of thousands lose power (ice storm), Lower Michigan.
- October 10, 2004: 100,000 without power (high wind), statewide.
- December 28, 2008: Hundreds of thousands lose power (high wind), statewide.

2.08 Nuclear Power Plant Emergencies: - None Identified.

2.09 Oil and Natural Gas Well Accidents: - No accidents identified.

- Oil and gas wells in Oceana County in 2012: 1,188
- ***1 well with known detectable levels of hydrogen sulfide in Golden Township.***

2.10 Pipeline Accidents: - None Identified.

2.11 Transportation Accidents: - None Identified.

3. <u>HUMAN -RELATED HAZARDS</u>

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.

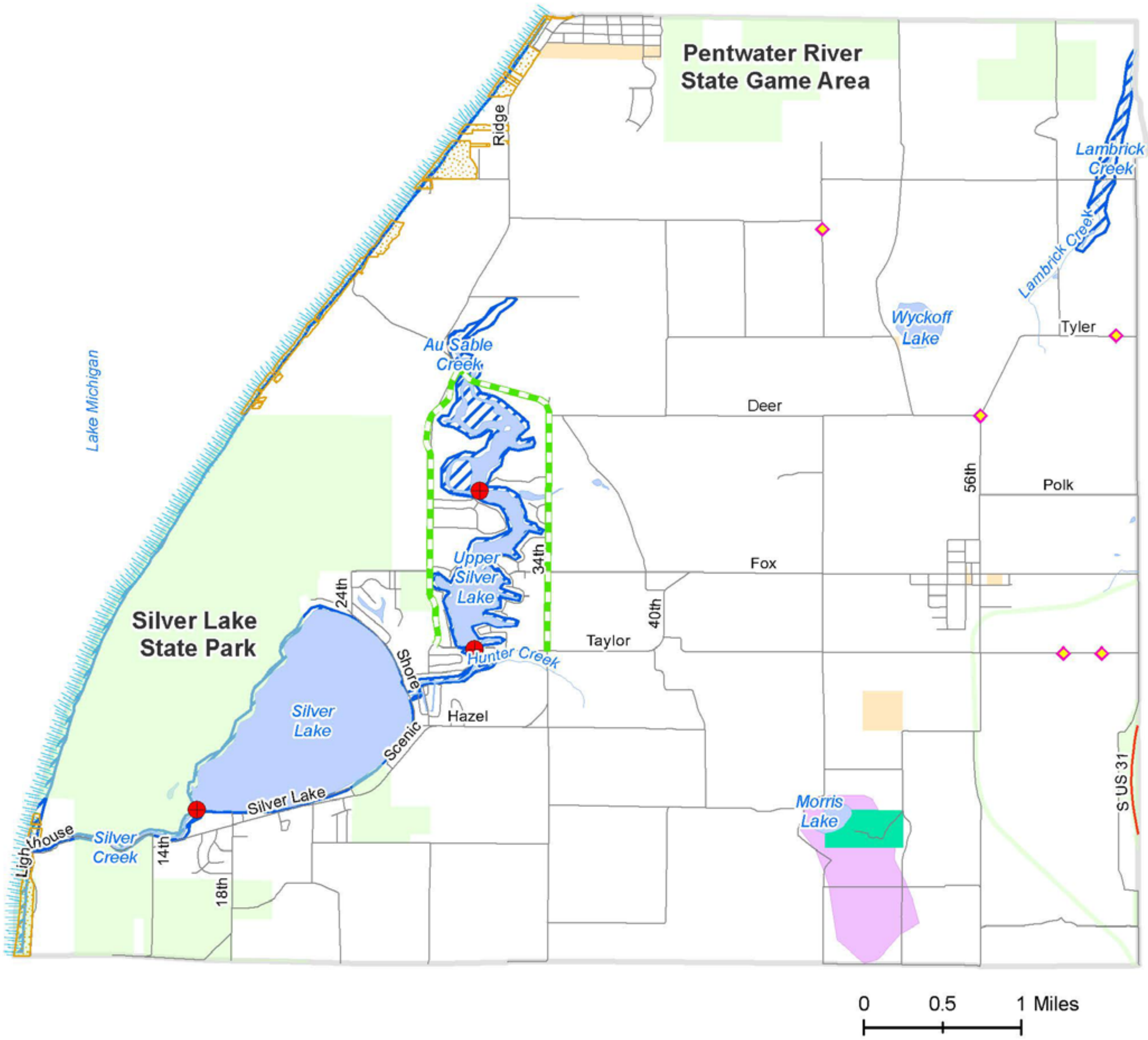
GOLDEN TOWNSHIP
Hazard Assessment
Ratings

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

GOLDEN TOWNSHIP
Hazard Vulnerability Rankings

Ranking	Hazard	Probability of Occurrence	X	Weighted Impacts	=	Hazard Score
1	Winter Storms	3		15		45
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	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
n/a	Earthquake	0		-		-
n/a	Nuclear Attack	0		-		-
n/a	Nuclear Power Emergencies	0		-		-

GOLDEN TOWNSHIP
Critical Facilities and Potential Hazards



- State Trunkline
- Street
- Propane Pipeline
- Great Lakes Shoreline Hazard
- SARA Title III Site
- Dam
- State Land
- Municipal Land
- School Property
- High-Risk Erosion Area
- Oil/Gas Field
- Floodplain

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, Oceana Co. Hazard Mitigation Plan Update 2014

Hazard Identification Profile

Grant Township

1. NATURAL HAZARDS

1.01 Celestial Impacts: - None Identified.

1.02 Drought:

- 12 recorded drought events in the area (including Lake, Mason, Muskegon, Newaygo, and Oceana counties) lasting eight months or greater: 1895-1896, 1899-1900, 1901-1902, 1909-1911, 1925-1926, 1930-1931, 1956-1957, 1962-1963, 1971-1972, 1976-1977, and 2002-2003.
- Summer 1871: Prolonged drought over much of the Great Lakes region.
- May-September, 1891: Drought devastated Michigan's lumber industry.
- 2013: Record "low" Lake Michigan water levels.

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.
- May 16, 1997: Record cold temperatures. $2m crop damage, Oceana County.
- March 2012: Record warm temperatures triggered early growing season. $209.8m crop damage across Michigan.

1.05 Flooding - Riverine/ Urban:

- September 10-19, 1986: Flooding. Declaration of major disaster by President.
- October 28, 1986: Flooding & heavy rain. Declaration of disaster by Governor.
- April 19, 1993: Flooding. $5m property damage across southern Lower Michigan.
- February 9-10, 2001: Flooding. $100k property damage, Oceana County.
- February 24-28, 2001: Flooding. $190k property damage across West Michigan.
- May 15-16, 2001: Flash flooding from severe thunderstorms. $550k property damage, $250k crop damage, Oceana Co.
- May 21-23, 2004: Flooding. $25m property damage and $4.6m crop damage across 23 counties in Lower Michigan.
- April 17-23, 2013: Flooding. $3m property damage, Oceana County.

1.06 Fog:

- January 11-13, 1995: Dense Fog. 4 traffic accident fatalities, 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 Oceana County, 1996-2012: 11
- ***May 10, 2003: 1.00 inch hail. $20k property damage, $10k crop damage, New Era Village (Grant and Shelby Twps).***
- May 6, 2004: 0.88 inch hail. $20k property damage, $20k crop damage, Oceana County.
- ***May 23, 2004: 0.75 inch hail. $15k property damage, $15k crop damage, New Era Village (Grant and Shelby Twps).***

1.09 Invasive Species: - Invasive species exist in Oceana County; No significant events identified.

1.10 Lightning: - None Identified.

1.11 Severe Winds:

- August 20 - September 6, 1975: Rainstorms, high winds. Declaration of major disaster by President.
- April 6, 1997: High wind. $5m property damage across southwest Lower Michigan.
- May 31, 1998: Severe thunderstorms. Local, Gubernatorial, and Presidential disaster declarations. $4.m public damage, 37 injuries, 26 homes and 6 businesses destroyed, 1415 homes and 109 businesses damaged in Oceana Co.
- July 8, 1999: Severe thunderstorms. $20k property damage across Oceana 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 17, 2006: Severe thunderstorms. $250k property damage, $50k crop damage, across Oceana County.
- November 17, 2013: High wind. $75k property damage and power outages across Oceana County.

1.12 Subsidence: - None Identified.

1.13 Tornadoes: - None Identified.

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 12 wildfires and 60 acres burned per year on county lands under MDNR jurisdiction (346 total wildfires, 1,766.0 total acres burned).

1.15 Winter Storms:

- March 2-7, 1976: Ice storms. Declaration of major disaster by President.
- January 26-31, 1977: Blizzard, snowstorm. Declaration of emergency by President.
- January 26-27, 1978: Blizzard, snowstorm. Declaration of statewide emergency by President.
- 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.
- January 2-15, 1999: Blizzard, snowstorm. Declaration of emergency by President.
- April 3, 2003: Ice storm. $4.9m property damage throughout West Michigan.
- February 16, 2006: Ice storm. $1m property damage across Lower Michigan.

2. TECHNOLOGICAL HAZARDS

2.01 Dam Failure: - None Identified.

2.02 Energy Emergencies: - None Identified.

2.03 Fire - Scrap Tire: - None Identified; Approximate scrap tire inventory in Oceana County in 2012: 11,000.

2.04 Fire - Structural:
- County fire rate per 1,000 population in 1998: 6.37

2.05 Hazard Material Incidents - Fixed Site (including industrial accidents):
- No incidents identified; SARA Title III Sites in Oceana County in 2012: 83.

2.06 Hazard Material Incidents - Transportation: - None Identified.

2.07 Infrastructure Failure:
- Number of NCDC with mention of downed power lines or power outages in Oceana County, 1993-2012: 32
- January 20, 1994: Frozen sewer/water lines and downed power lines (extreme cold), statewide.
- 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: 90,000 without power statewide (thunderstorm winds).
- May 31, 1998: over 861,000 without power (thunderstorm winds), statewide.
- November 10, 1998: 167,000 power outages (high wind), West Michigan.
- April 3, 2003: Hundreds of thousands lose power (ice storm), Lower Michigan.
- October 10, 2004: 100,000 without power (high wind), statewide.
- December 28, 2008: Hundreds of thousands lose power (high wind), statewide.

2.08 Nuclear Power Plant Emergencies: - None Identified.

2.09 Oil and Natural Gas Well Accidents: - No accidents identified.
- Oil and gas wells in Oceana County in 2012: 1,188
- ***1 well with known detectable levels of hydrogen sulfide Grant 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.

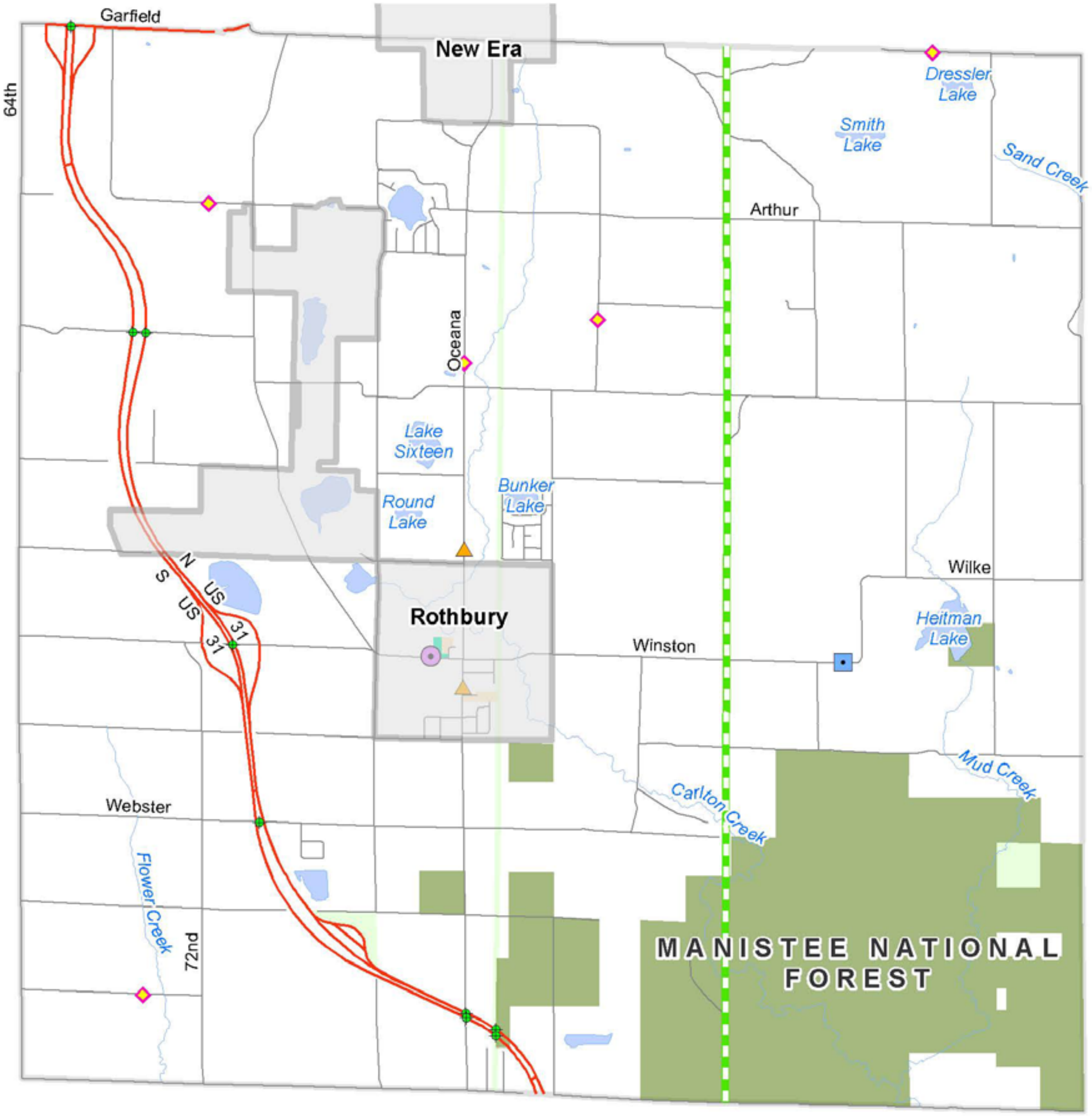
GRANT TOWNSHIP
Hazard Assessment
Ratings

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

GRANT TOWNSHIP
Hazard Vulnerability Rankings

Ranking	Hazard	Probability of Occurrence X	Weighted Impacts =	Hazard Score
1	Winter Storms	3	15	45
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
19	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
n/a	Dam failure	0	-	-
n/a	Earthquake	0	-	-
n/a	Great Lakes Shoreline	0	-	-
n/a	Nuclear Attack	0	-	-
n/a	Nuclear Power Emergencies	0	-	-

GRANT TOWNSHIP
Critical Facilities and Potential Hazards



- State Trunkline
- Street
- Gas Pipeline
- SARA Title III Site
- Fire/Police/EMS/911
- School
- Shelter
- 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, Oceana Co. Hazard Mitigation Plan Update 2014

Hazard Identification Profile
Greenwood Township

1. NATURAL HAZARDS

1.01 Celestial Impacts: - None Identified.

1.02 Drought:
- 12 recorded drought events in the area (including Lake, Mason, Muskegon, Newaygo, and Oceana counties) lasting eight months or greater: 1895-1896, 1899-1900, 1901-1902, 1909-1911, 1925-1926, 1930-1931, 1956-1957, 1962-1963, 1971-1972, 1976-1977, and 2002-2003.
- Summer 1871: Prolonged drought over much of the Great Lakes region.
- May-September, 1891: Drought devastated Michigan's lumber industry.
- 2013: Record "low" Lake Michigan water levels.

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.
- May 16, 1997: Record cold temperatures. $2m crop damage, Oceana County.
- March 2012: Record warm temperatures triggered early growing season. $209.8m crop damage across Michigan.

1.05 Flooding - Riverine/ Urban:
- September 10-19, 1986: Flooding. Declaration of major disaster by President.
- October 28, 1986: Flooding & heavy rain. Declaration of disaster by Governor.
- April 19, 1993: Flooding. $5m property damage across southern Lower Michigan.
- February 9-10, 2001: Flooding. $100k property damage, Oceana County.
- February 24-28, 2001: Flooding. $190k property damage across West Michigan.
- May 15-16, 2001: Flash flooding from severe thunderstorms. $550k property damage, $250k crop damage, Oceana Co.
- May 21-23, 2004: Flooding. $25m property damage and $4.6m crop damage across 23 counties in Lower Michigan.
- April 17-23, 2013: Flooding. $3m property damage, Oceana County.

1.06 Fog:
- January 11-13, 1995: Dense Fog. 4 traffic accident fatalities, 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 Oceana County, 1996-2012: 11
- May 6, 2004: 0.88 inch hail. $20k property damage, $20k crop damage, Oceana County.

1.09 Invasive Species: - Invasive species exist in Oceana County; No significant events identified.

1.10 Lightning: - None Identified.

1.11 Severe Winds:
- August 20 - September 6, 1975: Rainstorms, high winds. Declaration of major disaster by President.
- April 6, 1997: High wind. $5m property damage across southwest Lower Michigan.
- May 31, 1998: Severe thunderstorms. Local, Gubernatorial, and Presidential disaster declarations. $4.m public damage, 37 injuries, 26 homes and 6 businesses destroyed, 1415 homes and 109 businesses damaged in Oceana Co.
- July 8, 1999: Severe thunderstorms. $20k property damage across Oceana 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 17, 2006: Severe thunderstorms. $250k property damage, $50k crop damage, across Oceana County.
- November 17, 2013: High wind. $75k property damage and power outages across Oceana County.

1.12 Subsidence: - None Identified.

1.13 Tornadoes: - None Identified.

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 12 wildfires and 60 acres burned per year on county lands under MDNR jurisdiction (346 total wildfires, 1,766.0 total acres burned).

1.15 Winter Storms:
- March 2-7, 1976: Ice storms. Declaration of major disaster by President.
- January 26-31, 1977: Blizzard, snowstorm. Declaration of emergency by President.
- January 26-27, 1978: Blizzard, snowstorm. Declaration of statewide emergency by President.
- 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.
- January 2-15, 1999: Blizzard, snowstorm. Declaration of emergency by President.

- April 3, 2003: Ice storm. $4.9m property damage throughout West Michigan.
- February 16, 2006: Ice storm. $1m property damage across Lower Michigan.

2. TECHNOLOGICAL HAZARDS

2.01 Dam Failure: - None Identified.

2.02 Energy Emergencies: - None Identified.

2.03 Fire - Scrap Tire: - None Identified; Approximate scrap tire inventory in Oceana County in 2012: 11,000.

2.04 Fire - Structural:
- County fire rate per 1,000 population in 1998: 6.37

2.05 Hazard Material Incidents - Fixed Site (including industrial accidents):
- No incidents identified; SARA Title III Sites in Oceana County in 2012: 83.

2.06 Hazard Material Incidents - Transportation: - None Identified.

2.07 Infrastructure Failure:
- Number of NCDC with mention of downed power lines or power outages in Oceana County, 1993-2012: 32
- January 20, 1994: Frozen sewer/water lines and downed power lines (extreme cold), statewide.
- 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: 90,000 without power statewide (thunderstorm winds).
- May 31, 1998: over 861,000 without power (thunderstorm winds), statewide.
- November 10, 1998: 167,000 power outages (high wind), West Michigan.
- April 3, 2003: Hundreds of thousands lose power (ice storm), Lower Michigan.
- October 10, 2004: 100,000 without power (high wind), statewide.
- December 28, 2008: Hundreds of thousands lose power (high wind), statewide.

2.08 Nuclear Power Plant Emergencies: - None Identified.

2.09 Oil and Natural Gas Well Accidents: - No accidents identified.
- Oil and gas wells in Oceana County in 2012: 1,188

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.

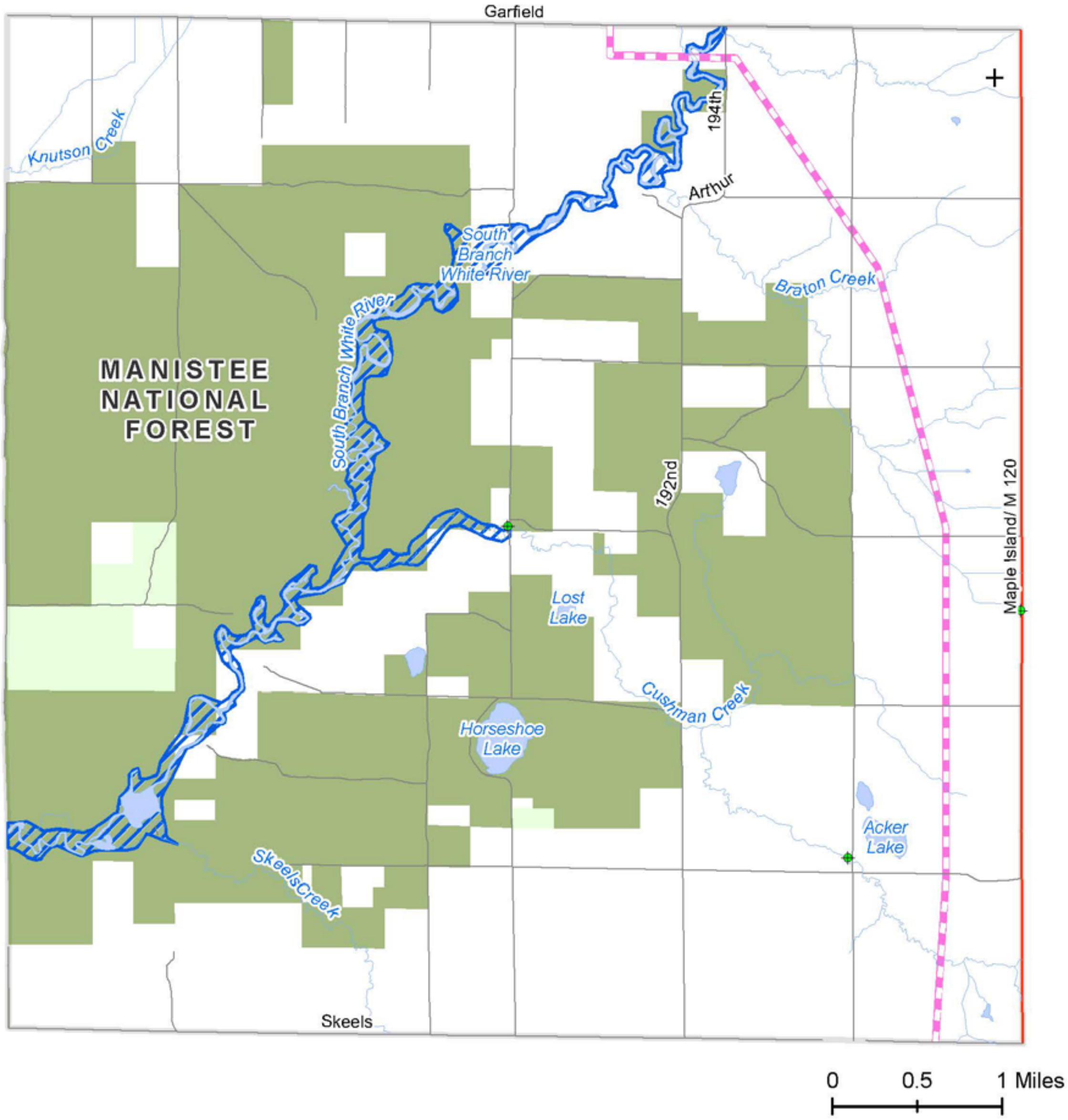
GREENWOOD TOWNSHIP
Hazard Assessment
Ratings

Natural Hazards	Probability of Occurrence	Population Affected	Property Damaged	Economic Impacts
1.01 Celestial Impacts	1	2	0	2
1.02 Drought	2	2	2	3
1.03 Earthquake	0	-	-	-
1.04 Extreme Temperatures	3	2	1	2
1.05 Flooding: Riverine/Urban	3	1	2	1
1.06 Fog	2	1	0	1
1.07 Great Lakes Shoreline	0	-	-	-
1.08 Hail	3	1	2	1
1.09 Invasive Species	2	1	1	2
1.10 Lightning	3	1	2	1
1.11 Severe Winds	3	2	3	2
1.12 Subsidence	1	1	1	1
1.13 Tornadoes	2	1	2	2
1.14 Wildfire	3	2	2	2
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	3
2.03 Fire – Scrap Tires	1	1	1	1
2.04 Fire – Structural	3	1	1	2
2.05 HAZMAT – Fixed Site	2	1	1	2
2.06 HAZMAT – Transportation	2	1	1	2
2.07 Infrastructure Failures	3	3	1	2
2.08 Nuclear Power Emergencies	0	-	-	-
2.09 Oil/Natural Gas Well Accidents	1	1	1	1
2.10 Pipeline Accidents	1	1	1	2
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	3
3.05 Terrorism & Similar Criminal Acts	1	1	1	1

GREENWOOD TOWNSHIP
Hazard Vulnerability
Rankings

Ranking	Hazard	Probability of Occurrence	X	Weighted Impacts	=	Hazard Score
1	Winter Storms	3		15		45
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
n/a	Earthquake	0		-		-
n/a	Great Lakes Shoreline	0		-		-
n/a	Nuclear Attack	0		-		-
n/a	Nuclear Power Emergencies	0		-		-

GREENWOOD TOWNSHIP
Critical Facilities and Potential Hazards



State Trunkline
Street
Power Line
Bridge
Communications Tower
Federal Land
State Land
Floodplain

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, Oceana Co. Hazard Mitigation Plan Update 2014

Hazard Identification Profile
Hart Township

1. NATURAL HAZARDS

1.01 Celestial Impacts: - None Identified.

1.02 Drought:

- 12 recorded drought events in the area (including Lake, Mason, Muskegon, Newaygo, and Oceana counties) lasting eight months or greater: 1895-1896, 1899-1900, 1901-1902, 1909-1911, 1925-1926, 1930-1931, 1956-1957, 1962-1963, 1971-1972, 1976-1977, and 2002-2003.
- Summer 1871: Prolonged drought over much of the Great Lakes region.
- May-September, 1891: Drought devastated Michigan's lumber industry.
- 2013: Record "low" Lake Michigan water levels.

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.
- May 16, 1997: Record cold temperatures. $2m crop damage, Oceana County.
- March 2012: Record warm temperatures triggered early growing season. $209.8m crop damage across Michigan.

1.05 Flooding - Riverine/ Urban:

- September 10-19, 1986: Flooding. Declaration of major disaster by President.
- October 28, 1986: Flooding & heavy rain. Declaration of disaster by Governor.
- April 19, 1993: Flooding. $5m property damage across southern Lower Michigan.
- February 9-10, 2001: Flooding. $100k property damage, Oceana County.
- February 24-28, 2001: Flooding. $190k property damage across West Michigan.
- May 15-16, 2001: Flash flooding from severe thunderstorms. $550k property damage, $250k crop damage, Oceana Co.
- May 21-23, 2004: Flooding. $25m property damage and $4.6m crop damage across 23 counties in Lower Michigan.
- April 17-23, 2013: Flooding. $3m property damage, Oceana County.

1.06 Fog:

- January 11-13, 1995: Dense Fog. 4 traffic accident fatalities, 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 Oceana County, 1996-2012: 11
- May 6, 2004: 0.88 inch hail. $20k property damage, $20k crop damage, Oceana County.

1.09 Invasive Species: - Invasive species exist in Oceana County; No significant events identified.

1.10 Lightning: - None Identified.

1.11 Severe Winds:

- August 20 - September 6, 1975: Rainstorms, high winds. Declaration of major disaster by President.
- April 6, 1997: High wind. $5m property damage across southwest Lower Michigan.
- May 31, 1998: Severe thunderstorms. Local, Gubernatorial, and Presidential disaster declarations. $4.m public damage, 37 injuries, 26 homes and 6 businesses destroyed, 1415 homes and 109 businesses damaged in Oceana Co.
- July 8, 1999: Severe thunderstorms. $20k property damage across Oceana 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 17, 2006: Severe thunderstorms. $250k property damage, $50k crop damage, across Oceana County.
- ***August 1, 2006: Severe thunderstorms. $20k property damage across northwest Oceana County.***
- November 17, 2013: High wind. $75k property damage and power outages across Oceana County.

1.12 Subsidence: - None Identified.

1.13 Tornadoes:

- ***May 28, 1991: Tornado (F2). $250k property damage, Hart 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 12 wildfires and 60 acres burned per year on county lands under MDNR jurisdiction (346 total wildfires, 1,766.0 total acres burned).

1.15 Winter Storms:

- March 2-7, 1976: Ice storms. Declaration of major disaster by President.
- January 26-31, 1977: Blizzard, snowstorm. Declaration of emergency by President.
- January 26-27, 1978: Blizzard, snowstorm. Declaration of statewide emergency by President.
- 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.
- January 2-15, 1999: Blizzard, snowstorm. Declaration of emergency by President.
- April 3, 2003: Ice storm. $4.9m property damage throughout West Michigan.
- February 16, 2006: Ice storm. $1m property damage across Lower Michigan.

2. TECHNOLOGICAL HAZARDS

2.01 Dam Failure:

- September 1986: Hart Hydro-Electric Dam, Hesperia Dam spillway erosion, Crystal Valley Dam spillway erosion.

2.02 Energy Emergencies: - None Identified.

2.03 Fire - Scrap Tire: - None Identified; Approximate scrap tire inventory in Oceana County in 2012: 11,000.

2.04 Fire - Structural:

- County fire rate per 1,000 population in 1998: 6.37

2.05 Hazard Material Incidents - Fixed Site (including industrial accidents):

- No incidents identified; SARA Title III Sites in Oceana County in 2012: 83.

2.06 Hazard Material Incidents - Transportation: - None Identified.

2.07 Infrastructure Failure:

- Number of NCDC with mention of downed power lines or power outages in Oceana County, 1993-2012: 32
- January 20, 1994: Frozen sewer/water lines and downed power lines (extreme cold), statewide.
- 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: 90,000 without power statewide (thunderstorm winds).
- May 31, 1998: over 861,000 without power (thunderstorm winds), statewide.
- November 10, 1998: 167,000 power outages (high wind), West Michigan.
- April 3, 2003: Hundreds of thousands lose power (ice storm), Lower Michigan.
- October 10, 2004: 100,000 without power (high wind), statewide.
- December 28, 2008: Hundreds of thousands lose power (high wind), statewide.

2.08 Nuclear Power Plant Emergencies: - None Identified.

2.09 Oil and Natural Gas Well Accidents: - No accidents identified.

- Oil and gas wells in Oceana County in 2012: 1,188

2.10 Pipeline Accidents: - None Identified.

2.11 Transportation Accidents:

- July 14, 2001: School bus rolled into a ditch. 2 children injured, Hart Township.

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.

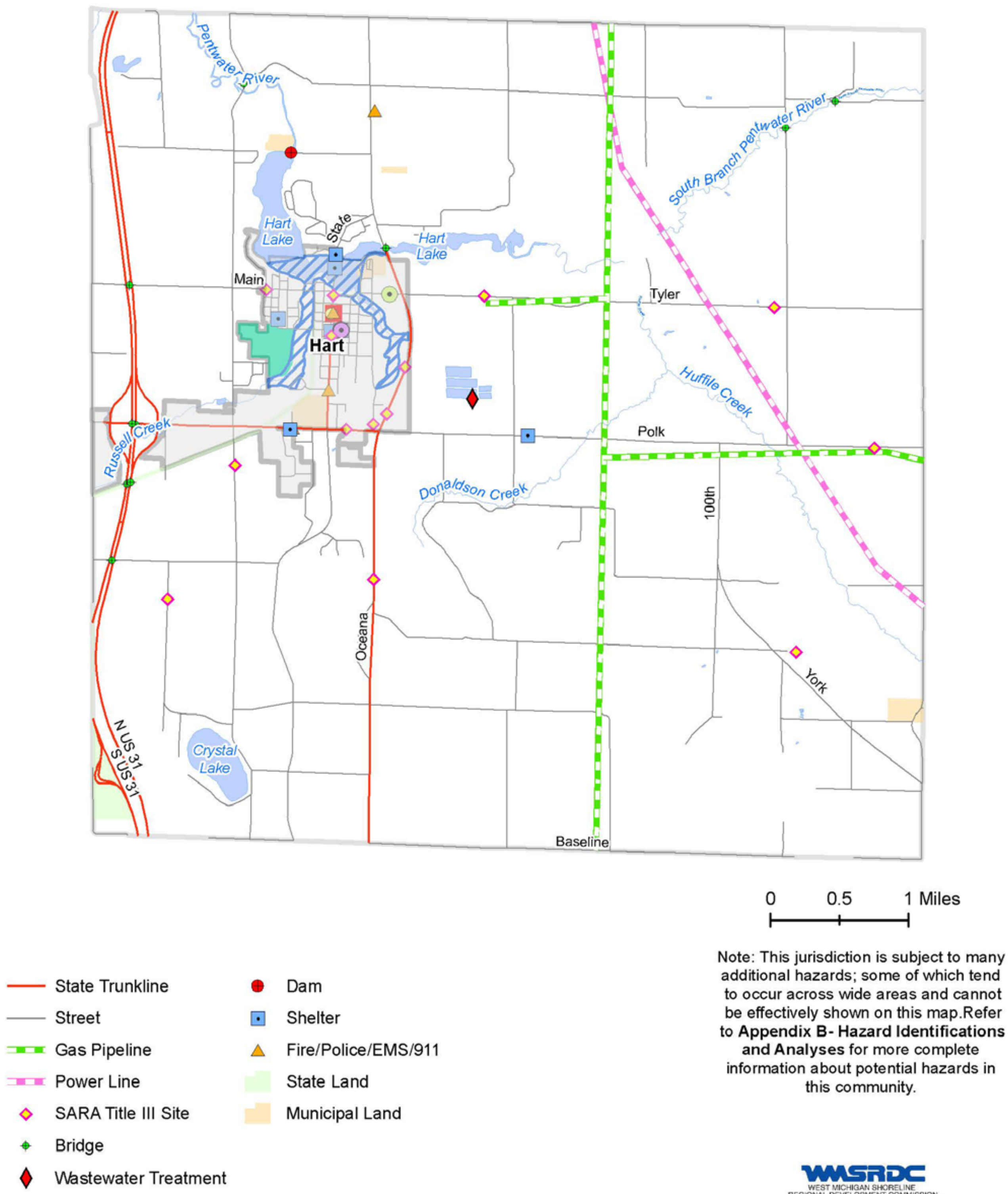
HART TOWNSHIP
Hazard Assessment
Ratings

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

HART TOWNSHIP
Hazard Vulnerability Rankings

Ranking	Hazard	Probability of Occurrence	X	Weighted Impacts	=	Hazard Score
1	Winter Storms	3		15		45
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
n/a	Earthquake	0		-		-
n/a	Great Lakes Shoreline	0		-		-
n/a	Nuclear Attack	0		-		-
n/a	Nuclear Power Emergencies	0		-		-

HART 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.

WMSRDC
WEST MICHIGAN SHORELINE REGIONAL DEVELOPMENT COMMISSION

Source: Michigan Geographic Data Library V 12b, Oceana Co. Hazard Mitigation Plan Update 2014

Hazard Identification Profile

Leavitt Township

1. NATURAL HAZARDS

1.01 Celestial Impacts: - None Identified.

1.02 Drought:

- 12 recorded drought events in the area (including Lake, Mason, Muskegon, Newaygo, and Oceana counties) lasting eight months or greater: 1895-1896, 1899-1900, 1901-1902, 1909-1911, 1925-1926, 1930-1931, 1956-1957, 1962-1963, 1971-1972, 1976-1977, and 2002-2003.
- Summer 1871: Prolonged drought over much of the Great Lakes region.
- May-September, 1891: Drought devastated Michigan's lumber industry.
- 2013: Record "low" Lake Michigan water levels.

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.
- May 16, 1997: Record cold temperatures. $2m crop damage, Oceana County.
- March 2012: Record warm temperatures triggered early growing season. $209.8m crop damage across Michigan.

1.05 Flooding - Riverine/ Urban:

- September 10-19, 1986: Flooding. Declaration of major disaster by President.
- October 28, 1986: Flooding & heavy rain. Declaration of disaster by Governor.
- April 19, 1993: Flooding. $5m property damage across southern Lower Michigan.
- February 9-10, 2001: Flooding. $100k property damage, Oceana County.
- February 24-28, 2001: Flooding. $190k property damage across West Michigan.
- May 15-16, 2001: Flash flooding from severe thunderstorms. $550k property damage, $250k crop damage, Oceana Co.
- May 21-23, 2004: Flooding. $25m property damage and $4.6m crop damage across 23 counties in Lower Michigan.
- April 17-23, 2013: Flooding. $3m property damage, Oceana County.

1.06 Fog:

- January 11-13, 1995: Dense Fog. 4 traffic accident fatalities, 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 Oceana County, 1996-2012: 11
- ***July 13, 2000: 1.75 inch hail. $50k property damage, $25k crop damage, Walkerville Village (Leavitt Twp).***
- May 6, 2004: 0.88 inch hail. $20k property damage, $20k crop damage, Oceana County.

1.09 Invasive Species: - Invasive species exist in Oceana County; No significant events identified.

1.10 Lightning: - None Identified.

1.11 Severe Winds:

- August 20 - September 6, 1975: Rainstorms, high winds. Declaration of major disaster by President.
- ***July 15, 1995: Severe thunderstorms. $15k property damage, Walkerville Village (Leavitt Twp).***
- April 6, 1997: High wind. $5m property damage across southwest Lower Michigan.
- May 31, 1998: Severe thunderstorms. Local, Gubernatorial, and Presidential disaster declarations. $4.m public damage, 37 injuries, 26 homes and 6 businesses destroyed, 1415 homes and 109 businesses damaged in Oceana Co.
- July 8, 1999: Severe thunderstorms. $20k property damage across Oceana 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 17, 2006: Severe thunderstorms. $250k property damage, $50k crop damage, across Oceana County.
- November 17, 2013: High wind. $75k property damage and power outages across Oceana County.

1.12 Subsidence: - None Identified.

1.13 Tornadoes: - None Identified.

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 12 wildfires and 60 acres burned per year on county lands under MDNR jurisdiction (346 total wildfires, 1,766.0 total acres burned).

1.15 Winter Storms:

- March 2-7, 1976: Ice storms. Declaration of major disaster by President.
- January 26-31, 1977: Blizzard, snowstorm. Declaration of emergency by President.
- January 26-27, 1978: Blizzard, snowstorm. Declaration of statewide emergency by President.
- 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.
- January 2-15, 1999: Blizzard, snowstorm. Declaration of emergency by President.
- April 3, 2003: Ice storm. $4.9m property damage throughout West Michigan.
- February 16, 2006: Ice storm. $1m property damage across Lower Michigan.

2. TECHNOLOGICAL HAZARDS

2.01 Dam Failure: - None Identified.

2.02 Energy Emergencies: - None Identified.

2.03 Fire - Scrap Tire: - None Identified; Approximate scrap tire inventory in Oceana County in 2012: 11,000.

2.04 Fire - Structural:

- County fire rate per 1,000 population in 1998: 6.37
- ***October 16, 2012: Major fire destroyed a 400 ft barn at a pork farm in Leavitt Township; unknown cause.***

2.05 Hazard Material Incidents - Fixed Site (including industrial accidents):

- No incidents identified; SARA Title III Sites in Oceana County in 2012: 83.

2.06 Hazard Material Incidents - Transportation: - None Identified.

2.07 Infrastructure Failure:

- Number of NCDC with mention of downed power lines or power outages in Oceana County, 1993-2012: 32
- January 20, 1994: Frozen sewer/water lines and downed power lines (extreme cold), statewide.
- 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: 90,000 without power statewide (thunderstorm winds).
- May 31, 1998: over 861,000 without power (thunderstorm winds), statewide.
- November 10, 1998: 167,000 power outages (high wind), West Michigan.
- April 3, 2003: Hundreds of thousands lose power (ice storm), Lower Michigan.
- October 10, 2004: 100,000 without power (high wind), statewide.
- December 28, 2008: Hundreds of thousands lose power (high wind), statewide.

2.08 Nuclear Power Plant Emergencies: - None Identified.

2.09 Oil and Natural Gas Well Accidents: - No accidents identified.

- Oil and gas wells in Oceana County in 2012: 1,188

2.10 Pipeline Accidents: - None Identified.

2.11 Transportation Accidents:

- ***December 1, 2012: Private helicopter crashed into Manistee National Forest. 1 fatality and 1 injury, Leavitt Twp.***

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.

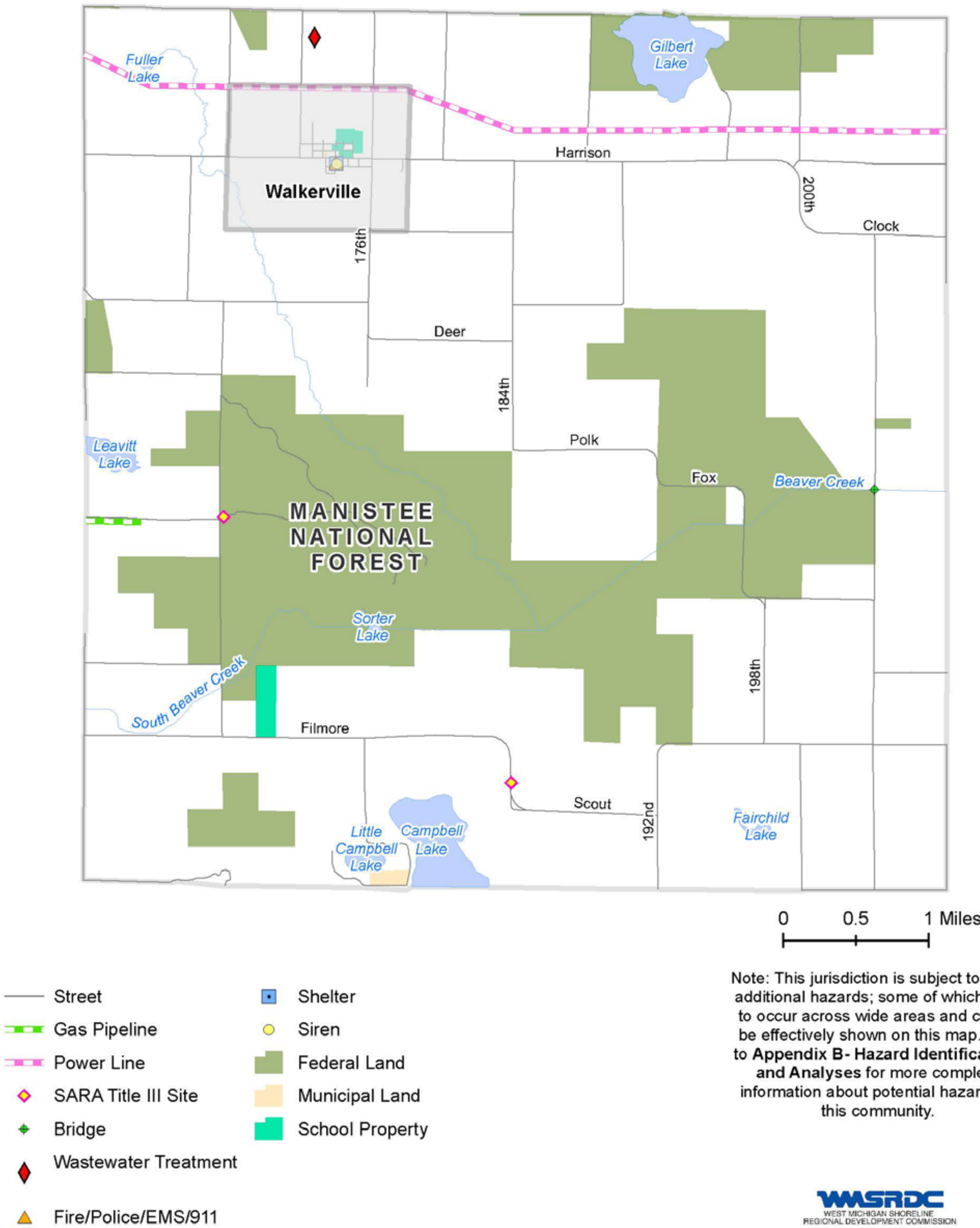
LEAVITT TOWNSHIP
Hazard Assessment Ratings

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

LEAVITT TOWNSHIP
Hazard Vulnerability Rankings

Ranking	Hazard	Probability of Occurrence	X	Weighted Impacts	=	Hazard Score
1	Winter Storms	3		15		45
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	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
n/a	Dam failure	0		-		-
n/a	Earthquake	0		-		-
n/a	Great Lakes Shoreline	0		-		-
n/a	Nuclear Attack	0		-		-
n/a	Nuclear Power Emergencies	0		-		-

LEAVITT TOWNSHIP
Critical Facilities and Potential Hazards



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WMSRDC
WEST MICHIGAN SHORELINE REGIONAL DEVELOPMENT COMMISSION

Source: Michigan Geographic Data Library V 12b, Oceana Co. Hazard Mitigation Plan Update 2014

Hazard Identification Profile
Newfield Township

1. NATURAL HAZARDS

1.01 Celestial Impacts: - None Identified.

1.02 Drought:
- 12 recorded drought events in the area (including Lake, Mason, Muskegon, Newaygo, and Oceana counties) lasting eight months or greater: 1895-1896, 1899-1900, 1901-1902, 1909-1911, 1925-1926, 1930-1931, 1956-1957, 1962-1963, 1971-1972, 1976-1977, and 2002-2003.
- Summer 1871: Prolonged drought over much of the Great Lakes region.
- May-September, 1891: Drought devastated Michigan's lumber industry.
- 2013: Record "low" Lake Michigan water levels.

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.
- May 16, 1997: Record cold temperatures. $2m crop damage, Oceana County.
- March 2012: Record warm temperatures triggered early growing season. $209.8m crop damage across Michigan.

1.05 Flooding - Riverine/ Urban:
- September 10-19, 1986: Flooding. Declaration of major disaster by President.
- October 28, 1986: Flooding & heavy rain. Declaration of disaster by Governor.
- April 19, 1993: Flooding. $5m property damage across southern Lower Michigan.
- February 9-10, 2001: Flooding. $100k property damage, Oceana County.
- February 24-28, 2001: Flooding. $190k property damage across West Michigan.
- May 15-16, 2001: Flash flooding from severe thunderstorms. $550k property damage, $250k crop damage, Oceana Co.
- May 21-23, 2004: Flooding. $25m property damage and $4.6m crop damage across 23 counties in Lower Michigan.
- April 17-23, 2013: Flooding. $3m property damage, Oceana County.

1.06 Fog:
- January 11-13, 1995: Dense Fog. 4 traffic accident fatalities, 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 Oceana County, 1996-2012: 11
- May 6, 2004: 0.88 inch hail. $20k property damage, $20k crop damage, Oceana County.

1.09 Invasive Species: - Invasive species exist in Oceana County; No significant events identified.

1.10 Lightning: - None Identified.

1.11 Severe Winds:
- August 20 - September 6, 1975: Rainstorms, high winds. Declaration of major disaster by President.
- April 6, 1997: High wind. $5m property damage across southwest Lower Michigan.
- May 31, 1998: Severe thunderstorms. Local, Gubernatorial, and Presidential disaster declarations. $4.m public damage, 37 injuries, 26 homes and 6 businesses destroyed, 1415 homes and 109 businesses damaged in Oceana Co.
- July 8, 1999: Severe thunderstorms. $20k property damage across Oceana 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 17, 2006: Severe thunderstorms. $250k property damage, $50k crop damage, across Oceana County.
- November 17, 2013: High wind. $75k property damage and power outages across Oceana County.

1.12 Subsidence: - None Identified.

1.13 Tornadoes: - None Identified.

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 12 wildfires and 60 acres burned per year on county lands under MDNR jurisdiction (346 total wildfires, 1,766.0 total acres burned).

1.15 Winter Storms:
- March 2-7, 1976: Ice storms. Declaration of major disaster by President.
- January 26-31, 1977: Blizzard, snowstorm. Declaration of emergency by President.
- January 26-27, 1978: Blizzard, snowstorm. Declaration of statewide emergency by President.
- 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.
- January 2-15, 1999: Blizzard, snowstorm. Declaration of emergency by President.

- April 3, 2003: Ice storm. $4.9m property damage throughout West Michigan.
- February 16, 2006: Ice storm. $1m property damage across Lower Michigan.

2. TECHNOLOGICAL HAZARDS

2.01 Dam Failure:

- September 1986: Hart Hydro-Electric Dam, ***Hesperia Dam spillway erosion***, Crystal Valley Dam spillway erosion.

2.02 Energy Emergencies: - None Identified.

2.03 Fire - Scrap Tire: - None Identified; Approximate scrap tire inventory in Oceana County in 2012: 11,000.

2.04 Fire - Structural:

- County fire rate per 1,000 population in 1998: 6.37

2.05 Hazard Material Incidents - Fixed Site (including industrial accidents):

- No incidents identified; SARA Title III Sites in Oceana County in 2012: 83.

2.07 Infrastructure Failure:

- Number of NCDC with mention of downed power lines or power outages in Oceana County, 1993-2012: 32
- January 20, 1994: Frozen sewer/water lines and downed power lines (extreme cold), statewide.
- 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: 90,000 without power statewide (thunderstorm winds).
- May 31, 1998: over 861,000 without power (thunderstorm winds), statewide.
- November 10, 1998: 167,000 power outages (high wind), West Michigan.
- April 3, 2003: Hundreds of thousands lose power (ice storm), Lower Michigan.
- October 10, 2004: 100,000 without power (high wind), statewide.
- December 28, 2008: Hundreds of thousands lose power (high wind), statewide.

2.08 Nuclear Power Plant Emergencies: - None Identified.

2.09 Oil and Natural Gas Well Accidents: - No accidents identified.

- Oil and gas wells in Oceana County in 2012: 1,188

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.

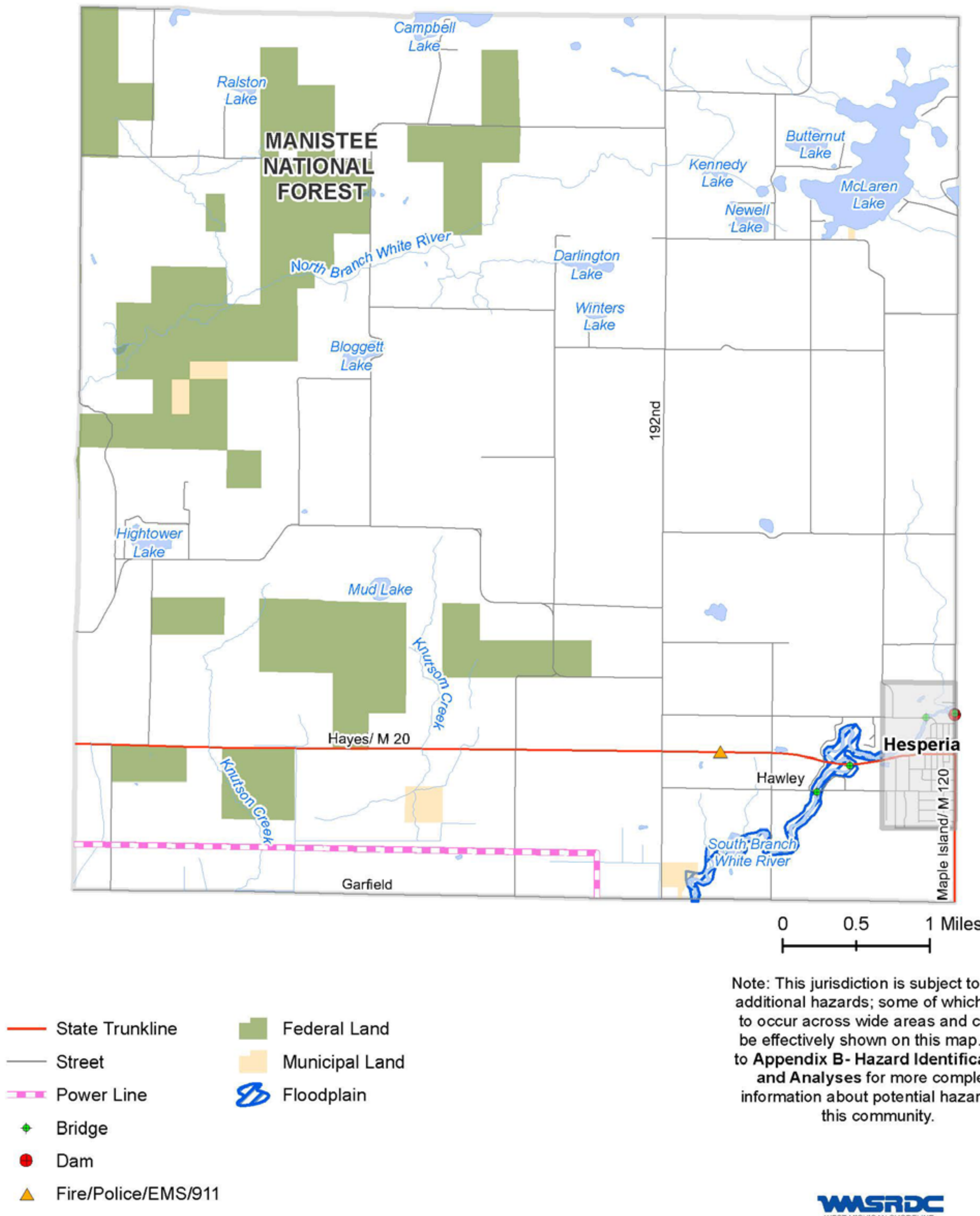
NEWFIELD TOWNSHIP
Hazard Assessment
Ratings

Natural Hazards	Probability of Occurrence	Population Affected	Property Damaged	Economic Impacts
1.01 Celestial Impacts	1	2	0	2
1.02 Drought	2	2	2	3
1.03 Earthquake	0	-	-	-
1.04 Extreme Temperatures	3	2	1	2
1.05 Flooding: Riverine/Urban	3	1	2	1
1.06 Fog	2	1	0	1
1.07 Great Lakes Shoreline	0	-	-	-
1.08 Hail	3	1	2	1
1.09 Invasive Species	2	1	1	1
1.10 Lightning	3	1	2	1
1.11 Severe Winds	3	2	3	2
1.12 Subsidence	1	1	1	1
1.13 Tornadoes	2	1	2	2
1.14 Wildfire	3	2	2	2
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	3
2.03 Fire – Scrap Tires	1	1	1	1
2.04 Fire – Structural	3	1	2	2
2.05 HAZMAT – Fixed Site	2	1	1	2
2.06 HAZMAT – Transportation	2	1	1	2
2.07 Infrastructure Failures	3	3	1	2
2.08 Nuclear Power Emergencies	0	-	-	-
2.09 Oil/Natural Gas Well Accidents	1	1	1	1
2.10 Pipeline Accidents	1	1	1	2
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	3
3.05 Terrorism & Similar Criminal Acts	1	1	1	1

NEWFIELD TOWNSHIP
Hazard Vulnerability
Rankings

Ranking	Hazard	Probability of Occurrence	X	Weighted Impacts	=	Hazard Score
1	Winter Storms	3		15		45
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	Flooding: Riverine/Urban	3		8		24
8	Hail	3		8		24
8	Lightning	3		8		24
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
18	Invasive Species	2		6		12
18	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
n/a	Earthquake	0		-		-
n/a	Great Lakes Shoreline	0		-		-
n/a	Nuclear Attack	0		-		-
n/a	Nuclear Power Emergencies	0		-		-

NEWFIELD 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.

WMSRDC
WEST MICHIGAN SHORELINE REGIONAL DEVELOPMENT COMMISSION

Source: Michigan Geographic Data Library V 12b, Oceana Co. Hazard Mitigation Plan Update 2014

Hazard Identification Profile
Otto Township

1. NATURAL HAZARDS

1.01 Celestial Impacts: - None Identified.

1.02 Drought:
- 12 recorded drought events in the area (including Lake, Mason, Muskegon, Newaygo, and Oceana counties) lasting eight months or greater: 1895-1896, 1899-1900, 1901-1902, 1909-1911, 1925-1926, 1930-1931, 1956-1957, 1962-1963, 1971-1972, 1976-1977, and 2002-2003.
- Summer 1871: Prolonged drought over much of the Great Lakes region.
- May-September, 1891: Drought devastated Michigan's lumber industry.
- 2013: Record "low" Lake Michigan water levels.

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.
- May 16, 1997: Record cold temperatures. $2m crop damage, Oceana County.
- March 2012: Record warm temperatures triggered early growing season. $209.8m crop damage across Michigan.

1.05 Flooding - Riverine/ Urban:
- September 10-19, 1986: Flooding. Declaration of major disaster by President.
- October 28, 1986: Flooding & heavy rain. Declaration of disaster by Governor.
- April 19, 1993: Flooding. $5m property damage across southern Lower Michigan.
- February 9-10, 2001: Flooding. $100k property damage, Oceana County.
- February 24-28, 2001: Flooding. $190k property damage across West Michigan.
- May 15-16, 2001: Flash flooding from severe thunderstorms. $550k property damage, $250k crop damage, Oceana Co.
- May 21-23, 2004: Flooding. $25m property damage and $4.6m crop damage across 23 counties in Lower Michigan.
- April 17-23, 2013: Flooding. $3m property damage, Oceana County.

1.06 Fog:
- January 11-13, 1995: Dense Fog. 4 traffic accident fatalities, 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 Oceana County, 1996-2012: 11
- May 6, 2004: 0.88 inch hail. $20k property damage, $20k crop damage, Oceana County.

1.09 Invasive Species: - Invasive species exist in Oceana County; No significant events identified.

1.10 Lightning: - None Identified.

1.11 Severe Winds:
- August 20 - September 6, 1975: Rainstorms, high winds. Declaration of major disaster by President.
- April 6, 1997: High wind. $5m property damage across southwest Lower Michigan.
- May 31, 1998: Severe thunderstorms. Local, Gubernatorial, and Presidential disaster declarations. $4.m public damage, 37 injuries, 26 homes and 6 businesses destroyed, 1415 homes and 109 businesses damaged in Oceana Co.
- July 8, 1999: Severe thunderstorms. $20k property damage across Oceana 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 17, 2006: Severe thunderstorms. $250k property damage, $50k crop damage, across Oceana County.
- November 17, 2013: High wind. $75k property damage and power outages across Oceana County.

1.12 Subsidence: - None Identified.

1.13 Tornadoes: - None Identified.

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 12 wildfires and 60 acres burned per year on county lands under MDNR jurisdiction (346 total wildfires, 1,766.0 total acres burned).

1.15 Winter Storms:
- March 2-7, 1976: Ice storms. Declaration of major disaster by President.
- January 26-31, 1977: Blizzard, snowstorm. Declaration of emergency by President.
- January 26-27, 1978: Blizzard, snowstorm. Declaration of statewide emergency by President.
- 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.
- January 2-15, 1999: Blizzard, snowstorm. Declaration of emergency by President.

- April 3, 2003: Ice storm. $4.9m property damage throughout West Michigan.
- February 16, 2006: Ice storm. $1m property damage across Lower Michigan.

2. TECHNOLOGICAL HAZARDS

2.01 Dam Failure: - None Identified.

2.02 Energy Emergencies: - None Identified.

2.03 Fire - Scrap Tire: - None Identified; Approximate scrap tire inventory in Oceana County in 2012: 11,000.

2.04 Fire - Structural:
- County fire rate per 1,000 population in 1998: 6.37

2.05 Hazard Material Incidents - Fixed Site (including industrial accidents):
- No incidents identified; SARA Title III Sites in Oceana County in 2012: 83.

2.06 Hazard Material Incidents - Transportation: - None Identified.

2.07 Infrastructure Failure:
- Number of NCDC with mention of downed power lines or power outages in Oceana County, 1993-2012: 32
- January 20, 1994: Frozen sewer/water lines and downed power lines (extreme cold), statewide.
- 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: 90,000 without power statewide (thunderstorm winds).
- May 31, 1998: over 861,000 without power (thunderstorm winds), statewide.
- November 10, 1998: 167,000 power outages (high wind), West Michigan.
- April 3, 2003: Hundreds of thousands lose power (ice storm), Lower Michigan.
- October 10, 2004: 100,000 without power (high wind), statewide.
- December 28, 2008: Hundreds of thousands lose power (high wind), statewide.

2.08 Nuclear Power Plant Emergencies: - None Identified.

2.09 Oil and Natural Gas Well Accidents: - No accidents identified.
- Oil and gas wells in Oceana County in 2012: 1,188

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.

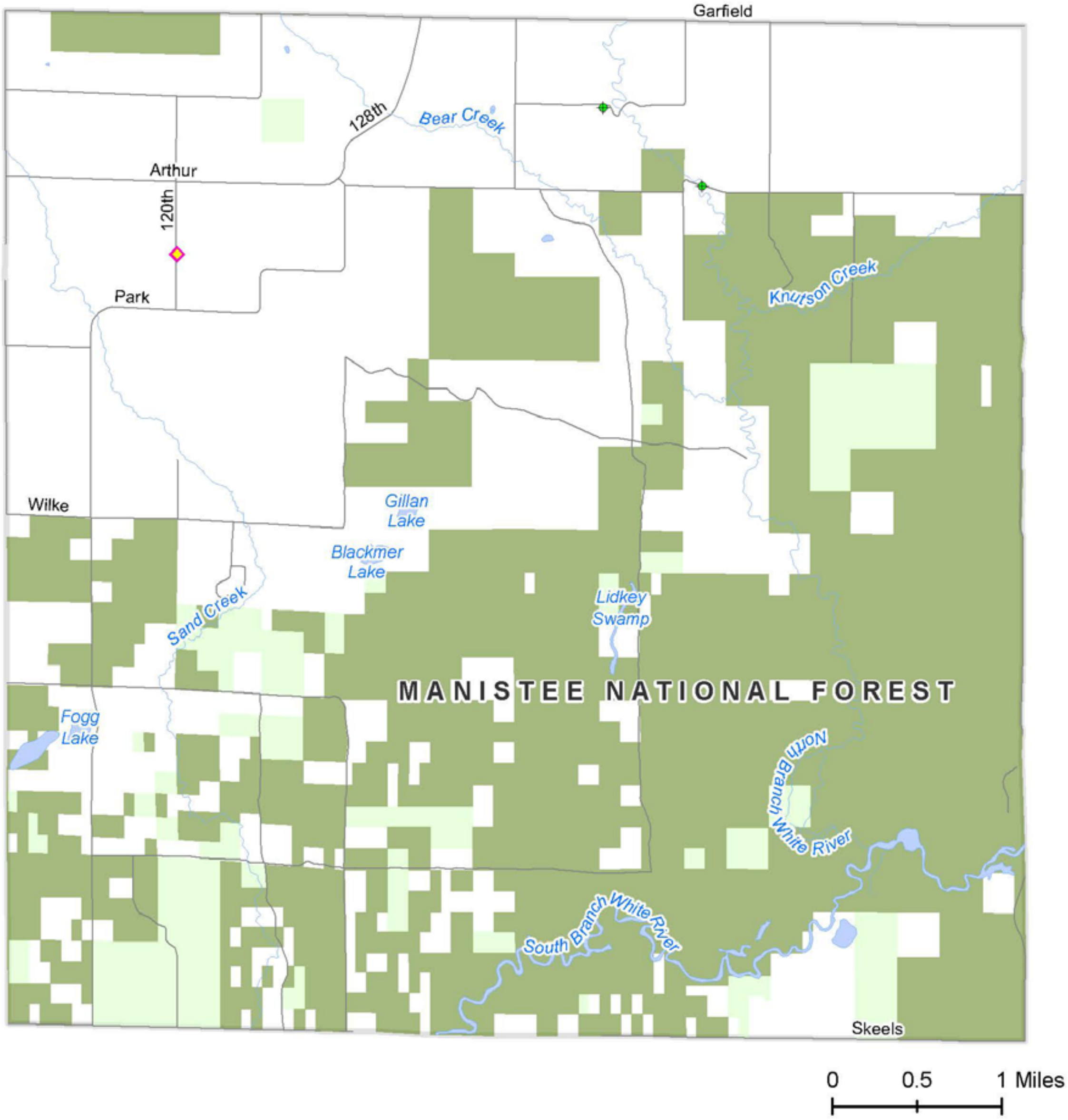
OTTO TOWNSHIP
Hazard Assessment
Ratings

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

OTTO TOWNSHIP
Hazard Vulnerability Rankings

Ranking	Hazard	Probability of Occurrence	X	Weighted Impacts	=	Hazard Score
1	Winter Storms	3		15		45
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	Flooding: Riverine/Urban	3		6		18
10	Public Health Emergencies	2		9		18
10	Tornadoes	2		9		18
15	HAZMAT – Transportation	2		7		14
15	Invasive Species	2		7		14
17	Dam failure	2		6		12
18	Celestial Impacts	1		8		8
18	Fog	2		4		8
20	HAZMAT – Fixed Site	1		7		7
20	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
22	Transportation Accidents	1		6		6
n/a	Earthquake	0		-		-
n/a	Great Lakes Shoreline	0		-		-
n/a	Nuclear Attack	0		-		-
n/a	Nuclear Power Emergencies	0		-		-

OTTO 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.

Street
SARA Title III Site
Bridge
Federal Land
State Land

WMSRDC
WEST MICHIGAN SHORELINE REGIONAL DEVELOPMENT COMMISSION

Source: Michigan Geographic Data Library V 12b, Oceana Co. Hazard Mitigation Plan Update 2014

Hazard Identification Profile
Pentwater Township

1. NATURAL HAZARDS

1.01 Celestial Impacts: - None Identified.

1.02 Drought:

- 12 recorded drought events in the area (including Lake, Mason, Muskegon, Newaygo, and Oceana counties) lasting eight months or greater: 1895-1896, 1899-1900, 1901-1902, 1909-1911, 1925-1926, 1930-1931, 1956-1957, 1962-1963, 1971-1972, 1976-1977, and 2002-2003.
- Summer 1871: Prolonged drought over much of the Great Lakes region.
- May-September, 1891: Drought devastated Michigan's lumber industry.
- 2013: Record "low" Lake Michigan water levels.

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.
- May 16, 1997: Record cold temperatures. $2m crop damage, Oceana County.
- March 2012: Record warm temperatures triggered early growing season. $209.8m crop damage across Michigan.

1.05 Flooding - Riverine/ Urban:

- September 10-19, 1986: Flooding. Declaration of major disaster by President.
- October 28, 1986: Flooding & heavy rain. Declaration of disaster by Governor.
- April 19, 1993: Flooding. $5m property damage across southern Lower Michigan.
- February 9-10, 2001: Flooding. $100k property damage, Oceana County.
- February 24-28, 2001: Flooding. $190k property damage across West Michigan.
- May 15-16, 2001: Flash flooding from severe thunderstorms. $550k property damage, $250k crop damage, Oceana Co.
- May 21-23, 2004: Flooding. $25m property damage and $4.6m crop damage across 23 counties in Lower Michigan.
- April 17-23, 2013: Flooding. $3m property damage, Oceana County.

1.06 Fog:

- January 11-13, 1995: Dense Fog. 4 traffic accident fatalities, school closures, and flight delays across Lower Michigan.

1.07 Great Lakes Shoreline Hazards:

- June 1986: Record high water level on Lake Michigan.
- Extreme high water levels in the Great Lakes: 1929, 1952, 1973, 1986, and 1997.
- 2013: Record low water level on Lake Michigan.
- Extreme low water levels in the Great Lakes: 1926, 1934, 1964, 2003, and 2013.
- Rip current incidents on Lake Michigan, 2002-2012: 77 fatalities, 230 rescues.
- ***July 13, 1938: Seiche/storm surge on Lake Michigan. 3 drowned in Holland, 1 in Muskegon, and 1 near Pentwater.***
- ***August 3, 2011: 13-year old girl died after being swept away by a rip current near the north pier in Pentwater.***

1.08 Hail:

- Severe hail events (1" or greater) recorded in Oceana County, 1996-2012: 11
- May 6, 2004: 0.88 inch hail. $20k property damage, $20k crop damage, Oceana County.

1.09 Invasive Species: - Invasive species exist in Oceana County; No significant events identified.

1.10 Lightning: - None Identified.

1.11 Severe Winds:

- August 20 - September 6, 1975: Rainstorms, high winds. Declaration of major disaster by President.
- April 6, 1997: High wind. $5m property damage across southwest Lower Michigan.
- May 31, 1998: Severe thunderstorms. Local, Gubernatorial, and Presidential disaster declarations. $4.m public damage, 37 injuries, 26 homes and 6 businesses destroyed, 1415 homes and 109 businesses damaged in Oceana Co.
- July 8, 1999: Severe thunderstorms. $20k property damage across Oceana 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 26, 2005: Severe thunderstorms. $15k property damage, Pentwater Village (Pentwater Twp).***
- July 17, 2006: Severe thunderstorms. $250k property damage, $50k crop damage, across Oceana County.
- ***August 1, 2006: Severe thunderstorms. $20k property damage across northwest Oceana County.***
- November 17, 2013: High wind. $75k property damage and power outages across Oceana County.

1.12 Subsidence: - None Identified.

1.13 Tornadoes: - None Identified.

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 12 wildfires and 60 acres burned per year on county lands under MDNR jurisdiction (346 total wildfires, 1,766.0 total acres burned).

1.15 Winter Storms:

- March 2-7, 1976: Ice storms. Declaration of major disaster by President.
- January 26-31, 1977: Blizzard, snowstorm. Declaration of emergency by President.
- January 26-27, 1978: Blizzard, snowstorm. Declaration of statewide emergency by President.
- 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.
- January 2-15, 1999: Blizzard, snowstorm. Declaration of emergency by President.
- April 3, 2003: Ice storm. $4.9m property damage throughout West Michigan.
- February 16, 2006: Ice storm. $1m property damage across Lower Michigan.

2. TECHNOLOGICAL HAZARDS

2.01 Dam Failure: - None Identified.

2.02 Energy Emergencies: - None Identified.

2.03 Fire - Scrap Tire: - None Identified; Approximate scrap tire inventory in Oceana County in 2012: 11,000.

2.04 Fire - Structural:

- County fire rate per 1,000 population in 1998: 6.37

2.05 Hazard Material Incidents - Fixed Site (including industrial accidents):

- No incidents identified; SARA Title III Sites in Oceana County in 2012: 83.

2.06 Hazard Material Incidents - Transportation: - None Identified.

2.07 Infrastructure Failure:

- Number of NCDC with mention of downed power lines or power outages in Oceana County, 1993-2012: 32
- January 20, 1994: Frozen sewer/water lines and downed power lines (extreme cold), statewide.
- 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:*** 90,000 without power statewide (thunderstorm winds). ***Power lines downed in Pentwater.***
- May 31, 1998: over 861,000 without power (thunderstorm winds), statewide.
- November 10, 1998: 167,000 power outages (high wind), West Michigan.
- April 3, 2003: Hundreds of thousands lose power (ice storm), Lower Michigan.
- October 10, 2004: 100,000 without power (high wind), statewide.
- December 28, 2008: Hundreds of thousands lose power (high wind), statewide.

2.08 Nuclear Power Plant Emergencies: - None Identified.

2.09 Oil and Natural Gas Well Accidents: - No accidents identified.

- Oil and gas wells in Oceana County in 2012: 1,188
- ***12 wells with known detectable levels of hydrogen sulfide in Pentwater 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.

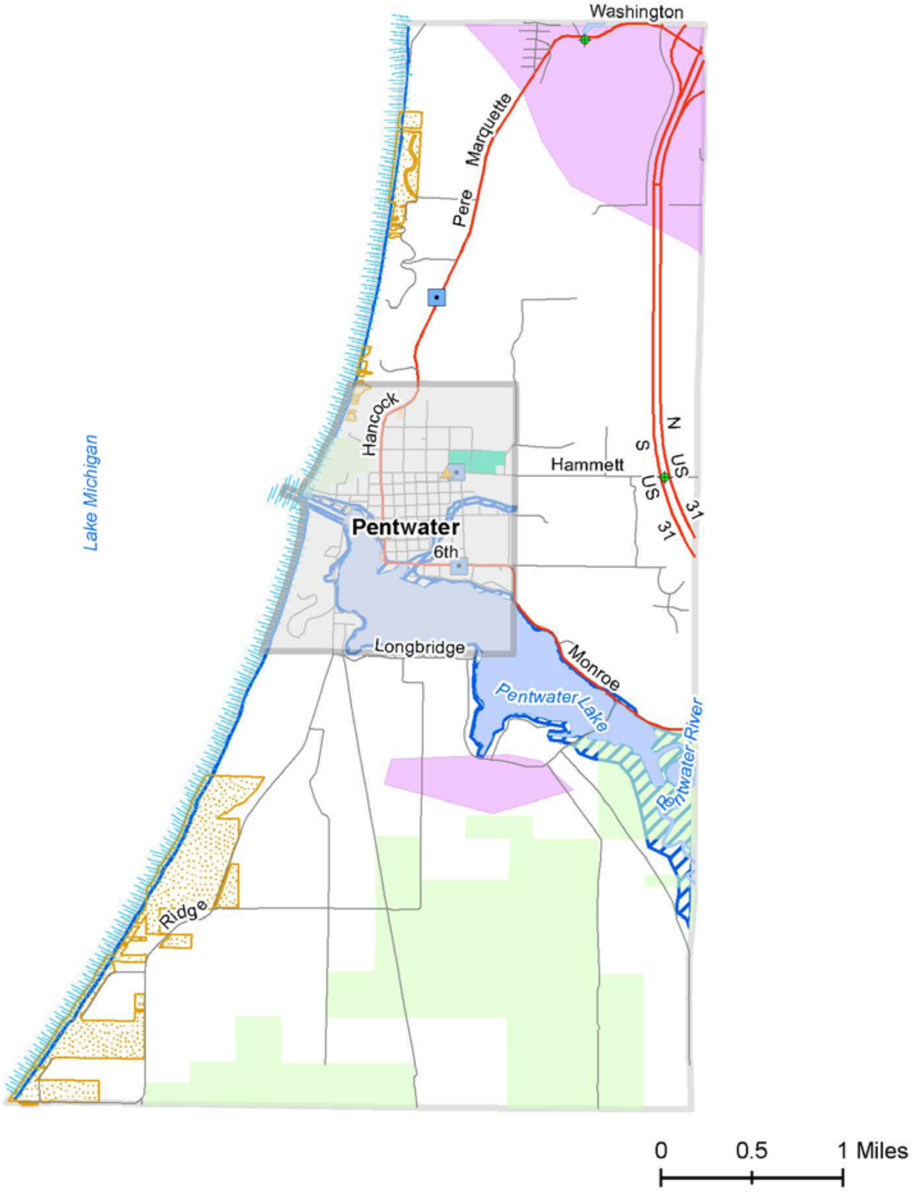
PENTWATER TOWNSHIP
Hazard Assessment
Ratings

Natural Hazards	Probability of Occurrence	Population Affected	Property Damaged	Economic Impacts
1.01 Celestial Impacts	1	2	0	2
1.02 Drought	2	2	2	3
1.03 Earthquake	0	-	-	-
1.04 Extreme Temperatures	3	2	1	2
1.05 Flooding: Riverine/Urban	3	1	2	1
1.06 Fog	3	1	0	1
1.07 Great Lakes Shoreline	3	1	2	1
1.08 Hail	3	1	2	1
1.09 Invasive Species	2	1	1	1
1.10 Lightning	3	1	2	1
1.11 Severe Winds	3	2	3	2
1.12 Subsidence	1	1	1	1
1.13 Tornadoes	2	1	2	2
1.14 Wildfire	3	2	2	2
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	3
2.03 Fire – Scrap Tires	1	1	1	1
2.04 Fire – Structural	3	1	2	2
2.05 HAZMAT – Fixed Site	1	1	1	1
2.06 HAZMAT – Transportation	2	1	1	2
2.07 Infrastructure Failures	3	3	1	2
2.08 Nuclear Power Emergencies	0	-	-	-
2.09 Oil/Natural Gas Well Accidents	2	2	1	1
2.10 Pipeline Accidents	1	1	1	2
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	3
3.05 Terrorism & Similar Criminal Acts	1	1	1	1

PENTWATER TOWNSHIP
Hazard Vulnerability
Rankings

Ranking	Hazard	Probability of Occurrence	X	Weighted Impacts	=	Hazard Score
1	Winter Storms	3		15		45
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	Flooding: Riverine/Urban	3		8		24
8	Great Lakes Shoreline	3		8		24
8	Hail	3		8		24
8	Lightning	3		8		24
12	Catastrophic Incidents	1		18		18
12	Dam failure	2		9		18
12	Energy Emergencies	2		9		18
12	Oil/Natural Gas Well Accidents	2		9		18
12	Public Health Emergencies	2		9		18
12	Tornadoes	2		9		18
18	HAZMAT – Transportation	2		7		14
19	Fog	3		4		12
19	Invasive Species	2		6		12
19	Transportation Accidents	2		6		12
22	Celestial Impacts	1		8		8
23	Pipeline Accidents	1		7		7
24	Civil Disturbances	1		6		6
24	Fire – Scrap Tires	1		6		6
24	HAZMAT – Fixed Site	1		6		6
24	Subsidence	1		6		6
24	Terrorism & Similar Criminal Acts	1		6		6
n/a	Earthquake	0		-		-
n/a	Nuclear Attack	0		-		-
n/a	Nuclear Power Emergencies	0		-		-

PENTWATER TOWNSHIP
Critical Facilities and Potential Hazards



State Trunkline
Street
Great Lakes Shoreline Hazard
Bridge
Shelter
Municipal Land
State Land
High-Risk Erosion Area
Oil/ Gas Field
Floodplain

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, Oceana Co. Hazard Mitigation Plan Update 2014

Hazard Identification Profile

Shelby Township

1. NATURAL HAZARDS

1.01 Celestial Impacts: - None Identified.

1.02 Drought:

- 12 recorded drought events in the area (including Lake, Mason, Muskegon, Newaygo, and Oceana counties) lasting eight months or greater: 1895-1896, 1899-1900, 1901-1902, 1909-1911, 1925-1926, 1930-1931, 1956-1957, 1962-1963, 1971-1972, 1976-1977, and 2002-2003.
- Summer 1871: Prolonged drought over much of the Great Lakes region.
- May-September, 1891: Drought devastated Michigan's lumber industry.
- 2013: Record "low" Lake Michigan water levels.

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.
- May 16, 1997: Record cold temperatures. $2m crop damage, Oceana County.
- March 2012: Record warm temperatures triggered early growing season. $209.8m crop damage across Michigan.

1.05 Flooding - Riverine/ Urban:

- September 10-19, 1986: Flooding. Declaration of major disaster by President.
- October 28, 1986: Flooding & heavy rain. Declaration of disaster by Governor.
- April 19, 1993: Flooding. $5m property damage across southern Lower Michigan.
- February 9-10, 2001: Flooding. $100k property damage, Oceana County.
- February 24-28, 2001: Flooding. $190k property damage across West Michigan.
- May 15-16, 2001: Flash flooding from severe thunderstorms. $550k property damage, $250k crop damage, Oceana Co.
- May 21-23, 2004: Flooding. $25m property damage and $4.6m crop damage across 23 counties in Lower Michigan.
- April 17-23, 2013: Flooding. $3m property damage, Oceana County.

1.06 Fog:

- January 11-13, 1995: Dense Fog. 4 traffic accident fatalities, 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 Oceana County, 1996-2012: 11
- ***May 10, 2003: 1.00 inch hail. $20k property damage, $10k crop damage, New Era Village (Grant and Shelby Twps).***
- May 6, 2004: 0.88 inch hail. $20k property damage, $20k crop damage, Oceana County.
- ***May 23, 2004: 0.75 inch hail. $15k property damage, $15k crop damage, New Era Village (Grant and Shelby Twps).***

1.09 Invasive Species: - Invasive species exist in Oceana County; No significant events identified.

1.10 Lightning: - None Identified.

1.11 Severe Winds:

- August 20 - September 6, 1975: Rainstorms, high winds. Declaration of major disaster by President.
- April 6, 1997: High wind. $5m property damage across southwest Lower Michigan.
- May 31, 1998: Severe thunderstorms. Local, Gubernatorial, and Presidential disaster declarations. $4.m public damage, 37 injuries, 26 homes and 6 businesses destroyed, 1415 homes and 109 businesses damaged in Oceana Co.
- July 8, 1999: Severe thunderstorms. $20k property damage across Oceana County.
- ***May 12, 2000: Severe thunderstorms. $50k property damage, Shelby Twp.***
- 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 17, 2006: Severe thunderstorms. $250k property damage, $50k crop damage, across Oceana County.
- November 17, 2013: High wind. $75k property damage and power outages across Oceana County.

1.12 Subsidence: - None Identified.

1.13 Tornadoes: - None Identified.

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 12 wildfires and 60 acres burned per year on county lands under MDNR jurisdiction (346 total wildfires, 1,766.0 total acres burned).

1.15 Winter Storms:

- March 2-7, 1976: Ice storms. Declaration of major disaster by President.
- January 26-31, 1977: Blizzard, snowstorm. Declaration of emergency by President.
- January 26-27, 1978: Blizzard, snowstorm. Declaration of statewide emergency by President.
- 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.
- January 2-15, 1999: Blizzard, snowstorm. Declaration of emergency by President.
- April 3, 2003: Ice storm. $4.9m property damage throughout West Michigan.
- February 16, 2006: Ice storm. $1m property damage across Lower Michigan.

2. TECHNOLOGICAL HAZARDS

2.01 Dam Failure: - None Identified.

2.02 Energy Emergencies: - None Identified.

2.03 Fire - Scrap Tire: - None Identified; Approximate scrap tire inventory in Oceana County in 2012: 11,000.

2.04 Fire - Structural:

- County fire rate per 1,000 population in 1998: 6.37

2.05 Hazard Material Incidents - Fixed Site (including industrial accidents):

- No incidents identified; SARA Title III Sites in Oceana County in 2012: 83.

2.06 Hazard Material Incidents - Transportation: - None Identified.

2.07 Infrastructure Failure:

- Number of NCDC with mention of downed power lines or power outages in Oceana County, 1993-2012: 32
- January 20, 1994: Frozen sewer/water lines and downed power lines (extreme cold), statewide.
- 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: 90,000 without power statewide (thunderstorm winds).
- May 31, 1998: over 861,000 without power (thunderstorm winds), statewide.
- November 10, 1998: 167,000 power outages (high wind), West Michigan.
- April 3, 2003: Hundreds of thousands lose power (ice storm), Lower Michigan.
- October 10, 2004: 100,000 without power (high wind), statewide.
- December 28, 2008: Hundreds of thousands lose power (high wind), statewide.

2.08 Nuclear Power Plant Emergencies: - None Identified.

2.09 Oil and Natural Gas Well Accidents: - No accidents identified.

- Oil and gas wells in Oceana County in 2012: 1,188

2.10 Pipeline Accidents:

- ***March 5, 2010: Damage to residential gas meter causing natural gas leak. Minor neighborhood evacuations and temporary relocation of schoolchildren, Shelby Village.***

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.

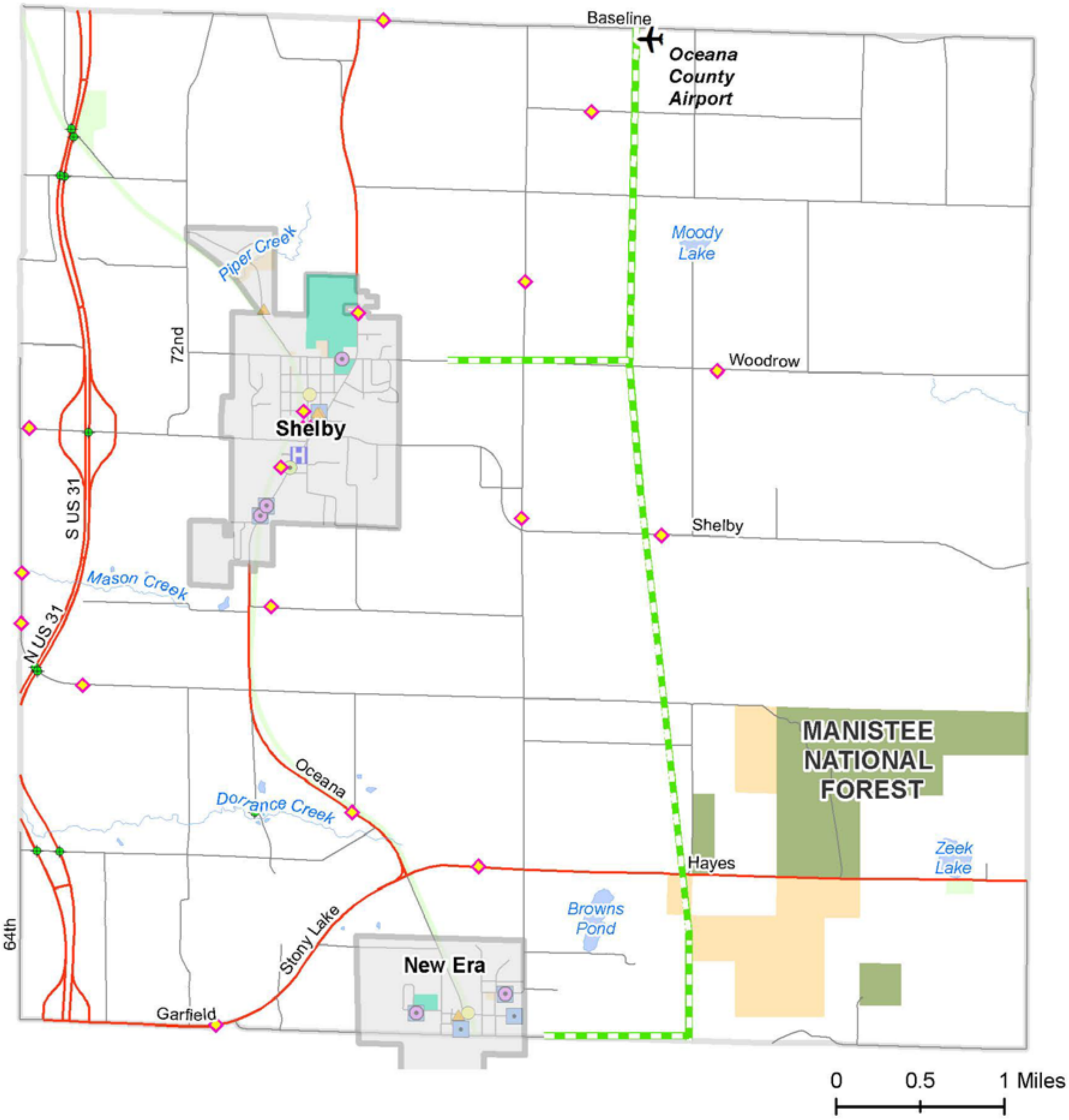
SHELBY TOWNSHIP
Hazard Assessment
Ratings

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

SHELBY TOWNSHIP
Hazard Vulnerability
Rankings

Ranking	Hazard	Probability of Occurrence	X	Weighted Impacts	=	Hazard Score
1	Winter Storms	3		15		45
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	Transportation Accidents	2		6		12
18	Pipeline Accidents	1		10		10
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	Flooding: Riverine/Urban	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
n/a	Dam failure	0		-		-
n/a	Earthquake	0		-		-
n/a	Great Lakes Shoreline	0		-		-
n/a	Nuclear Attack	0		-		-
n/a	Nuclear Power Emergencies	0		-		-

SHELBY TOWNSHIP
Critical Facilities and Potential Hazards



State Trunkline
Street
Gas Pipeline
SARA Title III Site
Bridge
Airport
Federal Land
State Land
Municipal 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 Geograhpic Data Library V 12b, Oceana Co. Hazard Mitigation Plan Update 2014

Hazard Identification Profile

Weare Township

1. NATURAL HAZARDS

1.01 Celestial Impacts: - None Identified.

1.02 Drought:

- 12 recorded drought events in the area (including Lake, Mason, Muskegon, Newaygo, and Oceana counties) lasting eight months or greater: 1895-1896, 1899-1900, 1901-1902, 1909-1911, 1925-1926, 1930-1931, 1956-1957, 1962-1963, 1971-1972, 1976-1977, and 2002-2003.
- Summer 1871: Prolonged drought over much of the Great Lakes region.
- May-September, 1891: Drought devastated Michigan's lumber industry.
- 2013: Record "low" Lake Michigan water levels.

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.
- May 16, 1997: Record cold temperatures. $2m crop damage, Oceana County.
- March 2012: Record warm temperatures triggered early growing season. $209.8m crop damage across Michigan.

1.05 Flooding - Riverine/ Urban:

- September 10-19, 1986: Flooding. Declaration of major disaster by President.
- October 28, 1986: Flooding & heavy rain. Declaration of disaster by Governor.
- April 19, 1993: Flooding. $5m property damage across southern Lower Michigan.
- February 9-10, 2001: Flooding. $100k property damage, Oceana County.
- February 24-28, 2001: Flooding. $190k property damage across West Michigan.
- May 15-16, 2001: Flash flooding from severe thunderstorms. $550k property damage, $250k crop damage, Oceana Co.
- May 21-23, 2004: Flooding. $25m property damage and $4.6m crop damage across 23 counties in Lower Michigan.
- April 17-23, 2013: Flooding. $3m property damage, Oceana County.

1.06 Fog:

- January 11-13, 1995: Dense Fog. 4 traffic accident fatalities, 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 Oceana County, 1996-2012: 11
- May 6, 2004: 0.88 inch hail. $20k property damage, $20k crop damage, Oceana County.

1.09 Invasive Species: - Invasive species exist in Oceana County; No significant events identified.

1.10 Lightning: - None Identified.

1.11 Severe Winds:

- August 20 - September 6, 1975: Rainstorms, high winds. Declaration of major disaster by President.
- April 6, 1997: High wind. $5m property damage across southwest Lower Michigan.
- May 31, 1998: Severe thunderstorms. Local, Gubernatorial, and Presidential disaster declarations. $4.m public damage, 37 injuries, 26 homes and 6 businesses destroyed, 1415 homes and 109 businesses damaged in Oceana Co.
- July 8, 1999: Severe thunderstorms. $20k property damage across Oceana 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 17, 2006: Severe thunderstorms. $250k property damage, $50k crop damage, across Oceana County.
- ***August 1, 2006: Severe thunderstorms. $20k property damage across northwest Oceana County.***
- November 17, 2013: High wind. $75k property damage and power outages across Oceana County.

1.12 Subsidence: - None Identified.

1.13 Tornadoes:

- ***March 30, 1977: Tornado (F1). $25k property damage, Weare 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 12 wildfires and 60 acres burned per year on county lands under MDNR jurisdiction (346 total wildfires, 1,766.0 total acres burned).

1.15 Winter Storms:

- March 2-7, 1976: Ice storms. Declaration of major disaster by President.
- January 26-31, 1977: Blizzard, snowstorm. Declaration of emergency by President.
- January 26-27, 1978: Blizzard, snowstorm. Declaration of statewide emergency by President.
- 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.
- January 2-15, 1999: Blizzard, snowstorm. Declaration of emergency by President.
- April 3, 2003: Ice storm. $4.9m property damage throughout West Michigan.
- February 16, 2006: Ice storm. $1m property damage across Lower Michigan.

2. TECHNOLOGICAL HAZARDS

2.01 Dam Failure: - None Identified.

2.02 Energy Emergencies: - None Identified.

2.03 Fire - Scrap Tire: - None Identified; Approximate scrap tire inventory in Oceana County in 2012: 11,000.

2.04 Fire - Structural:
- County fire rate per 1,000 population in 1998: 6.37

2.05 Hazard Material Incidents - Fixed Site (including industrial accidents):
- No incidents identified; SARA Title III Sites in Oceana County in 2012: 83.

2.06 Hazard Material Incidents - Transportation: - None Identified.

2.07 Infrastructure Failure:
- Number of NCDC with mention of downed power lines or power outages in Oceana County, 1993-2012: 32
- January 20, 1994: Frozen sewer/water lines and downed power lines (extreme cold), statewide.
- 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: 90,000 without power statewide (thunderstorm winds).
- May 31, 1998: over 861,000 without power (thunderstorm winds), statewide.
- November 10, 1998: 167,000 power outages (high wind), West Michigan.
- April 3, 2003: Hundreds of thousands lose power (ice storm), Lower Michigan.
- October 10, 2004: 100,000 without power (high wind), statewide.
- December 28, 2008: Hundreds of thousands lose power (high wind), statewide.

2.08 Nuclear Power Plant Emergencies: - None Identified.

2.09 Oil and Natural Gas Well Accidents: - No accidents identified.
- Oil and gas wells in Oceana County in 2012: 1,188
- ***31 wells with known detectable levels of hydrogen sulfide Weare 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.

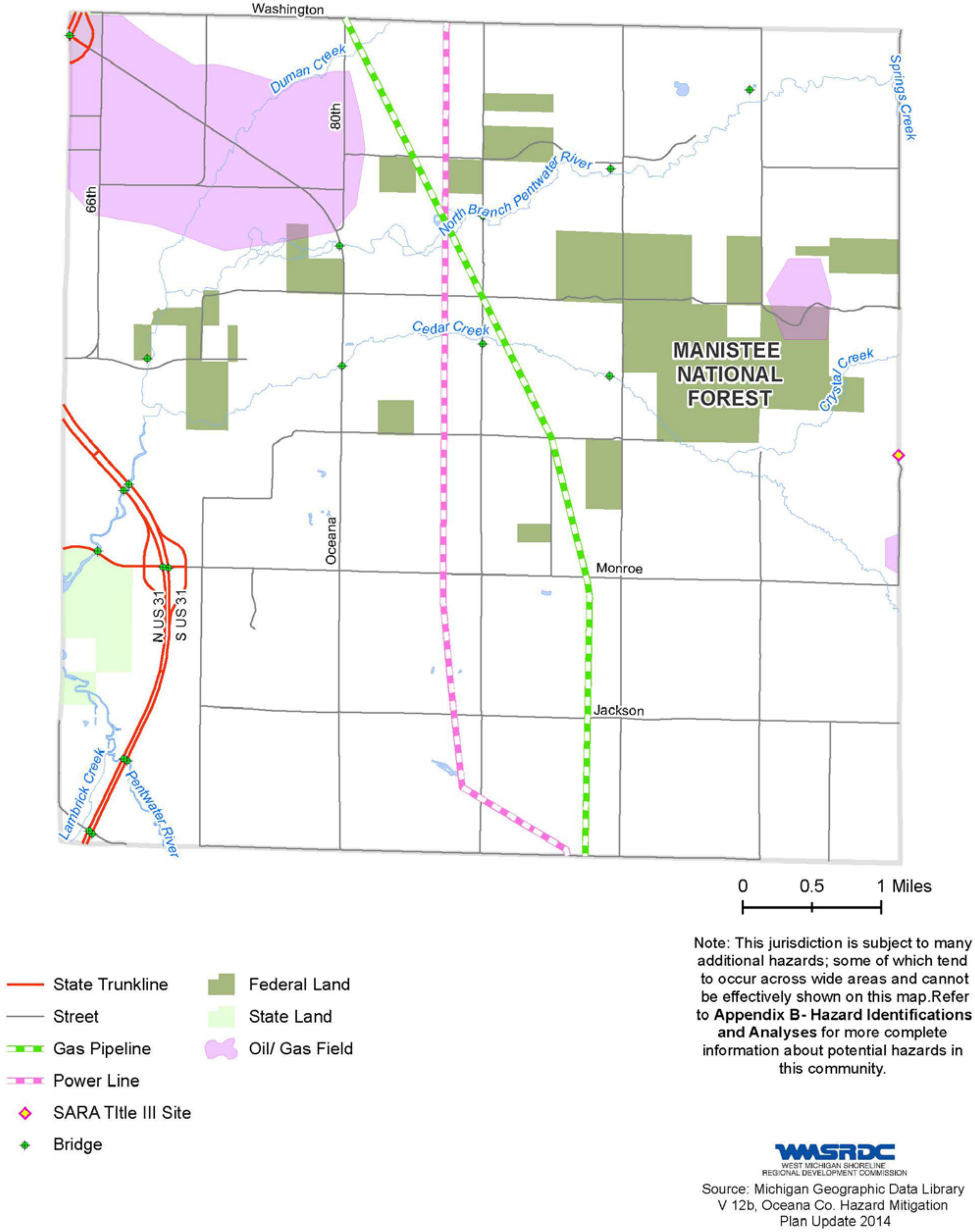
3.05 Terrorism and Similar Criminal Activities: - None Identified.

WEARE TOWNSHIP
Hazard Assessment
Ratings

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

WEARE TOWNSHIP Hazard Vulnerability Rankings				
Ranking	Hazard	Probability of Occurrence X	Weighted Impacts =	Hazard Score
1	Winter Storms	3	15	45
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	Flooding: Riverine/Urban	2	8	16
17	HAZMAT – Fixed Site	2	7	14
17	HAZMAT – Transportation	2	7	14
19	Dam failure	2	6	12
19	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
n/a	Earthquake	0	-	-
n/a	Great Lakes Shoreline	0	-	-
n/a	Nuclear Attack	0	-	-
n/a	Nuclear Power Emergencies	0	-	-

WEARE TOWNSHIP
Critical Facilities and Potential Hazards



Appendix C:
HAZARD IDENTIFICATION DATA AND MAPS

National Climatic Data Center: Storm Events

157 events reported in Oceana County between 01/01/1950 and 03/31/2005

The NCDC Database contains data from the following sources:
- All Weather Events from 1993 - 1995, as entered into Storm Data. (Except 6/93 - 7/93, which is missing Latitude/Longitude)
- All Weather Events from 1996 - Current, as entered into Storm Data. (Including Latitude/Longitude)
- Storm Prediction Center data including: Tornadoes 1950-1992, Thunderstorm Winds 1955-1992, and Hail 1955-1992.

COUNTY	DATE	TIME	TYPE	MAGNITUDE	DEATHS	INJURIES	PROP DMG	CROP DMG
1 OCEANA	9/1/60	1130	Tstm Wind	0 kts.	0	0	0	0
2 OCEANA	9/9/65	1843	Tstm Wind	0 kts.	0	0	0	0
3 OCEANA	8/15/66	1750	Tstm Wind	0 kts.	0	0	0	0
4 OCEANA	4/6/67	0035	Tstm Wind	0 kts.	0	0	0	0
5 OCEANA	7/11/67	1530	Tornado	F1	0	0	25K	0
6 OCEANA	5/14/68	1920	Hail	1.75 in.	0	0	0	0
7 OCEANA	3/30/77	1630	Tornado	F1	0	3	25K	0
8 OCEANA	7/26/78	1115	Tstm Wind	0 kts.	0	0	0	0
9 OCEANA	8/15/78	2305	Tornado	F2	0	12	50K	0
10 OCEANA	6/20/79	1800	Hail	1.75 in.	0	0	0	0
11 OCEANA	6/20/79	1810	Tstm Wind	0 kts.	0	0	0	0
12 OCEANA	4/4/81	235	Tstm Wind	0 kts.	0	0	0	0
13 OCEANA	8/3/82	2020	Tstm Wind	0 kts.	0	0	0	0
14 OCEANA	7/21/83	1715	Tstm Wind	0 kts.	0	0	0	0
15 OCEANA	7/28/83	215	Tstm Wind	0 kts.	0	0	0	0
16 OCEANA	7/29/83	145	Tstm Wind	0 kts.	0	0	0	0
17 OCEANA	7/29/83	230	Tstm Wind	0 kts.	0	0	0	0
18 OCEANA	7/31/83	1615	Hail	0.75 in.	0	0	0	0
19 OCEANA	7/31/83	1700	Hail	0.75 in.	0	0	0	0
20 OCEANA	5/6/86	1550	Hail	0.75 in.	0	0	0	0
21 OCEANA	4/5/88	2220	Hail	0.75 in.	0	0	0	0
22 OCEANA	8/4/89	2300	Tstm Wind	0 kts.	0	0	0	0
23 OCEANA	9/14/90	635	Tornado	F1	0	0	25K	0
24 OCEANA	5/28/91	1805	Tornado	F2	0	0	250K	0
25 OCEANA	6/14/91	1610	Tstm Wind	0 kts.	0	0	0	0
26 OCEANA	7/3/91	1630	Tstm Wind	0 kts.	0	0	0	0
27 OCEANA	9/9/91	1830	Tstm Wind	0 kts.	0	0	0	0
28 OCEANA	9/9/91	1840	Hail	0.75 in.	0	0	0	0
29 OCEANA	6/17/92	1310	Tstm Wind	0 kts.	0	0	0	0
30 MIZ004	1/12/93	2300	Heavy Snow	N/A	0	0	50K	0
31 MIZ001	1/21/93	0	Ice Storm	N/A	0	0	0	0
32 MIZ004	3/23/93	300	Freezing Rain	N/A	0	0	0	0
33 Lower MI	4/1/93	0	Heavy Snow	N/A	0	0	50K	0
34 MIZ001	4/19/93	1200	Flood	N/A	0	0	5.0M	0
35 MIZ001	12/23/93	1400	Heavy Snow	N/A	0	0	0	0
36 Near L	1/12/94	0	Heavy Snow	N/A	0	0	500K	0
37 Miz000	1/13/94	0	Record Cold	N/A	0	0	50.0M	0
38 All	1/27/94	0	Hvy Snw/frzing Rain	N/A	0	0	5.0M	0
39 W. Lower MI	2/2/94	0	Heavy Snow	N/A	0	0	0	0
40 Central	2/22/94	1900	Heavy Snow	N/A	0	0	0	0
41 Hart	7/4/94	2230	Tstm Winds	N/A	0	0	0	0
42 New Era	7/20/94	335	Thunderstorm Winds	N/A	0	0	0	0
43 S. Lower	12/6/94	1800	Heavy Snow	N/A	0	0	0	0
44 N. Lower	12/16/94	1900	Heavy Snow	N/A	0	0	0	0
45 Lower MI	1/11/95	1800	Dense Fog	N/A	0	0	0	0
46 UP & S. Lower	1/20/95	0	Heavy Snow	N/A	0	0	0	0
47 UP & W. Lower	2/7/95	0	Heavy Lake Snow	N/A	0	0	0	0
48 S. Lower	2/25/95	1500	Heavy Snow	N/A	0	0	0	0
49 S. Lower	2/27/95	100	Ice Storm	N/A	0	0	0	0
50 Lower MI	3/6/95	0	Ice Storm	N/A	0	0	0	0
51 UP & NW Lower	3/6/95	0	Heavy Snow	N/A	0	0	0	0
52 Lower MI	3/28/95	1500	Heavy Snow	N/A	0	0	0	0
53 New Era	4/18/95	1851	Tstm Winds	N/A	0	0	0	0
54 Walkerville	7/15/95	1400	Tstm Winds	N/A	0	0	15K	0
55 Rothbury	8/13/95	1805	Tstm Winds	50 kts	0	0	0	0
56 W. Lower	11/27/95	700	Heavy Snow	N/A	0	0	0	0
57 Shelby	4/12/96	12:00PM	Hail	1.75 in.	0	0	0	0
58 MIZ037	11/10/96	01:00AM	Heavy Snow	N/A	0	0	0	0
59 MIZ037	12/25/96	07:00PM	Heavy Snow	N/A	0	0	0	0
60 MIZ043	1/10/97	02:00AM	Heavy Snow	N/A	0	0	0	0
61 MIZ039	1/15/97	11:00PM	Heavy Snow	N/A	0	0	0	0
62 MIZ043	1/25/97	03:00AM	Heavy Snow	N/A	0	0	0	0
63 Rothbury	2/21/97	08:00AM	Flash Flood	N/A	0	0	0	0
64 Lower MI	4/6/97	4:00PM	High Wind	N/A	0	0	5.0M	0

65 Stony Lake	4/6/97	4:20 PM	High Wind	61 kts.	0	0	0	0
66 MIZ043	5/16/97	12:00AM	Extreme Cold	N/A	0	0	0	2.0M
67 MIZ037	11/11/97	9:00 PM	Lake Snow	N/A	0	0	0	0
68 MIZ037	12/4/97	7:00 PM	Lake Snow	N/A	0	0	0	0
69 MIZ043	12/24/97	4:00 PM	Winter Storm	N/A	0	0	0	0
70 MIZ037	12/30/97	7:00 AM	Lake Snow	N/A	0	0	0	0
71 MIZ037	1/4/98	12:00 AM	Freezing Rain	N/A	0	0	0	0
72 MIZ037	1/7/98	5:00 PM	Winter Storm	N/A	0	0	0	0
73 MIZ037	1/22/98	7:00 PM	Winter Storm	N/A	0	0	0	0
74 MIZ037	3/9/98	7:00 AM	Blizzard	N/A	0	0	0	0
75 MIZ037	3/10/98	1:00 AM	Lake Snow	N/A	0	0	0	0
76 MIZ037	3/13/98	3:00 PM	Heavy Snow	N/A	0	0	0	0
77 Pentwater	5/29/98	12:10 AM	Tstm Wind	0 kts.	0	0	10K	0
78 Oceana Co.	5/31/98	3:50 AM	Tstm Wind	N/A	0	37	4.0M	0
79 Pentwater	5/31/98	3:53 AM	Tstm Wind	52 kts	0	0	0	0
80 Mears	6/25/98	9:40 PM	Tstm Wind	70 kts.	0	0	0	0
81 Hart	8/4/98	6:40 AM	Flash Flood	N/A	0	0	0	0
82 MIZ037	11/10/98	10:00 AM	High Wind	87 kts.	1	0	0	0
83 MIZ037	12/21/98	1:00 PM	Lake Snow	N/A	0	0	0	0
84 W. Lower MI	12/29/98	7:00 PM	Lake Effect Snow	N/A	0	0	0	0
85 MIZ037	1/2/99	7:00 AM	Blizzard	N/A	0	0	0	0
86 MIZ037	1/3/99	12:00 AM	Heavy Snow	N/A	0	0	0	0
87 W. Lower MI	1/4/99	12:00 AM	Snow	N/A	0	0	0	0
88 MIZ037	1/5/99	9:00 PM	Lake Snow	N/A	0	0	0	0
89 MIZ037	1/8/99	8:00 AM	Lake Snow	N/A	0	0	0	0
90 MIZ037	1/10/99	4:00 AM	Winter Storm	N/A	0	0	0	0
91 MIZ037	1/11/99	4:00 AM	Snow	N/A	0	0	0	0
92 MIZ037	2/5/99	7:00 PM	Freezing Rain	N/A	0	0	0	0
93 MIZ043	2/12/99	11:00 AM	Lake Snow	N/A	0	0	0	0
94 MIZ037	3/2/99	2:00 PM	Snow	N/A	0	0	0	0
95 MIZ037	3/4/99	10:00 PM	Snow	N/A	0	0	0	0
96 MIZ037	3/8/99	10:00 PM	Snow	N/A	0	0	0	0
97 Countywide	7/8/99	10:45 PM	Tstm Wind	53 kts.	0	0	20K	0
98 MIZ043	12/28/99	7:00 AM	Heavy Snow	N/A	0	0	0	0
99 MIZ037	1/3/00	3:00 PM	Winter Storm	N/A	0	0	0	0
100 MIZ037	1/12/00	12:00 PM	Winter Storm	N/A	0	0	0	0
101 MIZ037	1/19/00	4:00 PM	Winter Storm	N/A	0	0	0	0
102 MIZ037	1/25/00	10:00 AM	Winter Storm	N/A	0	0	0	0
103 Rothbury	3/8/00	9:20 PM	Hail	0.75 in.	0	0	10K	0
104 Hart	3/8/00	9:30 PM	Hail	0.75 in.	0	0	10K	0
105 MIZ037	4/7/00	12:00 PM	Winter Storm	N/A	0	0	0	0
106 Shelby	5/12/00	1:15 AM	Tstm Wind	53 kts.	0	0	50K	0
107 Hart	6/1/00	8:35 PM	Tstm Wind	53 kts.	0	0	50K	0
108 Walkerville	7/13/00	9:30 PM	Hail	1.75 in.	0	0	50K	25K
109 MIZ037	11/19/00	6:00 PM	Winter Storm	N/A	0	0	0	0
110 MIZ037	12/5/00	7:00 PM	Heavy Snow	N/A	0	0	0	0
111 MIZ037	12/11/00	6:00 AM	Winter Storm	N/A	0	0	0	0
112 W. Lower MI	12/19/00	7:00 AM	Heavy Snow	N/A	0	0	0	0
113 MIZ037	12/20/00	7:00 PM	Heavy Snow	N/A	0	0	0	0
114 MIZ037	12/23/00	7:00 AM	Heavy Snow	N/A	0	0	0	0
115 MIZ037	2/7/01	10:00 PM	Winter Storm	N/A	0	0	0	0
116 Countywide	2/9/01	9:00 AM	Flood	N/A	0	0	100K	0
117 MIZ043	2/24/01	9:00 PM	Flood	N/A	0	0	190K	0
118 Countywide	5/15/01	8:00 AM	Flood	N/A	0	0	25K	25K
119 Countywide	5/15/01	12:40 AM	Flash Flood	N/A	0	0	500K	200K
120 Countywide	5/16/01	1:00 AM	Flash Flood	N/A	0	0	25K	25K
121 Ferry	9/7/01	11:16 PM	Tstm Wind	53 kts	0	0	5K	0
122 Hart	9/7/01	10:56 PM	Tstm Wind	53 kts.	0	0	5K	0
123 MIZ037	12/23/01	3:00 PM	Winter Storm	N/A	0	0	0	0
124 MIZ037	1/16/02	10:00 AM	Winter Storm	N/A	0	0	0	0
125 MIZ037	2/25/02	7:00 PM	Winter Storm	N/A	0	0	0	0
126 MIZ037	3/2/02	1:00 AM	Winter Storm	N/A	0	0	0	0
127 MIZ037	3/9/02	12:54 PM	High Wind	62 kts.	0	0	485K	0
128 Pentwater	4/18/02	7:35 PM	Hail	1.00 in.	0	0	10K	10K
129 Hesperia	4/18/02	8:15 PM	Tstm Wind	53 kts.	0	0	5K	0
130 Hesperia	4/18/02	11:40 PM	Tstm Wind	53 kts	0	0	5K	0
131 Mears	5/6/02	9:10 PM	Hail	1.00 in.	0	0	5K	5K
132 Shelby	5/6/02	9:18 PM	Hail	1.00 in.	0	0	5K	5K
133 Hart	7/8/02	7:11 PM	Tstm Wind	53 kts.	0	0	10K	0
134 New Era	8/1/02	7:50 PM	Hail	0.75 in.	0	0	10K	5K
135 MIZ037	1/18/03	10:00 AM	Heavy Snow	N/A	0	0	0	0
136 W. Lower MI	2/10/03	4:00 AM	Heavy Snow	N/A	0	0	0	0
137 MIZ037	2/11/03	10:00 AM	Heavy Snow	N/A	0	0	0	0
138 MIZ037	3/4/03	6:00 PM	Heavy Snow	N/A	0	0	0	0
139 MIZ037	4/3/03	10:00 AM	Ice Storm	N/A	0	0	4.9M	0

140 New Era	5/10/03	11:30 PM	Hail	1.00 in.	0	0	20K	10K
141 Countywide	8/1/03	8:28 PM	Tstm Wind	52 kts.	0	0	10K	0
142 Countywide	8/2/03	12:15 PM	Tstm Wind	52 kts.	0	0	10K	0
143 Crystal Vly	8/21/03	3:45 AM	Tstm Wind	52 kts.	0	0	15K	0
144 MIZ037	1/14/04	4:00 AM	Heavy Snow	N/A	0	0	0	0
145 MIZ037	1/18/04	7:00 AM	Heavy Snow	N/A	0	0	0	0
146 MIZ037	1/27/04	7:00 AM	Winter Storm	N/A	0	0	0	0
147 Shelby	3/1/04	09:51 PM	Hail	0.75 in.	0	0	5K	0
148 Pentwater	5/6/04	09:40 AM	Hail	0.88 in.	0	0	20K	20K
149 MIZ037	5/21/04	11:32 PM	Flood	N/A	0	0	25.0M	4.6M
150 New Era	5/23/04	07:32 PM	Hail	0.75 in.	0	0	15K	15K
151 Rothbury	8/27/04	03:45 AM	Tstm Wind	53 kts.	0	0	10K	0
152 MIZ037	10/30/04	11:00 AM	High Wind	59 kts.	0	0	1.2M	0
153 MIZ037	12/20/04	07:00 AM	Heavy Snow	N/A	0	0	0	0
154 MIZ037	1/18/05	11:00 AM	Heavy Snow	N/A	0	0	0	0
155 MIZ037	2/20/05	05:00 AM	Heavy Snow	N/A	0	0	0	0
156 MIZ037	2/27/05	07:00 PM	Heavy Snow	N/A	0	0	0	0
157 Hart	3/30/05	08:10 PM	Tstm Wind	50 kts.	0	0	10K	0

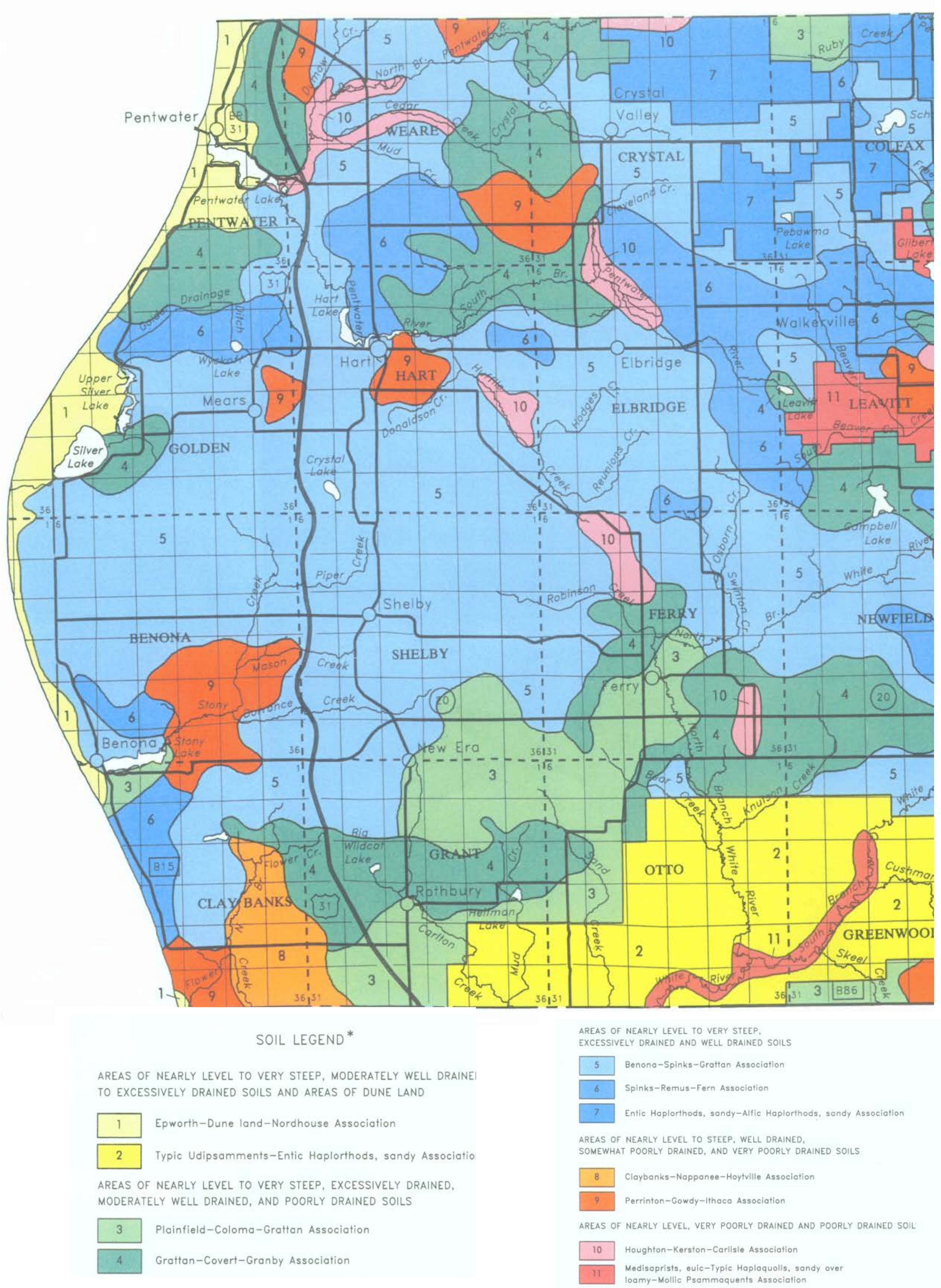
National Climatic Data Center: Storm Events

04/01/2005 through 03/31/2014 ♦ 78 events reported for Oceana County

Location or Zone (zone indicates multiple counties)	Date	Duration	Type	Magnitude	Death	Injury	Damage ($)		Notes
							property	crop	
Hart	7/26/05	<1 day	Thunderstorm Wind	61 mph	0	0	10k	0	Downed trees and powerlines across area
Pentwater	7/26/05	<1 day	Thunderstorm Wind	61 mph	0	0	15k	0	Downed trees and powerlines across area
Walkerville	8/4/05	<1 day	Thunderstorm Wind	61 mph	0	0	5k	0	2 mi. W of Walkerville in Elbridge T.
Oceana Co. (zone)	1/20/06	1 day	Heavy Snow	6-10" snow	0	0	0	0	6-10" snow
Oceana Co. (zone)	2/16/06	1 day	Ice Storm	N/A	0	0	1m	0	Downed trees and powerlines across area
Ferry	6/26/06	<1 day	Hail	1"	0	0	10k	5k	Hail covered ground
Walkerville	7/9/06	<1 day	Hail	1"	0	0	5k	5k	3 mi. S of Walkerville in Leavitt T.
Shelby	7/17/06	<1 day	Hail	.75"	0	0	10k	5k	
Shelby	7/17/06	<1 day	Hail	.75"	0	0	15k	5k	
Countywide	7/17/06	<1 day	Thunderstorm Wind	69 mph	0	0	250k	50k	Hundreds of trees down across county
Mears	8/1/06	<1 day	Thunderstorm Wind	60 mph	0	0	20k	0	Downed trees and powerlines across Golden & Pentwater townships
Shelby (2 mi. E)	10/2/06	<1 day	Hail	.88"	0	0	10k	10k	2 mi. W of Shelby in Benona T.
Ferry Township	10/2/06	<1 day	Hail	.75"	0	0	10k	10k	
Walkerville (2 mi. NW)	10/2/06	<1 day	Hail	.88"	0	0	10k	10k	2 mi. NW of Walkerville in Colfax T.
Walkerville (2 mi. NW)	10/2/06	<1 day	Hail	.75"	0	0	10k	10k	2 mi. NW of Walkerville in Colfax T.
Walkerville (4mi. NNW)	10/3/06	<1 day	Hail	.75"	0	0	10k	10k	4 mi. NNW of Walkerville in Colfax T.
Walkerville (4mi. NNW)	10/4/06	<1 day	Hail	.75"	0	0	10k	10k	4 mi. NNW of Walkerville in Colfax T.
Oceana Co. (zone)	12/1/06	1 day	Heavy Snow	8-10" snow	0	0	0	0	
Oceana Co. (zone)	12/4/06	1 day	Lake Effect Snow	6-8" snow	0	0	0	0	
Oceana Co. (zone)	12/6/06	1 day	Lake Effect Snow	6-10" snow	0	0	0	0	
Oceana Co. (zone)	1/29/07	1 day	Lake Effect Snow	9" snow	0	0	0	0	
Oceana Co. (zone)	2/2/07	2 days	Blizzard	up to10" snow, 40 mph wind	0	0	0	0	Blizzard conditions caused road closures, power outages, and car accidents
Oceana Co. (zone)	3/2/07	2 days	Lake Effect Snow	up to 11" snow	0	0	0	0	
Little Sable Point	11/27/07	<1 day	High Wind	58 mph	0	0	0	0	Non-thunderstorm wind at Little Sable Point in Benona and Golden townships.
Oceana Co. (zone)	12/1/07	2 days	Winter Storm	Snow, sleet, and freezing rain	0	0	0	0	Numerous traffic accidents on snowy to icy roads
Oceana Co. (zone)	12/23/07	1 day	Winter Storm	6-8" snow	0	0	0	0	High winds produced near-blizzard conditions
Oceana Co. (zone)	12/28/07	1 day	Heavy Snow	6-8" snow	0	0	0	0	
Oceana Co. (zone)	1/10/08	1 day	Winter Storm	6-7" snow	0	0	0	0	
Oceana Co. (zone)	1/23/08	1 day	Winter Storm	6-10" snow	0	0	0	0	
Oceana Co. (zone)	1/29/08	1 day	Blizzard	4-7" snow	0	0	0	0	
Oceana Co. (zone)	2/6/08	1 day	Winter Storm	up to12" snow	0	0	0	0	
Oceana Co. (zone)	2/14/08	1 day	Winter Storm	up to12" snow	0	0	0	0	
Oceana Co. (zone)	2/18/08	2 days	Lake Effect Snow	10-15" snow	0	0	0	0	
Rothbury	6/8/08	<1 day	Thunderstorm Wind	60 mph	0	0	0	0	Several trees downed around Rothbury
Mears	6/14/08	<1 day	Hail	1"	0	0	0	0	
Oceana Co. (zone)	11/20/08	1 day	Lake Effect Snow	8.6" snow	0	0	0	0	
Oceana Co. (zone)	12/6/08	1 day	Winter Storm	8-14" snow	0	0	0	0	
Oceana Co. (zone)	12/8/08	1 day	Winter Storm	10-12" snow	0	0	0	0	

Oceana Co. (zone)	12/19/08	1 day	Winter Storm	8-12” snow	0	0	0	0	
Oceana Co. (zone)	12/20/08	2 days	Blizzard	8-12” snow, 45 mph wind	0	0	0	0	Blizzard conditions caused several highway closures and traffic accidents
Oceana Co. (zone)	12/23/08	1 day	Winter Storm	6-10” snow	0	0	0	0	
Oceana Co.	12/28/08	<1 day	High Wind	60 mph	0	0	0	0	Hundreds of thousands lost power across Michigan
Oceana Co. (zone)	1/17/09	2 days	Winter Storm	up to 15” snow	0	0	0	0	
Oceana Co. (zone)	2/21/09	1 day	Winter Storm	8” snow	0	0	0	0	
Oceana Co. (zone)	12/7/09	1 day	Lake Effect Snow	5-7” snow	0	0	0	0	
Oceana Co. (zone)	12/8/09	1 day	Winter Storm	6-10” snow	0	0	0	0	
Oceana Co. (zone)	12/24/09	1 day	Winter Weather	.1-.25” ice	0	0	0	0	A wintery mix resulted in several traffic accidents
Oceana Co. (zone)	12/26/09	1 day	Lake Effect Snow	up to 8” snow	0	0	0	0	
Oceana Co. (zone)	1/1/10	2 days	Lake Effect Snow	12-16” snow	0	0	0	0	
Oceana Co. (zone)	2/15/10	1 day	Lake Effect Snow	7-8.6” snow	0	0	0	0	
Oceana Co. (zone)	2/23/10	1 day	Lake Effect Snow	9” snow	0	0	0	0	
Oceana Co. (zone)	12/5/10	3 days	Lake Effect Snow	up to 24” snow	0	0	0	0	
Oceana Co. (zone)	1/3/11	1 day	Winter Weather	3.4” snow	0	0	0	0	
Oceana Co. (zone)	1/6/11	3 days	Lake Effect Snow	10-12” snow	0	0	0	0	
Oceana Co. (zone)	2/1/11	1 day	Winter Storm	6-12” snow, up to 50 mph wind	0	0	0	0	Near blizzard conditions
Oceana Co. (zone)	2/20/11	1 day	Winter Storm	6-10” snow	0	0	0	0	Numerous traffic accidents across the area
Oceana Co. (zone)	3/4/11	1 day	Winter Weather	.1” ice	0	0	0	0	Numerous traffic accidents across the area
Oceana Co. (zone)	3/22/11	1 day	Winter Storm	.25-.5” ice	0	0	0	0	Winter weather resulted in school closings and scattered power outages
Shelby	6/8/11	<1 day	Hail	1.75”	0	0	0	0	
Hart	7/11/11	<1 day	Thunderstorm Wind	60 mph	0	0	0	0	Trees and powerlines downed in Hart
Hart	7/31/11	<1 day	Hail	.88”	0	0	0	0	
Oceana Co. (zone)	1/12/12	2 days	Winter Storm	8-12” snow	0	0	0	0	
Countywide	5/3/12	<1 day	Hail	1”	0	0	0	0	1” hail reported near Hart and near Shelby
Pentwater	5/15/12	<1 day	Hail	.88”	0	0	0	0	
Walkerville	7/5/12	<1 day	Thunderstorm Wind	61 mph	0	0	0	0	
Hart	7/17/12	<1 day	Thunderstorm Wind	60 mph	0	0	0	0	Numerous trees and powerlines blown down just east of Hart
Hart	7/17/12	<1 day	Thunderstorm Wind	60 mph	0	0	0	0	Several trees and large limbs blown down near Hart
Shelby	7/25/12	<1 day	Thunderstorm Wind	60 mph	0	0	0	0	Powerline blown down in Shelby
Walkerville	7/30/12	<1 day	Thunderstorm Wind	60 mph	0	0	0	0	
Oceana Co. (zone)	10/30/12	<1 day	High Wind	60 mph	0	0	0	0	Trees downed near coastline.
Oceana Co. (zone)	12/21/12	1 day	Winter Storm	6-8” snow, up to 65 mph wind	0	0	0	0	Scattered power outages
Oceana Co. (zone)	1/21/13	1 day	Lake Effect Snow	Up to 12” snow, up to 65 mph wind	0	0	0	0	Downed trees and power lines prior to snowfall
Oceana Co. (zone)	2/15/13	1 day	Lake Effect Snow	10-16” snow	0	0	0	0	
Oceana Co. (zone)	4/17/13	6 days	Flood	Heavy rain	0	0	3m	0	
Benona Township	6/17/13	<1 day	Thunderstorm Wind	60 mph	0	0	2k	0	Tree limbs downed over Stony Lake Road
Oceana Co. (zone)	11/17/13	1 day	High Wind	60-70 mph	0	0	75k	0	Numerous power outages
Oceana Co. (zone)	1/22/14	1 day	Heavy Snow	8” snow	0	0	0	0	
Oceana Co. (zone)	2/17/14	1 day	Heavy Snow	9” snow	0	0	0	0	

GENERAL SOILS MAP



Source: USDA/Mich.Dept.Agr.(issued September, 1995)

Oceana County Dams

The National Inventory of Dams (NID) identifies 8 dams within Oceana 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

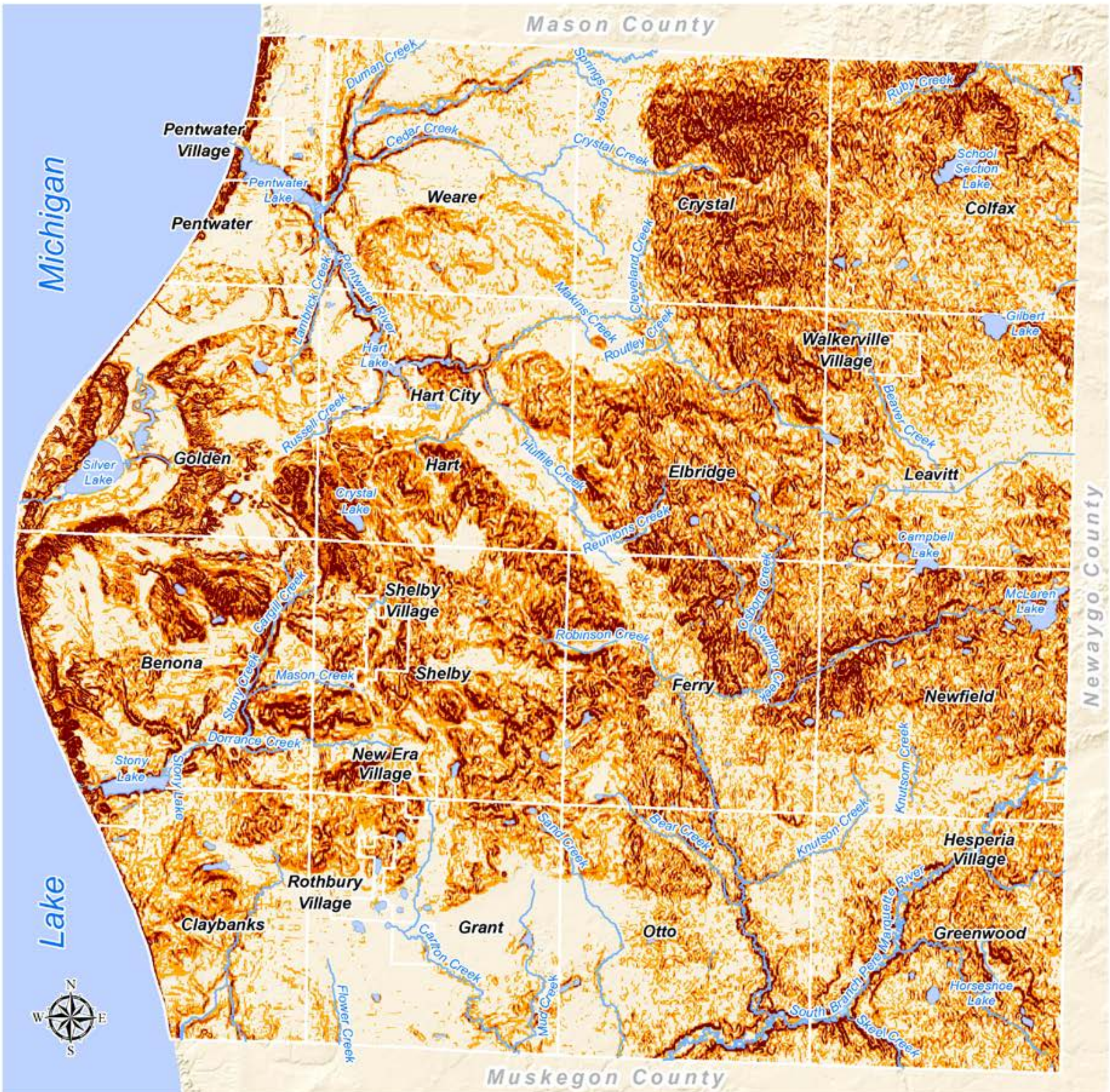
Dams assigned the high hazard potential classification are those where failure or misoperation will probably cause loss of human life.

NAME	LOCATION	HAZARD POTENTIAL
Hart Lake Dam	Hart Township	Low
Gales Pond Dam	Elbridge Township	
Silver Lake Level Control Structure	Golden Township	
Crystal Valley Dam	Crystal Township	
Foster Lake Dam	Colfax Township	Significant
Hesperia Pond Dam	Hesperia Village	
Holiday Lake Dam	Golden Township	High
Upper Silver Lake Dam	Golden Township	

Source: National Inventory of Dams (online), US Army Corps of Engineers; July, 2013

Oceana County
Significant Landscape Map

Oceana County
County Slopes Map



Percentage Slope

- 11 - 20% Moderate
- 21 - 30% Significant
- 31% + Severe

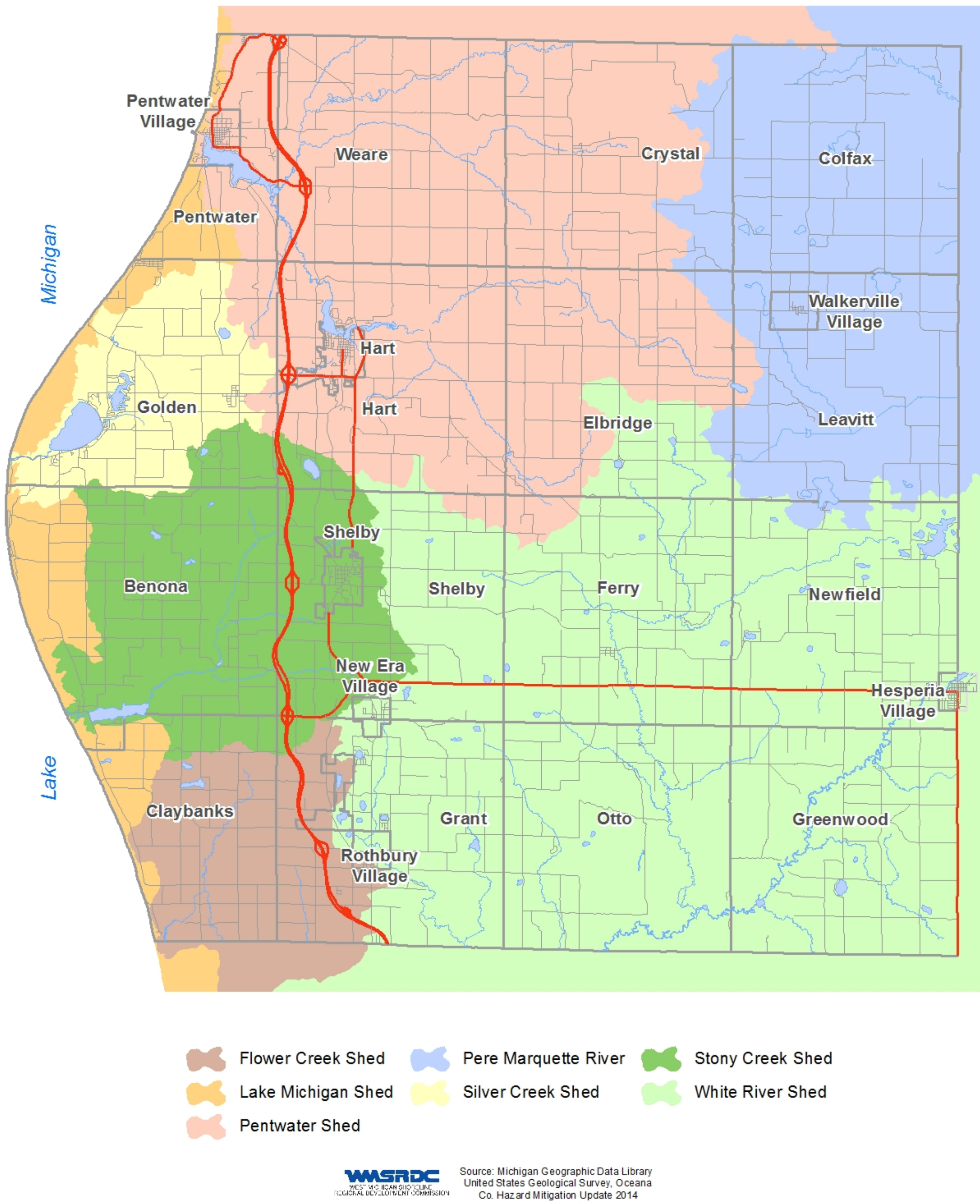
Lake

River/Stream

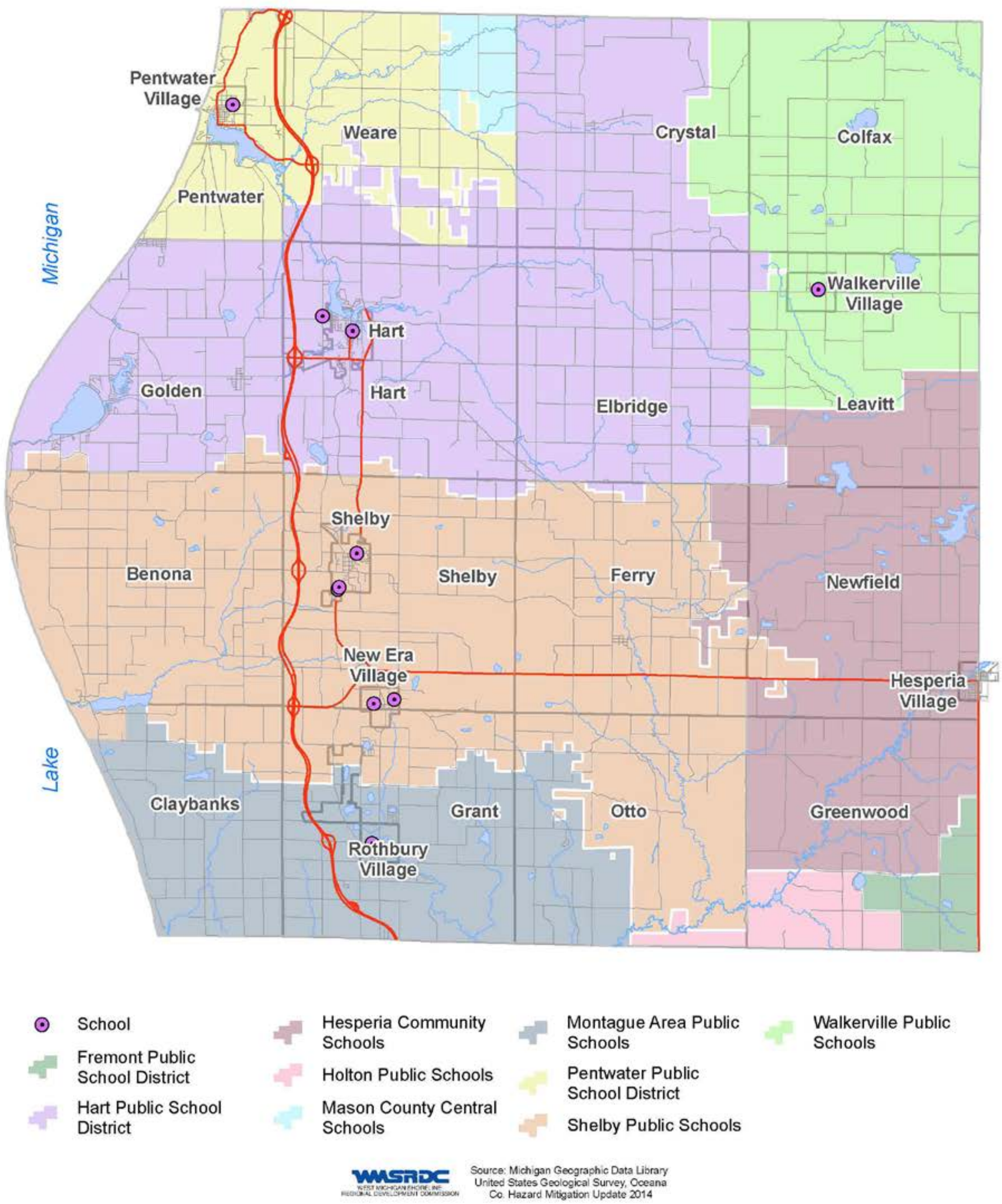
WMSRDC West Michigan Shoreline Regional Development Commission

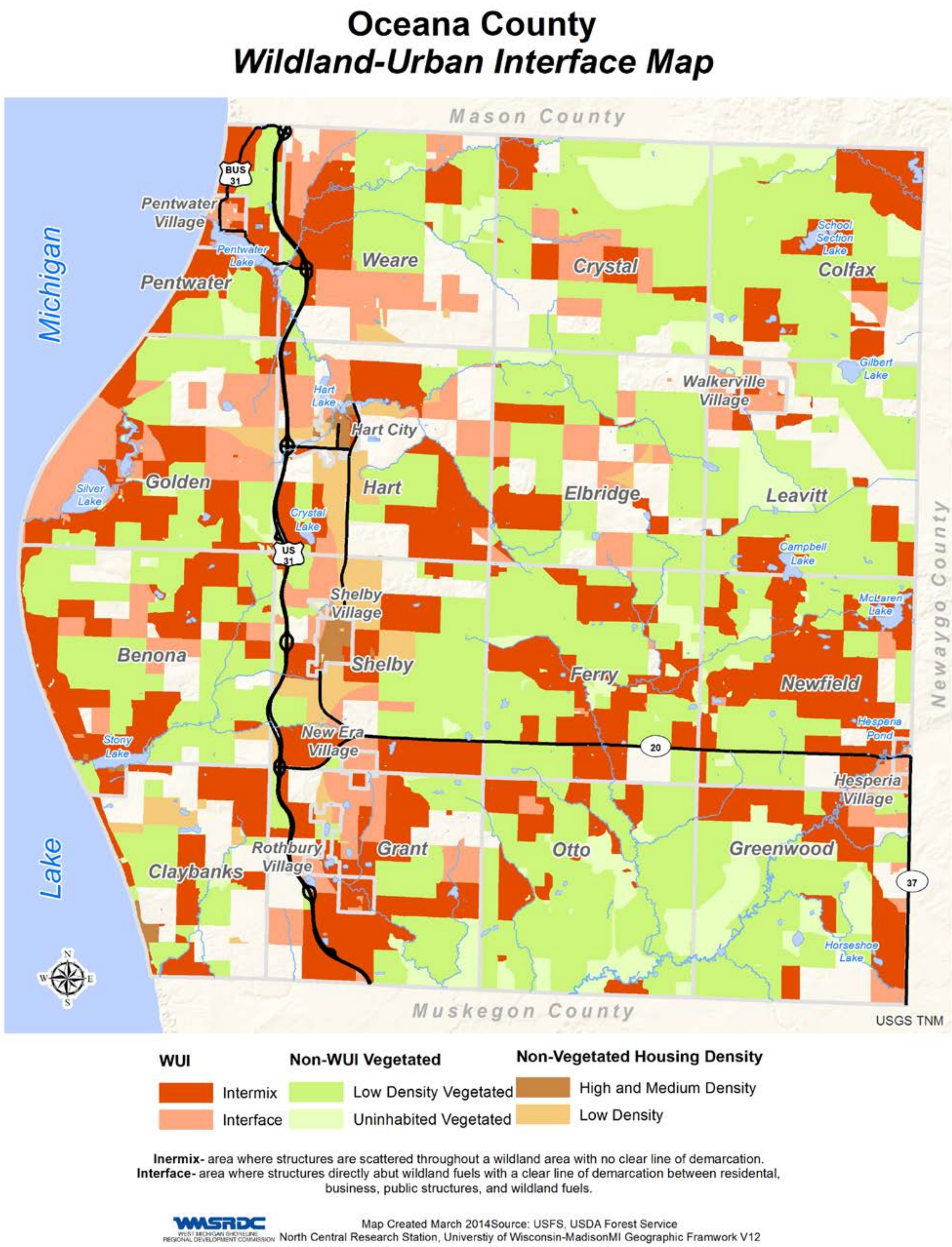
Map Created May 2014 Source: USGS TNM MIDNR, MI Geographic Framework V12

OCEANA COUNTY
Watersheds



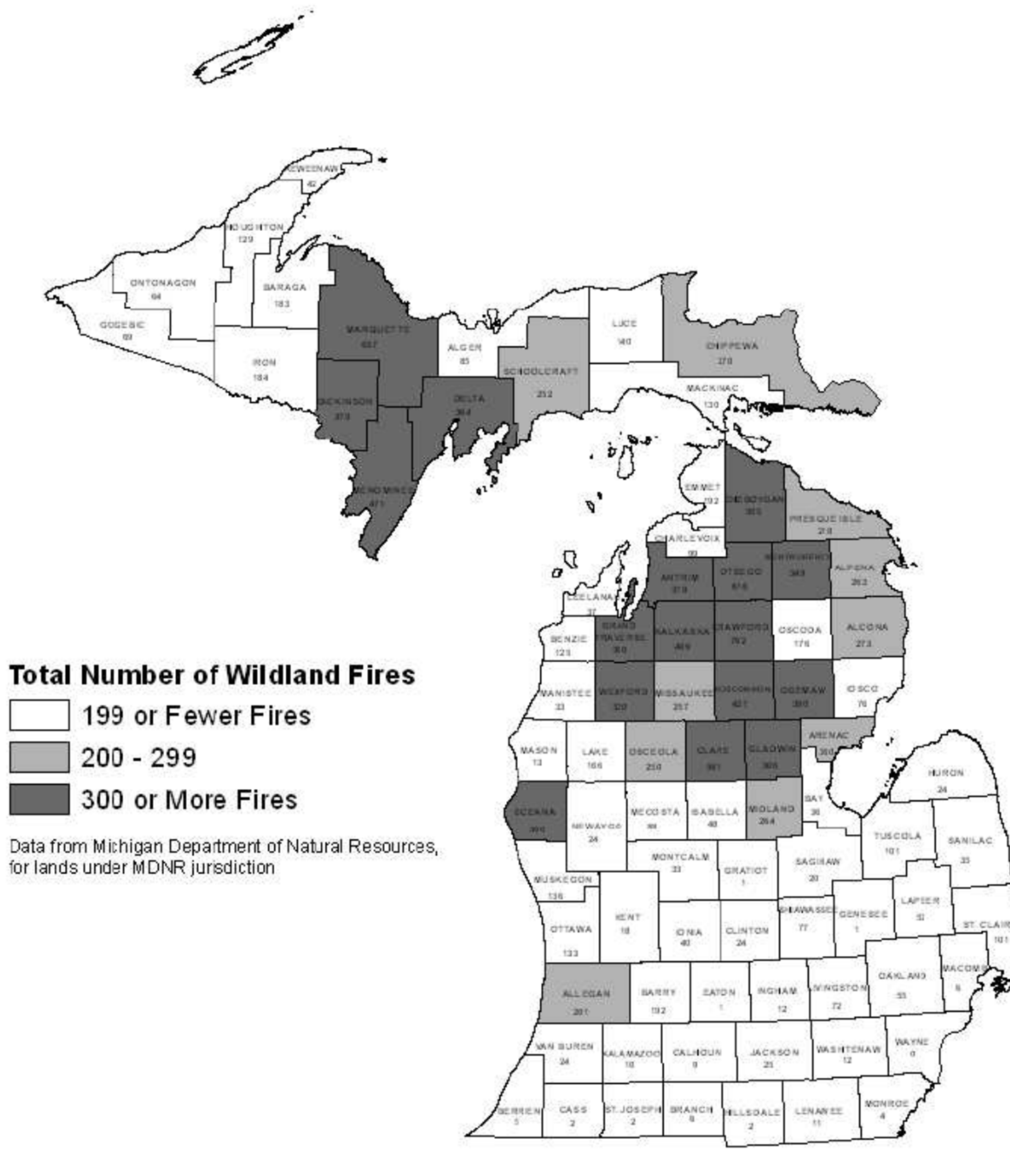
OCEANA COUNTY
School Districts





Source: Oceana County Community Wildfire Protection Plan (2014)

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)

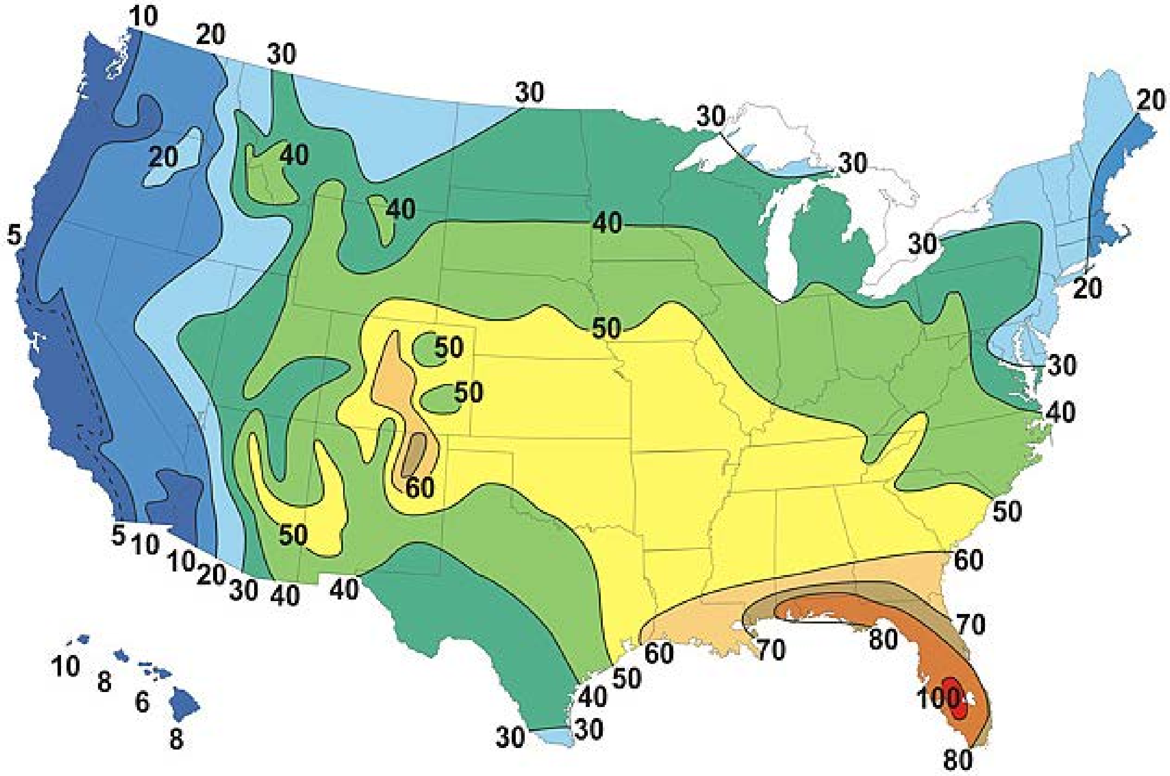
County	Number of Wildfires	Number of Wildfires/Year* (over 30 year period)	Number of Acres Burned	Number of Acres Burned/Year* (over 30 year period)
Alcona	119	4	843.8	28
Alger	41	1	123.0	4
Allegan	72	2	312.0	10
Alpena	156	5	267.2	9
Antrim	194	6	194.1	6
Arenac	127	4	418.8	14
Baraga	57	2	1897.6	63
Barry	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

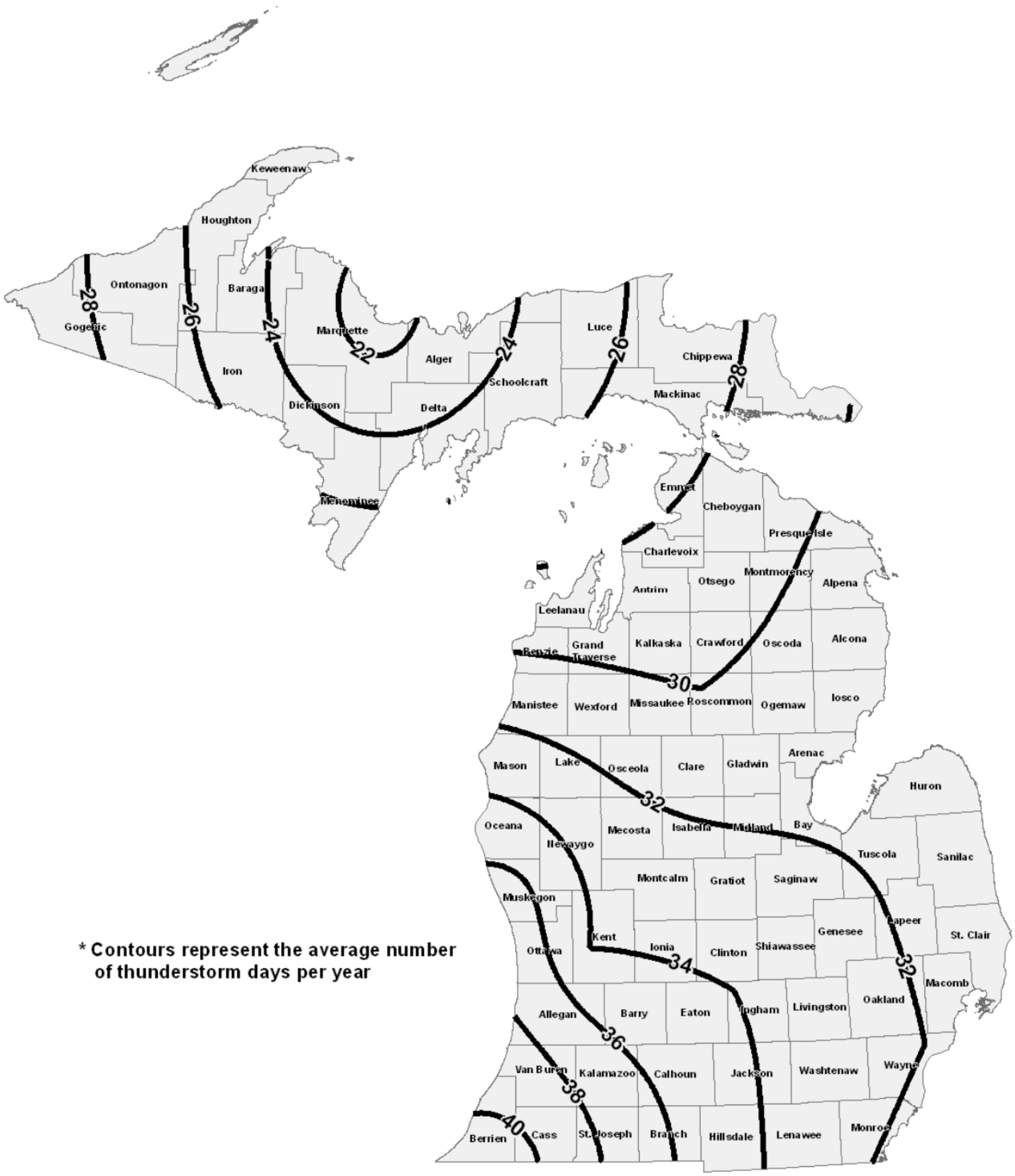
Source: Michigan Hazard Mitigation Plan, 2011

Average Annual Thunderstorm Days



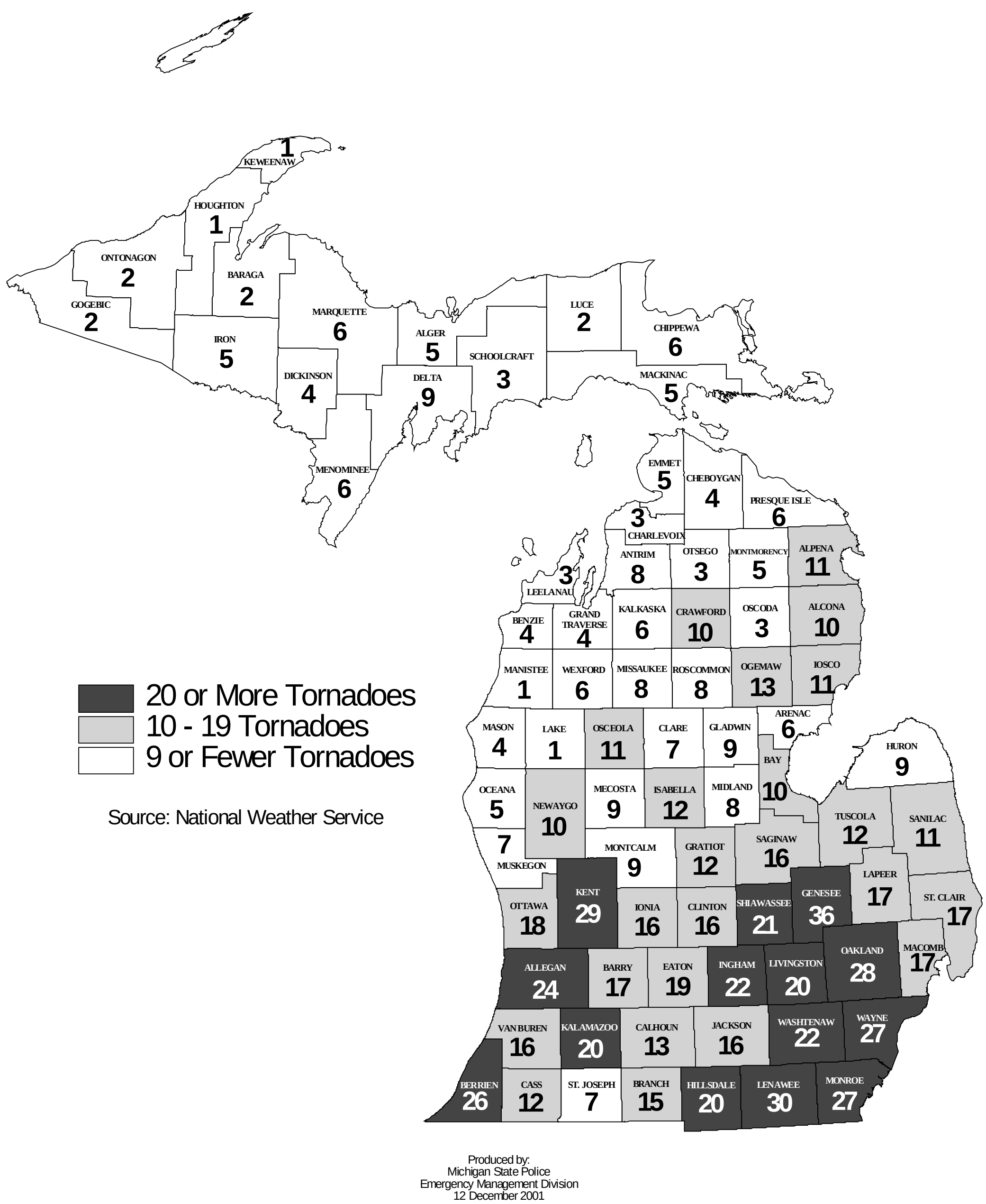
Source: NOAA National Weather Service

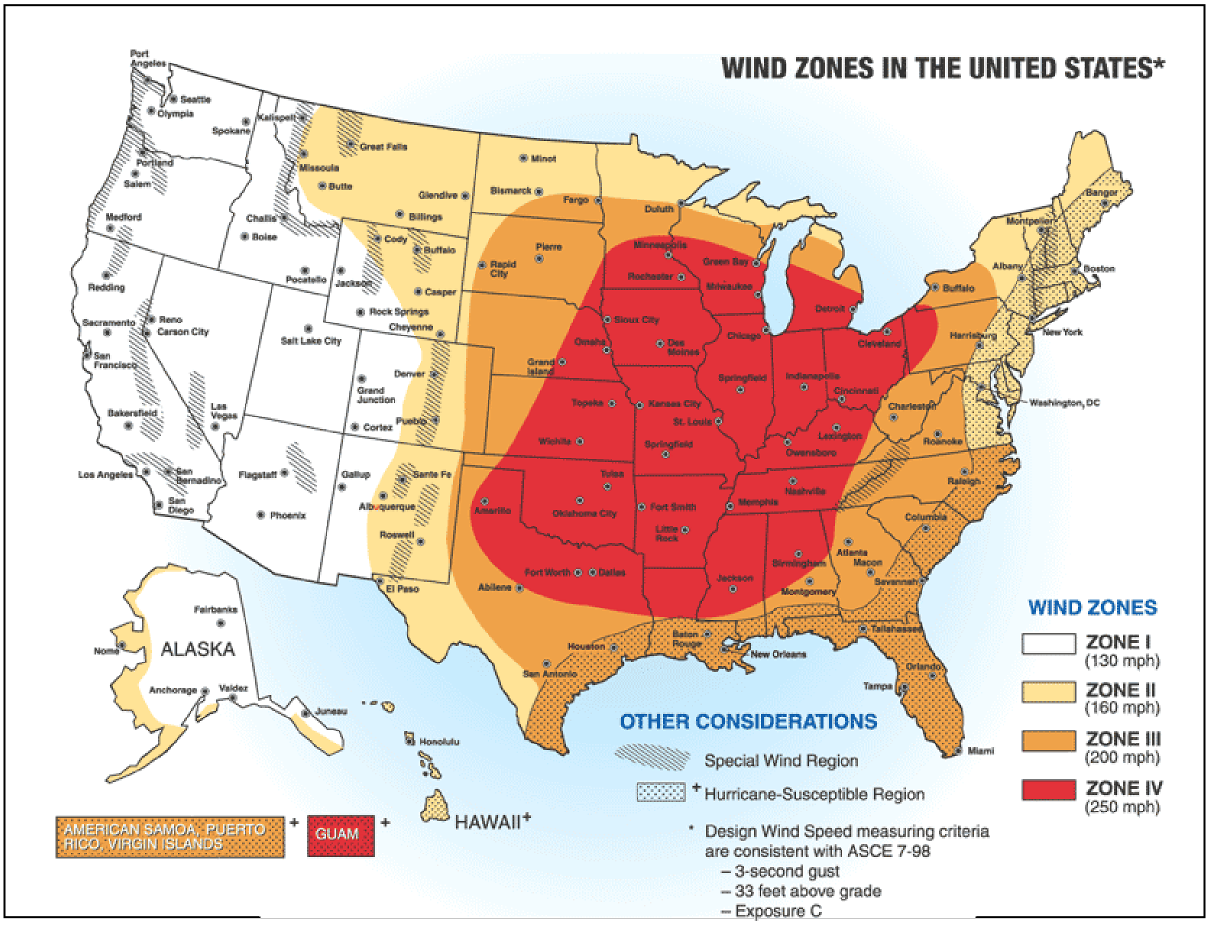
Thunderstorm Hazards



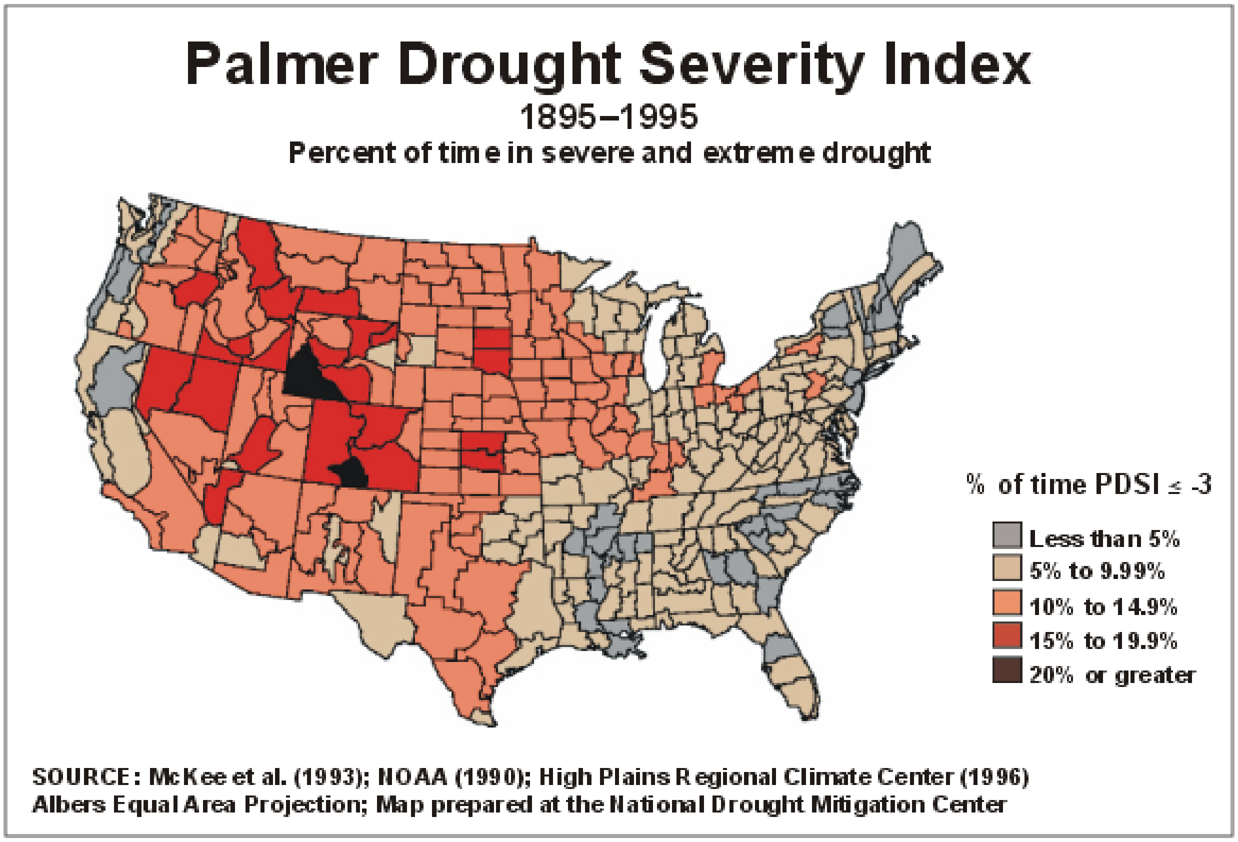
Produced by:
Michigan State Police
Emergency Management and Homeland Security Division
January 2011

Number of Tornadoes in Michigan
by County, 1950-2001



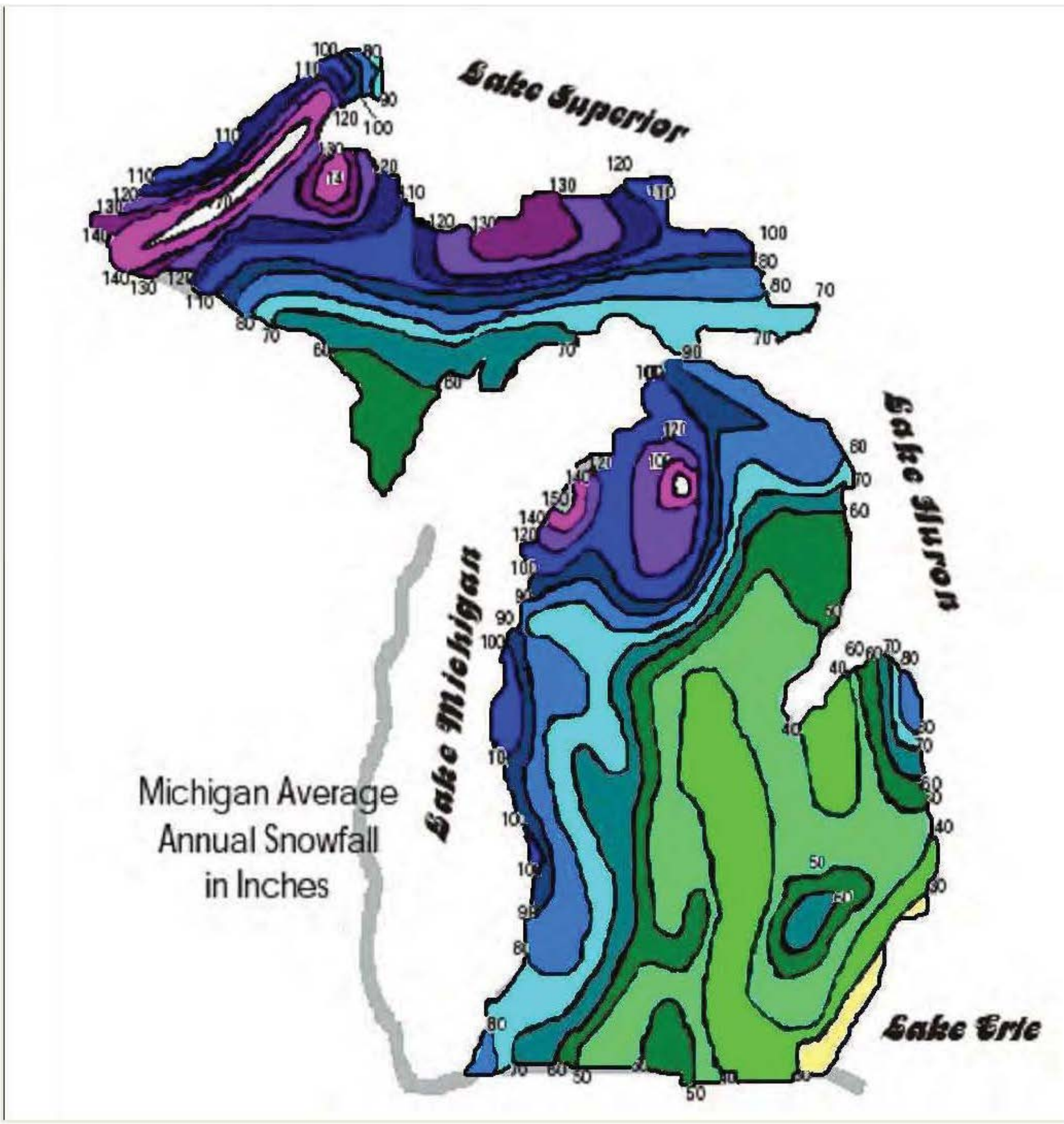


Source: Federal Emergency Management Agency

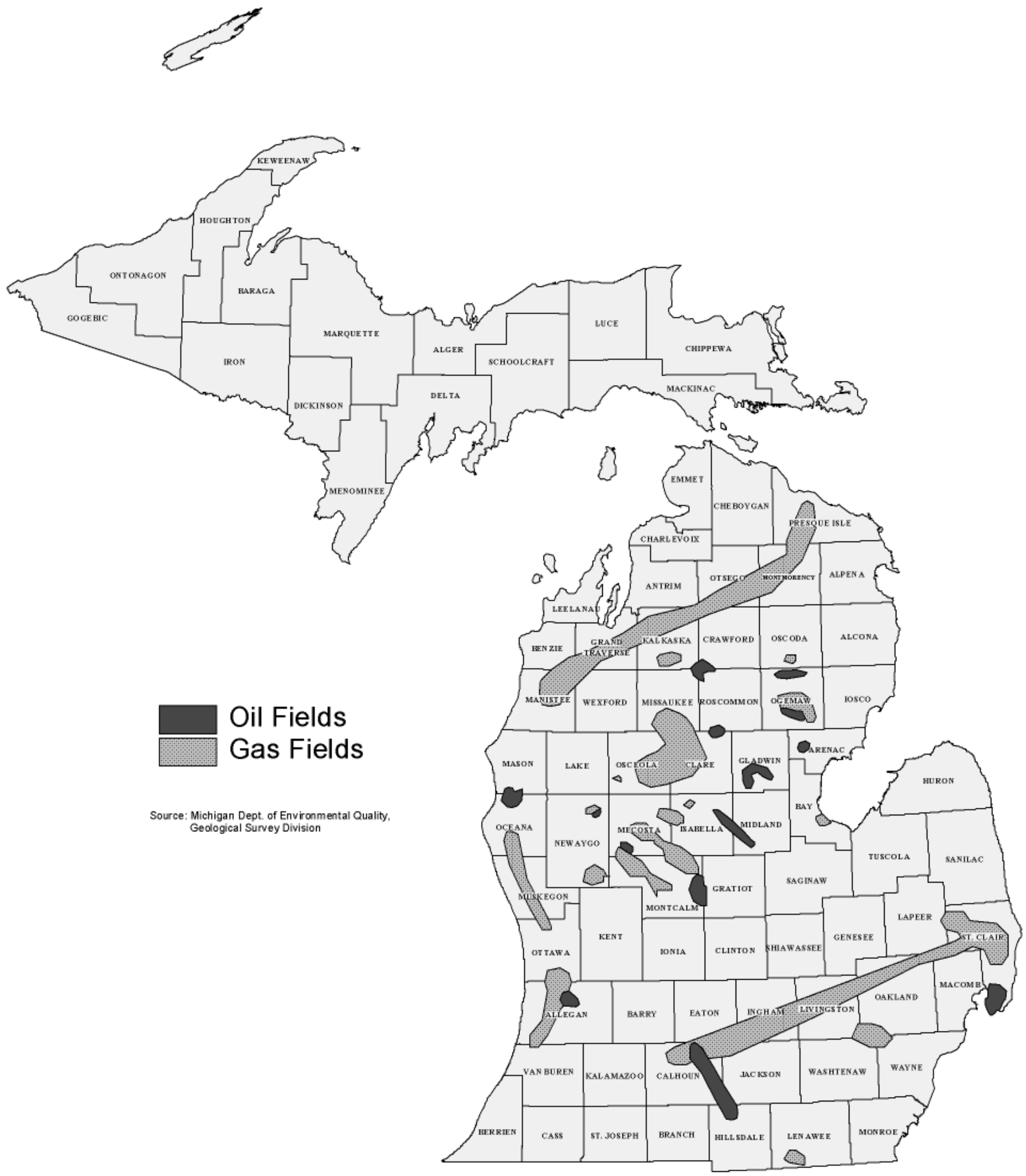

Palmer Drought Severity Index
1895–1995
Percent of time in severe and extreme drought
% of time PDSI ≤ -3
Less than 5%
5% to 9.99%
10% to 14.9%
15% to 19.9%
20% or greater
SOURCE: McKee et al. (1993); NOAA (1990); High Plains Regional Climate Center (1996)
Albers Equal Area Projection; Map prepared at the National Drought Mitigation Center

Michigan Average Annual Snowfall

Source: Michigan Committee for Severe Weather Awareness



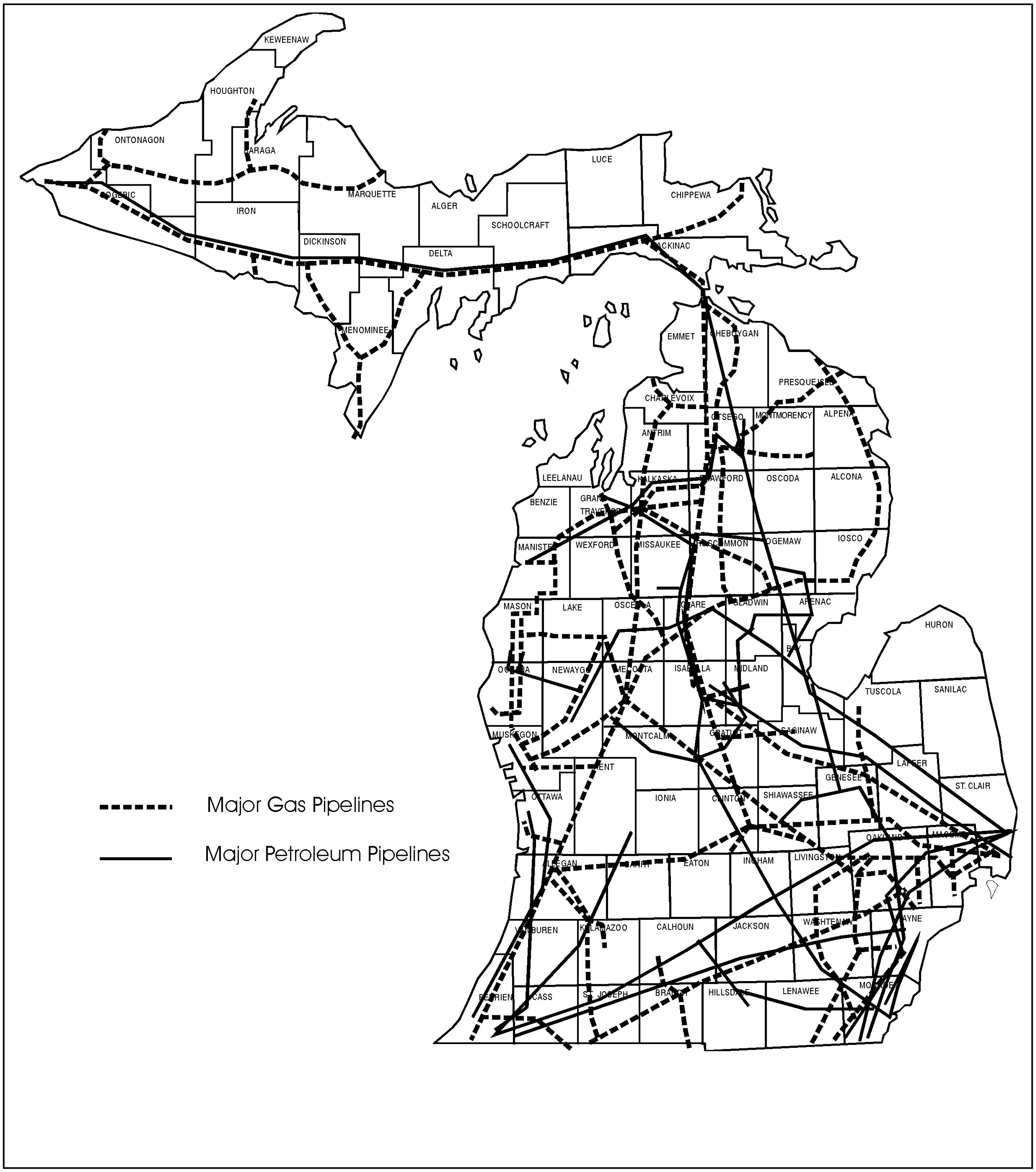
Michigan's Oil and Gas Fields



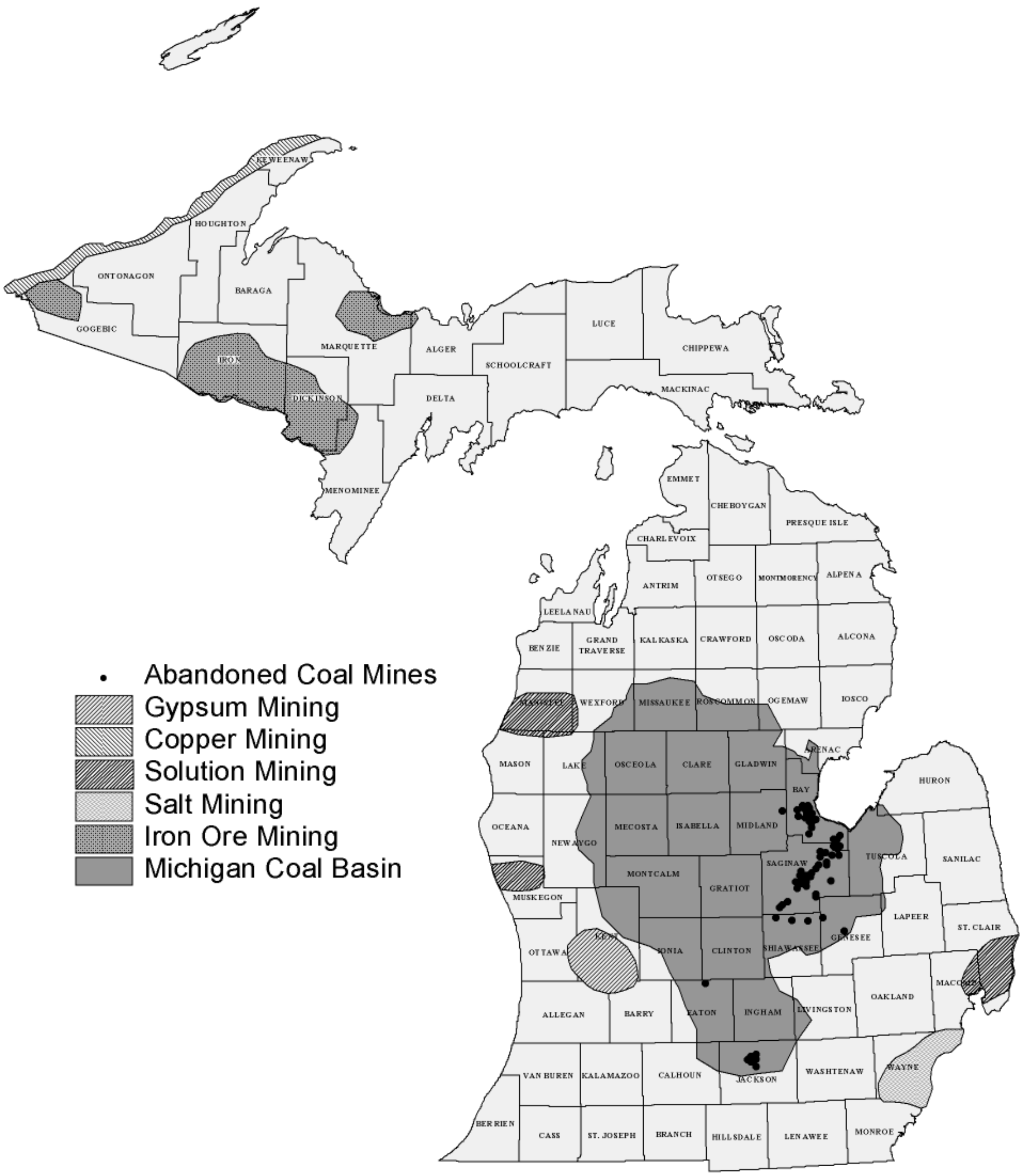
Produced by:
Michigan State Police
Emergency Management Division
13 November 2000

Major Petroleum and Natural Gas Pipelines in Michigan

Source: Michigan Public Service Commission; pipeline company maps



Potential Subsidence Hazards



Produced by:
Michigan State Police
Emergency Management Division
20 November 2000

Appendix D:

HAZARD MITIGATION PLAN UPDATE SURVEY

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 Oceana 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 Oceana 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 Friday, March 23, 2012.

A public hearing is scheduled for Tuesday, March 27, 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 Oceana County LEPC meeting at 12:00 P.M. in the Board Conference Room of the Oceana County Building, 100 State Street, Hart, MI 49420.

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

OCEANA COUNTY Hazard Mitigation Plan Update Survey

PART 1 - Hazard Identification

Provided below is documentation of historical hazard events in Oceana County, according to the Hazard Mitigation Plan for Oceana 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.
- July 11, 1967: Tornado (F1). $25k property damage, Ferry Township.
- August 20 - September 6, 1975: Rainstorms, high winds. Declaration of major disaster by President.
- March 2-7, 1976: Tornadoes. Declaration of major disaster by President.
- March 30, 1977: Tornado (F1). $25k property damage, Weare Township.
- August 12, 1978: Tornado (F2). $250k property damage.
- September 14, 1990: Tornado (F1). $25k property damage, Ferry Township.
- May 28, 1991: Tornado (F2). $250k property damage, Hart Township.
- July 15, 1995: Severe thunderstorm winds. $15k property damage, Village of Walkerville.
- May 31, 1998: Thunderstorms & high winds. Declaration of major disaster by President. $4m property damage in Oceana County.
- June 3-5, 1998: Thunderstorms & high winds. Declaration of disaster by Governor.
- July 8, 1999: Severe thunderstorm winds. $20k property damage throughout Oceana County.
- March 8, 2000: .75 inch hail. $10k property damage in Hart and Rothbury.
- May 12, 2000: Severe thunderstorm winds. $50k property damage, Shelby Township.
- June 1, 2000: Severe thunderstorm winds. $50k property damage, Golden Township.
- July 13, 2000: Severe t-storm winds and 1.75 inch hail. $50k property and $25k crop damage, Village of Walkerville.

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

- March 20, 1976: Ice storms. Declaration of major disaster by President.
- January 26-31, 1977: Blizzard, snowstorm. Declaration of emergency by President.
- January 26-27, 1978: Blizzard, snowstorm. Declaration of statewide emergency by President and statewide 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.
- January 2-15, 1999: Blizzard, snowstorm. Declaration of emergency by President.
- April 3, 2003: Ice storm. $4.9m property damage throughout West Michigan.

Floods (shoreline, riverine, urban):

- September 10-19, 1986: Flooding. Declaration of major disaster by President.
- October 28, 1986: Flooding & heavy rain. Declaration of disaster by Governor.
- May 15-16, 2001: Flash flooding from severe thunderstorms. $500k property damage and $200k crop damage in Oceana County.

Extreme Temperatures:

- January 20, 1994: Record cold. $50m property damage across Michigan.
- May 16, 1997: Record cold temperatures. $2m crop damage, Oceana County.

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, and 1986-1989.
- Lower Peninsula: 1939-1942 (crop damage).
- 1964: Record "low" water levels.

Wildfires:

- October 1871: Flames swept across much of the lower peninsula, killing 200 and burning 1.2 million acres.
- May-September 1891: Uncontrollable wildfires across Michigan during the drought of 1891.
- Approximately 12 wildfires per year from 1981 to 2000 (249 wildfires).

Structural and Scrap Tire Fires (including explosions, industrial accidents):

- Scrap tire inventory at Oceana County disposal sites in 2001: 44,000.
- County Fire Rate per 1,000 Population in 1998: 6.37.

Dam Failures:

- September 1986: Hart Hydro-Electric Dam, Hesperia Pond Dam spillway, Crystal Valley Dam spillway erosion.

Infrastructure Failure (storm/sanitary sewers, water, electrical, and communications systems):

- January 20, 1994: Frozen sewer/water lines.
- March 9, 1998: 1,900 power outages in Lake, Clare, Oceana and Muskegon Counties. Blizzard conditions.
- April 18, 2002: Downed power lines, City of Hart and Village of Hesperia. Severe thunderstorms.
- June 8, 2002: Downed power lines, countywide. Severe thunderstorms.
- April 3, 2003: Hundreds of thousands lose power in Lower Michigan. Ice storm.

Oil and Gas Well/Pipeline Accidents:

- 1,123 oil and gas wells within Oceana County.

Other Hazard Events:

- Earthquake /Land Subsidence
- Hazard Material Incidents (fixed site and transportation related, nuclear material). SARA Title III sites within Oceana Co: 72.
- Transportation Accidents
- Public Health Emergencies
- Civil Disturbances (riots, prison uprisings, etc.)
- Nuclear Attack/Civil Defense Emergency
- Weapons of Mass Destruction/Terrorism/Sabotage

Comments:

PART 2 – Hazard Ranking

Provided below is a prioritized list of hazards in Oceana County, according to the Hazard Mitigation Plan for Oceana 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	7.65	
2nd	Extreme Temperatures	6.60	
3rd	Severe Winds	6.35	
4th	Infrastructure Failures	6.10	
5th	Fire Hazards: Wildfire	5.95	
6th	Fire Hazards: Structural	5.65	
7th	Tornadoes	5.05	
8th	Drought	4.85	
9th	Public Health Emergencies	4.60	
10th	Flooding: Riverine/Urban	4.25	
11th	Hail	3.95	
12th	Lightning/Heavy Rain	3.80	
13th	Dam Failures	3.75	
14th	Flooding: Shoreline	3.60	
15th	Pipeline Accident	2.80	
16th	Transportation Accident	2.60	
17th	HAZMAT: Fixed Site	2.45	
18th	Oil/Gas Well Accident	2.00	
19th	HAZMAT: Transportation	1.95	
20th	Land Subsidence	1.25	
21st	Civil Disturbances	1.15	

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

Summary of Survey Results

Part 1 – Hazard Identification

Comments

- Other possible hazards: LP Gas Tank Farm Inc.; Factory Farm Combustables; Sour Gas Well Incident; Soil Erosion
- Fertilizer and bulk chemical storage/sales in Shelby and Hart.
- Sour gas line which runs in the middle of the county north and south.
- Possible failure of major powerline which runs from Consumers Energy & Wolverine Power.
- Bulk gas storage facility either leaking or fire.
- Septic systems located within 500ft of lake, river, stream, or wetland are hazardous; Local units and Health Dept. work together to ensure septic systems are serviced and maintained in proper working condition in areas near water bodies and wetlands.
- Better address septic system failure in plan update.

Part 2 – Hazard Ranking

Survey Responses

Hazard Mitigation Plan Rank	Hazard	Pent. Fire / 911 Dispatch	Oceana County Gov't	Oceana Co Commissioner	D10 Health Department	Oceana DHS	W. MI CMH System	MHP - Lakeshore Hosp.	MHP - Lakeshore Hosp.	Shelby Twp ZA	Golden Twp ZA	Grant Township	Hart Township	Pentwater PC	New Era Village	Ferry Twp PC	Rothbury Village	Elbridge Twp	USFS	SUBTTOAL	AVERAGE	Survey Rank	County Building Inspector (not included in statistics)
1	Snow/Ice/Sleet Storms	1	1	1	1	1	1	1	1	3	1	1	1	9	2	2	1	1	1	30	1.7	1	4
2	Extreme Temperatures	4	10	2	2	3	2	2	2	4	2	3	2	12	3	1	5	2	4	65	3.6	3	7
3	Severe Winds	2	2	3	3	2	3	3	3	8	3	2	3	1	1	3	4	3	2	51	2.8	2	7
4	Infrastructure Failure	9	7	4	4	4	4	4	4	7	4	6	4	2	5	7	6	4	8	93	5.2	4	5
5	Fire Hazards: Wildfire	3	12	5	5	5	5	9	5	6	5	5	5	5	7	9	13	5	3	112	6.2	5	7
6	Fire Hazards: Structural	13	14	6	6	6	6	7	6	5	6	4	6	4	6	17	7	6	5	130	7.2	6	5
7	Tornadoes	18	8	7	7	8	7	12	11	21	7	17	7	3	4	10	8	7	6	168	9.3	8	7
8	Drought	10	9	8	8	9	8	6	9	20	8	7	8	6	17	4	14	8	7	166	9.2	7	5
9	Public Health Emergencies	5	13	9	9	7	9	8	10	9	9	8	9	8	8	20	9	9	9	168	9.3	9	5
10	Flooding: Riverine/Urban	6	15	10	10	12	10	10	7	10	10	9	10	7	15	10	15	10	10	186	10.3	11	5
11	Hail	19	4	11	11	13	11	11	8	19	11	10	11	13	13	6	11	11	11	204	11.3	12	4
12	Lightning/Heavy Rain	8	3	12	12	14	12	5	12	11	12	11	12	10	9	5	12	12	12	184	10.2	10	4
13	Dam Failures	7	18	13	13	15	13	14	13	18	13	12	13	14	20	18	16	13	13	256	14.2	14	5
14	Flooding: Shoreline	14	19	14	14	17	14	13	14	17	14	15	14	15	18	19	17	14	14	276	15.3	17	5
15	Pipeline Accident	17	17	15	15	10	15	15	15	2	15	13	15	11	17	13	18	15	15	253	14.1	13	4
16	Transportation Accident	15	11	16	16	16	16	16	16	12	16	16	16	16	10	15	10	16	16	265	14.7	15	3
17	HAZMAT: Fixed Site	11	5	17	17	18	17	18	17	16	17	19	17	17	11	12	2	17	17	265	14.7	16	3
18	Oil/Gas Well Accident	16	16	18	18	11	18	17	18	1	18	17	18	18	19	8	19	18	18	286	15.9	18	3
19	HAZMAT: Transportation	12	6	19	19	19	19	19	19	15	19	18	19	19	12	16	3	19	19	291	16.2	19	2
20	Land Subsidence	20	20	20	20	21	20	20	20	14	20	20	20	20	16	14	20	20	20	345	19.2	20	5
21	Civil Disturbances	21	21	21	21	20	21	21	21	13	21	21	21	21	21	21	21	21	21	369	20.5	21	5

Survey Results Observations

1. Severe Winds a higher priority than Extreme Temperatures
2. Drought is a higher priority than Tornadoes
3. Lightning/Heavy Rain a higher priority than Hail and Flooding: Riverine/Urban
4. Pipeline Accident is now a much higher priority than Shoreline Flooding

Appendix E:

ACKNOWLEDGMENTS & DOCUMENTATION

Oceana County LEPC
2014 MEMBERSHIP ROSTER

Members Name	Group Representing
Mr. Larry Van Sickle, Chairperson	Elected
Mr. Thomas Osborn, Coordinator	Emergency Management
Mr. Jerry Frick	Community Group -Citizen
Lt. Kevin Leavitt, MSP	Law Enforcement
Mr. Robert Farber, Sheriff	Law Enforcement
Mr. Tim Priese, Undersheriff	Law Enforcement
Mr. Roland Brooks, Chief	Fire Services
Ms. Sue Ann Johnson	Public Information Officer
Mr. Lance Corey	Health Organization – EMS
Mr. Mark Hill	Health Organization – DHD #10
Mr. Bret Haner	Health Organization – DHD # 10
Ms. Arlene Kolbe	Health Organization – MHP
Mr. Jay Bryan	Health Organization – MHP
Mr. Loren Reed, D.O.	Health Organization – Medical Control Authority
Ms. Sandy Griffin	Transportation
Mr. Dave Robertson	RACES
Mr. Mike O'Brien	Health Organization -DHS
Ms. Kathi Lerg	AG – USDA
Mr. Jerry Spencer	Community Groups, Citizen
Mr. Jesse Beckman	Drain Office
Mr. Tom Story, Plumb/Mech Inspector	Community Group – Building Inspection
Lt. Mark Russo, MSP, Dist Coordinator	Law Enforcement – Dist #6
Mr. Thomas Branch	Community Group – Senior Resources
Mr. Laude Hartrum	Law Enforcement
Ms. Lynda Herremans	SARA Title III
Mr. Ben Werling	AG – MSUE
Mr. Mike Garcia	Animal Control
Mr. Brad Whitney	DPW
Mr. Bob Dodds	DPW
Mr. Ray Hasil	911 Dispatch

Oceana County Hazard Mitigation Plan Update
ADVISORY COMMITTEE

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MEETINGS

Public meetings attended by WMSRDC staff for the purpose of updating the Oceana County Hazard Mitigation Plan, including attendance lists and synopses of pertinent comments and discussion that took place during the meeting.

January 24, 2012: Oceana County LEPC Meeting

Attendees:

LARRY VAN SICKLE	LOCAL EMERGENCY PLANNING COMMITTEE CHAIRPERSON
TOM OSBORN	COORDINATOR, OCEANA COUNTY EMERGENCY MANAGEMENT
JERRY FRICK	DEPUTY, OCEANA COUNTY EMERGENCY MANAGEMENT
LT. KEVIN LEAVITT	COMMANDER, MICHIGAN STATE POLICE - HART POST
ROBERT FARBER	SHERIFF, OCEANA COUNTY SHERIFF DEPARTMENT
TIM PRIESE	UNDERSHERIFF, OCEANA COUNTY SHERIFF'S DEPARTMENT
WARREN HERRING	MICHIGAN DNR
BRET HANER	EMERGENCY RESPONSE COORDINATOR, DISTRICT #10 HEALTH DEPARTMENT
ARLENE KOLBE	MERCY HEALTH PARTNERS LAKESHORE CAMPUS INFECTION CONTROL COORDINATOR
THOMAS BRANCH	SENIOR RESOURCES
MICHAEL O'BRIEN	DEPARTMENT OF HUMAN SERVICES MANAGER
MARK HILL	SPECIALIST, DISTRICT #10 HEALTH DEPARTMENT-OCEANA
JERRY SPENCER	CHEMICAL REPRESENTATIVE
DAVID BETKA	OCEANA COUNTY EMS
ROLAND BROOKS	CHIEF, GRANT TOWNSHIP FIRE DEPARTMENT

Synopsis:

Introduction of Hazard Mitigation planning and a presentation of the anticipated planning process. Also discussed establishment of the Hazard Mitigation Advisory Team.

March 27, 2012: Oceana County LEPC Meeting and Hazard Mitigation Public Hearing

Attendees:

LARRY VAN SICKLE	LOCAL EMERGENCY PLANNING COMMITTEE CHAIRPERSON
TOM OSBORN	COORDINATOR, OCEANA COUNTY EMERGENCY MANAGEMENT
JERRY FRICK	DEPUTY, OCEANA COUNTY EMERGENCY MANAGEMENT
BOB FARBER	SHERIFF, OCEANA COUNTY SHERIFF'S DEPARTMENT
BRET HANER	EMERGENCY RESPONSE COORDINATOR, DISTRICT #10 HEALTH DEPARTMENT
ARLENE KOLBE	INFECTION CONTROL COORDINATOR, TRINITY-HEALTH PARTNERS LAKESHORE CAMPUS
SANDY GRIFFIN	MANAGER, OCEANA COUNTY ROAD COMMISSION
MICHAEL O'BRIEN	MANAGER, DEPARTMENT OF HUMAN SERVICES
ROLAND BROOKS	CHIEF, GRANT TOWNSHIP FIRE DEPARTMENT
LAUDE HARTRUM	CHIEF, PENTWATER POLICE DEPARTMENT
JESSE BECKMAN	COMMISSIONER, OCEANA COUNTY DRAIN OFFICE

OTHERS IN ATTENDANCE FOR PUBLIC HEARING:

STEPHEN CARLSON	WEST MICHIGAN SHORELINE REGIONAL DEVELOPMENT COMMISSION
JOSHUA CROFF	WEST MICHIGAN SHORELINE REGIONAL DEVELOPMENT COMMISSION

Synopsis:

Public meeting to discuss hazard mitigation at the beginning of the planning process. It was noticed in the Oceana Herald-Journal, 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 147 community individuals, and made available on the WMSRDC website.

May 22, 2012: Oceana County LEPC Meeting

Attendees:

TOM OSBORN	COORDINATOR, OCEANA COUNTY EMERGENCY MANAGEMENT
SANDY GRIFFIN	OCEANA COUNTY ROAD COMMISSION
BRET HANER	EMERGENCY RESPONSE COORDINATOR, DISTRICT #10 HEALTH DEPARTMENT
ARLENE KOLBE	MERCY HEALTH PARTNERS LAKESHORE CAMPUS INFECTION CONTROL COORDINATOR
MARK HILL	SPECIALIST, DISTRICT #10 HEALTH DEPARTMENT-OCEANA
ROLAND BROOKS	CHIEF, GRANT TOWNSHIP FIRE DEPARTMENT
LANCE COREY	DIRECTOR, OCEANA COUNTY EMERGENCY MEDICAL SERVICES
DAVID ROBERTSON	RACES/ARES EMERGENCY COORDINATOR
RANDY PHILLIPS	VILLAGE OF SHELBY DEPARTMENT OF PUBLIC WORKS
MICHAEL O'BRIEN	DEPARTMENT OF HUMAN SERVICES MANAGER
THOMAS BRANCH	SENIOR RESOURCES
TIM PRIESE	UNDERSHERIFF, OCEANA COUNTY SHERIFF'S DEPARTMENT
RICH FEOLE	MASON/OCEANA 911 DIRECTOR
RAY HASIL	MASON/OCEANA 911

Synopsis:

An update was given regarding feedback from the survey mailing and community profile mailing. Silver Lake State Park was announced to be StormReady. Oceana County Emergency Management is preparing to conduct a testing of the outdoor sirens across the county.

September 25, 2012: Oceana County LEPC Meeting

Attendees:

TOM OSBORN	COORDINATOR, OCEANA COUNTY EMERGENCY MANAGEMENT
BRET HANER	EMERGENCY RESPONSE COORDINATOR, DISTRICT #10 HEALTH DEPARTMENT
ARLENE KOLBE	MERCY HEALTH PARTNERS LAKESHORE CAMPUS INFECTION CONTROL COORDINATOR
ROBERT FARBER	OCEANA COUNTY SHERIFF
TIM PRIESE	UNDERSHERIFF, OCEANA COUNTY SHERIFF'S DEPARTMENT
SUE ANN JOHNSON	OCEANA COUNTY ADMINISTRATOR/FISCAL
MARK HILL	SPECIALIST, DISTRICT #10 HEALTH DEPARTMENT-OCEANA
JESSE BECKMAN	OCEANA COUNTY DRAIN COMMISSIONER
JERRY FRICK	WALKERVILLE AREA FIRE AND RESCUE
LANCE COREY	DIRECTOR, OCEANA COUNTY EMERGENCY MEDICAL SERVICES
MICHAEL O'BRIEN	DEPARTMENT OF HUMAN SERVICES MANAGER

Synopsis:

An update was given on the progress of the hazard mitigation project, including a discussion about the new hazards that would be added to the plan: Celestial Impacts, Fog, Invasive Species, Energy Emergencies, and Catastrophic Incidents. It was requested that amateur radio be incorporated into the plan. CityWatch notification system was utilized for warning the public about municipal water in the Village of Shelby. Dam repair/reconstruction of Gales Pond Dam underway. Recent drought conditions have led to dry wells across the county. Consider including ICE (In Case of Emergency) action item for cell phones.

December 18, 2012: Oceana County LEPC Meeting

Attendees:

LARRY VAN SICKLE	LOCAL EMERGENCY PLANNING COMMITTEE CHAIRPERSON
TOM OSBORN	COORDINATOR, OCEANA COUNTY EMERGENCY MANAGEMENT
ARLENE KOLBE	MERCY HEALTH PARTNERS LAKESHORE CAMPUS INFECTION CONTROL COORDINATOR
TIM PRIESE	UNDERSHERIFF, OCEANA COUNTY SHERIFF'S DEPARTMENT
MARK HILL	SPECIALIST, DISTRICT #10 HEALTH DEPARTMENT-OCEANA
JESSE BECKMAN	OCEANA COUNTY DRAIN COMMISSIONER
ROBERT FARBER	SHERIFF, OCEANA COUNTY SHERIFF'S DEPARTMENT
THOMAS BRANCH	SENIOR RESOURCES
JERRY SPENCER	CHEMICAL REPRESENTATIVE
RAY HASIL	MASON/OCEANA 911
JERRY FRICK	WALKERVILLE AREA FIRE AND RESCUE
DAVID ROBERTSON	RACES/ARES EMERGENCY COORDINATOR
LYNDA HERREMANS	OCEANA CONSERVATION DISTRICT – SARA TITLE III
BEN WERLING	MSU EXTENSION

Synopsis:

An update was given on the progress of the hazard mitigation project. A new siren was installed in Ferry Township. A helicopter crash in Leavitt Township resulted in a fatality on December 1, 2012. There was a methane explosion at a hog farm in Crystal Township on December 12, 2012.

February 26, 2013: Oceana County LEPC Meeting

Attendees:

LARRY VAN SICKLE	LOCAL EMERGENCY PLANNING COMMITTEE CHAIRPERSON
TOM OSBORN	COORDINATOR, OCEANA COUNTY EMERGENCY MANAGEMENT
ROBERT FARBER	OCEANA COUNTY SHERIFF
ARLENE KOLBE	MERCY HEALTH PARTNERS LAKESHORE CAMPUS INFECTION CONTROL COORDINATOR
MARK HILL	SPECIALIST, DISTRICT #10 HEALTH DEPARTMENT-OCEANA
JESSE BECKMAN	OCEANA COUNTY DRAIN COMMISSIONER
JERRY FRICK	WALKERVILLE AREA FIRE AND RESCUE
DAVID ROBERTSON	RACES/ARES EMERGENCY COORDINATOR
BRET HANER	EMERGENCY RESPONSE COORDINATOR, DISTRICT #10 HEALTH DEPARTMENT
LANCE COREY	DIRECTOR, OCEANA COUNTY EMERGENCY MEDICAL SERVICES
ROLAND BROOKS	CHIEF, GRANT TOWNSHIP FIRE DEPARTMENT
THOMAS BRANCH	SENIOR RESOURCES
RAY HASIL	DIRECTOR, MASON/OCEANA 911
JERRY SPENCER	CHEMICAL REPRESENTATIVE

Synopsis:

Information was gathered regarding small, neighborhood-level propane and natural gas distribution systems in the county. The LEPC identified the following as possible locations: Upper Silver Lake; north side of Hart Lake; Pentwater; and Valley View Pork in Colfax Township. Also discussed possible locations of scrap tire piles.

June 25, 2013: Oceana County LEPC Meeting

Attendees:

LARRY VAN SICKLE	LOCAL EMERGENCY PLANNING COMMITTEE CHAIRPERSON
TOM OSBORN	COORDINATOR, OCEANA COUNTY EMERGENCY MANAGEMENT
ARLENE KOLBE	MERCY HEALTH PARTNERS LAKESHORE CAMPUS INFECTION CONTROL COORDINATOR
MARK HILL	SPECIALIST, DISTRICT #10 HEALTH DEPARTMENT-OCEANA
JESSE BECKMAN	OCEANA COUNTY DRAIN COMMISSIONER
JERRY FRICK	WALKERVILLE AREA FIRE AND RESCUE
DAVID ROBERTSON	RACES/ARES EMERGENCY COORDINATOR
BRET HANER	EMERGENCY RESPONSE COORDINATOR, DISTRICT #10 HEALTH DEPARTMENT
LANCE COREY	DIRECTOR, OCEANA COUNTY EMERGENCY MEDICAL SERVICES
RAY HASIL	DIRECTOR, MASON/OCEANA 911
TODD MYERS	MASON/OCEANA 911
SANDY GRIFFIN	OCEANA COUNTY ROAD COMMISSION MANAGER
LLOYD GOWELL	OCEANA COUNTY ROAD COMMISSION
MICHAEL O'BRIEN	DEPARTMENT OF HUMAN SERVICES MANAGER
THOMAS BRANCH	SENIOR RESOURCES
ROBERT FARBER	OCEANA COUNTY SHERIFF
TIM PRIESE	UNDERSHERIFF, OCEANA COUNTY SHERIFF'S DEPARTMENT
JERRY SPENCER	CHEMICAL REPRESENTATIVE
LT. KEVIN LEAVITT	COMMANDER, MICHIGAN STATE POLICE - HART POST
DAVID BETKA	OCEANA COUNTY EMERGENCY MEDICAL SERIVCES
SUE ANN JOHNSON	OCEANA COUNTY ADMINISTRATOR/FISCAL OFFICER

Synopsis:

The revised hazard ratings and rankings for Oceana County were presented and discussed. Oceana County EMS requested that the probability of occurrence for HAZMAT Transportation be increased to reflect "Likely within 50 years." Emergency Management discussed how a fracking operation in Golden Township has produced foul odors and false alarms sent to nearby fire departments. It was also reported that the emergency response capabilities of Oceana County have greatly increased in recent years.

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 10, 2013: Oceana County LEPC Meeting

Attendees:

TOM OSBORN	COORDINATOR, OCEANA COUNTY EMERGENCY MANAGEMENT
JERRY SPENCER	CHEMICAL REPRESENTATIVE
BRET HANER	EMERGENCY RESPONSE COORDINATOR, DISTRICT #10 HEALTH DEPARTMENT
ARLENE KOLBE	MERCY HEALTH PARTNERS LAKESHORE CAMPUS INFECTION CONTROL COORDINATOR
DAVID ROBERTSON	RACES/ARES EMERGENCY COORDINATOR
TIM PRIESE	UNDERSHERIFF, OCEANA COUNTY SHERIFF'S DEPARTMENT
LANCE COREY	DIRECTOR, OCEANA COUNTY EMERGENCY MEDICAL SERVICES
LYNDA HERREMANS	OCEANA CONSERVATION DISTRICT – SARA TITLE III
MARK HILL	SPECIALIST, DISTRICT #10 HEALTH DEPARTMENT-OCEANA
RAY HASIL	DIRECTOR, MASON/OCEANA 911

Synopsis:

The committee was asked to review and discuss the Oceana County Hazard Mitigation Plan Goals & Objectives. The Goals & Objectives were distributed to the LEPC members prior to the meeting. No comments or objections were received. The committee was also asked to review the Hazard Mitigation Action Items from the 2006 Plan. A few comments were received regarding progress towards the Action Items. The Action Items were distributed to the LEPC and all local governments for review prior to the meeting.

February 25, 2014: Oceana County LEPC Meeting

Attendees:

LARRY VAN SICKLE	LOCAL EMERGENCY PLANNING COMMITTEE CHAIRPERSON
TOM OSBORN	COORDINATOR, OCEANA COUNTY EMERGENCY MANAGEMENT
ARLENE KOLBE	MERCY HEALTH PARTNERS LAKESHORE CAMPUS INFECTION CONTROL COORDINATOR
MARK HILL	SPECIALIST, DISTRICT #10 HEALTH DEPARTMENT-OCEANA
DAVID ROBERTSON	RACES/ARES EMERGENCY COORDINATOR
BRET HANER	EMERGENCY RESPONSE COORDINATOR, DISTRICT #10 HEALTH DEPARTMENT
ROLAND BROOKS	CHIEF, GRANT TOWNSHIP FIRE DEPARTMENT
RAY HASIL	DIRECTOR, MASON/OCEANA 911
TOM MYERS	MASON/OCEANA 911
TIM PRIESE	UNDERSHERIFF, OCEANA COUNTY SHERIFF'S DEPARTMENT
DAN YOST	OCEANA COUNTY EMERGENCY MEDICAL SERVICES

Synopsis:

An update was given regarding the progress of the Hazard Mitigation project; including a report summarizing the status of the 2006 Action Items.

September 23, 2014: Oceana County LEPC Meeting and Hazard Mitigation Public Meeting

Attendees:

LARRY VAN SICKLE	LOCAL EMERGENCY PLANNING COMMITTEE CHAIRPERSON
TOM OSBORN	COORDINATOR, OCEANA COUNTY EMERGENCY MANAGEMENT
DAVID ROBERTSON	RACES/ARES EMERGENCY COORDINATOR
BRET HANER	EMERGENCY RESPONSE COORDINATOR, DISTRICT #10 HEALTH DEPARTMENT
JANE HEDBERG	DEPARTMENT OF HUMAN SERVICES OCEANA COUNTY
JERRY SPENCER	CHEMICAL REPRESENTATIVE
MARK HILL	SPECIALIST, DISTRICT #10 HEALTH DEPARTMENT-OCEANA
ROLAND BROOKS	GRANT FIRE DEPARTMENT CHIEF
SANDY GRIFFIN	OCEANA COUNTY ROAD COMMISSION MANAGER
LLOYD GOWELL	OCEANA COUNTY ROAD COMMISSION
ARLENE KOLBE	MERCY HEALTH PARTNERS LAKESHORE CAMPUS INFECTION CONTROL COORDINATOR

OTHERS IN ATTENDANCE FOR PUBLIC HEARING:

STEPHEN CARLSON	WEST MICHIGAN SHORELINE REGIONAL DEVELOPMENT COMMISSION
JOSHUA CROFF	WEST MICHIGAN SHORELINE REGIONAL DEVELOPMENT COMMISSION
EVEYLYN KOLBE	OCEANA COUNTY COMMISSIONER
ED KOLBE	OCEANA COUNTY CITIZEN
DENNY POWERS	OCEANA COUNTY COMMISSIONER
GREGORY SHERBURN	MDNR-DRD-SILVER LAKE STATE PARK
ANNE SOLES	OCEANA COUNTY PLANNING COMMISSION CHAIRPERSON

Synopsis:

This meeting was noticed in the Oceana Herald-Journal, announced in the WMSRDC newsletter, and invitations were mailed and emailed to all local elected officials in Oceana County. 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. Recipients were offered an opportunity to comment on the drafted sections by attending the public meeting or by submitting written comments to WMSRDC staff prior to the meeting. One set of comments was received prior to the public meeting, which included a description of gas pipeline and electric transmission lines that traverse Oceana County. Those comments have been incorporated into the appropriate hazard descriptions in Part C of the hazard mitigation plan. The meeting also featured a work session, whereas a proposed set of hazard mitigation action items were reviewed, discussed, and prioritized utilizing interactive polling technology.

RESOURCES

Many resources, documents, and websites were researched and referenced during the development of this plan. The following were most helpful during this process:

Oceana County 2020 Master Plan (revised Feb 2010)

Oceana County Hazard Analysis (2000)

Oceana County Community Wildfire Protection Plan (2014)

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 Oceana County, Michigan (1996)

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 Oceana 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.

November 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.

March 15, 2012 – Oceana Herald-Journal

NOTICE OF PUBLIC HEARING REGARDING HAZARD MITIGATION

The West Michigan Shoreline Regional Development Commission (WMSRDC), in cooperation with Oceana County, has begun the process of updating the Oceana County Hazard Mitigation Plan. Public input is requested regarding natural and man-made hazards that pose a threat to people and property in Oceana County. A public hearing to discuss Hazard Mitigation and receive input from the community will take place at 12:00 AM on March 27, 2012 at the Oceana County Building located at 100 State Street, Hart, MI, 49420. Additional information about the Oceana 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 PM, 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.

September 11, 2014 – Oceana Herald-Journal

HAZARD MITIGATION PUBLIC MEETING

Public input is requested for the Oceana County Hazard Mitigation Plan, which is being developed by Oceana 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 12:00 PM on September 23, 2014 at the Oceana County Building, Board Conference Room, 100 State St, Hart. 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	Tornados 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	
14.219 Community Development Block Grants -Small Cities Program	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	
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	
14.511 Community Outreach Partnership Center Program	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
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	
59.008 Disaster Assistance Loans		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	
97.026 Emergency Management Institute-Training Assistance	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
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	
97.031 Cora Brown Fund	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	
97.037 Disaster Housing Program	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	
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	
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	
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	
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	
97.092 Repetitive Flood Claims						X	X								X	
97.110 Severe Repetitive Loss Program						X	X								X	