Hazard Mitigation Plan
for
Oceana County
and
Constituent Local Governments

Updated in 2023
Adopted by Oceana County
March 28, 2024

WEST MI 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. WMSRDC is also the planning agency for the metropolitan transportation planning (MPO) program for Muskegon and Northern Ottawa counties.

Mission Statement
The Commission's mission is to "promote and foster regional development in West Michigan through cooperation amongst local governments and regional partners." The general regional goal of the West Michigan Shoreline Regional Development Commission is to provide assistance to member local governments in addressing regional and public policy issues, especially as they pertain to planning and development.

Jennifer Hodges, Chairperson
Kathy Winczewski, Vice-Chairperson
James Rynberg, Secretary

Erin Kuhn, Executive Director

Project Staff:

Stephen Carlson, Program Manager

Prepared by WMSRDC in conjunction with the Oceana County Office of Emergency Management and the Oceana County Local Emergency Planning Committee

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Sample Letter of Transmittal

Dear Mr./ Ms.:

The Oceana County Hazard Mitigation Plan has been updated and was adopted by the Board of Commissioners on March 28, 2024. The plan is available to view and download at the Oceana County website, https://oceana.mi.us/.

This plan was developed by Oceana County in conjunction with the West Michigan Shoreline Regional Development Commission, the Michigan State Police, affected businesses, local governments, and interested members of the public. The plan provides the process for evaluation of land use and development in the county from a hazard mitigation perspective, which will help protect lives and property in the community.

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

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

I'll be happy to address any questions and concerns related to this plan. I'd also like to offer my presence at one of your meetings, upon your request. Please contact me at tmaloney@oceana.mi.us, or call (231) 873-4473.

Sincerely,

Troy Maloney, PEM
Emergency Manager
Oceana County Emergency Management

Resolution of adoption

OFFICE OF THE OCEANA COUNTY CLERK

Amy L. Anderson, County Clerk

100 State Street, Suite 1 – Hart, MI 49420
Office Phone: (231) 873-4328 Email: countyclerk@oceana.mi.us

OCEANA COUNTY RESOLUTION #24-07
HAZARD MITIGATION PLAN ADOPTION

Whereas Oceana County, Michigan has experienced natural and man-made disasters that have damaged commercial, residential, and public properties, displaced citizens and businesses, and presented general public health and safety concerns; and

Whereas Oceana County has prepared a Hazard Mitigation Plan under the guidance of the Oceana County Local Emergency Planning Committee (LEPC), which describes known disasters and impacts, potential hazards, and strategies to reduce overall damage and impact from hazards; and

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

Now, therefore, be it resolved that:

1. The Oceana County Hazard Mitigation Plan is hereby adopted as an official plan of Oceana County.

2. The Oceana County Emergency Management director is charged with supervising implementation and monitoring progress of the Plan's recommendations within the funding limitations as provided by the Oceana County Board of Commissioners or other sources.

3. The Oceana County LEPC shall provide oversight and guidance toward implementation of the Plan.

4. The Oceana County Emergency Management director shall provide an annual progress report to the Oceana County Board of Commissioners, including:
   a. A review of any disasters or emergencies that occurred during the previous calendar year.
   b. A review of mitigation actions taken, including accomplishments and limitations encountered during the previous year.
   c. A proposed outline of mitigation projects and activities for the following calendar year.

Roll call vote: AYES: Mr. Beggs, Mr. Erickson, Mr. Morse, Mr. Hardy and Mr. Walker
NAYES: None
ABSENT: None

CERTIFICATION:
The undersigned, being the Chief Deputy Clerk of Oceana County, does hereby certify that on the 28th day of March 2024, the Oceana County Board of Commissioners did adopt the above Resolution at its Regular Meeting.

Melanie A. Coon

Melanie A. Coon, Chief Deputy Clerk
Oceana County
Board of Commissioners

HAZARD MITIGATION PLAN
- 2023 Update -

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 accomplish while others require funding. The Federal Emergency Management Agency's (FEMA's) Pre-Disaster Mitigation (PDM) program, Hazard Mitigation Grant Program (HMGP), and Building Resilient Infrastructure and Communities (BRIC) 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 previously adopted by the county and fully approved by FEMA in 2015.

Plan Updates

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." The first edition of this Hazard Mitigation Plan was adopted by Oceana County in 2006 and approved by FEMA in 2007. The first update of this plan began in 2010 and culminated with a FEMA approval in August 2015. This edition of the plan is the second update. The planning process spanned from 2020 through 2023.

As applicable, each section of this plan provides detail as to how the section was reviewed and what significant updates were made. The general process for updating sections was led by WMSRDC, with assistance from Oceana County Emergency Management, followed by an opportunity for review by the Oceana County Local Emergency Planning Committee (LEPC).

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 update process was to request participation from each local unit of government within Oceana County. All units were also asked to provide a point of contact to receive communications about the planning process and opportunities to provide input. A checklist of community participation is included in the "Jurisdiction Participation" table later in this chapter.

The planning process followed in the update of the 2023 Oceana County Hazard Mitigation Plan Update consists 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
- 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) 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.

In 2023, the Oceana County LEPC was a twenty-nine-member committee appointed by the county board. It is comprised of individuals representing elected officials, emergency management, social services, law enforcement, fire services, health care, transportation, amateur radio, environmental, drain office, SARA Title III sites, public works, Michigan State Police, media, EMS, 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
- 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
- Agriculture

The Oceana County LEPC served as the Hazard Mitigation Advisory Team for the purpose of updating this plan; specifically to aid the process of reviewing and updating the hazard identification, vulnerability assessment, goals and objectives, and action agenda.

Appendix E includes the following documentation: LEPC Membership Roster (as of January 2023); 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, hazard mitigation articles published in WMSRDC newsletters, and any other means employed to engage stakeholders, communities, and the public.

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 an online "Community Hazards" survey made available May 2022 through January 2023. The survey was distributed to LEPC members, all Oceana County municipalities by mail, and mentioned in a public notice published August 18, 2022. The survey was available to the public on the WMSRDC website throughout the drafting stage of the planning process. Oceana County promoted the survey through flyers available on the Oceana County website and at a booth at the Oceana County fair in August 2022.

The Community Hazards survey was distributed early in the planning process and openly available on the WMSRDC website to serve several 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 provided an opportunity for respondents to comment on development changes, changing climate patterns, condition of infrastructure, and various impacts from hazards. Some respondents shared useful knowledge of local conditions such as hazardous or vulnerable areas and sites. Although much feedback obtained through the survey was inherently subjective, it was useful for gauging community opinions, and which were taken into consideration during review of the vulnerability analyses, goals & objectives and action agenda.

The survey elicited responses from a wide range of community elected and appointed officials, residents, landowners, and regional entities. A total of 33 surveys were collected for this plan. The survey instrument and a summary of responses can be found in Appendix D.

In addition, attempts to obtain input from community stakeholders were utilized at other stages of the Planning Process. In August 2023, the chief elected official, and in some cases the professional manager, of each local jurisdiction received a copy of its community and hazard profiles for review and comment. Follow-up conversations were held with communities that expressed interest in order to obtain additional feedback regarding the jurisdiction's capacity for engaging in hazard mitigation, identification of vulnerable populations, development changes, and observed hazard impacts of changing climate conditions.

The following chart shows the hazard mitigation participation status of each local jurisdiction in Oceana County. Participation is based on whether a representative from a jurisdiction (1) responded to the community hazards survey, (2) responded to a request for feedback regarding community profile information, or (3) communicated or contributed to the plan during the planning process.

Oceana County Hazard Mitigation Plan Local Jurisdiction Participation						
			2023 HazMit Plan Update			
Jurisdiction	Adopted 2006 HazMit Plan	2015 HazMit Plan Update Participant	Survey responses from elected or appointed official	Response to request for draft feedback	Other communication or participation	Did the community participate in the update process?
Oceana County	✓	✓	✓		✓	YES
Benona Twp	✓	✓	✓	✓ (email)		YES
Claybanks Twp	✓		✓			YES
Colfax Twp	✓				✓ (interview)	YES
Crystal Twp	✓	✓		✓ (email)		YES
Elbridge Twp	✓	✓	✓	✓ (email)		YES
Ferry Twp	✓	✓		✓ (interview)		YES
Golden Twp	✓	✓	✓	✓ (email)		YES
Grant Twp	✓	✓			✓ (interview)	YES
Greenwood Twp		✓			✓ (interview)	YES
Hart City	✓		✓	✓ (interview)		YES
Hart Twp		✓		✓ (interview)		YES
Hesperia Village						NO
Leavitt Twp	✓		✓		✓ (interview)	YES
New Era Village	✓	✓	✓		✓ (interview)	YES
Newfield Twp	✓	✓			✓ (interview)	YES
Otto Twp	✓				✓ (email)	YES
Pentwater Village	✓	✓	✓			YES
Pentwater Twp	✓	✓	✓	✓ (interview)		YES
Rothbury Village	✓	✓			✓ (interview)	YES
Shelby Village	✓	✓	✓		✓ (interview)	YES
Shelby Twp	✓	✓		✓ (interview)	✓ (email)	YES
Walkerville Village	✓	✓			✓ (interview)	YES
Weare Twp	✓	✓			✓ (interview)	YES

Neighboring counties were notified of the plan through a communication sent to their emergency manager and county administrator on August 23, 2023. 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 meeting on August 23, 2023. The meeting was noticed in the Oceana Heald Journal, posted on the WMSRDC website, and promoted in an email to the Oceana County Emergency Management contact list which included the LEPC and a broad range of local and regional stakeholders. 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 widely distributed and posted on the WMSRDC website.

A second public meeting was held during the drafting stage of the planning process. This meeting was hosted by the Oceana County Board of Commissioners during its regular meeting on September 28, 2023. The meeting was noticed in the Oceana Herald Journal and promoted in an August 25 emailing to all local units of government in Oceana County. These communications invited recipients to review drafted sections of the plan, including the Hazard Analysis, Goals & Objectives, and community profiles sections; all of which were posted on the WMSRDC website prior to the public meeting. All communications offered an opportunity to comment on the drafted sections by attending the public meeting, submitting written comments to WMSRDC staff prior to the meeting, or by contacting WMSRDC staff directly.

Hazard mitigation was featured several times in the WMSRDC print newsletter throughout the planning process. Not only were the newsletters distributed to all constituents and stakeholders in Lake, Mason, Muskegon, Newaygo and Oceana counties, but they also reached a majority of the county's neighboring communities. WMSRDC newsletters are publicly available on the WMSRDC website as well. Hazard mitigation was also featured on the WMSRDC website www.wmsrdc.org throughout the drafting phase. This offered an opportunity for the public to become familiar with hazard mitigation and participate in 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 available for public review.

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 Michigan State Police, Emergency Management and Homeland Security Division (MSP-EMHSD) to verify that the requirements of a hazard mitigation plan have been met. The plan will then be submitted to the Federal Emergency Management Agency (FEMA) for review. Subsequent to these steps, the LEPC then reviews any comments and feedback, 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 by resolution, 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

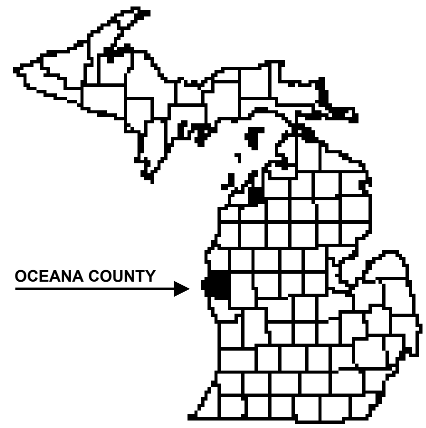
COMMUNITY PROFILE DESCRIPTIONS RELATED TO HAZARD RISK

(See Appendix A for additional community demographics and detail)

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 over 3,000 acres and about 30 miles of Lake Michigan coastline.



Over a third of the land cover 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 opportunities such as camping, paddling, fishing, hunting, hiking, and fruit picking.

Although the permanent population is 26,884 (2021 ACS 5-year estimates), Oceana County can experience significant seasonal population increases during warm months of the year. According to a rough calculation conducted for this plan, the potential peak seasonal population could nearly triple to over 76,000 if all the hotel rooms are filled, RV/camp sites are occupied, and vacant houses are rented. This estimation assumed two people per hotel room, four per RV/camp site, and six per vacant housing unit (which may be available for rent or seasonal use). The purpose of this estimate is to the demonstrate potential for seasonal population increases, which place a heavy burden upon infrastructure and services, which are designed to accommodate a much smaller permanent population and may complicate aspects of emergency management and response.

According to Council on Environmental Quality's Climate and Economic Justice Screening Tool, about two-thirds of Oceana County is considered "disadvantaged" due to various combinations of economic and environmental factors. Additional details are included in Appendix C.

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, combined with the temperature-moderating effects of Lake Michigan, create a unique and valuable agricultural setting. According to the 2017 Census of Agriculture, the county accounted for 2% of Michigan's agricultural sales. It was a Michigan top-10 in sales of "vegetables, melons, potatoes, sweet potatoes" (4^{th}), "fruits, tree nuts, berries" (6^{th}), "cultivated Christmas trees, short rotation woody crops" (8^{th}), "poultry and eggs" (8^{th}), and "hogs and pigs" (7^{th}). According to a 2009 Michigan Department of Agriculture report, 123,384 acres in the county, or 37.7 percent of the total land area, was farmland.

Oceana County is well known for its production of asparagus and fruit. 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. 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 also important enterprises. Some of the farmland in the county is used for livestock enterprises and hay crops. The livestock are mainly hogs, beef, and dairy cows.

1.05 Industry and Transportation

The main economic sectors in Oceana County are tied to farming, food processing, and tourism. Specialty crops are marketed fresh, frozen, or canned. 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. There are no railroads in the county.

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.

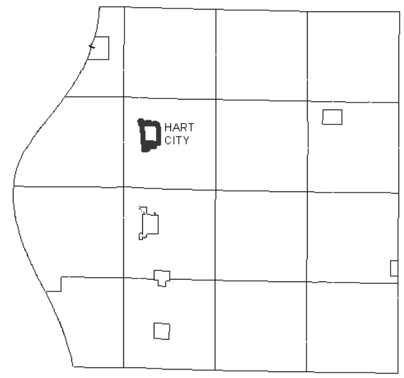
1.07 Lakes and Rivers

Oceana County has about 65 lakes and 4 major rivers. The largest lakes are Silver Lake (690 acres), Pentwater Lake (431 acres), Stony Lake (276 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 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, 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.



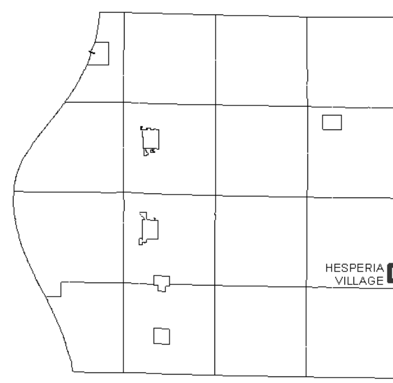
As the county seat, Hart is the administrative center of Oceana County. Hart is also a minor commercial hub, especially in the warm seasons due to its proximity to Silver Lake. The 2021 estimated population of the city was 2,193, with a potential seasonal population of about 3,100. The population declined 3.5 percent from 2010 to 2020. Distinctive features include the Oceana County Fairgrounds, Hart Lake, Hart-Montague Trail and trailhead, and a historic downtown.

3.0 VILLAGE PROFILE SUMMARIES

3.01 Hesperia Village

Hesperia Village straddles the county's eastern border with Newaygo County. It is located in Newfield Township in Oceana County, as well as Denver Township in Newaygo County.

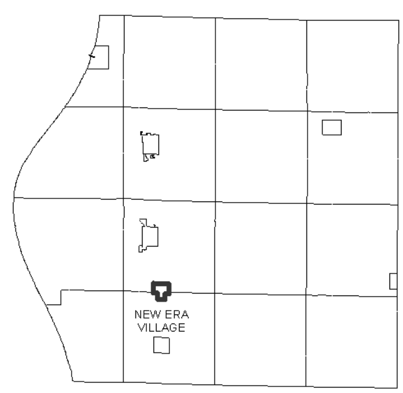
Hesperia had a 2021 estimated population of 830 and a total potential seasonal population of over 1,200. The population increased 8.4 percent from 2010 to 2020. Distinctive community features include a small historic downtown, Hesperia Community Schools, public library, Hesperia Dam, and the White River.



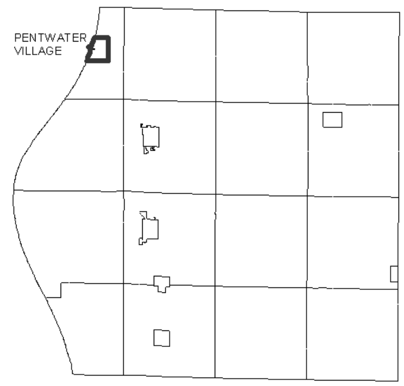
3.02 New Era Village

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.

New Era had a 2021 estimated population of 397 and a total potential seasonal population of nearly 500. Distinctive community features include the Hart-Montague Trail and trailhead, Carlton Creek headwaters, two schools, and a small historic downtown. The community is nearly evenly divided by Oceana Drive.



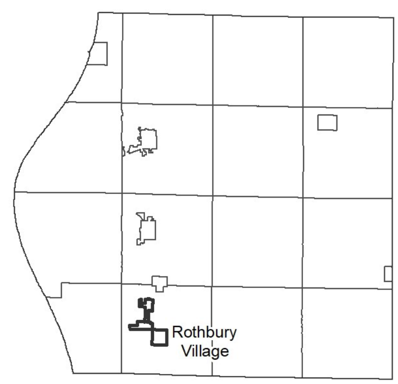
3.03 Pentwater Village



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 on the north side of town bears the name of Charles Mears.

Pentwater had a 2021 estimated population of 856 and a significant potential seasonal population of nearly 5,000. Distinctive community features include many historic houses and a historic downtown layout, recreational port with access to Lake Michigan, and Charles Mears State Park.

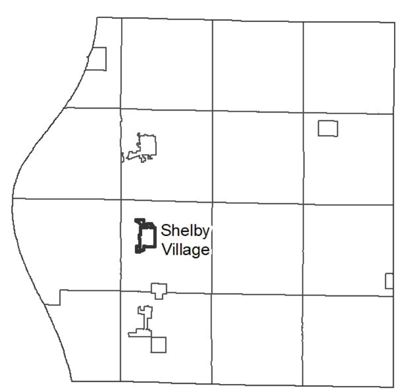
3.04 Rothbury Village



Rothbury is located in southern Oceana County in Grant Township. A large iron foundry closed in 2019, and this small town functions primarily as a commuter city to the surrounding areas. 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, after the post office station, as there was already another Greenwood in another county.

Rothbury had a 2021 estimated population of 384 and a total potential seasonal population of about 1,178. Rothbury may be best known as the host of the annual Electric Forest Music Festival which draws tens of thousands to Oceana County in the early summer. The Hart-Montague Trail also passes through the village.

3.05 Shelby Village

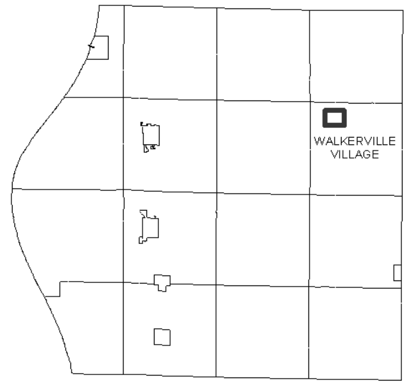


Shelby is located in west/central Oceana County within Shelby Township. Shelby’s economy is supported by tourism, local stores and businesses, many of which are located in an industrial park located at the north end of town. Surrounding agriculture also plays a significant role, as Shelby is located 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.

According to 2021 population estimates, Shelby is the most populated city or village in the county with 2,627 residents. In the summer, the seasonal population may increase to over 3,000. Shelby has a historic downtown district with easy access to the Hart-Montague Trail. Shelby is also host to the county’s only hospital and Shelby Public Schools.

Although the village population decreased 4.9 percent from 2010 to 2020, future growth is anticipated. The village may seek to expand its footprint to allow for extension of city services to new development.

3.06 Walkerville Village



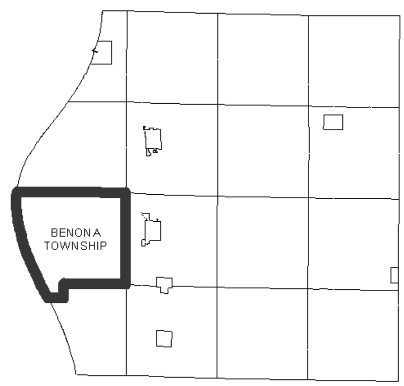
Walkerville is located in Leavitt Township in the northeastern quadrant of Oceana County. This small community is supported mainly by agriculture and tourism, being adjacent to several lakes and fishing streams located in the surrounding Manistee National Forest. Walkerville was named after Fayette Walker, 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.

With a 2021 estimated population of 243, Walkerville had the smallest population of all Oceana County municipalities. The population decreased 0.4 percent from 2010 to 2020. Important public facilities in the village consist of three schools, the Village Hall, police and fire departments, and a county road commission garage. The major employer in the village is Walkerville Public Schools.

Natural hazard concerns in the village include a high water table and drainage issues which can impact groundwater resources. Mobile homes and trailer dwellings in the village are relatively vulnerable to natural forces as well.

4.0 TOWNSHIP PROFILE SUMMARIES

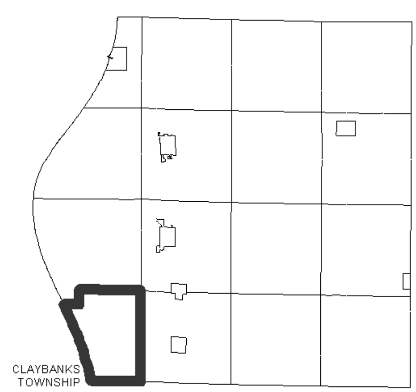
4.01 Benona Township



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. Agricultural lands and scattered rural and seasonal housing are interspersed throughout the terrain. A major feature is the Stony Lake area in the southwestern corner of the township. This is a significant residential, resort, and recreational location with several camps, campgrounds, parks, and a golf course.

Benona had a 2021 estimated population of 1,432, with the potential for a significant seasonal population increase to over 6,000. The population decreased 0.8 percent from 2010 to 2020. The Lake Michigan shoreline was cited as an area of the community that is frequently affected by natural hazards, including shoreline and dune erosion.

4.02 Claybanks Township

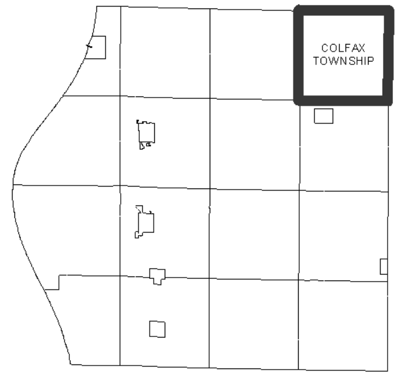


Claybanks Township is located in the southwest corner of Oceana County along the shoreline of Lake Michigan. The land is somewhat forested with rolling hills and sand dunes along Lake Michigan. The land is generally agricultural with scattered rural and seasonal housing. The township is a significant residential, resort, and recreational location with several camps and campgrounds especially near Stony Lake.

Claybanks had a 2021 estimated population of 882, with the potential for a seasonal population increase to over 2,800. The population increased 10 percent between 2010 and 2020. The

Lake Michigan shoreline was cited as an area of the community that is frequently affected by natural hazards, including shoreline and dune erosion.

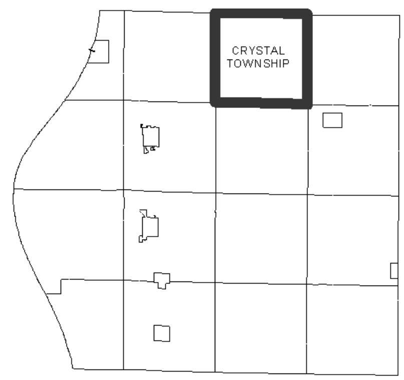
4.03 Colfax Township



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.

Colfax had a 2021 estimated population of 667, with the potential for a seasonal population increase to over 3,100. The population decreased 3.5 percent between 2010 and 2020. There are some properties along the Pere Marquette River that are known to be vulnerable to flooding. The township is not participating in the NFIP. However, as isolated development along the river continues, the township is looking into the program. Other issues of concern include wildfire due to the vast amount of Manistee National Forest, drastic water table variations, and spotty cell phone service which can impede dissemination of warnings to mobile devices.

4.04 Crystal Township

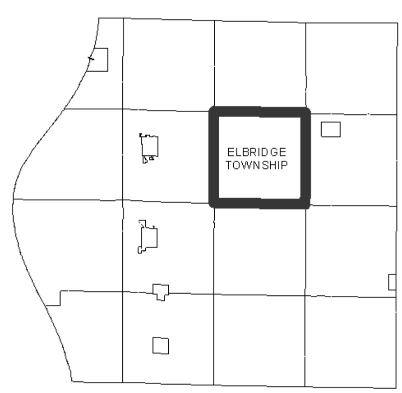


Crystal Township is located in north-central Oceana County. The terrain is mostly forested with rolling hills. Major natural terrain features are Crystal and Cleveland creeks, and about 6,400 acres of the Manistee National Forest. Agricultural lands and scattered rural and seasonal housing are interspersed throughout the township.

Crystal had a 2021 estimated population of 700, with the potential for a seasonal population increase to over 1,300. The population decreased 18.7 percent between 2010 and 2020. The Crystal Valley Dam, located within a county-owned park, is currently undergoing assessment. It was constructed in 1937.

In recent years, blight and road conditions have presented hazards, more new mobile homes have been observed than stick-built homes, and there have been road washouts linked to heavy runoff and poorly-maintained drainage ditches.

4.05 Elbridge Township

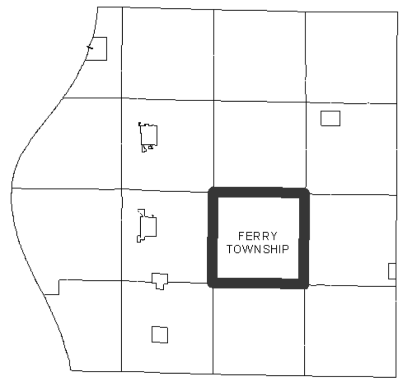


Elbridge Township is located in the center of Oceana County. The terrain is mostly forested with rolling hills. Natural features include the Pentwater River; Routley, Reunions, Swinton, and Osborn creeks; Cobmoosa, Evans, and Mud lakes; and the Manistee National Forest. The township is a rural community characterized by agriculture with scattered rural housing and natural land cover.

Elbridge had a 2021 estimated population of 857, with the potential for a seasonal population increase to over 1,700. The population increased 2.9 percent between 2010 and 2020. Infrastructure in the township includes Gales Pond Dam, a decommissioned gas pipeline, and two power transmission lines. Farms with chemicals stored onsite within the township were cited as a potential hazard.

4.06 Ferry Township

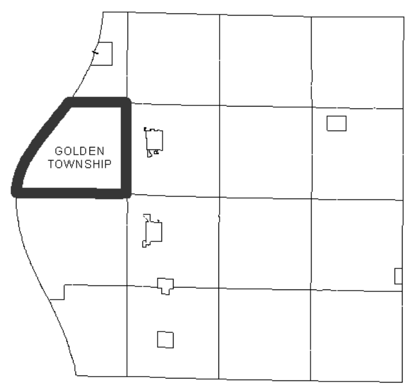
Ferry Township is located in the center of Oceana County. The terrain is mostly forested with rolling hills. Natural features include Knox Swamp, Robinson Creek, Swinton Creek, the North Branch of the White River, and the Manistee National Forest. Agricultural lands and scattered rural and seasonal housing are interspersed throughout the township.



Ferry had a 2021 estimated population of 1,073, with the potential for a seasonal population increase to about 2,000. The population decreased 1.6 percent between 2010 and 2020. Oceana County operates a transfer station within the township along state trunkline M-20.

4.07 Golden Township

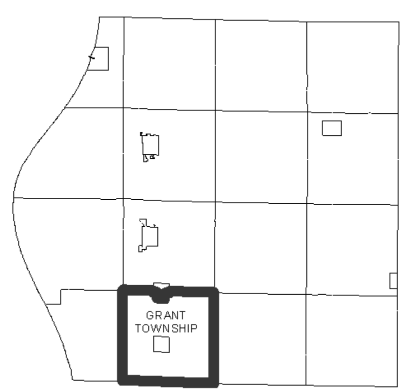
Golden Township is located in west-central Oceana County along the shoreline of Lake Michigan. The terrain is mostly forested with rolling hills and sand dunes along Lake Michigan. Other notable features include Silver Lake, Upper Silver Lake, Silver Lake State Park, and Pere Marquette State Forest. There are floodplains along the Lake Michigan shoreline, Silver Creek, Hunter Creek, Lambricks Creek, Golden drainage ditch, and around Silver Lake. Agricultural lands and scattered rural and seasonal housing are interspersed throughout the township. The Silver Lake and Mears area is a significant residential, resort, and recreation location with several camps, campgrounds, parks, a golf course, and the Hart-Montague Trail. A propane distribution system serves households around Lake Holiday and Upper Silver Lake and there are two high hazard potential dams there as well.



Golden had a 2021 estimated population of 1,707, with the potential for a significant seasonal population increase to over 20,500. The population decreased 4.7 percent between 2010 and 2020. The Silver Lake area has experienced an increase in resort accommodations in recent years, and that trend is expected to continue. Power outages were cited as a risk to vulnerable and elderly populations. Limited emergency access to properties, especially those tucked in the Lake Michigan dune environment, is also a concern.

4.08 Grant Township

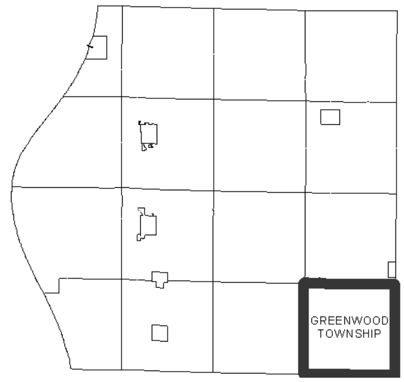
Grant Township is located in south-central Oceana County. The terrain is mostly forested with rolling hills. Natural features include Mud Lake, Carlton Creek, and the Manistee National Forest. Agricultural lands and scattered rural and seasonal housing are interspersed throughout the terrain. A significant feature is the Double JJ Resort nearby and Rothbury Village area which contains various residential, resort, and recreational locations. The township also includes part of New Era Village, as well as the Hart-Montague Trail.



Grant is the second most populated municipality in the county. The population increased 0.9 percent between 2010 and 2020. It had a 2021 estimated population of 3,000, with the potential for a seasonal population increase to over 5,200 (including the villages of Rothbury and New Era). In addition, the township, along with the Village of Rothbury, hosts the Electric Forest Music Festival which attracts tens of thousands of visitors every June.

Extended power outages may be the biggest vulnerability to township residents. The township fire department has made investments in equipment and coordinates well with state and federal agencies regarding response to wildfires. In addition, there is a small transient population that resides within spaces of federal forests, generally in the warm months. This brings a nuisance of trash, increased wildfire risk, and challenges with getting warnings out to those areas.

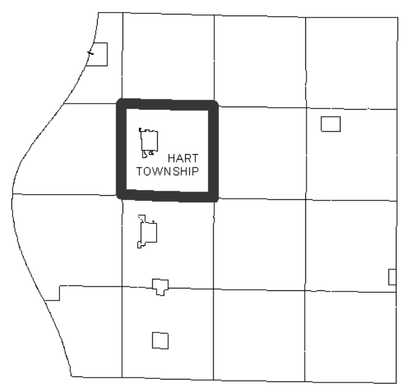
4.09 Greenwood Township



Greenwood Township is located in the southeastern corner of Oceana County. The terrain is mostly forested with rolling hills. Natural features include the White River, Cushman Creek, Skeels Creek, Brayton Creek, Horseshoe Lake, and the Manistee National Forest. Agricultural lands and scattered rural and seasonal housing are interspersed throughout the township.

Greenwood had a 2021 estimated population of 1,410, with the potential for a seasonal population increase to over 2,300. The population decreased 2.4 percent between 2010 and 2020. Wildfire and flood are the primary natural hazard threats. There are floodplains mapped along the White River, and the township began taking steps toward NFIP participation in 2023. About 40 percent of the township is state or federally owned forest land, which limits the potential for development and growth of the tax base. This presents financial limitations on the community.

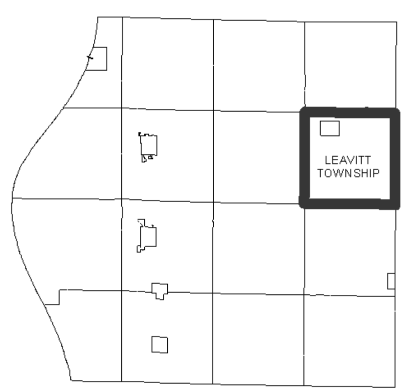
4.10 Hart Township



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. There are floodplains mapped along the Hart Lake shoreline, Pentwater River, Chippewa Creek, Russell Creek. Agricultural lands and scattered rural and seasonal housing are interspersed throughout the township.

Hart Township had a 2021 estimated population of 1,633, with the potential for a seasonal population increase to over 2,600. The population increased 9.4 percent between 2010 and 2020.

4.11 Leavitt Township

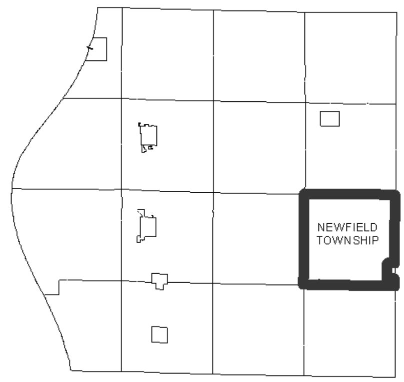


Leavitt Township is located in the northwest quadrant of Oceana County. The land is mostly forested with rolling hills. Natural features include Gilbert, Campbell, and Mud lakes; Beaver Creek; and about 5,400 acres of the Manistee National Forest including the Walkinshaw Wetlands. The township lies within the Pere Marquette River watershed and is characterized by Walkerville Village, agricultural lands, dense forests, and scattered rural housing.

Leavitt had a 2021 estimated population of 1,390, with the potential for a seasonal population increase to over 1,800. The population increased 2.2 percent between 2010 and 2020. Milder winters have been observed in recent years, which is a likely factor in the prevalence of ticks in the area. There may be groundwater contamination with PFAS having been detected locally. Large hog farming practices may be a significant contributor to this issue. There has also been a steady loss of wetlands claimed for agricultural purposes. A lack of a local zoning ordinance may be a contributor to this trend. There is also a washed-out road stream crossing on 190th Avenue that the township has had difficulty finding resources to address.

4.12 Newfield Township

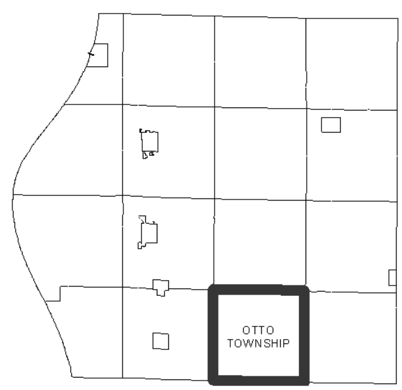
Newfield Township is located in the southeast quadrant of Oceana County. Key natural features consist of McLaren Lake, the North and South Branches of the White River, and the Manistee National Forest. The land is mostly forested with rolling hills. Agricultural lands and scattered rural and seasonal housing are interspersed throughout the township. Greater concentrations of development have occurred near the Village of Hesperia, along the White River, and around lakes.



Newfield had a 2021 estimated population of 2,078, with the potential for a seasonal population increase to over 4,700. The population decreased 3.0 percent between 2010 and 2020. Floodplains have been mapped along the White River and those areas would be at a substantial risk of flooding if the Hesperia Dam failed. Other noted items of caution include propane businesses along M-20 and a significant presence of seasonal camper/RV units and mobile homes scattered throughout the township.

4.13 Otto Township

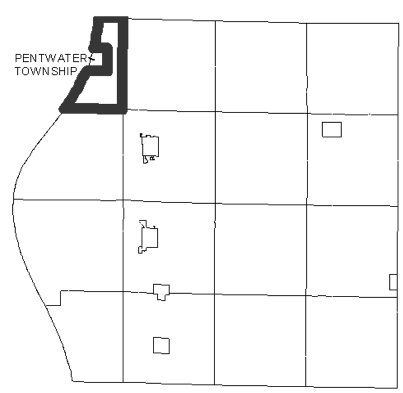
Otto Township is located in the southeast quadrant of Oceana County. The terrain is densely forested with rolling hills. Key natural features include the White River; Bear, Knutson, and Sand creeks; and the Manistee National Forest. Scattered rural and seasonal housing are interspersed throughout, with some agriculture along the north and northwest periphery of the township.



Otto had a 2021 estimated population of 739, with the potential for a seasonal population increase to about 1,400. The population increased 3.9 percent between 2010 and 2020. There are floodplains mapped along the White River and its north branch.

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. Key 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.

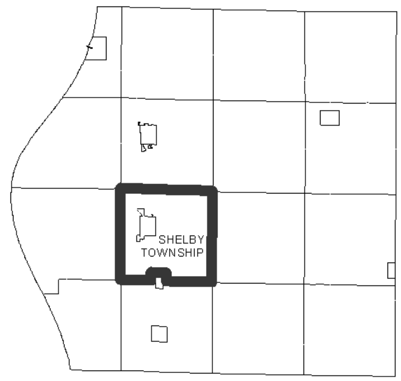


Pentwater Township had a 2021 estimated population of 1,704, with the potential for a seasonal population increase to almost 10,000. The population increased 9.0 percent between 2010 and 2020. These figures include the Village of Pentwater. There are floodplains mapped along the Lake Michigan and

Pentwater Lake shorelines and along the Pentwater River South Branch. Longbridge Road, an important route connecting to areas south of Pentwater Lake and which spans the transition between Pentwater River and Pentwater Lake, has been repeatedly plagued by fluctuating Great Lakes water levels in recent years.

4.15 Shelby Township

Shelby Township is located near the center of Oceana County. The land 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. Natural features include Round Lake, Browns Pond, and the Manistee National Forest. Together, the Shelby and Hart (to the north) area represents the industrial, commercial, and administrative core of the county.

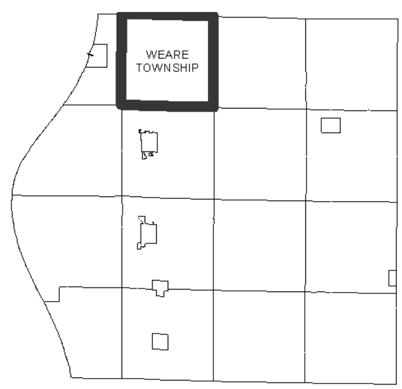


Shelby Township is the most populated municipality in Oceana County. It had a 2021 estimated population of 4,086, with the potential for a seasonal population increase to over 5,400. The population increased 1.0 percent between 2010 and 2020. The Oceana County Airport is located along the northern border of the township. Growth around the Village of Shelby is anticipated to occur.

Agriculture, food processing and tourism are essential to the local economy. Changing weather patterns are presenting challenges to farming in the form of increased temperatures and heavy rainfall events. Changing patterns are affecting pollinators as well as seasonal timing. Ground cover to mitigate soil erosion is a priority. Local farmers are also working with the West Michigan Research Station, an agricultural research facility, to study long term effects of soil compaction on farmlands which is known to affect water infiltration and groundwater supplies.

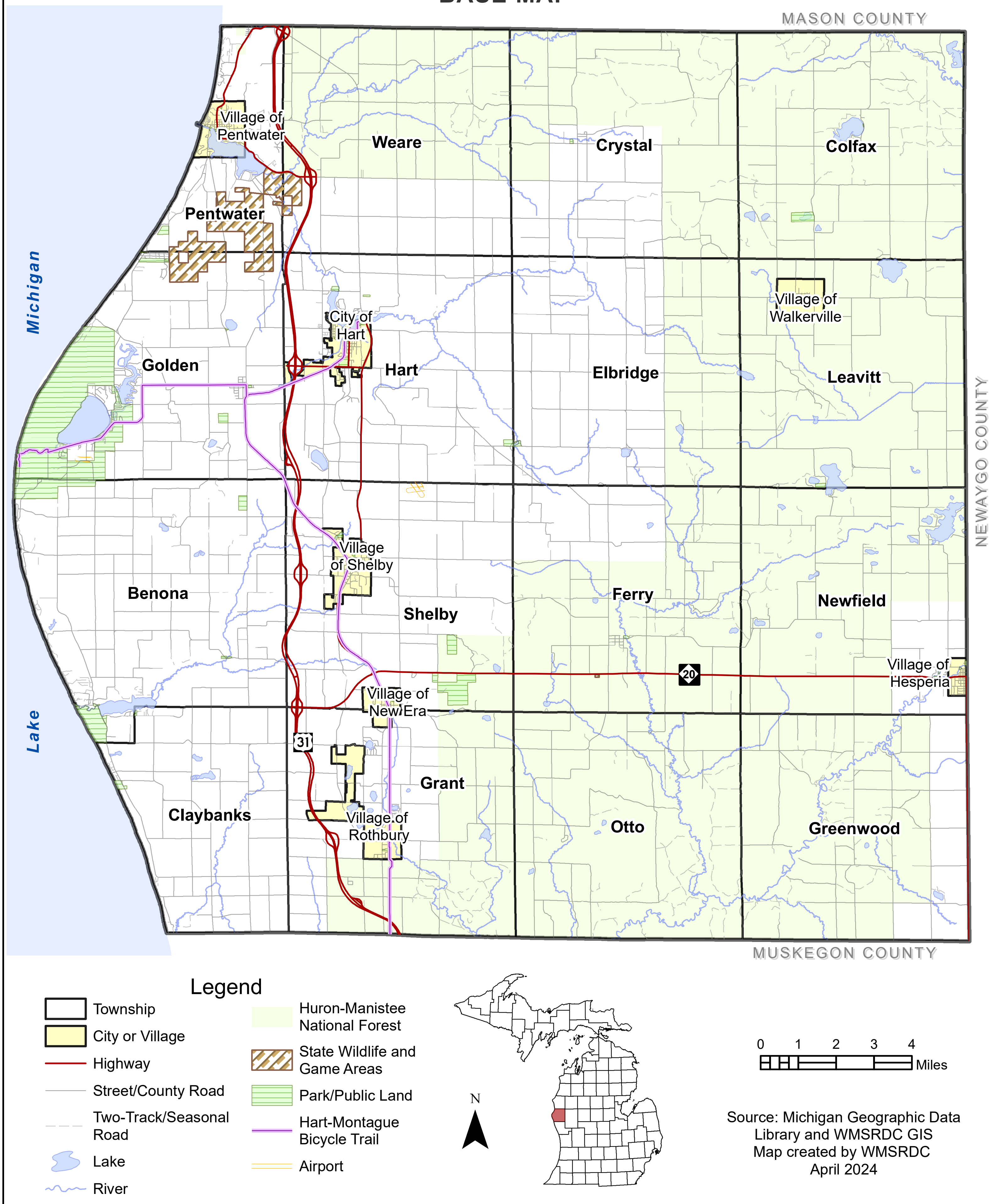
4.16 Weare Township

Weare Township is located in the northwest quadrant of Oceana County. The terrain is characterized by forested areas, farms, and rolling hills. Key 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 township.



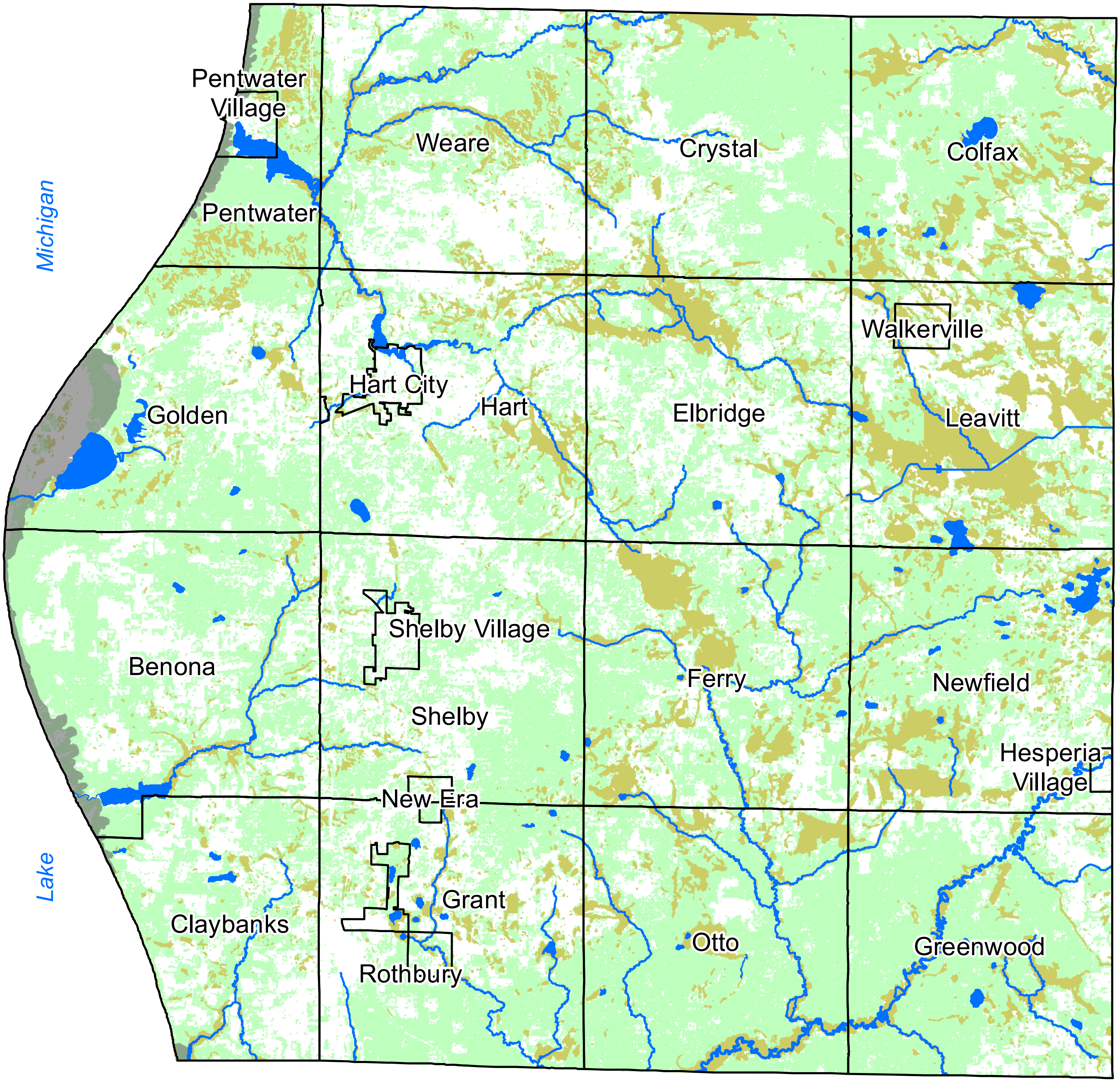
Weare had a 2021 estimated population of 1,311, with the potential for a seasonal population increase to almost 2,000. The population increased 1.2 percent between 2010 and 2020. Floodplains have been mapped along the Pentwater River and tributaries in the southwest area of the township. There are also numerous road-stream crossings along the Pentwater River and its tributaries.

OCEANA COUNTY
BASE MAP



Source: Michigan Geographic Data Library and WMSRDC GIS
Map created by WMSRDC
April 2024

OCEANA COUNTY
Natural Features

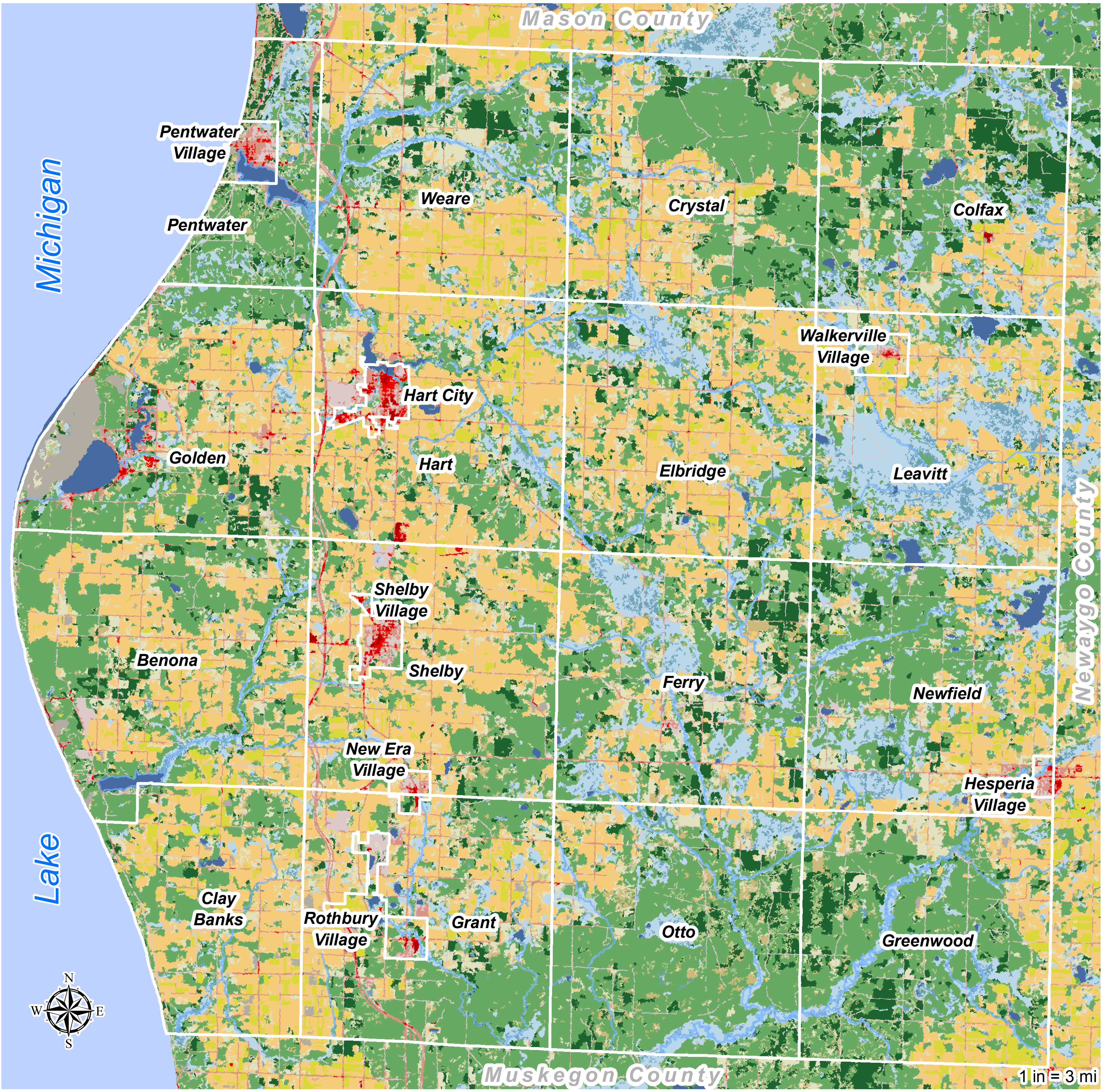


Forests
Critical Dunes
Wetlands
Water Features

WMSRDC
WEST MICHIGAN SHORELINE
REGIONAL DEVELOPMENT COMMISSION

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

Oceana County
Existing Land Cover



NLCD Classifications

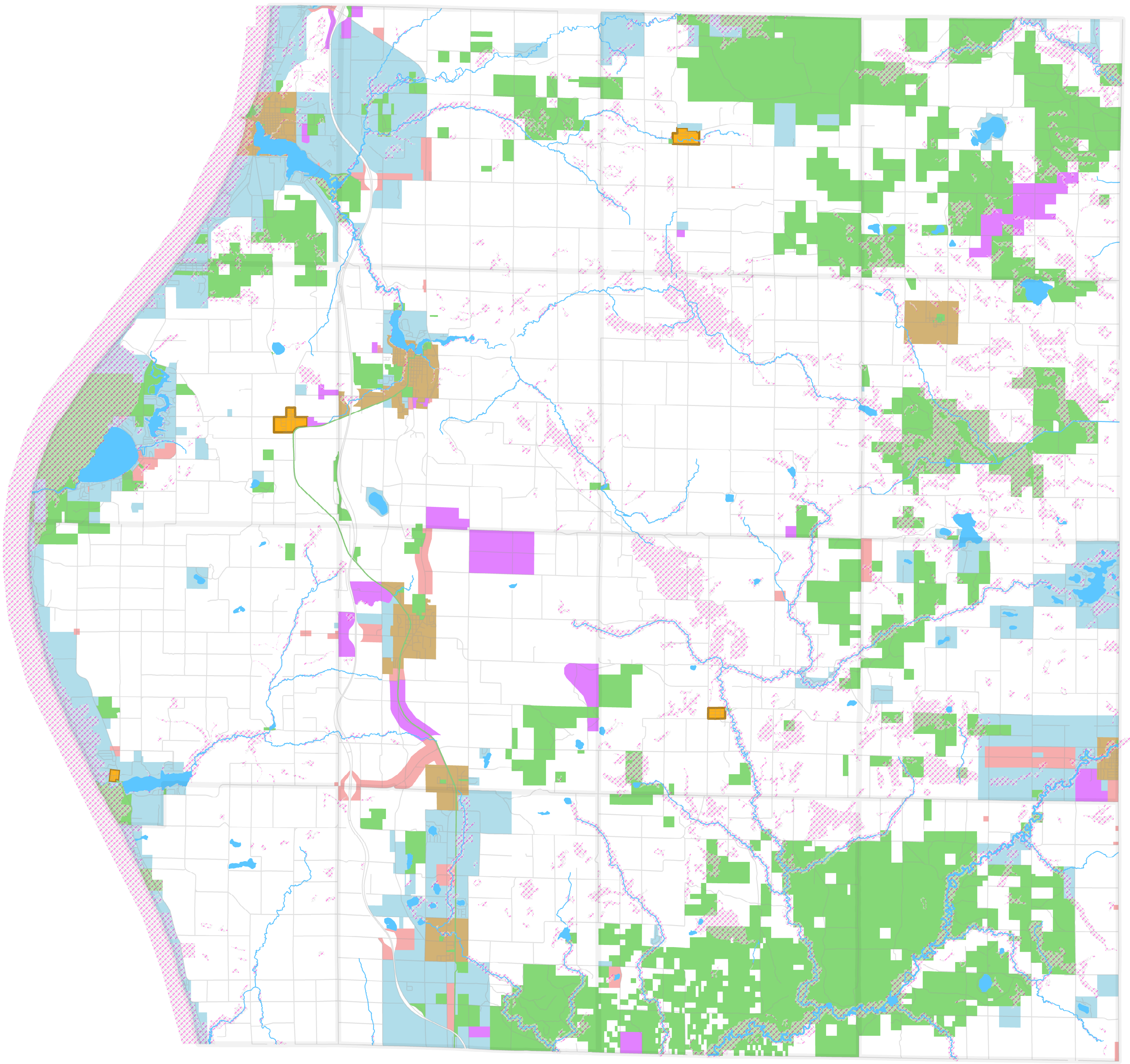
- Barren Land
- Cultivated Crops
- Deciduous Forest
- Developed, High Intensity
- Developed, Low Intensity
- Developed, Medium Intensity
- Developed, Open Space
- Emergent Herbaceuous Wetlands
- Evergreen Forest
- Hay/Pasture
- Herbaceuous
- Mixed Forest
- Open Water
- Shrub/Scrub
- Woody Wetlands

WMSRDC WEST MICHIGAN SHORELINE REGIONAL DEVELOPMENT COMMISSION

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

Oceana County

GENERALIZED FUTURE LAND USE MAP



Rural

Small Community

Residential

Incorporated Community

Commerce

Industry

Public Lands & Recreation

Sensitive Enviroments Overlay

0 1.25 2.5 5 Miles

This map is intended for general planning purposes only. Created in December 2015 for the Oceana County Master Plan.

WMSRDC

WEST MICHIGAN SHORELINE REGIONAL DEVELOPMENT COMMISSION

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 table below reveals the classification of hazards presented in this plan and described in-depth within this chapter.

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 Geologic 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, including protests, hooliganism, riots, and insurrection) ▪ Nuclear Attack ▪ Public Health Emergencies (including contagion and air/food/water contamination) ▪ Terrorism and Similar Criminal Activities

The Michigan Hazard Mitigation Plan 2019 edition (MHMP) and Michigan Hazard Analysis 2019 edition (MHA), produced by the Michigan State Police, Emergency Management and Homeland Security Division (MSP-EMHSD), consider a wide range of potential hazards in the state. These documents contain troves of information from which this plan draws. The MHMP and MHA may be consulted for information additional to that which is included in this document, especially regarding 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. Analyses draw heavily on historical records and available data, especially those of the National Centers for Environmental Information (NCEI), a division of the National Oceanic and Atmospheric Administration (NOAA). This information was previously attributed to the National Climatic Data Center (NCDC). Both NCEI and NCDC are mentioned in this plan in reference to the

Storm Events Database. The Storm Events Database is informed by National Weather Service (NWS) storm reports 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 occurrence in a particular area. On the other hand, the observations that are made will tend to come from areas of human development which may be more likely to benefit from hazard mitigation actions.

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

Significant Updates

The general format and organization of hazards within this chapter has remained the same. Where appropriate, updates within this chapter include: revisions to hazard descriptions; inclusion of recent hazard events, or additional events identified by research; consideration of changing land use and development; and adjustments to "Frequency of Occurrence." An important update to this edition of the Oceana County Hazard Mitigation Plan is the inclusion of "climate considerations," which have been added to appropriate hazard descriptions.

The changing climate presents complicated, intertwined, and evolving implications for numerous hazards described within this chapter. According to the Michigan Sea Grant website, Great Lakes residents must understand how climate change will affect their region. Specific projections vary, but scientists predict that the regional climate of the Great Lakes basin will be warmer, wetter, and less icy by the end of the century. According to the Great Lakes Integrated Sciences and Assessments (GLISA), some projections for the coming century include:

- Increases in average air temperatures by 3.6 to 11.2°F (2 to 6.2°C)
- More intense storms, leading to more damage from winds and flooding
- Less lake ice, leaving more water exposed to evaporate and become lake-effect rain or snow
- Larger and more severe algal blooms
- Fluctuating lake levels
- Greater displacement of native aquatic and terrestrial species by more adaptable species
- More frequent and severe droughts
- Longer growing season for crops, tempered by crop damage from heat, drought, and pests
- Increased risk of illness and death from heat waves and pest-borne diseases
- Interruptions to local economies dependent on winter tourism

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.
- 2020: Record high 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.
- March 8, 2017: High wind. $10m Property damage across Oceana County.
- February 24, 2019: High wind. $1m property damage across Oceana County.
- November 10, 2020: Severe thunderstorms. $100k property damage across 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.
- February 5, 2019: Ice storm. $1m property damage across Oceana County.

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

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 in the Michigan Hazard Analysis 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 small portion of the information contained within the state plan, which may 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 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 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: Space weather is defined in the Michigan Hazard Analysis as an impact or threatened impact from solar geomagnetic storms, coronal mass ejections, or similar phenomena that may damage or destroy Earth's electronic satellite systems, interfere with radio communications and navigation systems, create health risks for air travelers, and disrupt electrical utility and pipeline systems. Space weather is a term that describes the patterns of emissions from our Sun. Ordinary radiation emissions can be considered calm "weather," but there are periodic flare-ups and blasts of much greater energies that send charged particles that impact upon the Earth's atmosphere and magnetosphere. These solar geomagnetic storms can cause widespread failures of important satellite, electronic, communication, navigation, guidance and electric power systems—which have all formed a very important part of our modern technology and lifestyles. This hazard is considered fairly likely in the near term to cause notable disruptive effects, large economic impacts, and even some direct health risks to persons who are flying in aircraft in the far northern or southern areas of the planet, where the exposure to charged particles occurs in greater quantities.

An important type of impact involves the interference or disruption of modern electronic and communications systems, including those upon which our modern aviation networks rely. Solar flares and storms are important because of 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. On the ground, disrupted power systems can result in widespread power failures, and the movement of the mass of charged particles in geomagnetic storms can cause induced currents to flow within pipelines, unless special design features have inhibited such currents. An increase in ions (charged particles) that interact with the Earth's magnetosphere and then strike our upper atmosphere can cause a glow within the evening skies (which, in the northern hemisphere, includes the aurora borealis). Such "northern lights" become increasingly prominent, and extend farther to the south, during the most active solar storms.

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. Within the documented cycles so far, the time interval between a minimum and maximum has been as long as 14 years and as short as 8 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 2019, sunspot cycle number 24 (since a starting point in 1755) is almost over, having started in a solar minimum reached in December 2008, proceeded through a solar maximum that was reached in April 2014, and now (in 2019) reaching a new minimum again as the count of observed sunspots has dropped to nearly zero.

Another type of solar disturbance is 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).

Space weather can be very expensive for those who use or rely upon satellites. During a solar maximum, the Earth's upper atmosphere expands and increases the drag upon satellites within low orbits, which will then require boosting in order to remain aloft. Electronic circuits can malfunction and cause interruptions or complete losses in operational capacity. Space missions may also need to be delayed, in order to ensure their safety and success. Special design features may require additional expenses, to mitigate the effects of space weather. Communication disruptions can inhibit navigation and hinder the safe management of air and sea traffic.

Induced electric currents occur within conductive materials when magnetized material moves nearby and has a sufficiently powerful charge. Space weather creates such a phenomenon, when the planet is impacted by a moving mass of charged particles. The induced currents from space weather can affect electrical utility systems and pipeline infrastructure, potentially weakening and damaging these systems as well, increasing the chance of electronic malfunctions.

Three space weather scales are in use by NOAA/NWS to summarize the intensity and estimated potential impacts of three different types of space weather effects. Each uses a 5-category classification scheme, and the three scales denote (1) geomagnetic storm intensity (G-scale), (2) solar radiation storms (S-scale), and (3) radio blackouts (R-scale). Weaker events are given a number of 1 on the scale, and extreme events are rated as a 5. For more detailed information, please refer to the NOAA web site at http://www.swpc.noaa.gov/NOAAscales/.

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.

July 23, 2012 – International

The STEREO solar observatory (see below) detected and measured one of the largest solar storms ever recorded. The trajectory of the emissions were fortunately not directed at Earth during the time of the event, or it would have resulted in the type of extreme storm that has here been estimated as a "worst-case scenario." It has been calculated that if the solar eruption had taken place just one week earlier, then the Earth would have been aligned to receive the impacts putting electronic systems and investments at risk.

February 15, 2013 – Chelyabinsk, Russia, Meteorite and Shock Wave

A brightly glowing meteor became visible in the sky, and was soon followed by a shock wave that shattered windows throughout a wide portion of the major Russian city of Chelyabinsk. Over 1,000 persons were reported as injured by shattering glass throughout the city. Damage to a couple of industrial facilities also resulted, as the blast wave caused large doors to buckle and weakened structural components to the point of collapse. The meteorite's impact location was later located in a rural area, much reduced in size from the body that had originally blazed through the atmosphere. This was the first historical incident in which many injuries occurred as a result of this type of hazard. The physical size of this meteorite was much smaller than the Sikhote-Alin event of 1947 or the Tunguska event of 1908. It is fortunate that only the meteoritic blast wave was felt by the city, but this event is strongly indicative of the extent of damage that this hazard can cause. The destruction could have been far worse if the trajectory of the meteorite had been different. Meteorite fragments weighing about ¾ ton were later retrieved from the impact site at Chebarkul Lake, about 40 miles away. The meteorite was determined to have originally been one of the Apollo Near-Earth Asteroids, approximately 60 feet in its original size and with a mass of about 11,000 tons before it started to burn up in the atmosphere. The total impact energy was calculated by NASA to be the equivalent of about 440 kilotons of TNT. Purely by coincidence, many persons were already thinking about asteroids, because they were anticipating the near-Earth approach of an already-known body, asteroid 2012 DA14, which passed harmlessly by the Earth about 16 hours later, with a completely different (and thus unrelated) approach trajectory than the meteorite had shown. The Chelyabinsk meteorite had been traveling west-northwest above the earth's northern hemisphere, approaching from the general direction of the Sun, but the path of asteroid 2012 DA14 was going in a nearly perpendicular direction, and at its nearest it was about 17,000 miles away from the Earth's surface. The temporal proximity of the two bodies was mere coincidence, although 17,000 miles is quite close, in celestial terms, for a 150-foot diameter asteroid to pass by, allowing it to be clearly photographed from the Earth during its passage. This may be considered the fourth in a series of major modern impacts that tend to occur about every 50 years, on average—three of which have occurred in Russia. Damages were estimated at $33 million.

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 more likely to cause tangible effects in the short term. Due to the extent of our reliance on complicated electronic and satellite systems that are vulnerable to disruption, a consequential space weather event is possible. In addition to power failures and mobile communications 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 unusual hydrologic conditions such as a deficiency of rainfall, and 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, 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 it 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 began, once it is recognized then it can be classified within four different 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 time scales. A hydrologic drought involves the effects of precipitation shortfalls on stream flows and reservoir, lake, and groundwater levels. An agricultural drought involves deficiencies in soil moisture with respect to the water needs of plant life such as crops. A socioeconomic drought is when the effective demand for water exceeds the supply to the extent that costs begin to escalate, sometimes as a result of weather-related shortfalls. As the population increases (both in the U.S. and worldwide), so too does the need for water for drinking, growing food, and running businesses and homes. That increasing need will eventually increase human vulnerability to future droughts.

The U.S. Drought Monitor uses four classifications of severity, from the least intense category (D1) to the most intense (D4), with an additional (D0) category used to designate a "drought watch" area in which long-term conditions such as low reservoir levels are probably present. The Drought Monitor summary map is available online, identifying current drought areas and labeling their intensity. While not the only way to characterize droughts, the U.S. Drought Monitor is convenient, and their classification levels have recently been used in various reports and assessments of drought conditions. Short-term indicators are on the level of 1 to 3 months, while long-term indicators focus on durations of 6 to 60 months. The U.S. 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, , 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 -6.06.

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: Drought can be a "low-profile" hazard that does not get a lot of public attention in Michigan, compared with other parts of the United States. Nevertheless, parts of Michigan have tended to experience significant drought conditions about 20% of the time on average (depending upon how it is measured). Even if the occurrence of drought appears at first to be of lesser concern for a community, it is important to include a consideration of the drought hazard in local hazard mitigation planning, since plans are an excellent way to deal with gradual or longer-term hazards such as drought.

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 National Centers for Environmental Information (NCEI), Oceana County experienced drought conditions of eight months or greater 12 times in the 124-year period from 1895 to 2018. 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% chance of experiencing lengthy drought conditions in any given year.

Drought conditions of shorter duration are more common than lengthy events, as 55% of the years from 1895 to 2018 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 2018, which is 18.6%.

The MHA identifies 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). The table below has been updated in this edition of the plan, reflecting an additional eight years of data. There have been no significant droughts observed within that time, therefore all percentages shown are lower than reported in the previous plan, indicating a recent downward trend in historical drought frequency.

Percentage of Drought Months and Years, 1895 to 2018
Lake, , Muskegon, Newaygo, and Oceana Counties

	Years without any drought months	Palmer ≤ -2.0	Palmer ≤ -3.0	Palmer ≤ -4.0	Palmer ≤ -5.0	Palmer ≤ -6.0	Palmer ≤ -7.0
Drought Years	45%	55%	21%	10%	2%	1%	0%
Drought Months	81.4%	18.6%	6.8%	1.8%	0.4%	0.1%	0.0%

Climate Change Considerations: Although the effect of climate change on Michigan has involved an overall increase in precipitation, and the severity of Michigan's droughts has generally been decreasing over the past half-century, nevertheless there will still be drought events and drier seasonal phases, especially in areas that are locally more susceptible. In particular, shorter duration seasonal droughts are expected to worsen during the warmer half of the year, even though the overall annual averages have been showing increases in precipitation. With sufficient planning and water infrastructure, the climate change effects upon this hazard may actually be beneficial on the whole in the medium-term, although the hazard will definitely not disappear, and in the longer-term is expected to greatly worsen (after a period of several decades).

1.03 EARTHQUAKE

A shaking or trembling of ground (or earth's crust) caused by tectonic activity or other seismic forces.

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 tremors 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 on the following page, which show where 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.

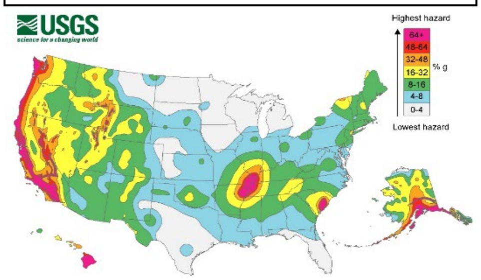
Actual movement of the ground in an earthquake is seldom the direct cause of injury or death. Most casualties result from falling objects and debris. Disruption of communications systems, electric power lines, and gas, sewer and water mains can be expected. Water supplies can become contaminated by seepage 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 widely reported across the southern half of Lower Michigan.

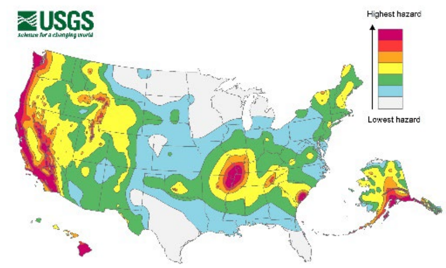
The New Madrid Seismic Zone is the most likely source of seismic activity to affect the area. It is located in the vicinity of the Mississippi River in Missouri, Tennessee, and Arkansas, poses a minimal threat to Oceana County. Notable historic earthquakes emanating from this area occurred in 1811, 1812 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.

Frequency of Occurrence: Earthquakes are not considered a significant hazard in Oceana County. 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. Notably, the 2018 National Seismic Hazard Map reveals a slight northward shift in the second-lowest risk category in southern Michigan. See maps on following page.

USGS National Seismic Hazard Map (circa 2012)



USGS National Seismic Hazard Map 2018



Source: https://www.usgs.gov/media/images/2018-long-term-national-seismic-hazard-map

1.04 EXTREME TEMPERATURES

Prolonged periods of very high or very low temperatures.

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 to human health and property, while prolonged periods of extreme temperatures can pose life-threatening problems for residents. Public education about these extreme temperature hazards, early notification of impending extremes, and the availability of cooling and warming shelters are all beneficial actions in mitigating the impacts of these hazards upon people. Prolonged periods of extreme temperatures, whether extreme summer heat or extreme winter cold, can pose life-threatening problems for residents. Although quite different from each other in terms of conditions and impacts, the two hazards share a commonality in that they both pose particular problems for the most vulnerable segments of society: the elderly, young children and infants, impoverished individuals, outdoor laborers, and persons who are in poor health. Extreme temperatures can also negatively impact livestock, crops, wildlife, infrastructure, and put a strain on energy demands.

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

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

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

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

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

The "Heat Index" table below 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 everyone 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.

National Weather Service Heat Index

Relative	Actual Temperature (degrees Fahrenheit)															
Humidity	80	82	84	86	88	90	92	94	96	98	100	102	104	106	108	110
40%	80	81	83	85	88	91	94	97	101	105	109	114	119	124	130	136
45%	80	82	84	87	89	93	96	100	104	109	114	119	124	130	137	
50%	81	83	85	88	91	95	99	103	108	113	118	124	131	137		
55%	81	84	86	89	93	97	101	106	112	117	124	130	137			
60%	82	84	88	91	95	100	105	110	116	123	129	137				
65%	82	85	89	93	98	103	108	114	121	128	136					
70%	83	86	90	95	100	105	112	119	126	134						
75%	84	88	92	97	103	109	116	124	132							
80%	84	89	94	100	106	113	121	129								
85%	85	90	96	102	110	117	126	135								
90%	86	91	98	105	113	122	131									
95%	86	93	100	108	117	127										
100%	87	95	103	112	121	132										

	Caution
	Extreme Caution
	Danger
	Extreme Danger

Source: NOAA National Weather Service

Prolonged extreme heat can also have an economic impact on society, through (1) lost work, (2) increased electricity usage, leading to brownouts or blackouts, (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

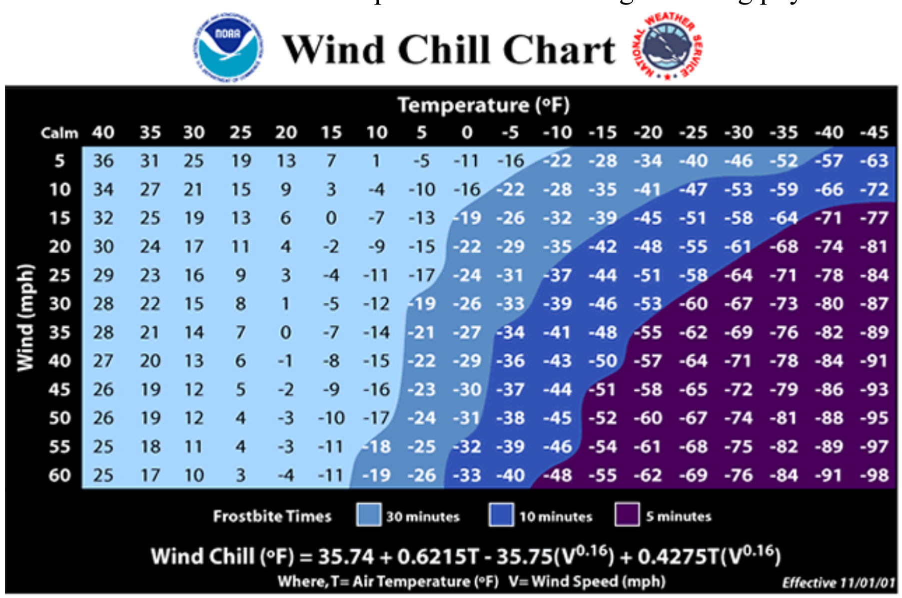
Source: Michigan State Climatologist's Office

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. Damage to buildings and infrastructure can also occur in bitter cold conditions, resulting in expensive repairs and potential days of business and school shutdowns.

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

- *Frostbite* is the freezing or partial freezing of some part of the body, usually occurring in the extremities such as toes, fingers, ears, or nose. Frostbite rarely results in death, but does damage the tissue that has been frozen, and in extreme cases may require amputation. A loss of feeling and a white or pale appearance in body parts are symptoms of frostbite.
- *Hypothermia* is a condition brought on when the body's temperature drops significantly due to exposure to cold. Hypothermia becomes serious when the body's internal temperature goes below 95 degrees Fahrenheit. When the body falls below 90 degrees, normal shivering reactions stop, and emergency treatment is necessary. Symptoms of hypothermia include uncontrollable shivering (when body temperature is above 90 degrees), slowed speech, memory lapses, frequent stumbling, drowsiness, and exhaustion. If left untreated or treated improperly, hypothermia can lead to death. Unlike frostbite, hypothermia can occur in a person who is exposed to only moderately cold temperatures (even when indoors)—typically over a prolonged period. Infants, the elderly, and people 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.



Wind Chill Chart

Temperature (°F)

Wind (mph) \ Calm	40	35	30	25	20	15	10	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45
5	36	31	25	19	13	7	1	-5	-11	-16	-22	-28	-34	-40	-46	-52	-57	-63
10	34	27	21	15	9	3	-4	-10	-16	-22	-28	-35	-41	-47	-53	-59	-66	-72
15	32	25	19	13	6	0	-7	-13	-19	-26	-32	-39	-45	-51	-58	-64	-71	-77
20	30	24	17	11	4	-2	-9	-15	-22	-29	-35	-42	-48	-55	-61	-68	-74	-81
25	29	23	16	9	3	-4	-11	-17	-24	-31	-37	-44	-51	-58	-64	-71	-78	-84
30	28	22	15	8	1	-5	-12	-19	-26	-33	-39	-46	-53	-60	-67	-73	-80	-87
35	28	21	14	7	0	-7	-14	-21	-27	-34	-41	-48	-55	-62	-69	-76	-82	-89
40	27	20	13	6	-1	-8	-15	-22	-29	-36	-43	-50	-57	-64	-71	-78	-84	-91
45	26	19	12	5	-2	-9	-16	-23	-30	-37	-44	-51	-58	-65	-72	-79	-86	-93
50	26	19	12	4	-3	-10	-17	-24	-31	-38	-45	-52	-60	-67	-74	-81	-88	-95
55	25	18	11	4	-3	-11	-18	-25	-32	-39	-46	-54	-61	-68	-75	-82	-89	-97
60	25	17	10	3	-4	-11	-19	-26	-33	-40	-48	-55	-62	-69	-76	-84	-91	-98

Frostbite Times: 30 minutes; 10 minutes; 5 minutes

Wind Chill (°F) = $35.74 + 0.6215T - 35.75(V^{0.16}) + 0.4275T(V^{0.16})$

Where, T= Air Temperature (°F) V= Wind Speed (mph)

Effective 11/01/01

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

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 Analysis also lists several significant heat waves affecting Michigan. For example, extreme heat during the summer of 1936 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. 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.

Climate Change Considerations: Certain indicators of climate change in Michigan have already been observed. For example, in daily record temperature data, Michigan's new heat records outnumbered new cold records by 3 to 1 during the 1990s, and by 6 to 1 during the 2000s. The Michigan State Police, Emergency Management and Homeland Security Division expects extreme heat problems to increase in the future and is coordinating with other agencies to assess the likely impacts of warming trends. It has long been known that although Michigan's winter season has been shortening, its winters will not disappear! Instead, a surprising pattern has recently been seen in which lessened differences in temperature between polar and temperate regions (due to the warming of the arctic and polar regions) can make it easier for a polar weather front to swing southward across the United States. Although this jet stream movement occurs every winter as a normal part of Michigan's seasonal patterns, the 2013-2014 season showed an unexpectedly challenging aspect of the “polar vortex” phenomenon, in which a series of challenging weather events—ice storms, persistently cold temperatures, freezing rain, and heavy snowstorms seemed to affect the state with increasing rapidity. Historical facts show that Michigan has experienced colder temperatures in the past (although specific records for individual days and locations will continue to be set over time), but one of the new patterns connected with climate change involves a lesser amount of time for persons to become acclimated to the cold weather—especially in the southern part of the Lower Peninsula. Increasingly mild fall months from October to early December may seem to suddenly give way to bitter cold, winds, ice, and snow, with the shorter winter season providing less time for people to adjust to the frigid weather. (By the calendar, winter is always three months long, but Michigan has long experienced winter weather conditions during months that are normally classified as part of Fall and Spring. One of the most prominent ways in which climate change has affected Michigan is in the shortening of its wintry weather, so that its seasons are becoming more closely aligned to those technically designated on the standard calendar as “winter.”)

1.05 FLOODING: RIVERINE/URBAN

Fluvial (riverine): The periodic overflowing of rivers, streams, and channels—due to inadequate drainage capacity, drainage system failures, ice or log jams, accumulated sediments, erosion, or meandering—that results in nearby property damage, safety issues, disruption of infrastructure function and services, and/or decreased quality of life.
Pluvial & Urban: The accumulation of water in low-lying and inadequately drained areas, following heavy precipitation events, including structural or power failures in municipal sewage systems, causing waters to flood or back-up into houses, other structures, and infrastructure.

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 to a number of watercourses, most notably Lake Michigan, Pentwater River, Pere Marquette River, and White River. Nine communities in the county currently participate in the National Flood Insurance Program (NFIP). Flood hazard areas, delineated on flood insurance rate maps (FIRM), are located along areas including the Lake Michigan shoreline, Silver Lake area, Pentwater River and Hart Lake, Stony Lake and Stony Creek, and the White River and tributaries. There is also a known, but unmapped, flood-prone area along the Pere Marquette River in Colfax Township, which does not participate in the NFIP.

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 these waters must be considered along with issues involving development in and adjacent to floodplains. Major flooding and flash flooding may damage these systems, endanger individuals, and negatively impact the local economy.

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 common cause of 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 May 2023, there had been no repetitive losses or recent claims in Oceana County. The tables below summarize current NFIP flood insurance policies, as well as flood claims that were documented in 2014.

NFIP Policy Information
- As of August 2023 -

Community	Total Premium	Number of Policies	Total Coverage
Benona Township	$6,729	7	$2,203,000
Ferry Township	$1,387	2	$411,000
Golden Township	$2,391	4	$1,050,000
Hesperia Village	$774	1	$40,000
Newfield Township	$14,875	12	$1,741,000
Pentwater Township	$458	1	$350,000
Pentwater Village	$8,057	25	$3,462,000
Unknown	$12,299	11	$2,822,000
Oceana County Total	**$46,970**	**63**	**$12,079,000**

Source: *NFIP Policy Information by State (8-31-23)*

NFIP Claims
- As of November 30, 2014 -

Community	Since 1978	
	# of Claims	*Claims Paid*
Benona Township	1	$0
Claybanks Township	1	$0
Golden Township	12	$25,602
Greenwood Township	2	$2,658
Hart City	2	$0
Hesperia Village	2	$12,904
Newfield Township	2	$36,442
Pentwater Township	1	$0
Pentwater Village	4	$18,212

Source: *Federal Emergency Management Agency, Policy Claim Statistics*

As of September 2023, there were nine communities in Oceana County participating in the NFIP: City of Hart; villages of Hesperia and Pentwater; and townships of Benona, Claybanks, Ferry, Golden, Newfield, and Pentwater. This represents an increase of two since 2014. The townships of Greenwood, Hart, Otto, and Weare have "special flood hazard areas" identified but were not participating in the program. Any combination of the following scenarios might contribute to non-participation: lack of awareness due to turnover in leadership; low priority due to low density of development; perceived barriers to entry into the program; or a general disinterest in engaging with state or federal entities. Lastly, community members have indicated that areas along the Pere Marquette River in Colfax Township have isolated development and are known to be flood prone.

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. In rural areas of Oceana County, 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 erosion and failure from 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 2022, six of which were attributed with 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. In April 2013 a flood led to about $3 million in property damage in Oceana County. No additional flood events have been documented through 2022.

Frequency of Occurrence: At the very least, minor flooding is likely to naturally occur every year in Oceana County. Areas of the county that are more likely to experience a higher degree of riverine flooding due to watercourses and drainage basins include the White, Pentwater, and Pere Marquette river areas. 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 cyclical, but impossible to predict at this point.

Thirteen communities in Oceana County, nine of which are participating in the NFIP, have at least some floodplains mapped. 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. In addition, the Village of Pentwater and the townships of Benona, Claybanks, Golden and Pentwater have coastal zones mapped along the Lake Michigan shoreline. Coastal areas have a 1% or greater chance of flooding and an additional hazard associated with storm waves. These areas have a 26% chance of flooding over the life of a 30-year mortgage.

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 37 years from 1986 through 2022. Lesser magnitude floods will have been observed at a rate of about once every three to four years. There are eight such events documented by NCDC in 30 years from 1993 through 2022.

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 Analysis, and is therefore discussed in this plan. The NCDC includes 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.

Although most fog, by itself, is not generally a hazard because it does not actually apply damaging forces, the interaction between humans and fog can be a dangerous situation, sometimes resulting in disastrous consequences. It must be noted, however, that freezing fog (a hazard for which the National Weather Service issues special statements) can cause direct harm by causing slickness on roadways, walkways, bridges, and highway ramps, and therefore leading to serious transportation accidents. One of the main risks involves morning school buses and the safety of students and their parents while waiting near roadways under conditions of very low visibility.

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 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 Analysis, 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 for impactful fog events. 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

Water-level fluctuations, current and wave actions, and other conditions in the Great Lakes that cause flooding or erosion, or otherwise threaten life, health, and property in shoreline areas, including harmful algal blooms, ice surges, storm surges, meteotsunamis, rip currents, shoreline erosion and recession.

Summary: 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, piers, and river mouths.

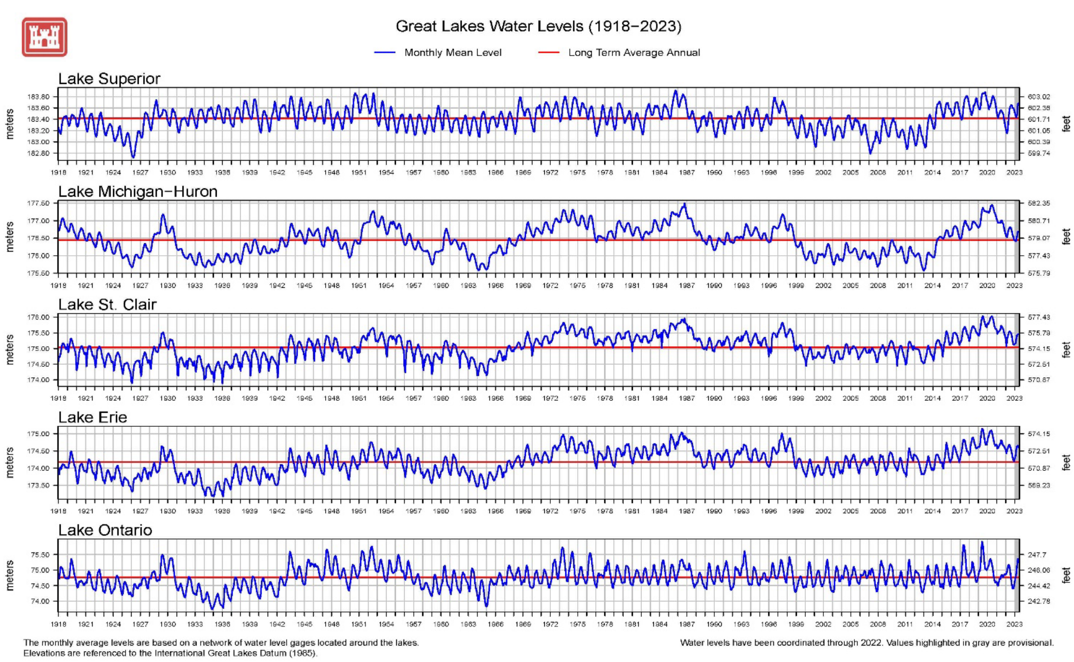
With about 30 miles of Lake Michigan coastline, Oceana County is at risk from Great Lakes shoreline hazards. According to the 2020 U.S. Census, approximately 1,233 citizens resided within census blocks located within a half-mile of the Lake Michigan shoreline. There were approximately 1,186 housing units within the same area. Communities that border Lake Michigan include Pentwater (village and township), Benona Township, Claybanks Township, and Golden Township. Each of these communities has popular public access points for recreation on Lake Michigan. 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.

Hazard Description: Michigan has over 3,200 miles of coastline, the longest freshwater coastline in the world. About 4.7 million people live in the state’s 41 shoreline counties. Wind, waves, water levels, and human activities constantly affect the communities along the shores of the Great Lakes. Shoreline flooding and erosion are natural processes, occurring at high, average, and even low Great Lakes water levels. However, during periods of high water, flooding and erosion are more obvious, causing serious damage to homes and businesses, roads, water and wastewater treatment facilities, and other structures in coastal communities. Low lake levels can also pose a hazard, as cargo ships are more prone to running aground and the shorelines may also become more polluted from lake bottom debris. Long-term and seasonal variations in precipitation and evaporation rates primarily control the Great Lakes water levels and their fluctuations. The extent of ice cover affects the rate of evaporation during the winter. Greater ice cover results in less evaporation during winter and leads to higher water levels in the spring.

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 land draining into the Great Lakes is so vast, changes in the amount of water running into the lakes from precipitation within the basin has an enormous effect on water levels. Following long periods of above-average yearly precipitation, there is an accompanying rise in water levels. This rise 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. The same holds true for below-average yearly precipitation. The reduced flow of runoff water eventually results in lower Great Lakes water levels.

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. In addition, meteorological conditions can cause damaging wave impacts (seiches and meteotsunamis), winter lake patterns can cause damaging ice surges (also known as ice shoves), rip currents cause multiple deaths and injuries each year, and harmful algal blooms (HAB) have led to serious reductions in water quality, as well as degrading the stock of healthy lake fish.

Great Lake water levels go through complicated cycles that are not easy to predict. The time between periods of high and low water levels can vary widely. Records indicate the maximum differences in levels have varied from nearly four feet on Lake Superior to over six and one-half feet on lakes Michigan and Huron. Seasonal fluctuations caused by more water runoff can cause lake level fluctuations averaging about one foot on lakes Superior, Michigan and Huron, and one and one-half feet on Lake Erie. The following graph shows the long-term annual average water levels of the Great Lakes since 1918. Current lake level information can be found at the Great Lakes Water Dashboard, at https://www.glerl.noaa.gov/data/dashboard/GLWLD.html, and the NOAA Lake Level Viewer at https://coast.noaa.gov/llv/.



In addition to natural causes of water level fluctuation, there are four human-caused factors that can also affect water levels to a limited 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. Even though these human-caused factors do affect water levels, natural factors such as precipitation, evaporation and winds have a far greater overall impact. The majority of shoreline flooding and erosion that occurs along the Great Lakes is caused by natural factors. 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. In fact, the sand for the recreational beaches we enjoy is formed from coastal erosion processes that are problematic in other areas.

Generally, low-lying lands along the coastline are prone to shoreline flooding during both high and low lake water periods. The Michigan Department of Environmental Quality (MDEQ) has designated 41 communities on Michigan's shoreline as flood risk areas, meaning that they have floodplain-like areas with at least a 1% annual chance of a designated flood level being exceeded. These designations allow the mapping of flood-prone areas in a manner similar to riverine flooding, but these shoreline areas may suffer from additional damages caused by the added effects of wave action and seiche activities on the Great Lakes. The MDEQ estimates that approximately 10% of Michigan's Great Lakes shoreline is flood-prone, involving lands encompassing more than 45,000 acres and located in 30 counties.

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, vehicles, and goods 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.

Shoreline erosion hazards involve the loss of property as the supporting sand or soil is removed by wind and wave action. Worst-case scenarios tend to involve inhabited structures that, over the years, have had adjacent lands eroded away and now stand perilously close to lake waters or shoreline cliffs. The foundation of a structure, or underground utility pipes in the area, may become fully exposed and vulnerable to weather, extreme temperatures, water damage, or other sources of risk. Roads and structures may be just one storm away from falling into the lake when the shoreline is significantly eroded to the extent that it reaches a structure's foundation and the area's important infrastructure. Another frequent situation in Michigan involves shoreline roadways whose banks erode and cause the road surface to crack, become unstable, or more prone to deposits of sand, snow, water and ice from nearby beaches and water bodies. The costs of delayed traffic and detours can be counted as harmful shoreline effects. Travel on shoreline highways can also be made treacherous by sand, mists, and snow blown in by wind gusts.

A high-risk erosion area (HREA) is defined by the Great Lakes Shorelands Administrative Rules (promulgated pursuant to Part 323, Shorelands Protection and Management, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended). An HREA is an area of shoreline where erosion studies have indicated that the landward edge of active erosion is receding at an average of one foot or more per year, over a minimum 15-year period. The MDEQ has identified 125 municipalities along the Great Lakes coast that have shorelines containing HREAs. Property owners within an HREA are notified of the erosion rates of their shoreline.

Within those erosion areas, any new permanent structure, including septic systems, must comply with building setback regulations that require a minimum distance between the existing erosion hazard line and proposed structures. Additions to existing structures must also adhere to setback regulations. 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 coast. Although shoreline flooding and erosion are inevitable, severe damage can be avoided if prudent shoreland management practices are followed and adequate emergency procedures are implemented. Coordination of federal, state and local shoreland management and emergency preparedness efforts is vital to keeping Michigan's shoreline areas as safe and undamaged as possible. The recession of the Great Lakes water levels is cyclical, but there is not much, other than dredging, that can be done to combat the negative effects. Therefore, it is important for those involved in water transportation to be prepared for all types of water fluctuations.

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 use what is known about coastal hazards to develop construction standards to protect property.

Under Part 323, the regulatory programs for high-risk erosion and flood risk areas may be administered by local units of government. The permitting responsibility for flood risk areas is handled at the local level due to the overlap of regulations found in Part 323, the NFIP, and the building codes. Presently, just two communities have added the regulatory responsibility of the erosion program to their 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 conflicts with the threat of property loss from future flood and erosion events. Political pressure can also be exerted in some situations. Compliance with these regulations has best been achieved through cooperation between state and local governments. Public understanding and support of these programs can be increased by improved communication with property owners regarding the natural hazards associated with the Great Lakes shoreline.

Weather-related events can also cause lake fluctuations that can last from several hours to several days. For example, windstorms combined with differences in barometric pressure can temporarily tilt the surface of a lake so it is higher at one end and lower at the other end. The water levels oscillate back and forth, with levels changing by as much as eight feet. This phenomenon is called a **seiche** (typically pronounced as saysh) and can drive lake waters inland over large areas, cause the weakening of existing structures and erosion of shoreline areas, make water travel hazardous, and cause flood damages, deaths, and injuries to occur. **Meteotsunamis** are similar to earthquake-generated tsunamis (and to wind-dominated seiche events) but are generally smaller and originate in meteorological events in which rapid changes and differences in barometric pressure (often associated with fast moving weather systems) are the predominant source of the different water levels. Large meteotsunamis can have devastating coastal impacts (damaging waves, flooding, strong currents) that cause significant damage, injury and death. Meteotsunamis are frequently observed in the Great Lakes, averaging 106 events per year (most of which are fortunately too small to be damaging). Although difficult for an ordinary observer to distinguish, a seiche and a meteotsunami can occur at the same time. They are technically distinct in that a seiche involves the presence of standing waves in which water levels usually take between three and seven hours to shift between their lowest and highest levels, while a meteotsunami involves a progressive wave moving onto shore, with a period under two hours (sometimes as low as two minutes). Meteotsunamis can cause and exacerbate rip currents and are believed to have played a role in some of the historic high-fatality rip current incidents that had previously been attributed to seiche events.

A **rip current** is a strong, narrow flow of water moving away from the shore, and can be life-threatening to swimmers. On sandy beaches, when wind drives waves toward the shore, the water accumulates near the shoreline, "piling up" landward of a sand bar. This water moves along the shoreline, as a longshore current, until it finds or creates an exit (rip channel) back to the lake. The current is strongest at the surface, and can dampen incoming waves, leading to the illusion of a particularly calm area. Rip current speeds are typically 1-2 feet per second. However, speeds as high as 8 feet per second have been measured. Rip currents cause approximately 100 deaths annually in the United States. In the Great Lakes alone, the average over the last sixteen years is 11 drownings per year caused by rip currents. About 80% of rescues by surf beach lifeguards are due to rip current.

Structural rip currents—those that form adjacent to human-made structures such as piers—cause more incidents than traditional rip currents. These currents form as the longshore current turns lakeward as it interacts with the structure. Structural currents pose increased dangers due to the deep trough that occurs along the structure, rocks and other hazards along the structure itself, and the fact that escape from this type of current is more difficult than a traditional rip current. Jumping and swimming from piers is popular in many Great Lakes coastal locations, but these actions should be discouraged as they directly expose persons to the dangers posed by structural rip currents. River outlet currents occur where streams and rivers flow into the Great Lakes, combining with lake currents to create a strong offshore flow that is dangerous to swimmers. The river typically cuts a deep trough into the lakebed, and these deep areas may cause swimmers additional difficulties. Swimmers should avoid river outlet areas. Channel currents form between the mainland and islands or rock outcrops that are close to shore. The current speed intensifies as it passes through the restricted channel, making these areas hazardous for swimmers as well.

In recent years, rip current advisories have been announced by the National Weather Service, as a part of their weather warning information system. These warnings advise about dangerous swimming conditions, and that rip currents are more likely to exist near break walls, sandbars, jetties, and piers. The National Weather Service hosts a Great Lakes Beach Forecast web map, showing expected beach conditions with color-coded swim-risk information, at https://www.weather.gov/greatlakes/beachhazards.

Cyanobacteria has been a periodic problem, especially in Lake Erie. When conditions are right, huge amounts of algae bloom within lake waters, and have a harmful effect upon water quality and the aquatic ecosystem. **Harmful algal blooms** (HABs) are associated with the runoff of nutrients from inland agricultural activities, but residential landscaping can also be a contributor. The primary human impact involves public health concerns—recreational uses of a lake and its shoreline can be brought to a halt, and the usefulness of the lake water as a source for municipal water systems can also be threatened. The Great Lakes Environmental Research Laboratory (GLERL) offers information and technical expertise on the health and ecosystem effects of cyanobacteria, HABs, and hypoxia. For more information, please refer to that agency's web site on this topic at http://www.glerl.noaa.gov/res/HABs_and_Hypoxia/; and to the appropriate state-level agency office of the MDEQ, at https://www.michigan.gov/deq/0,4561,7-135-3313_3681_3686_3728-383630--,00.html.

Not all shoreline areas have reported problems with **ice surges**, but selected locations appear to have recurrent problems with these events. The key location with the worst documented impacts found in media reports is on the western shoreline of Saginaw Bay, north of Bay City, where houses are at-risk along the shoreline and incidents have been reported in 2009, 2013, and 2014 (at a minimum). This hazard has not yet been fully analyzed, but research is currently in progress, especially involving NOAA and the Great Lakes Research Center that is a component of Michigan Technological University. Additional shoreline counties that may have experienced these risks include those in the Keweenaw Bay and Green Bay areas on lakes Superior and Michigan. NOAA reports that it is currently working to add ice predictions to its Great Lakes Coastal Forecast System (GLCFS).

Another Great Lakes hazard is the potential effect of severe winds upon marine activities. Although some description of marine accidents can be found in the Transportation Accidents section, 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 but involve contact with water instead of land) are a common occurrence posing a great threat to marine traffic. Seventeen Michigan waterspouts have been noted by NCDC between 1993 and 2001, including one that caused $200,000 in damage to a boat house and storage building at Drummond Island on July 3, 1999. Many additional events have occurred since, which NCDC has classified according to the corresponding lake location rather than as part of Michigan itself.

Historically Significant and Related Events: According to the Michigan Hazard Analysis, there had been 10 major periods of flooding/erosion on the Great Lakes between 1918 and approximately 2019. Extremely high water level peaks have been noted 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, late 1960s, and mid 1980's also resulting in millions of dollars in damage to shoreline communities. A high-water record was set 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.

More recently, a lengthy high-water event on Lake Michigan around 2019-2021, including a new high water record set in 2020, resulted in extensive shoreline erosion and property damage along the Lake Michigan shoreline. In the City of Ludington, just to the north of Oceana County, public and private property impacts from the high water and compounding storm events resulted in the need for an estimated $4.5 million to recover and mitigate impacts of future high-water events. The table below lists many high-water impacts observed in the Ludington area, as reported in the Ludington Area Shoreline Land Use and Resiliency Plan (WMSRDC, 2021). Most, if not all, of these impacts were observed in Oceana County as well.

SLURP SURVEY (January 2021) Noted Impacts of High Water in the Ludington Area	
Damage to the Built Environment - Marinas - Roads - Storm sewers - Pier/breakwall - Lost/relocated homes - Public parks/access - Sink holes undermining shoreline structures - Flooded shoreline properties Financial - Property devaluation - Mitigation costs (property protection) Unknown impacts upon underground utilities	Damage to the Natural Environment - Dune erosion - Beach loss - Beach/floating debris - Poor water quality (sedimentation) Boating hazards - Submerged/hidden structures - Floating debris Safety - Unstable piers - Beach debris - Standing water & pests Additional fortified/hardened shoreline Increased vulnerability to wave action and ice

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. Extremely 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 2013, a new all-time recorded low level was achieved, eclipsing the previous record low established in March 1964.

According to the Great Lakes Current Incident Database (National Weather Service, Marquette, MI) there were 77 rip current fatalities and 230 rescues (307 incidents) on Lake Michigan from 2002 through 2012. 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 Analysis, major periods of flooding/erosion have occurred on the Great Lakes approximately once per decade since 1918.

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. Drownings and rescues are expected to happen each year in Oceana County. The number of incidents can only be estimated but unfamiliar conditions such as heavy wind, high water, and strong currents tend to make drowning and rescue incidents more likely.

Climate Change Considerations: According to the U.S. Environmental Protection Agency (EPA), Michigan's climate is changing. Most of the state has warmed two to three degrees Fahrenheit in the last century. Heavy rainstorms are becoming more frequent, and ice cover on the Great Lakes is forming later or melting sooner. And although warmer temperatures are known to cause sea level to rise, the impact on water levels in the Great Lakes is not yet known.

Climate model predictions for specific weather outcomes vary greatly throughout the Great Lakes Basin and include both higher and lower water level scenarios. However, all models seem to forecast an increase in both the number and intensity of major storm events. This combination can result in unanticipated water level changes, larger waves, more dramatic seiches and greater storm surges than considered in original design parameters of Great Lakes infrastructure.

1.08 HAIL

Lumps of ice that form in weather systems such as thunderstorms, and then fall to earth as solid precipitation.

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 in Oceana County can vary greatly, depending on location. In rural areas of the county, crops and livestock may be most impacted; property damage is more likely in developed areas; and harm to people is possible in areas of outdoor recreation and activity. 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 with the potential to batter crops, dent autos, and injure 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) forecasts of severe thunderstorms 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, it is harder to prevent damage to crops. The NWS issues a watch for an area when the meteorological conditions are conducive to the development of severe weather. People in the watch area are instructed to stay tuned to National Oceanic and Atmospheric Administration (NOAA) weather radio and other media for weather updates, and to watch for developing storms. Once radar or a trained Skywarn spotter detects the existence of severe weather, the NWS will issue a specific warning, such as a "severe thunderstorm warning," that identifies where the weather system was observed, the direction in which it is moving, and the time frame during which the storm is expected to affect an area. Persons in the warning area are instructed to seek shelter immediately, postpone outdoor events, or to take other actions.

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 offices 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 online at www.weather.gov, where interactive maps are available. State and local government agencies also receive weather warnings through a variety of modern technologies such as private weather mobile applications and internet services. These applications and services allow local and state governments to send notifications of NWS warnings to the public. There are multiple web and mobile applications available for individuals to sign up for, that will provide them with alerts when the NWS issues weather warnings.

Historically Significant and Related Events: Oceana County is no stranger to hailstorms. The NCDC lists 39 hail events since 1955, 18 of which meet today's criteria for "severe" hail. All events occurred in the months of March through October. With about a quarter of the county's reports, May appears to be the leading month for severe hail. Severe hail reports were confined to the months of April, May, June, July, and September.

Between 1996 and 2022, there are 32 documented hail events, 16 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 - 2022

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.
5-7-14	Ferry Township	1.00 in.
6-18-14	New Era	1.00 in.
4-10-17	Shelby	1.75 in.
9-12-21	Countywide	1.00 in.
5-11-22	Grant Township	1.00 in.

Source: National Climatic Data Center

Frequency of Occurrence: With approximately 32 to 36 thunderstorm days per year, it is highly likely that Oceana County will experience multiple sub-severe hail events annually. There are 18 cases of severe hail (one inch or larger) documented by the NCDC in the 68 years encompassing 1955 though 2022. This data suggests that the county will experience a severe hail event once every three to four years. However, as population has increased and reporting techniques have improved, this estimate may understate the actual frequency. More recent records from the 27 years from 1996 through 2022 show 32 reported events, 16 of which were severe. Therefore, based on recent trends, Oceana County could expect to experience 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 relays 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). Invasive species typically fall into two broad categories—terrestrial (able to live on land) and aquatic (able to live within water bodies). Human actions have been an important consideration as a means of invasive species' sudden introduction (thus distinguishing the situation from natural shifts in the distribution of species), but a human-related cause may not be relevant to the extent of impact that results. Nationally, the current environmental, economic, and health costs of invasive species have been estimated as exceeding the costs of all other natural disasters combined, and Michigan's own potential costs have been estimated as extremely serious.

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 non-native 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 and animal infestations. For example, certain diseases could wipe out large segments of an animal population, creating a potentially serious agricultural disaster and a potential public health emergency (often with a need to properly and rapidly dispose of many animal carcasses).

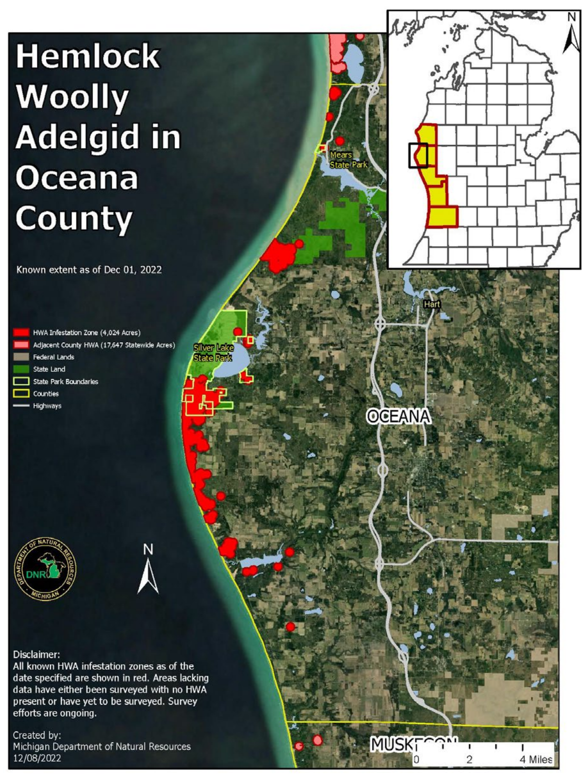
Similarly, a widespread insect infestation, such as that of the Emerald Ash Borer, can create serious public safety threats (especially in densely populated urban areas) due to dead and dying trees being fire prone (because of their dry, brittle nature) or to partial/total collapse due to high winds 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, conservation districts, and the Michigan State Police, Emergency Management Division.

Much additional information can be found at https://www.misin.msu.edu/ and http://www.invasive.org/. A Michigan watch list has been established, and can be found online at https://www.michigan.gov/invasives/0,5664,7-324-68002_74188---,00.html. Species on the watch list have been identified as posing an immediate and significant threat to Michigan's natural resources. The species have either not been confirmed in the wild in Michigan or have just a limited known distribution. Any occurrence of these species should be reported.

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.

The hemlock woolly adelgid has emerged as a threat along the Lake Michigan shoreline in recent years. This insect infests eastern hemlock trees which are found in naturally moist environments along streams and water bodies. Left untreated, hemlock woolly adelgid can cause tree death in 4-10 years, leading to falling trees and fire fuels hazards.



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 collapsed and caused property damage or 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 Oceana 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. To the right is a list of invasive species in the Great Lakes, according to the Great Lakes Information Network.

Aquatic Invasive Species in the Great Lakes

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
Insects:	Hemlock Wooly Adelgid
Viruses:	Viral Hemorrhagic Septicemia Virus (VHSv)
Potential Invaders	
Fish:	Asian Carp

Source: Great Lakes Information Network,

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.

Climate Change Considerations: Different patterns of wildlife have already been a concern as a result of the lengthening average growing season in Michigan. Species that had previously been found only in warmer areas to the south have started to appear in Michigan. Although the definition of invasive species specifically refers to human species introduction, to distinguish these patterns from naturally occurring ones, species transported by human action can be more likely to survive (and thus to become invasive) as climatic changes occur.

The following example of how climate change can impact the spread of autumn olive, an invasive species found in Michigan, comes from the Nature Conservancy website, www.nature.org:

> *As the climate warms, resilient invasive species like autumn olive can gain even more of a foothold over native plants. This plant takes advantage of changing seasons, leafing out early before native plants and keeping its foliage deep into the fall. By getting a head start, autumn olive can easily shade out other species. Autumn olive can also use fire to its advantage. In both woodland and grassland areas, autumn olive can gain a foothold by sprouting faster than native plants after natural and human-managed fires. As climate change dries out more regions and enhances the risk of fire, hardy invasive plants like autumn olive could benefit.*

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, heavy rains, and even snow. 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 occur 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 most of the general public, lightning is perceived as a minor hazard. That perception lingers even though 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:

Location of Lightning Strikes
· 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 online 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. Statewide statistics derived from NCDC data lend additional historical credence to the lightning risk in Oceana County. The tables below detail lightning-related injuries and deaths in Michigan from 1959 to 2005.

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

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

Source: Storm Data, National Climatic Data Center

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

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

Source: Storm Data, National Climatic Data Center

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.

On July 23, 2023, local media reported that the Silver Lake Pizza Factory in Golden Township was set ablaze after a lightning strike hit the gas meter. No one was injured, but the building was significantly damaged, and the business was closed for at least the remainder of the season to allow for repairs.

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.

1.11 SEVERE WINDS

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

Summary: Severe winds are a common occurrence in Oceana County. Although possible any time throughout the year, severe winds are most likely to occur in association with severe thunderstorms during the summer. Strong weather systems, generally in the fall, can also produce damaging winds. Though these high wind events may not reach a magnitude of 58 mph (severe wind criteria), they are often characterized by sustained strong winds, with occasionally severe gusts, affecting large areas for hours or even days.

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 approximately 32 to 36 thunderstorms which produce some or all 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: The 2019 Michigan Hazard Analysis states, "severe winds spawned by thunderstorms or other storm events have had devastating effects on Michigan, resulting in 36 deaths, about 270 injuries, and nearly $1.5 billion in damage to public and private property and agricultural crops since 1996." 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 high 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.

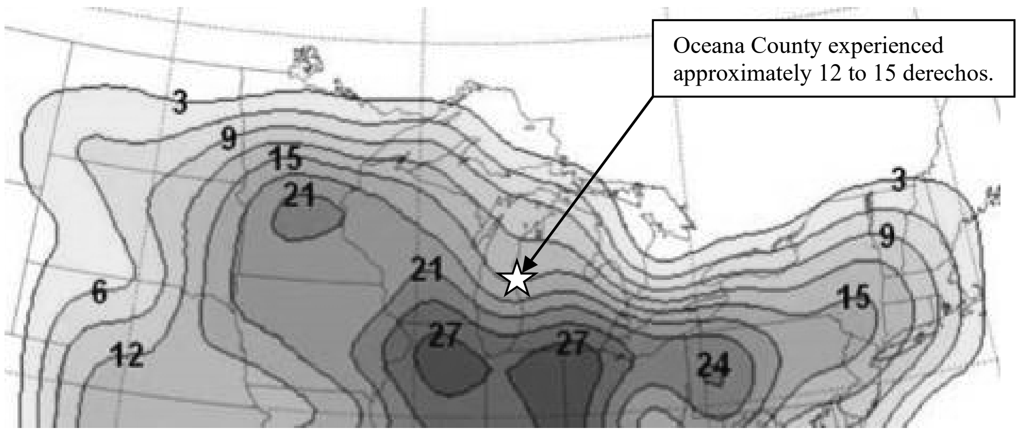
According to NOAA's National Severe Storms Laboratory, damage from severe thunderstorm winds account for half of all severe weather reports in the lower 48 states and is more common than damage from tornadoes. Wind speeds can reach up to 100 miles per hour and can produce a damage path extending for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

- ***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. For more information on derechos, go to http://www.spc.noaa.gov/misc/AbtDerechos/derechofacts.

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



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

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.

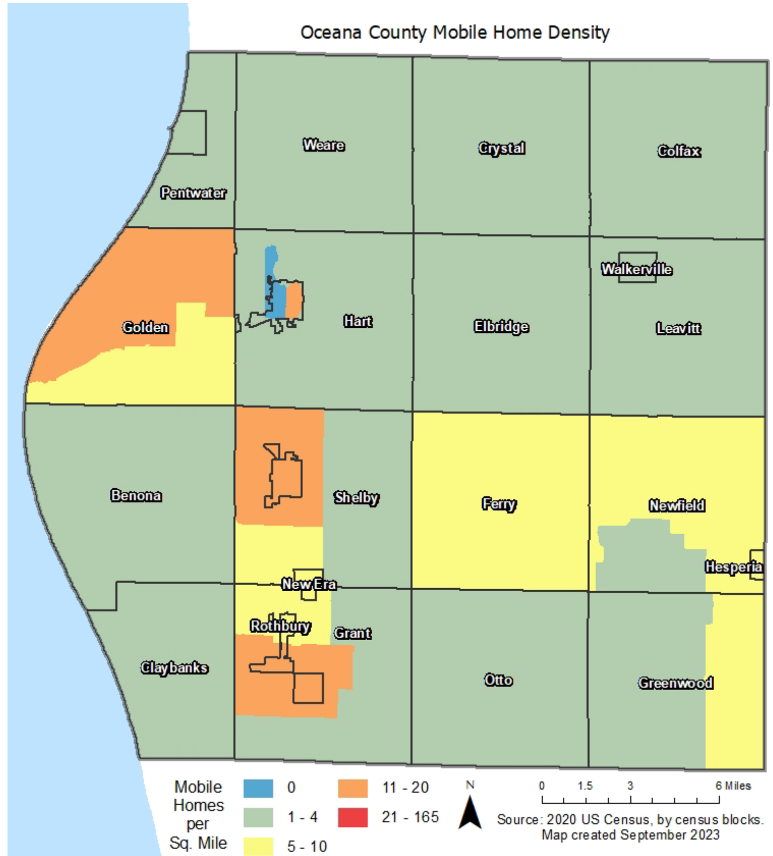
The State and local government agencies are warned via the Law Enforcement Information Network (LEIN), NOAA weather radio, and the Emergency Managers Weather Information Network (EMWIN). Public warning is provided through the Emergency Alert System (EAS). The NWS stations in Michigan transmit information directly to radio and television stations, which in turn pass the warning on to the public. The NWS also provides detailed warning information online 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 presence 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 2021 American Community Survey 5-year Estimates, mobile homes make up 10.7% 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.

Mobile Homes in Oceana County

Community	# Mobile Homes	% of Homes in Municipality
Oceana County *	2,749	17.6%
Hart City	11	1.3%
Hesperia Village	3	0.7%
New Era Village	0	0.0%
Pentwater Village	32	3.3%
Rothbury Village	44	31.4%
Shelby Village	74	8.7%
Walkerville Village	51	54.3%
Benona Township	88	6.6%
Claybanks Township	63	11.4%
Colfax Township	131	26.0%
Crystal Township	112	30.7%
Elbridge Township	86	18.8%
Ferry Township	182	32.9%
Golden Township	590	24.7%
Grant Township	324	27.6%
Greenwood Township	136	22.6%
Hart Township	87	9.8%
Leavitt Township	215	44.8%
Newfield Township	234	20.4%
Otto Township	128	34.8%
Pentwater Township	39	2.2%
Shelby Township	169	10.4%
Weare Township	154	29.3%

** total of city and townships only; village totals already included within township totals*
Source: 2021 American Community Survey 5-year Estimates



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

The Federal Emergency Management Agency (FEMA) has produced a wind zone classification map for the United States that divides the country into four wind 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 the highest potential winds in Zone IV. According to the map, Oceana County is located within zone III; meaning winds can reach speeds of up to 200 miles per hour.

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 70 wind events in Oceana County from 1955 through 2022, of which

59 were attributed to thunderstorms. About half of all recorded wind events occurred in July (all resulting from thunderstorms), which is more than any other month. In the 30-year period from 1993 through 2022, 42 thunderstorm wind events were observed in Oceana County, causing about $4.71 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. On November 10, 2020, thunderstorms knocked down trees across the county and was attributed with $100,000 property damage.

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. Twelve "high wind" events listed by the NCDC have involved Oceana County from 1993 through 2022. 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. On December 16, 2020, a system produced a 71 mile per hour gust in Pentwater.

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.

Frequency of Occurrence: Oceana County is subjected to between 32 and 36 thunderstorms per year according to the Michigan Hazard Analysis. 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. Locations along the immediate Lake Michigan shoreline are particularly at risk of experiencing the strongest winds approaching unimpeded from western directions.

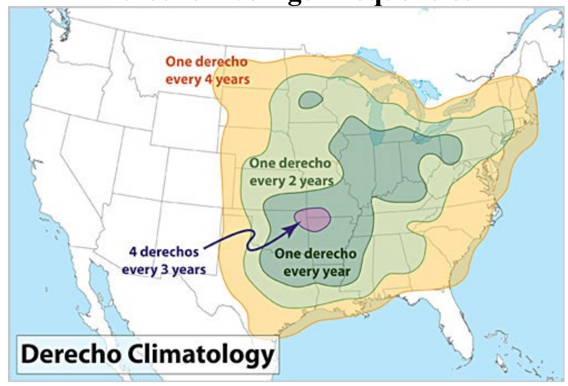
Long-term data from 1955 through 2022 suggest that Oceana County averages about one severe wind event every year (70 events in 68 years). However, increased consistency of storm documentation since the 1990's suggests that Oceana County will experience wind events more frequently. Observations from 1993 through 2022 yield 53 events over 30 years, demonstrating that severe wind events are documented about twice per year within Oceana County. In addition, 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.

Climate Change Considerations: The following climate change discussion is relayed from a National Oceanic and Atmospheric Administration website about derechos in particular:

https://www.spc.noaa.gov/misc/AbtDerechos/derechofacts.htm#climatechange.

Derecho Average Frequencies



Source: National Oceana and Atmospheric Administration

A warmer planet at first glance would appear to be more conducive to the development of the intense thunderstorms that comprise derecho-producing convective systems. But thunderstorm updrafts require the presence of strong *vertical* temperature gradients; any warming that occurs at the surface likely also would occur aloft. Thus, the net change in instability --- that is, the net change in the potential for strong updraft development --- likely would be minimal. In addition, although a warmer environment implies greater atmospheric moisture content and conditional instability (instability related to the release of latent heat during condensation; this is the type of instability that fuels a hurricane), all other factors being equal, the increased moisture also would yield more widespread low-level clouds. Such cloudiness would negatively impact storm initiation and derecho development.

There is nothing to suggest that a warmer world necessarily would favor stronger derechos. This is not only because vertical temperature differences likely would remain unchanged but also because derecho development requires the favorable coexistence of many interacting environmental factors over various scales of time and space. In particular, the small-scale processes involved in the initiation of individual storms --- and their growth and organization into long-lived mesoscale convective systems --- are incompletely understood. For this reason these processes are only crudely represented in both short-range (day-to-day forecast) and long-range (climate) numerical models. For example, increased moisture theoretically would be available for cloud and storm development in a warmer world. Increased cloud water content, in turn, generally enhances downdraft strength (through "water loading"). But it does not necessarily follow that storms with water-enhanced downdrafts would be more favorable building-blocks of derechos; if the downdrafts are too strong or ill-timed, their presence could short-circuit derecho development.

What can be said with greater certainty about derechos and climate change is that the corridors of maximum derecho frequency likely would shift poleward with time. This is because the bands of fast upper-level winds that arise from the equator-to-pole temperature gradient --- the *jet stream* --- would contract poleward in a warmer world. Because derechos tend to form on the equatorward side of jet streams, especially those that mark the northern fringes of warm high-pressure ("fair weather") systems, the areas most favored for derecho development also would shift poleward. It is unclear, however, how jet stream changes might impact derechos from a wind shear perspective. While derechos are not as sensitive to wind shear (changes in wind speed and/or direction with height) as are, for example, tornadoes, some degree of vertical shear is necessary for long-lived derechos. Because the most favorable wind shear environments are tied to the location of the jet stream, it seems reasonable to conclude that, overall, potential changes in shear would not appreciably impact derecho incidence or severity.

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 for minerals such as coal and copper is not a part of Oceana County's past. Because residents in rural areas of the county use groundwater for potable water and for agriculture, excessive groundwater withdrawal might be considered a subsidence threat to the county. Broken water and sewer pipes or the improper discharge of rainwater are other possible causes of water-related subsidence.

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 accompanying table.

Land Subsidence: Estimated Annual National Damage

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

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

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

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

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

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

- *Collapsing Cavities* - This type of subsidence is commonly triggered by ground-water-level declines caused by pumping and by enhanced percolation of groundwater. Collapse features tend to be associated with specific rock types, such as evaporites (salt, gypsum, and anhydrite) and carbonates (limestone and dolomite). These rocks are susceptible to dissolution in water and the formation of cavities. Salt and gypsum are much more soluble than limestone, the rock type most often associated with catastrophic sinkhole formation. Evaporite rocks underlie about 35 to 40% of the United States, though in many areas they are buried at great depths. Collapse sinkholes may develop over a period of hours and cause extensive damage.

In the past there has been pressure for the Great Lakes states to export bulk quantities of water to various locations in the United States. If plans to withdraw large amounts of water from the Great Lakes ever took place, it may have a major effect 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. Such risks include excessive groundwater withdrawal (especially during periods of low water levels); the presence of hundreds of abandoned oil, gas, and brine wells; and subsidence related to stormwater or infrastructure failure.

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 from 1950 through 2022, about 15 tornadoes occur in Michigan every year. 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 III; meaning winds can reach speeds of up to 200 miles per hour. Locally, wind speeds of this magnitude would likely be the result of a tornado.

Tornado damage 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 average lead time for a tornado warning by the National Weather Service is 10 to 15 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 air mass to generate severe thunderstorms. These thunderstorms often produce violently rotating columns of wind known as funnel clouds. Winds that converge from different directions, heights, and speeds are the source of the spinning pattern that gets concentrated as distinct funnels of wind. 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 or near the storm's path. The violently rotating winds then carry debris aloft that can be blown through the air as dangerous missiles, which provides another mechanism by which tornadoes cause such severe destruction.

A tornado may have winds of over 200 miles per hour, and this is the source of their destructive power. Although a tornado may have an interior air pressure that is 10-20% below that of the surrounding atmosphere, the effect of this difference is insignificant compared with the force directly applied by the winds. The old belief that opening windows would equalize air pressure was a misguided and harmful one—closer analysis of filmed images and damage patterns has since revealed that it is the force of winds that lift eaves and break down walls and then causes some structures to appear to implode or explode under a direct tornado strike. In fact, opening any windows may provide additional means by which tornado winds can cause stress on interior walls, and make a structure more vulnerable to collapse.

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. Even though an average tornado might spend only a few minutes on the ground, those few minutes can result in devastating damage.

Tornado intensity is measured on the Enhanced Fujita Scale, which examines the damage caused by a tornado on homes, commercial buildings, and other man-made structures. The Enhanced Fujita Scale rates the intensity of a tornado based upon measured damages, rather than by its size. It is important to know 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 is presented in the following table.

Enhanced Fujita Scale of Tornado Intensity

EF Scale Number	Intensity Descriptor	Wind Speed (mph)	Type/Intensity of Damage
EF0	Gale tornado	65-85	Light damage. Some damage to chimneys; breaks branches off trees; pushes over shallow-rooted trees; damages sign boards.
EF1	Weak tornado	86-110	Moderate damage. The lower limit is the beginning of hurricane wind speed; peels surface off roofs; mobile homes pushed off foundations or overturned; moving autos pushed off the roads; attached garages may be destroyed.
EF2	Strong tornado	111-135	Considerable damage. Roofs torn off frame houses; mobile homes demolished; boxcars pushed over; large trees snapped or uprooted; light object missiles generated.
EF3	Severe tornado	136-165	Severe damage. Roof and some walls torn off well-constructed houses; trains overturned; most trees in forest uprooted; heavy cars lifted off ground and thrown.
EF4	Devastating tornado	166-200	Devastating damage. Well-constructed houses leveled; structures with weak foundations blown off some distance; cars thrown and large missiles generated.
EF5	Incredible tornado	Over 200	Incredible damage. Strong frame houses lifted off foundations and carried considerable distances to disintegrate; automobile-sized missiles fly through the air in excess of 100 meters; trees debarked; steel reinforced concrete structures badly damaged; incredible phenomena will occur.

NOTE: When describing tornadoes, meteorologists often classify the storms as follows:
EF0 and EF1 = weak tornado; EF2 and EF3 = strong tornado; EF4 and EF5 = violent tornado
Source: The Tornado Project; National Climatic Data Center

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. Although serious casualties could occur if a strong tornado strikes, progress appears to have been made in allowing most people to reach shelters in time. Other initiatives to reduce wind vulnerabilities, such as structural bracing, urban forestry practices, manufactured home anchoring, and strengthening electrical system components, can further help to reduce public and private property damage. When a hazard cannot be prevented, it is still possible to mitigate its impacts by identifying and reducing vulnerabilities.

Tornado disasters require that communities plan and arrange for the mass care of residents left without electrical power, and for the clearance and disposal of tree and construction debris from roadways and facilities. Planning and preparedness efforts should include the identification of necessary mass care facilities and supplies, as well as debris 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 debris stream can be handled in the most expedient, efficient, and environmentally safe manner possible.

There is a concern for tornadoes and mobile/manufactured homes just as there is for severe winds. Every community in Oceana County is susceptible to tornadoes and should have an availability of secure shelter areas for those who live in mobile homes, or at temporary and seasonal locations. There are 2,749 mobile homes in the county according to the 2021 ACS 5-Year Estimates. The jurisdictions with the highest number of mobile homes include Golden Township (590), Grant Township (234), and Newfield Township (234). In addition, mobile homes make up over 30% of the housing stock in six communities: Village of Walkerville (54.3%), Leavitt Township (44.8%), Otto Township (34.8%), Ferry Township (32.9%), Village of Rothbury (31.4%), and Crystal Township (30.7%).

Historically Significant and Related Events: According to NCDC storm data, there have been five tornadoes observed in Oceana County from 1950 through 2022. 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, Oceana, Muskegon, and Newaygo have seen 30 tornadoes (35 including Oceana) over the same 72-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 the exception of two unrated tornadoes in Muskegon County, all of these tornadoes were F0, F1, EF1, or F2.

Tornado Touchdowns by Month
- 1950 through 2022 -

Oceana County and Adjacent Counties*									
Month	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.
Tornadoes	2	8	4	5	3	6	4	0	3
Percentage	5.7%	22.9%	11.4%	14.3%	8.6%	17.1%	11.4%	0.0%	8.6%

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

Frequency of Occurrence: In 72 years from 1950 through 2022, there have been five tornadoes in Oceana County reported to the NCDC. However, since Oceana County and its adjacent counties have seen 35 tornadoes combined over that span, the actual chance of tornado activity in the area is somewhat greater. Recent history shows that Oceana County and its neighbors average one tornado every two years somewhere in the area. April has experienced the greatest frequency of tornadoes in the area, claiming 22.9 percent of all tornado touchdowns.

Climate Change Considerations: A New York Times article describes the tornado-climate change relationship, without getting too technical:

> *The ingredients that give rise to tornadoes include warm, moist air at ground level; cool dry air higher up; and wind shear, which is the change in wind speed or direction. Each of these factors may be affected differently by climate change. As the planet warms and the climate changes, "we don't think they are all going to go in the same direction," said Dr. Brooks of NOAA. For instance, overall temperature and humidity, which provide energy in the air, may rise with a warming climate, but wind shear may not. (https://www.nytimes.com/article/tornado-climate-change.html. Published 4/3/23, Retrieved 7/24/23.)*

According to the National Oceanic and Atmospheric Administration, there is no known way to predict whether or how climate change is affecting thunderstorm and tornado frequency or severity. These types of weather events involve a different scale of phenomenon than climate change, and models of the latter have not yet been able to predict local trends in the former (http://www.spc.noaa.gov/faq/tornado/).

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. A wildland-urban interface (WUI) occurs where nature meets development. People and development residing within these areas are at greater risk from wildfires. 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 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. Recently, only about 4% of all wildfires in Michigan were caused by lightning strikes, and most other causes have been attributed to human activity. Outdoor debris burning is the leading cause of wildfires in Michigan. Most Michigan wildfires occur close to where people live and recreate, which puts both people and property at risk. The immediate danger from wildfires is the destruction of property, timber, wildlife, and injury or loss of life to persons who live in the affected area or who are using recreational facilities in the area. According to 2017 MDNR information, the leading causes of wildfires from the previous ten years were:

1. Debris burning (32%)
2. Miscellaneous (17%)
3. Powerline (16%)
4. Equipment (11%)
5. Campfires (9%)
6. Arson (6%)
7. Lightning (4%)
8. Fireworks (2%)
9. Structural fires (2%)
10. Smoking (1%)

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. According to the West Michigan Blueways and Greenways Plan (WMSRDC, 2012), 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.

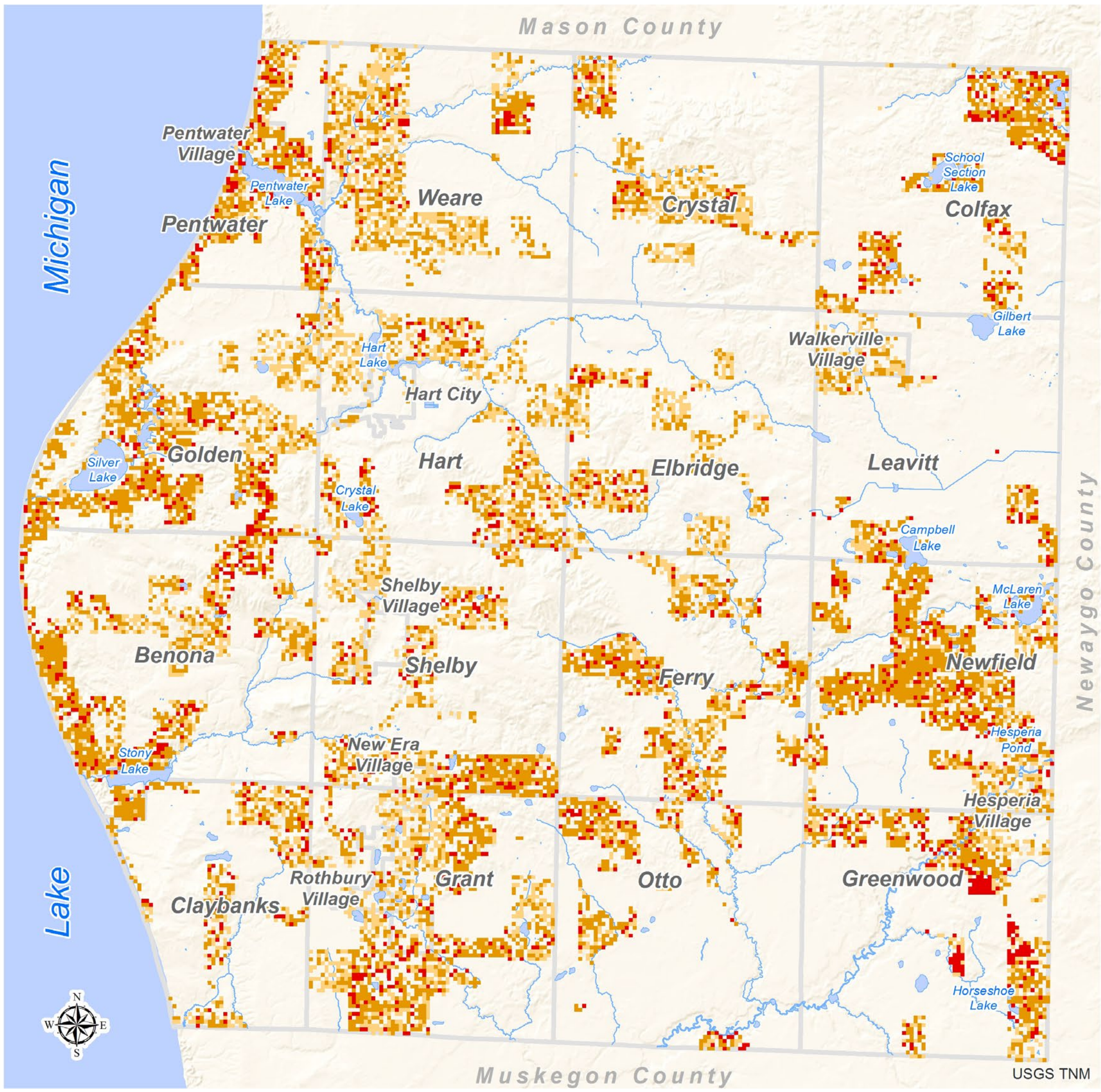
Frequency of Occurrence: Recent trends, such as above average temperatures, low water levels, below average precipitation (both rain and snow), and the occasional addition of fuel to the forests from the fallen trees by wind storms all help to ensure that wildfires will occur annually. It is difficult, however, to determine wildfire 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 26,659 (2020 Census), 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. During the peak summer vacation season, the county's nighttime population may potentially increase to somewhere over 75,000 (over 180% increase) according to estimates conducted for this plan.

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.

Climate Change Considerations: Recent trends, such as above average temperatures, cyclical (occasionally low) water levels, long stretches of below average precipitation (both rain and snow), milder winters, and the occasional addition of fuel to the forest floor from the fallen trees by windstorms and invasive pests all contribute to the sustained risk for impactful wildfires.

Oceana County
WUI Wildfire Risk Map



Wildfire Risk
Low Risk
High Risk
Moderate Risk

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-related 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 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, 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 in rural areas of the county. 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 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 137 severe winter weather events in the 30 years from 1993 through 2022 in Oceana County, most of which occurred in December and January. Significant ice/freezing rain was reported 15 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.

Eight of the listed events from 1993 through 2022 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 5-7, 2019, when two rounds of freezing rain impacted central lower Michigan. The storm produced around ¼ to ½ inch of ice accumulation and resulted in downed trees, power outages, and $1 million in property damage in Oceana County. Approximately one hundred and fifty thousand people lost power in the state.

Frequency of Occurrence: There is little doubt that winter hazards will typically occur a handful of times every year in Oceana County. A graphic borrowed from 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 137 severe winter weather reports collected by the NCDC from 1993 through 2022, Oceana County could expect approximately four to five significant 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 have been most common in the months of February and 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 2022 -

	Nov.	Dec.	Jan.	Feb.	Mar.	Apr
# of Events	8	37	43	25	16	5
Percentage	6.0%	27.6%	32.1%	18.7%	11.9%	3.7%

Source: Storm Data, National Climatic Data Center

In approximately the last 50 years, Oceana County has been affected by four major storms that resulted in a Presidential Declaration; or once every 10-15 years. It is notable that the most recent instance occurred more than 20 years ago. Less significant, yet still impactful, storms should be expected more frequently. NCDC records indicate the county experienced eight winter storms with documented property damages in the last 30 years, or once every three to four years.

Climate Change Considerations: Climate change effects seem likely to cause an increase in the number of ice and sleet storm events, at least across the southern part of Michigan. The reason involves average temperatures in and around the winter months that are closer to the freezing point, at which ice and sleet events typically occur. Instead of winter arriving and precipitation remaining in the form of snow, Michigan winters have involved many thawing episodes, followed by refreezes which cause treacherous ice cover upon frozen surfaces, weigh down cables and tree branches, and cause infrastructure failures. Even though Michigan’s winter season has been shortening over time, winters remain hazardous because the increasing level of precipitation more often takes the form of major snow events and provides a lot more moisture for refreezing after the warmer thawing periods have taken place.

It is uncertain how climate change will influence lake effect snow patterns. However, according to the Michigan Hazard Analysis, the effect of climate change upon Michigan is expected to cause an increase in the amount of precipitation during the next few decades. Even though the length of Michigan winters has been decreasing, the season remains an intense one, and periods of deep freeze may become more likely as temperature differences narrow between the arctic, polar, and tropical air masses during the Northern Hemisphere’s winter season. During the winter months, the increase in precipitation means that snowfall events will tend on average to be more intense. More snowfall is likely to happen at a time, in the form of significant snowstorm events (e.g. 8 or more inches, higher snowdrifts, cancelled school sessions, etc.).

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 like 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 is a structure that stretches across a stream or other water body in order to control its flow or to convert the energy within the water into more convenient forms, such as electricity. The impounded waters may be used for agriculture, flood-control, artificial lakes, municipal water supplies, or for energy generation. Some dams have become obsolete and should be removed to restore the natural water flow through the area. Otherwise, neglected dams will eventually fail, and would then be likely to cause a flash flood downstream, through the sudden release of their impounded waters. Some dams are constructed by wildlife instead of humans but can pose similar risks. Damlike obstacles can accidentally arise through the accumulation of logs, debris, or ice at a particular location, temporarily blocking waters (often causing floods nearby) but potentially vulnerable to giving way and thereby causing a flash flood downstream.

A dam failure can result in loss of life, and in extensive property or natural resource damage for miles downstream from the dam. Dam failures occur not only during flood events, which may cause overtopping of a dam, but also as a result of poor operation, lack of maintenance and repair, and vandalism. Such failures can be catastrophic because they occur unexpectedly, with no time for evacuation. The Michigan Department of Environmental Quality (MDEQ) has documented approximately 302 dam failures in Michigan since 1888.

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 are important components of the state's infrastructure and provide benefits to all citizens. However, history has demonstrated that dams can fail, sometimes with disastrous consequences, causing unfortunate loss of life, property, and natural resources. Many existing dams are getting older, and development often continues in potential inundation zones downstream from them. More people are at risk from dam failure than ever before, despite better engineering and construction methods. As a result, continued loss of property can be expected to occur.

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, except for 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. At the time of this writing, the Crystal Valley Dam was undergoing a process of assessment.

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 Oceana 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. In addition, if the Mill Pond Dam in White Cloud, Newaygo County were to fail, it could stress the downstream Hesperia Dam and put Oceana County properties along the White River at significant risk.

Historically Significant and Related Events: The MDEQ has documented approximately 302 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 damage 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: Dam failure is a function of numerous natural and human forces; therefore, frequency of occurrence is exceedingly difficult to estimate. It is important to consider that estimated frequencies are relative to the individual dam conditions, making it unwise to overestimate the structural integrity of any particular dam in lieu of regular inspections and maintenance. In addition, 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. However, as dams age, future failures in the county should be expected. With nine known failures between 1970 and 2022, the county averaged up to one failure every eight to nine years during that period. 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 (1986 flooding). It could therefore be argued that there will be approximately one weather event every 40 years severe enough to trigger widespread dam failures.

2.02 ENERGY EMERGENCIES

A lack or shortage of electric power, natural gas, fuel oil, propane, or gasoline of a sufficient magnitude and duration to threaten public safety, technological capabilities, or economic stability.

Summary: Historically, energy emergencies have not been considered a significant hazard in Oceana County. However, this hazard is discussed by the Michigan Hazard Analysis (2020 supplemental) 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 Analysis.

Hazard Description: A reliable and adequate energy supply is critical to economic and social well-being, and the United States has become accustomed to uninterrupted and relatively inexpensive power. Transient energy disruptions caused by weather damage (downed power lines) or temporary shortages (brownouts) have a relatively small impact, but even minor inconveniences have become more problematic as society's dependence on technology grows. Beyond energy related infrastructure failures, the inadequate supply of fuel itself can also create a hazard.

In general, there are four types of energy emergencies. The first involves the physical failures of energy production or distribution facilities due to aged or faulty equipment, poor maintenance, or employee accidents. The second involves exogenous factors, such as severe storms, cyberattacks, or other sabotage. Michigan has experienced several storm related disruptions in particular, mostly due to high winds or damage caused by ice. The third type of emergency involves a sharp and sudden escalation in energy prices, often by market manipulation or a reduction in oil supplies. The fourth to consider is a surge in demand caused by war and involving the mass mobilization of prioritized U.S. defense forces.

Many modern energy concerns can be best analyzed beginning in the 1970s. The 1973-74 OPEC Oil Embargo and the natural gas shortages of 1976-77 stirred significant public outcry, with long lines at gas stations and high heating prices. Since that time, many important steps have been taken to improve the nation's energy security. Our dependence on foreign oil imports has decreased due to the Strategic Petroleum Reserve and additional domestic production. Energy mixes have been broadened with wind and solar. There have been marked improvements in energy efficiency for homes and appliances, along with the use of automobile fuel standards. Technological changes with "distributed generation" (net-metering) and "smart grids" is relatively newer and ongoing.

Despite this, population sizes have increased, and more people are building larger homes, using more air conditioning, and powering additional devices. Mass transit is being emphasized, but drivers may also tend to purchase sports utility and other larger vehicles. The net effect of these various actions can be complex. In 2018, the United States consumed more energy than ever before but saw consumption slightly decrease in 2019. The effects of COVID-19 drove many of these energy usage patterns lower, at least in the near term. It is impossible to predict what the net impact of new work patterns and modern energy production will be in the long run. The dramatic decrease in total energy consumption seen in early 2020 was predominantly due to a decrease in gasoline and other travel-related fuels. In addition, a reduction in electricity usage was also significant although less profound than travel-related fuels.

Michigan has recently experienced a reduction in the number of coal-fired power plants. With less coal being used to generate electricity, the importance of natural gas as a fuel has become more critical for industrial, commercial, and residential electric use. This is in addition to its critical role in home heating. Recent census data shows that residential heating in Michigan is accomplished roughly 75% through natural gas. According to 2021 ACS 5-year estimates, 31.5% of occupied Oceana County housing units relied upon utility natural gas for heating, while and 37.5% used "bottled, tank, or LP gas."

The public relies heavily on energy to power their homes and vehicles, and even short outages can cause mass disruption. Health impacts can be extensive, depending on length of the energy emergency, associated temperature extremes, and other conditions. The loss of internet during blackouts in today's modern world can be profound. Chilled food storage can be compromised, and water wells without backup power will be inoperable. The failure of electric power systems may cause severe problems for persons who rely on medical equipment for their very survival, or for the maintenance of good health. A properly functioning power supply is also essential to maintain the safety of citizens who are working, traveling, attending to domestic matters, or involved in certain types of recreational activities. A sudden power failure may cause: (1) traffic lights to stop functioning, (2) traffic patterns to slow dramatically (resulting in traffic jams and delays in emergency response capabilities), (3) interference with important communication networks and needed machinery (including other important infrastructure, such as sewer lift stations and hospital equipment), or (4) sudden darkness when vital operations are taking place or dangerous activities are being performed as a part of people's ordinary occupations and activities. Food storage and safety relies heavily on an ongoing supply of electrical power. A great many community events, business operations, and tourist attractions are similarly reliant upon electrical infrastructure.

Most energy emergencies do not impact physical property itself from a structural standpoint, unless the nature of the emergency is secondary to other hazards that may have damaged buildings. An increased fire risk from overload or faulty energy infrastructure is possible. Extreme failures such as those seen in the case of nuclear accidents is covered in its own chapter. Facilities that cannot be adequately heated or cooled may be closed to the public. In some cases, energy emergencies may delay necessary infrastructure maintenance. The costs of asphalt in particular correlates heavily with the price of oil and may result in delayed road building or the need for other construction methods.

Whether due to infrastructure failure or energy shortages, every energy emergency presents unique challenges. Planning is necessary but preparing for emergencies taking place during times of extreme temperatures may be the most important. Electric failure during the Great Blackout of 2003 saw 50 million electric customers lose power during a time of high air-conditioning need. Michigan's "polar vortex" of 2019 saw frigid temperatures and demonstrated that natural gas reliability cannot be taken for granted.

Michigan Energy Emergency Plans: The Michigan Public Services Commission develops and maintains two energy emergency preparedness and response plans pertaining to electricity, natural gas, and petroleum: (1) the Michigan Energy Assurance Plan is a comprehensive, all-hazards plan that outlines state regulatory authority, roles and responsibilities, energy monitoring, emergency curtailment measures for electric and natural gas, and communication procedures, and (2) the Michigan Petroleum Shortage Response Plan concentrates solely on the petroleum sector and provides a comprehensive set of demand and supply management measures along with regulatory waivers which can be used in the event of a fuel disruption/shortage or a declared energy emergency. The plans outline the roles and responsibilities of local, federal, and state governments during an emergency. State involvement typically occurs when a local government's capacity to address an emergency is exceeded, with federal government involvement occurring when the state's capacity is exceeded. In these latter two instances, an Energy Emergency or a Disaster is declared, and the agency leading the response and recovery efforts change.

LEVEL 1 – Monitoring / Stand-By
Conditions: Routine monitoring uncovers current or potential impacts to Michigan's energy supply and/or systems. Although an impact to Michigan's communities has been observed, it is relatively low and likely in the initial stages.
Lead Agency: MPSC
LEVEL 2 – EERT Activation
Conditions: The impact on Michigan is moderate/limited compared to a more catastrophic event, however conditions are unstable or likely to worsen and additional information is required.
Lead Agency: MPSC
LEVEL 3 – State Energy Emergency Declaration
Conditions: The anticipated impact within the State of Michigan is moderate to high. Conditions have sufficiently deteriorated to the degree that the state has declared, or is considering declaring, an Energy Emergency under PA 191. The emergency is limited in scope to energy issues.
Lead Agency: MPSC / LARA
LEVEL 4 – State Disaster Declaration
Conditions: It is determined that the event involves more than an energy supply disruption, and that the impacts within Michigan are so severe that the governor has declared a State Disaster under PA 390. Governor directs necessary response actions led by Michigan State Police.
Lead Agency: MSP / EMHSD
LEVEL 5 – Federal Disaster Declaration
Conditions: The consequences of the event are extreme, the governor has requested, and/or the president has declared a National Disaster under the Robert T. Stafford Disaster Relief and Emergency Assistance Act.
Lead Agency: FEMA /DOE

(source: Michigan Public Service Commission)

Historically Significant and Related Events: Listed below are a few examples of energy emergencies that may 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 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 considering 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 to 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.

February 2003 – Western Lower Peninsula

A break in a major transmission line caused a 60-mile electrical blackout that stretched over parts of six counties. The break cut electricity to tens of thousands of customers in the counties of Montcalm, Mecosta, Oceana, Newaygo, Muskegon, and northern Kent. The customers included hospitals, retirement homes, and schools. The power outage apparently started in the Croton-Hardy Dam area in Newaygo County. The power line that was cut normally supplies electricity to about 70 substations in the affected counties.

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.

Winter 2013–2014 – Statewide – Propane Shortages

Michigan residents struggled with propane shortages during a period of extreme cold, with average prices more than doubling. The problem was exacerbated by: (1) farmers' use of more propane to dry grain crops following a wet, late harvest season during the fall, (2) pipeline disruptions and shutdowns, and (3) a rail closure in Canada. Heavy snowfall also made it difficult for propane delivery drivers who were forced to spend more time on the roads. Governor Snyder declared an energy emergency, which in part suspended state and federal regulations on the number of hours and consecutive days the drivers could operate. The U.S. Department of Transportation similarly declared an emergency and relaxed transportation rules until the emergency was over. The Michigan Department of Natural Resources offered a program for firewood permits, not typically sold during the winter. Other state-level efforts included $7 million in Michigan Energy Assistance Program (MEAP) funds devoted to deliverable fuel heating assistance, as well as $7 million in Low Income Heating and Energy Assistance Program (LIHEAP) assistance.

Winter 2019 – Major portions of Michigan – Natural Gas System Failure

January 30–31 saw a major portion of Michigan's natural gas system jeopardized despite an ample supply. The state's delivery capabilities were severely strained during an extreme weather event that came to be known as the "Polar Vortex," or PV19. Temperatures dropped below -25° F, having already caused high demand for natural gas when a fire ignited at Consumers Energy Ray Compressor Station. The station is the utility's largest natural gas storage facility, contributing up to 64 percent of their daily average of 2.5 billion cubic feet of natural gas to customers (supplying over one third of customer needs at peak times). The station sits above an underground natural gas storage area with a capacity of 41.2 billion cubic feet. Before the gas can be put into the pipeline system for delivery, however, it needs to be compressed. The station can compress 117 million cubic feet of gas per day, reaching pressures of 1,800 pounds per square inch. The fire ultimately caused a significant decline in pressure, which was only stabilized when customers lowered their thermostats and other natural gas suppliers pumped additional gas into the state's interconnected system. Given the temperature, a sustained loss would have been catastrophic. The fire at the Ray Compressor Station was caused by grounding interference on the facility's electrical system, leading to an automated procedure in which natural gas is released to the atmosphere. Instead of dispersing, the natural gas encountered nearby plant equipment that was hot, causing the gas to ignite.

Frequency of Occurrence: Localized interruptions of electrical service are the most likely type of energy emergency in the county (see section 2.07 Infrastructure Failures for more information regarding power outages). However, the list of energy emergencies presented above shows that county residents are occasionally exposed 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.

There may be a few small concentrations of scrap tires in Oceana County. However, thanks to annual cleanup grants awarded by the MDEQ, significant concentrations may have already been addressed. Even so, the threat remains for concentrations to redevelop, and careful steps should be taken to ensure proper disposal of scrap tires.

Hazard Description: Hazards posed by scrap tire fires don't neatly fit into a specific category but bear mention in this analysis due to their unique nature. The Environmental Protection Agency (EPA) does not consider scrap tires a hazardous waste. However, when a tire fire occurs, they break down into compounds including gases, heavy metals, and oil. The average passenger car tire is estimated to produce over two gallons of oil when burned. Tire fires often become major hazardous incidents affecting entire communities, producing toxic smoke and frequently requiring area evacuations. Oil that exudes into ground and surface water because of tire fires is a significant environmental pollutant. In some cases, this may trigger Superfund cleanup status. For every million tires consumed by fire, roughly 55,000 gallons of runoff oil are generated.

Scrap tires are difficult to ignite, but once tire fires start, they are generally very hard to control and extinguish. Using water and/or foam to extinguish a tire fire is often futile. Water is best used to keep adjacent, unburned tires from igniting. Smothering a tire fire with dirt or sand is usually the best option for extinguishing fires.

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 firefighting 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 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.

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. In 2012, the Michigan Department of Environmental Quality estimated 6,500 total scrap tires at one "Registration Non-Compliant" sites in Oceana County. One scrap tire cleanup grant for $10,444 was awarded in Oceana County in Fiscal Year 2012 to dispose the passenger tire equivalent (PTE) of 8,325 tires. It is possible that other, undocumented concentrations exist within the county.

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. It has been demonstrated that scrap tire piles accumulate over time. Although there were an estimated 44,000 scrap tires in Oceana County in 2001, many were likely cleaned up with a FEMA grant in 2000. 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 of the passenger tire equivalent (PTE) of 10,875 tires.

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 locations 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. From 2021-2023, the following scrap tire cleanup grants were awarded in Oceana County: Hart Township (2022) $6,000, Oceana Conservation District (2022) $4,020, and Oceana Conservation District (2021) $4,032.

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 solely 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 that ignites one or several buildings, spreading to cause injury or loss of life, property damage, or the loss of important services.

Summary: Fires have been deemed by some as the "universal hazard" because they are common in comparison to other incidents and can often be the result of so many other hazards. Looking at fires due to *all* causes in the United States, the country experienced roughly 1.3 million fires, with over 15,000 injuries and nearly 4,000 deaths in 2018. Estimated property losses for that period were over $25 billion. Looking specifically at structure fires, they represented roughly 39 percent of the total fires in the United States (*Source: NFPA).* In Oceana County, developed areas have a greater risk of experiencing widespread structural fires than rural areas. In addition, the county's stock of historical structures increases the threat of conflagration, especially in downtown areas. Historic buildings increase this risk because they often do not meet today's fire protection standards.

Hazard Description: Structural fires can cause displacement and homelessness, in addition to serious injuries, death, and economic hardship. Beyond the small-scale structural fires that only affect a single home or two at a time, emergency management authorities are primarily focused on disaster-level events involving multiple or major structures such as nursing homes, dormitories, hospitals, hotels, and other locations that involve greater risk and complexity due to the potential numbers of vulnerable people involved. Facilities and infrastructure may be taken out of service even from smoke damage, resulting in relocation or disruption. An unchecked urban conflagration can destroy entire portions of a city.

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. According to 2021 American Community Survey 5-year estimates, 13 percent of Oceana County homes rely on wood for heating. 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. The Oceana County Master Plan reveals the county's intent to encourage local ordinance enforcement as well as review local master plans and zoning ordinances to ensure their consistency with the countywide Master Plan.

Despite the predominately rural nature of Oceana County, another concern 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: In 2018, Michigan saw 10.9 deaths and 32.7 injuries per 1,000 structure fires. This compared with an average of 6.1 deaths and 32.7 injuries per 1,000 structure fires from aggregated data at the national level.

According to the Michigan Fire Inspectors Society, Michigan experienced 111 fire fatalities in 2022. Most fatal fires occurred on a Monday (24%), Tuesday (17%), or Wednesday (15%) and between 6 PM and 6 AM. See graphic in Appendix C for additional 2022 statistics.

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. Then 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 damage will be limited. Based on previous research including 2003 and 2010 fire estimates (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 2023, 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: According to FEMA, a hazardous material is any solid, liquid, or gas that can harm people, other living organisms, property, or the environment. They may be naturally occurring but are also increasingly man-made or brought more into human contact by our activities. Chemical manufacturers and industrial sites are sources for many such materials. When spilled or otherwise accidentally released at these facilities, known as a fixed site location, they pose a risk to quickly spread and create harm to the public. Other locations of concern include certain end user facilities (e.g., gas stations, hospitals, farms, universities) and storage areas where their quantities exist in sufficient amounts. The unique risks associated with the transportation of these materials is covered in section 2.06 of this chapter.

Because of their chemical, physical, or biological nature, a hazardous material may be a biohazard, poisonous, corrosive, explosive, flammable, or radioactive. They may also be an oxidizer, an asphyxiant, or a substance capable of causing severe allergic reactions. Such substances can vary greatly in their ability to cause harm and can be classified in a variety of ways. The Environmental Protection Agency (EPA) has made two classifications that are most important to this chapter: (1) "extremely hazardous substances" (EHS), and (2) "CERCLA hazardous substances." A consolidated listing of these materials and other hazardous substances are registered on the "List of Lists," which can be found at https://www.epa.gov/epcra/consolidated-list-lists. 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.

Some hazardous material releases may impact food or water supply chains for large regions or even the entire state. An example would include the persistent chemical commonly known as PFAS (Per- and polyfluoroalkyl substances). Such releases may be treated as a transmittable public health emergency because of their ability to spread to significant portions of the entire state (see the associated chapter). While these may have been local releases at one time, their aggregate or long-term effect has moved beyond that of a typical acute hazardous materials release.

Whether urban or rural, local leaders need to focus on the hazards present in their unique communities, as well as those of neighboring regions. This should include facilities that are typically upwind from their location or that have rivers or groundwater that flow into their area. When hazardous material releases do occur, they may be obvious, rupturing above ground tanks, setting off alarms, creating odors, causing fires, or immediately impacting people's health. Other releases are more insidious, leaking from underground storage tanks, seeping long distances through groundwater, or causing cancer that does not become apparent for several decades.

Most hazardous material releases are unintentional, although a lack of proper training or neglecting regulations can play an important role. Terrorists may attempt to weaponize chemicals, or criminals may steal fertilizer to make methamphetamine or explosives. Container design or other equipment flaws may occur. Less common are natural disasters that might impact an otherwise properly stored substance, such as a flood washing barrels downstream. Regardless of cause, the impact of hazardous releases on the public can be significant in both the short and long run.

Hazardous material incidents involve the potential for evacuation (or sheltering in place), creating significant concerns for special populations in hospitals, schools, nursing homes, and other such facilities. Certain types of extremely hazardous substances may result in a public health emergency and a resulting need for triage, mass treatment, and congregate care. Release location and accompanying weather may be important factors. Both short- and long-term health impacts may occur, including cancer or birth defects.

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.

As of 2023, there were 75 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 if 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: Research for this hazard revealed one fixed site hazardous materials release 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 addition, one industrial accident was identified. 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 accidental release cannot be overlooked. Industrial accidents also remain somewhat of a possibility but are reasonably expected to be rare occurrences.

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 2023, there were 75 SARA Title III sites in Oceana County (see discussion in 2.05 Hazardous Material Incidents: Fixed Site); most of which host agricultural or industrial activities associated with food processing. Therefore, the hazardous materials may be transported to both developed and rural/agricultural 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: All modes of traditional transportation—highway, rail, air, and marine—carry hazardous materials throughout our communities on a regular basis. Pipeline transportation is also common and covered under its own chapter. For transportation purposes, a hazardous material is defined by the United States Department of Transportation (USDOT) as a "substance or material capable of posing an unreasonable risk to health, safety, or property when transported in commerce." Examples include solids, liquids, or gases that can cause unreasonable harm to humans and other living organisms due to being radioactive, flammable, explosive, toxic, corrosive, a biohazard, an oxidizer, an asphyxiant, or hypoallergenic. Not all hazardous materials carry the same level of risk or have the potential to create a local emergency.

Although typically not cargo itself, vehicle fuel is extremely flammable and may complicate routine incidents. Trained teams may be deployed to address this fuel, even when incidents do not otherwise involve hazardous cargo. In addition to highway-related concerns, damaged or submerged ships may leak fuel into water, and planes may drop jet fuel mid-air prior to emergency landings.

A local emergency may occur depending on the material released and its amount, the weather, location, and other factors. Minor incidents involving hazardous materials can still prove dangerous but are routinely handled by response teams in an effective manner. Major incidents may involve a widespread hazardous release, adversely impacting the life safety of those near the incident site or affected by subsequent spread. Explosions, air plumes, and fires can occur. The environment can be severely impacted depending on the effectiveness of containment measures.

Statistics show that almost all hazardous material transportation incidents are the result of unintentional motor vehicle crashes or train derailments. Lack of sleep, drug use, poor training, or simple human error are contributing factors. Rarely are they caused solely by mechanical failures on the vessels carrying hazardous cargo. In addition, most hazardous material transportation incidents in Michigan are relatively small and localized to a specific community. In general, their impact is greatest when it occurs in urban areas, shutting down traffic and potentially presenting health hazards to large populations. Typically impacted infrastructure includes highways, overpasses, and rail crossings. Large airports are an area of concern, but often include highly trained, embedded response teams.

Michigan's comprehensive freight plan offers an excellent summary of the various materials moving throughout the state. It is an official supplement to the 2040 MI Transportation Plan.

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 along Oceana County transportation routes, there have been minor incidents. All highways within the county, except for 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. Periods of low Lake Michigan 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, so this is not a concern.

Historically Significant and Related Events: Research for this hazard did not reveal any major hazardous materials incidents occurring on Oceana County transportation routes. For events related specifically to what most people would think of as *accidents* (e.g., crashes, derailments), highway incidents represented by far the greatest number of occurrences. Trucks represent 95 percent of such highway shipments and typically haul only one bed, trailer, or tanker, limiting the individual effects of each incident.

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." For the purpose of this plan, "infrastructure failure" primarily focuses on water supply infrastructure, sewer systems, bridges and communication systems.

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.

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.

Built infrastructure provides the public with the essential components for modern life. The supply of fresh water (for drinking, cleaning, washing, cooking, and other uses) may sometimes be interrupted by pipe freezes, breaks, or water main failures. In addition to the need for citizens to find alternative sources of water, there is the potential for certain types of system failures to allow contaminated water to sicken the public. Water main failures may also cause localized damage, erosion, and flooding.

Drainage infrastructure failures may cause normally safe areas to become flood-prone, causing impacts in locations beyond those that are recognized as floodplain and wetland areas. Urban flooding results when drainage capacities of the area are exceeded, and polluted water backs up into streets, yards, and basements. This can cause transportation and access issues, property damage, contamination, cleaning costs, and the loss of important family possessions.

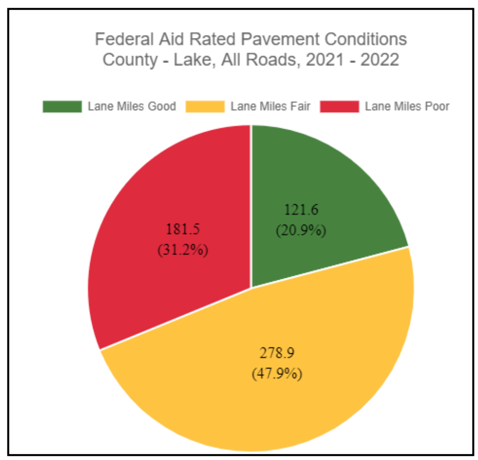
Communication systems are heavily used for residential and business purposes but are also vital for emergency response and operations. Failure of systems may include a region's mass media (conveying important public awareness and emergency information), its land-based and/or cellular telephone systems, and its public emergency 9-1-1 system access. During times of mass emergencies, it is possible for an excess of attempted calls to overwhelm a system. Situations may exist where cell phone calls may not work for everyone, but texting may still be possible.

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. A balance must be reached between structural integrity, operational reliability, and short- and long-term costs associated with upgrading facility codes and standards.

Though it is possible to design and operate facilities that are virtually "disaster-proof," in many cases it is not economically feasible. Extensive 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 Transportation Asset Management Council (TAMC), Oceana County had 360.4 miles of federal aid-eligible roads in 2021-2022. The accompanying chart outlines the rated condition of those roads from 2021-2022.

While not unique, Michigan's roads and bridges experience annual winter freeze and thaw cycles that cause continual breakdown of their surfaces. The state has also frequently experienced significant related funding challenges. This will be exacerbated over time as more vehicles use less gasoline (or none at all) because a major portion of the state's transportation funding comes from taxes placed upon gasoline. Although underinvestment can create risk anywhere in the system, bridge related incidents can be particularly dangerous. Michigan ranks above both national and regional averages as they relate to bridges rated in severe condition.

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.

Michigan's historical communications infrastructure, for much of the 20th century, consisted primarily of traditional telephone systems. While most Michigan residents no longer have a "landline" phone, the importance of their existing network and infrastructure should not be discounted. In some more rural areas of the state, such landlines provide an important alternative to cell phones where coverage areas are sparse. Although diminishing, traditional landlines remain a source of many 9-1-1 calls, and also provide some Internet connectivity via Digital Subscriber Lines (DSL). While slower than other forms of Internet, their use can still be vital. When viewed broadly, consideration for communication networks should also examine traditional broadcast radio and television stations. Emergency managers need to pay particular attention to their own specialized radio communication systems and interoperability (such as with police, fire, EMS, and amateur radio).

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 or power outages 36 times for Oceana County from 1993 through 2022; 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.

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
March 8, 2017	High wind	Over 1 million	Michigan
April 14, 2018	Winter storm	450,000	Michigan
February 5, 2019	Ice storm	150,000	Central Lower Michigan
February 24, 2019	High wind	1 million	Lower Michigan

Source: NCDC Storm Events Database, Local Reports

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 Boil Water Warnings in August and September as a 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 numerous times per year, infrastructure failures are possible anywhere in the county in any given season.

NCDC Storm Data includes 36 instances of downed power lines or outages in Oceana County between 1993 and 2022. At this rate, the county experienced one to two significant incidents per year. Most of these events were localized. Isolated or localized power failures can typically be resolved in a matter of hours, while regional events may take days to fully recover.

From 2019-2021, there were six sanitary system overflows in Oceana County reported to the Michigan Department of Environment, Great Lakes, and Energy. Five instances were attributed to the Shelby Wastewater Treatment Facility, and one was attributed to the Hart Wastewater Treatment Plant. These records are insufficient to establish a frequency of occurrence, however it should be noted that as municipal systems in Oceana County age, failures may become increasingly possible, or even likely without appropriate maintenance.

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 been trained to handle radioactive materials safely, who have specialized equipment to detect and monitor radiation, and who are trained in personal radiation exposure control.

Michigan has two operating nuclear power plant facilities (Enrico Fermi-2 and Donald C. Cook); both of which are more than 50 miles from Oceana County. The closest nuclear power plant is the Point Beach Nuclear Power Plant in Wisconsin. It is about 65 miles northwest of Little Sauble Point in Golden Township. 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.

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 several 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. There is a history of oil and natural gas exploration in Oceana County. Therefore, abandoned and insufficiently capped wells are possible to exist in the county.

Hazard Description: There have been over 60,000 commercial wells drilled in Michigan going back to roughly 1925. A speculative industry, only an estimated half ever ended up producing significant amounts of oil or natural gas. Drilling Unit Maps from EGLE's Oil, Gas, and Minerals Division are available for most counties in the state and contain details by fuel type, drilling methods, activity status, and other factors. Gas storage fields are also indicated. The Michigan GIS Open Data portal https://gis-michigan.opendata.arcgis.com/ hosts well locations and additional layers for further analysis.

Hazards associated with wellheads are very similar to those for pipelines, with occupational hazards being higher due to the increased use of personnel. Although also a danger with pipelines, many of Michigan's oil and gas wells contain poisonous hydrogen sulfide (H2S) gas, frequently referred to as "sour gas." Hydrogen sulfide is a naturally occurring gas mixed with natural gas or dissolved in 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. At concentrations of 700 ppm, even as little as one breath of hydrogen sulfide can be deadly. 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.

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. It can be very costly to properly plug one abandoned or out of use well.

According to the Michigan Department of Environment Great Lakes and Energy information updated in May 2023, there were 1,624 total oil and gas wells in Oceana County. While a vast majority of these wells are inactive or capped, 2 of them were "active" or "producing." One hundred eighteen wells were known to have detectable levels of hydrogen sulfide in the following Oceana County townships: Benona (12), Claybanks (33), Colfax (1), Crystal (2), Elbridge (5), Ferry (6), Golden (3), Grant (2), Hart (3), Otto (1), Pentwater (14), Shelby (1) and Weare (36). 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 alone is not cause for alarm, but merits 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. Individual community maps included in Appendix B show oil/gas well concentrations and wells that are known to have detectable levels of hydrogen sulfide.

An additional concern in Oceana County is the fact that many 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 daily, it is impossible to ascertain how many incidents may 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 well. Responders must understand the dangers associated with H_2S and must have a working knowledge of the wells that are in their areas of responsibility. In rare cases, gases may be 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. Although it is difficult to determine a frequency of occurrence for this hazard, it is likely the county will continue to experience effects of oil and gas wells; especially as former and orphan wells continue to age.

2.10 PIPELINE ACCIDENTS

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

Summary: Pipeline accidents are a real and constant threat to communities across the country.

Although over one-third of Oceana County's households rely upon site-based liquefied petroleum (LP) gas, just over 30% of households rely upon natural gas utilities. 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. Most 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. About 75% 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 ranked 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 DTE Energy natural gas transmission line runs through Oceana County, and natural gas utilities have become increasingly available in recent years. According to the Michigan Public Service Commission, the following communities are served by utility natural gas through DTE Energy: City of Hart, villages of Hesperia, New Era, Pentwater, Rothbury, and Walkerville, and townships of Claybanks, Colfax, Crystal, Elbridge, Ferry, Grant, Greenwood, Leavitt, Newfield, Otto, Pentwater, and Weare. In addition, there are two known distribution systems in the county serving Golden Township and Shelby Township by AmeriGas Eagle Propane.

According to the Oceana County Master Plan, 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: Major natural gas explosions in recent years have highlighted the danger of aging natural gas pipelines. In 2011, a large crack in an 83-year-old, cast-iron gas main caused a gas explosion in Allentown, Pa. The incident killed five and damaged nearly 50 homes. On February 27, 2013, a natural gas explosion rocked a neighborhood in Royal Oak, Michigan as a Consumers Energy work crew replaced pipelines dating to 1929. The incident killed a man, leveled his house, and damaged 30 other homes nearby.

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. It should be noted that as pipelines in Oceana County continue to age, accidents may become increasingly possible, or even likely without appropriate maintenance or replacement.

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 of 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 accidents 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 mode 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 several 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 transportation accident in a marine environment could require a water rescue operation, possibly under dangerous conditions on Lake Michigan. There are concerns that a major transportation accident could cause many injuries or deaths and might occupy all area responders.

A major land transportation accident in Michigan could involve a commercial intercity passenger bus, a local public transit bus, a school bus, an intercity passenger train, or a multi-vehicle pileup. Such accidents are more likely to occur in areas of heavy traffic, industrial activity, decrepit roads, and during periods of inclement weather. Lack of public transportation as well as unpaved roads are often cited as problematic for Oceana County residents. 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.

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 accidents. 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. Great Lakes port facilities in the county are limited to recreation at Pentwater and Stony Lake. While 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 several 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.

July 15, 2022 – Shelby Township

A Cessna 210C aircraft crashed shortly after takeoff from Oceana County Airport. Visibility was poor and it was raining. The pilot and the only passenger were both killed in the crash.

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 shouldn't be overlooked. Incidents detailed above demonstrate the potential for transportation-related accidents. However, major incidents are considered to have a low potential or possibility of occurrence. 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. The frequency of accidents with commercial carriers within the county is indiscernible.

3.0 HUMAN RELATED HAZARDS

3.01 CATASTROPHIC INCIDENTS (National Emergencies)

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

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

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

The National Response Framework (aka Federal Response Plan) involves 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 several 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) – 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 helping 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 catastrophic events 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.

Types of civil disturbance

- ***Protest*** – Usually contains some level of formal organization or shared discontent that allows goal-oriented activities to be collectively pursued. This includes political protests and labor disputes.
- ***Hooliganism*** – Relatively unorganized and involves individual or collective acts of deviance inspired by the presence of crowds, in which the means (and responsibility) for ordinary levels of social control are perceived to have slackened or broken down. Examples include disorder following a sporting event or block party.
- ***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 the established authority of a government or its representatives by persons within a society or under its authority. Some prison uprisings may fall into this category, although others may more properly be classified as riots or protests, depending upon the presence and extent of specific goals and organization, and the type of action used in achieving such goals.

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. Good labor-industrial relations are helpful in preventing incidents of labor unrest, but incidents of such unrest may be possible at some point in the future.

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, 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 60,000 visitors (workers, festival-goers, etc.). 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 and would most likely be confined to a single site.

3.03 NUCLEAR ATTACK

A hostile action taken against the United States or its citizens involving nuclear weapons and resulting in the loss of life and/or destruction of infrastructure and environment.

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, economic, 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

Widespread or severe infectious disease, contaminated water or food supply chains, sanitation breakdowns, or similar hazards that transmit or threaten to transmit significant sickness within the general 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. As the COVID-19 pandemic demonstrated, a widespread public health emergency may strain Oceana County's medical facilities and require the assistance of resources from outside the county.

No area in Michigan is immune to these types of transmittable public health emergencies, but areas with high population concentrations tend to be more at risk to these threats. In addition, the more vulnerable members of society—the elderly, children, impoverished individuals, and persons in poor health—are populations more likely to be impacted. Communicable diseases can be transmitted by a variety of mechanisms, including droplets from coughs and sneezes, insect bites, contaminated food or water, and other vectors/fomites.

Epidemiology Terms	
Cohort	A group of individuals sharing a common demographic, especially as used in a study.
Endemic	Continuously present in a region, but typically isolated and frequently found in low numbers.
Epidemic	More cases of a disease than would be expected in a community or region during a given period.
Pandemic	An epidemic that becomes very widespread and affects a whole region, continent, or the world.
Vector	The agent which carries and transmits an infectious pathogen into a living organism.
Zoonosis	An infectious disease that may be transmitted from animals to humans.

Hazard Description: Although now largely forgotten, a high prevalence of mosquito-borne malaria historically existed in Michigan. A rhyme from the 1800s warned *"Don't go to Michigan, that land of ills. The word means ague, fever, and chills."* While native malaria is no longer of major concern, the state still exhibits a variety of transmittable hazards that take many forms. Most recently, the COVID-19 pandemic (caused by the novel coronavirus SARS-CoV-2) and Flint water crisis (lead contamination in drinking water) have been massive public health disasters requiring large scale state response.

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, many people. Public health emergencies can be statewide, regional, or localized in scope and magnitude.

Impact on the Public, Property, Facilities, and Infrastructure

Disease epidemics and pandemics have the potential to cause widespread sickness and loss of life. These effects may be felt more acutely within certain population cohorts, such as those based on age or race. Interruptions to work-life schedules and productivity can occur as quarantines are put in place or parts of the economy/schools are shut down. Ensuring available testing, vaccinations, and treatments reach all potentially impacted populations, including minority cohorts that may be disproportionally impacted by certain diseases, is a necessity. Pandemic related population shifts (i.e., urban to rural) and chemical contamination may temporarily lower property values, sometimes permanently. Sanitation problems may require expensive or lengthy construction.

Industries, facilities, and businesses may be shut down as a means of preventing disease transmission or containing contamination. Medical resources may become overwhelmed and unable to deal with acute needs or routine services. Travel may become limited, either directly through governmental orders that limit movement, or indirectly through limitations placed on infrastructure, such as airports or other modes of mass transit. Depending on the nature and length of the emergency, preventative maintenance or repairs of infrastructure may be delayed if workers cannot be kept adequately safe or not enough workers exist (due to sickness, layoffs, or other issues).

Impact on the Economic Condition of the State

Costs associated with public health emergencies can be massive. The economic impact of COVID-19, for example, has been profound, not just in terms of direct costs associated with healthcare services but also as seen in high levels of unemployment, the numbers of bankruptcies, the interim effect on the stock market, and a multitude of other factors. Affected travel, including closed international borders, may affect the economy if trade is hampered. Foodborne illnesses can have a significant impact on restaurants and grocery stores. While healthcare costs are one of the greater economic impacts in this area, infrastructure costs, such as those needed to replace lead pipes as seen in the Flint water crisis, can also be substantial and may impact state budgets. An animal disease affecting cows or swine could not just cause sanitation issues related to carcass disposal but could badly damage the state's livestock economy.

Even prior to COVID-19, the impact of severe flu seasons was a significant factor when considering lost work time and economic efficiencies. Major chemical contamination, like that associated with Velsicol in St. Louis, Michigan, is also expensive and can take decades to clean. Damage to a community's reputation may impede local economies for just as long. While some of these factors are considered under the chapter on Hazardous Materials, necessary expenses to ensure safe water, or to compensate individuals for cancer, may also increase tax rates or bankrupt companies.

Oceana County has fairly limited medical resources, which could be especially stressed during a public health emergency or a disaster event. The county's only hospital is the Trinity Health Shelby Hospital in the Village of 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. In general, 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 could have the potential to strain existing medical resources, and interrupt businesses and services.

Influenza and COVID-19

Influenza viruses (commonly referred to as "the flu") are designated by letters and numbers. Three main types (A, B, and C) infect people, with influenza A and B capable of causing human *epidemics* and influenza A additionally capable of causing world-wide *pandemics*. Influenza A viruses are further differentiated into subtypes based on their various H and N proteins. For example, A(H1N1) and A(H3N2) have been involved in viruses confirmed to spread directly from person to person. Humans can be infected with some influenza viruses that exist in animals (e.g., swine, chicken).

Prior to 2019, influenza was the world's primary respiratory virus of concern. However, specific variants of coronavirus now rival, and in the near term still arguably surpass, influenza and all other viruses (the important Ebola virus for example has yet to see the world-wide spread or impact caused by COVID-19).

The COVID-19 pandemic (caused by the novel coronavirus SARS-CoV-2) has become the most significant disease threat of the modern era. Such a pandemic is still ongoing at the time of this writing and continues to evolve over time. Fatalities from the disease have been greatly reduced, but it would be difficult to understate the world-wide health and economic toll caused by the virus. While some specific COVID-19 resources are included later in this chapter, much of the information on communicable disease epidemics presented here will continue to focus on influenza epidemics which are scientifically more settled by comparison. In many cases information is relevant to both viruses.

SARS-CoV-2 virus

Despite the recent focus on COVID-19, influenza can still exact a terrible toll on communities. During a typical influenza season, roughly 1,200 deaths in Michigan can be expected. However, if a true influenza pandemic were to occur, as many as 10-100 times that many people may die without an adequate and well-organized public health care response. Influenza surveillance is conducted in order to provide the most advanced notice possible, but an influenza pandemic could still occur early in the season and spread rapidly. In the northern hemisphere, a *typica*l flu season starts in October/November and ends in April/May. Flu viruses spread more easily in cooler weather, and therefore predominate around the winter season in temperate climates. Contagion may also be assisted by people spending more time indoors during this time. While this pattern holds true in general, it is not applicable for all viruses (e.g., warmer weather did not limit a rise in COVID-19 cases as much as anticipated).

Influenza impacts may be exacerbated in the near term by: (1) lowered flu vaccination rates that correlate with COVID-19 "vaccination hesitancy", (2) atypical flu surges caused by the ending of lengthy COVID-19 "stay at home" behaviors that re-expose people to influenza, and (3) similar factors influencing other viruses (e.g., respiratory syncytial virus) that may strain hospital and healthcare resources as they experience surges from several viruses at the same time.

Coronaviruses differ from influenza and are named for the crown-like spikes on their surface. The subgrouping of coronavirus that would later be designated as SARS-CoV-1 was first active in 2002. It was the cause of severe acute respiratory syndrome (SARS), and because of its novel nature garnered significant concern but ended up being a relatively rare disease. At the end of its epidemic, as marked by June 2003, its incidence was 8,422 cases with a case fatality rate (CFR) of 11 percent. In 2019, the related virus strain severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) was identified. This new strain was the cause for COVID-19, which originated in China and quickly spread throughout the world. Cases rose in Michigan, with two mass treatment facilities and emergency morgue plans put into place. The state reached its first high peak in cases on April 3,

2020. There was a period of decline, followed by an increase in cases (and deaths) towards the end of the year.

PFAS

In recent years, Per- and polyfluoroalkyl substances (PFAS) have garnered increasing attention in Michigan. According to the Michigan PFAS Action Response Team (MPART), these are a large group of manmade chemicals that are resistant to heat, water, and oil. PFAS have been classified by the U.S. Environmental Protection Agency (EPA) as an emerging contaminant on the national landscape. For decades, they have been used in many industrial applications and consumer products such as carpeting, waterproof clothing, upholstery, food paper wrappings, personal care products, fire-fighting foams, and metal plating. They are still used today. PFAS have been found at low levels both in the environment and in blood samples of the general U.S. population.

These chemicals are persistent, which means they do not break down in the environment. They also bioaccumulate, meaning the amount builds up over time in the blood and organs. Studies in animals who were exposed to PFAS found links between the chemicals and increased cholesterol, changes in the body's hormones and immune system, decreased fertility, and increased risk of certain cancers. Studies in which animals were given high levels of PFAS showed effects including low birth weight, delayed puberty onset, elevated cholesterol levels, and reduced immunologic responses to vaccination. Animal studies help scientists understand what could happen in people.

PFAS can get into drinking water when products or wastes containing them are disposed of, used or spilled onto the ground or into lakes and rivers. PFAS move easily through the ground, getting into groundwater that is used for some water supplies or for private drinking water wells. When released into lakes or rivers used as sources of drinking water, they can get into drinking water supplies. PFAS released by facilities into the air can also end up in rivers and lakes used for drinking water.

Hydraulic Fracturing

It is worth noting that there have been 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.

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	• Release to surface or ground water through spills or leakage from on-site storage

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.	
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: The following are samples of various and unique public health emergencies that have had an impact upon the state:

- 1973: PBB (polybrominated biphenyl) disaster contaminated much of Michigan.
- 1994: Northern Michigan water and sewer infrastructure emergency cascaded into a Presidential Disaster Declaration.
- 2001: Concerns over mosquitos reappeared with an outbreak of West Nile disease.
- 2010: Increased awareness of PFAS (Per- and polyfluoroalkyl substances) chemical contamination when it was discovered in drinking water. PFAS groundwater contamination in Leavitt Township was noted during research and outreach for this plan.
- 2016: Large-scale Hepatitis-A outbreak, considered the largest in the country at the time.
- 2020-present: COVID-19 pandemic attributed for nearly 7 million confirmed deaths worldwide, including 97 confirmed deaths in Oceana County (as of July 11, 2023).

Like the rest of the United States and the world, Oceana County has had serious outbreaks of diseases like smallpox, measles, mumps, influenza, and COVID-19. The County has experienced many instances of power outages that could have created unhealthy conditions, as documented in Section 2.06. Fortunately, none have caused widespread health problems locally.

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

Most manifestations of public health emergencies are highly unpredictable. However, each year brings a unique and relatively unpredictable strain of the flu to county residents. Recent trends suggest that COVID-19 and its many variants may ebb and flow in a similar manner.

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 that might include proponents of any extreme ideology.

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. Cyber-attacks appear to be an increasingly eminent threat. 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 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 terrorism and large-scale criminal activities. 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 rating and ranking methodology used in this plan factors the expected 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 other community stakeholders. The following lists 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.

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

		Probability Occurrence	Impact on People	Impact on Property	Impact on Economy	Impacts Total	Hazard Score
	NATURAL HAZARDS						
1.01a	Celestial Impacts	2	2	0	3	9	18
1.01b	Space Weather	1	2	0	2	8	8
1.02	Drought	2	2	2	3	13	26
1.03	Earthquake	0	-	-	-	-	-
1.04	Extreme Temperatures	3	2	1	2	10	30
1.05	Flooding: Riverine/Urban	3	1	2	1	8	24
1.06	Fog	3	1	0	1	4	12
1.07	Great Lakes Shoreline	3	1	2	2	9	27
1.08	Hail	3	1	2	1	8	24
1.09	Invasive Species	2	1	2	2	9	18
1.10	Lightning	3	1	2	1	8	24
1.11	Severe Winds	3	2	2	2	12	36
1.12	Subsidence	1	1	1	1	6	6
1.13	Tornadoes	2	1	2	2	9	18
1.14	Wildfire	3	1	2	1	8	24
1.15	Winter Storms	3	3	2	2	15	45
	TECHNOLOGICAL HAZARDS						
2.01	Dam failure	2	1	2	2	9	18
2.02	Energy Emergencies	2	2	0	2	8	16
2.03	Fire – Scrap Tires	1	1	1	1	6	6
2.04	Fire – Structural	3	1	2	2	9	27
2.05	HAZMAT – Fixed Site	2	1	1	2	7	14
2.06	HAZMAT – Transportation	2	1	1	2	7	14
2.07	Infrastructure Failures	3	2	1	2	10	30
2.08	Nuclear Power Emergencies	0	-	-	-	-	-
2.09	Oil/Natural Gas Well Accidents	2	1	1	1	6	12
2.10	Pipeline Accidents	2	1	1	2	7	14
2.11	Transportation Accidents	2	1	1	1	6	12
	HUMAN RELATED HAZARDS						
3.01	Catastrophic Incidents	1	3	3	3	18	18
3.02	Civil Disturbances	1	1	1	1	6	6
3.03	Nuclear Attack	0	-	-	-	-	-
3.04	Public Health Emergencies	3	2	0	2	8	24
3.05	Terrorism & Similar Criminal Acts	1	1	1	1	6	6

Oceana County
Hazard Vulnerability Rankings

Probability Occurrence X Impacts Total = Hazard Score

		Probability Occurrence	Impacts Total	Hazard Score
1	Winter Storms	3	15	45
2	Severe Winds	3	12	36
3	Extreme Temperatures	3	10	30
3	Infrastructure Failures	3	10	30
5	Fire – Structural	3	9	27
5	Great Lakes Shoreline	3	9	27
7	Drought	2	13	26
8	Wildfire	3	8	24
8	Flooding: Riverine/Urban	3	8	24
8	Hail	3	8	24
8	Lightning	3	8	24
8	Public Health Emergencies	3	8	24
13	Catastrophic Incidents	1	18	18
13	Dam failure	2	9	18
13	Invasive Species	2	9	18
13	Tornadoes	2	9	18
13	Celestial Impacts - Space Weather	2	9	18
18	Energy Emergencies	2	8	16
19	HAZMAT – Fixed Site	2	7	14
19	HAZMAT – Transportation	2	7	14
19	Pipeline Accidents	2	7	14
22	Fog	3	4	12
22	Oil/Natural Gas Well Accidents	2	6	12
22	Transportation Accidents	2	6	12
25	Celestial Impacts - Space Debris	1	8	8
26	Civil Disturbances	1	6	6
26	Fire – Scrap Tires	1	6	6
26	Subsidence	1	6	6
26	Terrorism & Similar Criminal Acts	1	6	6
	Earthquake	0	-	-
	Nuclear Attack	0	-	-
	Nuclear Power Emergencies	0	-	-

2023 Rank	Hazard	2014 Rank	2014-2023 Change
1	Winter Storms	1	*- no change -*
2	Severe Winds	2	*- no change -*
3	Extreme Temperatures	4	↑1
3	Infrastructure Failures	4	↑1
5	Fire – Structural	6	↑1
5	Great Lakes Shoreline	8	↑3
7	Drought	7	↓1
8	Wildfire	3	↓5
8	Flooding: Riverine/Urban	8	↓1
8	Hail	8	*- no change -*
8	Lightning	8	*- no change -*
8	Public Health Emergencies	12	↑4
13	Catastrophic Incidents	12	↓1
13	Dam failure	12	↓1
13	Invasive Species	12	↓1
13	Tornadoes	12	↓1
13	Celestial Impacts - Space Weather	-	new ranking
18	Energy Emergencies	17	↓1
19	HAZMAT – Fixed Site	18	↓1
19	HAZMAT – Transportation	18	↓1
19	Pipeline Accidents	18	↓1
22	Fog	21	↓1
22	Oil/Natural Gas Well Accidents	21	↓1
22	Transportation Accidents	21	↓1
25	Celestial Impacts - Space Debris	24	↓1
26	Civil Disturbances	25	↓1
26	Fire – Scrap Tires	25	↓1
26	Subsidence	25	↓1
26	Terrorism & Similar Criminal Acts	25	↓1
not ranked	Earthquake	*not ranked*	-
not ranked	Nuclear Attack	*not ranked*	-
not ranked	Nuclear Power Emergencies	*not ranked*	-

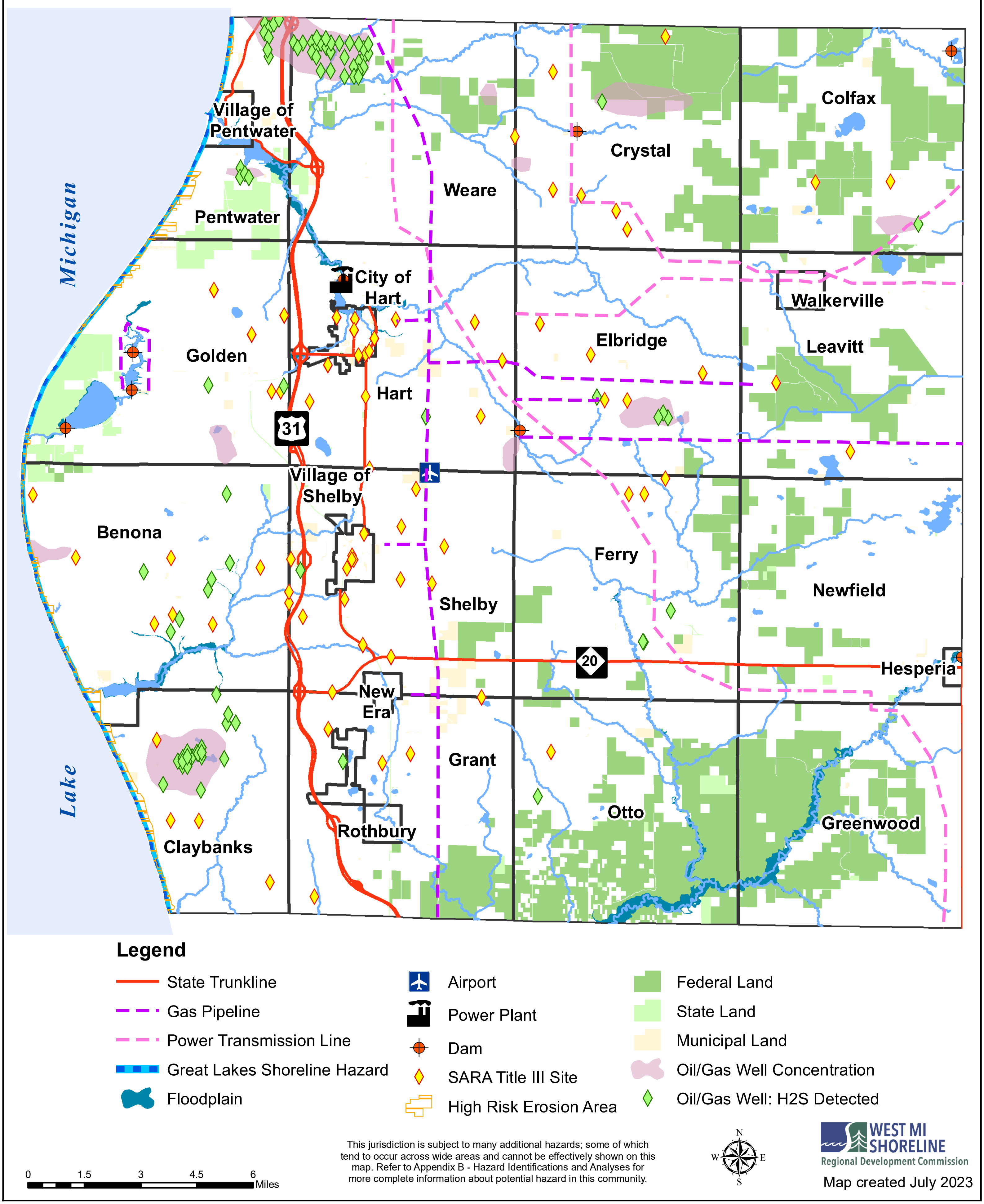
For this edition of the plan, a number of adjustments were made to account for recent events such as the Great Lakes high water episode and the COVID-19 pandemic. As a result, there are some noticeable changes in the Oceana County hazard rankings. The county's top two hazards remain the same, with *Winter Storms* in the #1 slot and *Severe Winds* at #2. *Great Lakes Shoreline* was elevated to #5, on par with *Structural Fire*. *Public Health Emergencies* moved up to #8, tied *Wildfire, Flooding, Hail* and *Lightning*. *Wildfire* fell five spots to #8 because the estimated impact upon people was reduced in the vulnerability assessment. Another ranking change to note is the addition of *Space Weather*. This hazard is a component of the *Celestial Impacts* hazard, but was individually assessed because *Space Weather* is assumed to be more likely to influence Oceana County within the foreseeable future than other aspects of the *Celestial Impacts* hazard.

Consideration of changing climate conditions is becoming increasingly accepted in public discourse. Still, according to public and stakeholder input, attitudes within the county are divided regarding the local impacts of climate change. In addition, while it is generally known and accepted that the climate is changing, it is not yet understood how these changes will affect Oceana County. For example, while it can be assumed that the changing climate will affect the geographic distribution and frequency of tornadoes across Michigan and the United States, it is impossible to know how those changes will affect Oceana County in the future. Therefore, climate projections were not explicitly considered in the hazard rankings assessment they relate to Oceana County. Part C – Identification of Hazards does include "climate considerations" where information was available.

The individual community level hazard rankings, located in Appendix B, are similar to the county rankings. For the city, villages, and townships, the top four hazards are W*inter Storms, Severe Winds, Extreme Temperatures and Infrastructure Failures*. 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.

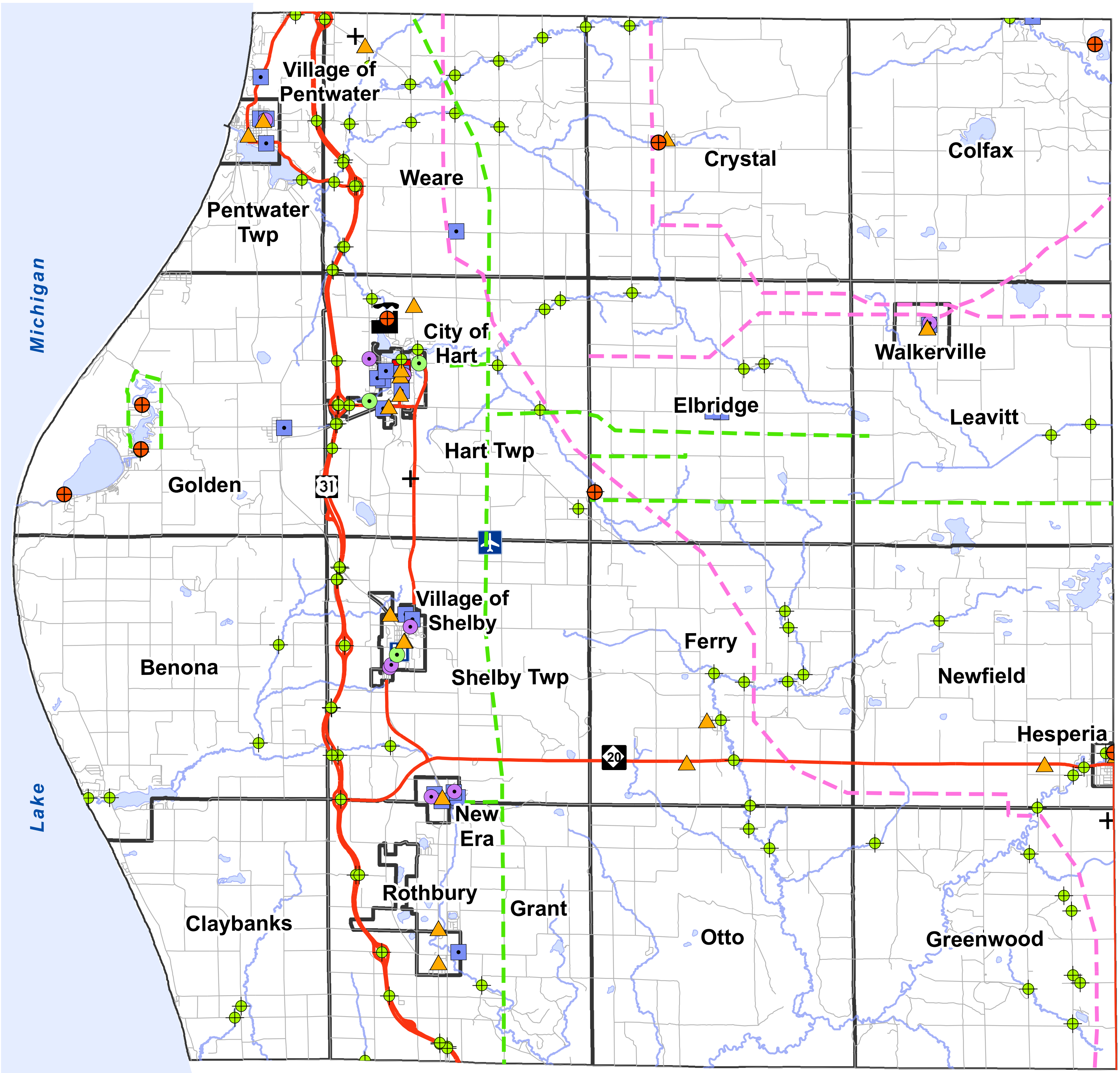
OCEANA COUNTY

Potential Hazards



OCEANA COUNTY

Critical Facilities



Legend

- State Trunkline
- Road
- Railroads
- Gas Pipeline
- Power Transmission Line
- Bridge
- Communication Tower
- Wastewater Treatment
- Airport
- Fire/Police/EMS/911
- Power Plant
- Hospital
- Medical Facility
- Dam
- School
- Shelter
- Correctional Facility

0 1.5 3 4.5 6 Miles

N W E S

WEST MI SHORELINE Regional Development Commission

Map created in July 2023

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 goals and objectives on the following page have been established for hazard mitigation efforts in Oceana County. They are based on the county's hazard analyses, as well as input from Oceana County Emergency Management, LEPC members, government officials, planning staff, emergency responders (including 911, fire, and police), and other interested stakeholders.

For the 2023 edition of this plan, the goals and objectives from the 2014 edition were collaboratively reviewed and discussed by emergency managers of Lake, Mason, and Oceana counties on May 16, 2023. This chapter was also made available for public review and referenced in a published public notice prior to the September 28 public meeting. It was determined that the goals and objectives remain valid and appropriate to meet the needs of Oceana County. Therefore, no significant changes or additions were proposed.

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.

Subsequent chapters in this plan offer guidance and encouragement toward concrete actions at the local level. 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.

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.

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 is certain to 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 have preferred 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.

The following are six basic hazard mitigation strategies that can reduce or prevent the harmful interaction between hazards, people, and development that may result in a disaster:

Strategy #1: Modification of the Hazard
The first strategy involves modification of the hazard itself—removing or eliminating the hazard, reducing its size or amount, or controlling the forces it exerts. In the right circumstances, this strategy can be successful, but it is often difficult to do. Examples of this strategy include stream widening or modification to improve water flow and prevent floods and slope planting to prevent erosion. These measures can be cost-effective, but their application is normally limited and expensive, and therefore not always as effective as other strategies in reducing or eliminating damage on a wide scale. In terms of "the disaster equation," if hazard forces can be reduced to zero, there will be no disaster. Hazard mitigation of this type attempts to reduce the impact of a hazard as much as possible.

Strategy #2: Segregating the Hazard
Strategy number two, segregating the hazard, attempts to "keep the hazard away from people." This is often accomplished in flood-prone areas through the construction of structural protection measures such as dams, levees, floodwalls, debris basins, and other public works projects designed to redirect the impacts of a flood away from people and development. This strategy can be highly effective, but it can also be expensive and in some cases can cause (or exacerbate) environmental problems. Also, history has shown that structural protection measures constructed to protect one community can increase problems in other communities (e.g., levees that channel and increase the velocity of floodwaters, causing severe flooding downstream). Limited budgets and structural maintenance costs may make this strategy less feasible in some communities and situations.

Strategy #3: Preventing or Limiting Development
The third strategy involves preventing or limiting development in locations where people and development would be at risk. This approach is based on "keeping the people away from the hazard" and includes a variety of land use planning and development regulation tools, such as comprehensive planning, zoning, floodplain management ordinances, capital improvements planning, and disclosure laws, as well as the acquisition and relocation of hazard-prone properties. This approach attempts to reduce or eliminate the vulnerability of persons and structures, through wise and prudent land use and development decision-making. When properly applied, this strategy can be highly effective in promoting safe, sustainable development. Hazards continue to exist, but if human vulnerability has been sufficiently reduced, no disaster will result from the hazard.

Strategy #4: Altering Design or Construction
The fourth strategy involves alteration of the design or construction of development to make it less vulnerable to disaster damage. This strategy can be thought of as "interacting with the hazard," and allows the hazards to interact with human systems that have been designed and planned to withstand potentially destructive impacts. Examples of this strategy include elevating structures, employing wet and dry flood-

proofing to improve flood damage resistance, managing vegetation buffer zones in urban/wildland interface areas, using wind bracing to improve structural wind resistance, and insulating water and sewer lines to prevent freezing damage. This strategy allows development in hazard prone areas, but requires that the development meet stringent disaster-resistant performance criteria. In many situations, this approach is an economically welcome method of reducing community hazard vulnerability. History has shown that the two goals are not mutually exclusive. When careful and prudent development decisions are made that take into account the reduction of hazard vulnerabilities, the result is safe and sustainable community development. Safe rooms should be widely considered, to protect residents at home, workers at work, and visitors at special events.

Strategy #5: System Capacity, Redundancy, and Back-Up Features
Like the previous strategy, this focuses upon mechanical, design, and construction elements, but of some important system (e.g. critical infrastructure) rather than just for a specific structure. The design of structures should include back-up power options for vital operations, and infrastructure should be able to accommodate the full extremes of weather, drainage patterns, temperatures, and so on. Capacity should not be presumed to be a statically defined concept that has never changed but should take into account current trends toward increasing precipitation and heavy rain events. Critical facilities should have a reliable source of back-up power. Road and power systems should, if possible, provide enough redundancies to allow the system to effectively handle the occasional breakdown in some of its components.

Strategy #6: Early Warning and Public Education (overlaps with emergency management preparedness/response)
This strategy 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. This strategy should be applied in all communities, as it is typically the last line of defense against serious disaster related injury or loss of life.

To create and maintain safe, sustainable communities, both preventive and corrective forms of hazard mitigation must occur at the state and local levels. An example of the preventive form of hazard mitigation at the local level would be a policy requiring that all future development occur in such a way as to avoid or reduce, to the extent possible, community exposure and vulnerability to hazards. That would seek to prevent the scope and magnitude of hazard impacts from increasing. The corrective form of hazard mitigation therefore could be applied in those areas that already have a high degree of exposure and vulnerability to certain hazards and therefore suffer severe and/or repetitive damage as a result. Such actions would correct current problems caused by unwise and/or outdated land development patterns.

Because disasters can be particularly devastating for private businesses and industry, creating and maintaining safe, sustainable communities makes "business sense" as well—statistics from the National Fire Protection Association (NFPA) show that 40% of organizations that suffer a major disaster of any kind go out of business within one year. A University of Minnesota study found that 93% of all businesses that lost their data centers for 10 days or more went out of business—50% filing for bankruptcy almost immediately. A follow up study by Datapro Research found that 43% of the businesses in the University of Minnesota study never reopened, and an additional 29% went under within two years. Creating and maintaining safe, sustainable communities through the implementation of mitigation measures at the state and local government levels is certainly in the best interests of private business and industry.

It must be emphasized that the hazard mitigation alternatives identified in this plan are, in reality, hazard mitigation opportunities. Identification of a possible hazard mitigation measure does not necessarily mean that it can or even should be implemented. Implementation (and the desirability) of a hazard 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 should preclude its implementation. Those decisions will be made locally and in the land use and land development decision-making processes. Typically, hazard 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.

Another point of emphasis: The focus and intent of this plan is not to encourage wholesale limits on development or in any way to usurp the authority or scope of local land use and land development decision-making. Land use decisions in Michigan, by and large, have been made by local officials based on local priorities and conditions. What this plan seeks to promote is safe, sustainable development and communities by integrating hazard mitigation considerations into everyday governmental and private sector business practices and processes. This in turn will help reduce injuries and loss of life, property and environmental damage, and adverse economic, social, and service impacts caused by natural, technological, and human-related hazards.

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 2023 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 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 later. 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 abides by the codes listed below. These codes are constantly being evaluated and updated to reflect new information and recommended practices.

- 2015 MI Residential Code
- 2015 MI Building Code
- 2018 MI Plumbing Code
- 2015 MI Mechanical Code
- 2017 MI Electrical Code (NEC & Part 8 Rules)
- 2018 International Fuel Gas Cod

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 Verisk (previously referred to as 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.disastersafety.org/fortified/.

The Verisk 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. Verisk 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 Verisk 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.

Well over one thousand Michigan communities have received a BCEGS rating. Fire chiefs, chief building officials, and community chief administrative officials may request a single, free copy of the BCEGS. If a community has not yet received a BCEGS grading, or if the community has recently made building code enforcement service improvements, 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 17.6% 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 (also referred to as master plan in this context) 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 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 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.

Although Oceana County does not engage in zoning at the county level, the Oceana County Planning Commission maintains a master plan to "provide a vision for future land use and development decisions within Oceana County over the next twenty to twenty-five years." At the time of this writing, the Oceana County Master Plan Update was scheduled for completion and adoption in early 2024. The plan features five primary themes: quality of life, environment, infrastructure, economic development and community development. "This comprehensive view is intended to make the "plan" a coordinating tool for governments, agencies, businesses, and citizens within the county."

Zoning ordinances in Oceana County are adopted and enforced by local jurisdictions; excepting Colfax and Leavitt townships which are not zoned.

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

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

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

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

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.

For the CIP to be an effective mechanism for implementing the comprehensive plan and zoning ordinance, public improvements must be targeted for those areas of the community where growth or certain types of land uses are desirable. Public improvements should not be put in those areas where growth or development is not desired. In that sense, the CIP should mirror the comprehensive plan and zoning ordinance; otherwise, the three mechanisms may work against each other (i.e., public expenditures in a non-desirable area may spur unwanted development). On the other hand, if desirable private development occurs or is proposed, the CIP may have to be adjusted somewhat to coordinate public investment with the desired private development. Each year, the planning commission must extend the CIP one more year through the established local planning process. As part of that process, the commission will reevaluate project proposals considering any developmental changes that might need revision in public improvement priorities. Each year, then, becomes the beginning of a new CIP.

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 Environment, Great Lakes, and Energy (EGLE) reviews subdivisions for floodplain impacts. (Refer to the Riverine Flooding chapter of the Michigan Hazard Analysis section in the MHMP for specific EGLE provisions that directly address flood mitigation.) The subdivision rules require a minimum buildable area above the BFE and outside of any wetlands, for each platted lot.

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 of the proposed plat and the use of restrictive deed covenants. However, the restrictive deed covenants that are filed under the Act are minimally effective as no agency has jurisdiction to enforce them. Enforcement would have to be accomplished by civil litigation from neighboring property owners. The building official has no jurisdiction over deed restrictions and cannot legally require applicants to follow them. However, the floodplain requirements of the Construction Codes must still be met, and developers are required to provide a subdivision layout that has a buildable area on each lot (which helps to prevent violations).

The land-division rules currently allow the construction of basements below the BFE, but these basements must be floodproofed, or it must be demonstrated by an engineering analysis that the basement will not be adversely impacted by hydrostatic pressures exerted by floodwaters. However, the Michigan Residential Code prohibits all basements below the BFE within the 1% annual chance floodplain. So, the developer must also obtain a letter of map revision based on fill (LOMR-f) from FEMA prior to construction, certifying that the property has been filled above the base flood elevation and the soil has been properly compacted. The LOMR-f officially removes the property from the Special Flood Hazard Area.

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 snowplows 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, an objective of the plan is to "Conduct an Agricultural Preservation Study to identify critical areas of county farmland and to justify their preservation at the local level."

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 Environment, Great Lakes, and Energy (EGLE) 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 September 2023, there were nine communities in Oceana County participating in the NFIP: City of Hart; villages of Hesperia and Pentwater; and townships of Benona, Claybanks, Ferry, Golden, Newfield, and Pentwater. This represents an increase of two since 2014. The townships of Greenwood, Hart, Otto, and Weare have "special flood hazard areas" identified but were not participating in the program.

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

The Michigan Drain Code (1956), administered by county drain commissioners, contains regulations regarding setbacks 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.

Appendix F includes a detailed listing of potential federal, state, and local funding sources for hazard-specific measures.

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 deveral 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 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, fireplaces, 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, 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 and patio 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 airconditioned environments. The use of fans to move air may help some, but recent research indicates that increased air movement may actually exacerbate heat stress in many individuals. However, air circulation is important and is limited for those unwilling to open windows because of security concerns. In these instances, inexpensive safety latches can be installed to allow windows to be opened far enough for air to circulate, while at the same time preventing them from being completely opened from the outside.

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

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

Critical facilities should be inventoried and proper insurance coverage should be reviewed (both types and amount, including deductibles and policy limits) and assured. Larger local governments can self-insure and absorb the cost of damage to one facility, but if many properties are exposed to damage, self-insurance can be a major drain on the treasury. Communities cannot expect federal disaster assistance to make up the difference. Under Section 406(d) of the Stafford Act “if an eligible insurable facility damaged by flooding is located in a [mapped floodplain] … and the facility is not covered (or is underinsured) by flood insurance on the date of such flooding, FEMA is required to reduce Federal disaster assistance by the *maximum* amount of insurance proceeds that would have been received had the buildings and contents been fully covered under a National Flood Insurance Program (NFIP) standard flood insurance policy”. Generally, the maximum amount of proceeds for a non-residential property is $500,000. In other words, the law expects public agencies to be fully insured as a condition of receiving federal disaster assistance.

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

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

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

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

Mandates are considered a last resort if information, funding, and incentives aren't enough to cause protective actions. Examples of retrofitting mandates are the requirements that downspouts be disconnected from sanitary sewer lines or that buildings in flood plains be elevated or brought up to current flood protection codes if "substantial" repair costs equal or exceed 50% of the value of the original building. Another possible mandate is to require less expensive hazard protection steps as a condition of a home improvement project. If a person were to apply for a permit for electrical work, the community could require that the service box be moved above the base flood elevation or that separate ground fault interrupter circuits be installed in the basement. An extreme mandate would be to "Fill your Basement with Water". For example, if the mandate is issued in an NFIP community during flood conditions under FEMA procedures, FEMA funds would later be made available to assist with repairs. However, those repairs would be less expensive since filling the basement would equalize pressure from saturated soils on building walls with watertight, near watertight, 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 2023, 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.

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
- 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 Environment, Great Lakes, and Energy). 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." More information is available at: https://www.michigan.gov/egle/about/organization/water-resources/sand-dunes/critical-dunes/maps. 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 outbuildings. Except for 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 and emergency 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 National Weather Service (NWS) is the prime agency for detecting meteorological threats, such as tornadoes and thunderstorms. The NWS uses a transmitter located at Wolf Lake in Lake County to reach receivers in Mason County. Severe weather warnings are transmitted through the NOAA Weather Radio System and, subsequently, through the Michigan State Police's Law Enforcement Information Network (LEIN). The network includes law enforcement agencies and emergency service providers such as "911" who then issue their own warnings. However, NWS coverage is done on a large scale and only considers if conditions are appropriate for formation of a tornado or thunderstorm. More site-specific and timely recognition is provided by sending out NWS trained spotters to watch and report on the weather when the NWS issues a watch or warning. Training for spotters is provided annually, usually in the spring, by Oceana County Emergency Management and NWS Grand Rapids. Alternatively, self-paced training can be obtained online by taking free courses through the COMET MetEd Program https://www.meted.ucar.edu/index.php and NOAA's JetStream online school for weather https://www.noaa.gov/jetstream/jetstream. Once training is completed, the county's Emergency Management office can be contacted to find out what can be done to become involved with the local spotter program.

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 disseminates 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
- 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
- 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
- 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. Topography also plays a role in outdoor warning effectiveness.
- 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 a few warning sirens currently in Oceana County, however, there is no organized "outdoor warning siren system." Municipalities that have been known to own a siren include: City of Hart; villages of New Era, Pentwater, Shelby and Walkerville; and townships of Crystal and Ferry. The current status and procedure for the operation of these sirens is unknown. There has been a significant shift in priority away from outdoor warning sirens in favor of mobile device alerts.

In areas not serviced by existing sirens, the most effective means of warning are mobile devices, radio, television, and cable systems (EAS); the EARS tone alert radios; and NOAA Weather Radios. The

Oceana County Office of Emergency Management may provide emergency and disaster early warning information on a request basis to special needs populations. 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.

Oceana County subscribes to the CodeRED notification system, whereby individuals can voluntarily sign up to receive emergency notifications from Oceana County Emergency Management. Promotion of this service to residents and visitors may be an extremely effective means to disseminate urgent information to the public. The web address for voluntary sign up for Oceana County is:
https://oceana.mi.us/departments/emergency-management/codered-community-notification-enrollment/

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. Certain requirements for each guideline may vary depending on the population of the community. More information on the program is available at https://www.weather.gov/stormready/. Oceana County is currently StormReady certified, and the Silver Lake and Charles Mears state parks are currently considered StormReady Supporters.

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)
- 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. Oceana County currently outsources GIS responsibilities to a third-party vendor. As such, the current setup is neither user-friendly nor readily accessible for use by county departments.

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 online 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 out to places and people where it is needed (such as information on wildfire hazards 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. District health department reports may also prove to be valuable resources for local hazard information.

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

C. Technical Assistance. Communities often have information that can assist homeowners. If they have FEMA's Flood Insurance Rate Maps and Flood Insurance Studies available, they can provide information to residents and can assist them in submitting requests for map amendments and revisions (Letter of Map Revision, or LOMR) when a building is not in the flood plain but a part of the property is. Lenders will notify applicants for federally insured loans if the involved property is in the flood plain and requires 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 Verisk (previously referred to as 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. https://www.isomitigation.com/bcegs/

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 and information into creation, update and review of 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. Drainage easements (allowing the planned and regulated public use of privately owned land for temporary water retention and drainage).

Action Item 11. Enforce the existing Michigan Drain Code requirement for "set-back" from the drain channel, thereby assuring proper carrying capacity of the drain.

Action Item 12. 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 13. 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 14. Enforce Michigan's Sand Dune and Shorelands Protection and Management Programs that control development in high-risk erosion areas and protect dunes.

Action Item 15. 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 16. 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 17. 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 18. Tree trimming and maintenance to prevent limb breakage and to safeguard nearby utility lines. (Ideal: Establishment of a community forestry program with a main goal of creating and maintaining a disaster-resistant landscape in public rights-of-way.)

Action Item 19. Develop policies or ordinances aimed at mitigating the impacts of drought conditions, such as: the promotion of planting crops tolerant of low moisture levels; partner with programs that promote soil health and monitor and preserve soil moisture; and prioritize or control water use during drought conditions.

Action Item 20. Maintain the Oceana County Community Wildfire Protection Plan (CWPP), and work to implement its recommendations to reduce the frequency and severity of wildfires.

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 21. 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 22. 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 23. 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 24. 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 25. Employ Firewise principles of proper grounds maintenance, equipment storage, vegetation clearance, and other techniques.

Action Item 26. Create firebreaks, wherein brush and other fuel are cleared away, in wildland areas.

Action Item 27. Identify and prioritize fuel reduction projects, especially for wildland-urban interface (WUI) areas.

Action Item 28. Encourage safe recreational burning practices and enforce any applicable ordinances that require burn permits.

Action Item 29. 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.

Action Item 30. Provide shelter for vehicles and equipment, or moving vehicles into garages or other covered areas before a storm hits.

Action Item 31. Protection or restoration of wetlands and natural water retention areas.

Objective 2.2. Use the most cost-effective approaches to protect existing buildings and sites from hazards.

Action Item 32. Encourage property owners and public facility operators to increase their property's resilience and resistance to natural hazards.

Action Item 33. 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 34. Dry floodproofing of structures within known flood areas (strengthening walls, sealing openings, use of waterproof compounds or plastic sheeting on walls).

Action Item 35. Wet floodproofing of structures (controlled flooding of structures to balance water forces and discourage structural collapse during floods). Elevation of flood-prone structures above the 100-year flood level.

Action Item 36. 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 37. Install lightning protection devices on the community's communications infrastructure and appropriate public facilities; and lightning grade surge protection devices on critical electronic components and equipment.

Action Item 38. Where appropriate, utilize buried or protected power and utility lines. (NOTE: Burial may sometimes cause additional problems and costs in cases where eventual cable breakages are harder to locate and more expensive to repair.)

Action Item 39. Use appropriate wind engineering measures and construction techniques (e.g. structural bracing, straps and clips, anchor bolts, laminated or impact-resistant glass, reinforced entry and garage doors, window shutters, waterproof adhesive sealing strips, and interlocking roof shingles) to strengthen public and private structures against severe wind damage.

Action Item 40. Proper anchoring of manufactured homes and exterior structures such as carports and porches.

Action Item 41. Removable barriers for shoreline protection during high-water periods.

Objective 2.3. Maximize insurance coverage to provide financial protection against hazard events.

Action Item 42. Assure insurance coverage on properties and obtain additional insurance coverage as appropriate (sump pump failure, sewer back-up, wildfire, dam failure, hail etc.).

Action Item 43. Encourage and assist municipalities that are at risk of 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 44. 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 45. 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 46. Utilize federal programs; such as but not limited to FEMA's Hazard Mitigation Assistance Program, Flood Mitigation Assistance Program, and Building Resilient Infrastructure and Communities (BRIC); to address community needs for hazard mitigation.

Action Item 47. 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 48. 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 49. Establish a cost sharing program to encourage low cost (for example 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 50. 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 51. Identify state and federal funding and technical assistance for dam/spillway repairs.

Action Item 52. Investigate the availability of resources and need for creating firebreaks and the availability of resources for acquiring land, as necessary, to achieve continuity of 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 53. 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 54. Implement improvements to the warning system as deemed necessary for improving coverage and effectiveness.

Action Item 55. Maintain a description of the public warning process and coordinate actions in a section of the Emergency Action Guidelines (EAG).

Action Item 56. Increase the coverage and use of NOAA All-Hazards radios and comparable device-based notifications.

Action Item 57. 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 58. 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 59. 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 60. Encourage electrical utilities to place power lines underground wherever possible, but especially when upgrading them or running power to new developments.

Action Item 61. 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 62. Install back-up generators, as needed for short-term relief from power failures, at critical facilities such as sewage pump stations, hospitals and medical centers, nursing home facilities, schools, shelters, and governmental facilities.

Action Item 63. Bury water/sewer lines below the frost line or insulate and maintain lines to protect against ground freeze.

Action Item 64. Increase the function and capacity of sewage lift stations and treatment plants (installation, expansion, and maintenance), including possible separation of combined storm/sanitary sewer systems (if appropriate), higher engineering standards for drain and sewer capacity, an/or the expansion of infrastructure to higher capacity.

Action Item 65. Establish safe and appropriate locations for temporary debris disposal sites.

Action Item 66. 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 67. Continue 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.

Action Item 68. Make roads more flood-resistant through better drainage and/or stabilization/armoring of vulnerable shoulders and embankments.

Action Item 69. Employ techniques of erosion control within the watershed area (proper bank stabilization, techniques such as planting of vegetation on slopes, creation of terraces on hillsides, use of riprap boulders and geotextile fabric, etc.).

Objective 3.3. Build and support local capacity, commitment and partnerships to continuously become less vulnerable to hazards.

Action Item 70. Adopt this Hazard Mitigation Plan by official resolution to assure both consideration of natural hazards and eligibility for FEMA Hazard Mitigation Assistance Grants.

Action Item 71. 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 72. 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 73. 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 74. 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 75. Design and plan for water supply infrastructure systems that include a consideration of, and are more resistant to, drought events.

Action Item 76. Continue to maintain, and acquire as necessary, fire-fighting and rescue equipment, including specialized equipment for limited access areas (such as the Lake Michigan shoreline), thermal imaging devices, and special equipment for water and ice rescues.

Action Item 77. 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 78. Coordinate with the Conservation District, local watershed councils, and lake associations to maintain healthy, free-flowing watercourses with minimal erosion and sedimentation, and to restore / preserve wetlands.

Action Item 79. Coordinate with fire departments to promote "Firewise" program recommendations and strategies to property owners, especially those within wildland/urban interface areas.

Action Item 80. Meet the criteria to become (or remain, if already recognized) 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 81. 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 82. Designate amateur radio operators to relay information on "immediately dangerous" weather situations and storm damage reports to the NWS, Central Dispatch, and/or Emergency Management.

Action Item 83. Create a volunteer outreach program, whereby a network of individuals regularly check on the needs and conditions of elderly, disabled, homebound, and other vulnerable populations during and after severe weather conditions; deliver goods / assistance to them; and / or disseminate information about emergency shelters.

Action Item 84. Utilize NWS-trained weather spotters to watch for developing storms, take flood water measurements, and monitor stream conditions.

Action Item 85. 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 86. 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 87. 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 mobile device notifications, fire stations, local radio stations and utilities.

Action Item 88. 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 89. 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 90. Provide local schools with information for the classroom regarding severe weather hazards and how families can prepare for and respond to them.

Action Item 91. Incorporate safety strategies for severe weather events in driver education classes and materials.

Action Item 92. 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 93. 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 94. Maintain a list of local and Michigan-based recovery “vendors” for post-disaster goods and services to support disaster recovery efforts.

Action Item 95. Identify and advertise available heated and cooled shelters to the elderly and other vulnerable populations who may be at risk during extreme temperature events and power outages.

Action Item 96. 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 97. 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 98. 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 99. 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 100. 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 101. Notify communities of hazard mitigation funds, as they become available, and assist them in applying for funds.

Action Item 102. 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 103. 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 104. 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 105. 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 106. 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 107. Utilize 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 108. 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.

In addition, the following options are presented as additional hazard mitigation opportunities for public health emergencies, which are listed in the Michigan Hazard Analysis:

- Maintaining proper levels of PPE for healthcare workers and first responders, with additional supplies for long-term care facilities
- Immunization programs to vaccinate against communicable diseases
- Improving ventilation techniques in areas, facilities, or vehicles that are prone to crowding or that may involve exposure to contagion or noxious atmospheres
- Maintaining community water and sewer infrastructure at acceptable operating standards
- Providing back-up generators for water and wastewater treatment facilities to maintain acceptable operating levels during power failures
- Demolition and clearance of vacant condemned structures to help prevent vermin infestation
- Adequate community clinics and school health services
- Brownfield and urban blight clean-up activities
- Proper location, installation, cleaning, monitoring, and maintenance of septic tanks
- Separation of storm and sanitary sewer systems
- Spraying programs to properly control mosquito populations
- Updated Continuity of Operations (COOP) plans and alternative “work from home” schedules

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. Lastly, it should be noted that some of the potential action items are already being implemented and were consequently not considered for implementation.

The next chapter presents a schedule of recommended action items for implementation. For each measure, the plan identifies basic details needed 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 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 (2015) included 20 action items for implementation and then assigned to the appropriate jurisdictions within Oceana County. This chapter contains a review of the 2015 Action Agenda, as well as a revised Action Agenda for the 2024-2028 period.

Review of Hazard Mitigation Progress

To identify any mitigation progress that had been made on the 2015 Action Agenda, discussions were held with Oceana County Emergency Management, county departments and the LEPC. In addition, eight individuals were invited to comment on hazard mitigation progress. These were individuals that participated in the 2022 Community Hazards survey and indicated interest in additional involvement in the hazard mitigation planning process.

The results of the Action Agenda review are compiled into the following table. The "Status Report" table summarizes the status of items on the 2015 Action Agenda, and reports any additional comments or information provided by stakeholders.

2015 Action Agenda
STATUS REPORT

2015 Action Items	Status in 2023				Comments
	Complete	Ongoing or In-Progress	Pending	Incomplete or Unknown	
#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.			x	x	**Oceana County Building Department:** No plans to contact ISO. ***Update Analysis: This remains viable option for supporting improvements to building code and enforcement.***
#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.		x			**Oceana County Planning Commission:** The county master plan includes discussion of hazard mitigation, reference to natural hazards, and a recommendation to use and refer to the county's hazard mitigation plan. ***Update Analysis: This remains a top priority to promote consideration of natural hazards and promote hazard mitigation at local levels of government.***
#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.				x	**Oceana County Building Department**: Funds have not been allocated for any of these listed projects. **Oceana County Emergency Management**: Funding is a limitation. ***Update Analysis: This remains a top priority to promote consideration of natural hazards and promote hazard mitigation at local levels of government.***
#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).				x	**WMSRDC:** Oceana County is not responsible for zoning, therefore this item mainly applies to sub-county units of government. The county's Planning Commission should promote implementation of this item through comments and recommendations. ***Update Analysis: Planning and zoning remain some of the most effective tools for mitigating natural hazards in Oceana County. This action will remain in the 2024 plan to draw attention to considering hazards in zoning processes.***
#14 - Consider regulation of development in the hydraulic shadows of dams (where flooding would occur if there was a severe dam failure).				x	**Oceana County Building Department**: Not sure if this is applicable any longer - Can we restrict where others have been able to build below Lake Holiday (Golden Township)? ***Update Analysis: Consideration of possible dam failure is important as Oceana County has dams with significant or high hazard potential. This item is important to encourage local vigilance when new development or redevelopment is considered in those areas.***

#25 - Maintain the Oceana County Community Wildfire Protection Plan (CWPP), and work to implement its recommendations to reduce the frequency and severity of wildfires.	x				**Oceana County Emergency Management**: Updated 2022; not reviewed annually. ***Update Analysis: Oceana County should prioritize upkeep and utilization of the CWPP as a means of securing state funding for wildfire mitigation.***
#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.		x			**Oceana County Building Department**: This should be ongoing with the Townships that are not participating so far. ***Update Analysis: Some progress has been made to enlist additional community participation in the NFIP since 2015. There remain 4 townships with SFHA that do not participate. This item will remain on the revised Action Agenda.***
#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.				x	**Oceana County Emergency Management**: In theory, this seems like a good idea. Not sure, what flood loss reduction activities would be beneficial or attainable? Remains valid, though may not be realistic for many communities. ***Update Analysis: This is a viable mitigation option for advancing flood mitigation, however for communities with a small number of insurance policies it may be difficult to justify the effort. This item will be removed from the Action Agenda to place greater focus on enrolling additional communities into the NFIP.***
#42 - Assess the need for and use of state and federal funding and technical assistance for dam / spillway repairs.				x	**Oceana County Drain Commissioner**: This action item no longer seems applicable or attainable as no state or federal funding exists for dam repairs or spillway repairs. Any recent funding was for high hazard dams such as Edenville and Sanford. **Oceana County Emergency Management**: Could be applicable to Crystal Valley dam. **Survey Response Phil Morse (county commissioner):** Dams are past their expected life and need to be replaced or removed. ***Update Analysis: Oceana County has dams with significant or high hazard potential. This item will remain in the revised Action Agenda.***
#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.		x			**Oceana County Emergency Management**: We should be testing. Using new technologies: IPAWS monthly proficiency testing and developing templates for quick deployment; Quarterly testing through Blue Lake public radio. ***Update Analysis: This is an ongoing priority of Oceana County Emergency Management.***
#45 - Implement improvements to the warning system as deemed necessary for improving coverage and effectiveness.		x			**Oceana County Emergency Management**: Increasing use and promotion of our CodeRed public mass notification app. **David Nobles:** Most of the weather warning sirens are no longer operational. The county has alert systems available over the phone and cell phones which give better information. Perhaps an increase in awareness would increase the awareness of and participation in these systems. ***Update Analysis: This is an ongoing priority of Oceana County Emergency Management.***
#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.			x		**Oceana County Emergency Management**: The County has applied for a grant to install backup generators in all County buildings. ***Update Analysis: Securing backup power remains a priority for Oceana County government facilities. This item will remain on the Action Agenda to support pending efforts to acquire generators.***
#56 - Assure the county has adequate personnel and equipment (road barriers, sand bags, portable lighting, snow plows, etc.) to respond to widespread weather events.	x				**Oceana County Road Commission**: Have increased its staffing and equipment levels over the years. **Grant Township**: The fire department has made investments to improve wildfire response capabilities. ***Update Analysis: Progress has been made by the road commission. This item will not be carried into the revised Action Agenda.***
#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.		x			**Oceana County Road Commission**: Making these improvements as funds allow. ***Update Analysis: Update Analysis: This is an ongoing priority for Oceana County.***

#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.		X			**Oceana County Emergency Management**: Sherriff Depts (Mason/Oceana) Special Response Team. ***Update Analysis: Coordination and communication is a priority of Oceana County Emergency Management.***
#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.		X			**Oceana County Emergency Management**: County fire departments are joining the Michigan Mutual Aid Box Alarm System (MABAS) to increase access to resources from across the State. (Departments joining resources). Volunteer firefighter levels are decreasing across the country including here in Oceana County. ***Update Analysis: This item will remain on the Action Agenda to support the needs of local fire departments.***
#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.		X			**Oceana County Emergency Management**: Mason and Oceana Counties share a RACES group. **David Nobles:** RACES has been replaced by AuxCom which is a FEMA discipline. The Oceana County amateur radio group is now known as Mason Oceana Amateur Radio Emergency Services. We maintain three repeaters, the main repeater is in Elbridge and is now upgraded to Fusion which allows both analog and digital. The second repeater is on Star Hill and is also Fusion allowing both digital and analog. This repeater is connected to WiresX which allows communication around the world on its internet pathway. The third repeater is in Mason County on the North side of the pumped storage project. This is at the current time analog only and has limited capabilities toward the South which would be Oceana County. We have two AuxCom trained individuals one of which is State of Michigan Certified. ***Update Analysis: This item is being addressed and will no longer be included in the Action Agenda.***
#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.		X			**Oceana County Emergency Management**: Mason and Oceana counties started having annual public forums for "Limited Access Dune Communities" which includes promotion of Firewise communities program. ***Update Analysis: Education & awareness outreach is a priority for Oceana County Emergency Management. This item will remain an ongoing activity to distribute information on natural hazards before and after impactful events.***
#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.		X			**Oceana County Emergency Management**: Continuing to conduct monthly test of the public warning system through Blue Lake Public Radio. Preparedness flyers, CodeRed Flyers out to public events and targeted groups. ***Update Analysis: This is an ongoing priority for Oceana County Emergency Management.***
#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.				X	***Update Analysis: Engagement and communication with local governments is an important step for encouraging hazard mitigation implementation.***

Revised Action Agenda

Much of the 2015 Action Agenda was not implemented directly under the intent of "hazard mitigation." Still, some progress was documented. This may indicate that more outreach and communication is needed to encourage buy-in and participation in hazard mitigation. Although most items on the Action Agenda remained priorities as of the time this plan was updated, three items were removed and three were added:

Removed Action Items:

- Action Item #35 regarding Community Rating System (CRS) participation
- Action Item #56 regarding road personnel and equipment
- Action Item #69 regarding amateur radio

Added Action Items:

- Action Item #78 regarding healthy, free-flowing watercourses
- Action Item #80 regarding StormReady certification
- Action Item #107 regarding coordination with Red Cross for shelter identification and certification

The action items highlighted in this section were selected from the list of potential hazard mitigation actions presented in Part G and are presented below as the action agenda for 2024-2028. The selection process was guided by criteria described in Part H and feedback gathered through the 2015 Action Agenda progress review. All items on the revised Action Agenda are considered to be of the highest priority. Implementation of these action items may be appropriate on the county level and / or the local level. The "List of Hazard Mitigation Actions Applicable to Governmental Units" at the end of the chapter assigns action items to appropriate jurisdictions within Oceana County. Each action item includes the following information to help facilitate implementation:

Priority Level

All identified action items are considered priorities within this Hazard Mitigation Plan. In order to help structure implementation of the Plan, a further prioritization of high, medium, or low is assigned to each measure. This is intended to convey a sense of importance relative to the other action items from a countywide perspective.

Timeframe

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

Applicable Governmental Unit(s) / Responsible Person (s)

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

Potential Technical / Financial Assistance

Identifies common sources of technical and financial assistance to supplement community resources and available funding. In many cases, identified parties will provide referrals to currently available or specialized assistance and / or guidance. Detail provided is not intended to be exhaustive because opportunities for assistance may come and go; such as following a disaster declaration. **A detailed listing of potential federal and state funding sources for hazard-specific measures is included in Appendix F.**

Comments

Additional details or helpful context about the action item.

2023 Action Agenda

Action Item 2. Contact Verisk (previously referred to as 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. https://www.isomitigation.com/bcegs/

Priority Level: Low

Timeframe: 2024-2025

Applicable Governmental Unit(s)/Responsible Person(s):
Oceana County Building Official; Grant Township; Newfield Township; Otto Township.

Potential Technical/Financial Assistance Sources:
Local building officials; Michigan State University Extension (MSUE).

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 and information into creation, update and review of 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: Medium

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:
West MI Shoreline Regional Development Commission (WMSRDC); MSUE.

Comments:
This basic hazard mitigation action remains an ongoing priority action item, as land use planning is one of the best tools for mitigating natural hazards in this area. Land use planning helps provide rationale for local rules and policies, so it is important to integrate principals of hazard mitigation into this process to protect new development. 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 reviewing, 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 (Planning Commission, Road Commission, Drain Commission, etc.).

Potential Technical/Financial Assistance Sources:
WMSRDC.

Comments:
This action item is already being implemented on a regular basis, although not always under the guise of hazard mitigation. This action item may help serve as a "common thread" amongst county departments, utility providers, etc. to ensure that infrastructure investments are coordinated, sustainable, and hazard resistant.

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:
MSUE.

Comments:
This basic hazard mitigation action remains an ongoing priority action item, as zoning is one of the best tools for directing development away from hazard-prone areas. 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. 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 15. 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: 2025

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 Department of Environmental Quality (MDEQ).

Comments:
OCEM should coordinate with local governments to identify areas that would be at high risk in the event of a severe dam failure. Local governments will be advised to consider limiting new development or redevelopment in those areas to minimize damage potential in the event of a dam failure.

Action Item 20. 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: Medium

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 (USFS); Michigan Department of Natural Resources (MDNR); MSUE.

Comments:
Oceana County should prioritize upkeep and utilization of the CWPP to identify wildfire needs/priorities, to facilitate coordination with state and federal forestry agencies and to remain eligible for wildfire mitigation funding.

Action Item 43. 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: 2024

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 NFIP participation include the townships of Colfax, Greenwood, Hart, Otto, and Weare.

Action Item 51. Identify state and federal funding and technical assistance for dam/spillway repairs.

Priority Level: Medium

Timeframe: Annually

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

Potential Technical/Financial Assistance Sources:
MDEQ.

Comments:
OCEM will coordinate with dam owners 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 53. 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: High

Timeframe: Annually

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

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

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

Action Item 54. Implement improvements to the warning system as deemed necessary for improving coverage and effectiveness.

Priority Level: Medium

Timeframe: Following evaluation of public warning system (Action Item 53), and as funding becomes available

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

Priority Level: High

Timeframe: As funds become available

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

Potential Technical/Financial Assistance Sources:
MSP-EMHSD; Hazard Mitigation Grant Program (HMGP).

Comments:
Though many facilities in Oceana County currently have generators, 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 67. Continue 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/Annually

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

Potential Technical/Financial Assistance Sources:
Michigan Department of Transportation (MDOT); Oceana County Conservation District; Michigan Department of Agriculture (MDARD) Intercounty Drain Program.

Comments:
OCEM, in coordination with the LEPC members, will identify opportunities to incorporate hazard mitigation provisions into management programs to protect new and existing infrastructure.

Action Item 72. 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.

Potential Technical/Financial Assistance Sources:
MSP-EMHSD.

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

Action Item 76. 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, USDA Rural Development.

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 78. Coordinate with the Conservation District, local watershed councils, and lake associations to maintain healthy, free-flowing watercourses with minimal erosion and sedimentation, and to restore / preserve wetlands.

Priority Level: High

Timeframe: Annually

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

Potential Technical/Financial Assistance Sources:
MSP-EMHSD; US Fish & Wildlife Service (USFWS); MDNR; Michigan Department Environment, Great Lakes, and Environment (EGLE); Watershed Protection and Flood Prevention Program (WFPO); EPA.

Comments:
OCEM will utilize the Oceana County LEPC to identify areas where opportunities exist for cooperation between mitigation, infrastructure, and environmental projects. Culvert repairs / replacements provide a terrific example of where the interests of multiple organizations overlap. This action item is a new addition to the Action Agenda.

Action Item 80. Meet the criteria to become (or remain, if already recognized) a NWS-approved "Storm Ready" community.

Priority Level: Medium

Timeframe: 2024, then every 2 years

Applicable Governmental Unit(s)/Responsible Person(s):
OCEM; Silver Lake State Park; Mears State Park.

Potential Technical/Financial Assistance Sources:
National Weather Service Grand Rapids.

Comments:
To be recognized as StormReady, a community must: Establish a 24-hour warning point and emergency operations center; Have more than one way to receive severe weather forecasts and warnings and to alert the public; Create a system that monitors local weather conditions; Promote the importance of public readiness through community seminars; and Develop a formal hazardous weather plan, which includes training severe weather spotters and holding emergency exercises. This action item is a new addition to the Action Agenda.

Action Item 86. 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 87. 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 mobile device notifications, 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:
Hazard Mitigation Grant Program; MSP-EMHSD; Public and private utilities; Community-based organizations.

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 88. 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: Ongoing/Annually

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

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

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

Action Item 108. 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.

Priority Level: Low

Timeframe: Annually

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

Potential Technical/Financial Assistance Sources:
Red Cross; Volunteers; Community-based organizations.

Comments:
OCEM will support and facilitate efforts of the Red Cross to identify, contact, and certify shelter facilities. Local leaders can also facilitate this process and distribute shelter information/awareness to residents and visitors. This is a new action item.

2024-2028 Action Agenda

List of Hazard Mitigation Actions Applicable to Governmental Units

ACTION AGENDA **Action Item**	BCEGS	LAND USE PLANNING	CAPITAL IMPROVEMENTS	ZONING ORDINANCES	HYDRAULIC SHADOW	IMPLEMENT CWPP	NFIP	DAM/SPILLWAY ASSISTANCE	WARNING SYSTEM EVALUATION	WARNING SYSTEM IMPROVEMENTS	GENERATORS	ROAD/BRIDGE/CULVERT MAINTENANCE	COORDINATED RESPONSE PLANS	EMERGENCY RESPONSE EQUIPMENT	WATER/WETLAND MANAGEMENT	STORM READY	HAZARD AND MITIGATION INFO.	PREPAREDNESS AND SAFETY INFORMATION	MITIGATION OUTREACH	SHELTER DESGNATIONS
Action Item #	**2**	**7**	**8**	**9**	**15**	**20**	**43**	**51**	**53**	**54**	**62**	**67**	**72**	**76**	**78**	**80**	**86**	**87**	**88**	**108**
APPLICABLE LOCAL GOVERNMENT																				
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 hazard mitigation plans are dynamic entities. Communities grow and risks change over time. Plans must evolve to be effective and to avoid becoming obsolete. Therefore, planning shouldn't stop once a plan is initiated. This 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 timelines for the various tasks.

The system for plan maintenance (monitoring, evaluating, and updating the plan) would ideally be the responsibility of a locally funded Hazard Mitigation Coordinator, with support from the Oceana County Office of Emergency Management 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 county's Emergency Manager with assistance from the LEPC.

Monitoring

The Oceana County Office of Emergency Management will be responsible for monitoring the implementation of the Hazard Mitigation Plan at the end of each calendar year, as work schedules allow. Such monitoring should include tracking of the following throughout the year: occurrence of impactful hazard events, local government plan adoptions, applications for hazard mitigation funds, grant awards, and project progress and implementation. In addition to county staff and LEPC knowledge, other sources of this information would be obtained through regular communication with local governments and through discussions during regular LEPC meetings, which are open to the public. Monitoring should certainly include tracking of disaster and emergency declarations made at the local, state, and federal levels.

Evaluating

The Emergency Management Coordinator would prepare and present a brief annual progress report for the LEPC at its first meeting of the year. The following outline may be followed 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 should also be shared with the Oceana County Board of Commissioners, the Oceana County Townships Association, and posted for public access on the county's Emergency Management website. In the event that workloads prohibit the preparation of an annual report, a more streamlined version (perhaps verbal) would be presented to the LEPC and County Board of Commissioners. This communication is essential for maintaining awareness and support for hazard mitigation, as well as cultivating partnerships for project implementation.

Updating

The county would comply with the FEMA requirement that the plan be reviewed every five years and updated if necessary. This work is the responsibility of the Oceana County Office of Emergency Management, at the direction of Oceana County Administration and with assistance from the LEPC. Projects that were completed over that time would be replaced with new ones. Priorities would be reassessed. Development patterns and changing environmental patterns would be analyzed to assess the relevance of the existing hazard mitigation plan. Lastly, hazard mitigation goals, priorities and information contained in the most current edition of the Michigan Hazard Mitigation Plan and Michigan Hazard Analysis 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 adjusted. There may even be new hazards that warrant consideration. Evaluations of the plan should also assess its effectiveness and if there are limitations (financial, legal, coordination, etc.) to implementing the Action Agenda.

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 evaluation and update 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 on the WMSRDC website, www.wmsrdc.org. The website presents an on-going opportunity for the public to review and comment on the plan, its implementation, and its update. All comments received via the WMSRDC website will be forwarded to the Emergency Management Director who will receive all other forms of correspondence. 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, conversations with communities and stakeholders, 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, these entities have the opportunity to comment on local land use plans and are encouraged to do so in order to promote more coordinated land use planning.

Appendix A:
COMMUNITY PROFILES

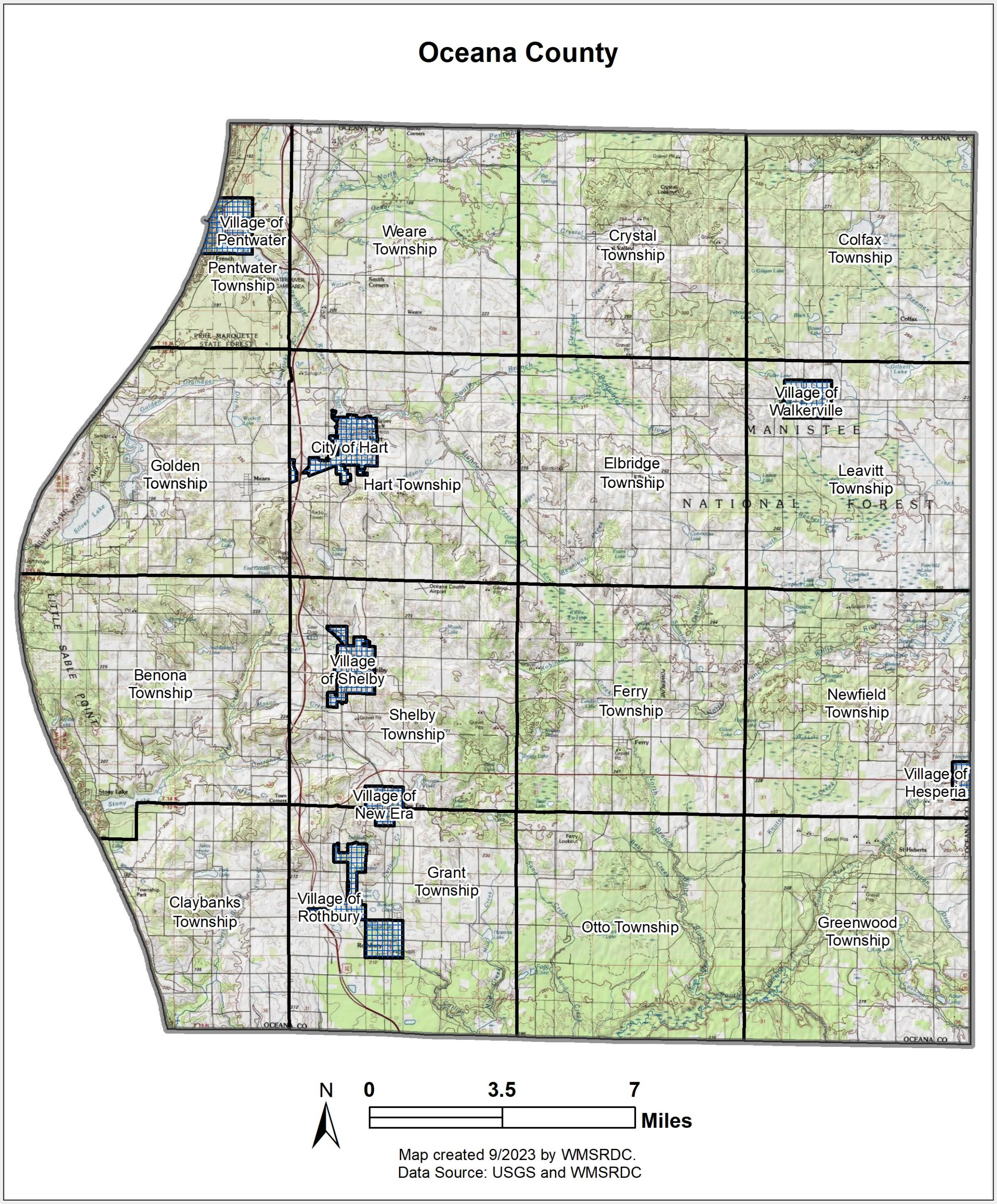
OCEANA COUNTY Community Profile			
1. Physical Features			
Lakes (acres)	Silver (690), Pentwater (431), Stony (276), McLaren (271), Hart (240)		
Rivers	Pentwater, Pere Marquette, White		
Cities	Hart		
Villages	Hesperia, New Era, Pentwater, Rothbury, Shelby, Walkerville		
Large public land areas	Huron Manistee National Forest; Pentwater State Game Area; Silver Lake State Park; Mears State Park; Hart-Montague Trail State Park		
Other features	Lake Michigan shoreline; Coastal dune environment; Freshwater estuary & drowned river mouth (Pentwater River)		
2. Land Cover: 2019 National Land Cover Dataset			*Source: Multi Resolution Land Characteristics Consortium*
% Developed	3.42 %	% Forests	16.59 %
% Agriculture	12.56 %	% Wetland	6.22 %
3. Land Value: 2022 Real and Personal Equalized Valuations			*Source: Oceana County Equalization Report 2022*
Agricultural	$194,802,808	Industrial	$41,664,600
Commercial	$103,825,918	Residential	$1,527,235,392
Total personal	$68,214,200		
4. Population Characteristics			*Source: 2021 American Community Survey 5-year Estimates, unless noted*
Population, 2021	26,884	% with disability	16.2 %
% change 2010 to 2020*	+ 0.3 %	% in poverty	13.0 %
Median age	43.5	ALICE households, 2021**	31 %
% under 18 years old	22.4 %	Avg. daily commute	23.4 minutes
% over 65 years old	20.7 %		
** US decennial census figures*	***Asset Limited, Income Constrained, Employed (United Way of Michigan)*		
5. Peak Seasonal Population			*Peak seasonal population = population + (hotel rooms x2) + (camp/RV sites x4) + (vacant houses x6)*
Hotel rooms*	536	Vacant housing units**	5,802
Campground & RV sites*	3,494	Peak seasonal population	76,744
** WMSRDC research conducted in 2022*	*** 2021 American Community Survey 5-year Estimates*		
6. Housing			*Source: 2021 American Community Survey 5-year Estimates*
Housing units	15,591	Single units	12,184
Occupied housing units	9,789	Multi-units in structure	647
Vacant housing units	5,802	Mobile homes	2,749
7. Public Services			
Fire	- 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.		
Police	- 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.
Wastewater	- City of Hart - Villages of Hesperia, New Era, Pentwater, Shelby, Walkerville
Community Water Systems	- City of Hart - Villages of Hesperia, Pentwater, Shelby - Greenlawn Mobile Home Court (Rothbury Village) - Oceana Acres (Hart Twp) - Golden Pond Estates (Golden Twp) - Hylander Valley (Weare Twp)
Public transportation	- *None identified*
Other	Oceana County Jail, 216 Lincoln St.
8. Critical Infrastructure	
Major roads	- Oceana Drive - B-15, B-86 - M-20, M-82, M-86, M-120 - US-31
Railroads	- *None identified*
Bridges	- M-20: White River North Branch, White River South Branch, US-31 overpass - US-31: Pentwater River South Branch, Pentwater River North Branch - US-31 Business Route: Bass Lake, Pentwater River North Branch - B-15: Pentwater Lake (Longbridge Rd) - Oceana Drive: Pentwater River North Branch, Hart Lake/Pentwater River South Branch
Airports	Oceana County Airport (Hart-Shelby), 1805 W. Baseline Rd.
Shelters	*Shelters surveyed by Red Cross:* - St. Joseph Catholic Church Hall, 2349 Jackson Rd (Weare Twp) - New Era Christian School, 1901 Oak Ave (New Era Village) - Pentwater Public Schools, 600 E Park St (Pentwater Village) - St. Vincent Catholic Church, 637 E 6th St (Pentwater Village) - Rothbury Community Church, 2440 W Winston Rd (Rothbury Village) - Shelby Middle School, 525 N State St (Shelby Village) - Walkerville Wesleyan Church, 144 S. Hamon (Walkerville Village) *Shelters that need to be surveyed by Red Cross:* - Congregational United Church of Christ, 408 S. State St., Hart, MI 49420 (Hart) - Elbridge Community Church, 2370 N 136th Ave., Hart, MI 49420 (Elbridge Twp) - Elbridge Township Hall, 2266 E. Polk Rd., Hart, MI 49420 (Elbridge Twp) - Golden Township Hall, 5527 W. Fox Rd, Mears, MI 49436 (Golden Twp) - Hart High School, 300 W. Johnson St., Hart, MI 49420 (Hart) - Hart Middle School, 308 W. Johnson St., Hart, MI 49420 (Hart) - Hart United Methodist Church, 308 State St., Hart, MI 49420 (Hart) - Hart VFW, 802 State St., Hart, MI 49420 (Hart) - Hart Wesleyan Church, 3400 Polk Rd., Hart, MI 49420 (Hart) - New Era Christian Reformed Church, 1820 Ray Ave, New Era, MI 49446 (New Era) - New Era Elementary, 2752 Hillcrest, New Era, MI 49446 (New Era) - New Era Reformed Church, 4775 First St., New Era, MI 49446 (New Era) - Pentwater Park Place, 310 Rush St., Pentwater, MI 49449 (Pentwater) - Pentwater VFW Hall, 8440 N. US 31, Pentwater, MI 49449 (Pentwater Twp) - Shelby High School, 641 N. State St., Shelby, MI 49455 (Shelby) - Shelby United Methodist Church, 68 E. Third St., Shelby, MI 49455 (Shelby) - St. Gregory's Church, 316 Peach St., Hart, MI 49420 (Hart) - Walkerville High School, 145 Lathrop, Walkerville, MI 49459 (Walkerville)
Schools	- Hart High School, 300 W. Johnson St. - Hart Middle School, 308 W. Johnson St.

	- Spitler Elementary School (Hart Public Schools), 302 W. Johnson St. - Diman-Wolf Early Childhood Center, 306 W. Johnson St. - New Era Christian Preschool, 1901 Oak Ave. - New Era Elementary (Shelby Public Schools), 2752 Hillcrest Dr. - Oceana Christian School, 3258 N. 72nd Ave. - Pentwater Public School (Elementary, Middle, and High School), 600 E. Park - Shelby High School, 641 N. State St. - Shelby Middle School, 525 N. State St. - Thomas Read Elementary (Shelby Public Schools), 155 6th St. - Shelby Early Childhood Center, 155 6th St. - Walkerville Elementary/Middle/High School, 180 E. Main St.
Community medical facilities, Hospitals	- Hart Family Medical Center, 611 E. Main St. (Hart) - Memorial Family Care Center, 2481 N. 72nd Ave. (Hart) - Trinity Health Shelby Hospital, 72 S. State St. (Shelby) - Northwest Michigan Health Services, 119 S. State St. (Shelby)
Ambulance service	- Emergency Medical Services, 3988 N. Oceana Dr. (Hart Township) - Emergency Medical Services, S. State St (Shelby Village)
Dams	Crystal Valley Dam, Foster Lake Dam, Gales Pond Dam, Hart Lake Dam, Lake Holiday Dam, Pond Dam (Hesperia), Silver Lake Level Control Structure, Upper Silver Lake Dam
9. Economic Assets	
Major employers	- Arbre Farms (Colfax Township) - Burnette Foods (New Era Village) - Big Hart Brewery (Hart City) - County Dairy (Shelby Township) - Double JJ Resort (Grant Township) - GHSP (Hart City) - Great Lakes Packing (Hart City) - Hallack Contracting (Hart City) - Hansen Foods (Hart City) - Hart Area Schools (Hart City) - Hometown Pharmacy (Hart, Shelby, New Era) - Media Technologies (Shelby Village) - Michigan Freeze Pack (Hart City) - Oceana County (Hart City) - Peterson Farms (Hart Township) - Seneca Foods / Gray and Company (Hart City) - Shelby Public Schools (Shelby Village) - Trinity Health Shelby Hospital (Shelby Village)
Power generation	Hart Lake Hydroelectric Dam
Electric transmission	Consumers Energy (townships of Crystal, Elbridge, Ferry, Grant, Greenwood, Hart, Leavitt, Newfield, Weare)
Pipelines	- Natural gas pipeline (townships of Elbridge, Grant, Hart, Leavitt, Shelby, Weare) - Natural gas pipeline & 30,000 gal storage tank, serving Lake Holiday & Upper Silver Lake (Golden Township)
Commercial transportation	- *None identified*
10. Other Assets, Infrastructure, etc.	
Community facilities	*Refer to individual community profiles*
Festivals	*Refer to individual community profiles*
Historic Sites	- Auto Tourist Camps/John Gurney Park, 300 Griswold St (Hart City) - Hart Historic Industrial District, 215-216 Lincoln St. & 109 Union St. (Hart City) - Daniel Weaver House, 84 S. Cook St. (Hesperia, Newago County) - Benona Township Hall, 7169 West Baker Road (Benona Twp) - Little Point Sable Light Station, Little Sable Point (Benona Twp)

	- Jared H Gay Log House, 128th Ave (Crystal Township) - Charles Mears Silver Lake Boardinghouse, SE Corner of Lighthouse & Silver Lake Channel rds. (Golden Twp) - US-31 (Old) Pentwater River Bridge, Oceana Dr. over Pentwater River (Hart Township) - Navigation Structures at Pentwater Harbor (Pentwater) - Veterans Day Storm-Graveyard of Ships Informational Designation, 421 S. Hancock St. (Pentwater) - Dumaw Creek Site (Pentwater Township) - Green Quarry Site (somewhere near Pentwater)

Land Use and Natural Features Map (USGS Quad.)

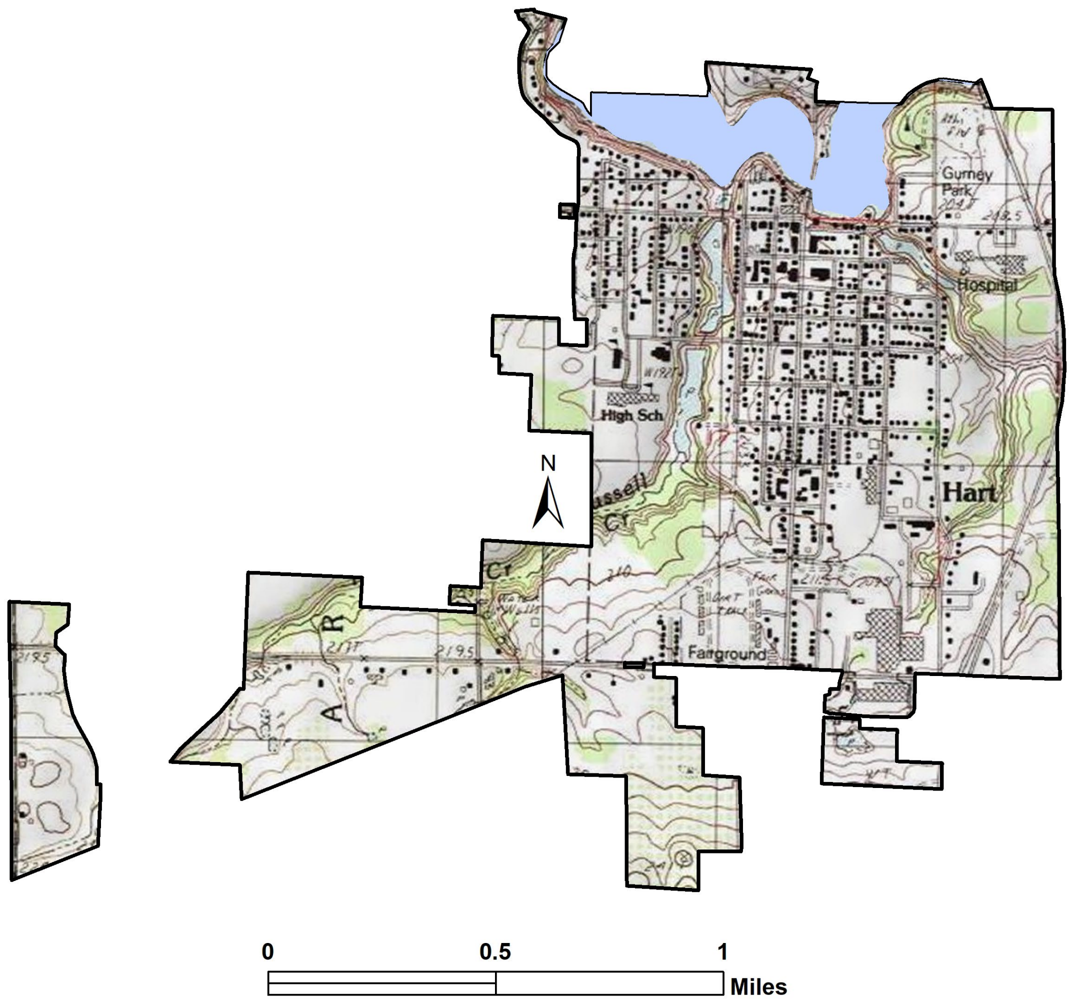


HART CITY
Community Profile

1. Physical Features			
Lakes	Hart (240)		
Rivers	Pentwater		
Notable features	- Hart-Montague Trail State Park - Gurney Park - Oceana County Fairgrounds - Historic downtown layout - County seat		
Land description	Mix of residential, commercial, and industrial uses		
2. Land Value: 2022 Real and Personal Equalized Valuations			*Source: Oceana County Equalization Report 2022*
Agricultural	$0	Industrial	$8,134,100
Commercial	$18,011,100	Residential	$32,044,500
Total personal	$3,115,100		
3. Population Characteristics			*Source: 2021 American Community Survey 5-year Estimates, unless noted*
Population estimate, 2021	2,193	% with disability	20.8 %
% change 2010 to 2020*	-3.4 %	% in poverty	18.8 %
Median age	37.3	ALICE households, 2021**	31 % (county)
% under 18 years old	27.0 %	Avg. daily commute	16.2 minutes
% over 65 years old	16.8 %		
** US decennial census figures*	***Asset Limited, Income Constrained, Employed (United Way of Michigan)*		
4. Peak Seasonal Population			*Peak seasonal population = population + (hotel rooms x2) + (camp/RV sites x4) + (vacant houses x6)*
Hotel rooms	85	Vacant housing units	71
Campground & RV sites	80	Peak seasonal population	3,109
** WMSRDC research conducted in 2022*	*** 2021 American Community Survey 5-year Estimates*		
5. Housing			*Source: 2021 American Community Survey 5-year Estimates*
Housing units	852	Single units	665
Occupied housing units	781	Multi-units in structure	176
Vacant housing units	71	Mobile homes	11
6. Public Services			
Fire	Hart Fire Department, 808 S. State		
Police	- Hart Police Department, 427 State St. - Michigan State Police/Hart Post 66, 3720 W. Polk Rd. - Oceana County Sheriff Department, 216 Lincoln St.		
Wastewater	City of Hart		
Community Water Systems	City of Hart		
Public transportation	- *None identified*		
Other	Oceana County Jail, 216 Lincoln St.		
7. Critical Infrastructure			
Major roads	- Oceana Drive - Polk Road		
Railroads	- *None identified*		
Bridges	- Oceana Drive over Pentwater River/Hart Lake - State Street over Hart Lake		
Airports	- *None identified*		
Shelters	*Shelters surveyed by Red Cross:* - None Identified		

	Shelters that need to be surveyed by Red Cross: - Congregational United Church of Christ, 408 S. State St., Hart, MI 49420 - 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 - St. Gregory's Church, 316 Peach St., Hart, MI 49420
Schools	- Hart High School, 300 W. Johnson St. - Hart Middle School, 308 W. Johnson St. - Spitler Elementary School, 302 W. Johnson St. - Diman-Wolf Early Childhood Center, 306 W. Johnson St.
Community medical facilities, Hospitals	- Trinity Health Primary Care-Hart, 611 E. Main St. - Oceana County Medical Care Facility, 701 E. Main St.
Ambulance service	- *None identified*
Dams	Hart Lake Dam
8. Economic Assets	
Major employers	- Big Hart Brewery (Hart City) - GHSP (Hart City) - Great Lakes Packing (Hart City) - Hallack Contracting (Hart City) - Hansen Foods (Hart City) - Hart Area Schools (Hart City) - Hometown Pharmacy (Hart, Shelby, New Era) - Michigan Freeze Pack (Hart City) - Oceana County (Hart City) - Seneca Foods / Gray and Company (Hart City)
Power generation	Hart Lake Dam (hydroelectric)
Electric transmission	- *None identified*
Pipelines	- *None identified*
Commercial transportation	- *None identified*
9. Other Assets, Infrastructure, etc.	
Community facilities:	- City of Hart, 407 State St. - Hart Public Library, 407 S. State St. - Oceana County Building, 100 N. State - County Services Building, 844 S. Griswold St.
Festivals:	- Hart Heritage Days (Labor Day weekend) - National Asparagus Festival (spring) - Oceana County Fair (3rd week in August)
Historic Sites:	- Auto Tourist Camps/John Gurney Park - Hart Downtown & Historic Industrial District

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



Map created 9/2023 by WMSRDC.
Data Source: USGS and WMSRDC

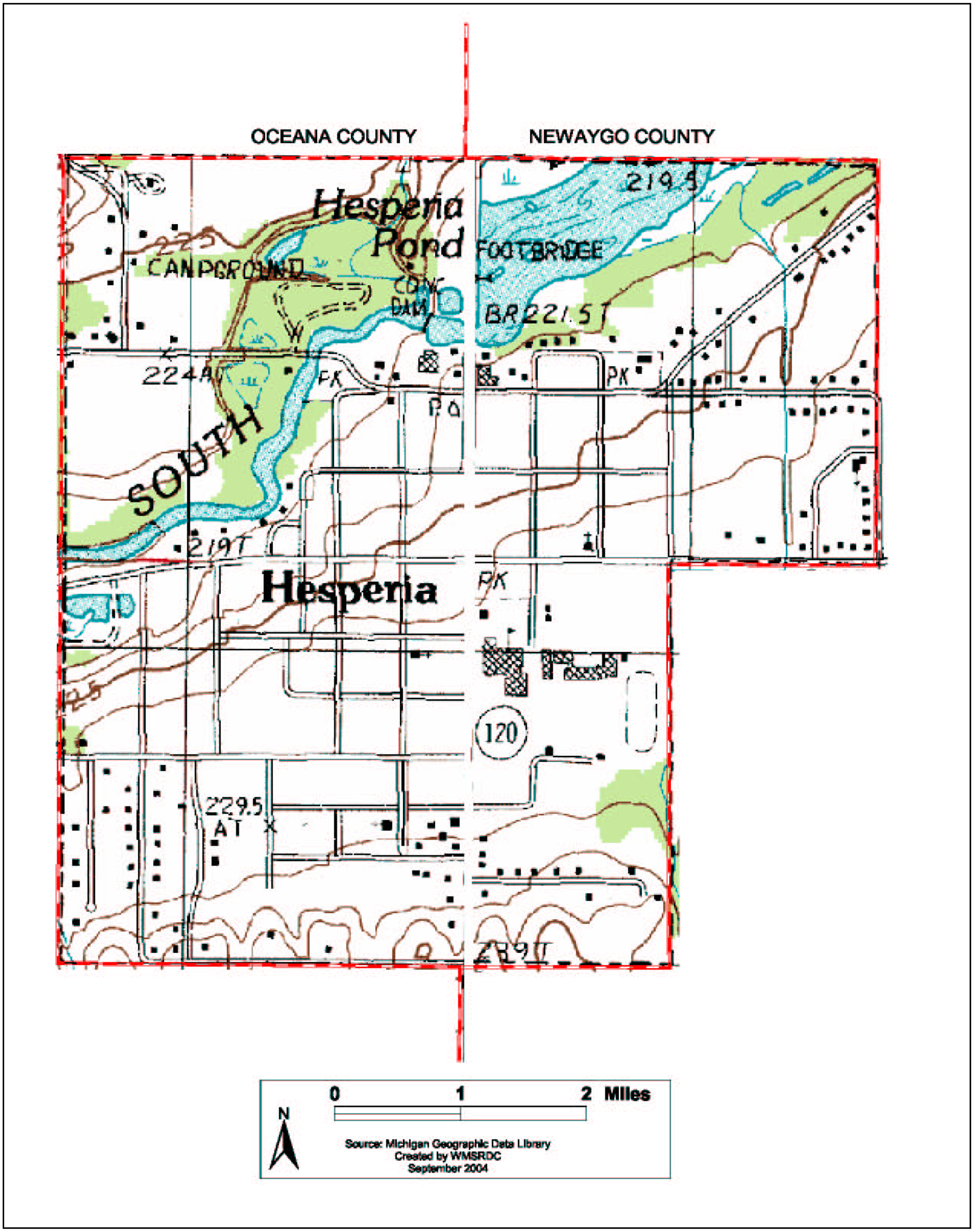
HESPERIA VILLAGE
Community Profile

1. Physical Features			
Lakes	None		
Rivers	White River		
Notable features	- Hesperia straddles the line between Oceana and Newaygo counties - Historic downtown layout - Hesperia dam		
Land description	Mix of residential and commercial uses mainly south of the White River. Much less developed north of White River.		
2. Land Value: 2022 Real and Personal Equalized Valuations		**Not available for village*	
Agricultural	*	Agricultural	*
Commercial	*	Commercial	*
Total personal	*		
3. Population Characteristics		*Source: 2021 American Community Survey 5-year Estimates, unless noted*	
Population, 2021	830	% with disability	19.3 %
% change 2010 to 2020*	+8.4 %	% in poverty	19.6 %
Median age	49.4	ALICE households, 2021**	31 % (county)
% under 18 years old	22.7 %	Avg. daily commute	28.8 minutes
% over 65 years old	25.5 %		
** US decennial census figures*	***Asset Limited, Income Constrained, Employed (United Way of Michigan)*		
4. Peak Seasonal Population	*Peak seasonal population = population + (hotel rooms x2) + (camp/RV sites x4) + (vacant houses x6)*		
Hotel rooms*	8	Vacant housing units**	39
Campground & RV sites*	49	Peak seasonal population	1,276
** WMSRDC research conducted in 2022*	*** 2021 American Community Survey 5-year Estimates*		
5. Housing		*Source: 2021 American Community Survey 5-year Estimates*	
Housing units	407	Single units	313
Occupied housing units	368	Multi-units in structure	91
Vacant housing units	39	Mobile homes	3
6. Public Services			
Fire	- *None identified*		
Police	Hesperia Village Police Department, 33 E. Michigan Ave. (Newaygo County)		
Wastewater	Village of Hesperia		
Community Water Systems	Village of Hesperia		
Public transportation	- *None identified*		
Other	- *None identified*		
7. Critical Infrastructure			
Major roads	M-20, M-120		
Railroads	None identified		
Bridges	M-20: White River North Branch		
Airports	None identified		
Shelters	None identified on the Oceana County side, though Hesperia Community Schools buildings on the Newaygo County side are likely made shelters in an emergency		
Schools	- Hesperia High School, 96 S Division (Newaygo County) - Hesperia Middle School, 96 S Division (Newaygo County) - Patricia St. Clair Elementary, 96 S Division (Newaygo County) - Hesperia Community Education, 232 S Cook St (Newaygo County)		

Community medical facilities, Hospitals	Hesperia Medical Center, 78 N Division (Newaygo County)
Ambulance service	None identified
Dams	Pond Dam (Hesperia)
8. Economic Assets	
Major employers	- *None identified*
Power generation	- *None identified*
Electric transmission	- *None identified*
Pipelines	- *None identified*
Commercial transportation	- *None identified*
9. Other Assets, Infrastructure, etc.	
Community facilities:	- Village of Hesperia, 33 E. Michigan Ave. (Newaygo County) - Hesperia Library & Civic Center, 80 S. Division St. (Newaygo County)
Festivals:	Family Fun Fest (around 4th of July)
Historic Sites:	Daniel Weaver House, 84 S. Cook St. (Hesperia, Newago County)

Land Use and Natural Features Map (USGS Quad.)

VILLAGE OF HESPERIA



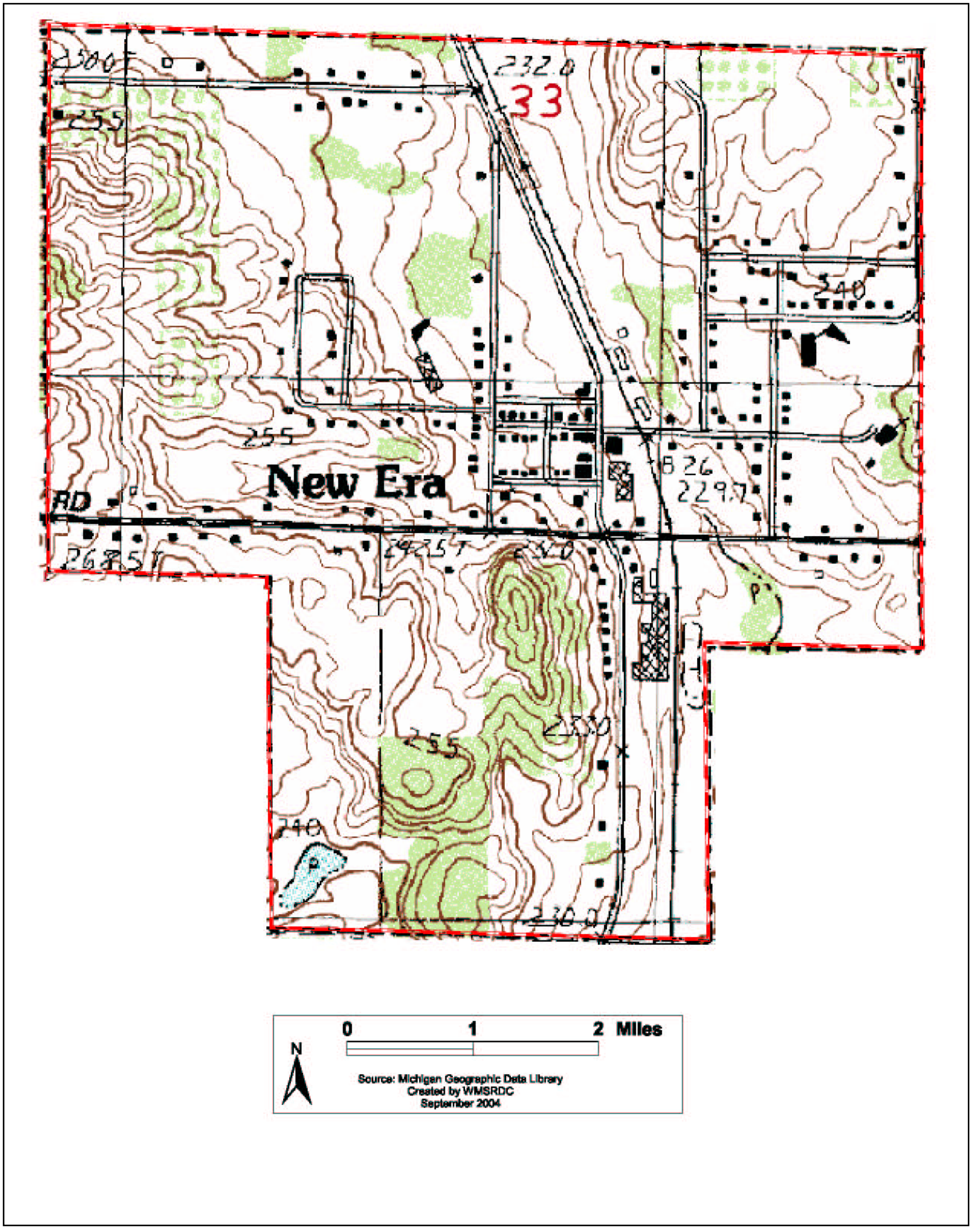
NEW ERA VILLAGE
Community Profile

1. Physical Features			
Lakes	None		
Rivers	- Carlton Creek headwaters		
Notable features	- Hart-Montague Trail State Park Trailhead - Wellhead protection area - Historic downtown layout		
Land description	Single family residential neighborhoods and a commercial district. Food processing facility at south end of town		
2. Land Value: 2022 Real and Personal Equalized Valuations		**Not available for village*	
Agricultural	*	Agricultural	*
Commercial	*	Commercial	*
Total personal	*		
3. Population Characteristics		*Source: 2021 American Community Survey 5-year Estimates, unless noted*	
Population, 2021	397	% with disability	10.6 %
% change 2010 to 2020*	-1.1 %	% in poverty	3.8 %
Median age	53.2	ALICE households, 2021**	31 % (county)
% under 18 years old	15.4 %	Avg. daily commute	22.3 minutes
% over 65 years old	34.5 %		
** US decennial census figures*	***Asset Limited, Income Constrained, Employed (United Way of Michigan)*		
4. Peak Seasonal Population		*Peak seasonal population = population + (hotel rooms x2) + (camp/RV sites x4) + (vacant houses x6)*	
Hotel rooms*	0	Vacant housing units**	15
Campground & RV sites*	0	Peak seasonal population	487
** WMSRDC research conducted in 2022*	*** 2021 American Community Survey 5-year Estimates*		
5. Housing		*Source: 2021 American Community Survey 5-year Estimates*	
Housing units	174	Single units	169
Occupied housing units	159	Multi-units in structure	5
Vacant housing units	15	Mobile homes	0
6. Public Services			
Fire	- *None identified*		
Police	New Era Police Department, 2580 Ray St.		
Wastewater	Village of New Era		
Community Water Systems	Village of New Era		
Public transportation	- *None identified*		
Other	- *None identified*		
7. Critical Infrastructure			
Major roads	Oceana Drive (1st St)		
Railroads	- *None identified*		
Bridges	- *None identified*		
Airports	- *None identified*		
Shelters	*Shelters surveyed by Red Cross:* - New Era Christian School, 1901 Oak Ave *Shelters that need to be surveyed by Red Cross:* - New Era Christian Reformed Church, 1820 Ray Ave, New Era, MI 49446 - New Era Elementary, 2752 Hillcrest, New Era, MI 49446 - New Era Reformed Church, 4775 First St., New Era, MI 49446		

Schools	- New Era Christian Preschool, 1901 Oak Ave. - New Era Elementary (Shelby Public Schools), 2752 Hillcrest Dr.
Community medical facilities, Hospitals	- *None identified*
Ambulance service	- *None identified*
Dams	- *None identified*
8. Economic Assets	
Major employers	- Burnette Foods (New Era Village) - Hometown Pharmacy (Hart, Shelby, New Era)
Power generation	- *None identified*
Electric transmission	- *None identified*
Pipelines	- *None identified*
Commercial transportation	- *None identified*
9. Other Assets, Infrastructure, etc.	
Community facilities:	New Era Village Hall, 2589 Garfield
Festivals:	New Era Fall Street Festival (September)
Historic Sites:	- *None identified*

Land Use and Natural Features Map (USGS Quad.)

VILLAGE OF NEW ERA

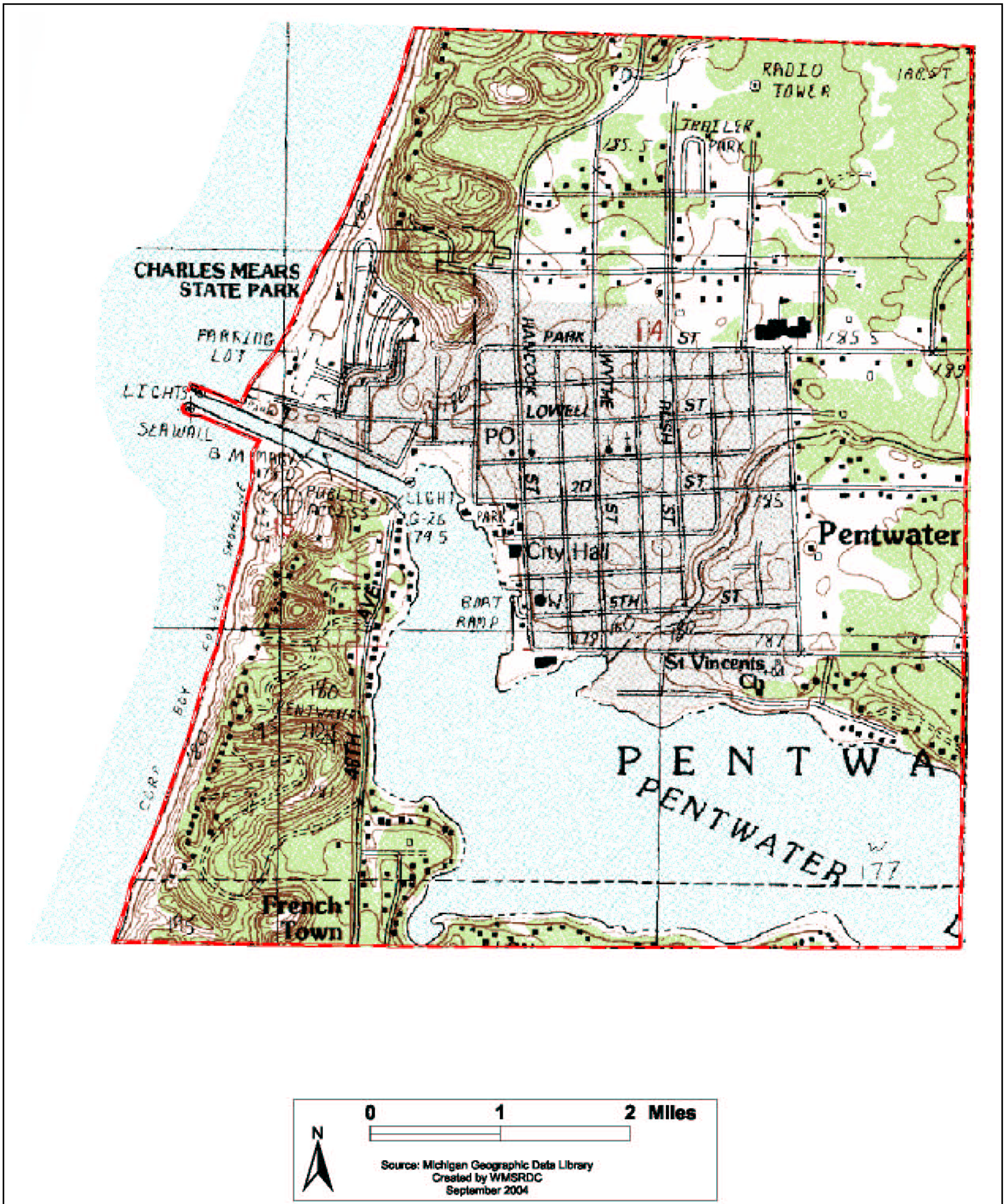


PENTWATER VILLAGE
Community Profile

1. Physical Features			
Lakes	Lake Michigan, Pentwater (240)		
Rivers	None		
Notable features	- Historic houses and downtown layout - Waterfront community, recreational port - Mears State Park		
Land description	Single family residential neighborhoods and a commercial district		
2. Land Value: 2022 Real and Personal Equalized Valuations		**Not available for village*	
Agricultural	*	Agricultural	*
Commercial	*	Commercial	*
Total personal	*		
3. Population Characteristics		*Source: 2021 American Community Survey 5-year Estimates, unless noted*	
Population estimate, 2021	856	% with disability	20.9 %
% change 2010 to 2020*	3.9 %	% in poverty	8.4 %
Median age	65.6	ALICE households, 2021**	31 % (county)
% under 18 years old	7.9 %	Avg. daily commute	21.1 minutes
% over 65 years old	53.2 %		
** US decennial census figures*	***Asset Limited, Income Constrained, Employed (United Way of Michigan)*		
4. Peak Seasonal Population		*Peak seasonal population = population + (hotel rooms x2) + (camp/RV sites x4) + (vacant houses x6)*	
Hotel rooms	8	Vacant housing units	538
Campground & RV sites	175	Peak seasonal population	4,800
** WMSRDC research conducted in 2022*		*** 2021 American Community Survey 5-year Estimates*	
5. Housing		*Source: 2021 American Community Survey 5-year Estimates*	
Housing units	956	Single units	811
Occupied housing units	418	Multi-units in structure	113
Vacant housing units	538	Mobile homes	32
6. Public Services			
Fire	Pentwater Fire Department, 486 E. Park		
Police	Pentwater Village Police Department, 326 Hancock St		
Wastewater	Village of Pentwater		
Community Water Systems	Village of Pentwater		
Public transportation	- *None identified*		
Other	- *None identified*		
7. Critical Infrastructure			
Major roads	Business US-31		
Railroads	- *None identified*		
Bridges	- *None identified*		
Airports	- *None identified*		
Shelters	*Shelters surveyed by Red Cross:* - Pentwater Public Schools, 600 E Park St - St. Vincent Catholic Church, 637 E 6th St *Shelters that need to be surveyed by Red Cross:* - Pentwater Park Place, 310 Rush St., Pentwater, MI 49449		
Schools	Pentwater Public Schools (Elementary, Middle, and High School), 600 E. Park		
Community medical facilities,	- *None identified*		

Hospitals	
Ambulance service	- *None identified*
Dams	- *None identified*
8. Economic Assets	
Major employers	Pentwater School District
Power generation	- *None identified*
Electric transmission	- *None identified*
Pipelines	- *None identified*
Commercial transportation	- *None identified*
9. Other Assets, Infrastructure, etc.	
Community facilities:	- Pentwater Village Hall, 327 S. Hancock - Pentwater Township Hall, 500 N. Hancock St
Festivals:	Oktoberfest (Fall)
Historic Sites:	- Navigation Structures at Pentwater Harbor - Veterans Day Storm-Graveyard of Ships Informational Designation, 421 S. Hancock St.

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

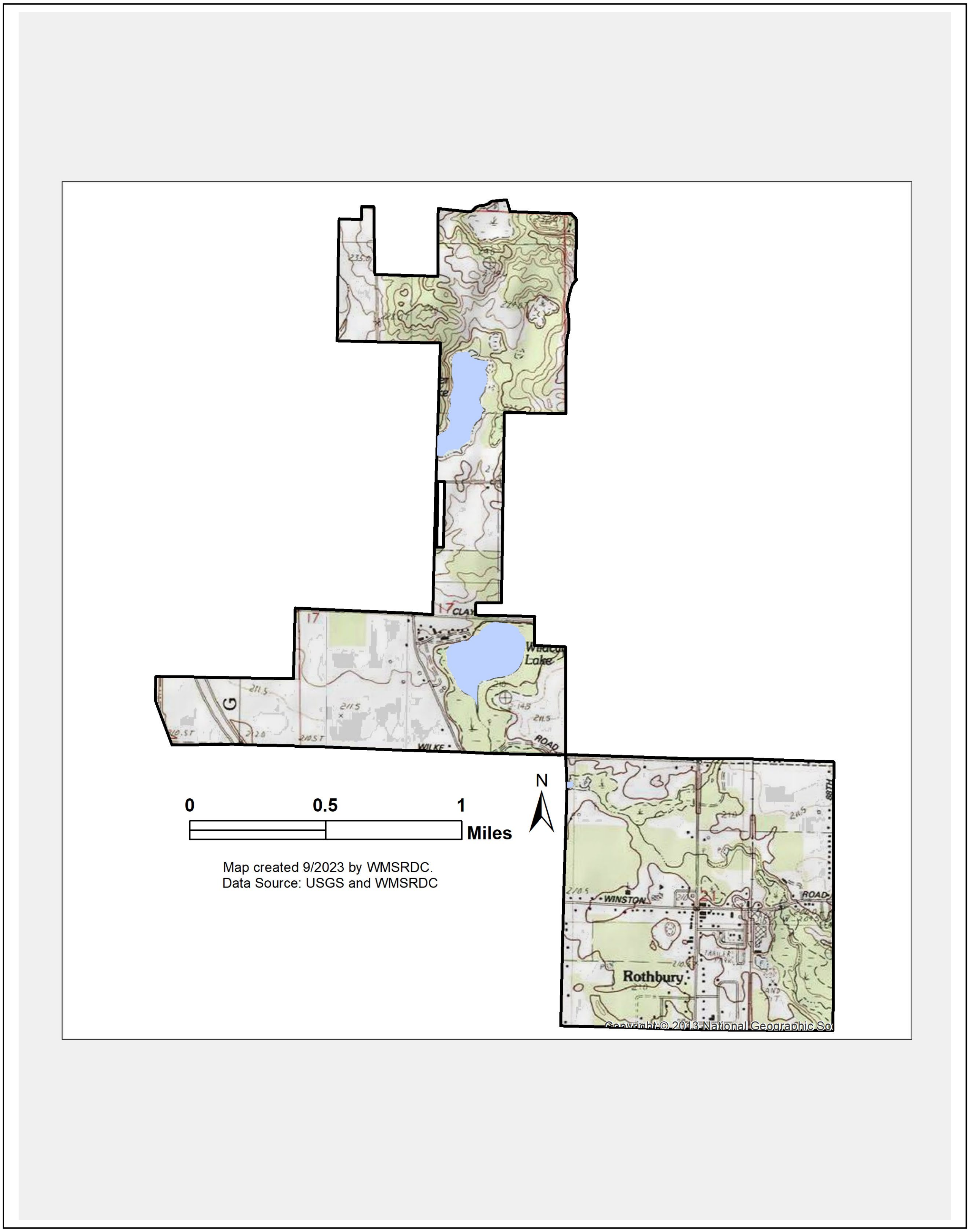


ROTHBURY VILLAGE
Community Profile

1. Physical Features			
Lakes	*- None identified*		
Rivers	*- None identified*		
Notable features	Hart-Montague Trail State Park		
Land description	Mix of residential and commercial		
2. Land Value: 2022 Real and Personal Equalized Valuations		**Not available for village*	
Agricultural	*	Agricultural	*
Commercial	*	Commercial	*
Total personal	*		
3. Population Characteristics		*Source: 2021 American Community Survey 5-year Estimates, unless noted*	
Population estimate, 2021	384	% with disability	17.7 %
% change 2010 to 2020*	6.9 %	% in poverty	20.8 %
Median age	35	ALICE households, 2021**	31 % (county)
% under 18 years old	31.0 %	Avg. daily commute	20.3 minutes
% over 65 years old	16.7 %		
** US decennial census figures*	***Asset Limited, Income Constrained, Employed (United Way of Michigan)*		
4. Peak Seasonal Population		*Peak seasonal population = population + (hotel rooms x2) + (camp/RV sites x4) + (vacant houses x6)*	
Hotel rooms	245	Vacant housing units	12
Campground & RV sites	58	Peak seasonal population	1,178
** WMSRDC research conducted in 2022*	*** 2021 American Community Survey 5-year Estimates*		
5. Housing		*Source: 2021 American Community Survey 5-year Estimates*	
Housing units	140	Single units	96
Occupied housing units	128	Multi-units in structure	0
Vacant housing units	12	Mobile homes	44
6. Public Services			
Fire	*- None identified*		
Police	Rothbury Police Department, 7752 Michigan Ave.		
Wastewater	*- None identified*		
Water	Greenlawn Mobile Home Court (community water system)		
Public transportation	*- None identified*		
Other	*- None identified*		
7. Critical Infrastructure			
Major roads	Oceana Drive (Michigan Ave)		
Railroads	*- None identified*		
Bridges	*- None identified*		
Airports	*- None identified*		
Shelters	*Shelters surveyed by Red Cross:* - Rothbury Community Church, 2440 W Winston Rd *Shelters that need to be surveyed by Red Cross:* - None		
Schools	*- None identified*		
Community medical facilities, Hospitals	*- None identified*		
Ambulance service	*- None identified*		
Dams	*- None identified*		

8. Economic Assets	
Major employers	Double JJ Resort
Power generation	- *None identified*
Electric transmission	- *None identified*
Pipelines	- *None identified*
Commercial transportation	- *None identified*
9. Other Assets, Infrastructure, etc.	
Community facilities:	Village of Rothbury, 7804 S. Michigan Ave
Festivals:	Electric Forest Music Festival (June)
Historic Sites:	- *None identified*

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



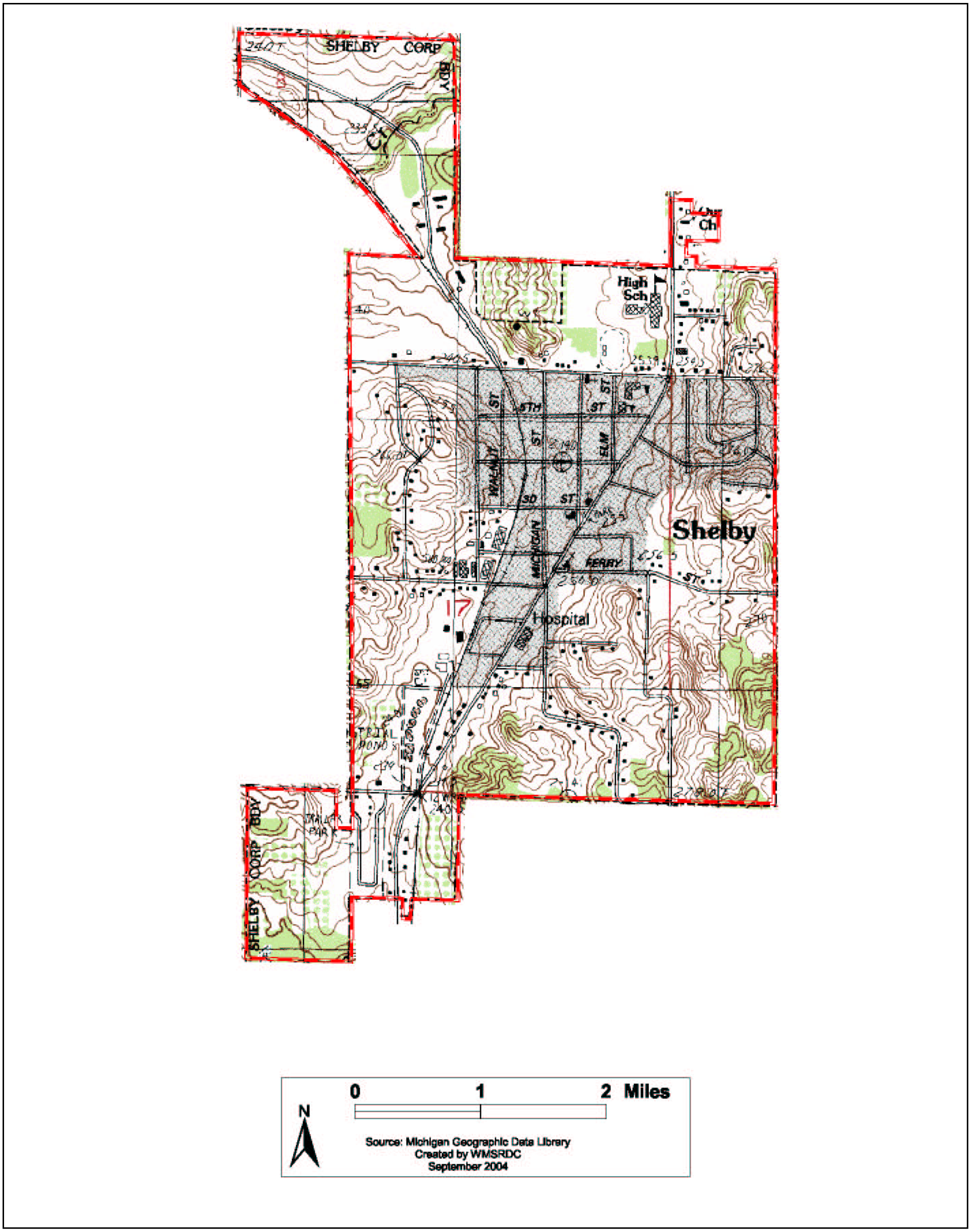
SHELBY VILLAGE
Community Profile

1. Physical Features			
Lakes (acres)	- *None identified*		
Rivers	- *None identified*		
Notable features	- Hart-Montague Trail State Park - Historic downtown layout		
Land description	Mix of residential, commercial, and industrial uses		
2. Land Value: 2022 Real and Personal Equalized Valuations*			*Source: Oceana County Equalization Report 2022*
Agricultural	*	Industrial	*
Commercial	*	Residential	*
Total personal	*	**Not available for village*	
3. Population Characteristics			*Source: 2021 American Community Survey 5-year Estimates, unless noted*
Population estimate, 2021	2,627	% with disability	10.3 %
% change 2010 to 2020*	-4.9 %	% in poverty	16.9 %
Median age	28.3	ALICE households, 2021**	31 % (county)
% under 18 years old	34.3 %	Avg. daily commute	17.3 minutes
% over 65 years old	9.9 %		
** US decennial census figures*	***Asset Limited, Income Constrained, Employed (United Way of Michigan)*		
4. Peak Seasonal Population			*Peak seasonal population = population + (hotel rooms x2) + (camp/RV sites x4) + (vacant houses x6)*
Hotel rooms	0	Vacant housing units	67
Campground & RV sites	0	Peak seasonal population	3,029
** WMSRDC research conducted in 2022*	*** 2021 American Community Survey 5-year Estimates*		
5. Housing			*Source: 2021 American Community Survey 5-year Estimates*
Housing units	853	Single units	627
Occupied housing units	786	Multi-units in structure	152
Vacant housing units	67	Mobile homes	74
6. Public Services			
Fire	Shelby-Benona Fire Department, 430 Industrial Park Dr		
Police	Shelby Police Department, 189 Maple St		
Wastewater	Village of Shelby		
Water	Village of Shelby		
Public transportation	- *None identified*		
Other	- *None identified*		
7. Critical Infrastructure			
Major roads	Oceana Drive (State St)		
Railroads	- *None identified*		
Bridges	- *None identified*		
Airports	- *None identified*		
Shelters	*Shelters surveyed by Red Cross:* - Shelby Middle School, 525 N State St *Shelters that need to be surveyed by Red Cross:* - Shelby High School, 641 N. State St., Shelby, MI 49455 - Shelby United Methodist Church, 68 E. Third St., Shelby, MI 49455		
Schools	- Shelby High School, 641 N. State St. - Shelby Middle School, 525 N. State St. - Thomas Read Elementary, 155 6th St.		

	- Shelby Early Childhood Center, 155 6th St.
Community medical facilities, Hospitals	- Trinity Health Shelby Hospital, 72 S. State St. - Northwest Michigan Health Services, 119 S. State St.
Ambulance service	Emergency Medical Services, S. State St
Dams	- *None identified*
8. Economic Assets	
Major employers	- Hometown Pharmacy (Hart, Shelby, New Era) - Media Technologies - Shelby Public Schools - Trinity Health Shelby Hospital
Power generation	- *None identified*
Electric transmission	- *None identified*
Pipelines	- *None identified*
Commercial transportation	- *None identified*
9. Other Assets, Infrastructure, etc.	
Community facilities:	- Village of Shelby, 189 N. Maple St. - Shelby Public Library, 189 N. Maple St.
Festivals:	Shelby Farm to Table Harvest Festival (Fall)
Historic Sites:	- *None identified*

Land Use and Natural Features Map (USGS Quad.)

VILLAGE OF SHELBY



WALKERVILLE VILLAGE
Community Profile

1. Physical Features

Lakes	*- None identified*
Rivers	*- None identified*
Notable features	Rural & agricultural community
Land description	Mix of residential, commercial, and civic uses

2. Land Value: 2022 Real and Personal Equalized Valuations

**Not available for village*

Agricultural	*	Agricultural	*
Commercial	*	Commercial	*
Total personal	*		

3. Population Characteristics

Source: 2021 American Community Survey 5-year Estimates, unless noted

Population estimate, 2021	243	% with disability	30.0 %
% change 2010 to 2020*	-0.4 %	% in poverty	33.6 %
Median age	35.3	ALICE households, 2021**	31 % (county)
% under 18 years old	35.0 %	Avg. daily commute	27.8 minutes
% over 65 years old	9.9 %		

** US decennial census figures* ***Asset Limited, Income Constrained, Employed (United Way of Michigan)*

4. Peak Seasonal Population

Peak seasonal population = population + (hotel rooms x2) + (camp/RV sites x4) + (vacant houses x6)

Hotel rooms*	0	Vacant housing units	8
Campground & RV sites*	0	Peak seasonal population	291

** WMSRDC research conducted in 2022* *** 2021 American Community Survey 5-year Estimates*

5. Housing

Source: 2021 American Community Survey 5-year Estimates

Housing units	94	Single units	43
Occupied housing units	86	Multi-units in structure	0
Vacant housing units	8	Mobile homes	51

6. Public Services

Fire	Walkerville Area Fire/Rescue, 134 S. East St
Police	Walkerville Police Department, 121 S. East St
Wastewater	Village of Walkerville
Water	*- None identified*
Public transportation	*- None identified*
Other	*- None identified*

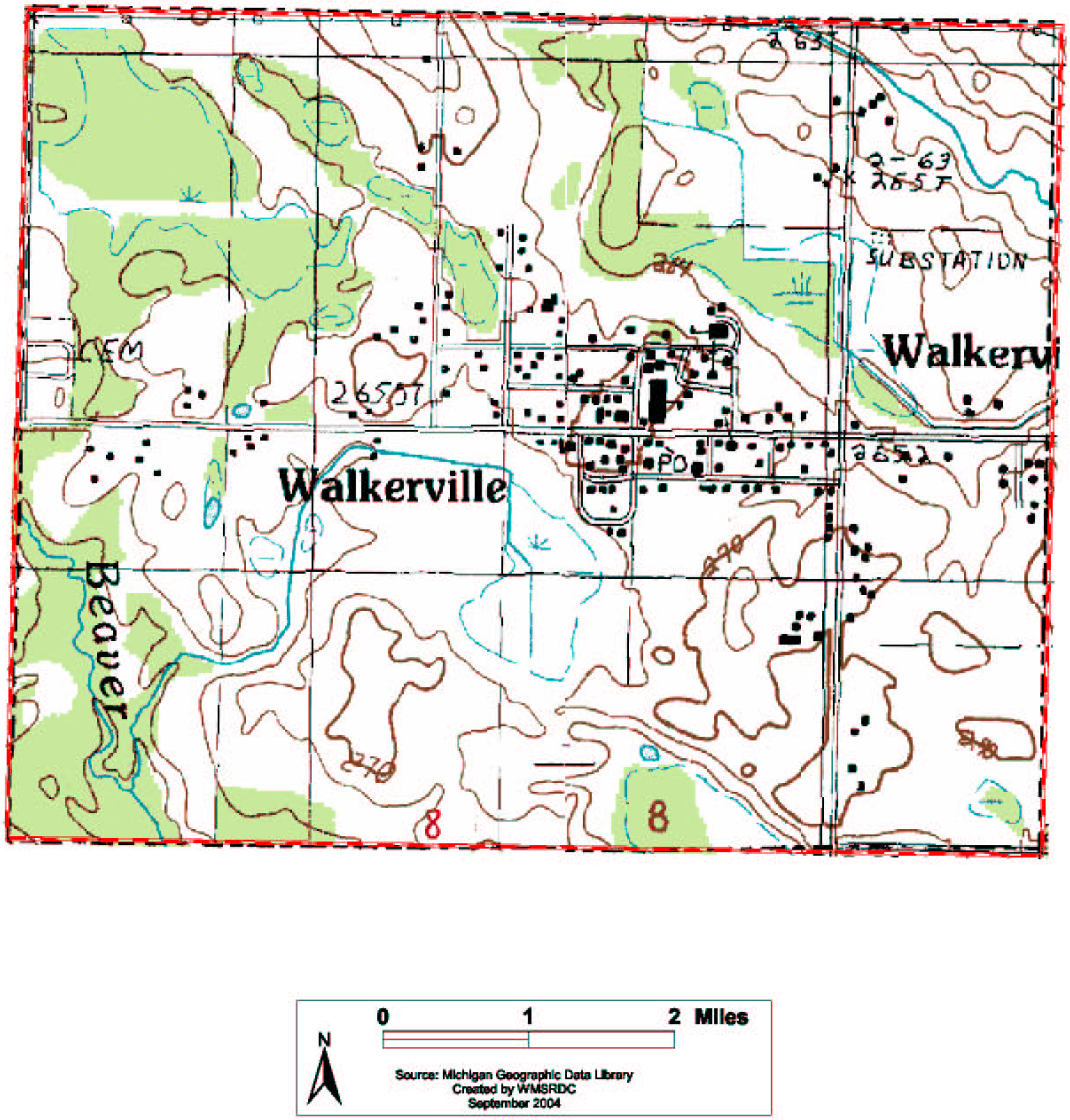
7. Critical Infrastructure

Major roads	*- None identified*
Railroads	*- None identified*
Bridges	*- None identified*
Airports	*- None identified*
Shelters	*Shelters surveyed by Red Cross:* - Walkerville Wesleyan Church, 144 S. Hamon *Shelters that need to be surveyed by Red Cross:* - Walkerville High School, 145 Lathrop St, Walkerville, MI 49459
Schools	Walkerville Elementary/Middle/High School, 145 Lathrop St
Community medical facilities, Hospitals	*- None identified*
Ambulance service	*- None identified*
Dams	*- None identified*

8. Economic Assets	
Major employers	- *None identified*
Power generation	- *None identified*
Electric transmission	- Consumers Energy Transmission Line - Wolverine Power Transmission Line and Substation
Pipelines	- *None identified*
Commercial transportation	- *None identified*
9. Other Assets, Infrastructure, etc.	
Community facilities:	Village of Walkerville, 1215 S. East St
Festivals:	- *None identified*
Historic Sites:	- *None identified*

Land Use and Natural Features Map (USGS Quad.)

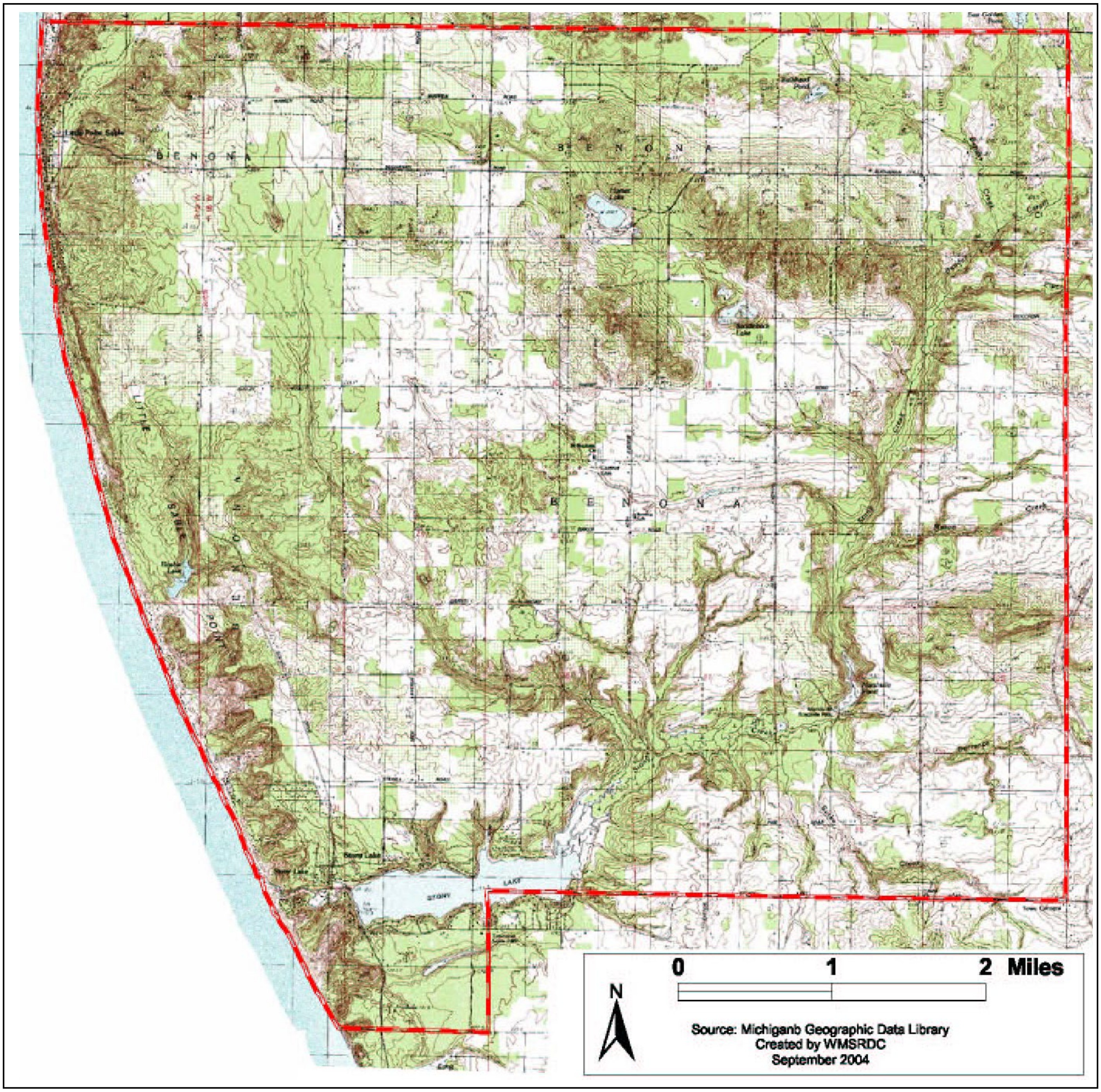
VILLAGE OF WALKERVILLE



BENONA TOWNSHIP Community Profile			
1. Physical Features			
Lakes	Stony Lake		
Rivers	Stony Creek		
Notable features	- Lake Michigan shoreline and dune environment - Stony Lake (unincorporated community)		
Land description	Mainly rural & agricultural with scattered residential; residential concentrations around Stony Lake and Lake Michigan shoreline		
2. Land Value: 2022 Real and Personal Equalized Valuations			*Source: Oceana County Equalization Report 2022*
Agricultural	$17,974,500	Industrial	$24,900
Commercial	$2,703,400	Residential	$234,617,400
Total personal	$3,249,800		
3. Population Characteristics			*Source: 2021 American Community Survey 5-year Estimates, unless noted*
Population estimate, 2021	1,432	% with disability	20.7 %
% change 2010 to 2020*	-0.8 %	% in poverty	8.4 %
Median age	54.6	ALICE households, 2021**	31 % (county)
% under 18 years old	14.9 %	Avg. daily commute	23.1 minutes
% over 65 years old	30.5 %		
** US decennial census figures*	***Asset Limited, Income Constrained, Employed (United Way of Michigan)*		
4. Peak Seasonal Population			*Peak seasonal population = population + (hotel rooms x2) + (camp/RV sites x4) + (vacant houses x6)*
Hotel rooms*	0	Vacant housing units**	752
Campground & RV sites*	70	Peak seasonal population	6,224
** WMSRDC research conducted in 2022*	*** 2021 American Community Survey 5-year Estimates*		
5. Housing			*Source: 2021 American Community Survey 5-year Estimates*
Housing units	1,342	Single units	1,245
Occupied housing units	590	Multi-units in structure	9
Vacant housing units	752	Mobile homes	88
6. Public Services			
Fire	- *None identified*		
Police	- *None identified*		
Wastewater	- *None identified*		
Water	- *None identified*		
Public transportation	- *None identified*		
Other	- *None identified*		
7. Critical Infrastructure			
Major roads	B-15 (Scenic Dr)		
Railroads	- *None identified*		
Bridges	B-15 (Scenic Dr) over Stony Creek		
Airports	- *None identified*		
Shelters	- *None identified*		
Schools	- *None identified*		
Community medical facilities, Hospitals	- *None identified*		
Ambulance service	- *None identified*		
Dams	- *None identified*		
8. Economic Assets			

Major employers	- *None identified*
Power generation	- *None identified*
Electric transmission	- *None identified*
Pipelines	- *None identified*
Commercial transportation	- *None identified*
9. Other Assets, Infrastructure, etc.	
Community facilities:	Benona Township Hall, 7169 W. Baker Rd
Festivals:	- *None identified*
Historic Sites:	- Benona Township Hall, 7169 West Baker Road - Little Point Sable Light Station, Little Sable Point

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

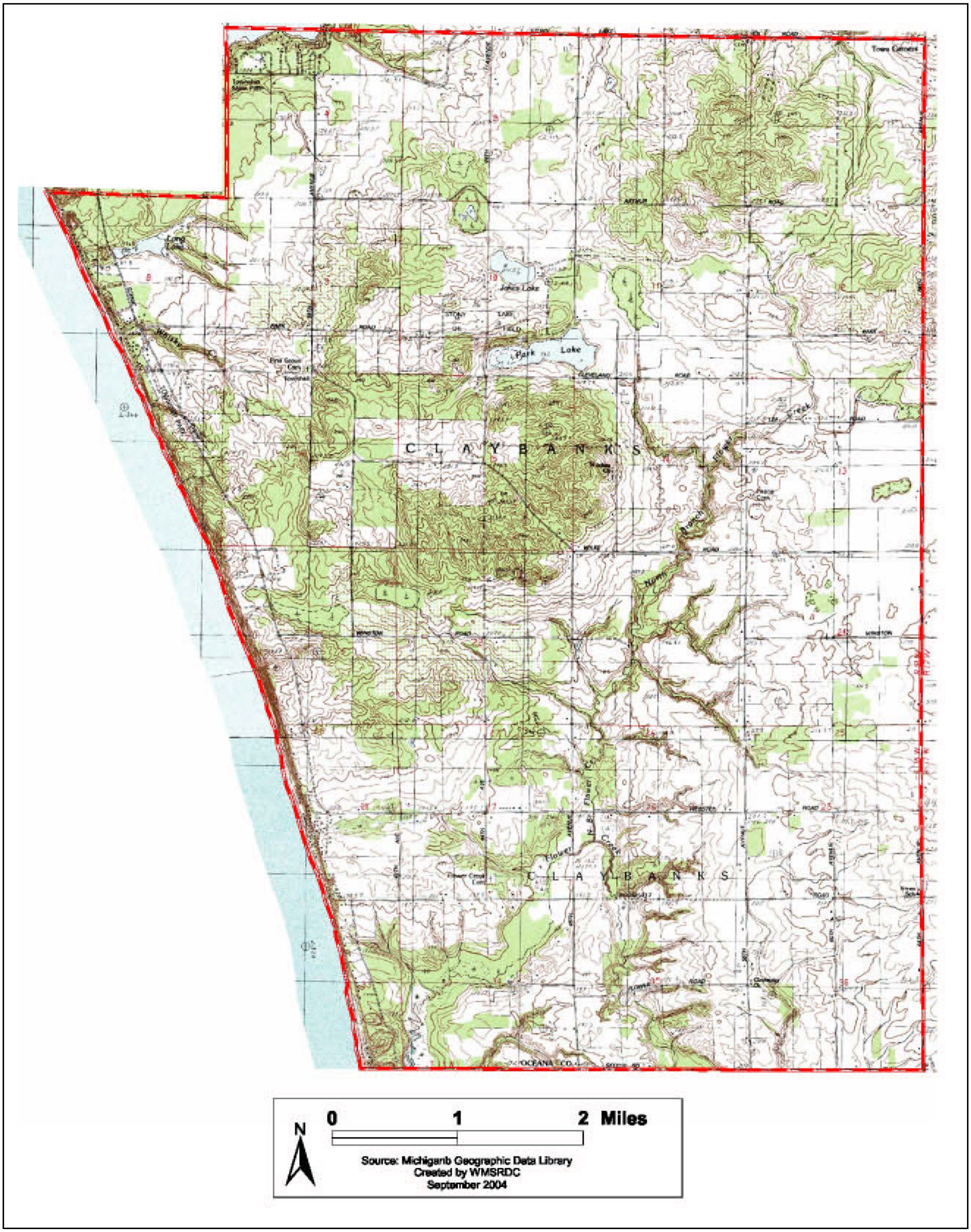


CLAYBANKS TOWNSHIP
Community Profile

1. Physical Features			
Lakes	Stony Lake		
Rivers	*- None identified*		
Notable features	Lake Michigan shoreline and dune environment		
Land description	Mainly undeveloped, rural & agricultural with scattered residential; residential concentrations around Stony Lake and Lake Michigan shoreline		
2. Land Value: 2022 Real and Personal Equalized Valuations			*Source: Oceana County Equalization Report 2022*
Agricultural	$18,435,000	Industrial	$31,500
Commercial	$383,100	Residential	$86,430,600
Total personal	$1,614,500		
3. Population Characteristics			*Source: 2021 American Community Survey 5-year Estimates, unless noted*
Population estimate, 2021	882	% with disability	13.0 %
% change 2010 to 2020*	+10.0 %	% in poverty	13.0 %
Median age	51.5	ALICE households, 2021**	31 % (county)
% under 18 years old	18.7 %	Avg. daily commute	25.7 minutes
% over 65 years old	27.3 %		
** US decennial census figures*	***Asset Limited, Income Constrained, Employed (United Way of Michigan)*		
4. Peak Seasonal Population	*Peak seasonal population = population + (hotel rooms x2) + (camp/RV sites x4) + (vacant houses x6)*		
Hotel rooms*	0	Vacant housing units**	212
Campground & RV sites*	172	Peak seasonal population	2,842
** WMSRDC research conducted in 2022*	*** 2021 American Community Survey 5-year Estimates*		
5. Housing			*Source: 2021 American Community Survey 5-year Estimates*
Housing units	555	Single units	488
Occupied housing units	343	Multi-units in structure	0
Vacant housing units	212	Mobile homes	63
6. Public Services			
Fire	*- None identified*		
Police	*- None identified*		
Wastewater	*- None identified*		
Water	*- None identified*		
Public transportation	*- None identified*		
Other	*- None identified*		
7. Critical Infrastructure			
Major roads	B-15 (Scenic Dr)		
Railroads	*- None identified*		
Bridges	*- None identified*		
Airports	*- None identified*		
Shelters	*- None identified*		
Schools	*- None identified*		
Community medical facilities, Hospitals	*- None identified*		
Ambulance service	*- None identified*		
Dams	*- None identified*		

8. Economic Assets	
Major employers	- *None identified*
Power generation	- *None identified*
Electric transmission	- *None identified*
Pipelines	- *None identified*
Commercial transportation	- *None identified*
9. Other Assets, Infrastructure, etc.	
Community facilities:	Township of Claybanks, 7577 W. Cleveland
Festivals:	- *None identified*
Historic Sites:	- *None identified*

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

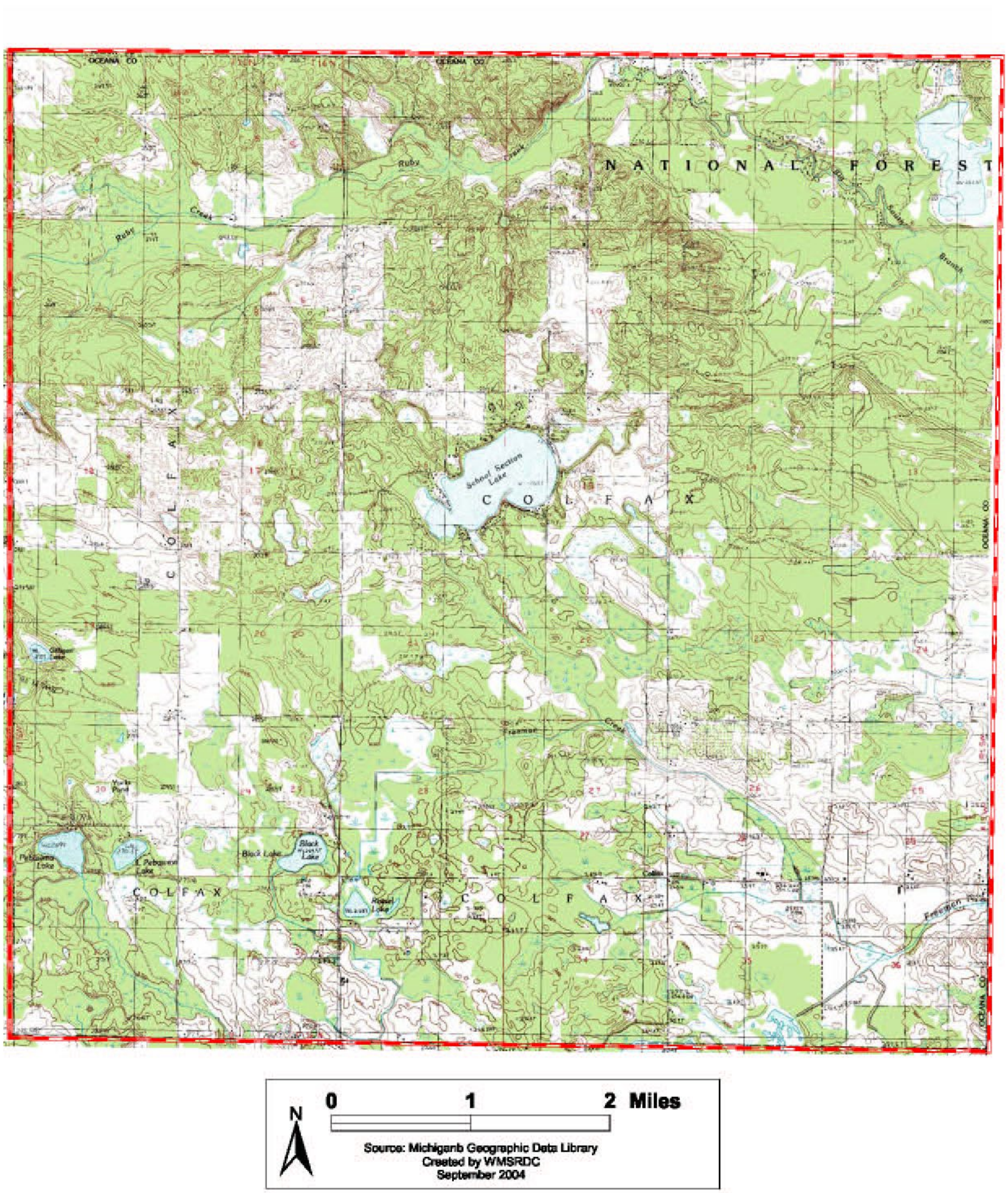


COLFAX TOWNSHIP
Community Profile

1. Physical Features			
Lakes	School Section Lake		
Rivers	South Branch Pere Marquette River		
Notable features	Manistee National Forest		
Land description	Most of the township is forested with agriculture being the most predominant land use		
2. Land Value: 2022 Real and Personal Equalized Valuations			*Source: Oceana County Equalization Report 2022*
Agricultural	$8,406,700	Industrial	$7,141,900
Commercial	$252,400	Residential	$31,265,200
Total personal	$2,174,700		
3. Population Characteristics			*Source: 2021 American Community Survey 5-year Estimates, unless noted*
Population estimate, 2021	667	% with disability	14.2 %
% change 2010 to 2020*	-3.5 %	% in poverty	27.0 %
Median age	35.5	ALICE households, 2021**	31 % (county)
% under 18 years old	23.5 %	Avg. daily commute	25.1 minutes
% over 65 years old	11.2 %		
** US decennial census figures*	***Asset Limited, Income Constrained, Employed (United Way of Michigan)*		
4. Peak Seasonal Population			*Peak seasonal population = population + (hotel rooms x2) + (camp/RV sites x4) + (vacant houses x6)*
Hotel rooms*	0	Vacant housing units**	337
Campground & RV sites*	122	Peak seasonal population	3,177
** WMSRDC research conducted in 2022*	*** 2021 American Community Survey 5-year Estimates*		
5. Housing			*Source: 2021 American Community Survey 5-year Estimates*
Housing units	503	Single units	372
Occupied housing units	166	Multi-units in structure	0
Vacant housing units	337	Mobile homes	131
6. Public Services			
Fire	- *None identified*		
Police	- *None identified*		
Wastewater	- *None identified*		
Water	- *None identified*		
Public transportation	- *None identified*		
Other	- *None identified*		
7. Critical Infrastructure			
Major roads	- *None identified*		
Railroads	- *None identified*		
Bridges	- *None identified*		
Airports	- *None identified*		
Shelters	- *None identified*		
Schools	- *None identified*		
Community medical facilities, Hospitals	- *None identified*		
Ambulance service	- *None identified*		
Dams	Foster Lake Dam		

8. Economic Assets	
Major employers	- Arbre Farms - Willow Cold Storage
Power generation	- *None identified*
Electric transmission	Wolverine Power Transmission Line
Pipelines	- *None identified*
Commercial transportation	- *None identified*
9. Other Assets, Infrastructure, etc.	
Community facilities:	Township of Colfax, 5594 N. 192nd Ave
Festivals:	- *None identified*
Historic Sites:	- *None identified*

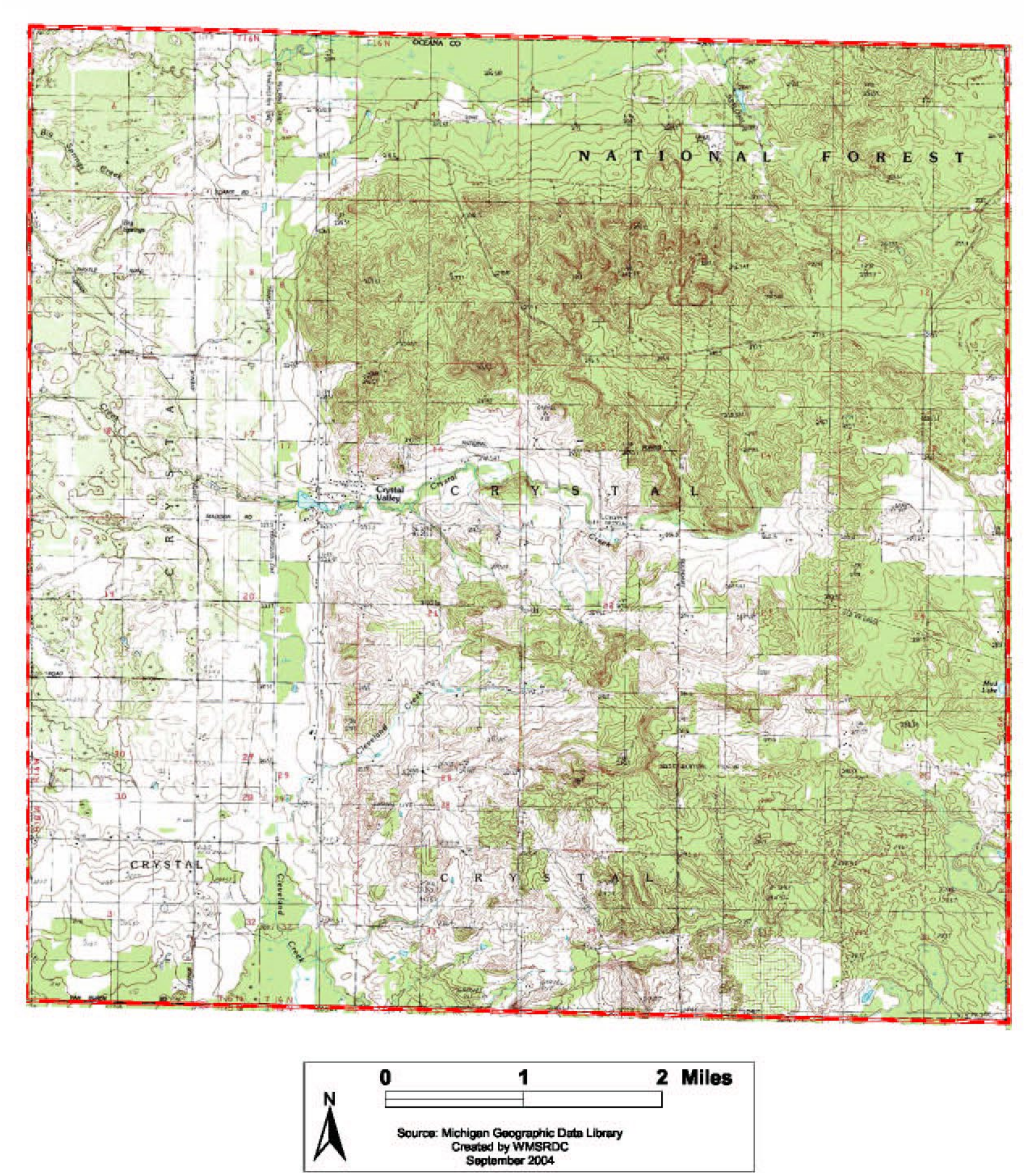
Land Use and Natural Features Map (USGS Quad.)
COLFAX TOWNSHIP



CRYSTAL TOWNSHIP Community Profile			
1. Physical Features			
Lakes	*- None identified*		
Rivers	North Branch Pentwater River		
Notable features	Manistee National Forest		
Land description	Much of the township is forested with agriculture being the most predominant land use		
2. Land Value: 2022 Real and Personal Equalized Valuations			*Source: Oceana County Equalization Report 2022*
Agricultural	$11,260,608	Industrial	$314,700
Commercial	$117,500	Residential	$21,196,900
Total personal	$2,004,600		
3. Population Characteristics			*Source: 2021 American Community Survey 5-year Estimates, unless noted*
Population estimate, 2021	700	% with disability	15.3 %
% change 2010 to 2020*	-18.7 %	% in poverty	21.4 %
Median age	42.3	ALICE households, 2021**	31 % (county)
% under 18 years old	14.9 %	Avg. daily commute	32.6 minutes
% over 65 years old	16.3 %		
** US decennial census figures*	***Asset Limited, Income Constrained, Employed (United Way of Michigan)*		
4. Peak Seasonal Population			*Peak seasonal population = population + (hotel rooms x2) + (camp/RV sites x4) + (vacant houses x6)*
Hotel rooms	0	Vacant housing units	110
Campground & RV sites	0	Peak seasonal population	1,360
** WMSRDC research conducted in 2022*	*** 2021 American Community Survey 5-year Estimates*		
5. Housing			*Source: 2021 American Community Survey 5-year Estimates*
Housing units	365	Single units	211
Occupied housing units	255	Multi-units in structure	35
Vacant housing units	110	Mobile homes	112
6. Public Services			
Fire	Crystal Township Fire Department, 1503 E. Hammett Rd		
Police	*- None identified*		
Wastewater	*- None identified*		
Water	*- None identified*		
Public transportation	*- None identified*		
Other	*- None identified*		
7. Critical Infrastructure			
Major roads	*- None identified*		
Railroads	*- None identified*		
Bridges	*- None identified*		
Airports	*- None identified*		
Shelters	*- None identified*		
Schools	*- None identified*		
Community medical facilities, Hospitals	*- None identified*		
Ambulance service	*- None identified*		
Dams	Crystal Valley Dam		

8. Economic Assets	
Major employers	*- None identified*
Power generation	*- None identified*
Electric transmission	Consumers Energy Transmission Line
Pipelines	*- None identified*
Commercial transportation	*- None identified*
9. Other Assets, Infrastructure, etc.	
Community facilities:	Township of Crystal, 1499 E. Hammett
Festivals:	*- None identified*
Historic Sites:	Jared H Gay Log House, 128th Ave

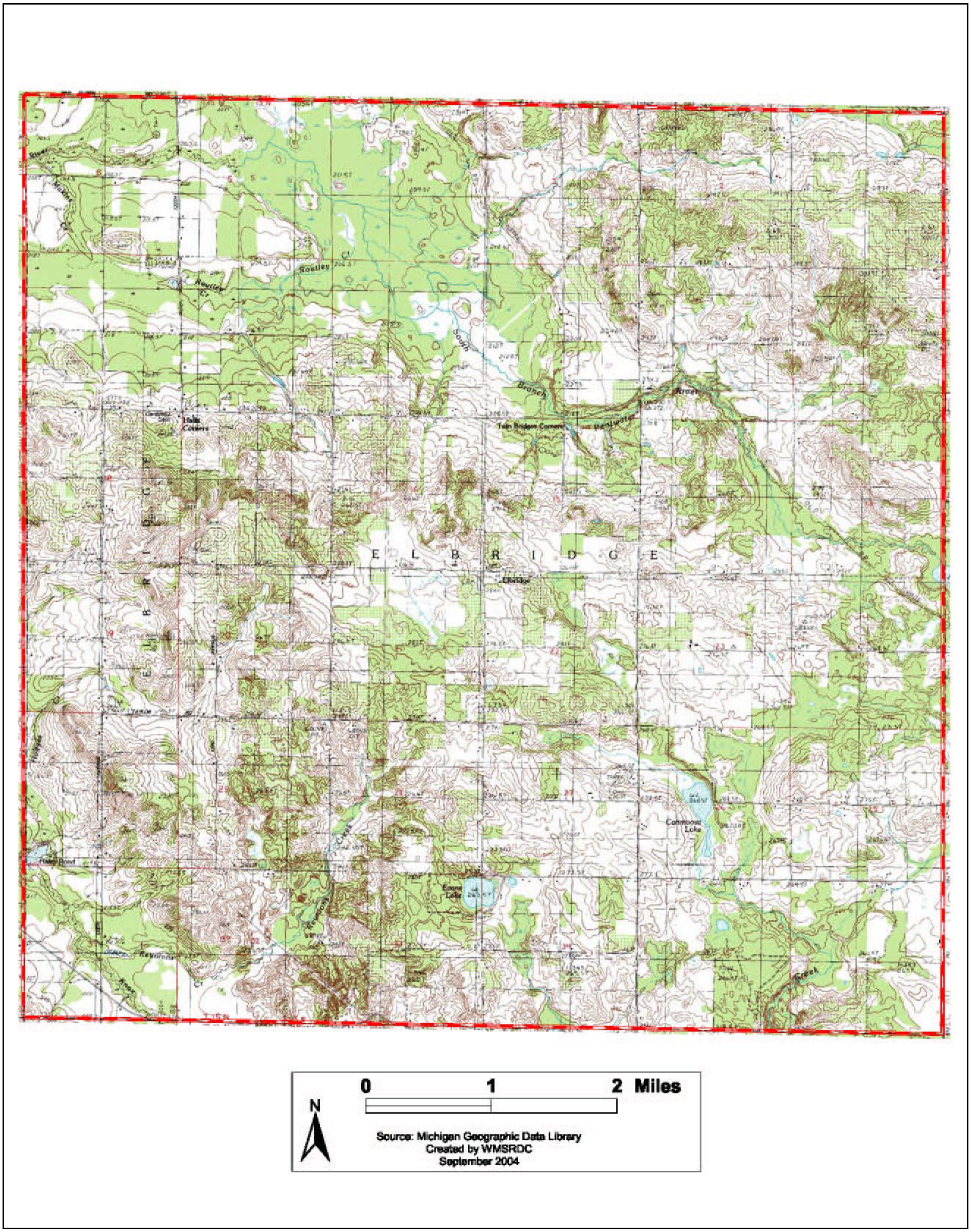
Land Use and Natural Features Map (USGS Quad.)
CRYSTAL TOWNSHIP



ELBRIDGE TOWNSHIP Community Profile			
1. Physical Features			
Lakes	Cobmoosa, Evans, Mud		
Rivers	South Branch Pentwater River		
Notable features	Manistee National Forest in SE corner of township		
Land description	Mainly rural and agricultural community		
2. Land Value: 2022 Real and Personal Equalized Valuations			*Source: Oceana County Equalization Report 2022*
Agricultural	$20,408,800	Industrial	$306,700
Commercial	$152,300	Residential	$27,206,220
Total personal	$2,249,300		
3. Population Characteristics			*Source: 2021 American Community Survey 5-year Estimates, unless noted*
Population estimate, 2021	857	% with disability	14.7 %
% change 2010 to 2020*	+2.9 %	% in poverty	9.2 %
Median age	45.8	ALICE households, 2021**	31 % (county)
% under 18 years old	25.6 %	Avg. daily commute	18.5 minutes
% over 65 years old	19.4 %		
** US decennial census figures*	***Asset Limited, Income Constrained, Employed (United Way of Michigan)*		
4. Peak Seasonal Population			*Peak seasonal population = population + (hotel rooms x2) + (camp/RV sites x4) + (vacant houses x6)*
Hotel rooms	0	Vacant housing units	141
Campground & RV sites	0	Peak seasonal population	1,703
** WMSRDC research conducted in 2022*	*** 2021 American Community Survey 5-year Estimates*		
5. Housing			*Source: 2021 American Community Survey 5-year Estimates*
Housing units	458	Single units	343
Occupied housing units	317	Multi-units in structure	29
Vacant housing units	141	Mobile homes	86
6. Public Services			
Fire	- *None identified*		
Police	- *None identified*		
Wastewater	- *None identified*		
Water	- *None identified*		
Public transportation	- *None identified*		
Other	- *None identified*		
7. Critical Infrastructure			
Major roads	- *None identified*		
Railroads	- *None identified*		
Bridges	- *None identified*		
Airports	- *None identified*		
Shelters	*Shelters surveyed by Red Cross:* - None *Shelters that need to be surveyed by Red Cross:* - Elbridge Community Church, 2370 N 136th Ave., Hart, MI 49420 - Elbridge Township Hall, 2266 E. Polk Rd., Hart, MI 49420		
Schools	Telamon Hart Migrant Head Start, 2354 E Polk Rd, Hart, MI 49420		
Community medical facilities, Hospitals	- *None identified*		
Ambulance service	- *None identified*		

Dams	Gales Pond Dam
8. Economic Assets	
Major employers	- *None identified*
Power generation	- *None identified*
Electric transmission	- Consumers Energy Transmission Line - Wolverine Power Transmission Line
Pipelines	Gas transmission pipeline (currently shut down)
Commercial transportation	- *None identified*
9. Other Assets, Infrastructure, etc.	
Community facilities:	Township of Elbridge, 2266 E. Polk Rd
Festivals:	- *None identified*
Historic Sites:	- *None identified*

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

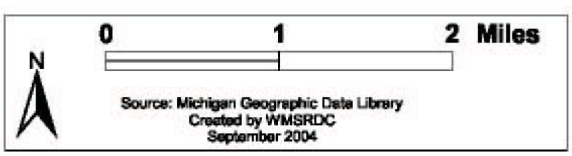


FERRY TOWNSHIP
Community Profile

1. Physical Features			
Lakes	*- None identified*		
Rivers	North Branch White River		
Notable features	- Ferry (unincorporated community) - Manistee National Forest in SW and NE corners of township		
Land description	Mainly forested with scattered agricultural and residential uses		
2. Land Value: 2022 Real and Personal Equalized Valuations			*Source: Oceana County Equalization Report 2022*
Agricultural	$8,263,600	Industrial	$541,500
Commercial	$745,200	Residential	$39,912,400
Total personal	$1,604,600		
3. Population Characteristics			*Source: 2021 American Community Survey 5-year Estimates, unless noted*
Population estimate, 2021	1,073	% with disability	16.6 %
% change 2010 to 2020*	-1.6 %	% in poverty	7.8 %
Median age	51.3	ALICE households, 2021**	31 % (county)
% under 18 years old	15.8 %	Avg. daily commute	31.7 minutes
% over 65 years old	25.9 %		
** US decennial census figures*	***Asset Limited, Income Constrained, Employed (United Way of Michigan)*		
4. Peak Seasonal Population	*Peak seasonal population = population + (hotel rooms x2) + (camp/RV sites x4) + (vacant houses x6)*		
Hotel rooms	0	Vacant housing units	102
Campground & RV sites	68	Peak seasonal population	1,957
** WMSRDC research conducted in 2022*	*** 2021 American Community Survey 5-year Estimates*		
5. Housing			*Source: 2021 American Community Survey 5-year Estimates*
Housing units	554	Single units	372
Occupied housing units	452	Multi-units in structure	0
Vacant housing units	102	Mobile homes	182
6. Public Services			
Fire	- Ferry Township Fire Department, 2140 E. Main St. - DNR - Oceana Field Office, 1757 E. Hayes Rd. (M-20)		
Police	*- None identified*		
Wastewater	*- None identified*		
Water	*- None identified*		
Public transportation	*- None identified*		
Other	*- None identified*		
7. Critical Infrastructure			
Major roads	M-20		
Railroads	*- None identified*		
Bridges	M-20 over White River North Branch		
Airports	*- None identified*		
Shelters	*- None identified*		
Schools	*- None identified*		
Community medical facilities, Hospitals	*- None identified*		
Ambulance service	*- None identified*		
Dams	*- None identified*		
8. Economic Assets			

Major employers	- *None identified*
Power generation	- *None identified*
Electric transmission	Consumers Energy Power Line
Pipelines	- *None identified*
Commercial transportation	- *None identified*
9. Other Assets, Infrastructure, etc.	
Community facilities:	- Township of Ferry, 2154 E. Main St. - Oceana County Road Commission, 110 E. M-20 - Oceana County Transfer Station/ Recycling Center, 1600 E Hayes Rd (M-20)
Festivals:	Ferry Ghost Town Day (July)
Historic Sites:	- *None identified*

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



GOLDEN TOWNSHIP
Community Profile

1. Physical Features

Lakes	Lake Holiday, Silver Lake, Upper Silver Lake
Rivers	Lambricks Creek, Hunter Creek, Silver Creek
Notable features	- Silver Lake & Mears (unincorporated communities) - Lake Michigan shoreline & dune environment - Little Sable Point - Hart-Montague Trail State Park - Silver Lake State Park - Significant seasonal population increase
Land description	Agricultural community with residential and commercial land use concentrations in the Silver Lake and Mears areas; heavily forested along the north and south portions

2. Land Value: 2022 Real and Personal Equalized Valuations *Source: Oceana County Equalization Report 2022*

Agricultural	$10,385,500	Industrial	$42,300
Commercial	$19,997,500	Residential	$270,490,700
Total personal	$4,137,900		

3. Population Characteristics *Source: 2021 American Community Survey 5-year Estimates, unless noted*

Population estimate, 2021	1,707	% with disability	14.2 %
% change 2010 to 2020*	-4.7 %	% in poverty	5.6 %
Median age	56.4	ALICE households, 2021**	31 % (county)
% under 18 years old	15.6 %	Avg. daily commute	21.6 minutes
% over 65 years old	30.6 %		

** US decennial census figures* ***Asset Limited, Income Constrained, Employed (United Way of Michigan)*

4. Peak Seasonal Population *Peak seasonal population = population + (hotel rooms x2) + (camp/RV sites x4) + (vacant houses x6)*

Hotel rooms	156	Vacant housing units	1,625
Campground & RV sites	2,204	Peak seasonal population	20,585

** WMSRDC research conducted in 2022* *** 2021 American Community Survey 5-year Estimates*

5. Housing *Source: 2021 American Community Survey 5-year Estimates*

Housing units	2,389	Single units	1,771
Occupied housing units	764	Multi-units in structure	28
Vacant housing units	1,625	Mobile homes	590

6. Public Services

Fire	*- None identified*
Police	*- None identified*
Wastewater	*- None identified*
Water	Golden Pond Estates (community water system)
Public transportation	*- None identified*
Other	*- None identified*

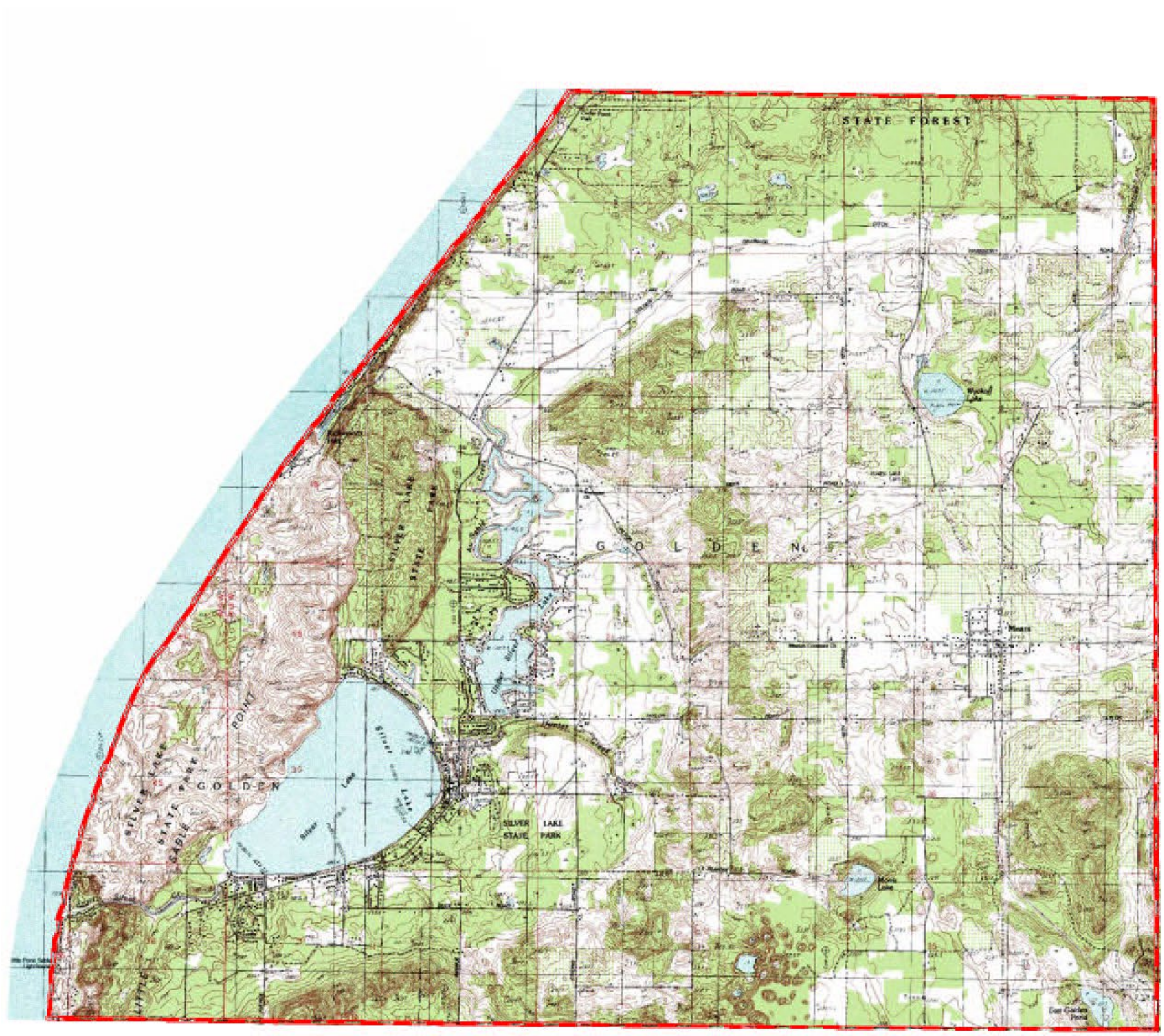
7. Critical Infrastructure

Major roads	B-15
Railroads	*- None identified*
Bridges	*- None identified*
Airports	*- None identified*
Shelters	*Shelters surveyed by Red Cross:* - None *Shelters that need to be surveyed by Red Cross:* - Golden Township Hall, 5527 W. Fox Rd, Mears, MI 49436

Schools	- *None identified*
Community medical facilities, Hospitals	- *None identified*
Ambulance service	- *None identified*
Dams	- Lake Holiday Dam - Silver Lake Level Control Structure - Upper Silver Lake Dam
8. Economic Assets	
Major employers	- *None identified*
Power generation	- *None identified*
Electric transmission	- *None identified*
Pipelines	Natural gas pipeline & 30,000 gal storage tank, serving Lake Holiday & Upper Silver Lake
Commercial transportation	- *None identified*
9. Other Assets, Infrastructure, etc.	
Community facilities:	Golden Township Hall, 5527 W Fox Rd
Festivals:	- Jeep Invasion (1st weekend June) - Hero on the Dunes (July) - Mears Art Fair (3rd Saturday July) - Silver Lake Sand Dunes Apple & BBQ Festival (September) - Hippie Fest (Fall) -On the Farm (Spring and Fall)
Historic Sites:	Charles Mears Silver Lake Boardinghouse, SE Corner of Lighthouse & Silver Lake Channel roads

Land Use and Natural Features Map (USGS Quad.)

GOLDEN TOWNSHIP



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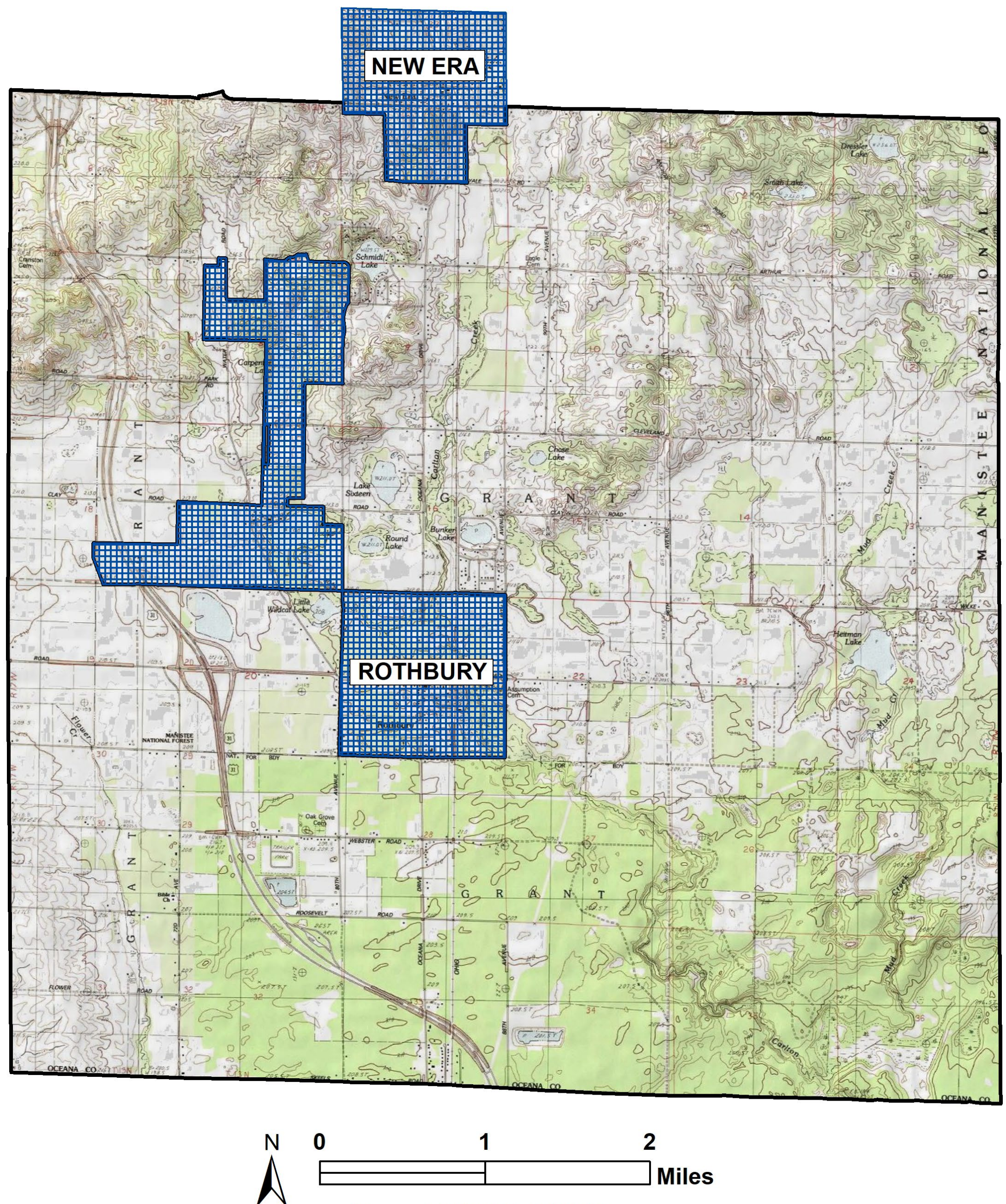
Source: Michigan Geographic Data Library
Created by WMSRDC
September 2004

GRANT TOWNSHIP
Community Profile

1. Physical Features			
Lakes	A few small lakes		
Rivers	*- None identified*		
Notable features	- Village of Rothbury and part of Village of New Era - Manistee National Forest - Hart Montague Trail State Park - Double JJ Resort - Electric Forest Festival		
Land description	Rural agricultural community with pockets of residential development and dense forests in the SE corner of the township		
2. Land Value: 2022 Real and Personal Equalized Valuations	*Source: Oceana County Equalization Report 2022*		
Agricultural	$10,496,700	Industrial	$2,845,500
Commercial	$8,845,400	Residential	$76,547,500
Total personal	$7,766,500		
3. Population Characteristics	*Source: 2021 American Community Survey 5-year Estimates, unless noted*		
Population estimate, 2021	3,000	% with disability	14.9 %
% change 2010 to 2020*	+0.9 %	% in poverty	18.9 %
Median age	38.6	ALICE households, 2021**	31 % (county)
% under 18 years old	27.4 %	Avg. daily commute	21.5 minutes
% over 65 years old	14.2 %		
** US decennial census figures*	***Asset Limited, Income Constrained, Employed (United Way of Michigan)*		
4. Peak Seasonal Population	*Peak seasonal population = population + (hotel rooms x2) + (camp/RV sites x4) + (vacant houses x6)*		
Hotel rooms	245	Vacant housing units	172
Campground & RV sites	178	Peak seasonal population***	5,234
** WMSRDC research conducted in 2022*	*** 2021 American Community Survey 5-year Estimates* ****includes Village of Rothbury and part of Village of New Era; add approximately 40,000 additional people for Electric Forest Festival*		
5. Housing	*Source: 2021 American Community Survey 5-year Estimates*		
Housing units	1,176	Single units	827
Occupied housing units	1,004	Multi-units in structure	25
Vacant housing units	172	Mobile homes	324
6. Public Services			
Fire	Grant Township Fire Department, 7140 S. Oceana Dr		
Police	*- None identified*		
Wastewater	*- None identified*		
Water	*- None identified*		
Public transportation	*- None identified*		
Other	*- None identified*		
7. Critical Infrastructure			
Major roads	US-31, M-20		
Railroads	*- None identified*		
Bridges	M-20 over US-31		
Airports	*- None identified*		
Shelters	*- None identified*		
Schools	*- None identified*		
Community medical facilities, Hospitals	*- None identified*		

Ambulance service	- *None identified*
Dams	- *None identified*
8. Economic Assets	
Major employers	Double JJ Resort
Power generation	- *None identified*
Electric transmission	- *None identified*
Pipelines	Natural gas pipeline
Commercial transportation	- *None identified*
9. Other Assets, Infrastructure, etc.	
Community facilities:	Township of Grant, 7140 S. Oceana Dr
Festivals:	Electric Forest Music Festival (June)
Historic Sites:	- *None identified*

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



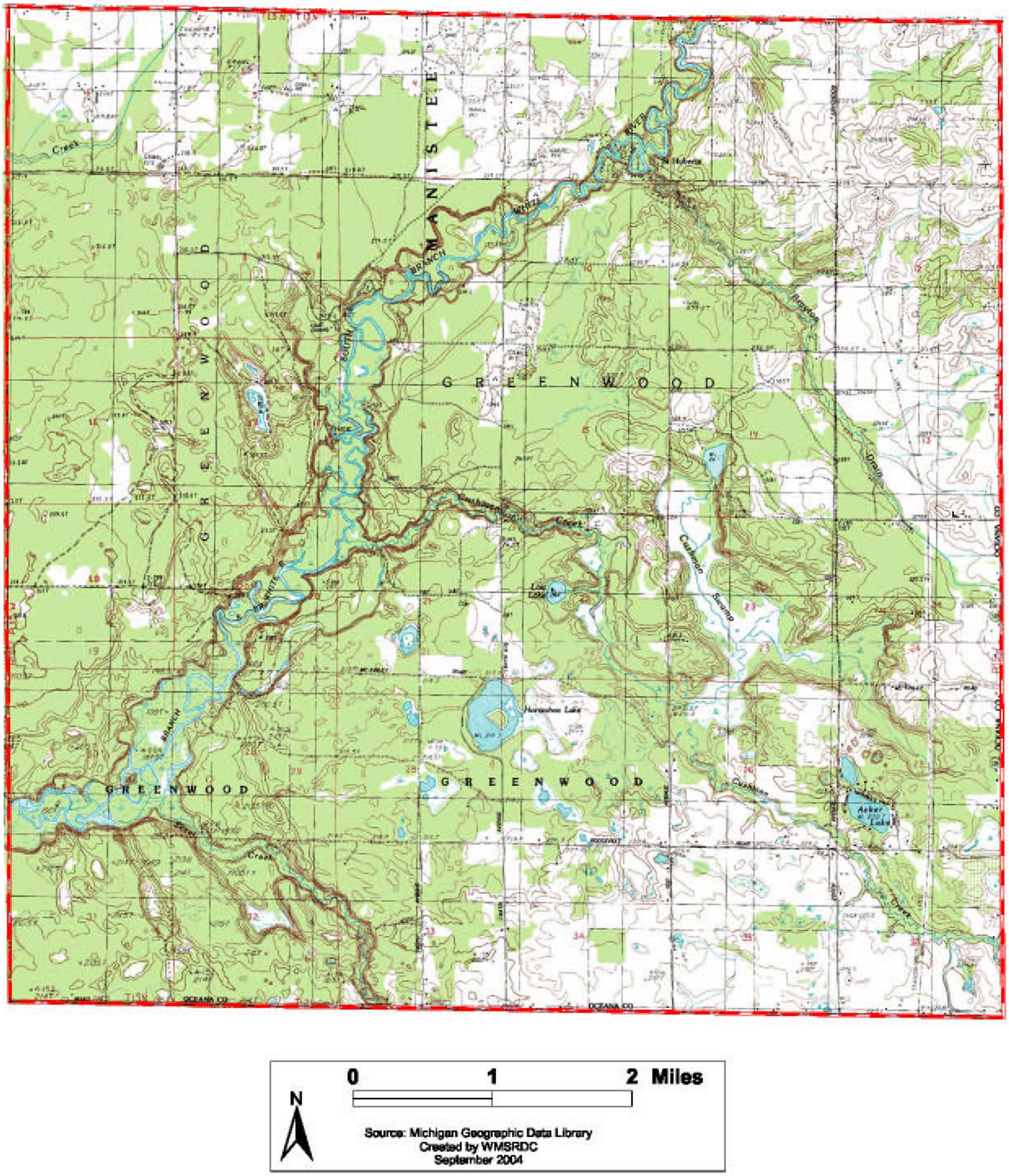
Map created 9/2023 by WMSRDC.
Data Source: USGS and WMSRDC

GREENWOOD TOWNSHIP
Community Profile

1. Physical Features			
Lakes	Acker Lake		
Rivers	White River		
Notable features	- Manistee National Forest - Michigan Natural River (White River)		
Land description	Mostly forested with scattered residential and agricultural land uses along the north, east, and south peripheries. Residential pockets around Acker Lake and St. Hubert's subdivision on White River		
2. Land Value: 2022 Real and Personal Equalized Valuations			*Source: Oceana County Equalization Report 2022*
Agricultural	$7,660,900	Industrial	$600,800
Commercial	$837,700	Residential	$37,001,500
Total personal	$1,554,800		
3. Population Characteristics			*Source: 2021 American Community Survey 5-year Estimates, unless noted*
Population estimate, 2021	1,410	% with disability	12.1 %
% change 2010 to 2020*	-2.4 %	% in poverty	18.1 %
Median age	34.8	ALICE households, 2021**	31 % (county)
% under 18 years old	27.9 %	Avg. daily commute	24.7 minutes
% over 65 years old	9.9 %		
** US decennial census figures*	***Asset Limited, Income Constrained, Employed (United Way of Michigan)*		
4. Peak Seasonal Population			*Peak seasonal population = population + (hotel rooms x2) + (camp/RV sites x4) + (vacant houses x6)*
Hotel rooms	0	Vacant housing units	151
Campground & RV sites	5	Peak seasonal population	2,336
** WMSRDC research conducted in 2022*	*** 2021 American Community Survey 5-year Estimates*		
5. Housing			*Source: 2021 American Community Survey 5-year Estimates*
Housing units	601	Single units	462
Occupied housing units	450	Multi-units in structure	3
Vacant housing units	151	Mobile homes	136
6. Public Services			
Fire	*- None identified*		
Police	*- None identified*		
Wastewater	*- None identified*		
Water	*- None identified*		
Public transportation	*- None identified*		
Other	*- None identified*		
7. Critical Infrastructure			
Major roads	- B86 - M120		
Railroads	*- None identified*		
Bridges	Garfield Rd over White River		
Airports	*- None identified*		
Shelters	*- None identified*		
Schools	*- None identified*		
Community medical facilities, Hospitals	*- None identified*		
Ambulance service	*- None identified*		

Dams	*- None identified*
8. Economic Assets	
Major employers	*- None identified*
Power generation	*- None identified*
Electric transmission	Consumers Energy Power Line
Pipelines	*- None identified*
Commercial transportation	*- None identified*
9. Other Assets, Infrastructure, etc.	
Community facilities:	Township of Greenwood, 5589 S. 200th Ave
Festivals:	*- None identified*
Historic Sites:	*- None identified*

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



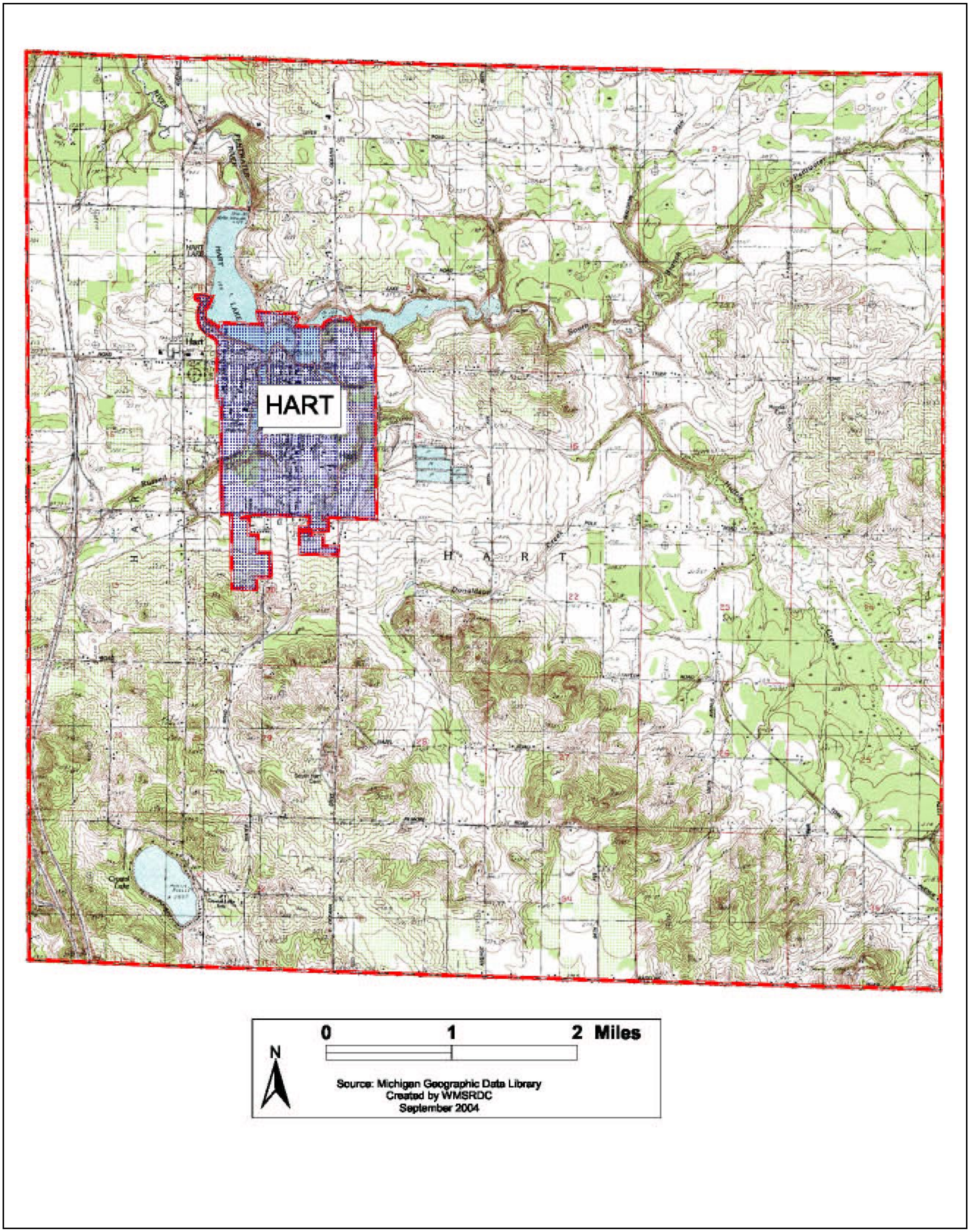
HART TOWNSHIP
Community Profile

1. Physical Features			
Lakes	Crystal Lake, Hart Lake		
Rivers	Pentwater River		
Notable features	- City of Hart - Hart-Montague Trail State Park		
Land description	Agricultural community with residential concentrations along Crystal and Hart lakes and to the west of the City of Hart		
2. Land Value: 2022 Real and Personal Equalized Valuations			*Source: Oceana County Equalization Report 2022*
Agricultural	$22,706,600	Industrial	$14,554,100
Commercial	$2,452,000	Residential	$64,768,700
Total personal	$13,497,900		
3. Population Characteristics			*Source: 2021 American Community Survey 5-year Estimates, unless noted*
Population estimate, 2021	1,633	% with disability	20.8 %
% change 2010 to 2020*	+9.4 %	% in poverty	10 %
Median age	55	ALICE households, 2021**	31 % (county)
% under 18 years old	15.2 %	Avg. daily commute	16.3 minutes
% over 65 years old	27.3 %		
** US decennial census figures*	***Asset Limited, Income Constrained, Employed (United Way of Michigan)*		
4. Peak Seasonal Population			*Peak seasonal population = population + (hotel rooms x2) + (camp/RV sites x4) + (vacant houses x6)*
Hotel rooms	17	Vacant housing units	168
Campground & RV sites	0	Peak seasonal population	2,675
** WMSRDC research conducted in 2022*	*** 2021 American Community Survey 5-year Estimates*		
5. Housing			*Source: 2021 American Community Survey 5-year Estimates*
Housing units	889	Single units	776
Occupied housing units	721	Multi-units in structure	36
Vacant housing units	168	Mobile homes	87
6. Public Services			
Fire	- *None identified*		
Police	- *None identified*		
Wastewater	- *None identified*		
Water	Oceana Acres (community water system)		
Public transportation	- *None identified*		
Other	- District 10 Health Department, 3886 N Oceana Dr - Oceana County Council on Aging, 4250 W Tyler Rd - Oceana County Road Commission, 3501 W. Polk Rd		
7. Critical Infrastructure			
Major roads	US-31, Oceana Drive		
Railroads	- *None identified*		
Bridges	Oceana Drive over Hart Lake		
Airports	- *None identified*		
Shelters	- *None identified*		
Schools	Oceana Christian School, 3258 N. 72nd Ave.		
Community medical facilities, Hospitals	- *None identified*		
Ambulance service	Emergency Medical Services, 3988 N. Oceana Dr		

Dams	Hart Hydroelectric Dam
8. Economic Assets	
Major employers	Peterson Farms
Power generation	Hart Hydroelectric Dam
Electric transmission	Consumers Energy Power Line
Pipelines	Natural Gas Pipeline
Commercial transportation	- *None identified*
9. Other Assets, Infrastructure, etc.	
Community facilities:	Township of Hart, 3437 W. Polk Rd
Festivals:	- *None identified*
Historic Sites:	US-31 (Old) Pentwater River Bridge, Oceana Dr. over Pentwater River

Land Use and Natural Features Map (USGS Quad.)

HART TOWNSHIP

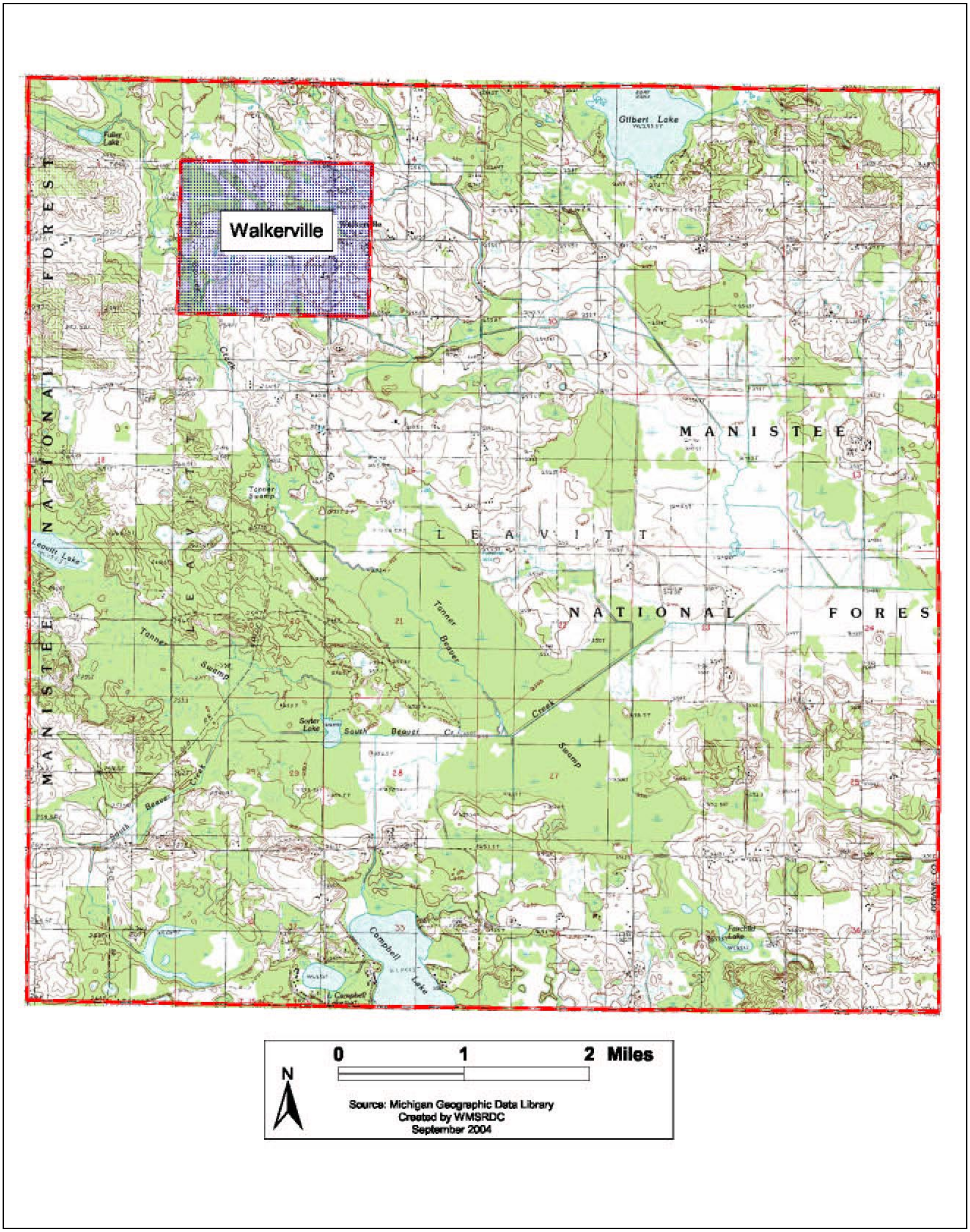


LEAVITT TOWNSHIP
Community Profile

1. Physical Features			
Lakes	Campbell Lake, Little Campbell Lake		
Rivers	*- None identified*		
Notable features	- Walkerville Village - Walkinshaw Wetlands - Manistee National Forest		
Land description	Rural agricultural community with dense forests		
2. Land Value: 2022 Real and Personal Equalized Valuations			*Source: Oceana County Equalization Report 2022*
Agricultural	$13,634,200	Industrial	$320,100
Commercial	$1,001,900	Residential	$20, 989,200
Total personal	$2,536,300		
3. Population Characteristics			*Source: 2021 American Community Survey 5-year Estimates, unless noted*
Population estimate, 2021	1,039	% with disability	26.7 %
% change 2010 to 2020*	+2.2 %	% in poverty	20.0 %
Median age	35.4	ALICE households, 2021**	31 % (county)
% under 18 years old	29.9 %	Avg. daily commute	28.2 minutes
% over 65 years old	13.9 %		
** US decennial census figures*	***Asset Limited, Income Constrained, Employed (United Way of Michigan)*		
4. Peak Seasonal Population			*Peak seasonal population = population + (hotel rooms x2) + (camp/RV sites x4) + (vacant houses x6)*
Hotel rooms	0	Vacant housing units	128
Campground & RV sites	0	Peak seasonal population***	1,807
** WMSRDC research conducted in 2022*	*** 2021 American Community Survey 5-year Estimates*		****includes Village of Walkerville*
5. Housing			*Source: 2021 American Community Survey 5-year Estimates*
Housing units	480	Single units	265
Occupied housing units	352	Multi-units in structure	0
Vacant housing units	128	Mobile homes	215
6. Public Services			
Fire	*- None identified*		
Police	*- None identified*		
Wastewater	*- None identified*		
Water	*- None identified*		
Public transportation	*- None identified*		
Other	*- None identified*		
7. Critical Infrastructure			
Major roads	*- None identified*		
Railroads	*- None identified*		
Bridges	*- None identified*		
Airports	*- None identified*		
Shelters	*- None identified*		
Schools	*- None identified*		
Community medical facilities, Hospitals	*- None identified*		
Ambulance service	*- None identified*		
Dams	*- None identified*		

8. Economic Assets	
Major employers	- *None identified*
Power generation	- *None identified*
Electric transmission	- Consumers Energy Transmission Line - Wolverine Power Transmission Line
Pipelines	Natural Gas Pipeline
Commercial transportation	- *None identified*
9. Other Assets, Infrastructure, etc.	
Community facilities:	Township of Leavitt, 2401 N. 184th Ave
Festivals:	- *None identified*
Historic Sites:	- *None identified*

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



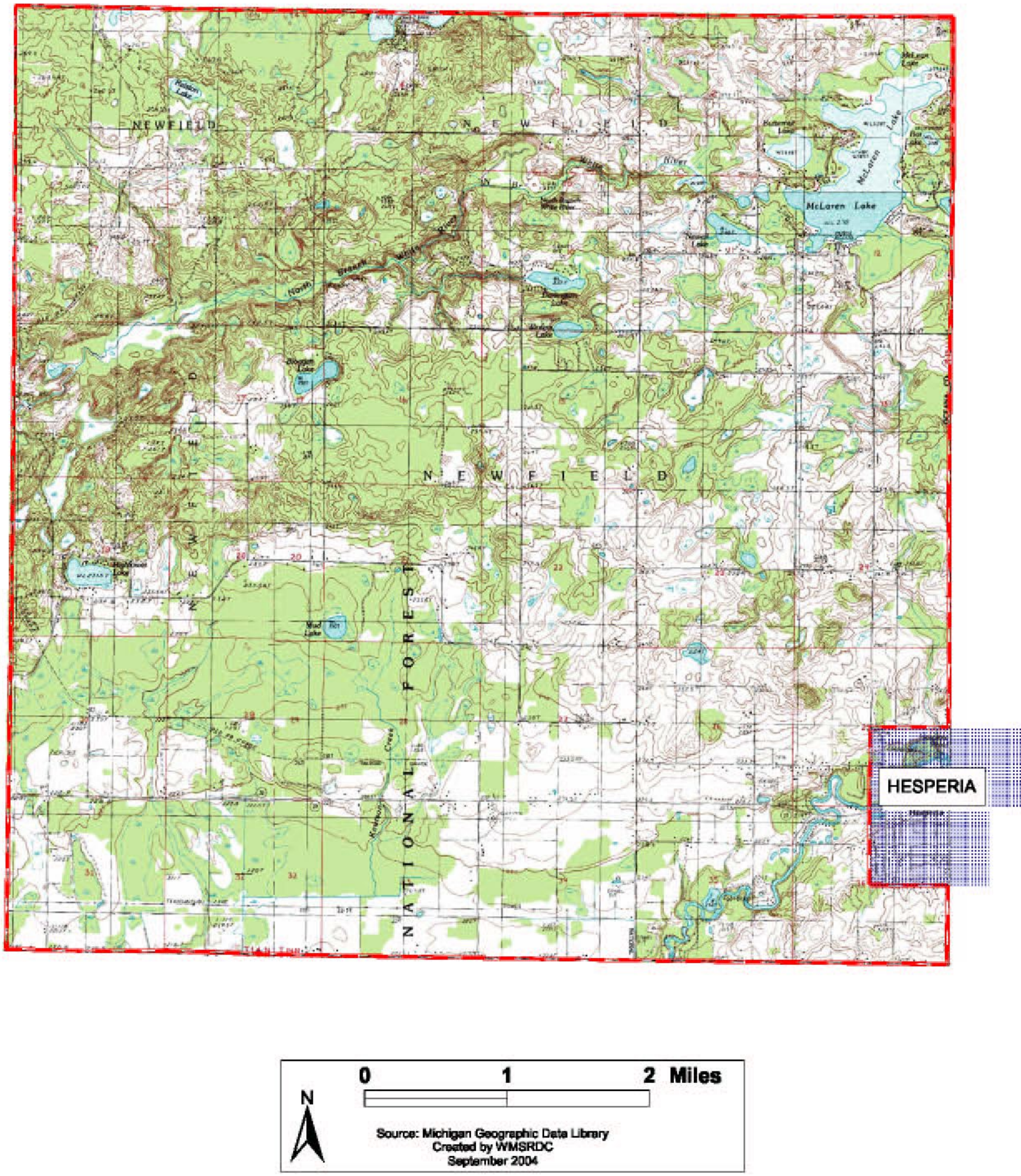
NEWFIELD TOWNSHIP
Community Profile

1. Physical Features			
Lakes	McLaren Lake, Campbell Lake, and a few smaller lakes		
Rivers	White River		
Notable features	- Village of Hesperia (part) - Manistee National Forest - Michigan Natural River (White River)		
Land description	Mainly forest and agriculture, with residential concentrations around many lakes		
2. Land Value: 2022 Real and Personal Equalized Valuations			*Source: Oceana County Equalization Report 2022*
Agricultural	$8,465,300	Industrial	$391,300
Commercial	$4,472,700	Residential	$85,954,800
Total personal	$1,896,100		
3. Population Characteristics			*Source: 2021 American Community Survey 5-year Estimates, unless noted*
Population estimate, 2021	2,078	% with disability	20.6 %
% change 2010 to 2020*	-3.0 %	% in poverty	8.7 %
Median age	46.0	ALICE households, 2021**	31 % (county)
% under 18 years old	22.9 %	Avg. daily commute	28.8 minutes
% over 65 years old	20.4 %		
** US decennial census figures*	***Asset Limited, Income Constrained, Employed (United Way of Michigan)*		
4. Peak Seasonal Population	*Peak seasonal population = population + (hotel rooms x2) + (camp/RV sites x4) + (vacant houses x6)*		
Hotel rooms	8	Vacant housing units	415
Campground & RV sites	49	Peak seasonal population***	4,780
** WMSRDC research conducted in 2022*	*** 2021 American Community Survey 5-year Estimates*		****includes Village of Hesperia*
5. Housing			*Source: 2021 American Community Survey 5-year Estimates*
Housing units	1,149	Single units	883
Occupied housing units	734	Multi-units in structure	132
Vacant housing units	415	Mobile homes	234
6. Public Services			
Fire	Hesperia Area Fire Department, 8320 E. M-20		
Police	- *None identified*		
Wastewater	- *None identified*		
Water	- *None identified*		
Public transportation	- *None identified*		
Other	- *None identified*		
7. Critical Infrastructure			
Major roads	M-20, M-120		
Railroads	- *None identified*		
Bridges	M-20 over White River		
Airports	- *None identified*		
Shelters	- *None identified*		
Schools	- *None identified*		
Community medical facilities, Hospitals	- *None identified*		
Ambulance service	- *None identified*		
Dams	- *None identified*		

8. Economic Assets	
Major employers	- *None identified*
Power generation	- *None identified*
Electric transmission	Consumers Energy Power Line
Pipelines	- *None identified*
Commercial transportation	- *None identified*
9. Other Assets, Infrastructure, etc.	
Community facilities:	Township of Newfield, 3890 198th Ave
Festivals:	- *None identified*
Historic Sites:	- *None identified*

Land Use and Natural Features Map (USGS Quad.)

NEWFIELD TOWNSHIP

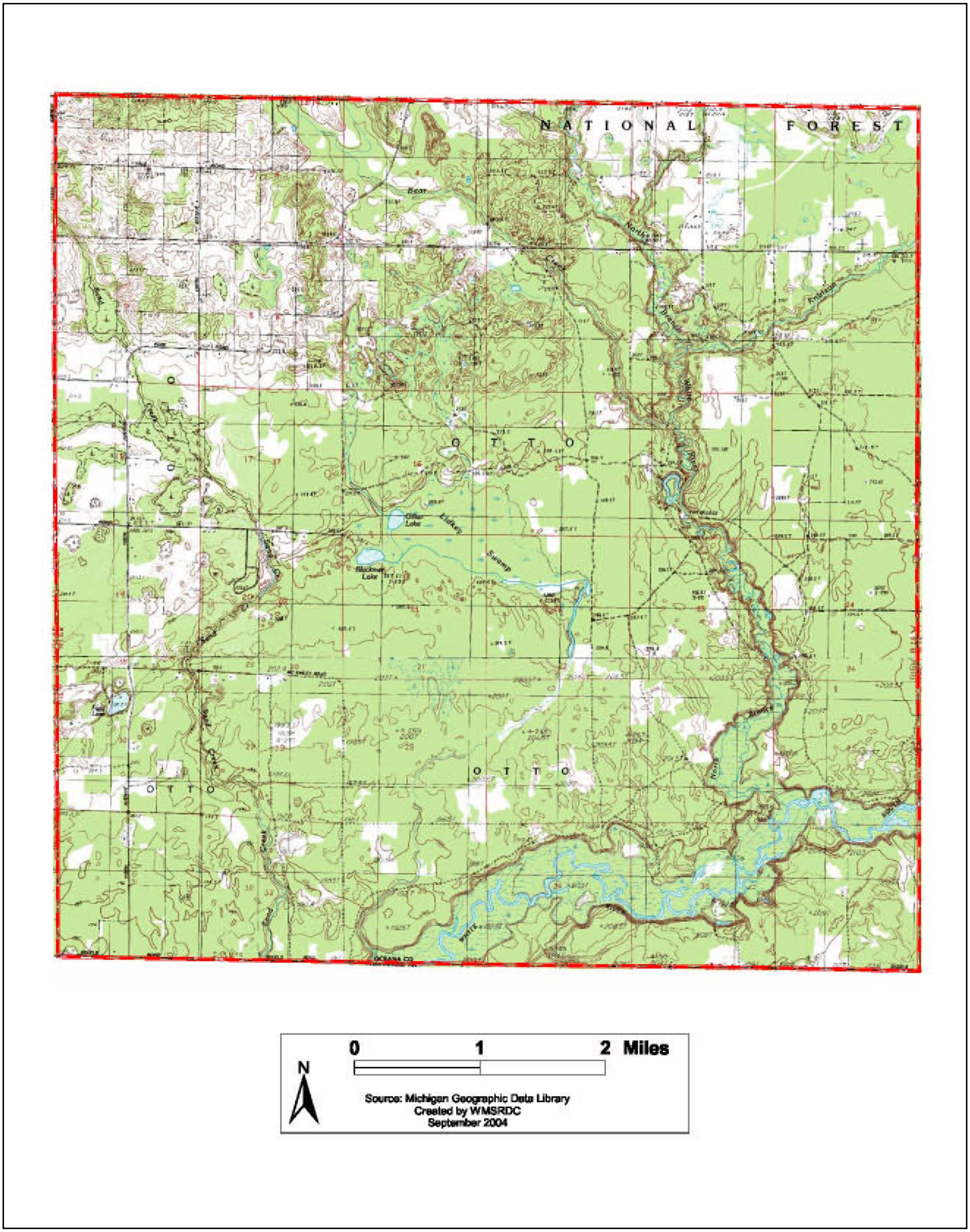


OTTO TOWNSHIP Community Profile			
1. Physical Features			
Lakes	- *None identified*		
Rivers	White River		
Notable features	- Manistee National Forest - Michigan Natural River (White River)		
Land description	Mostly forested with some agriculture and scattered residential uses		
2. Land Value: 2022 Real and Personal Equalized Valuations			*Source: Oceana County Equalization Report 2022*
Agricultural	$3,545,800	Industrial	$13,900
Commercial	$68,300	Residential	$29,600,800
Total personal	$2,912,100		
3. Population Characteristics			*Source: 2021 American Community Survey 5-year Estimates, unless noted*
Population estimate, 2021	763	% with disability	14.2 %
% change 2010 to 2020*	+3.9 %	% in poverty	14.3 %
Median age	41.4	ALICE households, 2021**	31 % (county)
% under 18 years old	21.0 %	Avg. daily commute	34.3 minutes
% over 65 years old	10.7 %		
** US decennial census figures*	***Asset Limited, Income Constrained, Employed (United Way of Michigan)*		
4. Peak Seasonal Population			*Peak seasonal population = population + (hotel rooms x2) + (camp/RV sites x4) + (vacant houses x6)*
Hotel rooms	0	Vacant housing units	103
Campground & RV sites	2	Peak seasonal population	1,389
** WMSRDC research conducted in 2022*	*** 2021 American Community Survey 5-year Estimates*		
5. Housing			*Source: 2021 American Community Survey 5-year Estimates*
Housing units	368	Single units	240
Occupied housing units	265	Multi-units in structure	0
Vacant housing units	103	Mobile homes	128
6. Public Services			
Fire	- *None identified*		
Police	- *None identified*		
Wastewater	- *None identified*		
Water	- *None identified*		
Public transportation	- *None identified*		
Other	- *None identified*		
7. Critical Infrastructure			
Major roads	B-86		
Railroads	- *None identified*		
Bridges	- *None identified*		
Airports	- *None identified*		
Shelters	- *None identified*		
Schools	- *None identified*		
Community medical facilities, Hospitals	- *None identified*		
Ambulance service	- *None identified*		
Dams	- *None identified*		
8. Economic Assets			

Major employers	- *None identified*
Power generation	- *None identified*
Electric transmission	- *None identified*
Pipelines	- *None identified*
Commercial transportation	- *None identified*
9. Other Assets, Infrastructure, etc.	
Community facilities:	Township of Otto, 5458 S. 128th Ave
Festivals:	- *None identified*
Historic Sites:	- *None identified*

Land Use and Natural Features Map (USGS Quad.)

OTTO TOWNSHIP



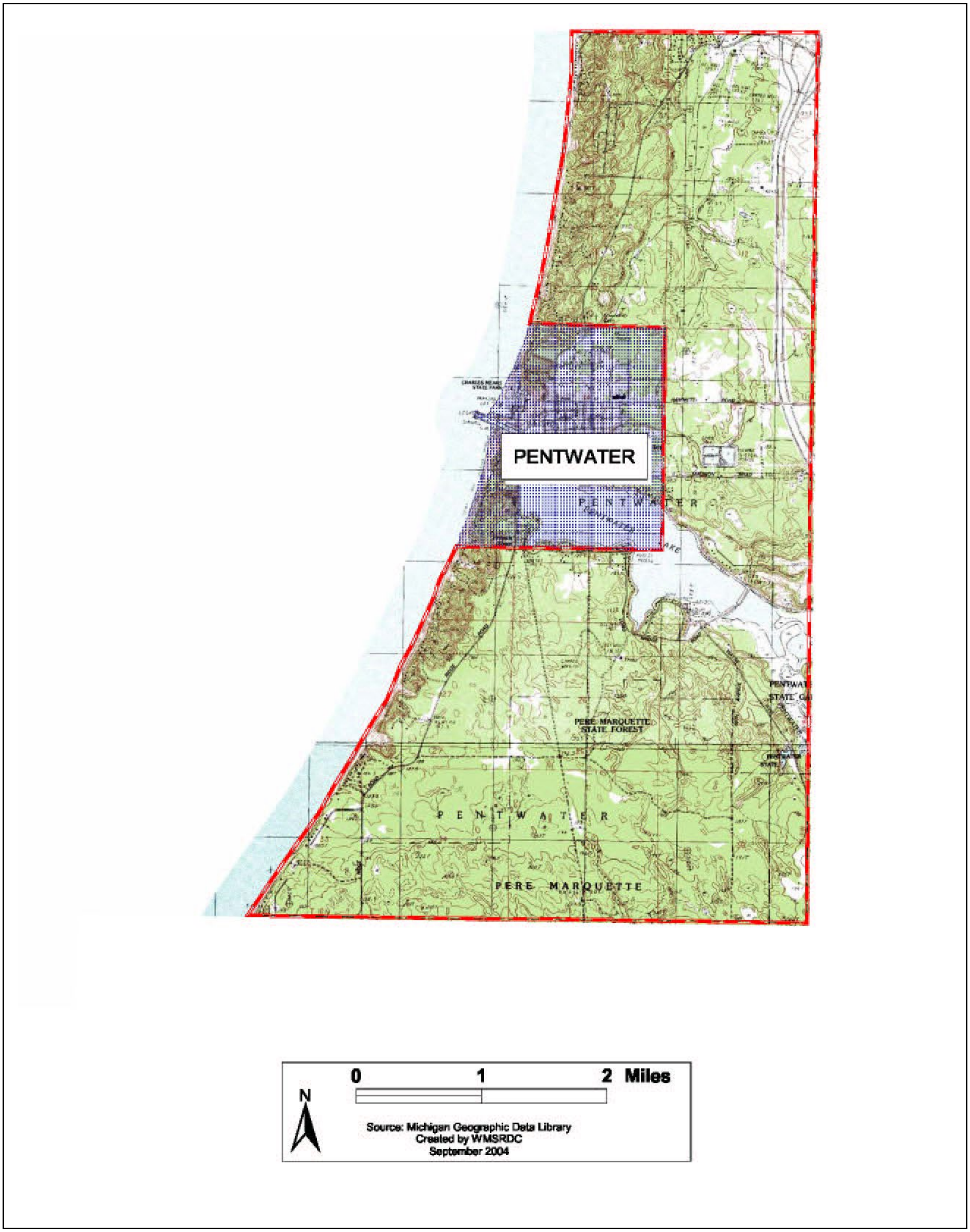
PENTWATER TOWNSHIP
Community Profile

1. Physical Features			
Lakes	Pentwater Lake		
Rivers	Pentwater River		
Notable features	- Village of Pentwater - Lake Michigan shoreline & dune environment - Pentwater River State Game Area		
Land description	Pentwater Lake and to the north: residential and commercial development concentrations around Pentwater Lake, Village of Pentwater, and along Business 31. Elsewhere: Mainly forested with scattered residential uses		
2. Land Value: 2022 Real and Personal Equalized Valuations		*Source: Oceana County Equalization Report 2022*	
Agricultural	$0	Industrial	$276,300
Commercial	$12,986,800	Residential	$328,998,100
Total personal	$3,733,100		
3. Population Characteristics		*Source: 2021 American Community Survey 5-year Estimates, unless noted*	
Population estimate, 2021	1,704	% with disability	17.8 %
% change 2010 to 2020*	+9.0 %	% in poverty	6.9 %
Median age	64.9	ALICE households, 2021**	31 % (county)
% under 18 years old	11.0 %	Avg. daily commute	23.4 minutes
% over 65 years old	49.7 %		
** US decennial census figures*	***Asset Limited, Income Constrained, Employed (United Way of Michigan)*		
4. Peak Seasonal Population	*Peak seasonal population = population + (hotel rooms x2) + (camp/RV sites x4) + (vacant houses x6)*		
Hotel rooms	25	Vacant housing units	982
Campground & RV sites	544	Peak seasonal population***	9,822
** WMSRDC research conducted in 2022*	*** 2021 American Community Survey 5-year Estimates*	****includes Village of Pentwater*	
5. Housing		*Source: 2021 American Community Survey 5-year Estimates*	
Housing units	1,758	Single units	1,606
Occupied housing units	776	Multi-units in structure	113
Vacant housing units	982	Mobile homes	39
6. Public Services			
Fire	- *None identified*		
Police	- *None identified*		
Wastewater	- *None identified*		
Water	- *None identified*		
Public transportation	- *None identified*		
Other	- *None identified*		
7. Critical Infrastructure			
Major roads	US-31, Business US-31, B-15		
Railroads	- *None identified*		
Bridges	Business US-31 over Bass Lake, B-15 (Longbridge Rd) over Pentwater Lake		
Airports	- *None identified*		
Shelters	*Shelters surveyed by Red Cross:* - None *Shelters that need to be surveyed by Red Cross:* - Pentwater VFW Hall, 8440 N. US 31, Pentwater, MI 49449		
Schools	- *None identified*		
Community medical facilities,	- *None identified*		

Hospitals	
Ambulance service	- *None identified*
Dams	- *None identified*
8. Economic Assets	
Major employers	- *None identified*
Power generation	- *None identified*
Electric transmission	- *None identified*
Pipelines	- *None identified*
Commercial transportation	- *None identified*
9. Other Assets, Infrastructure, etc.	
Community facilities:	Pentwater Township Office, 500 N. Hancock St (in Village of Pentwater)
Festivals:	- *None identified*
Historic Sites:	- Dumaw Creek Site - Green Quarry Site (somewhere near Pentwater)

Land Use and Natural Features Map (USGS Quad.)

PENTWATER TOWNSHIP

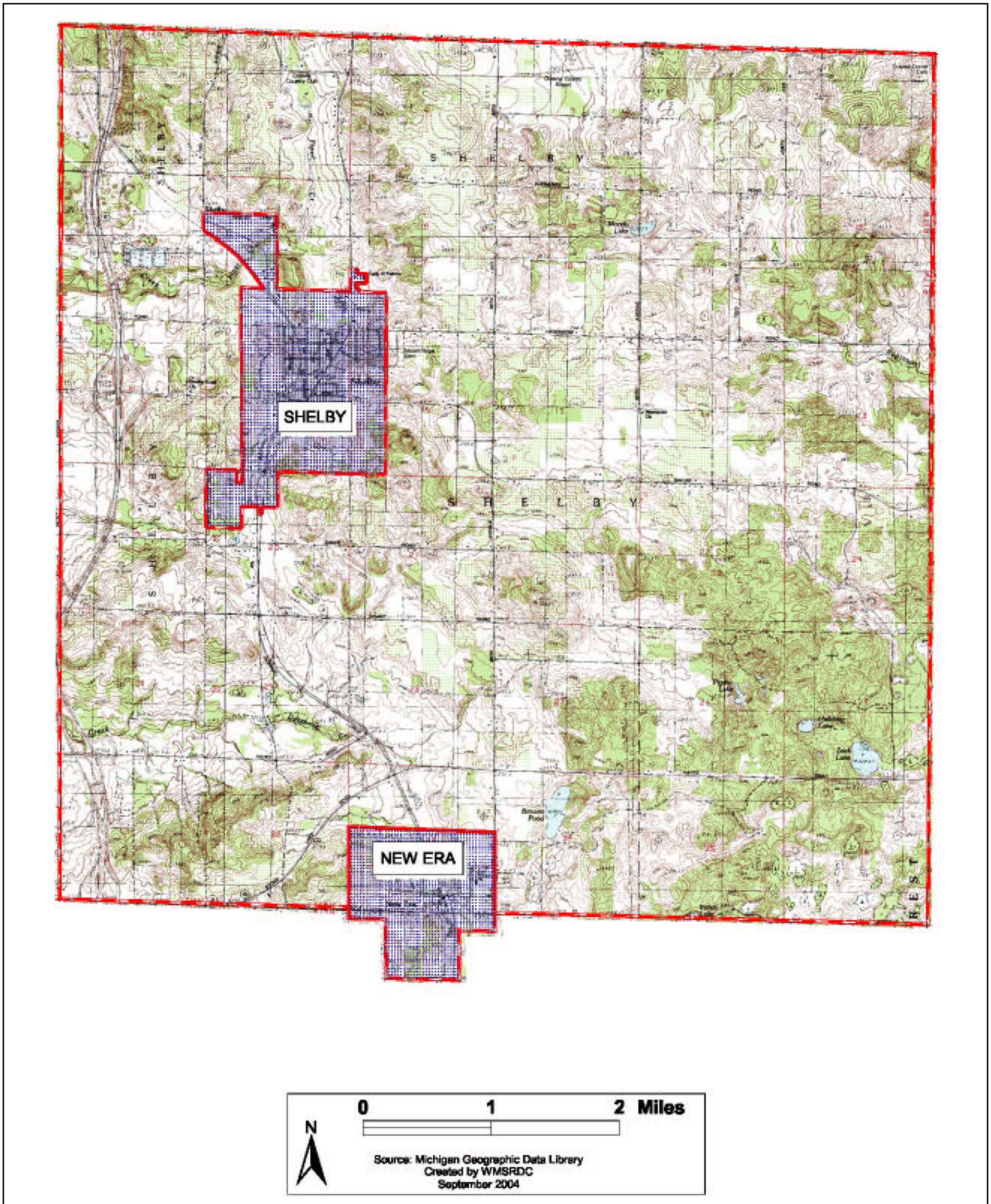


SHELBY TOWNSHIP
Community Profile

1. Physical Features			
Lakes	*- None identified*		
Rivers	*- None identified*		
Notable features	- Village of Shelby - Village of New Era (part) - Hart-Montague Trail State Park - Manistee National Forest		
Land description	Primarily rural agricultural community with dense forests to the east and southeast		
2. Land Value: 2022 Real and Personal Equalized Valuations			*Source: Oceana County Equalization Report 2022*
Agricultural	$15,597,800	Industrial	$5,706,500
Commercial	$25,681,300	Residential	$90,246,100
Total personal	$8,831,900		
3. Population Characteristics			*Source: 2021 American Community Survey 5-year Estimates, unless noted*
Population estimate, 2021	4,086	% with disability	9.9 %
% change 2010 to 2020*	+1.0 %	% in poverty	11.3 %
Median age	34.1	ALICE households, 2021**	31 % (county)
% under 18 years old	28.6 %	Avg. daily commute	18.6 minutes
% over 65 years old	14.0 %		
** US decennial census figures*	***Asset Limited, Income Constrained, Employed (United Way of Michigan)*		
4. Peak Seasonal Population			*Peak seasonal population = population + (hotel rooms x2) + (camp/RV sites x4) + (vacant houses x6)*
Hotel rooms	0	Vacant housing units	233
Campground & RV sites	0	Peak seasonal population***	5,484
** WMSRDC research conducted in 2022*	*** 2021 American Community Survey 5-year Estimates*		
****includes Village of Shelby and part of Village of New Era*			
5. Housing			*Source: 2021 American Community Survey 5-year Estimates*
Housing units	1,626	Single units	1,300
Occupied housing units	1,393	Multi-units in structure	157
Vacant housing units	233	Mobile homes	169
6. Public Services			
Fire	*- None identified*		
Police	*- None identified*		
Wastewater	*- None identified*		
Water	*- None identified*		
Public transportation	*- None identified*		
Other	Oceana County Animal Shelter, 2185 Baseline Rd		
7. Critical Infrastructure			
Major roads	US-31, M-20, Oceana Drive		
Railroads	*- None identified*		
Bridges	M-20 over US-31		
Airports	Oceana County Airport (Hart-Shelby), 1805 W. Baseline Rd.		
Shelters	*- None identified*		
Schools	*- None identified*		
Community medical facilities, Hospitals	*- None identified*		

Ambulance service	- *None identified*
Dams	- *None identified*
8. Economic Assets	
Major employers	Peterson Farms
Power generation	- *None identified*
Electric transmission	- *None identified*
Pipelines	Natural Gas Pipeline
Commercial transportation	- *None identified*
9. Other Assets, Infrastructure, etc.	
Community facilities:	Township of Shelby, 198 N. Michigan Ave (in Village of Shelby)
Festivals:	- *None identified*
Historic Sites:	- *None identified*

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



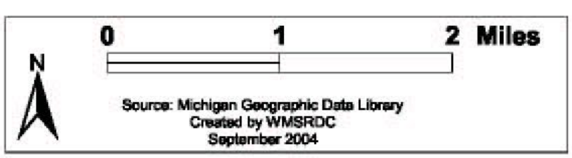
WEARE TOWNSHIP
Community Profile

1. Physical Features			
Lakes	*- None identified*		
Rivers	North Branch Pentwater River, South Branch Pentwater River		
Notable features	- Manistee National Forest - Pentwater River State Game Area		
Land description	Rural agricultural community with forested wetlands feeding Pentwater River		
2. Land Value: 2022 Real and Personal Equalized Valuations			*Source: Oceana County Equalization Report 2022*
Agricultural	$17,560,800	Industrial	$418,500
Commercial	$4,120,000	Residential	$50,124,500
Total personal	$5,335,000		
3. Population Characteristics			*Source: 2021 American Community Survey 5-year Estimates, unless noted*
Population estimate, 2021	1,311	% with disability	15.6 %
% change 2010 to 2020*	+1.2 %	% in poverty	13.3 %
Median age	38.3	ALICE households, 2021**	31 % (county)
% under 18 years old	22.8 %	Avg. daily commute	29.8 minutes
% over 65 years old	15.3 %		
** US decennial census figures*	***Asset Limited, Income Constrained, Employed (United Way of Michigan)*		
4. Peak Seasonal Population			*Peak seasonal population = population + (hotel rooms x2) + (camp/RV sites x4) + (vacant houses x6)*
Hotel rooms	0	Vacant housing units	100
Campground & RV sites	0	Peak seasonal population	1,911
** WMSRDC research conducted in 2022*	*** 2021 American Community Survey 5-year Estimates*		
5. Housing			*Source: 2021 American Community Survey 5-year Estimates*
Housing units	526	Single units	368
Occupied housing units	426	Multi-units in structure	4
Vacant housing units	100	Mobile homes	154
6. Public Services			
Fire	*- None identified*		
Police	Mason-Oceana 911 Central Dispatch, 9160 N. Oceana Drive		
Wastewater	*- None identified*		
Water	Hylander Valley (community water system)		
Public transportation	*- None identified*		
Other	MSU AgBioResearch West Central Michigan Research and Extension Center, 5185 N Oceana Drive		
7. Critical Infrastructure			
Major roads	US-31, Business US-31, Oceana Drive		
Railroads	*- None identified*		
Bridges	- US-31 over Pentwater River North and South branches - Business US-31 (Monroe Rd) over North Branch Pentwater River - Oceana Drive over North Branch Pentwater River - Hammett Rd over North Branch Pentwater River		
Airports	*- None identified*		
Shelters	*Shelters surveyed by Red Cross:* - St. Joseph Catholic Church Hall, 2349 Jackson Rd		
Schools	*- None identified*		
Community medical facilities, Hospitals	*- None identified*		

Ambulance service	- *None identified*
Dams	- *None identified*
8. Economic Assets	
Major employers	- *None identified*
Power generation	Consumers Energy Power Line
Electric transmission	- *None identified*
Pipelines	Natural Gas Pipeline
Commercial transportation	- *None identified*
9. Other Assets, Infrastructure, etc.	
Community facilities:	Weare Township Hall, 6506 N. Oceana Drive
Festivals:	- *None identified*
Historic Sites:	- *None identified*

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:

NFIP Participation: (see individual communities) **FIRM Map Date: (see individual communities)**

Flood Insurance Policies In-Force: 65 **Total Flood Insurance Coverage: $12,844,300**

Floodplains and Flood-prone Areas: (see individual communities)

- 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.
- 2019-21: Lengthy high water event on Lake Michigan. High water record in 2020. Extensive shoreline erosion and property damage along Lake Michigan shoreline.

1.08 Hail:

- Severe hail events (1" or greater) recorded in Oceana County, 1996-2022: 16
- 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:

- July 26, 2023: Lightning strike sparked a fire at the Silver Lake Pizza Factory, forcing it to close down for the season to be gutted and renovated, Golden Township.

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.
- March 8, 2017: High wind. $10m Property damage across Oceana County.
- July 26, 2018: Severe thunderstorms. $20k property damage, Benona Township.
- August 28, 2018: Severe thunderstorms. $20k property damage, Golden Township.
- February 24, 2019: High wind. $1m property damage across Oceana County.
- November 10, 2020: Severe thunderstorms. $100k property damage across Oceana County.

1.12 Subsidence: - None Identified.

1.13 Tornadoes:

Number of tornadoes 1950-2022: 5 (0 deaths, 4 injuries)
- 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.
- April 14, 2018: Winter storm. $100k property damage across Oceana County.
- February 5, 2019: Ice storm. $1m property damage across Oceana County.

2. <u>TECHNOLOGICAL HAZARDS</u>

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 within the county in 2023: 75
- 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, 1993-2022: 36
- 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.
- March 8, 2017: Over 1 million without power (high wind), statewide.
- April 14, 2018: 450,000 without power (winter storm), statewide.
- February 5, 2019: 150,000 without power (ice storm), Central Lower Michigan.

- February 24, 2019: 1 million without power (high wind), statewide.

2.08 Nuclear Power Plant Emergencies: - None Identified.

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

1,624 oil and gas test well surface hole locations within Oceana County.

- 2 wells "Active" for: Gas Injection (1), Brine Disposal (1)

- 118 wells with known detectable levels of hydrogen sulfide in the townships of: Benona (12), Claybanks (33), Colfax (1), Crystal (2), Elbridge (5), Ferry (6), Golden (3), Grant (2), Hart (3), Otto (1), Pentwater (14), Shelby (1), Weare (36)

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.
- July 15, 2022: A private aircraft crashed shortly after takeoff from Oceana County Airport. 2 fatalities, Shelby 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:

- 2020 to current: Covid-19 Pandemic. Nearly 7 million confirmed deaths worldwide. 97 confirmed deaths in Oceana County as of July 11, 2023.

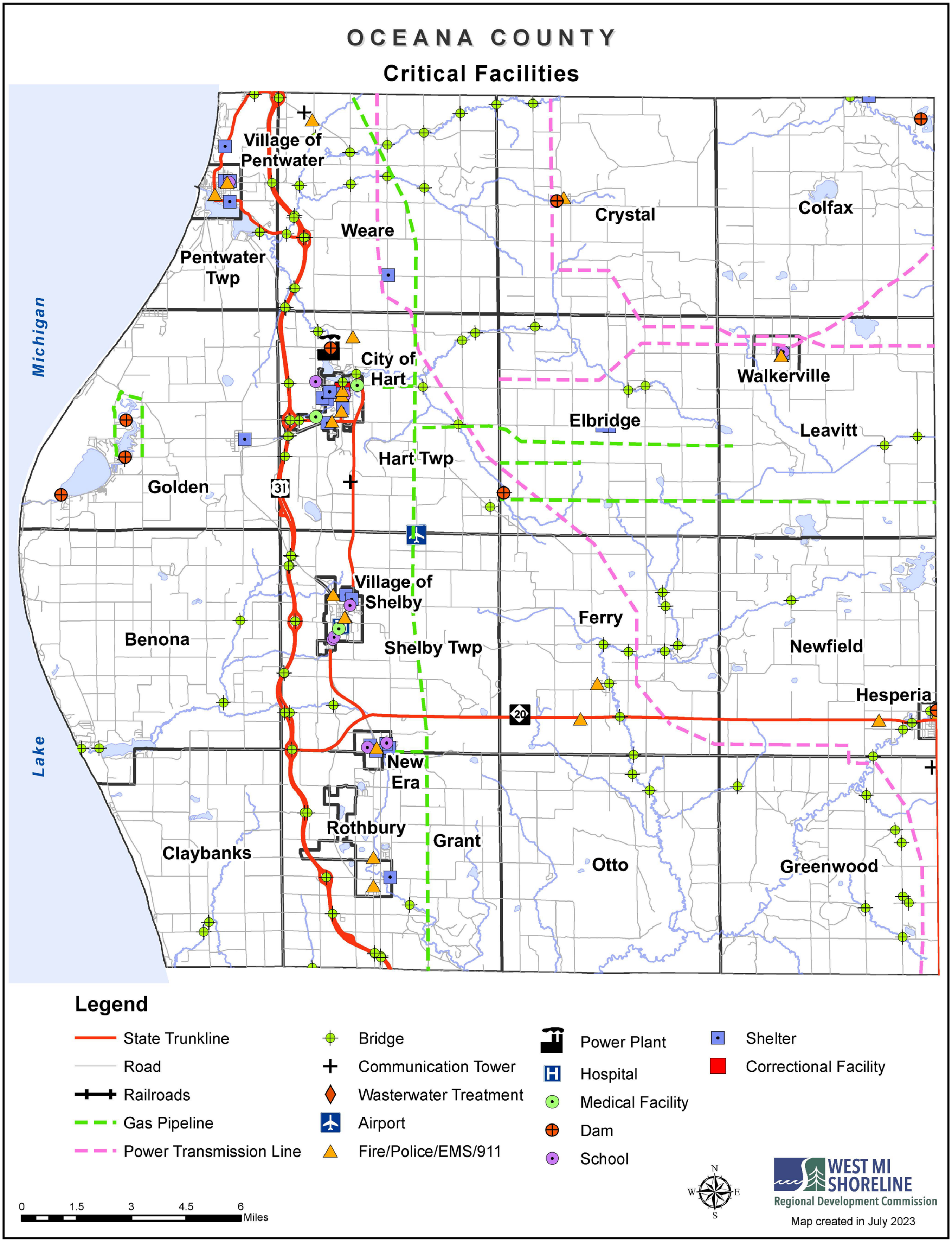
3.05 Terrorism and Similar Criminal Activities: - None Identified.

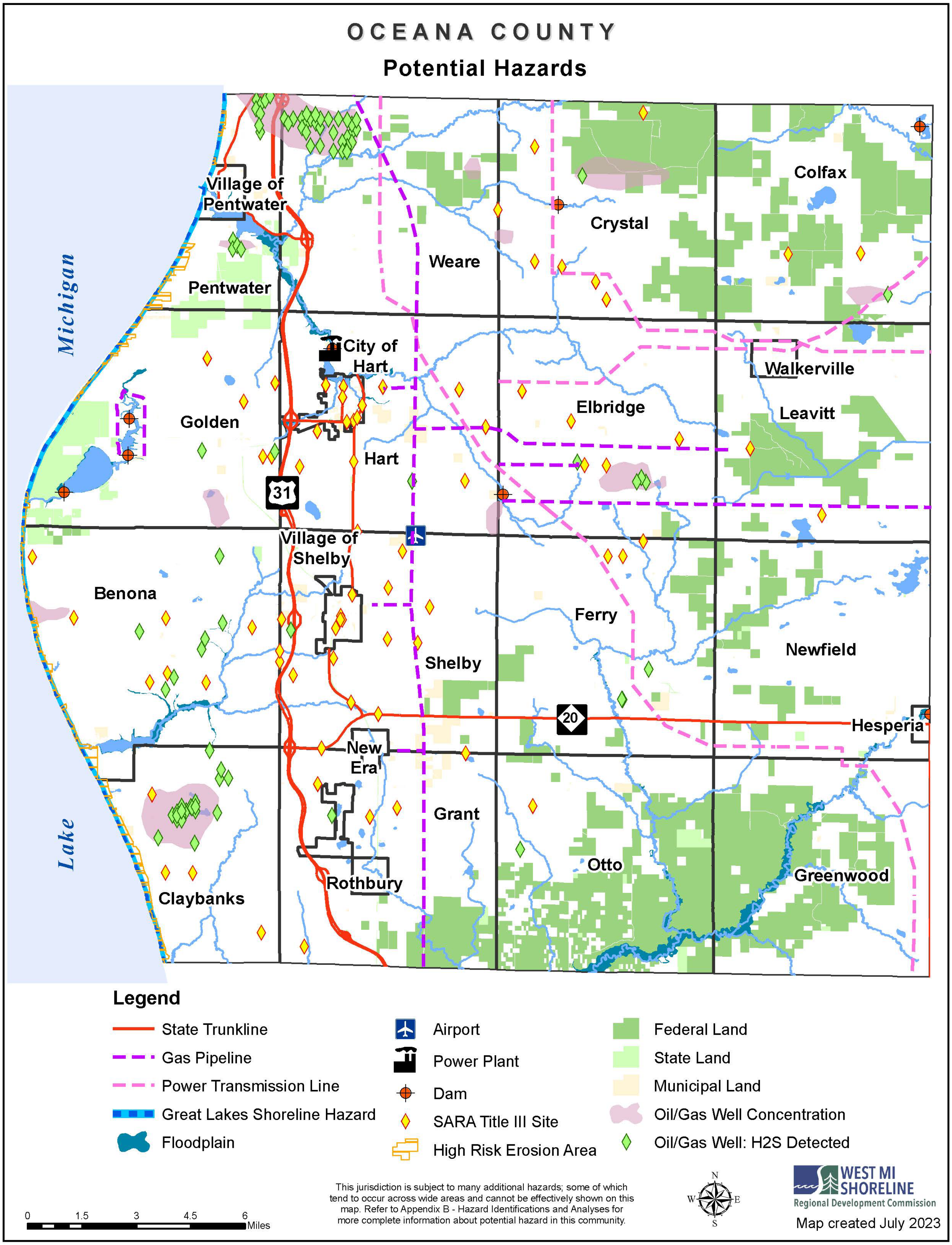
OCEANA COUNTY
Hazard Assessment
Ratings

Natural Hazards	Probability of Occurrence	Population Affected	Property Damaged	Economic Impacts
1.01a Space Weather	2	2	0	3
1.01b 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	2
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	1	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	3	2	0	2
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	Extreme Temperatures	3		10		30
3	Infrastructure Failures	3		10		30
5	Fire – Structural	3		9		27
5	Great Lakes Shoreline	3		9		27
7	Drought	2		13		26
8	Wildfire	3		8		24
8	Flooding: Riverine/Urban	3		8		24
8	Hail	3		8		24
8	Lightning	3		8		24
8	Public Health Emergencies	3		8		24
13	Catastrophic Incidents	1		18		18
13	Dam failure	2		9		18
13	Invasive Species	2		9		18
13	Tornadoes	2		9		18
13	Space Weather	2		9		18
18	Energy Emergencies	2		8		16
19	HAZMAT – Fixed Site	2		7		14
19	HAZMAT – Transportation	2		7		14
19	Pipeline Accidents	2		7		14
22	Fog	3		4		12
22	Oil/Natural Gas Well Accidents	2		6		12
22	Transportation Accidents	2		6		12
25	Celestial Impacts - Space Debris	1		8		8
26	Civil Disturbances	1		6		6
26	Fire – Scrap Tires	1		6		6
26	Subsidence	1		6		6
26	Terrorism & Similar Criminal Acts	1		6		6
	Earthquake	0		-		-
	Nuclear Attack	0		-		-
	Nuclear Power Emergencies	0		-		-


OCEANA COUNTY
Critical Facilities
Village of Pentwater
Pentwater Twp
Weare
Crystal
Colfax
City of Hart
Walkerville
Elbridge
Leavitt
Hart Twp
Golden
Michigan
Lake
31
Village of Shelby
Benona
Ferry
Shelby Twp
Newfield
Hesperia
20
New Era
Rothbury
Grant
Claybanks
Otto
Greenwood
Legend
State Trunkline
Road
Railroads
Gas Pipeline
Power Transmission Line
Bridge
Communication Tower
Wastewater Treatment
Airport
Fire/Police/EMS/911
Power Plant
Hospital
Medical Facility
Dam
School
Shelter
Correctional Facility
0
1.5
3
4.5
6
Miles
N
W
E
S
WEST MI SHORELINE
Regional Development Commission
Map created in July 2023



OCEANA COUNTY
Potential Hazards
Michigan
Lake
Village of Pentwater
Pentwater
Weare
Crystal
Colfax
City of Hart
Walkerville
Golden
Hart
Elbridge
Leavitt
31
Village of Shelby
Benona
Ferry
Newfield
Shelby
20
Hesperia
New Era
Grant
Otto
Greenwood
Rothbury
Claybanks
Legend
State Trunkline
Gas Pipeline
Power Transmission Line
Great Lakes Shoreline Hazard
Floodplain
Airport
Power Plant
Dam
SARA Title III Site
High Risk Erosion Area
Federal Land
State Land
Municipal Land
Oil/Gas Well Concentration
Oil/Gas Well: H2S Detected
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 hazard in this community.
0 1.5 3 4.5 6 Miles
N W E S
WEST MI SHORELINE
Regional Development Commission
Map created July 2023

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:

NFIP Participation: Participating in NFIP **FIRM Map Date:** 08/24/21

Flood Insurance Policies In-Force: N/A **Total Flood Insurance Coverage: $**N/A

Floodplains and Flood-prone Areas: Chippewa Creek, Russell Creek, Hart Lake shoreline

- 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.
- March 8, 2017: High wind. $10m Property damage across Oceana County.
- February 24, 2019: High wind. $1m property damage across Oceana County.
- November 10, 2020: Severe thunderstorms. $100k property damage 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.
- April 14, 2018: Winter storm. $100k property damage across Oceana County.
- February 5, 2019: Ice storm. $1m property damage across Oceana County.

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 within the county in 2023: 75

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.
- March 8, 2017: Over 1 million without power (high wind), statewide.
- April 14, 2018: 450,000 without power (winter storm), statewide.
- February 5, 2019: 150,000 without power (ice storm), Central Lower Michigan.
- February 24, 2019: 1 million without power (high wind), statewide.

2.08 Nuclear Power Plant Emergencies: - None Identified.

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

2.10 Pipeline Accidents: - None Identified.

2.11 Transportation Accidents: - None Identified.

3. HUMAN -RELATED HAZARDS

3.01 Catastrophic Incidents (National Emergencies): - None Identified.

3.02 Civil Disturbances: - None Identified.

3.03 Nuclear Attack: - None Identified.

3.04 Public Health Emergencies:

- 2020 to current: Covid-19 Pandemic. Nearly 7 million confirmed deaths worldwide. 97 confirmed deaths in Oceana County as of July 11, 2023.

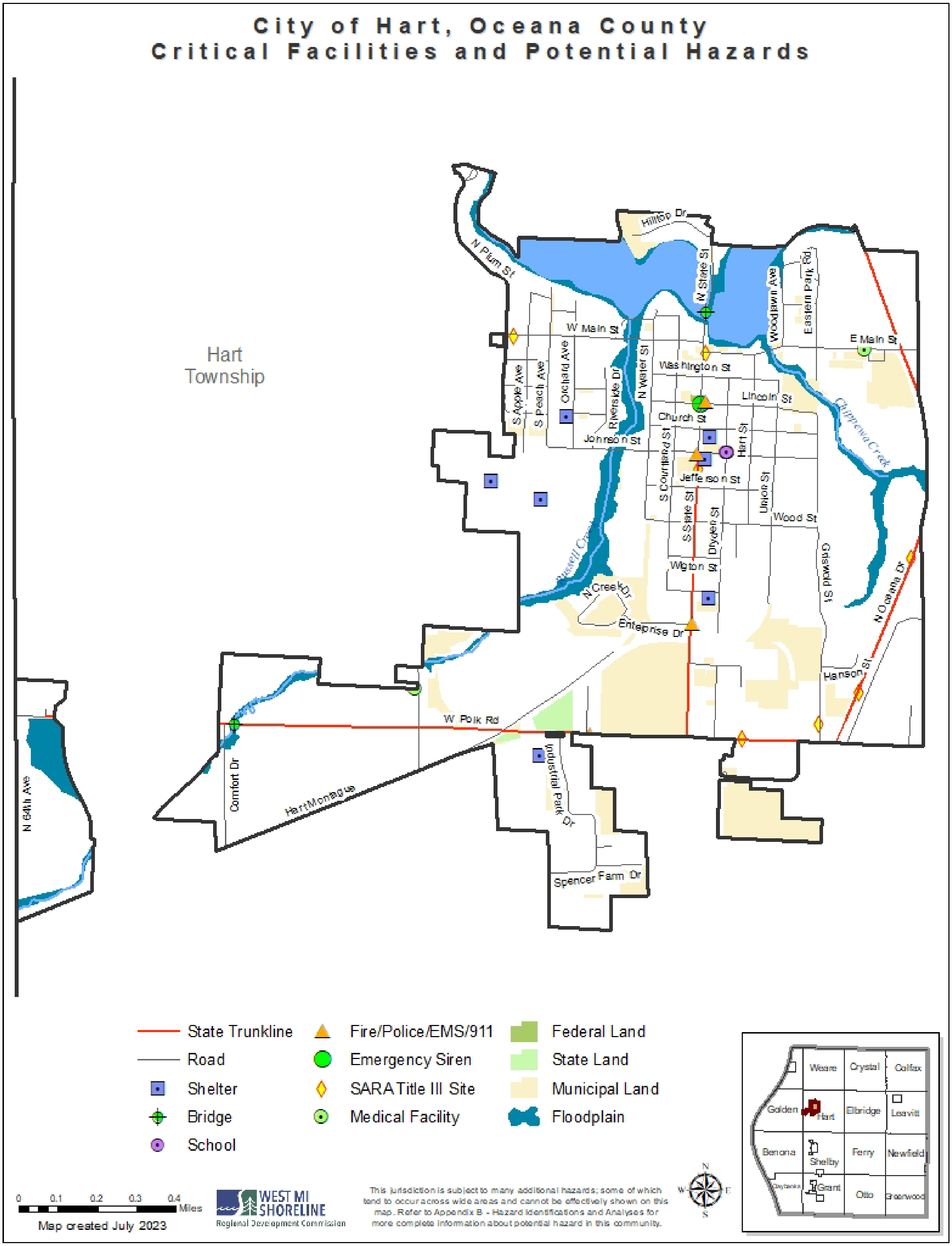
3.05 Terrorism and Similar Criminal Activities: - None Identified.

CITY OF HART
Hazard Assessment
Ratings

Natural Hazards	Probability of Occurrence	Population Affected	Property Damaged	Economic Impacts
1.01a Space Weather	2	2	0	3
1.01b 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	2	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	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	0	-	-	-
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	2	1
3.03 Nuclear Attack	0	-	-	-
3.04 Public Health Emergencies	3	2	0	2
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		12		36
3	Extreme Temperatures	3		10		30
3	Infrastructure Failures	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	Public Health Emergencies	3		8		24
7	Wildfire	2		12		24
11	Hail	2		11		22
12	Catastrophic Incidents	1		18		18
12	Space Weather	2		9		18
12	Invasive Species	2		9		18
15	Energy Emergencies	2		8		16
16	Tornadoes	1		15		15
17	Dam failure	2		7		14
17	HAZMAT – Fixed Site	2		7		14
17	HAZMAT – Transportation	2		7		14
20	Transportation Accidents	2		6		12
21	Celestial Impacts	1		8		8
21	Civil Disturbances	1		8		8
21	Fog	2		4		8
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		-		-
n/a	Oil/Natural Gas Well Accidents	0		-		-
n/a	Pipeline Accidents	0		-		-


City of Hart, Oceana County
Critical Facilities and Potential Hazards
Hart Township
Hilltop Dr
N Plum St
N State St
Woodlawn Ave
Eastern Park Rd
E Main St
W Main St
Washington St
Lincoln St
Church St
Johnson St
Jefferson St
Wood St
Wigton St
N Creek Dr
Enterprise Dr
Hanson St
N Oceana Dr
Chippewa Creek
W Polk Rd
Comfort Dr
Hart Montague
Industrial Park Dr
Spencer Farm Dr
N 64th Ave
State Trunkline
Road
Shelter
Bridge
School
Fire/Police/EMS/911
Emergency Siren
SARA Title III Site
Medical Facility
Federal Land
State Land
Municipal Land
Floodplain
Miles
Map created July 2023
WEST MI SHORELINE
Regional Development Commission
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 hazard in this community.
Weare
Crystal
Colfax
Golden
Hart
Elbridge
Leavitt
Benona
Shelby
Ferry
Newfield
Grant
Otto
Greenwood

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:

NFIP Participation: Participating in NFIP **FIRM Map Date:** 08/04/14

Flood Insurance Policies In-Force: 1 **Total Flood Insurance Coverage:** $38,800

Floodplains and Flood-prone Areas: White River
- 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.
- March 8, 2017: High wind. $10m Property damage across Oceana County.
- February 24, 2019: High wind. $1m property damage across Oceana County.
- November 10, 2020: Severe thunderstorms. $100k property damage 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.
- April 14, 2018: Winter storm. $100k property damage across Oceana County.
- February 5, 2019: Ice storm. $1m property damage across Oceana County.

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 within the county in 2023: 75

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.
- March 8, 2017: Over 1 million without power (high wind), statewide.
- April 14, 2018: 450,000 without power (winter storm), statewide.
- February 5, 2019: 150,000 without power (ice storm), Central Lower Michigan.
- February 24, 2019: 1 million without power (high wind), statewide.

2.08 Nuclear Power Plant Emergencies: - None Identified.

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

2.10 Pipeline Accidents: - None Identified.

2.11 Transportation Accidents: - None Identified.

3. HUMAN -RELATED HAZARDS

3.01 Catastrophic Incidents (National Emergencies): - None Identified.

3.02 Civil Disturbances: - None Identified.

3.03 Nuclear Attack: - None Identified.

3.04 Public Health Emergencies:
- 2020 to current: Covid-19 Pandemic. Nearly 7 million confirmed deaths worldwide. 97 confirmed deaths in Oceana County as of July 11, 2023.

3.05 Terrorism and Similar Criminal Activities: - None Identified.

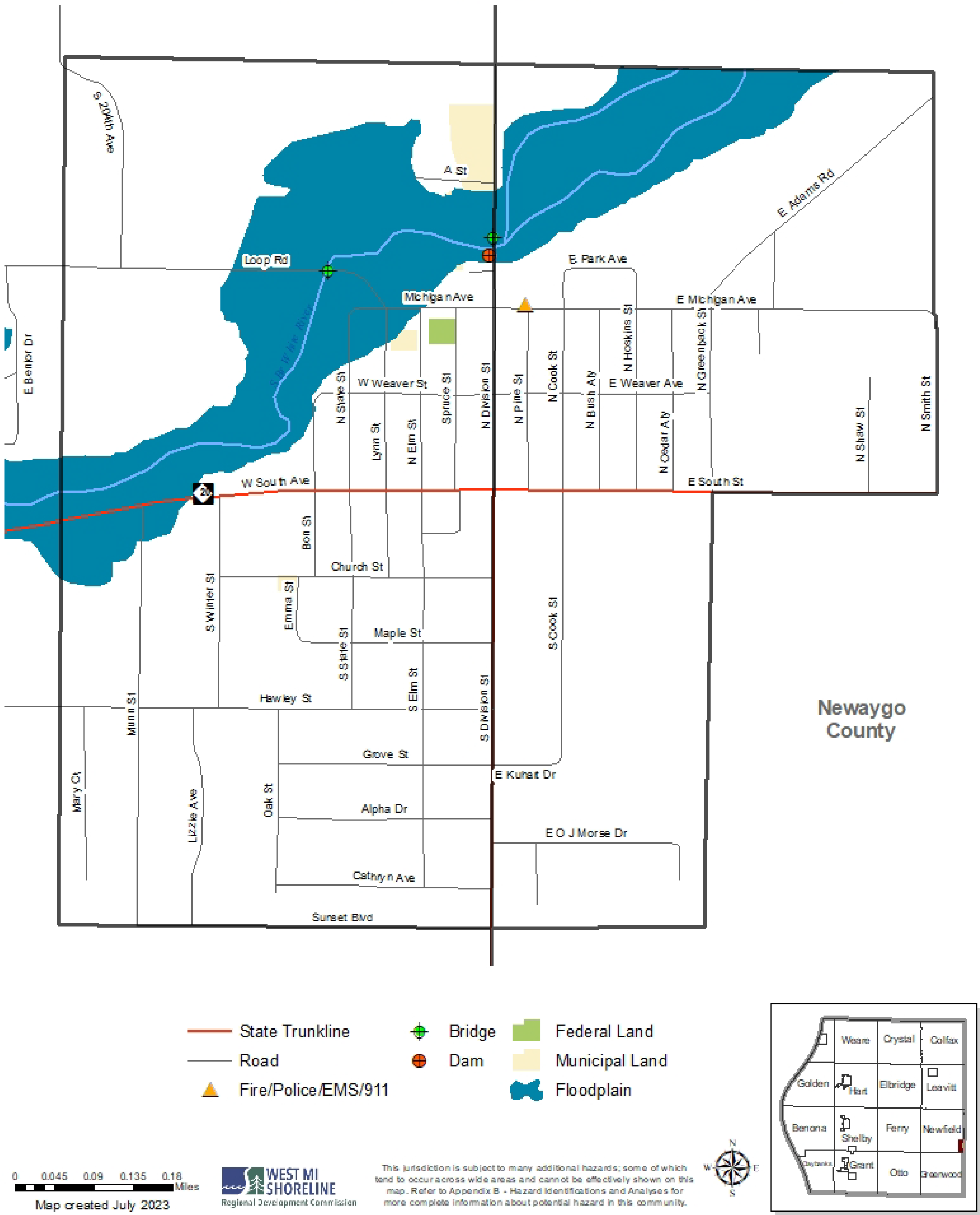
HESPERIA VILLAGE
Hazard Assessment
Ratings

Natural Hazards	Probability of Occurrence	Population Affected	Property Damaged	Economic Impacts
1.01a Space Weather	2	2	0	3
1.01b 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	2	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	2
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	2	1	2
2.08 Nuclear Power Emergencies	0	-	-	-
2.09 Oil/Natural Gas Well Accidents	0	-	-	-
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	3	2	0	2
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		12		36
3	Extreme Temperatures	3		10		30
3	Infrastructure Failures	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	Public Health Emergencies	3		8		24
7	Wildfire	2		12		24
11	Hail	2		11		22
12	Catastrophic Incidents	1		18		18
12	Space Weather	2		9		18
12	Dam failure	2		9		18
15	Energy Emergencies	2		8		16
16	Tornadoes	1		15		15
17	HAZMAT – Transportation	2		7		14
17	Invasive Species	2		7		14
19	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	HAZMAT – Fixed Site	1		6		6
22	Subsidence	1		6		6
22	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		-		-
n/a	Pipeline Accidents	0		-		-

Village of Hesperia, Oceana County
Critical Facilities and Potential Hazards



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:

NFIP Participation: N/A **FIRM Map Date:** N/A

Flood Insurance Policies In-Force: 0 **Total Flood Insurance Coverage:** N/A

Floodplains and Flood-prone Areas: N/A
- 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.
- March 8, 2017: High wind. $10m Property damage across Oceana County.
- February 24, 2019: High wind. $1m property damage across Oceana County.
- November 10, 2020: Severe thunderstorms. $100k property damage 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.
- April 14, 2018: Winter storm. $100k property damage across Oceana County.
- February 5, 2019: Ice storm. $1m property damage across Oceana County.

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 within the county in 2023: 75

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.
- March 8, 2017: Over 1 million without power (high wind), statewide.
- April 14, 2018: 450,000 without power (winter storm), statewide.
- February 5, 2019: 150,000 without power (ice storm), Central Lower Michigan.
- February 24, 2019: 1 million without power (high wind), statewide.

2.08 Nuclear Power Plant Emergencies: - None Identified.

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

2.10 Pipeline Accidents: - None Identified.

2.11 Transportation Accidents: - None Identified.

3. HUMAN -RELATED HAZARDS

3.01 Catastrophic Incidents (National Emergencies): - None Identified.

3.02 Civil Disturbances: - None Identified.

3.03 Nuclear Attack: - None Identified.

3.04 Public Health Emergencies:
- 2020 to current: Covid-19 Pandemic. Nearly 7 million confirmed deaths worldwide. 97 confirmed deaths in Oceana County as of July 11, 2023.

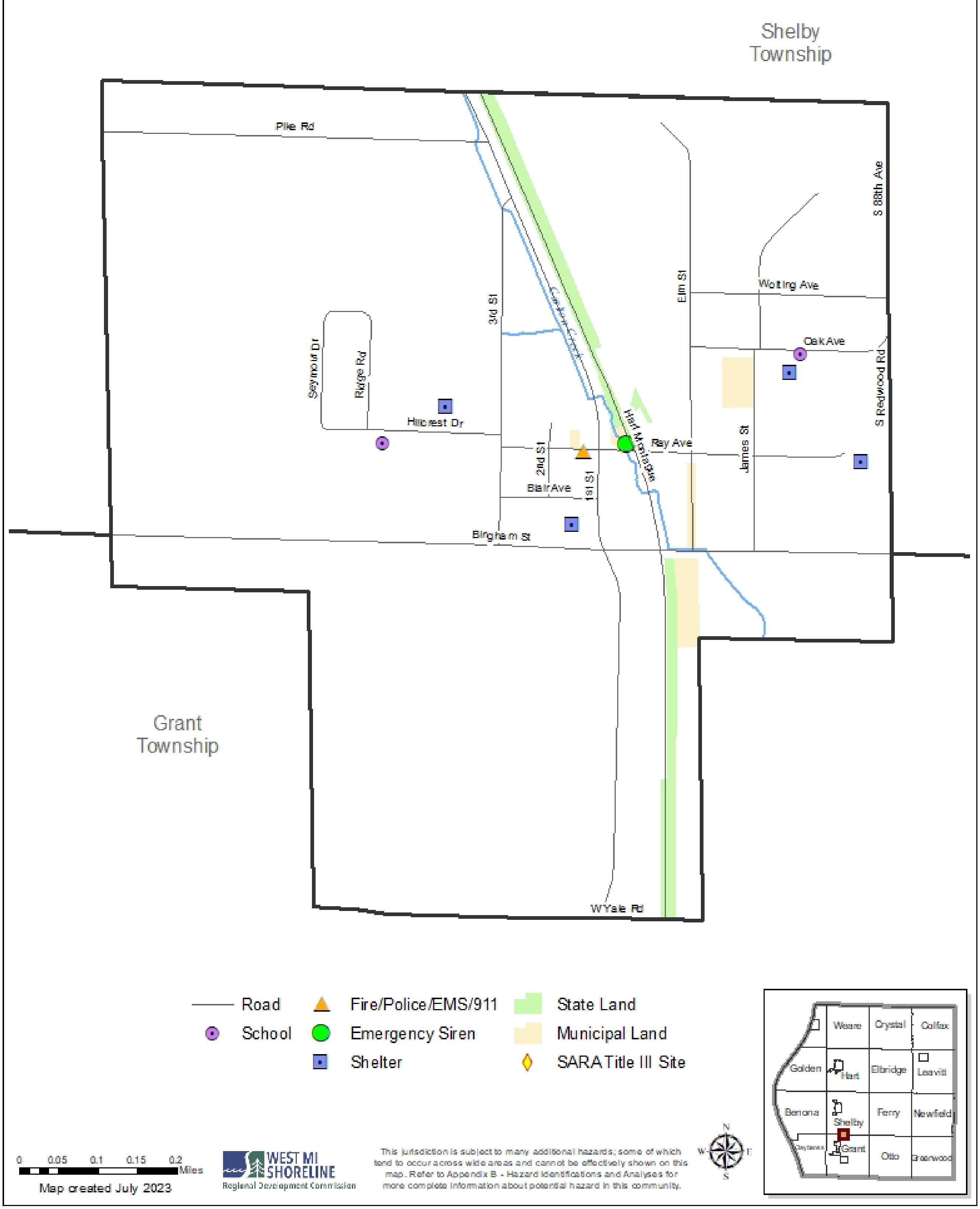
3.05 Terrorism and Similar Criminal Activities: - None Identified.

NEW ERA VILLAGE Hazard Assessment Ratings				
Natural Hazards	Probability of Occurrence	Population Affected	Property Damaged	Economic Impacts
1.01a Space Weather	2	2	0	3
1.01b 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	2	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	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	1
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	0	-	-	-
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	3	2	0	2
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		12		36
3	Extreme Temperatures	3		10		30
3	Infrastructure Failures	3		10		30
5	Fire – Structural	3		9		27
6	Drought	2		13		26
7	Lightning	3		8		24
7	Public Health Emergencies	3		8		24
7	Wildfire	2		12		24
10	Hail	2		11		22
11	Catastrophic Incidents	1		18		18
11	Space Weather	2		9		18
13	Energy Emergencies	2		8		16
14	Tornadoes	1		15		15
15	HAZMAT – Transportation	2		7		14
15	Invasive Species	2		7		14
17	Flooding: Riverine/Urban	2		6		12
17	HAZMAT – Fixed Site	2		6		12
17	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	Oil/Natural Gas Well Accidents	0		-		-
n/a	Pipeline Accidents	0		-		-

Village of New Era, Oceana County
Critical Facilities and Potential Hazards



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:

NFIP Participation: Participating in NFIP | **FIRM Map Date:** 08/24/21

Flood Insurance Policies In-Force: 26 | **Total Flood Insurance Coverage:** $3,811,500

Floodplains and Flood-prone Areas: Lake Michigan shoreline, Pentwater Lake shoreline, Pentwater Lake tributary
- 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.***
- 2019-21: Lengthy high water event on Lake Michigan. High water record in 2020. Extensive shoreline erosion and property damage along Lake Michigan shoreline.

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.
- March 8, 2017: High wind. $10m Property damage across Oceana County.
- February 24, 2019: High wind. $1m property damage across Oceana County.
- November 10, 2020: Severe thunderstorms. $100k property damage 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.
- April 14, 2018: Winter storm. $100k property damage across Oceana County.
- February 5, 2019: Ice storm. $1m property damage across Oceana County.

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 within the county in 2023: 75

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.
- March 8, 2017: Over 1 million without power (high wind), statewide.
- April 14, 2018: 450,000 without power (winter storm), statewide.
- February 5, 2019: 150,000 without power (ice storm), Central Lower Michigan.
- February 24, 2019: 1 million without power (high wind), statewide.

2.08 Nuclear Power Plant Emergencies: - None Identified.

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

2.10 Pipeline Accidents: - None Identified.

2.11 Transportation Accidents: - None Identified.

3. HUMAN -RELATED HAZARDS

3.01 Catastrophic Incidents (National Emergencies): - None Identified.

3.02 Civil Disturbances: - None Identified.

3.03 Nuclear Attack: - None Identified.

3.04 Public Health Emergencies:

- 2020 to current: Covid-19 Pandemic. Nearly 7 million confirmed deaths worldwide. 97 confirmed deaths in Oceana County as of July 11, 2023.

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
1.01a Space Weather	2	2	0	3
1.01b 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	2
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	2	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	2
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	1	1	1	2
2.07 Infrastructure Failures	3	2	1	2
2.08 Nuclear Power Emergencies	0	-	-	-
2.09 Oil/Natural Gas Well Accidents	0	-	-	-
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	3	2	0	2
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		12		36
3	Extreme Temperatures	3		10		30
3	Infrastructure Failures	3		10		30
5	Fire – Structural	3		9		27
5	Great Lakes Shoreline	3		9		27
7	Drought	2		13		26
8	Flooding: Riverine/Urban	3		8		24
8	Lightning	3		8		24
8	Public Health Emergencies	3		8		24
8	Wildfire	2		12		24
12	Hail	2		11		22
13	Catastrophic Incidents	1		18		18
13	Space Weather	2		9		18
13	Dam failure	2		9		18
16	Energy Emergencies	2		8		16
17	Tornadoes	1		15		15
18	Fog	3		4		12
18	Invasive Species	2		6		12
18	Transportation Accidents	2		6		12
21	Celestial Impacts	1		8		8
22	HAZMAT – Transportation	1		7		7
23	Civil Disturbances	1		6		6
23	Fire – Scrap Tires	1		6		6
23	HAZMAT – Fixed Site	1		6		6
23	Subsidence	1		6		6
23	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		-		-
n/a	Pipeline Accidents	0		-		-

Village of Pentwater, Oceana County
Critical Facilities and Potential Hazards

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:

NFIP Participation: N/A **FIRM Map Date:** N/A

Flood Insurance Policies In-Force: 0 **Total Flood Insurance Coverage:** N/A

Floodplains and Flood-prone Areas: N/A
- 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.
- March 8, 2017: High wind. $10m Property damage across Oceana County.
- February 24, 2019: High wind. $1m property damage across Oceana County.
- November 10, 2020: Severe thunderstorms. $100k property damage 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.
- April 14, 2018: Winter storm. $100k property damage across Oceana County.
- February 5, 2019: Ice storm. $1m property damage across Oceana County.

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 within the county in 2023: 75

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.
- March 8, 2017: Over 1 million without power (high wind), statewide.
- April 14, 2018: 450,000 without power (winter storm), statewide.
- February 5, 2019: 150,000 without power (ice storm), Central Lower Michigan.
- February 24, 2019: 1 million without power (high wind), statewide.

2.08 Nuclear Power Plant Emergencies: - None Identified.

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

2.10 Pipeline Accidents: - None Identified.

2.11 Transportation Accidents: - None Identified.

3. HUMAN -RELATED HAZARDS

3.01 Catastrophic Incidents (National Emergencies): - None Identified.

3.02 Civil Disturbances: - None Identified.

3.03 Nuclear Attack: - None Identified.

3.04 Public Health Emergencies:
- 2020 to current: Covid-19 Pandemic. Nearly 7 million confirmed deaths worldwide. 97 confirmed deaths in Oceana County as of July 11, 2023.

3.05 Terrorism and Similar Criminal Activities: - None Identified.

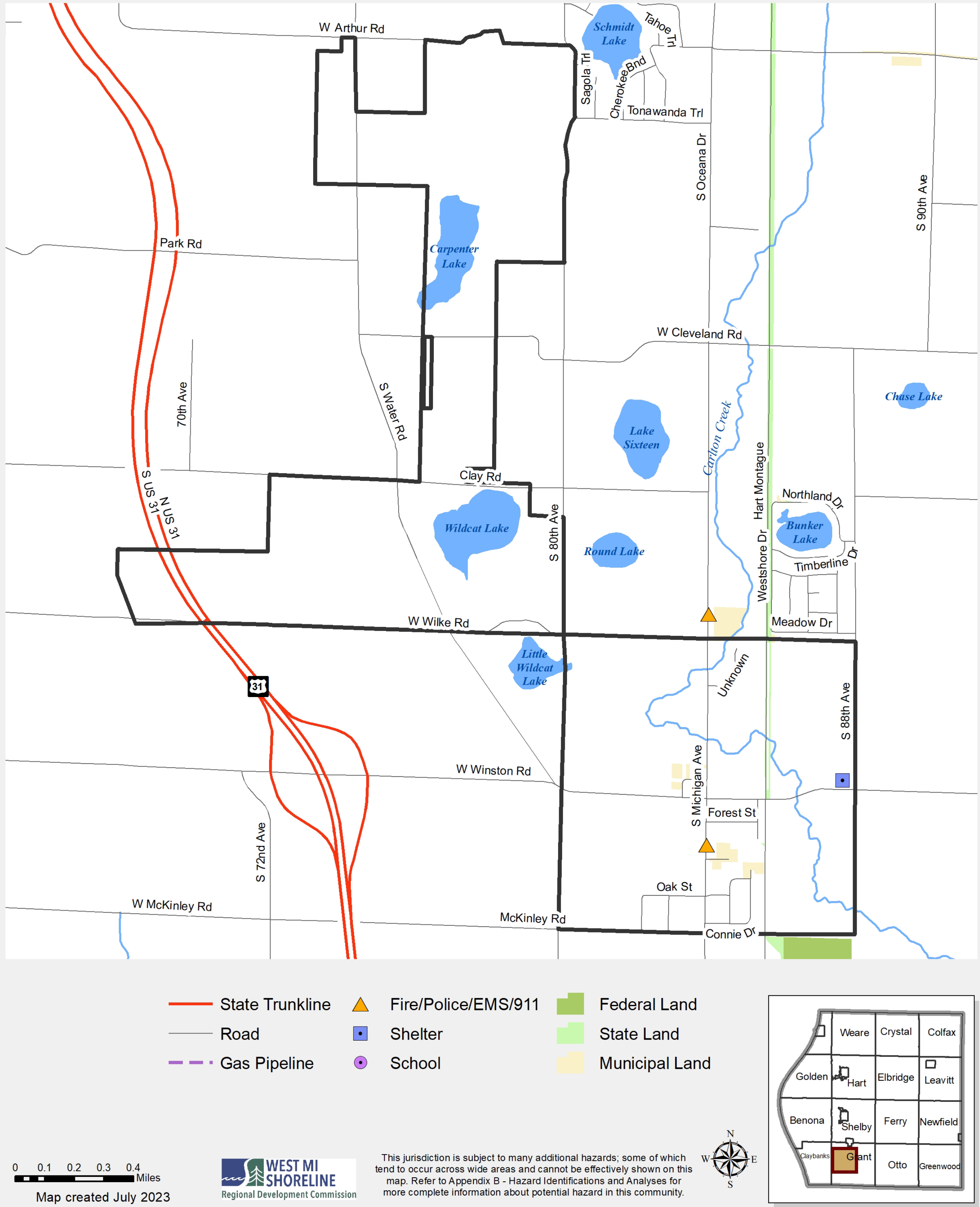
ROTHBURY VILLAGE
Hazard Assessment
Ratings

Natural Hazards	Probability of Occurrence	Population Affected	Property Damaged	Economic Impacts
1.01a Space Weather	2	2	0	3
1.01b 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	2	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	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	1
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	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	3	2	0	2
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		12		36
3	Extreme Temperatures	3		10		30
3	Infrastructure Failures	3		10		30
5	Fire – Structural	3		9		27
6	Drought	2		13		26
7	Lightning	3		8		24
7	Public Health Emergencies	3		8		24
7	Wildfire	2		12		24
10	Hail	2		11		22
11	Catastrophic Incidents	1		18		18
11	Space Weather	2		9		18
13	Energy Emergencies	2		8		16
14	Tornadoes	1		15		15
15	HAZMAT – Transportation	2		7		14
16	Flooding: Riverine/Urban	2		6		12
16	HAZMAT – Fixed Site	2		6		12
16	Invasive Species	2		6		12
16	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	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		-		-
n/a	Pipeline Accidents	0		-		-

Village of Rothbury, Oceana County
Critical Facilities and Potential Hazards



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:

NFIP Participation: N/A　**FIRM Map Date:** N/A

Flood Insurance Policies In-Force: 0　**Total Flood Insurance Coverage:** N/A

Floodplains and Flood-prone Areas: N/A
- 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.
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- 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.
- March 8, 2017: High wind. $10m Property damage across Oceana County.
- February 24, 2019: High wind. $1m property damage across Oceana County.
- November 10, 2020: Severe thunderstorms. $100k property damage 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.
- April 14, 2018: Winter storm. $100k property damage across Oceana County.
- February 5, 2019: Ice storm. $1m property damage across Oceana County.

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 within the county in 2023: 75

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.
- March 8, 2017: Over 1 million without power (high wind), statewide.
- April 14, 2018: 450,000 without power (winter storm), statewide.
- February 5, 2019: 150,000 without power (ice storm), Central Lower Michigan.
- February 24, 2019: 1 million without power (high wind), statewide.

2.08 Nuclear Power Plant Emergencies: - None Identified.

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

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:
- 2020 to current: Covid-19 Pandemic. Nearly 7 million confirmed deaths worldwide. 97 confirmed deaths in Oceana County as of July 11, 2023.

3.05 Terrorism and Similar Criminal Activities: - None Identified.

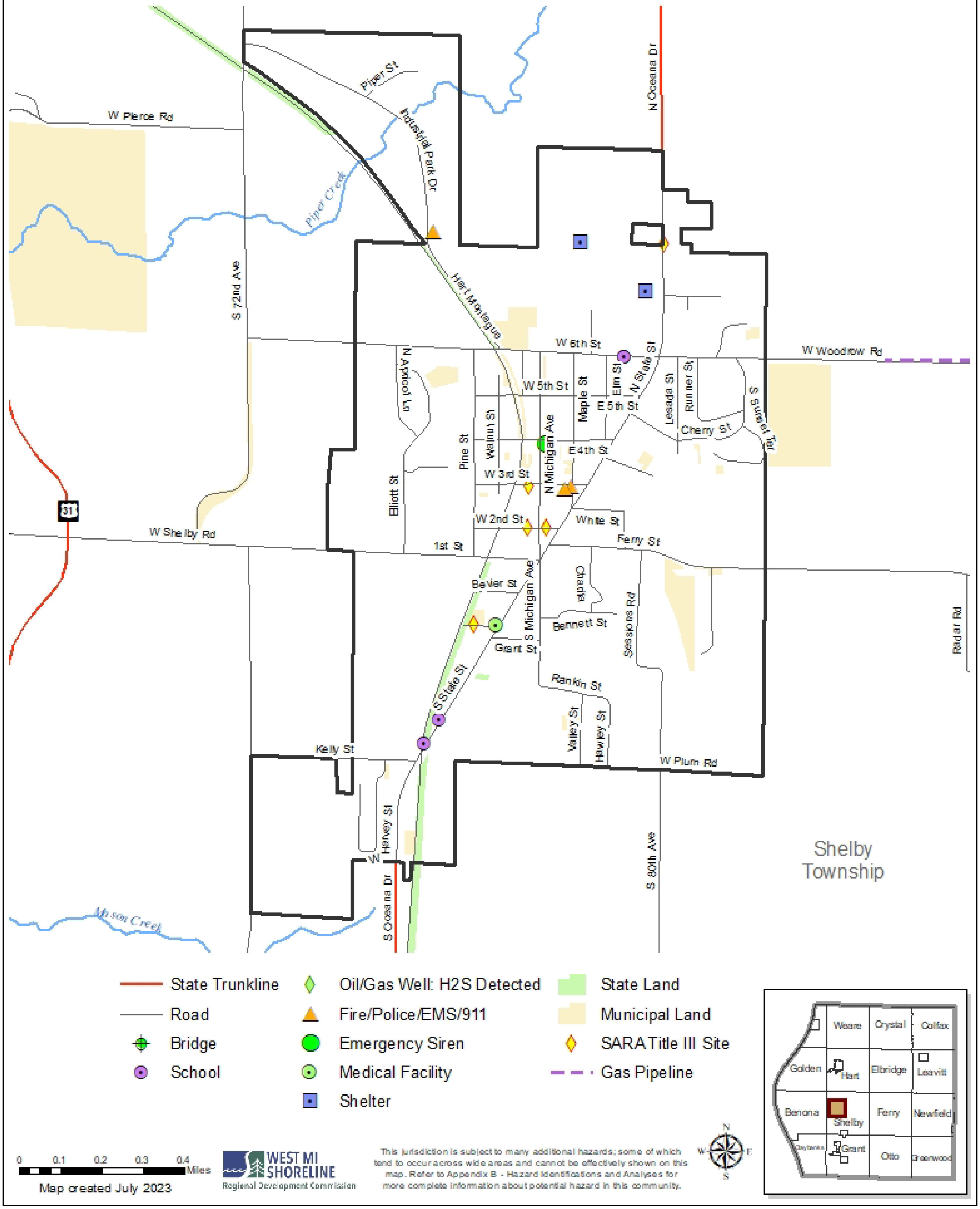
SHELBY VILLAGE
Hazard Assessment
Ratings

Natural Hazards	Probability of Occurrence	Population Affected	Property Damaged	Economic Impacts
1.01a Space Weather	2	2	0	3
1.01b 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	2	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	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	1
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	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	3	2	0	2
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		12		36
3	Extreme Temperatures	3		10		30
3	Infrastructure Failures	3		10		30
5	Fire – Structural	3		9		27
6	Drought	2		13		26
7	Lightning	3		8		24
7	Public Health Emergencies	3		8		24
7	Wildfire	2		12		24
10	Hail	2		11		22
11	Catastrophic Incidents	1		18		18
11	Space Weather	2		9		18
13	Energy Emergencies	2		8		16
14	Tornadoes	1		15		15
15	HAZMAT – Transportation	2		7		14
16	Flooding: Riverine/Urban	2		6		12
16	HAZMAT – Fixed Site	2		6		12
16	Invasive Species	2		6		12
16	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	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		-		-
n/a	Pipeline Accidents	0		-		-

Shelby Village, Oceana County
Critical Facilities and Potential Hazards



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:

NFIP Participation: N/A | **FIRM Map Date:** N/A

Flood Insurance Policies In-Force: 0 | **Total Flood Insurance Coverage:** N/A

Floodplains and Flood-prone Areas: N/A

- 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.
- March 8, 2017: High wind. $10m Property damage across Oceana County.
- February 24, 2019: High wind. $1m property damage across Oceana County.
- November 10, 2020: Severe thunderstorms. $100k property damage 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.
- April 14, 2018: Winter storm. $100k property damage across Oceana County.
- February 5, 2019: Ice storm. $1m property damage across Oceana County.

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 within the county in 2023: 75

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.
- March 8, 2017: Over 1 million without power (high wind), statewide.
- April 14, 2018: 450,000 without power (winter storm), statewide.
- February 5, 2019: 150,000 without power (ice storm), Central Lower Michigan.
- February 24, 2019: 1 million without power (high wind), statewide.

2.08 Nuclear Power Plant Emergencies: - None Identified.

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

2.10 Pipeline Accidents: - None Identified.

2.11 Transportation Accidents: - None Identified.

3. HUMAN -RELATED HAZARDS

3.01 Catastrophic Incidents (National Emergencies): - None Identified.

3.02 Civil Disturbances: - None Identified.

3.03 Nuclear Attack: - None Identified.

3.04 Public Health Emergencies:

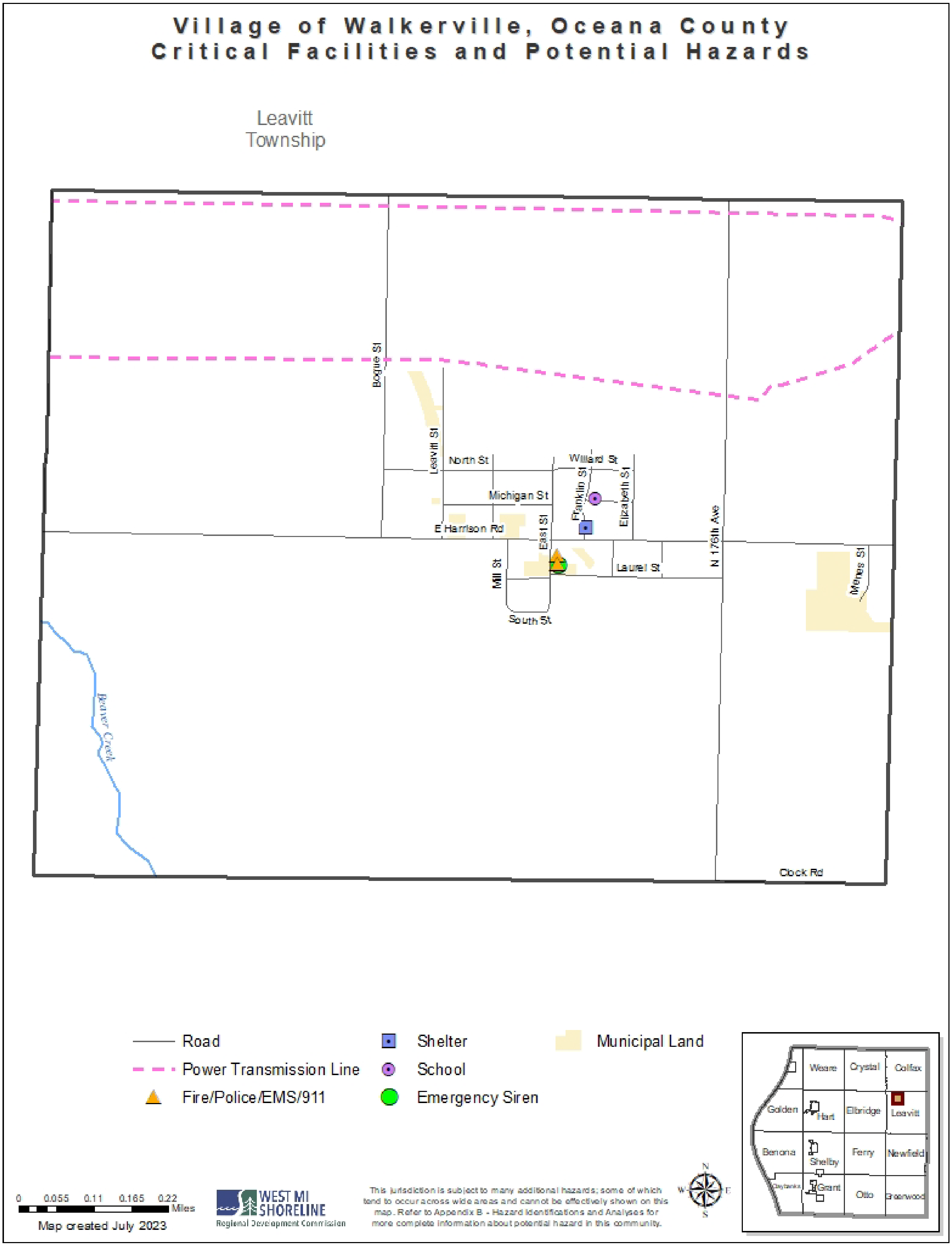
- 2020 to current: Covid-19 Pandemic. Nearly 7 million confirmed deaths worldwide. 97 confirmed deaths in Oceana County as of July 11, 2023.

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
1.01a Space Weather	2	2	0	3
1.01b 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	2	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	2
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	2	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	3	2	0	2
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	12	36
3	Extreme Temperatures	3	10	30
3	Infrastructure Failures	3	10	30
5	Fire – Structural	3	9	27
6	Drought	2	13	26
7	Lightning	3	8	24
7	Public Health Emergencies	3	8	24
7	Wildfire	2	12	24
10	Hail	2	11	22
11	Catastrophic Incidents	1	18	18
11	Space Weather	2	9	18
13	Energy Emergencies	2	8	16
14	Tornadoes	1	15	15
15	HAZMAT – Transportation	2	7	14
15	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	HAZMAT – Fixed Site	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	-	-


Village of Walkerville, Oceana County
Critical Facilities and Potential Hazards
Leavitt Township
Bogue St
Leavitt St
North St
Willard St
Franklin St
Elizabeth St
Michigan St
E Harrison Rd
East St
N 176th Ave
Mill St
Laurel St
Mones St
South St
Beaver Creek
Clock Rd
Road
Power Transmission Line
Fire/Police/EMS/911
Shelter
School
Emergency Siren
Municipal Land
Weare
Crystal
Colfax
Golden
Hart
Elbridge
Leavitt
Benona
Shelby
Ferry
Newfield
Claybanks
Grant
Otto
Greenwood
0 0.055 0.11 0.165 0.22
Miles
Map created July 2023
WEST MI SHORELINE
Regional Development Commission
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 hazard in this community.
N
W
E
S

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:

NFIP Participation: Participating in NFIP **FIRM Map Date:** 08/24/21

Flood Insurance Policies In-Force: 7 **Total Flood Insurance Coverage:** $2,170,000

Floodplains and Flood-prone Areas: Lake Michigan shoreline, Stony Lake shoreline, Stony Creek and tributaries

- 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.***
- 2019-21: Lengthy high water event on Lake Michigan. High water record in 2020. Extensive shoreline erosion and property damage along Lake Michigan shoreline.

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.
- March 8, 2017: High wind. $10m Property damage across Oceana County.
- ***July 26, 2018: Severe thunderstorms. $20k property damage, Benona Township.***
- February 24, 2019: High wind. $1m property damage across Oceana County.
- November 10, 2020: Severe thunderstorms. $100k property damage 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.
- April 14, 2018: Winter storm. $100k property damage across Oceana County.
- February 5, 2019: Ice storm. $1m property damage across Oceana County.

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 within the county in 2023: 75

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.
- March 8, 2017: Over 1 million without power (high wind), statewide.
- April 14, 2018: 450,000 without power (winter storm), statewide.
- February 5, 2019: 150,000 without power (ice storm), Central Lower Michigan.
- February 24, 2019: 1 million without 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 test wells in Benona Township in 2023: 155***
- ***12 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:

- 2020 to current: Covid-19 Pandemic. Nearly 7 million confirmed deaths worldwide. 97 confirmed deaths in Oceana County as of July 11, 2023.

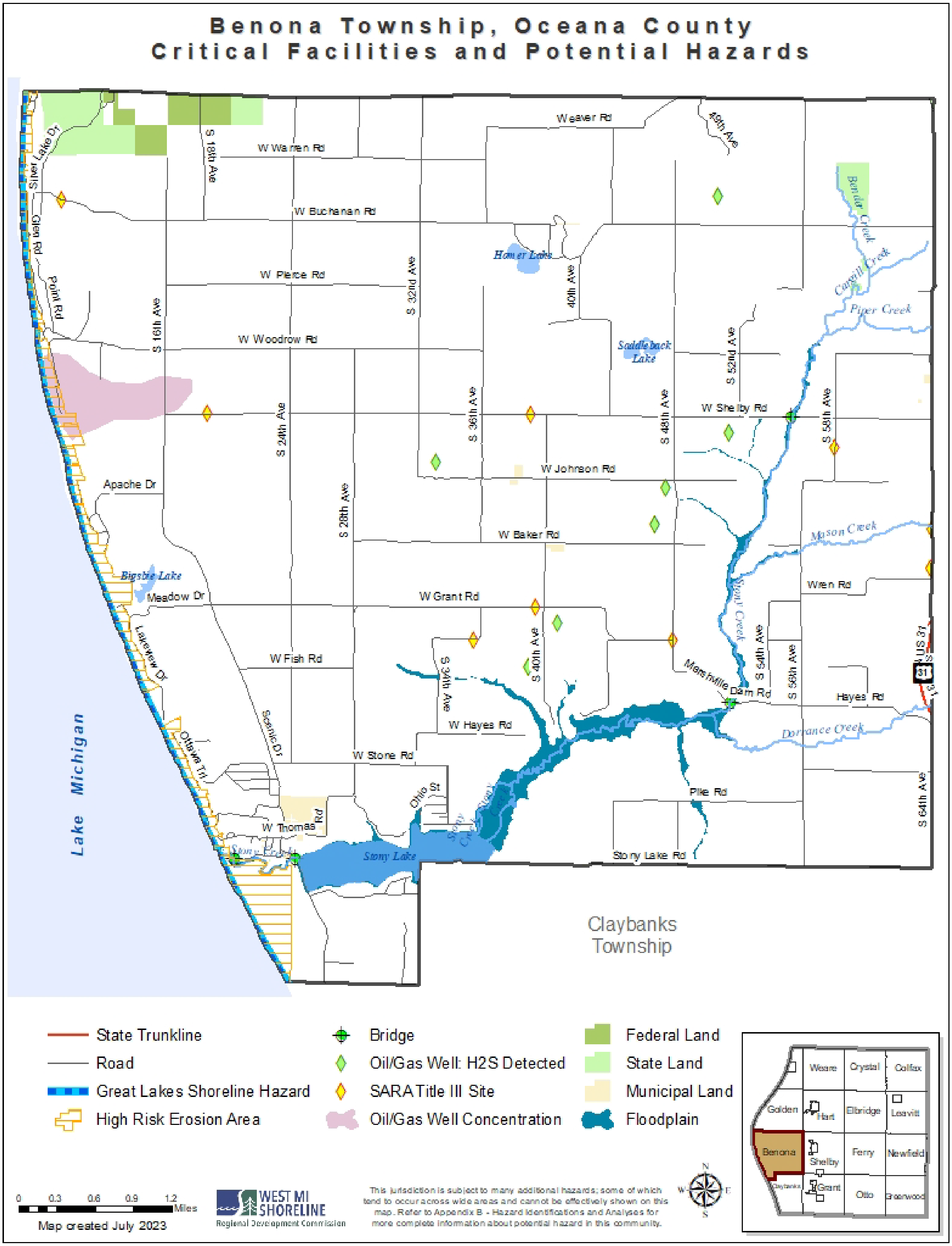
3.05 Terrorism and Similar Criminal Activities: - None Identified.

BENONA TOWNSHIP
Hazard Assessment
Ratings

Natural Hazards	Probability of Occurrence	Population Affected	Property Damaged	Economic Impacts
1.01a Space Weather	2	2	0	3
1.01b 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	2
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	1	2	2
1.15 Winter Storms	3	3	2	2
Technological Hazards				
2.01 Dam Failure	0	-	-	-
2.02 Energy Emergencies	2	2	0	2
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	1
2.06 HAZMAT – Transportation	2	1	1	2
2.07 Infrastructure Failures	3	2	1	1
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	3	2	0	2
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		12		36
3	Extreme Temperatures	3		10		30
4	Great Lakes Shoreline	3		9		27
4	Infrastructure Failures	3		9		27
4	Wildfire	3		9		27
7	Drought	2		13		26
8	Hail	3		8		24
8	Lightning	3		8		24
8	Public Health Emergencies	3		8		24
11	Fire – Structural	3		7		21
12	Catastrophic Incidents	1		18		18
12	Space Weather	2		9		18
12	Invasive Species	2		9		18
12	Oil/Natural Gas Well Accidents	2		9		18
12	Tornadoes	2		9		18
17	Energy Emergencies	2		8		16
17	Flooding: Riverine/Urban	2		8		16
19	HAZMAT – Transportation	2		7		14
20	Fog	3		4		12
20	HAZMAT – Fixed Site	2		6		12
20	Transportation Accidents	2		6		12
23	Celestial Impacts	1		8		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	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, Oceana County
Critical Facilities and Potential Hazards
Lake Michigan
Claybanks Township
Silver Lake Dr
Glen Rd
Point Rd
S 18th Ave
W Warren Rd
W Buchanan Rd
W Pierce Rd
S 16th Ave
W Woodrow Rd
S 32nd Ave
Homer Lake
40th Ave
Weaver Rd
49th Ave
Saddleback Lake
S 52nd Ave
Bender Creek
Carroll Creek
Piper Creek
S 24th Ave
S 36th Ave
S 48th Ave
W Shelby Rd
S 58th Ave
W Johnson Rd
Apache Dr
S 28th Ave
W Baker Rd
Mason Creek
Bigsbie Lake
Meadow Dr
W Grant Rd
Wren Rd
Stony Creek
Lakeview Dr
W Fish Rd
S 34th Ave
S 40th Ave
Marshville Dam Rd
S 54th Ave
S 56th Ave
Hayes Rd
US 31
Ottawa Trl
Scenic Dr
W Hayes Rd
Dorrance Creek
W Stone Rd
Ohio St
Pile Rd
S 64th Ave
W Thomas Rd
Stony Creek
Stony Lake
Stony Lake Rd
State Trunkline
Road
Great Lakes Shoreline Hazard
High Risk Erosion Area
Bridge
Oil/Gas Well: H2S Detected
SARA Title III Site
Oil/Gas Well Concentration
Federal Land
State Land
Municipal Land
Floodplain
Weare
Crystal
Colfax
Golden
Hart
Elbridge
Leavitt
Benona
Shelby
Ferry
Newfield
Claybanks
Grant
Otto
Greenwood
0 0.3 0.6 0.9 1.2 Miles
Map created July 2023
WEST MI SHORELINE Regional Development Commission
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 hazard in this community.
N S E W

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:

NFIP Participation: Participating in NFIP **FIRM Map Date:** 08/24/21

Flood Insurance Policies In-Force: N/A **Total Flood Insurance Coverage:** N/A

Floodplains and Flood-prone Areas: Lake Michigan shoreline, Stony Lake shoreline, Flower Creek

- 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.
- 2019-21: Lengthy high water event on Lake Michigan. High water record in 2020. Extensive shoreline erosion and property damage along Lake Michigan shoreline.

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.
- March 8, 2017: High wind. $10m Property damage across Oceana County.
- February 24, 2019: High wind. $1m property damage across Oceana County.
- November 10, 2020: Severe thunderstorms. $100k property damage 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.
- April 14, 2018: Winter storm. $100k property damage across Oceana County.
- February 5, 2019: Ice storm. $1m property damage across Oceana County.

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 within the county in 2023: 75

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.
- March 8, 2017: Over 1 million without power (high wind), statewide.
- April 14, 2018: 450,000 without power (winter storm), statewide.
- February 5, 2019: 150,000 without power (ice storm), Central Lower Michigan.
- February 24, 2019: 1 million without 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 test wells in Claybanks Township in 2023: 172

- 33 wells with known detectable levels of hydrogen sulfide in Claybanks 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:

- 2020 to current: Covid-19 Pandemic. Nearly 7 million confirmed deaths worldwide. 97 confirmed deaths in Oceana County as of July 11, 2023.

3.05 Terrorism and Similar Criminal Activities: - None Identified.

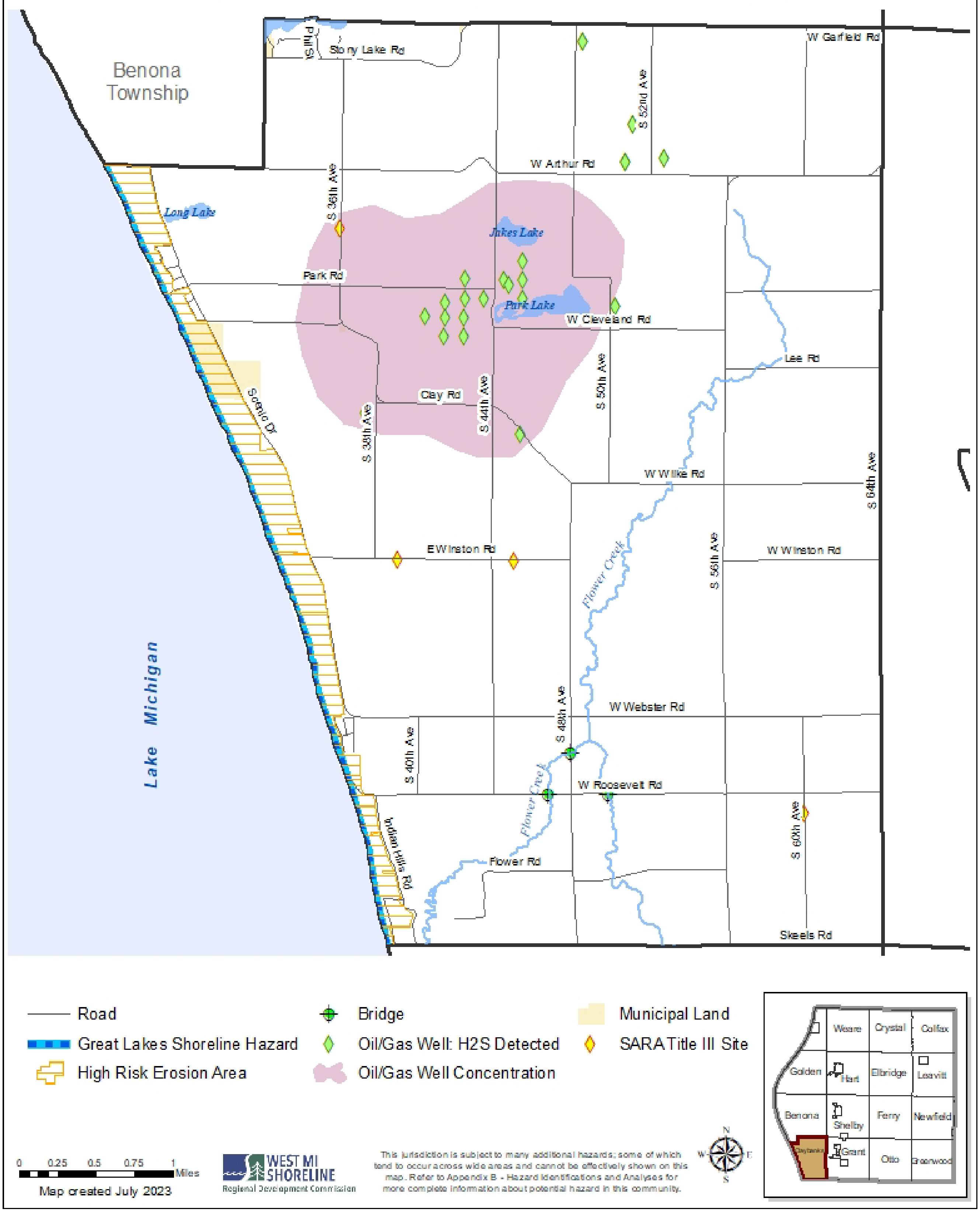
CLAYBANKS TOWNSHIP
Hazard Assessment
Ratings

Natural Hazards	Probability of Occurrence	Population Affected	Property Damaged	Economic Impacts
1.01a Space Weather	2	2	0	3
1.01b 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	2
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	1	2	2
1.15 Winter Storms	3	3	2	2
Technological Hazards				
2.01 Dam Failure	0	-	-	-
2.02 Energy Emergencies	2	2	0	2
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	1
2.06 HAZMAT – Transportation	2	1	1	2
2.07 Infrastructure Failures	3	2	1	1
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	3	2	0	2
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		12		36
3	Extreme Temperatures	3		10		30
4	Great Lakes Shoreline	3		9		27
4	Infrastructure Failures	3		9		27
4	Wildfire	3		9		27
7	Drought	2		13		26
8	Hail	3		8		24
8	Lightning	3		8		24
8	Public Health Emergencies	3		8		24
11	Fire – Structural	3		7		21
12	Catastrophic Incidents	1		18		18
12	Space Weather	2		9		18
12	Invasive Species	2		9		18
12	Oil/Natural Gas Well Accidents	2		9		18
12	Tornadoes	2		9		18
17	Energy Emergencies	2		8		16
17	Flooding: Riverine/Urban	2		8		16
19	HAZMAT – Transportation	2		7		14
20	Fog	3		4		12
20	HAZMAT – Fixed Site	2		6		12
22	Celestial Impacts	1		8		8
23	Civil Disturbances	1		6		6
23	Fire – Scrap Tires	1		6		6
23	Subsidence	1		6		6
23	Terrorism & Similar Criminal Acts	1		6		6
23	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, Oceana County Critical Facilities and Potential Hazards



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:

NFIP Participation: N/A — **FIRM Map Date:** N/A

Flood Insurance Policies In-Force: 0 — **Total Flood Insurance Coverage:** N/A

Floodplains and Flood-prone Areas: South Branch Pere Marquette River, Ruby Creek
- 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.
- March 8, 2017: High wind. $10m Property damage across Oceana County.
- February 24, 2019: High wind. $1m property damage across Oceana County.
- November 10, 2020: Severe thunderstorms. $100k property damage 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.
- April 14, 2018: Winter storm. $100k property damage across Oceana County.
- February 5, 2019: Ice storm. $1m property damage across Oceana County.

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 within the county in 2023: 75

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.
- March 8, 2017: Over 1 million without power (high wind), statewide.
- April 14, 2018: 450,000 without power (winter storm), statewide.
- February 5, 2019: 150,000 without power (ice storm), Central Lower Michigan.
- February 24, 2019: 1 million without 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 test wells in Colfax Township in 2023: 98
- 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:
- 2020 to current: Covid-19 Pandemic. Nearly 7 million confirmed deaths worldwide. 97 confirmed deaths in Oceana County as of July 11, 2023.

3.05 Terrorism and Similar Criminal Activities: - None Identified.

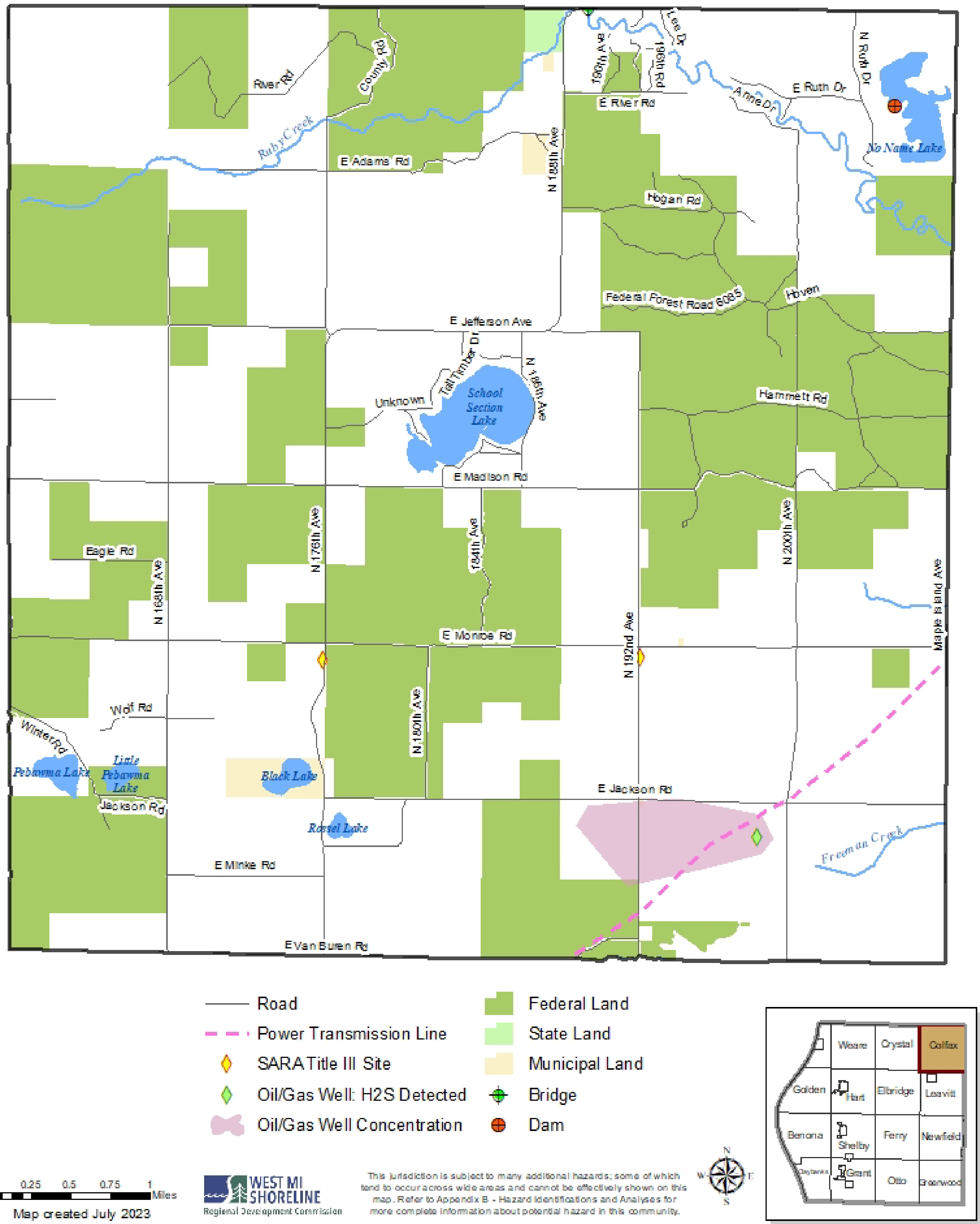
COLFAX TOWNSHIP
Hazard Assessment
Ratings

Natural Hazards	Probability of Occurrence	Population Affected	Property Damaged	Economic Impacts
1.01a Space Weather	2	2	0	3
1.01b 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	2	2
1.12 Subsidence	1	1	1	1
1.13 Tornadoes	2	1	2	2
1.14 Wildfire	3	1	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	2
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	2	1	1
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	3	2	0	2
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		12		36
3	Extreme Temperatures	3		10		30
4	Infrastructure Failures	3		9		27
4	Wildfire	3		9		27
6]	Drought	2		13		26
7	Hail	3		8		24
7	Lightning	3		8		24
7	Public Health Emergencies	3		8		24
10	Fire – Structural	3		7		21
11	Catastrophic Incidents	1		18		18
11	Space Weather	2		9		18
11	Dam failure	2		9		18
11	Invasive Species	2		9		18
11	Oil/Natural Gas Well Accidents	2		9		18
11	Tornadoes	2		9		18
17	Energy Emergencies	2		8		16
18	HAZMAT – Fixed Site	2		7		14
18	HAZMAT – Transportation	2		7		14
20	Flooding: Riverine/Urban	2		6		12
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		-		-
n/a	Pipeline Accidents	0		-		-

Colfax Township, Oceana County
Critical Facilities and Potential Hazards



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:

NFIP Participation: N/A | **FIRM Map Date:** N/A

Flood Insurance Policies In-Force: 0 | **Total Flood Insurance Coverage:** N/A

Floodplains and Flood-prone Areas: N/A
- 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.
- March 8, 2017: High wind. $10m Property damage across Oceana County.
- February 24, 2019: High wind. $1m property damage across Oceana County.
- November 10, 2020: Severe thunderstorms. $100k property damage 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.
- April 14, 2018: Winter storm. $100k property damage across Oceana County.
- February 5, 2019: Ice storm. $1m property damage across Oceana County.

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 within the county in 2023: 75
- ***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.
- March 8, 2017: Over 1 million without power (high wind), statewide.
- April 14, 2018: 450,000 without power (winter storm), statewide.
- February 5, 2019: 150,000 without power (ice storm), Central Lower Michigan.
- February 24, 2019: 1 million without 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 test wells in Crystal Township in 2023: 137***
- ***2 wells 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:

- 2020 to current: Covid-19 Pandemic. Nearly 7 million confirmed deaths worldwide. 97 confirmed deaths in Oceana County as of July 11, 2023.

3.05 Terrorism and Similar Criminal Activities: - None Identified.

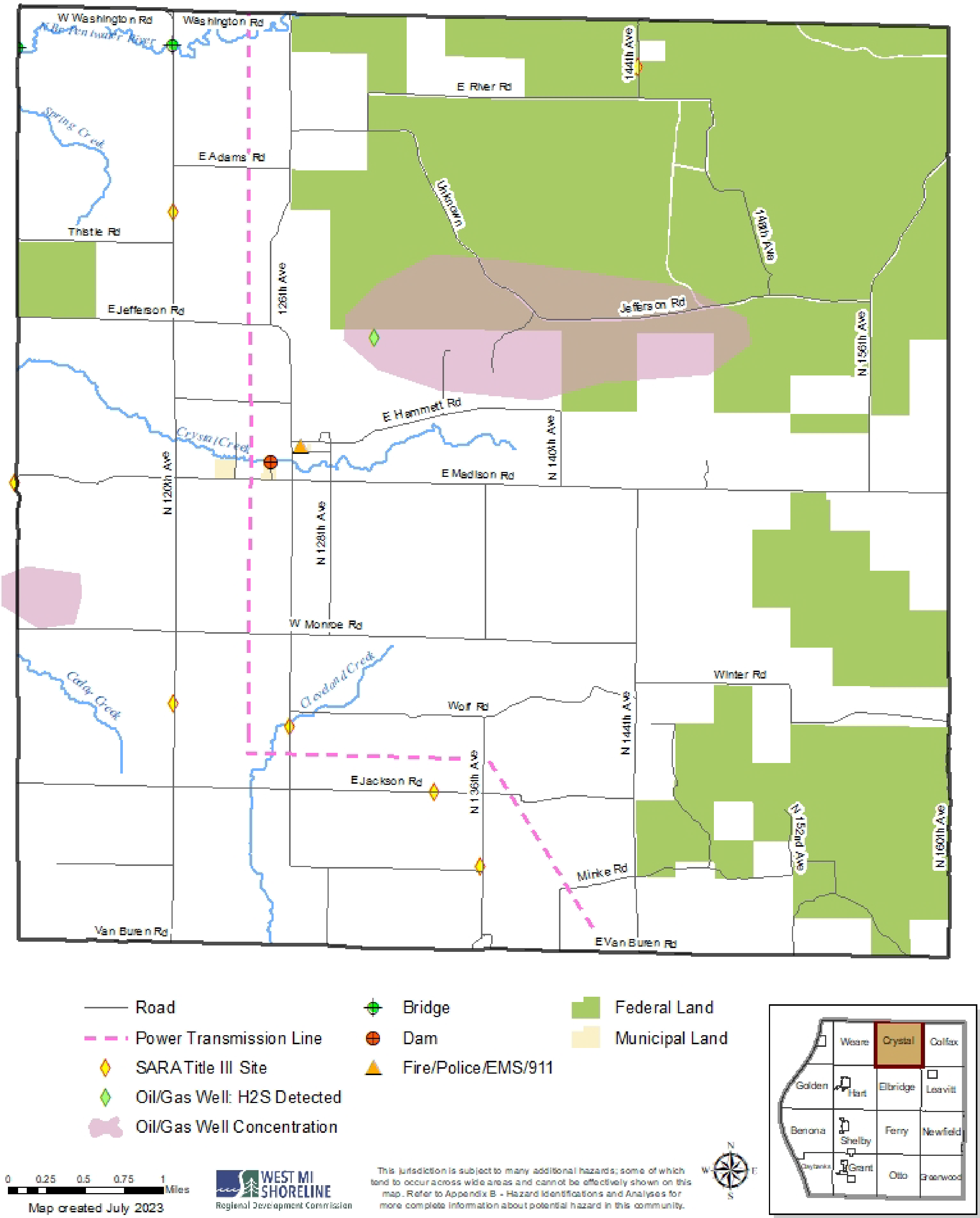
CRYSTAL TOWNSHIP
Hazard Assessment
Ratings

Natural Hazards	Probability of Occurrence	Population Affected	Property Damaged	Economic Impacts
1.01a Space Weather	2	2	0	3
1.01b 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	2	2
1.12 Subsidence	1	1	1	1
1.13 Tornadoes	2	1	2	2
1.14 Wildfire	3	1	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	2
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	1
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	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	3	2	0	2
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		12		36
3	Extreme Temperatures	3		10		30
4	Infrastructure Failures	3		9		27
4	Wildfire	3		9		27
6	Drought	2		13		26
7	Hail	3		8		24
7	Lightning	3		8		24
7	Public Health Emergencies	3		8		24
10	Fire – Structural	3		7		21
11	Catastrophic Incidents	1		18		18
11	Space Weather	2		9		18
11	Invasive Species	2		9		18
11	Oil/Natural Gas Well Accidents	2		9		18
11	Tornadoes	2		9		18
16	Energy Emergencies	2		8		16
17	HAZMAT – Transportation	2		7		14
18	Dam failure	2		6		12
18	Flooding: Riverine/Urban	2		6		12
18	HAZMAT – Fixed Site	2		6		12
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		-		-
n/a	Pipeline Accidents	0		-		-

Crystal Township, Oceana County
Critical Facilities and Potential Hazards



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:

NFIP Participation: N/A **FIRM Map Date:** N/A

Flood Insurance Policies In-Force: 0 **Total Flood Insurance Coverage:** N/A

Floodplains and Flood-prone Areas: N/A
- 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.
- March 8, 2017: High wind. $10m Property damage across Oceana County.
- February 24, 2019: High wind. $1m property damage across Oceana County.
- November 10, 2020: Severe thunderstorms. $100k property damage 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.
- April 14, 2018: Winter storm. $100k property damage across Oceana County.
- February 5, 2019: Ice storm. $1m property damage across Oceana County.

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 within the county in 2023: 75

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.
- March 8, 2017: Over 1 million without power (high wind), statewide.
- April 14, 2018: 450,000 without power (winter storm), statewide.
- February 5, 2019: 150,000 without power (ice storm), Central Lower Michigan.
- February 24, 2019: 1 million without 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 test wells in Elbridge Township in 2023: 111***
- ***5 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:
- 2020 to current: Covid-19 Pandemic. Nearly 7 million confirmed deaths worldwide. 97 confirmed deaths in Oceana County as of July 11, 2023.

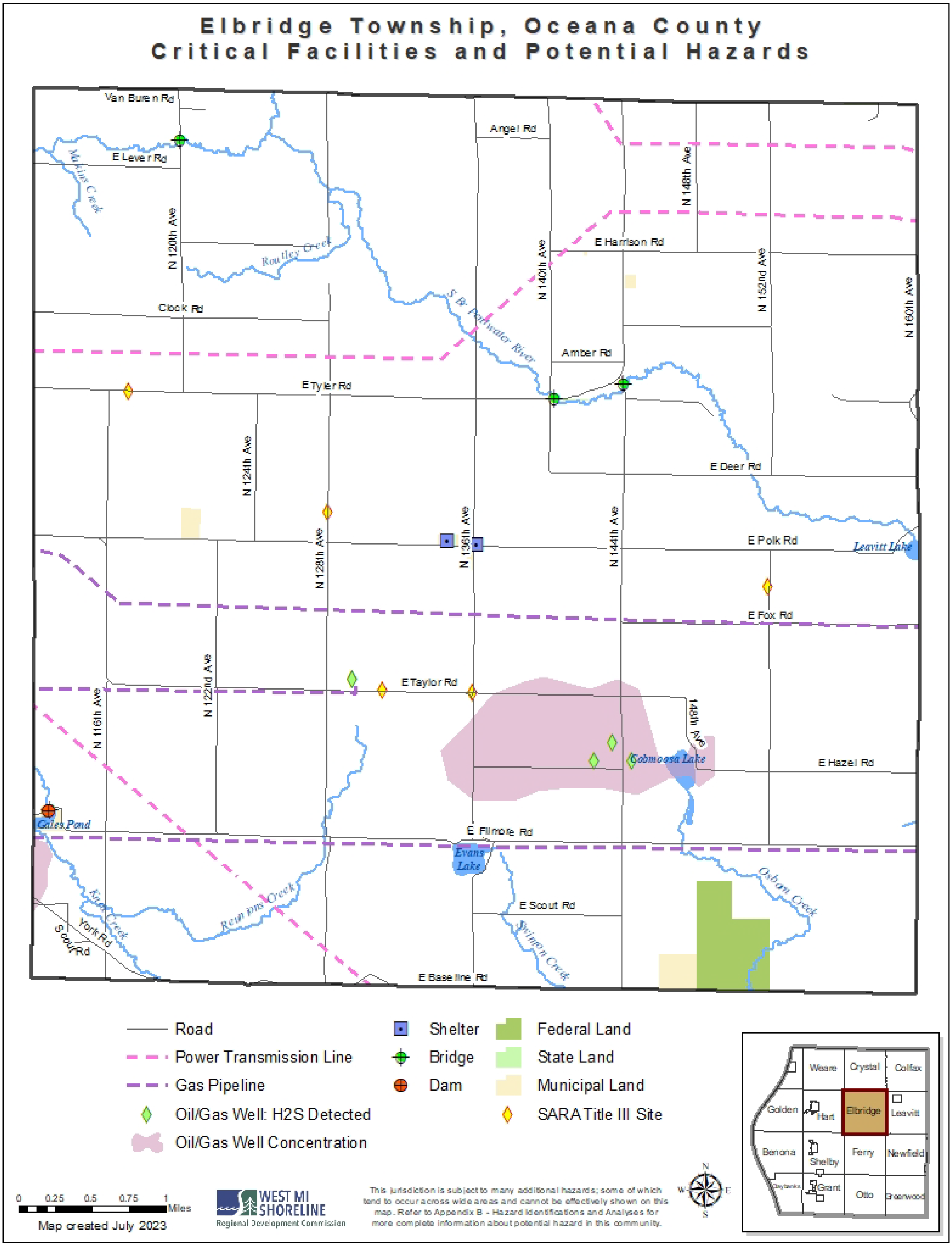
3.05 Terrorism and Similar Criminal Activities: - None Identified.

ELBRIDGE TOWNSHIP
Hazard Assessment
Ratings

Natural Hazards	Probability of Occurrence	Population Affected	Property Damaged	Economic Impacts
1.01a Space Weather	2	2	0	3
1.01b 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	2	2
1.12 Subsidence	1	1	1	1
1.13 Tornadoes	2	1	2	2
1.14 Wildfire	3	1	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	2
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	1
2.06 HAZMAT – Transportation	2	1	1	2
2.07 Infrastructure Failures	3	2	1	1
2.08 Nuclear Power Emergencies	0	-	-	-
2.09 Oil/Natural Gas Well Accidents	2	2	1	1
2.10 Pipeline Accidents	1	1	1	1
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	3	2	0	2
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		12		36
3	Extreme Temperatures	3		10		30
4	Infrastructure Failures	3		9		27
4	Wildfire	3		9		27
6	Drought	2		13		26
7	Hail	3		8		24
7	Lightning	3		8		24
7	Public Health Emergencies	3		8		24
10	Fire – Structural	3		7		21
11	Catastrophic Incidents	1		18		18
11	Space Weather	2		9		18
11	Invasive Species	2		9		18
11	Oil/Natural Gas Well Accidents	2		9		18
11	Tornadoes	2		9		18
16	Energy Emergencies	2		8		16
17	HAZMAT – Transportation	2		7		14
18	Dam failure	2		6		12
18	Flooding: Riverine/Urban	2		6		12
18	HAZMAT – Fixed Site	2		6		12
21	Celestial Impacts	1		8		8
21	Fog	2		4		8
23	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
24	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, Oceana County
Critical Facilities and Potential Hazards
Van Buren Rd
Angel Rd
E Lever Rd
Malins Creek
N 120th Ave
N 148th Ave
Rourley Creek
E Harrison Rd
N 140th Ave
N 152nd Ave
N 160th Ave
Clock Rd
S B. Pentwater River
Amber Rd
E Tyler Rd
E Deer Rd
N 124th Ave
N 128th Ave
N 136th Ave
N 144th Ave
E Polk Rd
Leavitt Lake
E Fox Rd
N 122nd Ave
E Taylor Rd
N 116th Ave
148th Ave
Cobmoosa Lake
E Hazel Rd
Gales Pond
E Fillmore Rd
Evans Lake
Osborn Creek
Knox Creek
Reun ims Creek
E Scout Rd
Swigan Creek
York Rd
Scout Rd
E Base line Rd
Road
Power Transmission Line
Gas Pipeline
Oil/Gas Well: H2S Detected
Oil/Gas Well Concentration
Shelter
Bridge
Dam
Federal Land
State Land
Municipal Land
SARA Title III Site
0 0.25 0.5 0.75 1 Miles
Map created July 2023
WEST MI SHORELINE
Regional Development Commission
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 hazard in this community.
N
S
E
W
Weare
Crystal
Colfax
Golden
Hart
Elbridge
Leavitt
Benona
Shelby
Ferry
Newfield
Claybanks
Grant
Otto
Greenwood

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:

NFIP Participation: Participating in NFIP **FIRM Map Date:** 08/04/14

Flood Insurance Policies In-Force: 2 **Total Flood Insurance Coverage:** $411,000

Floodplains and Flood-prone Areas: North Branch White River

- 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.
- March 8, 2017: High wind. $10m Property damage across Oceana County.
- February 24, 2019: High wind. $1m property damage across Oceana County.
- November 10, 2020: Severe thunderstorms. $100k property damage 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.
- April 14, 2018: Winter storm. $100k property damage across Oceana County.
- February 5, 2019: Ice storm. $1m property damage across Oceana County.

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 within the county in 2023: 75

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.
- March 8, 2017: Over 1 million without power (high wind), statewide.
- April 14, 2018: 450,000 without power (winter storm), statewide.
- February 5, 2019: 150,000 without power (ice storm), Central Lower Michigan.
- February 24, 2019: 1 million without 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 test wells in Ferry Township in 2023: 106
- 6 wells with known detectable levels of hydrogen sulfide in Ferry 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:

- 2020 to current: Covid-19 Pandemic. Nearly 7 million confirmed deaths worldwide. 97 confirmed deaths in Oceana County as of July 11, 2023.

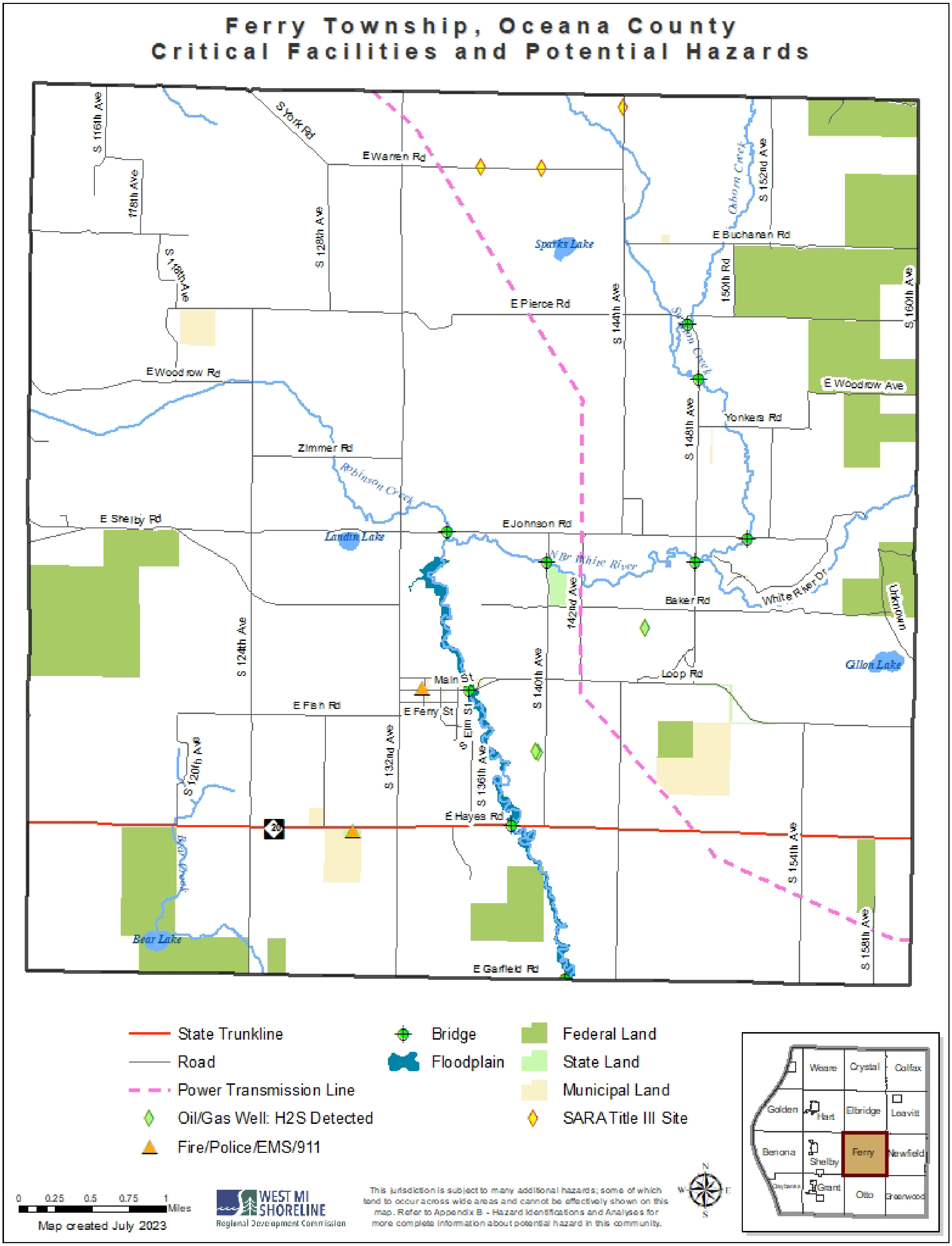
3.05 Terrorism and Similar Criminal Activities: - None Identified.

FERRY TOWNSHIP
Hazard Assessment
Ratings

Natural Hazards	Probability of Occurrence	Population Affected	Property Damaged	Economic Impacts
1.01a Space Weather	2	2	0	3
1.01b 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	2	2
1.12 Subsidence	1	1	1	1
1.13 Tornadoes	2	1	2	2
1.14 Wildfire	3	1	2	2
1.15 Winter Storms	3	3	2	2
Technological Hazards				
2.01 Dam Failure	0	-	-	-
2.02 Energy Emergencies	2	2	0	2
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	1
2.06 HAZMAT – Transportation	2	1	1	2
2.07 Infrastructure Failures	3	2	1	1
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	3	2	0	2
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		12		36
3	Extreme Temperatures	3		10		30
4	Infrastructure Failures	3		9		27
4	Wildfire	3		9		27
6	Drought	2		13		26
7	Hail	3		8		24
7	Lightning	3		8		24
7	Public Health Emergencies	3		8		24
10	Fire – Structural	3		7		21
11	Catastrophic Incidents	1		18		18
11	Space Weather	2		9		18
11	Oil/Natural Gas Well Accidents	2		9		18
11	Tornadoes	2		9		18
15	Energy Emergencies	2		8		16
16	HAZMAT – Transportation	2		7		14
16	Invasive Species	2		7		14
18	Flooding: Riverine/Urban	2		6		12
18	HAZMAT – Fixed Site	2		6		12
18	Transportation Accidents	2		6		12
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		-		-
n/a	Pipeline Accidents	0		-		-


Ferry Township, Oceana County
Critical Facilities and Potential Hazards
S 116th Ave
118th Ave
S York Rd
E Warren Rd
S 128th Ave
S 148th Ave
Sparks Lake
E Buchanan Rd
S 152nd Ave
150th Rd
S 160th Ave
E Pierce Rd
S 144th Ave
E Woodrow Rd
E Woodrow Ave
Yonkers Rd
S 148th Ave
Zimmer Rd
Robinson Creek
E Shelby Rd
E Johnson Rd
Landon Lake
N Br White River
142nd Ave
Baker Rd
White River Dr
Unknown
S 124th Ave
S 140th Ave
Loop Rd
Gillon Lake
Main St
E Ferry St
Elm St
E Fish Rd
S 120th Ave
S 132nd Ave
S 136th Ave
E Hayes Rd
S 154th Ave
S 158th Ave
Bear Lake
E Garfield Rd
State Trunkline
Road
Power Transmission Line
Oil/Gas Well: H2S Detected
Fire/Police/EMS/911
Bridge
Floodplain
Federal Land
State Land
Municipal Land
SARA Title III Site
Weare
Crystal
Colfax
Golden
Hart
Elbridge
Leavitt
Benona
Shelby
Ferry
Newfield
Grant
Otto
Greenwood
0 0.25 0.5 0.75 1 Miles
Map created July 2023
WEST MI SHORELINE
Regional Development Commission
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 hazard in this community.

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:

NFIP Participation: Participating in NFIP **FIRM Map Date:** 08/24/21

Flood Insurance Policies In-Force: 5 **Total Flood Insurance Coverage:** $1,400,000

Floodplains and Flood-prone Areas: Lake Michigan shoreline, Silver Lake shoreline, Upper Silver Lake shoreline, Holiday Lake shoreline, Au Sable Creek, Hunter Creek, Lambrick Creek, Silver Creek
- 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.
- 2019-21: Lengthy high water event on Lake Michigan. High water record in 2020. Extensive shoreline erosion and property damage along Lake Michigan shoreline.

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:
- ***July 26, 2023: Lightning strike sparked a fire at the Silver Lake Pizza Factory, forcing it to close down for the season to be gutted and renovated, Golden Township.***

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.
- March 8, 2017: High wind. $10m Property damage across Oceana County.

- August 28, 2018: Severe thunderstorms. $20k property damage, Golden Township.
- February 24, 2019: High wind. $1m property damage across Oceana County.
- November 10, 2020: Severe thunderstorms. $100k property damage 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.
- April 14, 2018: Winter storm. $100k property damage across Oceana County.
- February 5, 2019: Ice storm. $1m property damage across Oceana County.

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 within the county in 2023: 75

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.
- March 8, 2017: Over 1 million without power (high wind), statewide.
- April 14, 2018: 450,000 without power (winter storm), statewide.
- February 5, 2019: 150,000 without power (ice storm), Central Lower Michigan.
- February 24, 2019: 1 million without 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 test wells in Golden Township in 2023: 102
- 3 wells with known detectable levels of hydrogen sulfide in Golden 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:
- 2020 to current: Covid-19 Pandemic. Nearly 7 million confirmed deaths worldwide. 97 confirmed deaths in Oceana County as of July 11, 2023.

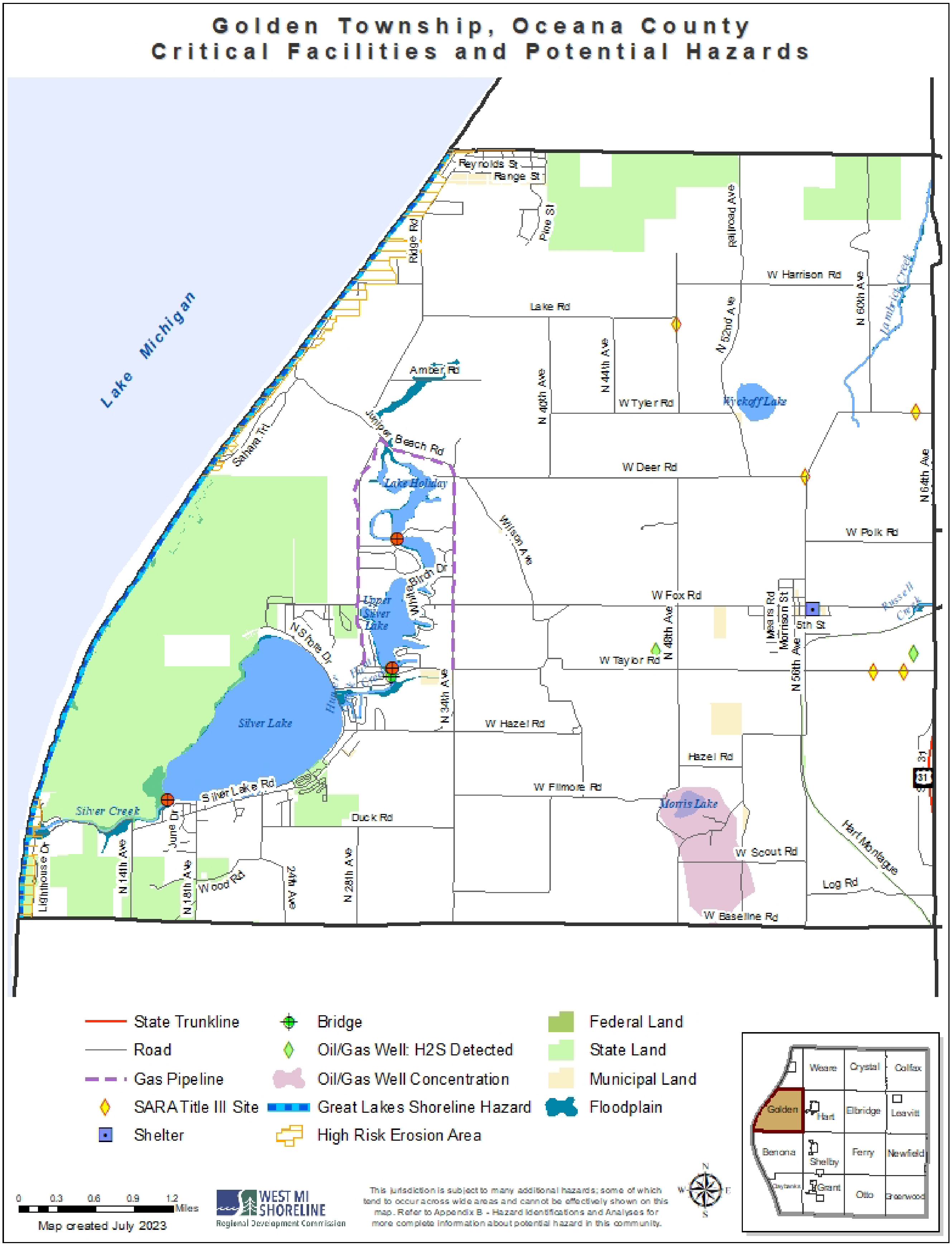
3.05 Terrorism and Similar Criminal Activities: - None Identified.

GOLDEN TOWNSHIP
Hazard Assessment
Ratings

Natural Hazards	Probability of Occurrence	Population Affected	Property Damaged	Economic Impacts
1.01a Space Weather	2	2	0	3
1.01b 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	2
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	2	2
1.12 Subsidence	1	1	1	1
1.13 Tornadoes	2	1	2	2
1.14 Wildfire	3	1	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	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	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	3	2	0	2
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		12		36
3	Extreme Temperatures	3		10		30
3	Infrastructure Failures	3		10		30
5	Fire – Structural	3		9		27
5	Great Lakes Shoreline	3		9		27
5	Wildfire	3		9		27
8	Drought	2		13		26
9	Dam failure	2		12		24
9	Flooding: Riverine/Urban	3		8		24
9	Hail	3		8		24
9	Lightning	3		8		24
9	Public Health Emergencies	3		8		24
14	Catastrophic Incidents	1		18		18
14	Space Weather	2		9		18
14	Oil/Natural Gas Well Accidents	2		9		18
14	Tornadoes	2		9		18
18	Energy Emergencies	2		8		16
18	Invasive Species	2		8		16
20	HAZMAT – Fixed Site	2		7		14
20	HAZMAT – Transportation	2		7		14
22	Fog	3		4		12
22	Transportation Accidents	2		6		12
24	Pipeline Accidents	1		10		10
25	Celestial Impacts	1		8		8
26	Civil Disturbances	1		6		6
26	Fire – Scrap Tires	1		6		6
26	Subsidence	1		6		6
26	Terrorism & Similar Criminal Acts	1		6		6
n/a	Earthquake	0		-		-
n/a	Nuclear Attack	0		-		-
n/a	Nuclear Power Emergencies	0		-		-


Golden Township, Oceana County
Critical Facilities and Potential Hazards
Lake Michigan
Silver Lake
Upper Silver Lake
Lake Holiday
Wyckoff Lake
Morris Lake
Silver Creek
Russell Creek
Lambrick Creek
State Trunkline
Road
Gas Pipeline
SARA Title III Site
Shelter
Bridge
Oil/Gas Well: H2S Detected
Oil/Gas Well Concentration
Great Lakes Shoreline Hazard
High Risk Erosion Area
Federal Land
State Land
Municipal Land
Floodplain
Map created July 2023
WEST MI SHORELINE Regional Development Commission
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 hazard in this community.

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:

NFIP Participation: N/A **FIRM Map Date:** N/A

Flood Insurance Policies In-Force: 0 **Total Flood Insurance Coverage:** N/A

Floodplains and Flood-prone Areas: N/A

- 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.
- March 8, 2017: High wind. $10m Property damage across Oceana County.
- February 24, 2019: High wind. $1m property damage across Oceana County.
- November 10, 2020: Severe thunderstorms. $100k property damage 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.
- April 14, 2018: Winter storm. $100k property damage across Oceana County.
- February 5, 2019: Ice storm. $1m property damage across Oceana County.

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 within the county in 2023: 75

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.
- March 8, 2017: Over 1 million without power (high wind), statewide.
- April 14, 2018: 450,000 without power (winter storm), statewide.
- February 5, 2019: 150,000 without power (ice storm), Central Lower Michigan.
- February 24, 2019: 1 million without 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 test wells in Grant Township in 2023: 64
- 2 wells with known detectable levels of hydrogen sulfide in 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:

- 2020 to current: Covid-19 Pandemic. Nearly 7 million confirmed deaths worldwide. 97 confirmed deaths in Oceana County as of July 11, 2023.

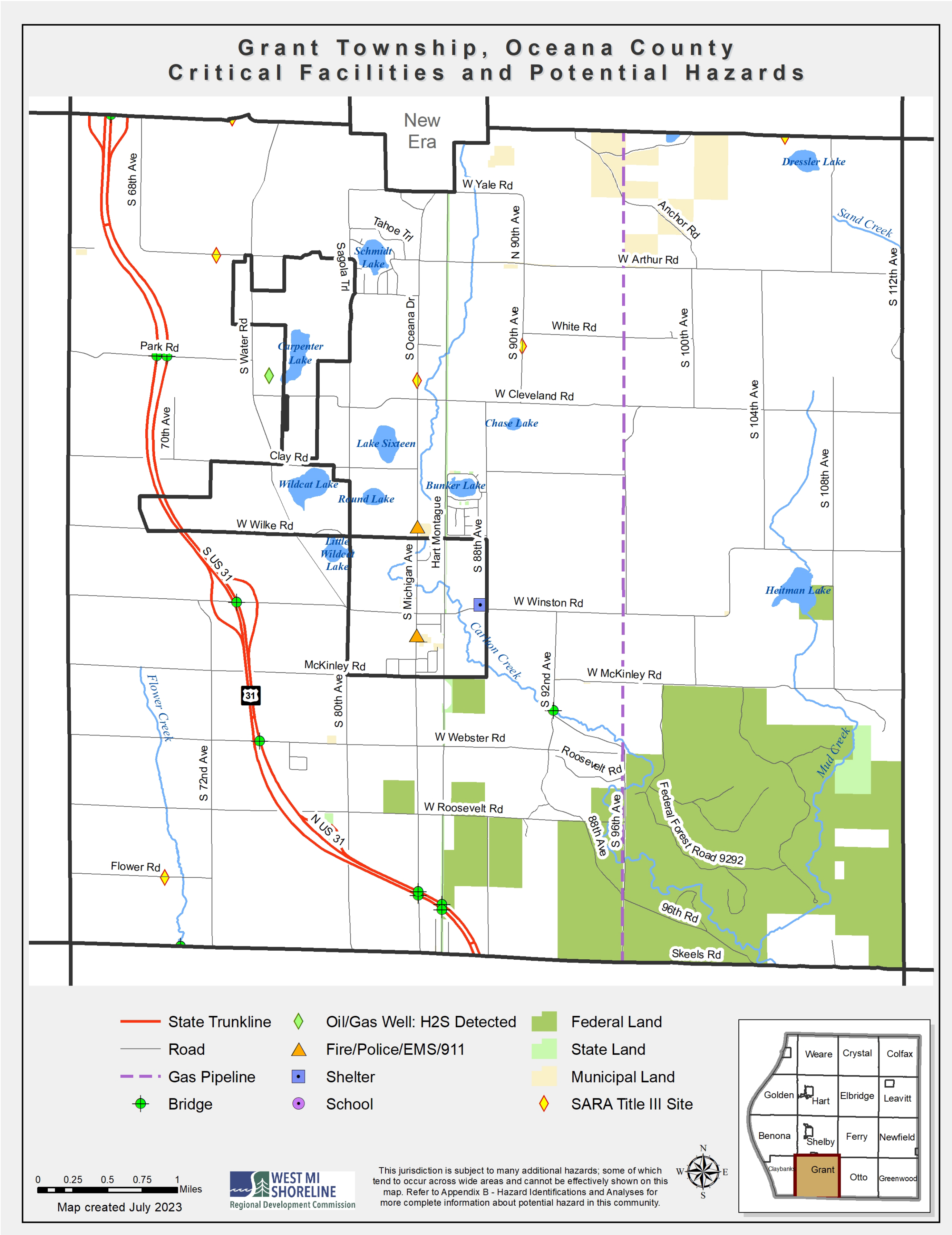
3.05 Terrorism and Similar Criminal Activities: - None Identified.

GRANT TOWNSHIP
Hazard Assessment
Ratings

Natural Hazards	Probability of Occurrence	Population Affected	Property Damaged	Economic Impacts
1.01a Space Weather	2	2	0	3
1.01b 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	2	2
1.12 Subsidence	1	1	1	1
1.13 Tornadoes	2	1	2	2
1.14 Wildfire	3	1	2	2
1.15 Winter Storms	3	3	2	2
Technological Hazards				
2.01 Dam Failure	0	-	-	-
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	1
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	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	3	2	0	2
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		12		36
3	Extreme Temperatures	3		10		30
3	Infrastructure Failures	3		10		30
5	Fire – Structural	3		9		27
5	Wildfire	3		9		27
7	Drought	2		13		26
8	Hail	3		8		24
8	Lightning	3		8		24
8	Public Health Emergencies	3		8		24
11	Catastrophic Incidents	1		18		18
11	Space Weather	2		9		18
11	Invasive Species	2		9		18
11	Tornadoes	2		9		18
15	Energy Emergencies	2		8		16
16	HAZMAT – Transportation	2		7		14
17	Flooding: Riverine/Urban	2		6		12
17	HAZMAT – Fixed Site	2		6		12
17	Oil/Natural Gas Well Accidents	2		6		12
17	Transportation Accidents	2		6		12
21	Celestial Impacts	1		8		8
21	Fog	2		4		8
23	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	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, Oceana County
Critical Facilities and Potential Hazards
New Era
W Yale Rd
Dressler Lake
Sand Creek
Anchor Rd
Tahoe Trl
Schmidt Lake
Sagola Trl
W Arthur Rd
S 68th Ave
N 90th Ave
S 112th Ave
White Rd
S 100th Ave
S 90th Ave
Park Rd
S Water Rd
Carpenter Lake
S Oceana Dr
W Cleveland Rd
S 104th Ave
Chase Lake
70th Ave
Lake Sixteen
Clay Rd
Wildcat Lake
Round Lake
Bunker Lake
S 108th Ave
W Wilke Rd
Hart Montague
S 88th Ave
S US 31
Little Wildcat Lake
S Michigan Ave
Heitman Lake
W Winston Rd
Carlton Creek
McKinley Rd
W McKinley Rd
S 92nd Ave
S 80th Ave
Flower Creek
31
W Webster Rd
Roosevelt Rd
Mud Creek
S 72nd Ave
Federal Forest Road 9292
W Roosevelt Rd
S 96th Ave
88th Ave
N US 31
Flower Rd
96th Rd
Skeels Rd
State Trunkline
Road
Gas Pipeline
Bridge
Oil/Gas Well: H2S Detected
Fire/Police/EMS/911
Shelter
School
Federal Land
State Land
Municipal Land
SARA Title III Site
Weare
Crystal
Colfax
Golden
Hart
Elbridge
Leavitt
Benona
Shelby
Ferry
Newfield
Claybanks
Grant
Otto
Greenwood
0 0.25 0.5 0.75 1 Miles
Map created July 2023
WEST MI SHORELINE
Regional Development Commission
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 hazard in this community.
N
W
E
S

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:

NFIP Participation: Not Participating in NFIP **FIRM Map Date:** 08/04/14
Flood Insurance Policies In-Force: 0 **Total Flood Insurance Coverage:** $0
Floodplains and Flood-prone Areas: White River, Skeels Creek
- 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.
- March 8, 2017: High wind. $10m Property damage across Oceana County.
- February 24, 2019: High wind. $1m property damage across Oceana County.
- November 10, 2020: Severe thunderstorms. $100k property damage 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.
- April 14, 2018: Winter storm. $100k property damage across Oceana County.
- February 5, 2019: Ice storm. $1m property damage across Oceana County.

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 within the county in 2023: 75

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.
- March 8, 2017: Over 1 million without power (high wind), statewide.
- April 14, 2018: 450,000 without power (winter storm), statewide.
- February 5, 2019: 150,000 without power (ice storm), Central Lower Michigan.
- February 24, 2019: 1 million without 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 test wells in Greenwood Township in 2023: 52

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:
- 2020 to current: Covid-19 Pandemic. Nearly 7 million confirmed deaths worldwide. 97 confirmed deaths in Oceana County as of July 11, 2023.

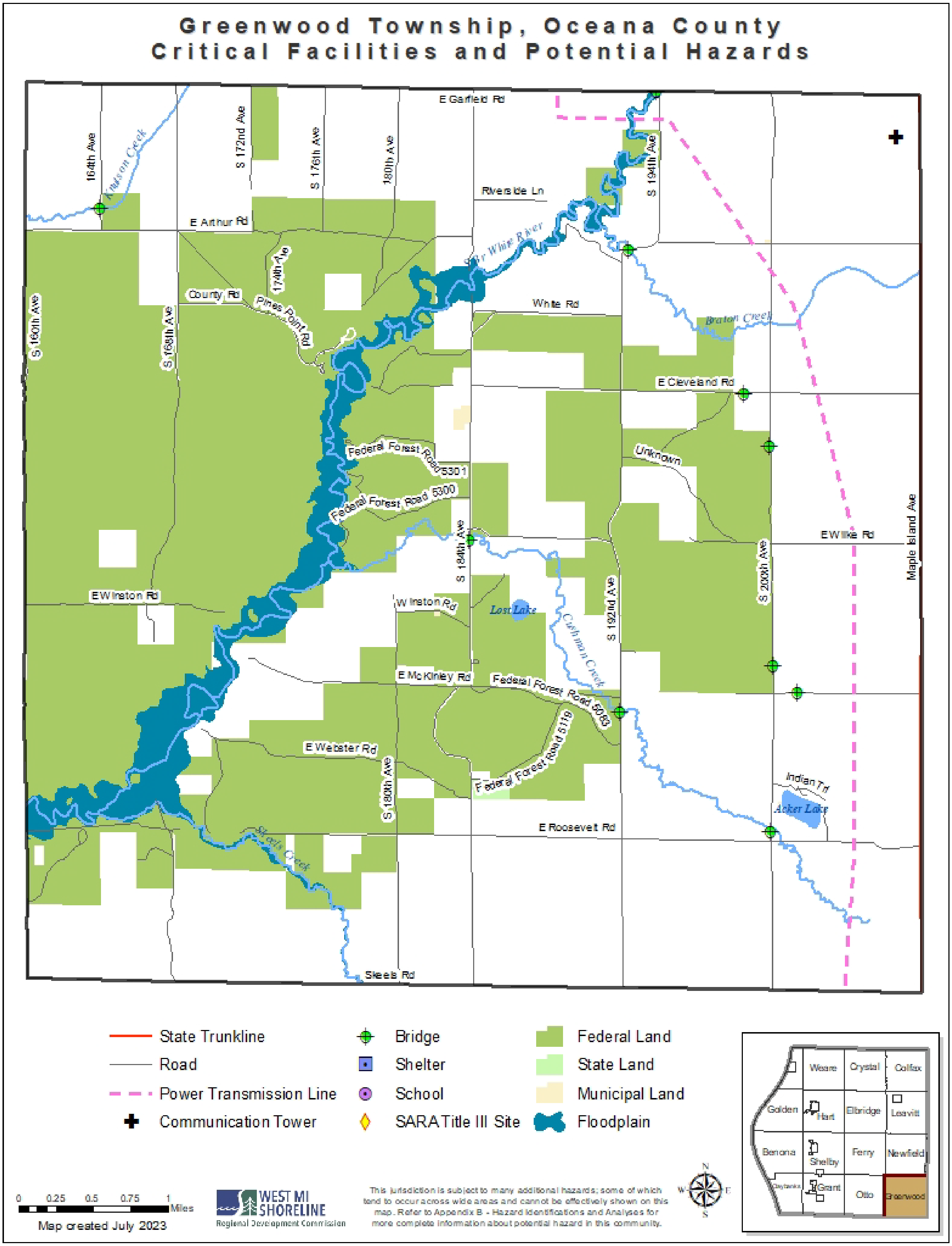
3.05 Terrorism and Similar Criminal Activities: - None Identified.

GREENWOOD TOWNSHIP
Hazard Assessment
Ratings

Natural Hazards	Probability of Occurrence	Population Affected	Property Damaged	Economic Impacts
1.01a Space Weather	2	2	0	3
1.01b 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	2	2
1.12 Subsidence	1	1	1	1
1.13 Tornadoes	2	1	2	2
1.14 Wildfire	3	1	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	2
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	1
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	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	3	2	0	2
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		12		36
3	Extreme Temperatures	3		10		30
3	Infrastructure Failures	3		10		30
5	Wildfire	3		9		27
6	Drought	2		13		26
7	Flooding: Riverine/Urban	3		8		24
7	Hail	3		8		24
7	Lightning	3		8		24
7	Public Health Emergencies	3		8		24
11	Fire – Structural	3		7		21
12	Catastrophic Incidents	1		18		18
12	Space Weather	2		9		18
12	Dam failure	2		9		18
12	Tornadoes	2		9		18
16	Energy Emergencies	2		8		16
17	HAZMAT – Transportation	2		7		14
17	Invasive Species	2		7		14
19	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	HAZMAT – Fixed Site	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	Earthquake	0		-		-
n/a	Great Lakes Shoreline	0		-		-
n/a	Nuclear Attack	0		-		-
n/a	Nuclear Power Emergencies	0		-		-
n/a	Pipeline Accidents	0		-		-



Greenwood Township, Oceana County
Critical Facilities and Potential Hazards
E Garfield Rd
164th Ave
S 172nd Ave
S 176th Ave
180th Ave
S 194th Ave
Riverside Ln
E Arthur Rd
174th Ave
County Rd
Pines Point Rd
White Rd
Braton Creek
S 160th Ave
S 168th Ave
E Cleveland Rd
Unknown
Federal Forest Road 5301
Federal Forest Road 5300
E Wilke Rd
Maple Island Ave
S 184th Ave
S 200th Ave
E Winston Rd
W Winston Rd
Lost Lake
S 192nd Ave
E McKinley Rd
Federal Forest Road 5083
E Webster Rd
S 180th Ave
Federal Forest Road 5118
Indian Trl
Acker Lake
E Roosevelt Rd
Skeels Creek
Skeels Rd
State Trunkline
Road
Power Transmission Line
Communication Tower
Bridge
Shelter
School
SARA Title III Site
Federal Land
State Land
Municipal Land
Floodplain
Weare
Crystal
Colfax
Golden
Hart
Elbridge
Leavitt
Benona
Shelby
Ferry
Newfield
Claybanks
Grant
Otto
Greenwood
0 0.25 0.5 0.75 1 Miles
Map created July 2023
WEST MI SHORELINE
Regional Development Commission
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 hazard in this community.

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:

NFIP Participation: Not Participating in NFIP **FIRM Map Date:** 08/24/21

Flood Insurance Policies In-Force: 0 **Total Flood Insurance Coverage:** $0

Floodplains and Flood-prone Areas: Hart Lake shoreline, Pentwater River, Chippewa Creek, Russell Creek
- 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.
- March 8, 2017: High wind. $10m Property damage across Oceana County.
- February 24, 2019: High wind. $1m property damage across Oceana County.
- November 10, 2020: Severe thunderstorms. $100k property damage 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.
- April 14, 2018: Winter storm. $100k property damage across Oceana County.
- February 5, 2019: Ice storm. $1m property damage across Oceana County.

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 within the county in 2023: 75

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.
- March 8, 2017: Over 1 million without power (high wind), statewide.
- April 14, 2018: 450,000 without power (winter storm), statewide.
- February 5, 2019: 150,000 without power (ice storm), Central Lower Michigan.
- February 24, 2019: 1 million without 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 test wells in Hart Township in 2023: 89

- 3 wells with known detectable levels of hydrogen sulfide in Hart Township

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:

- 2020 to current: Covid-19 Pandemic. Nearly 7 million confirmed deaths worldwide. 97 confirmed deaths in Oceana County as of July 11, 2023.

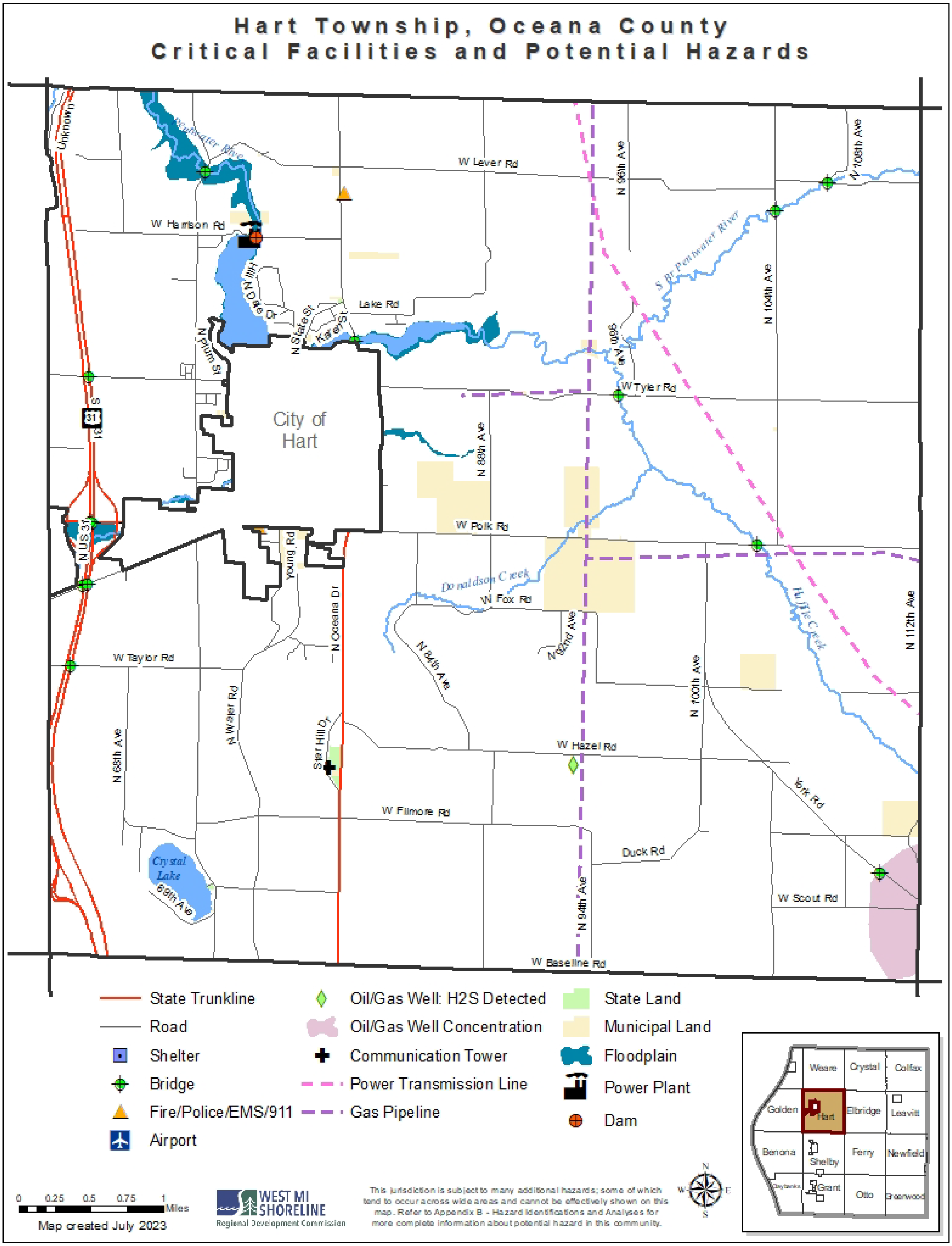
3.05 Terrorism and Similar Criminal Activities: - None Identified.

HART TOWNSHIP
Hazard Assessment
Ratings

Natural Hazards	Probability of Occurrence	Population Affected	Property Damaged	Economic Impacts
1.01a Space Weather	2	2	0	3
1.01b 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	2	2
1.12 Subsidence	1	1	1	1
1.13 Tornadoes	2	1	2	2
1.14 Wildfire	3	1	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	2
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	2	1	2
2.08 Nuclear Power Emergencies	0	-	-	-
2.09 Oil/Natural Gas Well Accidents	2	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	3	2	0	2
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		12		36
3	Extreme Temperatures	3		10		30
3	Infrastructure Failures	3		10		30
5	Wildfire	3		9		27
6	Drought	2		13		26
7	Hail	3		8		24
7	Lightning	3		8		24
7	Public Health Emergencies	3		8		24
10	Fire – Structural	3		7		21
11	Catastrophic Incidents	1		18		18
11	Space Weather	2		9		18
11	Invasive Species	2		9		18
11	Tornadoes	2		9		18
15	Energy Emergencies	2		8		16
15	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	Oil/Natural Gas Well Accidents	2		6		12
19	Transportation Accidents	2		6		12
22	Celestial Impacts	1		8		8
22	Fog	2		4		8
24	Pipeline Accidents	1		7		7
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	Great Lakes Shoreline	0		-		-
n/a	Nuclear Attack	0		-		-
n/a	Nuclear Power Emergencies	0		-		-


Hart Township, Oceana County
Critical Facilities and Potential Hazards
City of Hart
W Lever Rd
W Harrison Rd
Lake Rd
W Tyler Rd
W Polk Rd
W Fox Rd
W Taylor Rd
W Hazel Rd
W Fillmore Rd
Duck Rd
W Scout Rd
W Baseline Rd
York Rd
N 88th Ave
N 96th Ave
N 104th Ave
N 108th Ave
N 100th Ave
N 112th Ave
N 94th Ave
N 68th Ave
N 84th Ave
N 92nd Ave
N Oceana Dr
N Water Rd
N US 31
Young Rd
Star Hill Dr
N Plum St
N State St
Crystal Lake
Donaldson Creek
S Br Pentwater River
Pentwater River
Unknown
State Trunkline
Road
Shelter
Bridge
Fire/Police/EMS/911
Airport
Oil/Gas Well: H2S Detected
Oil/Gas Well Concentration
Communication Tower
Power Transmission Line
Gas Pipeline
State Land
Municipal Land
Floodplain
Power Plant
Dam
Weare
Crystal
Colfax
Golden
Hart
Elbridge
Leavitt
Benona
Shelby
Ferry
Newfield
Grant
Otto
Greenwood
0 0.25 0.5 0.75 1 Miles
Map created July 2023
WEST MI SHORELINE Regional Development Commission
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 hazard in this community.

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:

NFIP Participation: N/A **FIRM Map Date:** N/A

Flood Insurance Policies In-Force: 0 **Total Flood Insurance Coverage:** N/A

Floodplains and Flood-prone Areas: N/A

- 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.
- March 8, 2017: High wind. $10m Property damage across Oceana County.
- February 24, 2019: High wind. $1m property damage across Oceana County.
- November 10, 2020: Severe thunderstorms. $100k property damage 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.
- April 14, 2018: Winter storm. $100k property damage across Oceana County.
- February 5, 2019: Ice storm. $1m property damage across Oceana County.

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
- ***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 within the county in 2023: 75

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.
- March 8, 2017: Over 1 million without power (high wind), statewide.
- April 14, 2018: 450,000 without power (winter storm), statewide.
- February 5, 2019: 150,000 without power (ice storm), Central Lower Michigan.
- February 24, 2019: 1 million without 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 test wells in Leavitt Township in 2023: 88***

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. <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:

- 2020 to current: Covid-19 Pandemic. Nearly 7 million confirmed deaths worldwide. 97 confirmed deaths in Oceana County as of July 11, 2023.

3.05 Terrorism and Similar Criminal Activities: - None Identified.

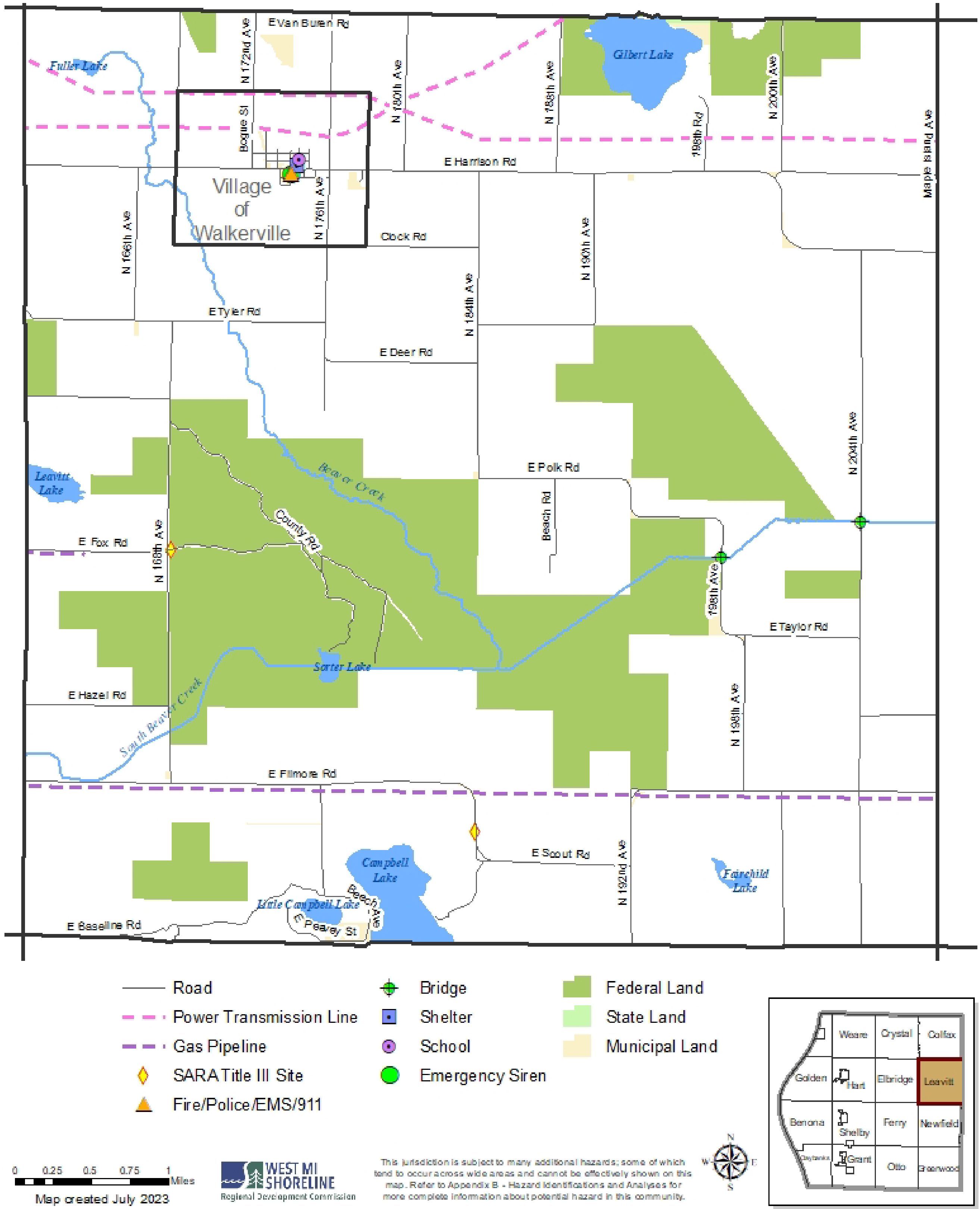
LEAVITT TOWNSHIP
Hazard Assessment
Ratings

Natural Hazards	Probability of Occurrence	Population Affected	Property Damaged	Economic Impacts
1.01a Space Weather	2	2	0	3
1.01b 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	2	2
1.12 Subsidence	1	1	1	1
1.13 Tornadoes	2	1	2	2
1.14 Wildfire	3	1	2	2
1.15 Winter Storms	3	3	2	2
Technological Hazards				
2.01 Dam Failure	0	-	-	-
2.02 Energy Emergencies	2	2	0	2
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	1
2.06 HAZMAT – Transportation	2	1	1	2
2.07 Infrastructure Failures	3	2	1	1
2.08 Nuclear Power Emergencies	0	-	-	-
2.09 Oil/Natural Gas Well Accidents	2	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	3	2	0	2
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		12		36
3	Extreme Temperatures	3		10		30
4	Infrastructure Failures	3		9		27
4	Wildfire	3		9		27
6	Drought	2		13		26
7	Hail	3		8		24
7	Lightning	3		8		24
7	Public Health Emergencies	3		8		24
10	Fire – Structural	3		7		21
11	Catastrophic Incidents	1		18		18
11	Space Weather	2		9		18
11	Invasive Species	2		9		18
11	Tornadoes	2		9		18
15	Energy Emergencies	2		8		16
16	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	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	HAZMAT – Fixed Site	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, Oceana County
Critical Facilities and Potential Hazards



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:

NFIP Participation: Participating in NFIP **FIRM Map Date:** 08/04/14

Flood Insurance Policies In-Force: 12 **Total Flood Insurance Coverage:** $1,741,000

Floodplains and Flood-prone Areas: White River
- 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.
- March 8, 2017: High wind. $10m Property damage across Oceana County.
- February 24, 2019: High wind. $1m property damage across Oceana County.
- November 10, 2020: Severe thunderstorms. $100k property damage 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.
- April 14, 2018: Winter storm. $100k property damage across Oceana County.
- February 5, 2019: Ice storm. $1m property damage across Oceana County.

2. <u>TECHNOLOGICAL HAZARDS</u>

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 within the county in 2023: 75

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.
- March 8, 2017: Over 1 million without power (high wind), statewide.
- April 14, 2018: 450,000 without power (winter storm), statewide.
- February 5, 2019: 150,000 without power (ice storm), Central Lower Michigan.
- February 24, 2019: 1 million without 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 test wells in Newfield Township in 2023: 27

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:
- 2020 to current: Covid-19 Pandemic. Nearly 7 million confirmed deaths worldwide. 97 confirmed deaths in Oceana County as of July 11, 2023.

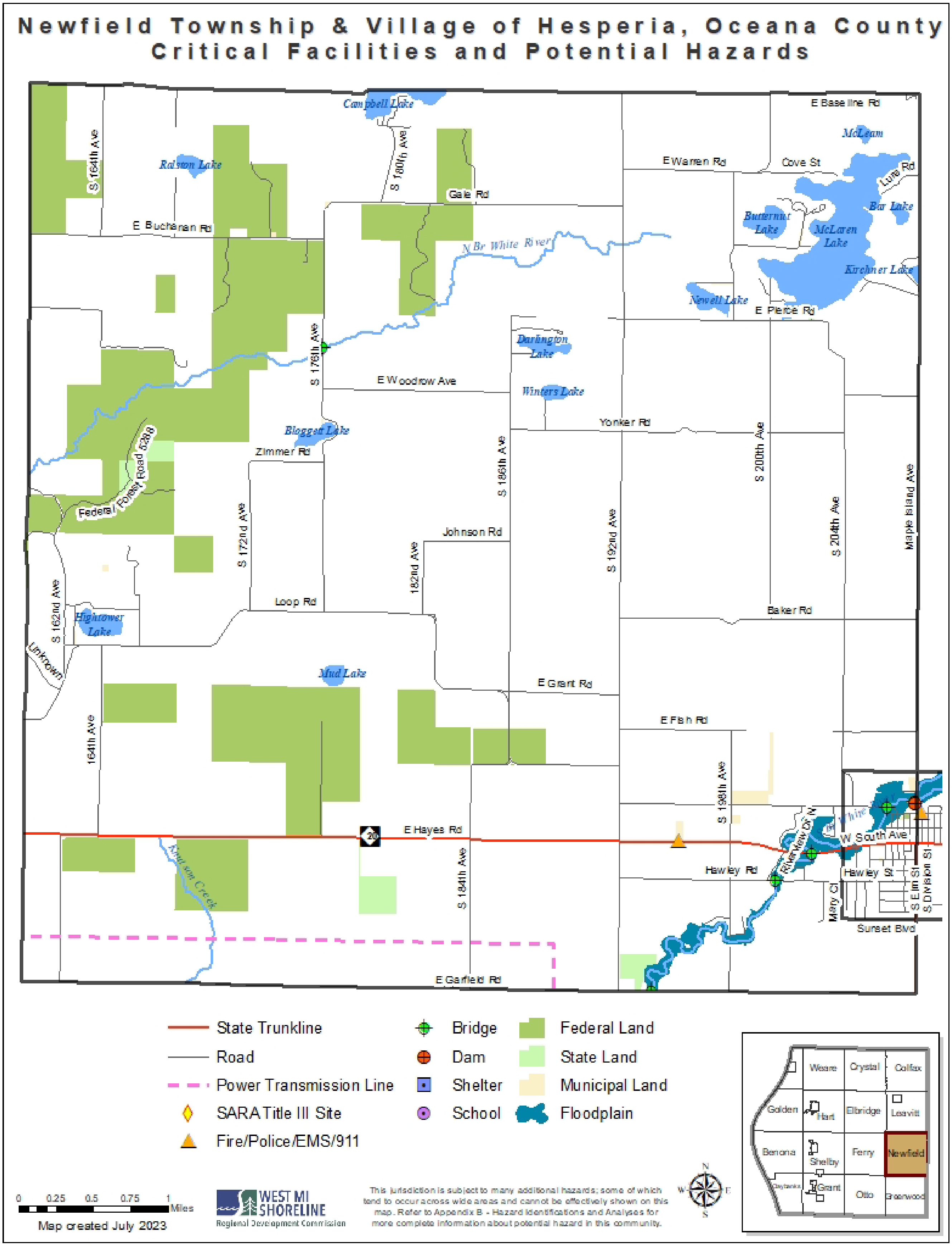
3.05 Terrorism and Similar Criminal Activities: - None Identified.

NEWFIELD TOWNSHIP
Hazard Assessment
Ratings

Natural Hazards	Probability of Occurrence	Population Affected	Property Damaged	Economic Impacts
1.01a Space Weather	2	2	0	3
1.01b 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	2	2
1.12 Subsidence	1	1	1	1
1.13 Tornadoes	2	1	2	2
1.14 Wildfire	3	1	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	2
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	2	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	3	2	0	2
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		12		36
3	Extreme Temperatures	3		10		30
3	Infrastructure Failures	3		10		30
5	Fire – Structural	3		9		27
5	Wildfire	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
8	Public Health Emergencies	3		8		24
12	Catastrophic Incidents	1		18		18
12	Space Weather	2		9		18
12	Dam failure	2		9		18
12	Tornadoes	2		9		18
16	Energy Emergencies	2		8		16
17	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	Civil Disturbances	1		6		6
22	Fire – Scrap Tires	1		6		6
22	HAZMAT – Fixed Site	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	Earthquake	0		-		-
n/a	Great Lakes Shoreline	0		-		-
n/a	Nuclear Attack	0		-		-
n/a	Nuclear Power Emergencies	0		-		-
n/a	Pipeline Accidents	0		-		-


Newfield Township & Village of Hesperia, Oceana County
Critical Facilities and Potential Hazards
Campbell Lake
Ralston Lake
McLeam
Butternut Lake
McLaren Lake
Bar Lake
Kirchner Lake
Newell Lake
Darlington Lake
Winters Lake
Bloggett Lake
Hightower Lake
Mud Lake
N Br White River
Knutson Creek
E Base line Rd
E Warren Rd
Cove St
Lure Rd
Gale Rd
E Buchanan Rd
E Pierce Rd
E Woodrow Ave
Yonker Rd
Zimmer Rd
Federal Forest Road 5268
Johnson Rd
Loop Rd
Baker Rd
E Grant Rd
E Fish Rd
E Hayes Rd
Hawley Rd
W South Ave
Hawley St
Sunset Blvd
E Garfield Rd
S 164th Ave
S 180th Ave
S 176th Ave
S 186th Ave
S 172nd Ave
182nd Ave
S 192nd Ave
S 200th Ave
S 204th Ave
Maple Island Ave
S 162nd Ave
Unknown
164th Ave
S 184th Ave
S 198th Ave
River View Dr
Mary Ct
S Elm St
S Division St
20
State Trunkline
Road
Power Transmission Line
SARA Title III Site
Fire/Police/EMS/911
Bridge
Dam
Shelter
School
Federal Land
State Land
Municipal Land
Floodplain
0 0.25 0.5 0.75 1 Miles
Map created July 2023
WEST MI SHORELINE
Regional Development Commission
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 hazard in this community.
N
E
S
W
Weare
Crystal
Colfax
Golden
Hart
Elbridge
Leavitt
Benona
Shelby
Ferry
Newfield
Claybanks
Grant
Otto
Greenwood

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:

NFIP Participation: Not participating in NFIP **FIRM Map Date:** 08/04/14
Flood Insurance Policies In-Force: 0 **Total Flood Insurance Coverage:** $0
Floodplains and Flood-prone Areas: White River, North Branch White River
- 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.
- March 8, 2017: High wind. $10m Property damage across Oceana County.
- February 24, 2019: High wind. $1m property damage across Oceana County.
- November 10, 2020: Severe thunderstorms. $100k property damage 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.
- April 14, 2018: Winter storm. $100k property damage across Oceana County.
- February 5, 2019: Ice storm. $1m property damage across Oceana County.

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 within the county in 2023: 75

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.
- March 8, 2017: Over 1 million without power (high wind), statewide.
- April 14, 2018: 450,000 without power (winter storm), statewide.
- February 5, 2019: 150,000 without power (ice storm), Central Lower Michigan.
- February 24, 2019: 1 million without 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 test wells in Otto Township in 2023: 50

- 1 well with known detectable levels of hydrogen sulfide in Otto 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:

- 2020 to current: Covid-19 Pandemic. Nearly 7 million confirmed deaths worldwide. 97 confirmed deaths in Oceana County as of July 11, 2023.

3.05 Terrorism and Similar Criminal Activities: - None Identified.

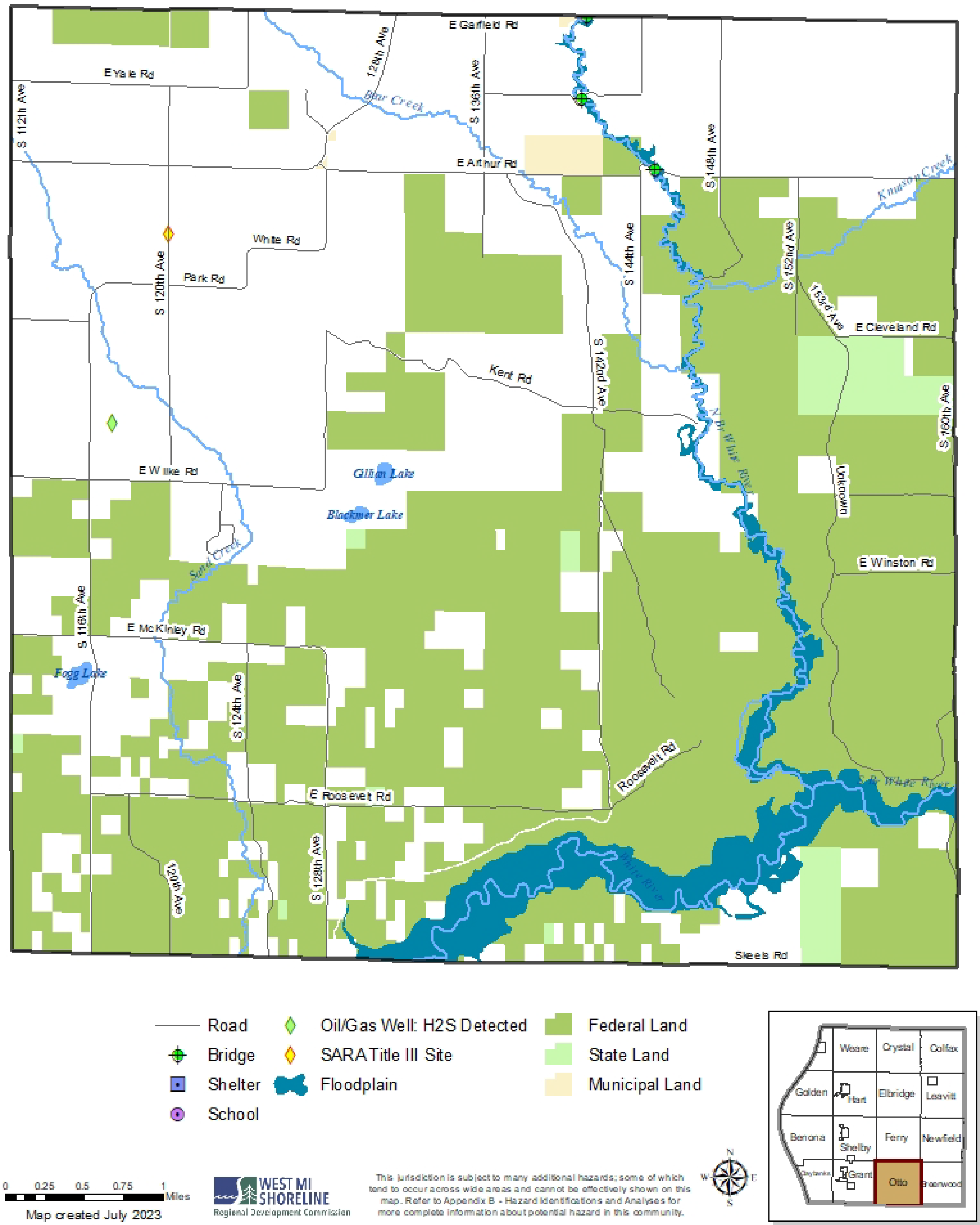
OTTO TOWNSHIP
Hazard Assessment
Ratings

Natural Hazards	Probability of Occurrence	Population Affected	Property Damaged	Economic Impacts
1.01a Space Weather	2	2	0	3
1.01b 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	2	2
1.12 Subsidence	1	1	1	1
1.13 Tornadoes	2	1	2	2
1.14 Wildfire	3	1	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	2
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	1
2.06 HAZMAT – Transportation	2	1	1	2
2.07 Infrastructure Failures	3	2	1	1
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	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	3	2	0	2
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		12		36
3	Extreme Temperatures	3		10		30
4	Infrastructure Failures	3		9		27
4	Wildfire	3		9		27
6	Drought	2		13		26
7	Hail	3		8		24
7	Lightning	3		8		24
7	Public Health Emergencies	3		8		24
10	Fire – Structural	3		7		21
11	Catastrophic Incidents	1		18		18
11	Space Weather	2		9		18
11	Flooding: Riverine/Urban	3		6		18
11	Tornadoes	2		9		18
15	Energy Emergencies	2		8		16
16	HAZMAT – Transportation	2		7		14
16	Invasive Species	2		7		14
18	Dam failure	2		6		12
18	HAZMAT – Fixed Site	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	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		-		-
n/a	Pipeline Accidents	0		-		-

Otto Township, Oceana County
Critical Facilities and Potential Hazards



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:

NFIP Participation: Participating in NFIP **FIRM Map Date:** 08/24/21

Flood Insurance Policies In-Force: 2 **Total Flood Insurance Coverage:** $700,000

Floodplains and Flood-prone Areas: Lake Michigan shoreline, Pentwater Lake shoreline, South Branch Pentwater River

- 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.***
- 2019-21: Lengthy high water event on Lake Michigan. High water record in 2020. Extensive shoreline erosion and property damage along Lake Michigan shoreline.

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.
- March 8, 2017: High wind. $10m Property damage across Oceana County.
- February 24, 2019: High wind. $1m property damage across Oceana County.

- November 10, 2020: Severe thunderstorms. $100k property damage 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.
- April 14, 2018: Winter storm. $100k property damage across Oceana County.
- February 5, 2019: Ice storm. $1m property damage across Oceana County.

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 within the county in 2023: 75

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.
- March 8, 2017: Over 1 million without power (high wind), statewide.
- April 14, 2018: 450,000 without power (winter storm), statewide.
- February 5, 2019: 150,000 without power (ice storm), Central Lower Michigan.
- February 24, 2019: 1 million without 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 test wells in Pentwater Township in 2023: 67***
- ***14 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:

- 2020 to current: Covid-19 Pandemic. Nearly 7 million confirmed deaths worldwide. 97 confirmed deaths in Oceana County as of July 11, 2023.

3.05 Terrorism and Similar Criminal Activities: - None Identified.

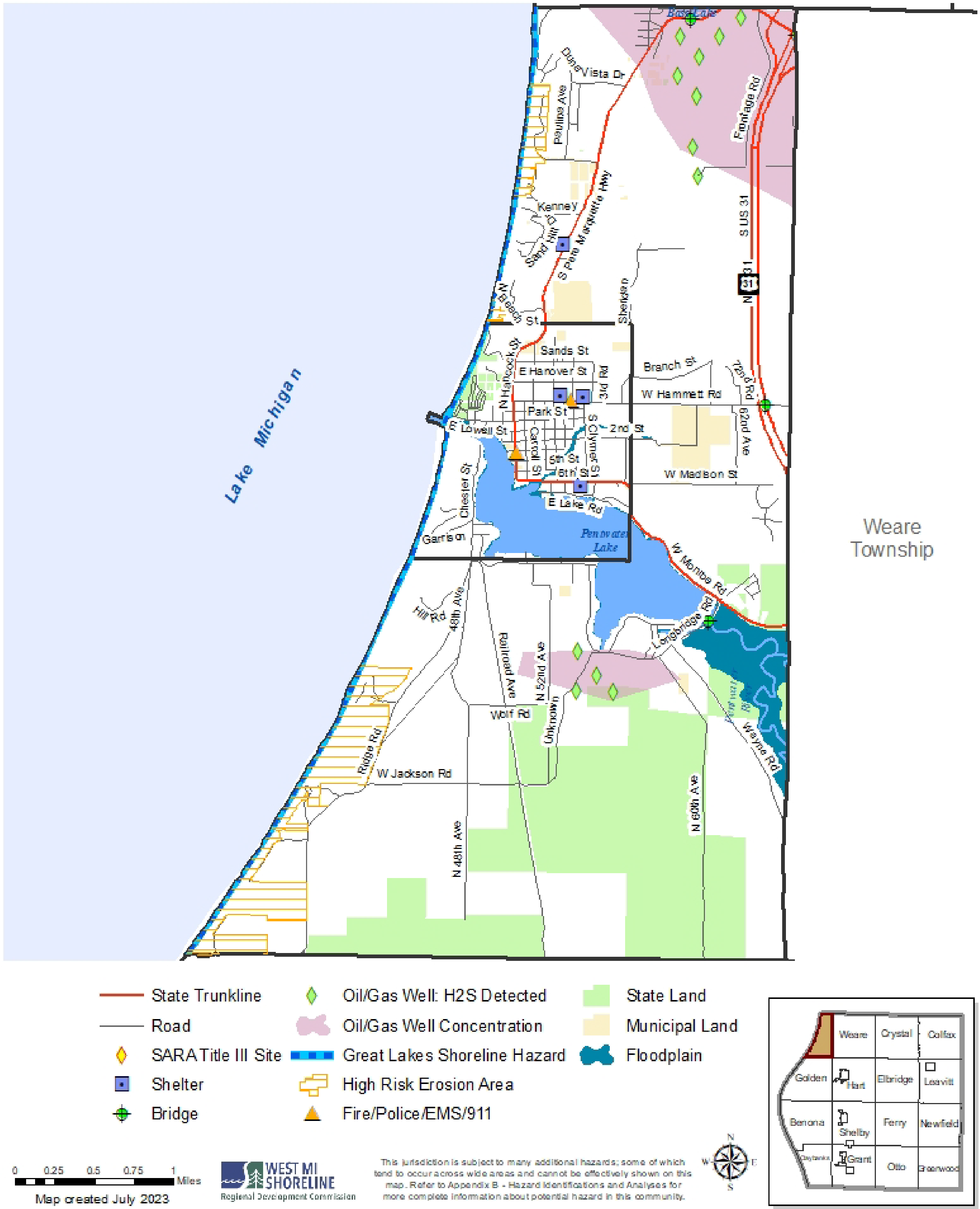
PENTWATER TOWNSHIP
Hazard Assessment
Ratings

Natural Hazards	Probability of Occurrence	Population Affected	Property Damaged	Economic Impacts
1.01a Space Weather	2	2	0	3
1.01b 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	2
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	2	2
1.12 Subsidence	1	1	1	1
1.13 Tornadoes	2	1	2	2
1.14 Wildfire	3	1	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	2
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	2	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	3	2	0	2
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		12		36
3	Extreme Temperatures	3		10		30
3	Infrastructure Failures	3		10		30
5	Fire – Structural	3		9		27
5	Great Lakes Shoreline	3		9		27
5	Wildfire	3		9		27
8	Drought	2		13		26
9	Flooding: Riverine/Urban	3		8		24
9	Hail	3		8		24
9	Lightning	3		8		24
9	Public Health Emergencies	3		8		24
13	Catastrophic Incidents	1		18		18
13	Space Weather	2		9		18
13	Dam failure	2		9		18
13	Oil/Natural Gas Well Accidents	2		9		18
13	Tornadoes	2		9		18
18	Energy Emergencies	2		8		16
19	HAZMAT – Transportation	2		7		14
20	Fog	3		4		12
20	Invasive Species	2		6		12
20	Transportation Accidents	2		6		12
23	Celestial Impacts	1		8		8
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		-		-
n/a	Pipeline Accidents	0		-		-

Pentwater Township and Village, Oceana County
Critical Facilities and Potential Hazards



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:

NFIP Participation: N/A | **FIRM Map Date:** N/A

Flood Insurance Policies In-Force: 0 | **Total Flood Insurance Coverage:** N/A

Floodplains and Flood-prone Areas: N/A

- 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.
- March 8, 2017: High wind. $10m Property damage across Oceana County.
- February 24, 2019: High wind. $1m property damage across Oceana County.
- November 10, 2020: Severe thunderstorms. $100k property damage 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.
- April 14, 2018: Winter storm. $100k property damage across Oceana County.
- February 5, 2019: Ice storm. $1m property damage across Oceana County.

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 within the county in 2023: 75

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.
- March 8, 2017: Over 1 million without power (high wind), statewide.
- April 14, 2018: 450,000 without power (winter storm), statewide.
- February 5, 2019: 150,000 without power (ice storm), Central Lower Michigan.
- February 24, 2019: 1 million without 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 test wells in Shelby Township in 2023: 64***
- ***1 well with known detectable levels of hydrogen sulfide in Shelby Township***

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 15, 2022: A private aircraft crashed shortly after takeoff from Oceana County Airport. 2 fatalities, Shelby 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:
- 2020 to current: Covid-19 Pandemic. Nearly 7 million confirmed deaths worldwide. 97 confirmed deaths in Oceana County as of July 11, 2023.

3.05 Terrorism and Similar Criminal Activities: - None Identified.

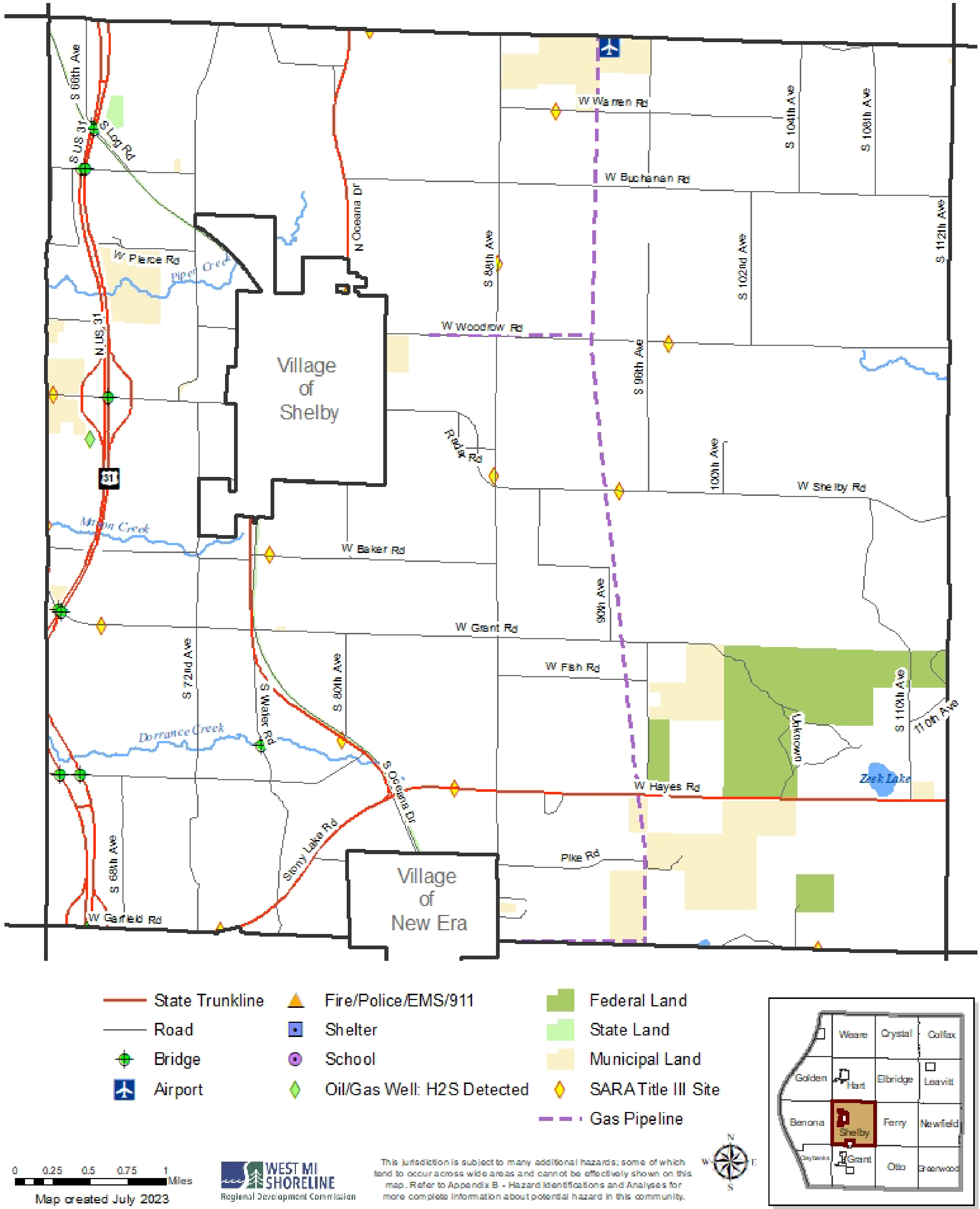
SHELBY TOWNSHIP
Hazard Assessment
Ratings

Natural Hazards	Probability of Occurrence	Population Affected	Property Damaged	Economic Impacts
1.01a Space Weather	2	2	0	3
1.01b 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	2	2
1.12 Subsidence	1	1	1	1
1.13 Tornadoes	2	1	2	2
1.14 Wildfire	3	1	2	2
1.15 Winter Storms	3	3	2	2
Technological Hazards				
2.01 Dam Failure	0	-	-	-
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	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	3	2	0	2
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		12		36
3	Extreme Temperatures	3		10		30
3	Infrastructure Failures	3		10		30
5	Fire – Structural	3		9		27
5	Wildfire	3		9		27
7	Drought	2		13		26
8	Hail	3		8		24
8	Lightning	3		8		24
8	Public Health Emergencies	3		8		24
11	Catastrophic Incidents	1		18		18
11	Space Weather	2		9		18
11	Invasive Species	2		9		18
11	Tornadoes	2		9		18
15	Energy Emergencies	2		8		16
16	HAZMAT – Fixed Site	2		7		14
16	HAZMAT – Transportation	2		7		14
18	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	Flooding: Riverine/Urban	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		-		-

Shelby Township, Oceana County
Critical Facilities and Potential Hazards



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:

NFIP Participation: Not Participating in NFIP **FIRM Map Date:** 08/24/21

Flood Insurance Policies In-Force: 0 **Total Flood Insurance Coverage:** $0

Floodplains and Flood-prone Areas: South Branch Pentwater River, Lambrick Creek, North Branch Pentwater River
- 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.
- March 8, 2017: High wind. $10m Property damage across Oceana County.
- February 24, 2019: High wind. $1m property damage across Oceana County.
- November 10, 2020: Severe thunderstorms. $100k property damage 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.
- April 14, 2018: Winter storm. $100k property damage across Oceana County.
- February 5, 2019: Ice storm. $1m property damage across Oceana County.

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 within the county in 2023: 75

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.
- March 8, 2017: Over 1 million without power (high wind), statewide.
- April 14, 2018: 450,000 without power (winter storm), statewide.
- February 5, 2019: 150,000 without power (ice storm), Central Lower Michigan.
- February 24, 2019: 1 million without 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 test wells in Weare Township in 2023: 242***
- ***36 wells with known detectable levels of hydrogen sulfide in 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:
- 2020 to current: Covid-19 Pandemic. Nearly 7 million confirmed deaths worldwide. 97 confirmed deaths in Oceana County as of July 11, 2023.

3.05 Terrorism and Similar Criminal Activities: - None Identified.

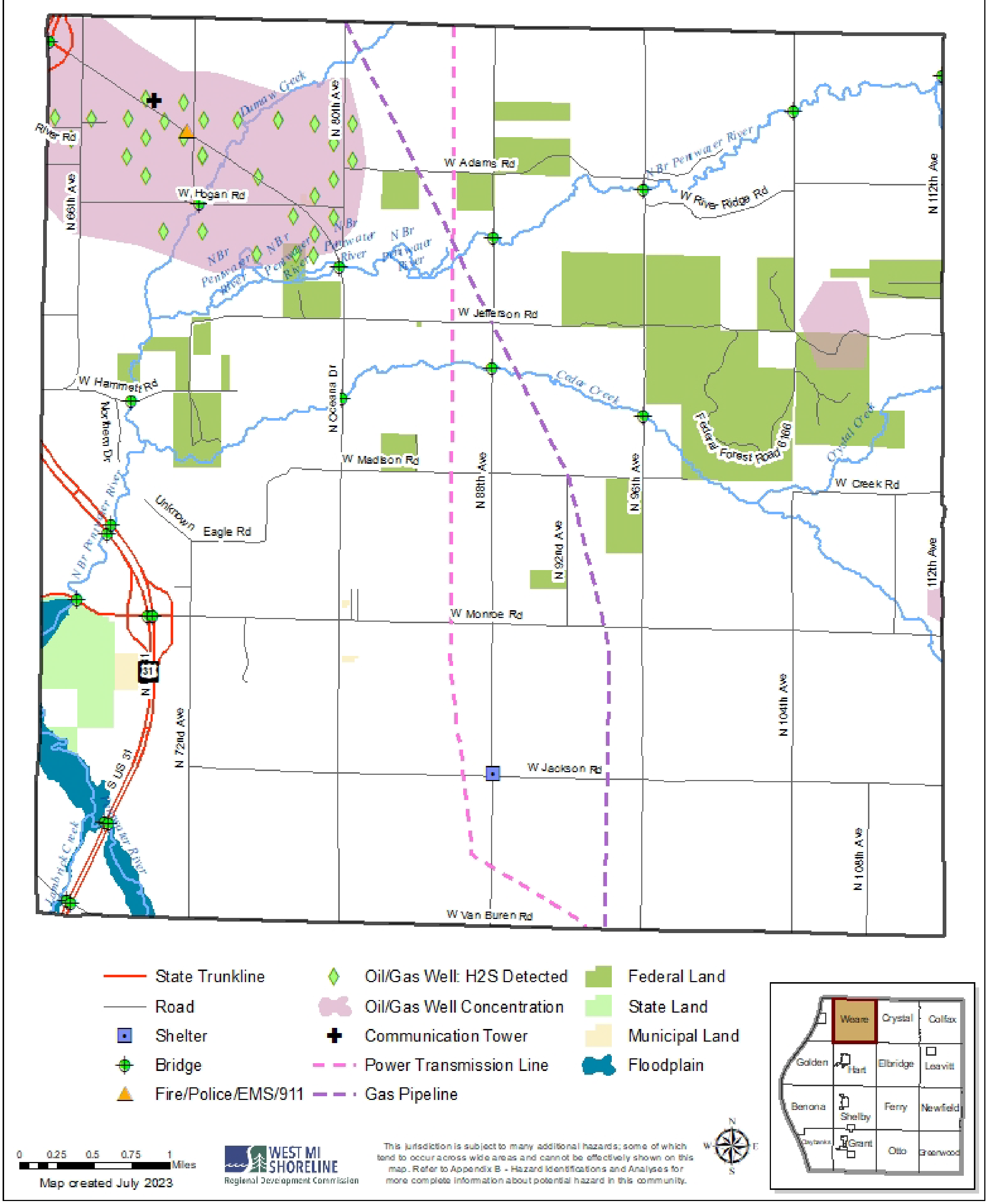
WEARE TOWNSHIP
Hazard Assessment Ratings

Natural Hazards	Probability of Occurrence	Population Affected	Property Damaged	Economic Impacts
1.01a Space Weather	2	2	0	3
1.01b 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	2	2
1.12 Subsidence	1	1	1	1
1.13 Tornadoes	2	1	2	2
1.14 Wildfire	3	1	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	2
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	1
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	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	3	2	0	2
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		12		36
3	Extreme Temperatures	3		10		30
3	Infrastructure Failures	3		10		30
5	Wildfire	3		9		27
6	Drought	2		13		26
7	Hail	3		8		24
7	Lightning	3		8		24
7	Public Health Emergencies	3		8		24
10	Fire – Structural	3		7		21
11	Catastrophic Incidents	1		18		18
11	Space Weather	2		9		18
11	Invasive Species	2		9		18
11	Oil/Natural Gas Well Accidents	2		9		18
11	Tornadoes	2		9		18
16	Energy Emergencies	2		8		16
16	Flooding: Riverine/Urban	2		8		16
18	HAZMAT – Transportation	2		7		14
19	Dam failure	2		6		12
19	HAZMAT – Fixed Site	2		6		12
19	Transportation Accidents	2		6		12
22	Celestial Impacts	1		8		8
22	Fog	2		4		8
24	Pipeline Accidents	1		7		7
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	Great Lakes Shoreline	0		-		-
n/a	Nuclear Attack	0		-		-
n/a	Nuclear Power Emergencies	0		-		-

Weare Township, Oceana County
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

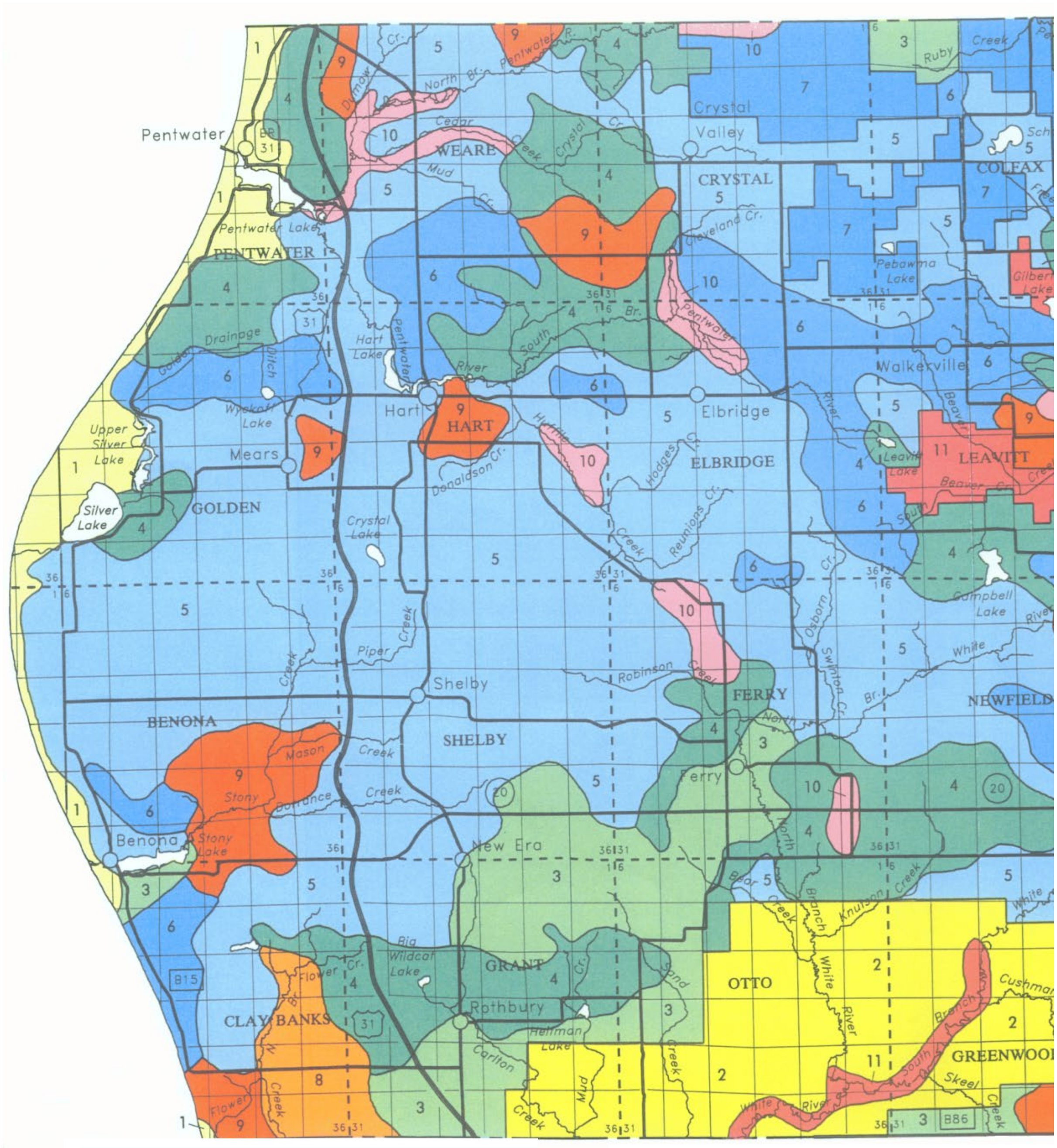
Location or Zone (zone indicates multiple counties)	Date	Duration	Type	Magnitude	Death	Injury	Damage ($)		Notes
							property	crop	
Hart	7/26/05	<1 day	Thunderstorm Wind	61 mph	0	0	10k	0	Downed trees and powerlines across area
Pentwater	7/26/05	<1 day	Thunderstorm Wind	61 mph	0	0	15k	0	Downed trees 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	

National Climatic Data Center: Storm Events
04/1/14 through 02/28/23 * 33 events reported for Oceana County

LOCATION or ZONE (zone implies multiple counties)	DATE	DUR-ATION	TYPE	MAG-NITUDE	DEATHS	INJURY	DAMAGE ($)		NOTES
							property	crop	
Ferry Twp	5/7/2014	1 day	Hail	1 in	0	0	0	0	
New Era	6/18/2014	1 day	Hail	1 in	0	0	0	0	
OCEANA (ZONE)	11/17/2014	5 days	Lake-Effect Snow		0	0	0	0	Up to 24 inches of snow across southeast Oceana County
OCEANA (ZONE)	1/8/2015	2 days	Heavy Snow		0	0	0	0	10-12 inches of snow across northwestern Oceana County
OCEANA (ZONE)	2/13/2015	3 days	Winter Storm		0	0	0	0	8-10 inches of snow, drifted roads
Grant Twp	8/2/2015	1 day	Thunderstorm Wind	60 mph	0	0	10k	0	Trees downed along Arthur Rd
OCEANA (ZONE)	12/29/2015	1 day	Sleet		0	0	0	0	2 inches of sleet
OCEANA (ZONE)	1/9/2016	5 days	Lake-Effect Snow		0	0	0	0	12-18 inches of snow across
OCEANA (ZONE)	3/23/2016	2 days	Winter Storm		0	0	0	0	Ice and snow
OCEANA (ZONE)	12/8/2016	3 days	Lake-Effect Snow		0	0	0	0	6-10 inches of snow
OCEANA (ZONE)	3/8/2017	1 day	High Wind	60 mph	0	0	10m	0	wind gusts up to 60 mph, numerous downed trees and limbs and power lines and widespread power outages
Near Shelby	4/10/2017	1 day	Hail	1.75 in	0	0	0	0	
Near Pentwater	4/20/2017	1 day	Thunderstorm Wind	59 mph	0	0	0	0	
OCEANA (ZONE)	12/28/2017	3 days	Heavy Snow		0	0	0	0	12-18 inches of snow across western Oceana County
OCEANA (ZONE)	4/14/2018	1 day	Winter Storm		0	0	100k	0	Heavy sleet and strong winds caused power outages
Benona Twp	7/26/2018	1 day	Thunderstorm Wind	60 mph	0	0	20k	0	Roof blown off of a garage near Shelby
Golden Twp	8/28/2018	1 day	Thunderstorm Wind	60 mph	0	0	20k	0	Trees uprooted or snapped
OCEANA (ZONE)	1/28/2019	1 day	Winter Storm		0	0	0	0	12-16 inches of snow
OCEANA (ZONE)	1/29/2019	3 days	Winter Storm		0	0	0	0	6-12 inches of snow with -20 to -40 degree wind chills
OCEANA (ZONE)	2/5/2019	3 days	Ice Storm	.25-.5 in	0	0	1m	0	Numerous downed trees, limbs, power lines and widespread power outages
OCEANA (ZONE)	2/24/2019	2 days	High Wind	60 mph	0	0	1m	0	Downed tree limbs and power lines and resulted in widespread power outages
OCEANA (ZONE)	4/14/2019	2 days	Heavy Snow		0	0	0	0	Over 6 inches of snow
Claybanks Twp	8/7/2019	1 day	Thunderstorm Wind	60 mph	0	0	3k	0	Tree uprooted, a fence blown down and a camper top was blown off 30 feet
OCEANA (ZONE)	11/11/2019	2 days	Lake-Effect Snow		0	0	0	0	8-12 inches of snow
Hart	6/2/2020	1 day	Thunderstorm Wind	60 mph	0	0	10k	0	Downed trees
OCEANA CO.	11/10/2020	1 day	Thunderstorm Wind	60 mph	0	0	100k	0	Downed trees
Weare Twp	8/10/2021	1 day	Thunderstorm Wind	66 mph	0	0	0	0	66 mph was measured at the Mason Oceana 911 call center
OCEANA CO.	9/12/2021	1 day	Hail	1 in	0	0	0	0	
Pentwater	12/16/2021	1 days	High Wind	71 mph	0	0	0	0	
OCEANA (ZONE)	1/5/2022	3 days	Winter Storm		0	0	0	0	8-12 inches of snow
Grant Twp	5/11/2022	1 days	Hail	1 in	0	0	0	0	
OCEANA (ZONE)	11/17/2022	4 days	Winter Storm		0	0	0	0	6-8 inches of snow
OCEANA (ZONE)	12/22/2022	3 days	Blizzard		0	0	0	0	8 inches of snow and blizzard conditions

GENERAL SOILS MAP



SOIL LEGEND*

AREAS OF NEARLY LEVEL TO VERY STEEP, MODERATELY WELL DRAINED TO EXCESSIVELY DRAINED SOILS AND AREAS OF DUNE LAND

- 1 Epworth–Dune land–Nordhouse Association
- 2 Typic Udipsamments–Entic Haplorthods, sandy Association

AREAS OF NEARLY LEVEL TO VERY STEEP, EXCESSIVELY DRAINED, MODERATELY WELL DRAINED, AND POORLY DRAINED SOILS

- 3 Plainfield–Coloma–Grattan Association
- 4 Grattan–Covert–Granby Association

AREAS OF NEARLY LEVEL TO VERY STEEP, EXCESSIVELY DRAINED AND WELL DRAINED SOILS

- 5 Benona–Spinks–Grattan Association
- 6 Spinks–Remus–Fern Association
- 7 Entic Haplorthods, sandy–Alfic Haplorthods, sandy Association

AREAS OF NEARLY LEVEL TO STEEP, WELL DRAINED, SOMEWHAT POORLY DRAINED, AND VERY POORLY DRAINED SOILS

- 8 Claybanks–Nappanee–Hoytville Association
- 9 Perrinton–Gowdy–Ithaca Association

AREAS OF NEARLY LEVEL, VERY POORLY DRAINED AND POORLY DRAINED SOILS

- 10 Houghton–Kerston–Carlisle Association
- 11 Medisaprists, euic–Typic Haplaquolls, sandy over loamy–Mollic Psammaquents Association

Source: USDA/Mich.Dept.Agr.(issued September, 1995)

<u>**Oceana County Dams**</u>

The National Inventory of Dams (NID) identifies eight dams within Oceana County. Two of the dams are classified “high” hazard potential, two “significant,” and four “low.” FEMA dam hazard potential classes are defined as the following:

LOW HAZARD POTENTIAL

Dams assigned the low hazard potential classification are those where failure or mis-operation 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 mis-operation results in no probable loss of human life but can cause economic loss, environmental damage, disruption of lifeline facilities, or can impact other concerns.

HIGH HAZARD POTENTIAL

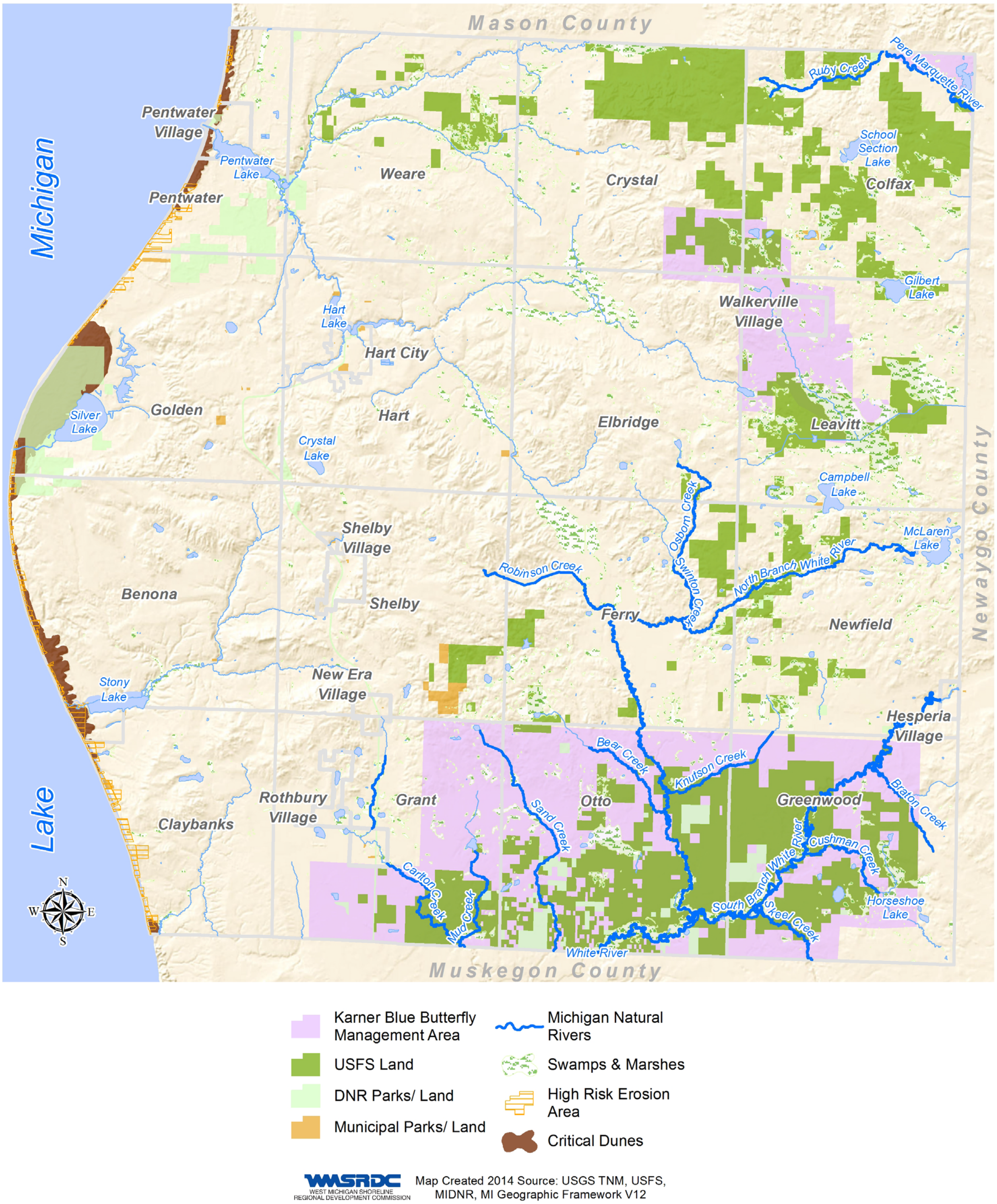
Dams assigned the high hazard potential classification are those where failure or mis-operation will probably cause loss of human life.

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	

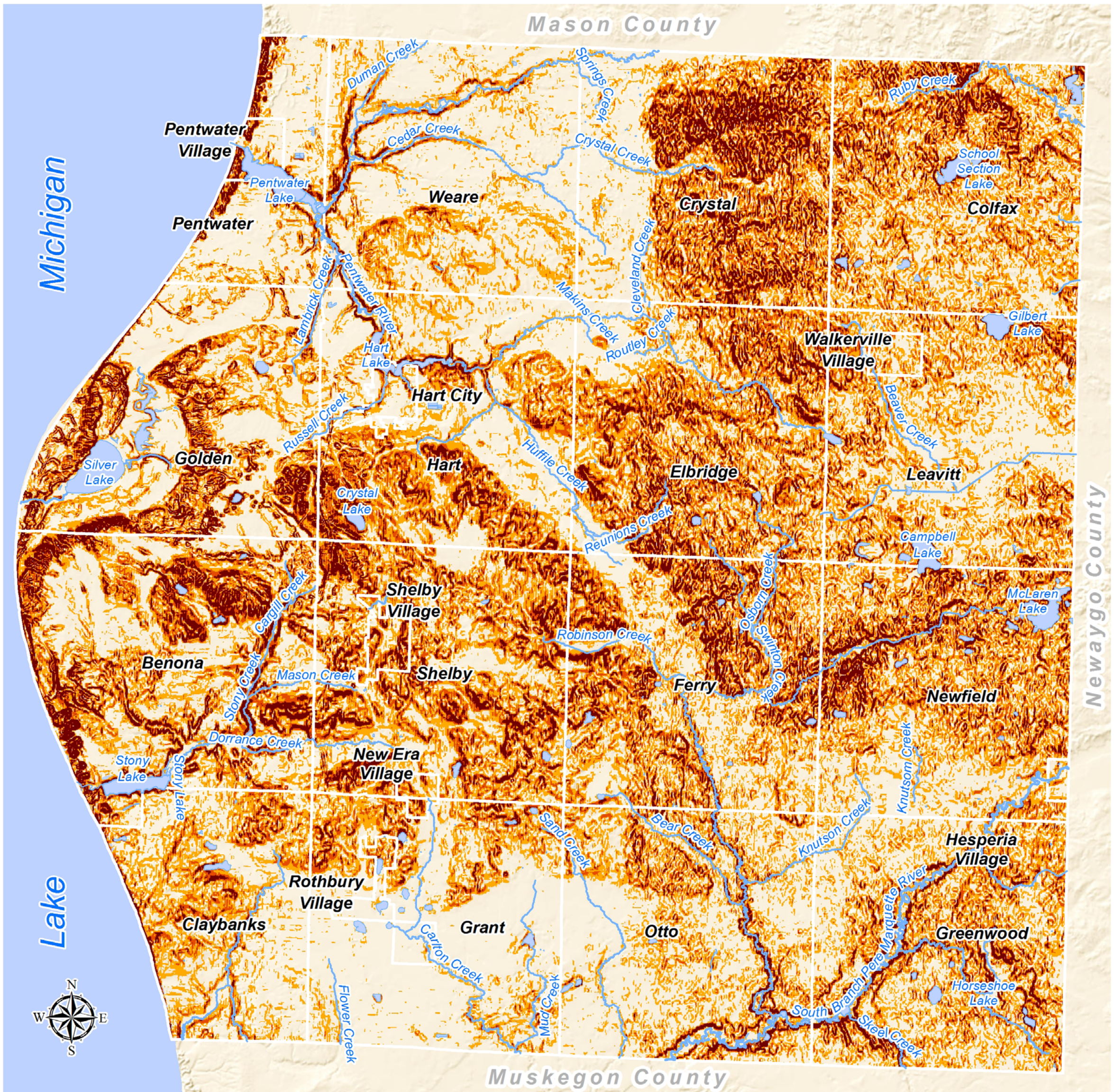
Source: National Inventory of Dams, US Army Corps of Engineers, https://nid.sec.usace.army.mil/#/ October 2, 2023

In addition to the dams listed above, the Michigan Dam Inventory lists 16 additional low hazard potential dams scattered throughout the county that are worthy of mention. Locations and details are readily viewable at: https://gis-egle.hub.arcgis.com/datasets/c0033d45400e484a9a9bfc83f9a60ce8/explore

Oceana County
Significant Landscape Map



Oceana County
County Slopes Map



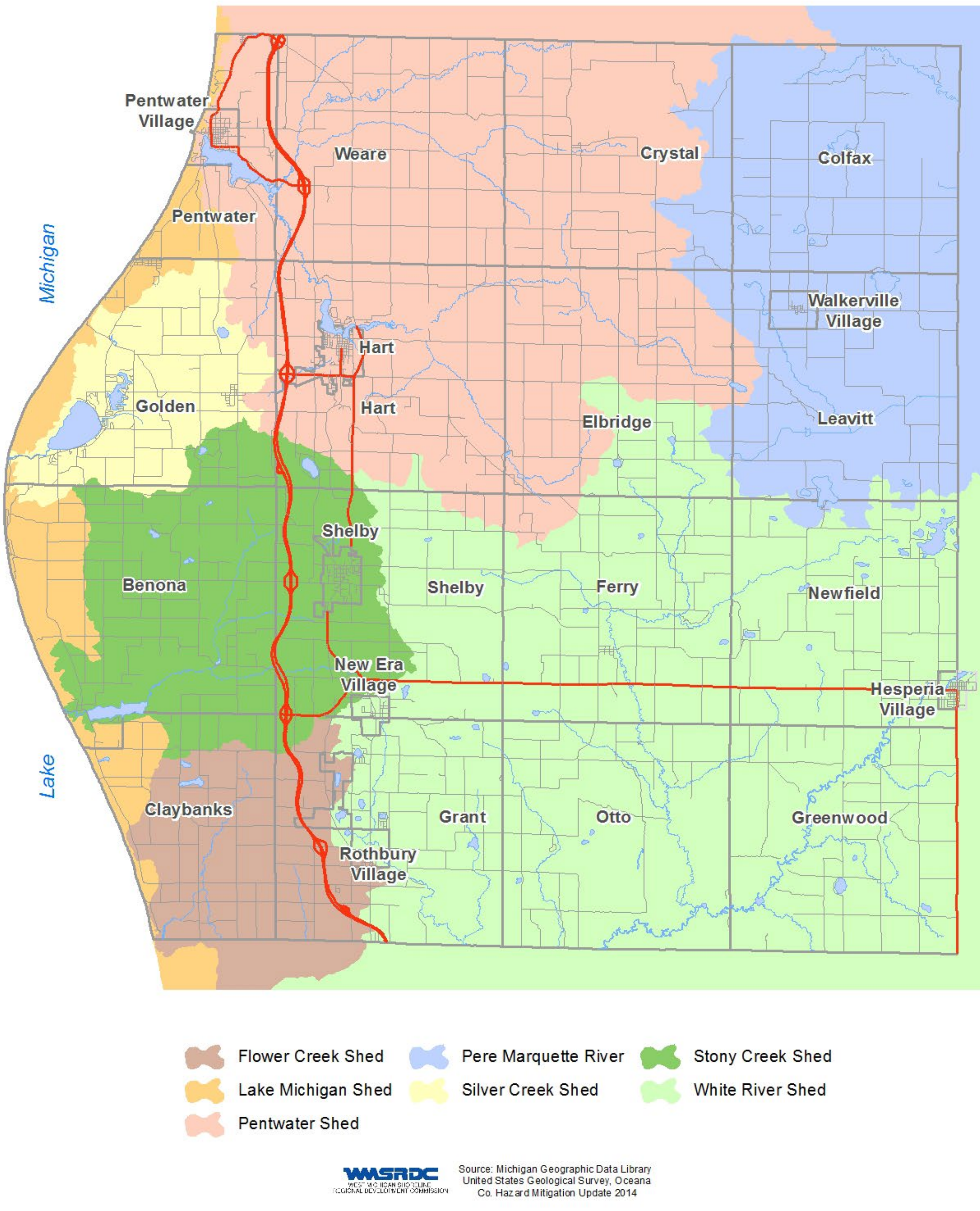
Percentage Slope

- 11 - 20% Moderate
- 21 - 30% Significant
- 31% + Severe
- Lake
- River/Stream

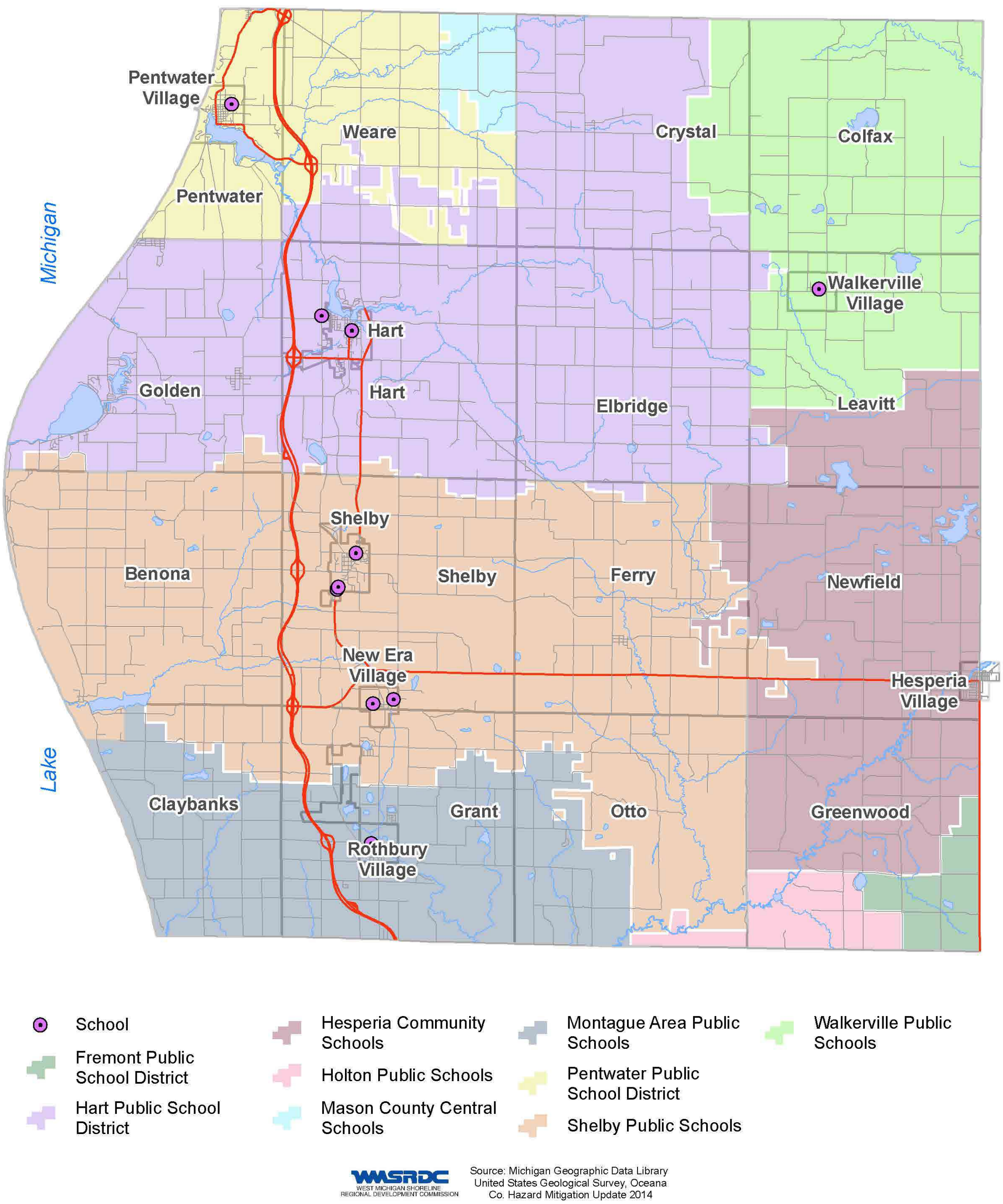
WMSRDC
WEST MICHIGAN SHORELINE REGIONAL DEVELOPMENT COMMISSION

Map Created May 2014 Source: USGS TNM MIDNR, MI Geographic Framework V12

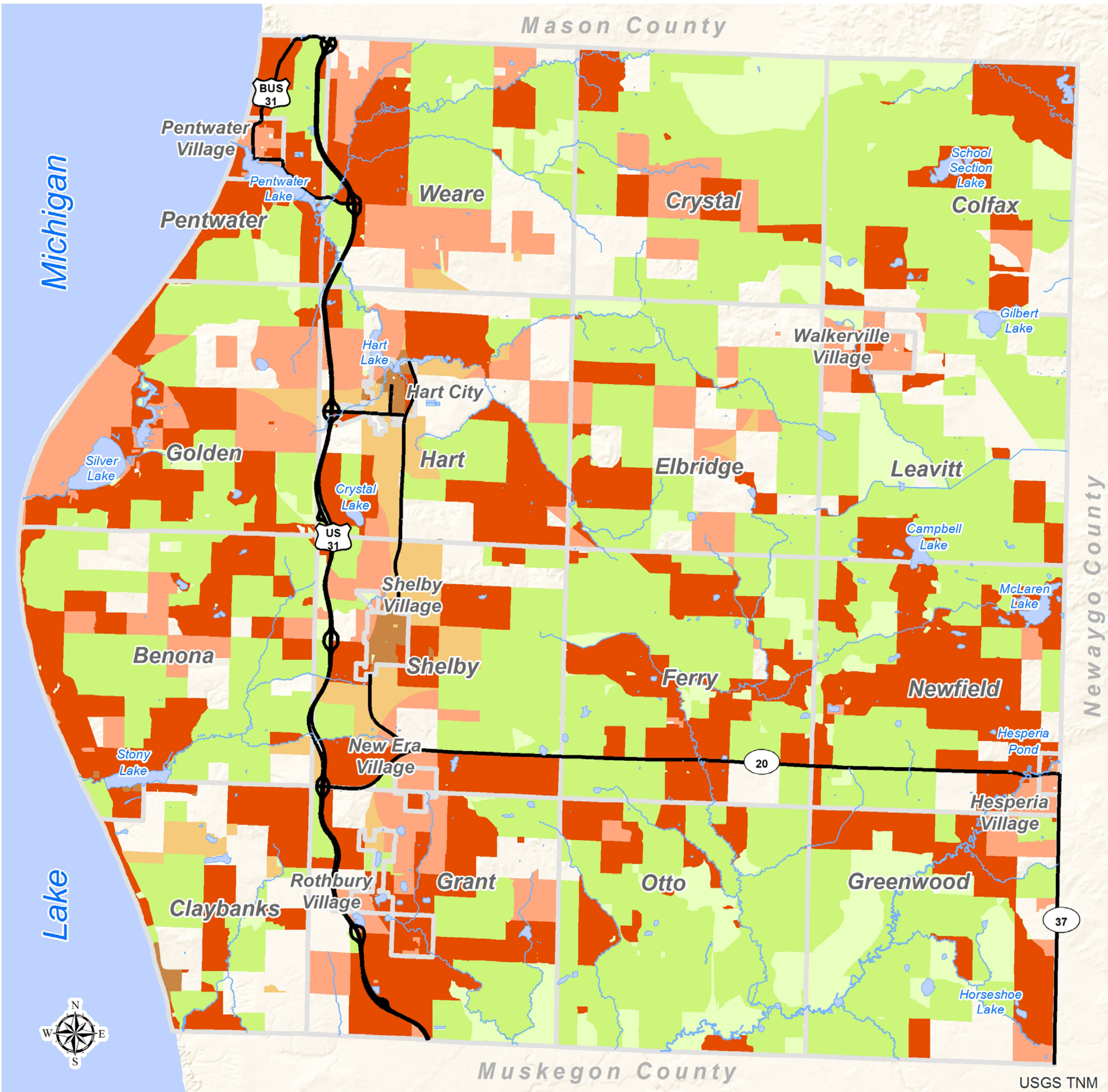
OCEANA COUNTY
Watersheds



OCEANA COUNTY
School Districts



Oceana County
Wildland-Urban Interface Map



WUI		Non-WUI Vegetated		Non-Vegetated Housing Density	
	Intermix		Low Density Vegetated		High and Medium Density
	Interface		Uninhabited Vegetated		Low Density

Inermix- area where structures are scattered throughout a wildland area with no clear line of demarcation.
Interface- area where structures directly abut wildland fuels with a clear line of demarcation between residental, business, public structures, and wildland fuels.

WMSRDC WEST MICHIGAN SHORELINE REGIONAL DEVELOPMENT COMMISSION

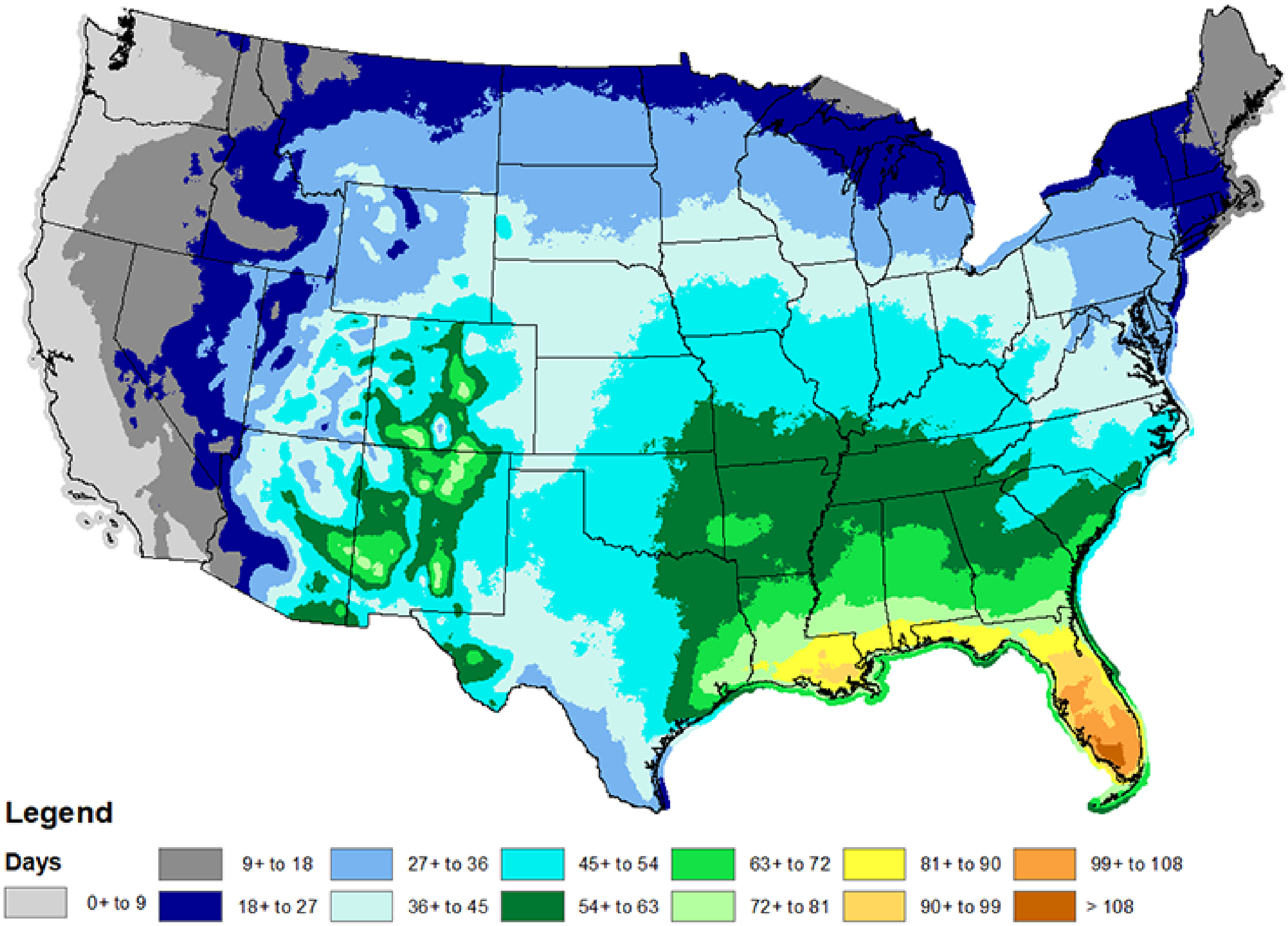
Map Created March 2014Source: USFS, USDA Forest Service
North Central Research Station, Universtiy of Wisconsin-MadisonMI Geographic Framwork V12

Source: Oceana County Community Wildfire Protection Plan (2014)

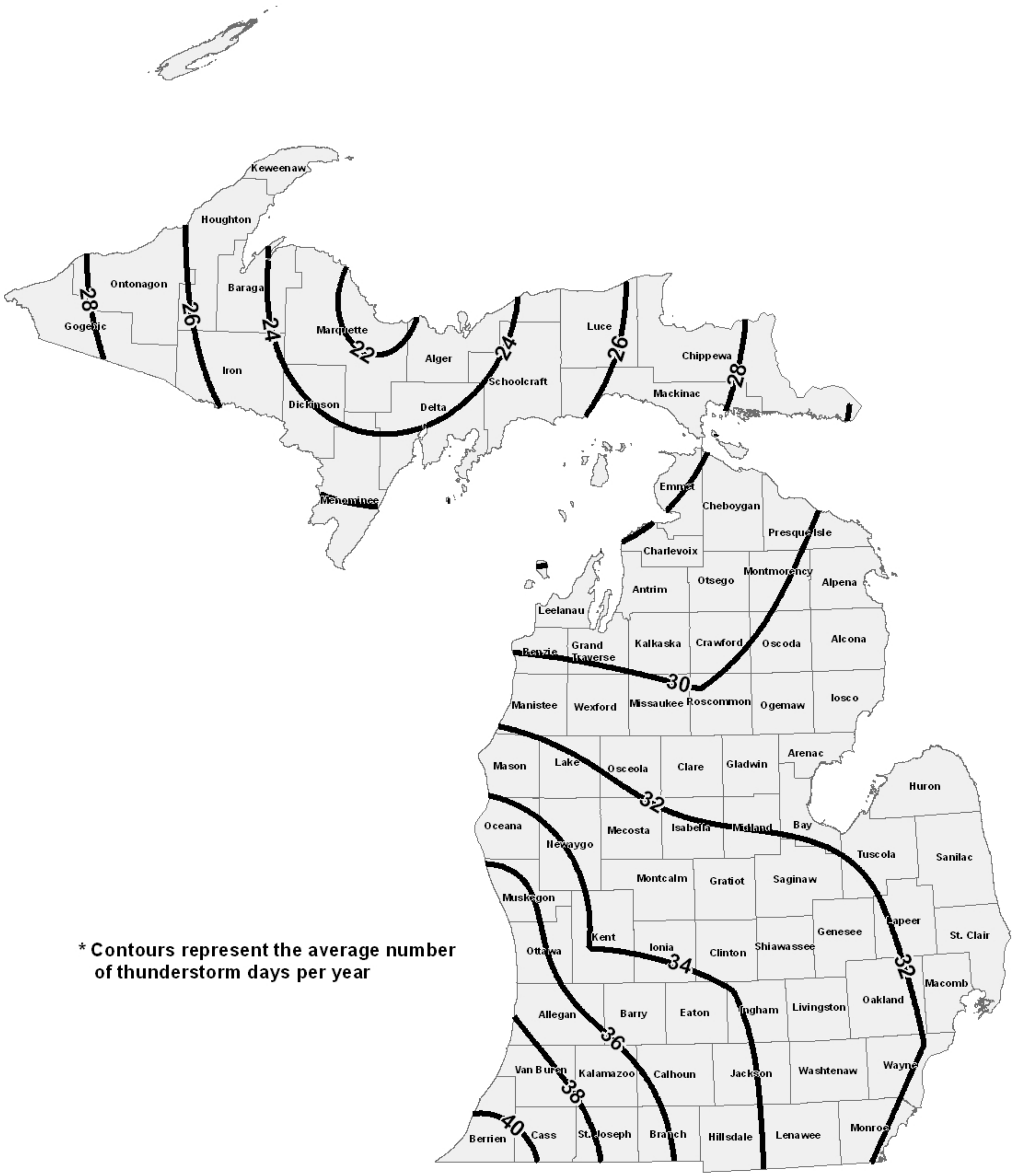
Number of Wildfires and Acres Burned, by County: 1981-2018 (MDNR jurisdiction only) Source: MDNR/FRD

County	*Number of Fires*	*Number of Wildfires/Year*	*Number of Acres Burned*	*Acres Burned/Year*
Alcona	257	6.8	1,567.6	41.3
Alger	64	1.7	201.2	5.3
Allegan	125	3.3	594.6	15.6
Alpena	281	7.4	441.6	11.6
Antrim	256	6.7	285.3	7.5
Arenac	183	4.8	703.7	18.5
Baraga	74	1.9	1,936.6	51.0
Barry	125	3.3	613.1	16.1
Bay	24	0.6	180.7	4.8
Benzie	184	4.8	396.8	10.4
Berrien	12	0.3	25.9	0.7
Branch	9	0.2	173.9	4.6
Calhoun	11	0.3	45.3	1.2
Cass	3	0.1	27.0	0.7
Charlevoix	173	4.6	522.2	13.7
Cheboygan	828	21.8	1,571.4	41.4
Chippewa	474	12.5	5,916.4	155.7
Clare	1,019	26.8	2,647.8	69.7
Clinton	29	0.8	142.7	3.8
Crawford	1,291	34.0	32,506.0	855.4
Delta	620	16.3	3,393.7	89.3
Dickinson	560	14.7	2,547.6	67.0
Eaton	3	0.1	0.3	0.0
Emmet	377	9.9	649.6	17.1
Genesee	1	0.0	0.1	0.0
Gladwin	587	15.4	2,161.3	56.9
Gogebic	120	3.2	254.9	6.7
Grand Traverse	435	11.4	1,484.2	39.1
Gratiot	3	0.1	42.7	1.1
Hillsdale	2	0.1	23.0	0.6
Houghton	192	5.1	1,211.9	31.9
Huron	30	0.8	982.5	25.9
Ingham	18	0.5	479.0	12.6
Ionia	35	0.9	765.8	20.2
Iosco	144	3.8	1782.8	46.9
Iron	324	8.5	2,041.2	53.7
Isabella	144	3.8	1,782.8	46.9
Jackson	38	1.0	562.0	14.8
Kalamazoo	19	0.5	125.3	3.3
Kalkaska	627	16.5	3,200.4	84.2
Kent	28	0.7	213.5	5.6
Keweenaw	63	1.7	381.9	10.1
Lake	355	9.3	1,541.8	40.6
Lapeer	67	1.8	629.4	16.6
Leelanau	60	1.6	267.6	7.0
Lenawee	30	0.8	224.2	5.9
Livingston	93	2.4	812.1	21.4
Luce	254	6.7	39,821.3	1,047.9
Mackinac	226	5.9	1,695.9	44.6
Macomb	7	0.2	15.4	0.4
Manistee	54	1.4	1,070.7	28.2
Marquette	1,018	26.8	16,607.2	437.0
Mason	38	1.0	206.2	5.4
Mecosta	227	6.0	1,039.7	27.4
Menominee	745	19.6	2,615.8	68.8
Midland	560	14.7	1,596.3	42.0
Missaukee	406	10.7	1,884.9	49.6
Monroe	7	0.2	658.4	17.3
Montcalm	40	1.1	640.2	16.8
Montmorency	645	17.0	1,371.7	36.1
Muskegon	299	7.9	2,944.9	77.5
Newaygo	74	1.9	548.9	14.4
Oakland	57	1.5	399.9	10.5
Oceana	427	11.2	1,983.6	52.2
Ogemaw	646	17.0	9,480.1	249.5
Ontonagon	100	2.6	1,509.0	39.7
Osceola	466	12.3	1,192.4	31.4
Oscoda	309	8.1	8,872.9	233.5
Otsego	1,110	29.2	2,123.2	55.9
Ottawa	152	4.0	494.3	13.0
Presque Isle	378	9.9	968.6	25.5
Roscommon	691	18.2	4,667.4	122.8
Saginaw	21	0.6	478.6	12.6
Sanilac	49	1.3	453.7	11,9
Schoolcraft	390	10.3	6,770.9	178.2
Shiawassee	82	2.2	618.5	16.3
St. Clair	114	3.0	1,758.1	46.3
St. Joseph	4	0.1	20.3	0.5
Tuscola	126	3.3	1,355.0	35.7
Van Buren	42	1.1	259.4	6.8
Washtenaw	20	0.5	249.1	6.6
Wayne	2	0.1	42.2	1.1
Wexford	467	12.3	1,199.1	31.6

Annual Mean Thunderstorm Days (1993-2018)



Thunderstorm Hazards



*** Contours represent the average number of thunderstorm days per year**

Produced by:
Michigan State Police
Emergency Management and Homeland Security Division
January 2011

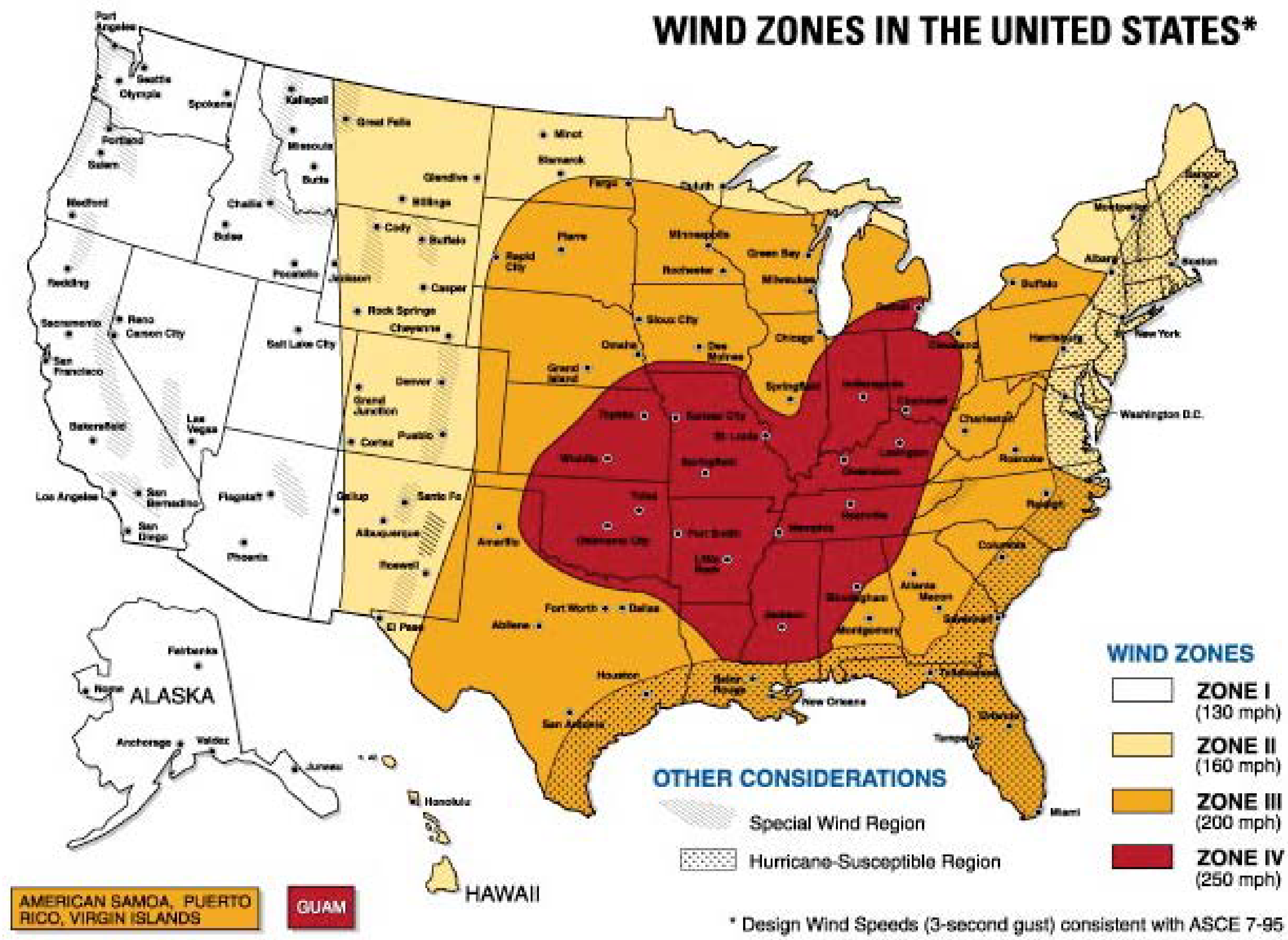
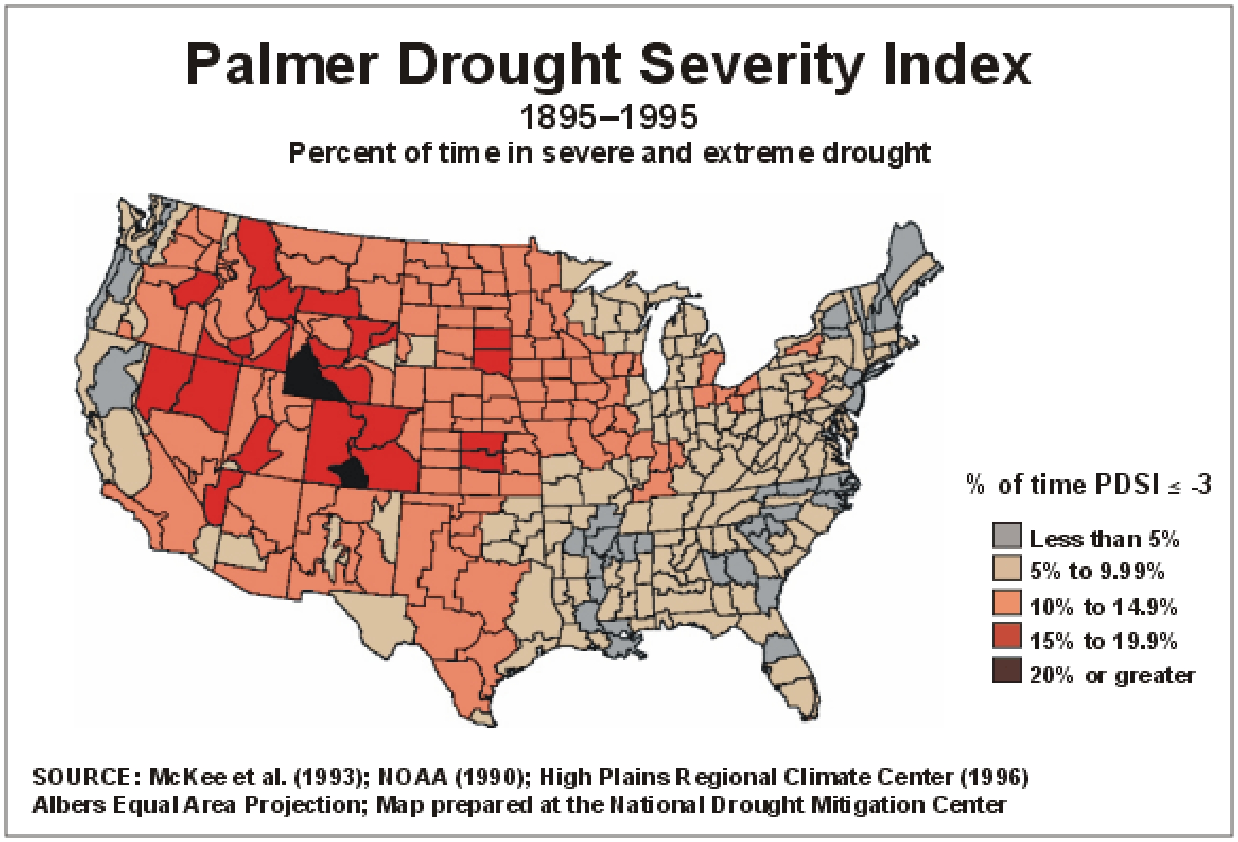
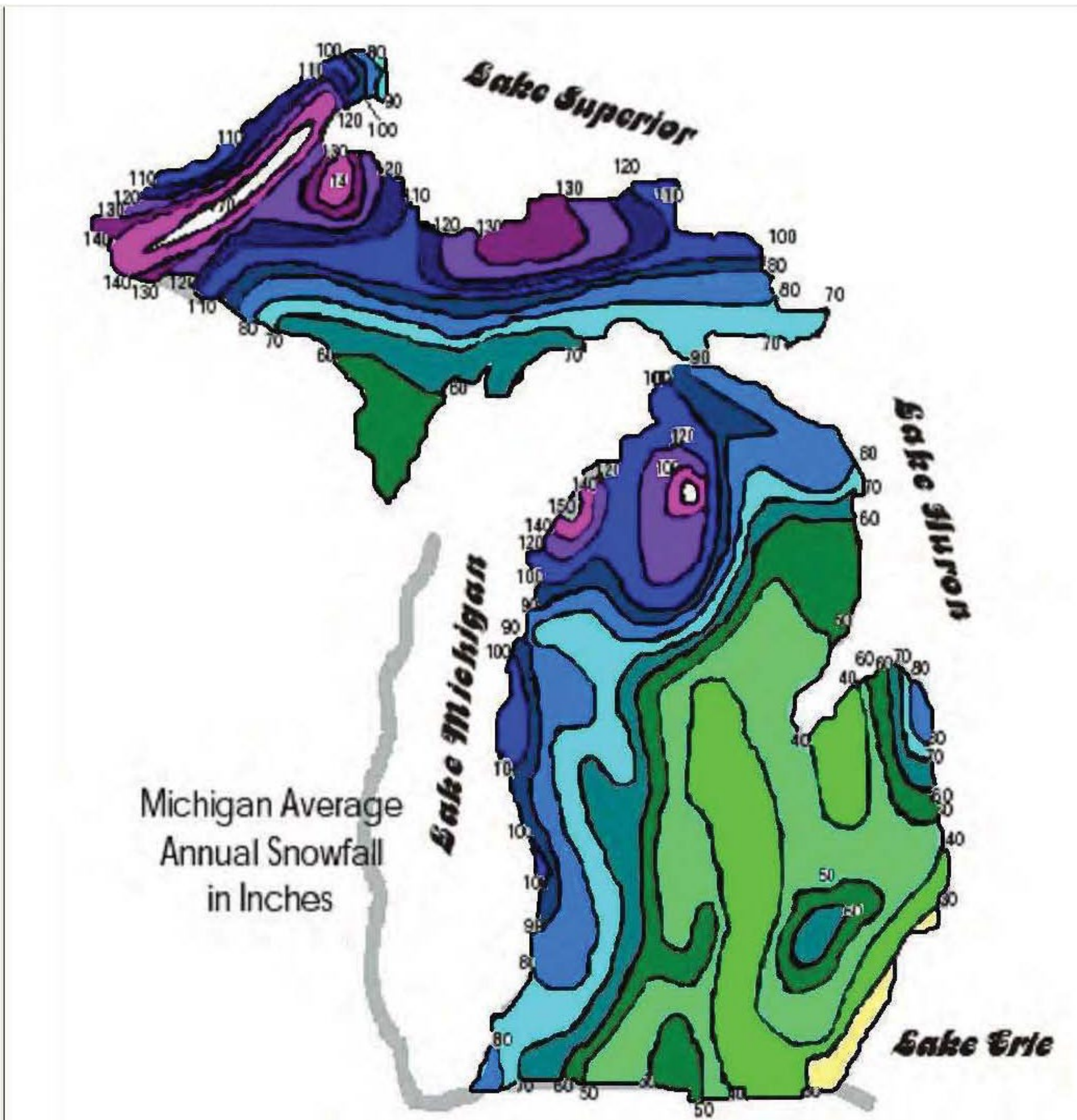


Figure I2 Wind zones in the United States


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 FATAL FIRE STATISTICS

State of Michigan FY2022

111 TOTAL DEATHS

95 TOTAL FIRES

GENDER

66% MALE

33% FEMALE

1% not reported

AGES

68% OF VICTIMS were between the ages of 50 and 89

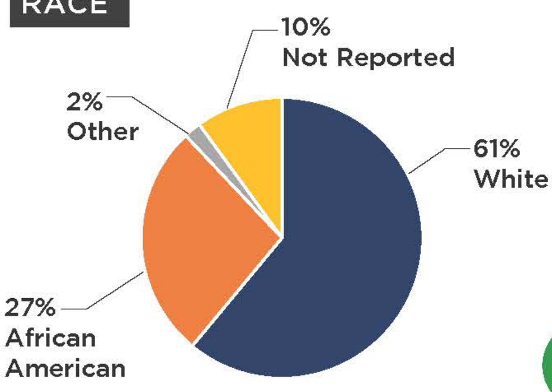
17% OF VICTIMS were between the ages of 0 and 19

THE TOP AGE GROUPS OF VICTIMS WERE 60-69 | 70-79

25% of victims were reported as disabled

10% of victims were on oxygen

RACE



TIME

6pm - 6am 62%

6am - 6pm 38%

DAYS

Most fatal fires occurred on

Monday	Tuesday	Wednesday
24%	17%	15%

TOP FATAL FIRE CAUSES

SMOKING	ELECTRICAL	COOKING
46%	13%	11%

TOP AREAS OF ORIGIN

LIVING ROOM	BEDROOM
40%	19%

ALARM STATUS IN HOME

YES 23%

NO 39%

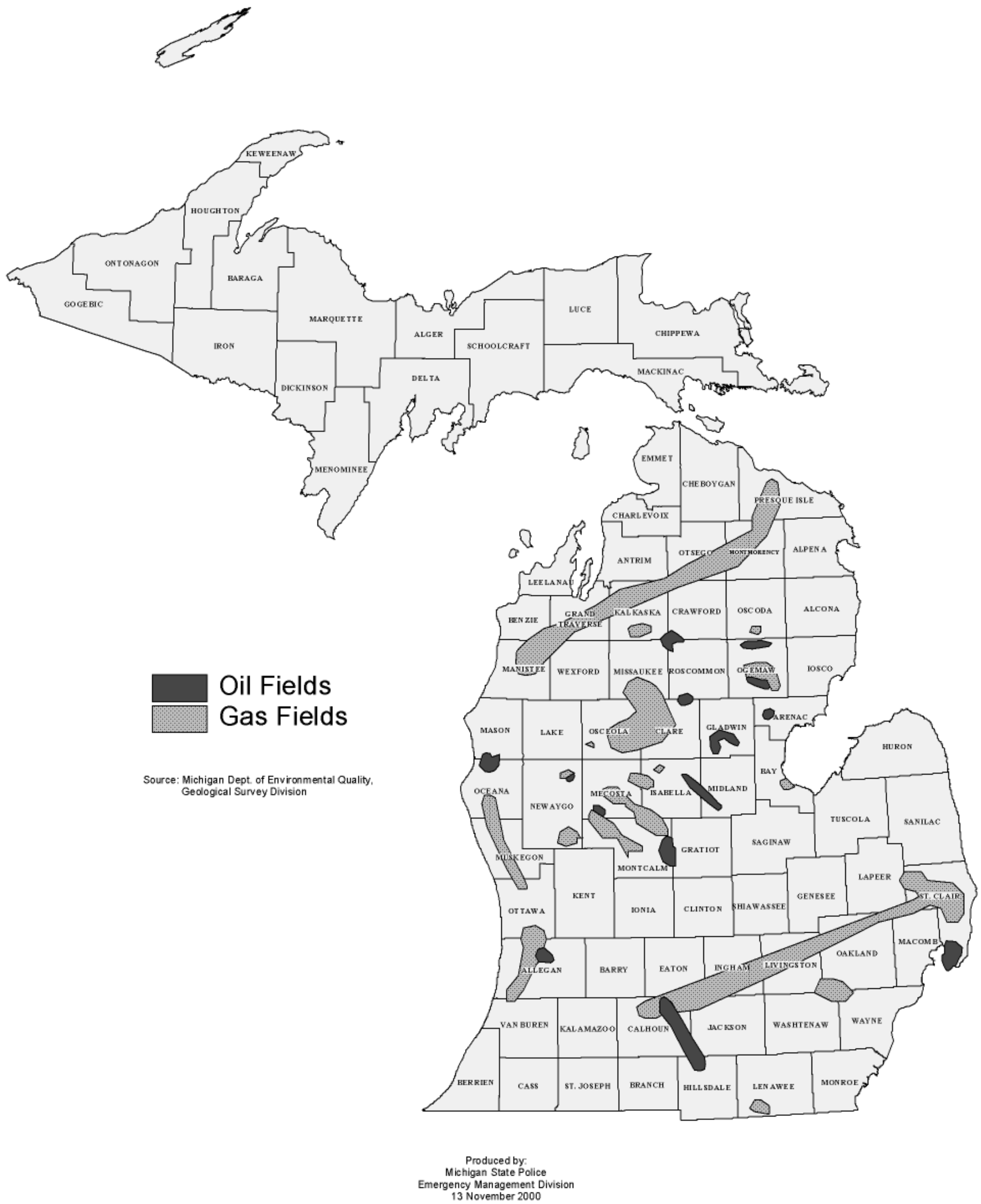
UNKNOWN 38%

MICHIGAN FIRE INSPECTORS SOCIETY FOUNDATION

MI-PREVENTION COMMUNITY RISK REDUCTION

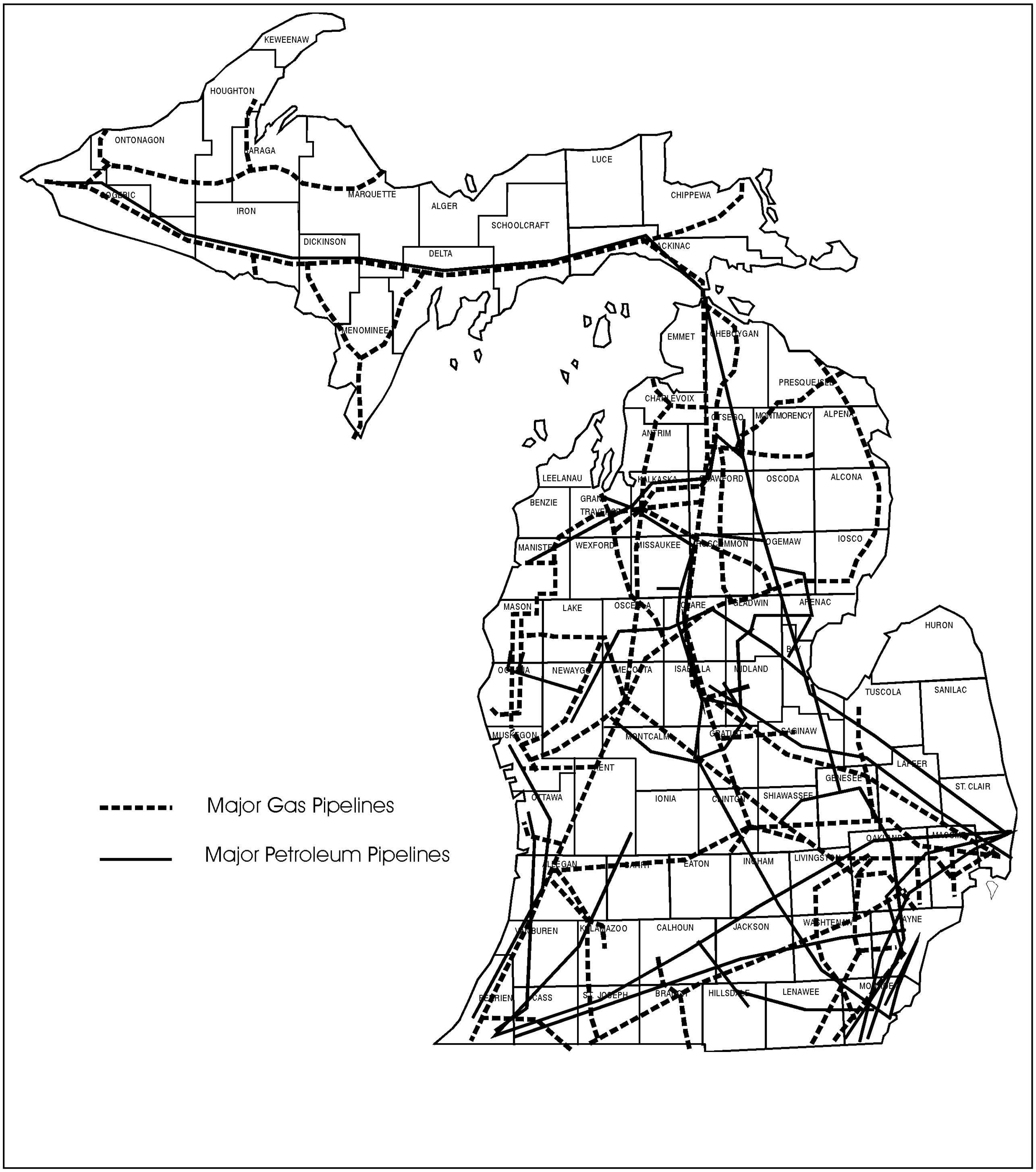
MFISfoundation.org

Michigan's Oil and Gas Fields

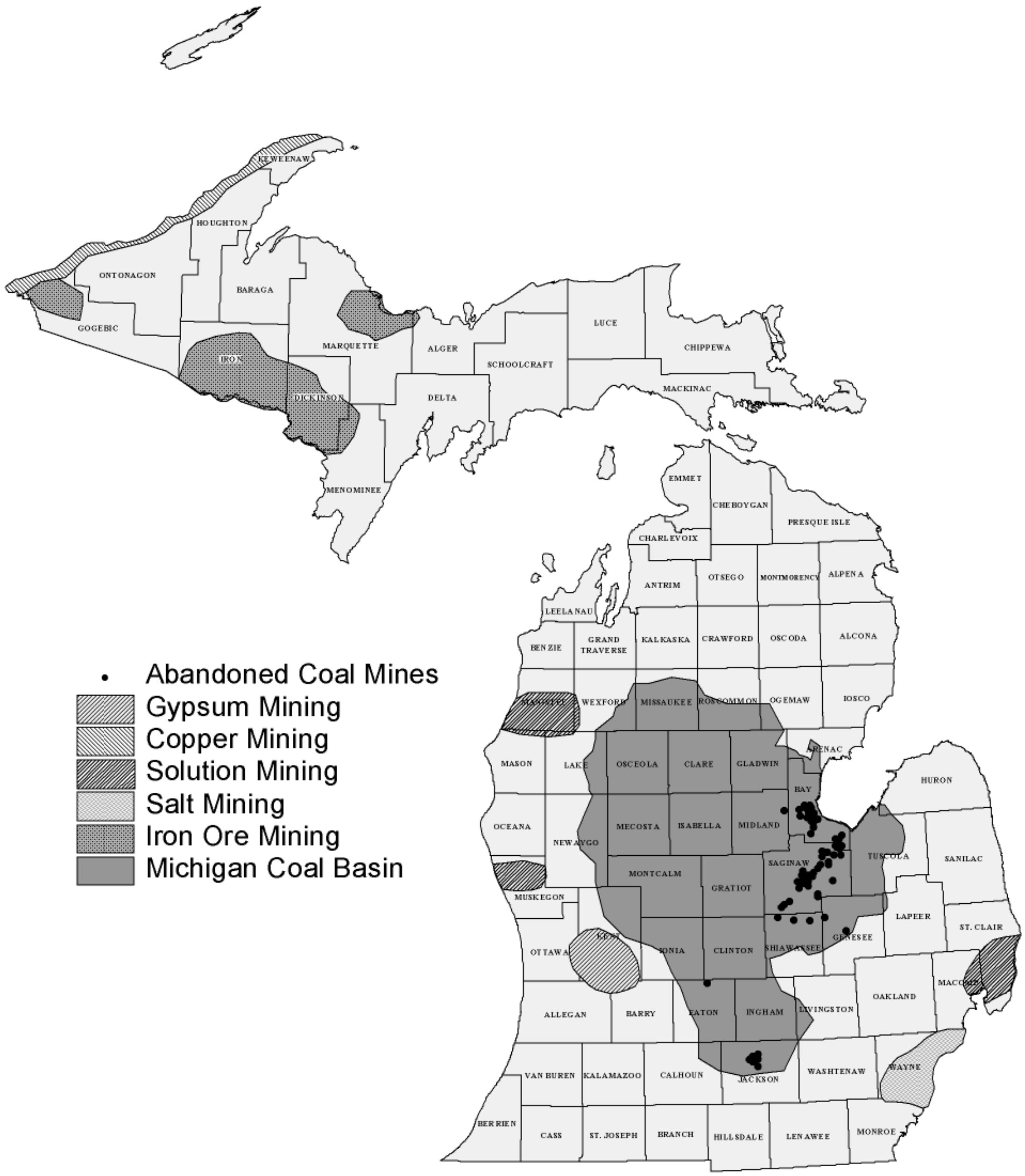


Major Petroleum and Natural Gas Pipelines in Michigan

Source: Michigan Public Service Commission; pipeline company maps



Potential Subsidence Hazards



Produced by:
Michigan State Police
Emergency Management Division
20 November 2000

DISADVANTAGED AREAS

In January of 2021, President Biden issued Executive Order 14008. The order directed the Council on Environmental Quality (CEQ) to develop a new tool. This tool is called the Climate and Economic Justice Screening Tool. The tool has an interactive map and uses datasets that are indicators of burdens in eight categories: climate change, energy, health, housing, legacy pollution, transportation, water and wastewater, and workforce development. The tool uses this information to identify communities that are experiencing these burdens. These are the communities that are disadvantaged because they are overburdened and underserved.

Federal agencies will use the tool to help identify disadvantaged communities that will benefit from programs included in the Justice40 Initiative. The Justice40 Initiative seeks to deliver 40% of the overall benefits of investments in climate, clean energy, and related areas to disadvantaged communities. Go to https://screeningtool.geoplatform.gov/en/ to access the Climate and Economic Justice Screening Tool.

Oceana County Summary

According to the screening tool, roughly the eastern two-thirds of Oceana County is considered "disadvantaged." These determinations are based on census blocks and do not always align with municipal boundaries. These tracts are considered disadvantaged because they meet more than 1 burden threshold **AND** the associated socioeconomic threshold (low income).

Disadvantaged Areas		
General Location	*Jurisdictions (all or part)*	*Burdens*
Northeast quarter of Oceana County	Townships of Colfax, Crystal, Elbridge, Leavitt Village of Walkerville	Low Income Energy (energy cost) Health (heart disease) Transportation (transportation barriers)
Southeast quarter of Oceana County	Townships of Ferry, Greenwood, Newfield, Otto Village of Hesperia	Low Income Energy (energy cost) Transportation (transportation barriers)
Hart	City of Hart, Hart Township	Low Income Energy (energy cost) Legacy Pollution (proximity to risk management plan facilities)
Oceana Drive corridor, south of Hart	Townships of Grant, Shelby Villages of New Era, Rothbury, Shelby	Low Income Legacy Pollution (formerly used defense sites)

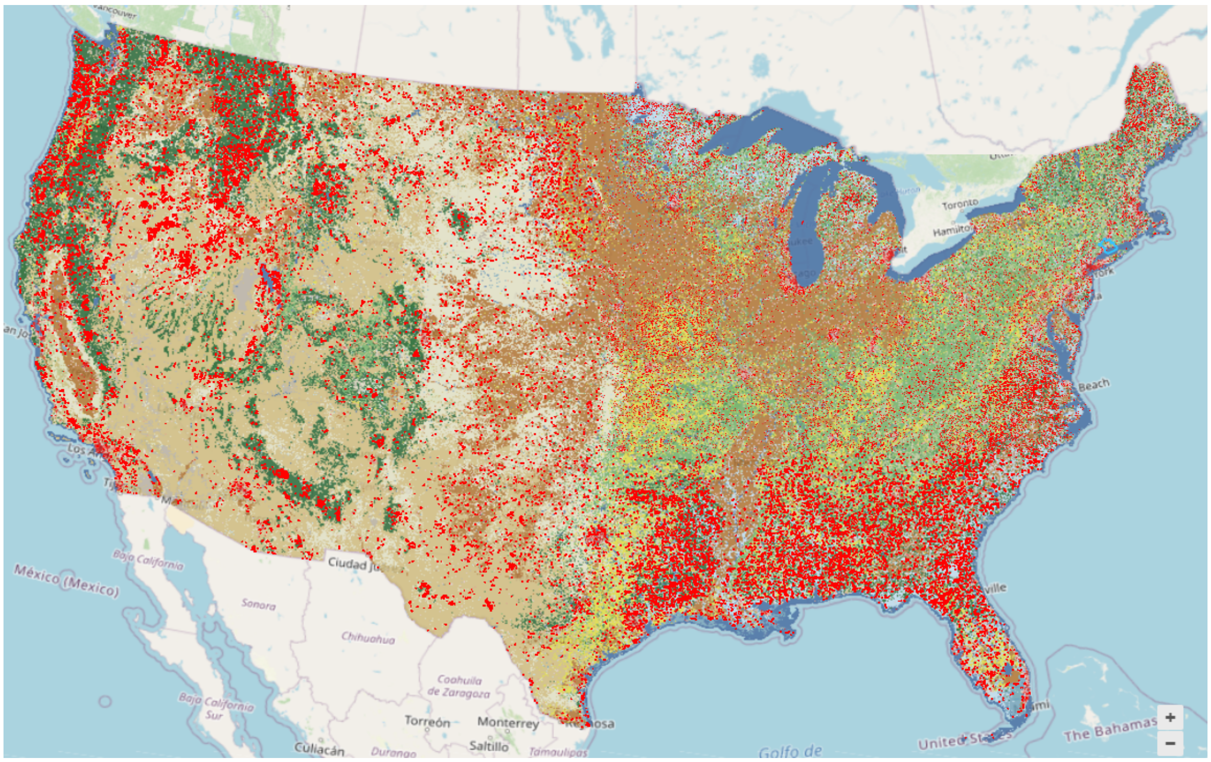
Oceana County, Michigan

2019 Land Cover

Having an accurate picture of an area's landscape and understanding how that landscape is changing is important information for any planning effort. Land cover data can help provide that big-picture view.

The data seen in the map below was derived through the Multi Resolution Land characteristics Consortium (MRLC). The MRLC produces the National Landcover Database (NLCD), a nationally standardized land cover and land change information product for the United States Multiple dates of satellite imagery are used to document changes in various types of land cover. The 2019 land cover for Oceana County can be seen below.

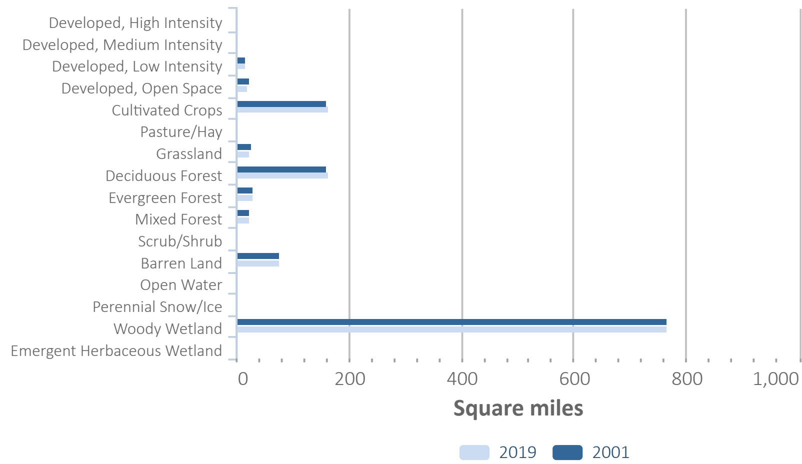
These summary sheets provide an easy way to understand some of the important information derived from these data for Oceana County.



Land Cover Overview
Oceana County, Michigan
Land Cover Data: 2001 to 2019

Land Cover Basics

1.19 percent or 15.55 square miles of this County changed.



Communities comparing data from one year to the next can evaluate how their land use management efforts are working, and can also use information on trends to aid future planning initiatives. In this bar chart, showing each land cover class, the difference between the two bars represents the net difference in the area for that category. This data represents a beginning to end year comparison,and does not quantify cumulative change between years. For instance, an evergreen forest that was harvested after the beginning year and re-grew to Evergreen forest before the end year would not be represented in the statistics. Additional GIS analysis is needed for this type of cumulative change. Other data sources available through the MRLC consortium include developed impervious surface, percent forest canopy cover, and nine discrete rangeland components for the Western United States. All of these additional components provide increased and complementary detail for analysis across the United States.

Land Cover Categories	Area 2001	Area Lost	Area Gained	Area 2019	Net Change	Percent Change
Developed, High Intensity	0.64	0.00	0.30	0.93	0.30	46.30%
Developed, Medium Intensity	3.70	-0.02	0.89	4.58	0.87	23.52%
Developed, Low Intensity	17.88	-0.37	0.45	17.96	0.08	0.44%
Developed, Open Space	21.82	-0.88	0.24	21.18	-0.64	-2.94%
Cultivated Crops	160.84	-1.79	3.51	162.56	1.72	1.07%
Pasture/Hay	1.46	-0.04	0.08	1.50	0.04	2.45%
Grassland	27.05	-3.80	1.63	24.88	-2.17	-8.04%
Deciduous Forest	161.88	-2.09	2.90	162.68	0.81	0.50%
Evergreen Forest	30.74	-1.50	0.43	29.67	-1.07	-3.49%
Mixed Forest	24.40	-0.16	0.19	24.44	0.03	0.14%
Scrub/Shrub	4.79	-1.51	1.71	4.99	0.20	4.25%
Woody Wetland	76.97	-1.08	1.10	76.99	0.02	0.02%
Emergent Herbaceous Wetland	3.94	-1.28	1.59	4.25	0.31	7.91%
Barren Land	4.75	-0.59	0.02	4.18	-0.57	-12.00%
Open Water	765.87	-0.46	0.54	765.95	0.08	0.01%
Perennial Snow/Ice	0.00	0.00	0.00	0.00	0.00	0.00%

*All numbers expressed in square miles

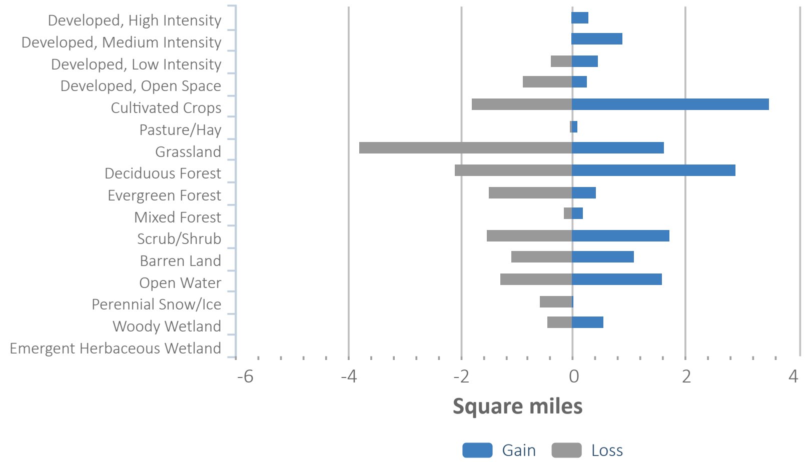
Land Cover Overview

Oceana County, Michigan

Land Cover Data: 2001 to 2019

Area Gained - Area Lost = Net change

Net change numbers can be deceiving; forests may be lost on one side of the County, while another area may experience an increase. The net change might be minimal, yet the total area of change could be substantial, and the quality of new growth areas may be different than those lost. It is important to look at these offsetting losses and gains, in addition to the overall net difference.

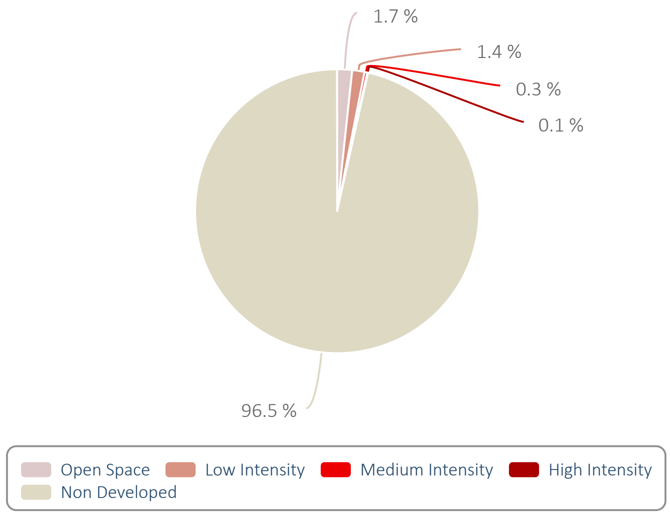


Development
Oceana County, Michigan
Land Cover Data: 2001 to 2019

Development and Impervious Surfaces (2019)

3.42% of Oceana County is developed and 0.82% is impervious.

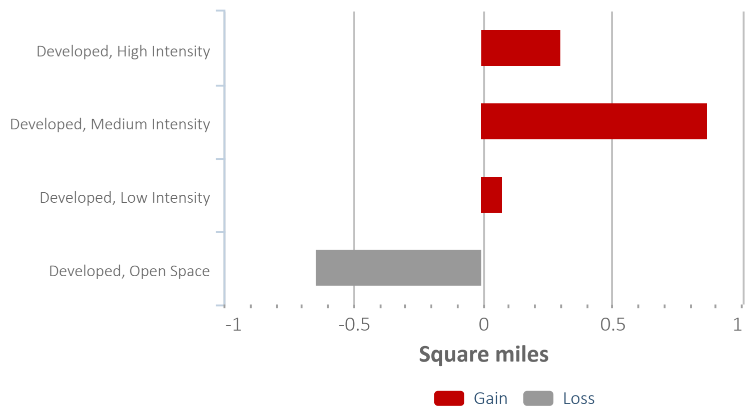
More development means more impervious surfaces, which translates into a greater risk for increased flooding and decreased water quality. Areas with impervious surface rates approaching or exceeding 12 percent to 15 percent will likely experience negative impacts to water quality. Severe degradation can be expected when rates reach 25 percent. This chart highlights the percentage of the County developed in 2019.



Development Change

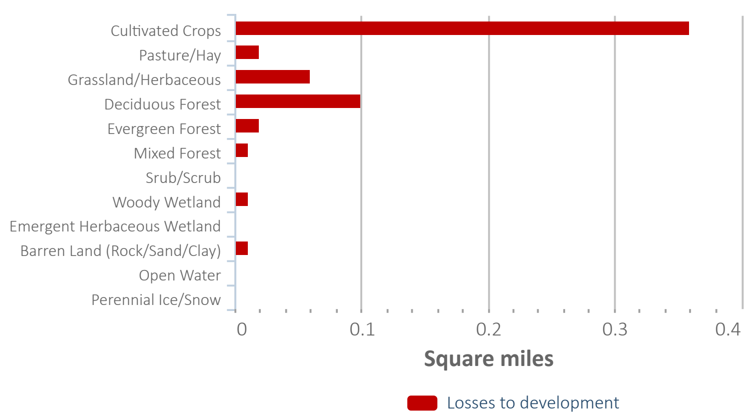
0.60 square miles of development and 0.72 square miles of impervious surfaces were gained between 2001 and 2019.

Low density and open space development can impact water quality negatively, though usually to a lesser degree than with higher density development. This graph shows how each type of development changed between 2001 and 2019.



What's Being Lost

Unlike natural land cover changes, land lost to development tends to be permanent. This graph shows the types of lands that changed to developed between 2001 and 2019. It does not show any potential losses of previously developed areas, as this is a rare occurrence.

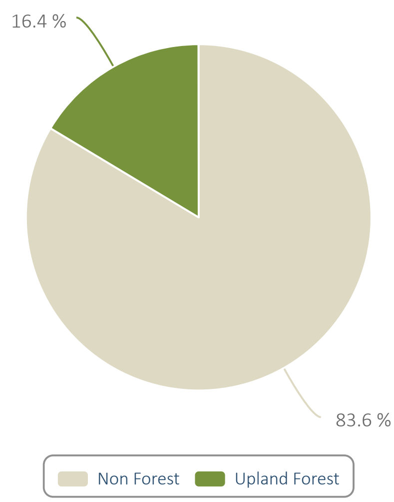


Forests
Oceana County, Michigan
Land Cover Data: 2001 to 2019

Current State of Forests (2019)

16.59% of Oceana County is forest.

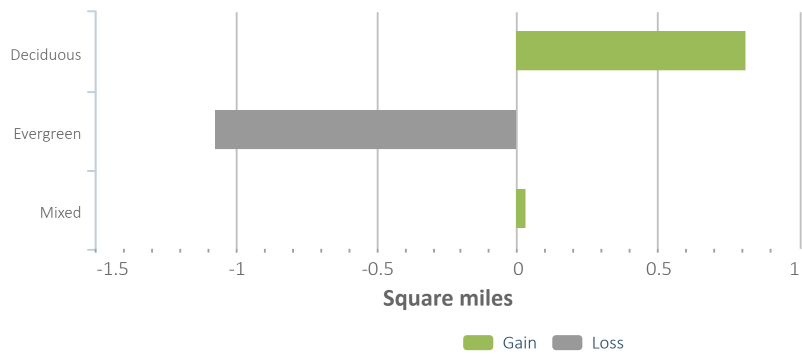
Healthy forests are a vital part of a healthy ecosystem, but it is important to understand the types of forest that are present. This chart shows the percentage of the County that is forested as well as the percentage in uplands and wetlands.



Forest Change

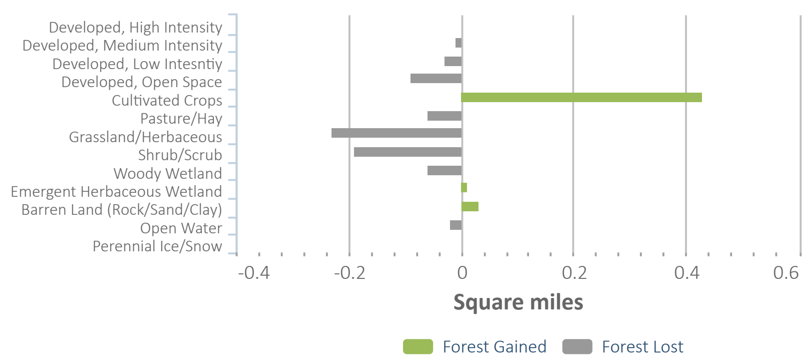
0.23 square miles of the forest was lost between 2001 and 2019.

Knowing which types of forests are being lost or gained can be as important as knowing about changes in the total forest area. Different forest types can differ in ecosystem value. This graph highlights changes in each forest type over a specific time frame.



What is Changing

A forest can go through a transitional period after a fire, other natural disaster, or logging operation, but typically can be expected to recover. Some losses, such as forests converted to development, tend to be permanent. This graph highlights the transformation of forestlands into different land cover types. It also highlights the origin of any forest gains.



Wetlands

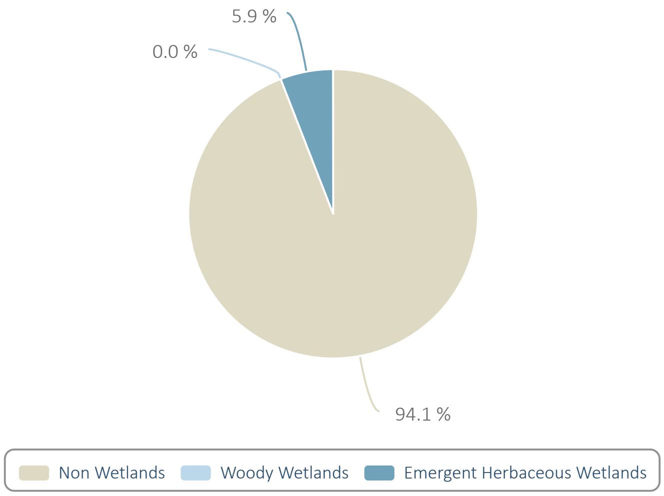
Oceana County, Michigan

Land Cover Data: 2001 to 2019

Current State of Wetlands (2019)

6.22% of Oceana County is wetland.

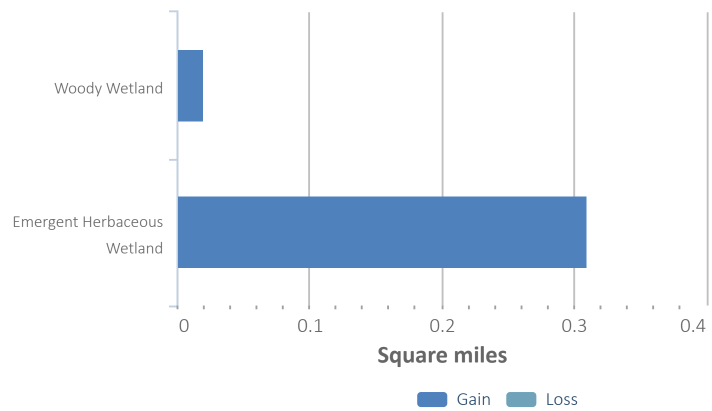
Wetlands are among the most productive environments on Earth. Wetlands provide habitat and food, buffer the impacts of storm surge and flooding, and help control erosion. Wetlands also absorb, store, and filter urban and agricultural runoff to maintain water quality. This chart highlights how much of the County is covered by wetlands.



Wetland Change

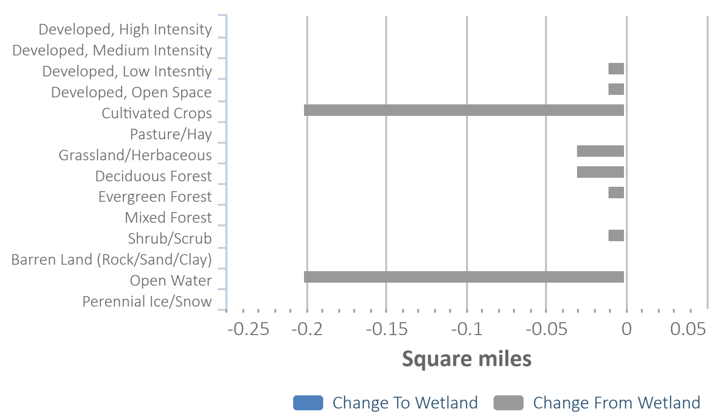
0.33 square miles of wetlands were gained between 2001 and 2019.

When a wetland area or type undergoes change, the benefits of the wetland will change as well. Understanding which type of wetland is changing, and how, can help in determining the eventual impacts of the change. This graph highlights the change or changes in each type of wetland.



What Is Changing

Understanding wetland changes can help communities identify potential management actions to reverse or mitigate the trend. This graph highlights the transformation of lost wetlands into different land cover types. It also highlights the origin of any wetland gains.



Agriculture

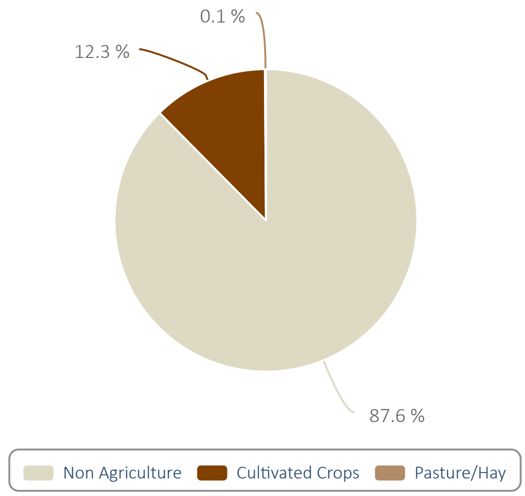
Oceana County, Michigan

Land Cover Data: 2001 to 2019

Current State of Agriculture (2019)

12.56% of Oceana County is agriculture.

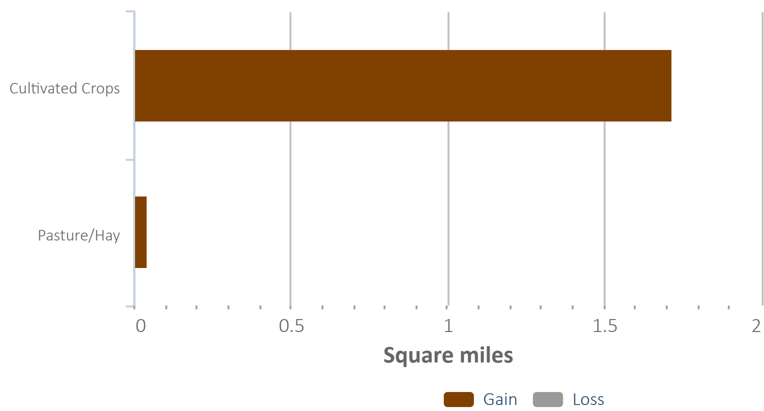
NLCD Agriculture classes include land used for production of annual crops as well as areas intensively managed for livestock production. Agricultural areas are managed in in a variety of ways including tillage, fertilization, and other man-made interventions that make the area more productive than it would be naturally.



Agriculture Change

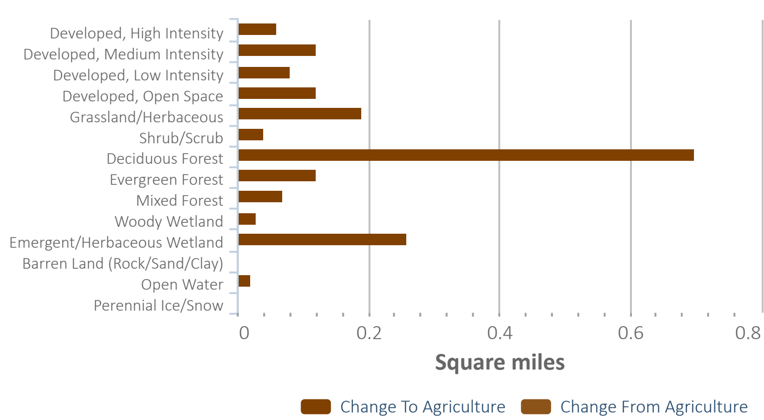
1.76 square miles of agriculture were between 2001 and 2019.

Agricultural lands can have a high impact on surrounding areas. This can be for a variety of reasons including runoff, pesticide application, fertilizer application, etc. This can also show conversion of natural areas to more highly managed areas which relate to overall increases for local impacts. This can also include areas of hay pasture, which generally have lower impacts on the landscape, to higher production cultivated crops. Decreasing agricultural land can show habitat restoration, increased urbanization, decreasing water availability, and a host of other factors important for resource managers and local communities.



What Is Changing

As agricultural lands increase or decrease, a variety of impacts can happen. Increasing agricultural lands can sometimes identify increased water usage as well as loss of natural habitat. Decreasing agricultural lands can highlight droughts, long-term water shortages, habitat restoration, etc. etc. Understanding how these changes are occurring and to what extent help to identify usage and potential risks for producers and the community.



Digging Deeper

Understanding how your County's land cover has changed over the years is an excellent way to document trends, understand the effects of past land use decisions, and consider future land use planning needs. This report, which covers 2001 and 2019, provides a solid foundation.

Communities adding additional data and analysis are able to generate findings designed to meet their specific needs. There are additional tools developed by NOAA's Digital Coast. This provides data and information useful for this purpose in coastal areas. Visit the website at coast.noaa.gov/digitalcoast. Some examples are listed below.

Land Cover Resources

Interested in more information related to land cover, or in taking this analysis one step further? Start with the following tools that use land cover to analyze specific issues.

- **Nonpoint - Source Pollution and Erosion Comparison Tool -** Investigates potential water quality impacts from development, and other change. coast.noaa.gov/nspect
- **Coastal County Snapshots**- Provides local officials with easy-to-understand graphics and analysis that cover a county's demographics, infrastructure, and environment. https://coast.noaa.gov/snapshots
- **Sea Level Rise Impacts Viewer**- Displays maps of potential impacts of sea level rise along the coast and provides related information and data for community officials. https://coast.noaa.gov/slr
- **Coastal Flood Exposure Mapper**- Supports communities that are assessing their coastal hazard risks and vulnerabilities. The tool creates a collection of user-defined maps that show the people, places, and natural resources exposed to coastal flooding. https://coast.noaa.gov/floodexposure

About the Source Data

The data seen in the map below was derived through the MRLC(Multi Resolution Land characteristics Consortium). The MRLC produces the National Landcover Database (NLCD), a nationally standardized land cover and land change information product for the United States. Multiple dates of satellite imagery are used to document changes in various types of land cover.

- **Notes and Limitations** While efforts have been made to ensure that data are accurate and reliable within the limits of current technology, NLCD data sets were made for analysis at a regional and national scale. These data are intended for use in identifying regional landscape patterns and major functional habitats. NLCD is a national and regional data set that should be used only as a screening tool for very local or site-specific management decisions. Small features and changes should be verified with a higher resolution data source. Additional resources on accuracy and methodology can be found on the MRLC publications page Publications | Multi-Resolution Land Characteristics (MRLC) Consortium (https://www.mrlc.gov/publications)

Appendix D:

HAZARD MITIGATION PLAN UPDATE SURVEY

Survey Distribution Letter:

This letter was mailed in Spring of 2022 to local units of government, elected officials, county departments, and other stakeholders in Oceana County.

WEST MI SHORELINE
Regional Development Commission

Community Hazards Survey Available

The West Michigan Shoreline Regional Development Commission (WMSRDC), in partnership with local emergency management leaders, is working to update Hazard Mitigation plans for the West Michigan counties of Lake, Mason, and Oceana.

Hazard mitigation is any sustainable action that reduces or eliminates long-term risk to people and property from future disasters. Mitigation planning breaks the cycle of disaster damage, reconstruction, and repeated damage. Hazard mitigation includes long-term solutions that reduce the impact of disasters in the future. Once Hazard Mitigation plans are approved by FEMA and adopted locally, communities become eligible to apply for pre-disaster and post-disaster mitigation funding.

Public input is essential to identifying and planning for local hazards. An online survey has been created to collect comments from community members, leaders, and stakeholders and is available at:
https://app.surveymethods.com/EndUser.aspx?E1C5A9B6E3A0B2BAE4.

The survey may also be accessed through the WMSRDC website:
https://wmsrdc.org/project/hazard-mitigation-plan-updates/

The survey will be open through the summer, though participants are encouraged to complete the survey as soon as possible. In addition, public hearings will be held in Lake, Mason, and Oceana counties to provide additional opportunities for public input later in 2022. Once dates are identified, public notices will be published in local newspapers and noted on social media and the WMSRDC website.

For additional information please visit wmsrdc.org or contact Stephen Carlson at scarlson@wmsrdc.org.

316 Morris Avenue, Suite 340, Muskegon, MI 49440
Telephone: (231) 722-7878 / www.wmsrdc.org

Press Release:

Oceana County Emergency Management distributed this press release to local media, and it was posted on the WMSRDC Facebook page.

FOR IMMEDIATE RELEASE

WEST MI SHORELINE
Regional Development Commission

Community Hazards Survey Available

June 8, 2022

The West Michigan Shoreline Regional Development Commission (WMSRDC), in partnership with local emergency management leaders, is working to update Hazard Mitigation plans for the West Michigan counties of Lake, Mason, and Oceana.

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Public input is essential to identifying and planning for local hazards. An online survey has been created to collect comments from community members, leaders, and stakeholders and is available at https://app.surveymethods.com/EndUser.aspx?E1C5A9B6E3A0B2BAE4. The survey will be open through July 2022, though participants are encouraged to complete the survey as soon as possible.

In addition, public hearings will be held in Lake, Mason, and Oceana counties to provide additional opportunities for public input later in 2022. Once dates are identified, public notices will be published in local newspapers and noted on social media and the WMSRDC website.

For additional information please go to https://wmsrdc.org/project/hazard-mitigation-plan-updates/.

###

Online Survey Form:

Community Hazards Survey

1. **Select a county for the purpose of this survey.**
   - ❍ Lake County
   - ❍ Mason County
   - ❍ Oceana County
   - ❍ All three counties (regional perspective)
   - ❍ If other, please specify

     ____

2. **In what city, village, or township of this area do you primarily live, own land, or serve?**

   ____
   ____
   ____
   ____

3. **Select all that apply to you.**
   - ❑ Local official (elected or appointed)
   - ❑ Public employee
   - ❑ Local resident
   - ❑ Land owner
   - ❑ If other, please specify

     ____

Page 2 - Land Use

4. **Land use planning is often cited as a primary tool for reducing or preventing property damage and loss of life. Does your community have a master plan?**
   - ❍ Yes
   - ❍ No
   - ❍ I don't know

5. **If possible, please share the date the master plan was adopted.**

   ____
   ____
   ____
   ____

6. **Does your community have a zoning ordinance?**
   - ❍ Yes
   - ❍ No
   - ❍ I don't know

7. **Describe any significant land use changes you have observed over the <u>past 10</u> years in your area.**

   ____
   ____
   ____
   ____

8. **Describe any significant land use changes you anticipate to happen over the <u>next 10</u> years in your area.**

   ____
   ____
   ____
   ____

9. **Rate your level of concern for changes in weather patterns to impact your community.**
   - ❍ Very concerned
   - ❍ Somewhat concerned
   - ❍ Neutral
   - ❍ Not concerned

     Additional Comments

10. **Rate your level of concern regarding the condition of infrastructure in your community. (roads, bridges, culverts, water/sewer, utilities, etc)**

- ❍ Very concerned
- ❍ Somewhat concerned
- ❍ Neutral
- ❍ Not concerned

Additional Comments

____

____

11. **What hazards do you feel pose the greatest threat to <u>people</u> in your area. (select up to 5)**

- ❑ Civil Disturbance
- ❑ Dam Failure
- ❑ Drought
- ❑ Erosion
- ❑ Extreme Temperatures
- ❑ Great Lakes Shoreline Hazards
- ❑ Hazardous Materials Accident
- ❑ Infrastructure Failure
- ❑ Invasive Species
- ❑ Oil & Gas Well Accident
- ❑ Petroleum and Natural Gas Pipeline Accident
- ❑ Public Health Emergency
- ❑ Riverine/Runoff Flooding
- ❑ Severe Winter Weather (snow, ice, & sleet)
- ❑ Structural Fire
- ❑ Sustained Wind Events
- ❑ Terrorism and Criminal Activity
- ❑ Thunderstorm Hazards (Hail, Lightning, Severe Wind, & Tornados)
- ❑ Wildfire
- ❑ If other, please specify

____

12. **What hazards do you feel pose the greatest threat to <u>property</u> in your area. (select up to 5)**

- ❑ Civil Disturbance
- ❑ Dam Failure
- ❑ Drought
- ❑ Erosion
- ❑ Extreme Temperatures
- ❑ Great Lakes Shoreline Hazards
- ❑ Hazardous Materials Accident
- ❑ Infrastructure Failure
- ❑ Invasive Species
- ❑ Oil & Gas Well Accident
- ❑ Petroleum and Natural Gas Pipeline Accident
- ❑ Public Health Emergency
- ❑ Riverine/Runoff Flooding
- ❑ Severe Winter Weather (snow, ice, & sleet)
- ❑ Structural Fire
- ❑ Sustained Wind Events
- ❑ Terrorism and Criminal Activity
- ❑ Thunderstorm Hazards (Hail, Lightning, Severe Wind, & Tornados)
- ❑ Wildfire
- ❑ If other, please specify

____

13. **What hazards do you feel pose the greatest threat to the economy in your area.**
- ❑ Civil Disturbance
- ❑ Dam Failure
- ❑ Drought
- ❑ Erosion
- ❑ Extreme Temperatures
- ❑ Great Lakes Shoreline Hazards
- ❑ Hazardous Materials Accident
- ❑ Infrastructure Failure
- ❑ Invasive Species
- ❑ Oil & Gas Well Accident
- ❑ Petroleum and Natural Gas Pipeline Accident
- ❑ Public Health Emergency
- ❑ Riverine/Runoff Flooding
- ❑ Severe Winter Weather (snow, ice, & sleet)
- ❑ Structural Fire
- ❑ Sustained Wind Events
- ❑ Terrorism and Criminal Activity
- ❑ Thunderstorm Hazards (Hail, Lightning, Severe Wind, & Tornados)
- ❑ Wildfire
- ❑ If other, please specify

____

14. **Are there any areas in your community that are frequently affected by hazards? Please describe the location(s) and hazard(s). This information will be helpful for identifying potential mitigation projects.**

____
____
____
____

15. **Note your concerns for hazards or complicating factors that may compromise the safety of people and property in your community.**

____
____
____
____

Page 4 - Optional Information

16. **Enter your email address to receive notification of future opportunities to provide input and to be notified when the draft hazard mitigation plan is available for public review and comment. (This step is optional)**

____

Summary of Survey Results:

Hazard Mitigation Survey Results
Oceana County

SURVEYS COMPLETED BY OCEANA COUNTY				
City/village/township where you primarily live, own land or serve	**Local official (elected or appointed)**	**Public employee**	**Local resident**	**Land owner**
Leavitt Township	1		1	1
Village of Shelby	1		2	1
Village of Pentwater	6	2	6	6
New Era	2		3	
Claybanks Township	1			
Mears	1			
Benona Township	1		1	
Elbridge	1			1
Logan	1		1	
Walkerville		1	1	
City of Hart	1		1	
Weare Township		1	1	1
Newfield Township				1

DOES YOUR COMMUNITY HAVE A MASTER PLAN?			
City/village/township where you primarily live, own land or serve	**Yes**	**No**	**I Don't Know**
Leavitt Township		1	
Village of Shelby	1		1
Village of Pentwater	3	3	1
New Era	2		2
Claybanks Township	1		
Mears	1		
Benona Township	1		
Elbridge	1	1	
Logan	1		
Walkerville	1		
City of Hart	1		
Weare Township	1		
Newfield Township			1

Hazard Mitigation Survey Results
Oceana County

DOES YOUR COMMUNITY HAVE A ZONING ORDINANCE?			
City/village/township where you primarily live, own land or serve	**Yes**	**No**	**I don't know**
Leavitt Township		1	
Village of Shelby	2		
Village of Pentwater	7		
New Era	2		2
Claybanks Township	1		
Mears	1		
Benona Township	1		
Elbridge	1	1	
Logan	1		
Walkerville	1		
City of Hart	1		
Weare Township	1		
Newfield Township	1		

- OBSERVED Significant land use changes in the PAST 10 years:
  - More run down mobile homes. No blight
  - Fewer stick built homes. More manufactured housing
  - Marijuana industry facilities
  - Fewer small farms or locally grown food
  - Growth in CAFOs, especially hogs
  - Monoculture farming – corn
  - Exploration for natural gas - fracking
  - Our Industrial Park is at full capacity and Village annexation may be required to find adequate space for business development and growth.
  - We also need to pursue annexation or an Intergovernmental Agreement in order to make suitable land and space available for mor single family and multi-family housing and to deliver services such as fire, police, water, and sewer.
  - Continual building in the Township especially in the areas near Pentwater Lake and Lake Michigan. Efforts to improve park areas within the township.
  - The intersection of M-20 and Oceana Drive will have a gas station and a large corporate office by the end of this year.
  - More housing on agricultural ground
  - Increased resort accommodations
  - Renter rules
  - More people moving in
  - Pig farms
  - In the Shelby area, there is a new housing development that is going up. Unfortunately, the downtown business situation is grim.

Hazard Mitigation Survey Results
Oceana County

- ANTICIPATED significant land use changed in the NEXT 10 years:
  - More identification of PFAS in area
  - Issues with water supply as aquifers are overused by industrial farming.
  - WISH LIST: Small farmers growing and selling local foods.
  - WISH LIST: Mobile homes replaced by "tiny homes"
  - Annexation of property now zoned as agricultural or residential in Shelby Township by the Village of Shelby in order to ensure that land is available for more housing and commercial/industrial growth and development.
  - Proposal to complete the Pentwater Hart Trail should occur in the next 3 years. Continued building in outlying areas and in areas where businesses have closed and land is available for alternate uses.
  - In Shelby Township there will likely be a housing development and a new township park. The new Brownfield Authority will provide potential opportunities.
  - Continued increase in resort attractions.
  - Changing building lot sizes to 10 acres
  - Windmills
  - Anticipating a significant amount of housing taking up land that was once used for farming.
  - Increase in housing development and additional commercial property.
  - Anticipate expanded housing projects within the Township.
  - Continued expansion into the township and along the shoreline.
  - Continued building in the Township. Perhaps additional building along Lake Michigan. With the Village – several properties will be developed.
  - Vacant and forestry land lost to agricultural and housing.
  - In lakeshore communities I see the rental property trend continuing, leaving an even greater increase in lack of affordable housing for young families and retirees.

Hazard Mitigation Survey Results
Oceana County

RATE YOUR LEVEL OF CONCERN FOR CHANGES IN WEATHER PATTERNS TO IMPACT YOUR COMMUNITY:	Very Concerned	Somewhat Concerned	Not Concerned	Neutral
Comments about the level of concern for changes in weather patterns that will impact your community:	5	4	6	9

- These changes are real and happening worldwide but so many have made the climate change discussion political that little real progress is being made in dealing with the issue.
- Water levels in Pentwater Lake, etwater Channel, the Marsh and rivers and in Lake Michigan.
- Dramatic weather changes – more severe weather events.
- Precipitation is near freezing point rather than colder.

RATE YOUR LEVEL OF CONCERN REGARDING THE CONDITION OF INFRASTRUCTURE AND PUBLIC FACILITIES IN YOUR COMMUNITY (roads, bridges, culverts, dams, water/sewer, utilities, etc.):	Very Concerned	Somewhat Concerned	Not Concerned	Neutral
Comments about the level of concern regarding the condition of infrastructure and public facilities in your community	12	10	1	1

- Even a small drainage waterway is too expensive for repair, according to road commission. Two bridges in the area seem to be closed permanently for no reason other than funding. Impact on the lives of residents is ignored. Municipalities without the ability to fund water/sewer for their area are left out of monies for housing projects.
- We have a number of outdated roads. The culverts are not maintained to an adequate level due to the lack of funding in the Drain Commissioner's office. The dams are also past their expected life and need to be replaced or removed. We are getting TruStream in our county as we speak which will be very positive. Although, unfortunately, that doesn't cover all areas.
- Roads are the largest concern. Failure to use tax money in a responsible manner is a secondary related concern.
- There has been progress made but there is still aged infrastructure especially in the more rural areas.
- The roads in the Walkerville townships are in desperate need of attention.
- Growing communities address their infrastructure. The City of Hart is probably one of the few communities that have continued to address their infrastructure. The townships have done a very poor job being progressive about infrastructure improvement. Water, sewer, electric, high speed internet, roads are critical in the progress of a community.

Hazard Mitigation Survey Results
Oceana County

Your opinion on hazards and the threats they pose. Of the hazards listed, which do you feel pose the great threat in your area to:	PEOPLE
Severe Winter Weather (snow, ice & sleet)	14
Public Health Emergency	10
Thunderstorm Hazards (Hail, Lightning, Severe Wind, & Tornados)	10
Great Lakes Shoreline Hazards	8
Sustained Wind Events	8
Civil Disturbance	6
Terrorism and Criminal Activity	5
Invasive Species	4
Hazardous Materials Accident	4
Wildfire	4
Erosion	3
Infrastructure Failure	2
Petroleum and Natural Gas Pipeline Accident	1
Oil & Gas Well Accident	1
Structural Fire	1
Specify – Drug Usage	1

Your opinion on hazards and the threats they pose. Of the hazards listed, which do you feel pose the great threat in your area to:	PROPERTY
Thunderstorm Hazards (Hail, Lightning, Severe Wind, & Tornados)	12
Severe Winter Weather (snow, ice & sleet)	10
Erosion	9
Great Lakes Shoreline Hazards	8
Invasive Species	6
Sustained Wind Events	6
Wildfire	5
Drought	4
Infrastructure Failure	4
Civil Disturbance	3
Structural Fire	3
Terrorism and Criminal Activity	3
Hazardous Materials Accident	2
Oil & Gas Well Accident	2
Extreme Temperatures	1

Petroleum and Natural Gas Pipeline Accident	1
Public Health Emergency	1
Your opinion on hazards and the threats they pose. Of the hazards listed, which do you feel pose the great threat in your area to:	ECONOMY
Public Health Emergency	8
Great Lakes Shoreline Hazards	8
Thunderstorm Hazards (Hail, Lightning, Severe Wind, & Tornados)	7
Severe Winter Weather (snow, ice & sleet)	6
Sustained Wind Events	6
Drought	5
Hazardous Materials Accident	5
Infrastructure Failure	5
Civil Disturbance	4
Erosion	4
Extreme Temperatures	3
Wildfire	3
Invasive Species	2
Terrorism and Criminal Activity	2

- Areas in your community that are frequently affected by hazards?
  - High poverty areas are at risk with populations not educated in potential hazards and with the lack of preparation at the local level.
    Fire Departments in rural areas are struggling to keep members because of the amount of training required. Rural firefighters must complete same training as large urban areas. Does it make sense that small, rural departments are required to be trained in high rise fires events? NO.
  - Windstorms and thunderstorm hazards pose the greatest threat to crops in Oceana County. Anywhere in the County,
  - Shoreline along Lake Michigan. Shoreline of Pentwater Lake Straight-line winds in the area.
  - If the water levels rise again, flooding can be a significant problem.
  - Lake Michigan shoreline erosion
  - summer wind storm or winter snow storms are most common hazard.
  - Lakeshore erosion
  - Farms with hazardous chemicals

- Note your concerns for hazards or complicating factors that might compromise the safety of people and property in your community.
  - Lack of planning and support at County level. Lack of collaboration with services, education, training. Lack of support from state and federal government to rural areas.
  - Windstorms and thunderstorm hazards pose the greatest threat to crops in Oceana County. Anywhere in the County,
  - The fire department is small and volunteers respond to fires. Township does not have its own DPW or police department. It takes time for emergency people to respond to any type of incident.
  - Drug usage, particularly meth, is a particular concern of mine. I know of two homes that were broken into by someone high on meth not to steal or do any personal harm, I presume, but simply because they were high. Even though their intentions are likely not to hurt anyone, they still have the capability to hurt or kill someone and do significant property damage.
  - Any disaster could effect the community
  - power outage for at risk/elderly or limited access in or out during storms and clean up
  - Lack of funding and staffing of local EMS
  - Chemical cloud
  - Mostly from the government
  - Not sure how this fits with this topic but soil quality is a concern. Again, low or high water levels are a concern.

Appendix E:

ACKNOWLEDGMENTS & DOCUMENTATION

Oceana County LEPC
2023 MEMBERSHIP ROSTER

Name	Group Representing
Troy Maloney	Emergency Management - EM
Jim Colman	Michigan State Police-Post Commander
Tracy Byard	County Administrator
David Nobles	Oceana Co. CERT / MRC
Craig Mast	Sheriff's Office - Sheriff
David Robertson	RACES / AUXCOMM
Brad Fritcher	Co. Fire Rep.
Mike Schiller	City of Hart - Hydo Superintendent
Juan Salazar	Local Law Enforcement
Dan Yost	Co. Fire Rep.
Mark Timmer	Oceana County Road Commission
John Cavanagh	Print Media
Robert Simonson	Broadcast Media
Jeff Stockhill	Life EMS Ambulance Service
Michelle Martin	Oceana County Drain Commissioner
Ray Hasil	Mason-Oceana 911 Director
Todd Goodrich	Michigan State Police - Community Trooper
Bret Haner	District #10 Health Department - EP
Ray Cole	Michigan DNR - Fire Officer
William "Luke" Aurner	Region 6 Healthcare Coalition
Lynda Herremans	Oceana Co. Soil Conservation District
Danielle Roberts	Oceana County Medical Care Facility - EC
Linda Doerr	DHHS - Family Services
Jeffrey Nawrot	American Red Cross Rep.
Lt. Orville Theaker	MSP/EMHSD
Robert Walker	County Board of Commissioners - Board Chairperson
Zack Vanderwall	West Michigan Community Mental Health
Connie Fergson	Gray & Company
Dave Wierzbicki	EGLE

PARTICIPATING LOCAL OFFICIALS

Jurisdiction	Name/Title	Method of Participation/Date(s)
Benona Twp	Mr. Flemming, Supervisor N/A (elected or appointed official)	Email 10/23/23 Survey response 7/18/22
Claybanks Twp	Mr. Lombard, Supervisor	Survey response 6/22/22
Colfax Twp	Mr. Leonard, Supervisor	Phone interview 11/6/23
Crystal Twp	Mr. Hyslop, Supervisor	Email 11/6/23
Elbridge Twp	Ms. Van Sickle, Clerk	Email 10/24/23 Survey response 7/26/22
Ferry Twp	Mr. Schmieding, Supervisor	Phone interview 10/26/23
Golden Twp	Rachel Iteen, Clerk N/A (elected or appointed official)	Emails 10/25/23 Survey response 6/22/22
Grant Twp	Mr. Schmidt, Supervisor	Phone interview 11/2/23
Greenwood Twp	Mr. Hunt, Supervisor	Phone interview 11/8/23
Hart City	Mr. Splane, City Manager N/A (elected or appointed official)	Phone interview 10/25/23 Survey response 8/24/22
Hart Twp	Mr. McGhan, Supervisor	Phone interview 10/26/23
Hesperia Village		
Leavitt Twp	Ms. Kerwin, Supervisor N/A (elected or appointed official)	Phone interview 10/6/23 Survey response 6/10/22
New Era Village	Mr. Fessenden, President N/A (elected or appointed official)	Phone interview 11/8/23 Survey response 8/22/22
Newfield Twp	Ms. David, Supervisor	Phone interview 11/15/23
Otto Twp	Mr. Brimmer, Supervisor	Email 11/07/23
Pentwater Village	N/A (elected or appointed official)	Survey response 8/11/22
Pentwater Twp	Ms. Cavazos, Supervisor	Phone interview, Emails 10/25/23 Survey response 8/27/22
Rothbury Village	Ms. Williams, Clerk	Phone interview, 10/16/23
Shelby Village	Mr. Selner, Village Manager Mr. Inglis, Village President	Phone interview 10/18/23 Survey response 6/11/22
Shelby Twp	Mr. Raffaelli, Supervisor	Phone interview 8/28/23, Emails
Walkerville Village	Mr. Metts, President	Phone interview 11/17/23
Weare Twp	Mr. Doran, Supervisor	Phone interview 11/9/23

MEETINGS

Meetings attended for the purpose of updating the Oceana County Hazard Mitigation Plan; including lists of attendees and synopses of relevant comments and discussion.

August 24, 2021: Oceana County LEPC Meeting

Attendees:

JAMES C. DURAM	OCEANA COUNTY EMERGENCY MANAGEMENT – EMERGENCY MANAGER
ROBERT WALKER	OCEANA COUNTY BOARD OF COMMISSIONERS – CHAIR
DAVID NOBLES	OCEANA COUNTY CERT/MRC – COORDINATOR
ZACK VANDERWALL	WEST MICHIGAN COMMUNITY MENTAL HEALTH
ORVILLE THEAKER	MSP/EMHSD
ARLENE KOLBE	MERCY HEALTH PARTNERS LAKESHORE CAMPUS - INFECTION CONTROL
BRANDI WALDMAN	SENIOR RESOURCES
LOGAN LEAVITT	AMERICAN RED CROSS
MATT BOYLES	ARBRE FARMS
STEPHEN CARLSON	WMSRDC
CRAIG MAST	OCEANA COUNTY SHERIFF

Synopsis:

Introduction of Hazard Mitigation planning and a presentation of the anticipated planning process. Also discussed establishment of the Hazard Mitigation Advisory Team.

APRIL 24, 2021: Oceana County LEPC Meeting

Attendees:

SIGN-IN SHEET

OCEANA COUNTY LEPC MEETING

Date: 04/26/2022 Time: 11:00 A.M.

Location: Oceana County Services Building – Classroom

	NAME	AGENCY	E-MAIL
1	David A. Nobles	Oceana MRC/CERT	Sailor 616@msn.com
2	BRAD Fritcher	FTFD/OCEANA Fire Depts.	fritcherb@oceanasheriff.net
3	Orville Theaker	MSP EMHSD	
4	Troy MALONEY	OCEANA CO EM	tmaloney@oceana.mi.us
5	Bob Walker	" "	
6	Connie Ferguson	Gray & Company	cferguson@senecafoods.com
7	Danielle Roberts	OCMCF	danielle@oceanamcf.org
8	Eric Strait	OCMCF	erics@oceanamcf.org
9	Lianna Doerr	DHHS	doerrL@michigan.gov
10	Jim Heeremа	Life EMS	Jheerema@lifeems.com
11	Arlene Kolbe	Shelby Hospital	
12	Lynda Herremans	Oceana CD	lynda.herremans@macd.org
13	Stephen Carlson	WMSRDC	scarlson@wmsrdc.org
14	Craig Mast	Sheriff	MastC@oceanasheriff
15	DAvid Robertson	ARES/Auxcomm	drobertson1950@gmail.com

Synopsis:

Facilitated discussion regarding frequent community hazards, land use trends, and other hazards/concerning. Also reviewed opportunities for public input and the plan update timeline.

August 23, 2022: Oceana County LEPC Meeting & Public Input Opportunity

Attendees:

TROY MALONEY	OCEANA COUNTY EM
CRAIG MAST	OCEANA COUNTY SHERIFF
TODD GOODRIDT	MSP
STEVE WALTZ	SHELBY PD
BETTY CARTER	FAMILY COURT
JEN SILL	FAMILY COURT
BRAD LAMBRIX	PROBATE JUDGE
ARLENE KOLBE	LAKESHOR HOSPITAL
DANIELLE ROBERTS	OCMCF
LIANNA DOERR	DHHS
ROBERT WALKER	OCEANA COUNTY BOARD OF COMMISSIONERS
ZACH VANDERWALL	WM COMMUNITY MENTAL HEALTH
STEPHEN CARLSON	WMSRC
ERIC STRAIT	OCMCF
RAY HASIL	MASON-OCEANA 911
CONNIE FERGSON	GRAY & COMPANY
DAVE WIERZBICKI	EGLE
DAVID NOBLES	OCEANA COUNTY CERT
JUAN SALAZAR	HART PD
LYNDA HERREMANNS	OCEANA CONSERVATION DISTRICT
RYAN SCHILLER	OCEANA COUNTY SO
JIM HARREMA	LIFE EMS
GARY MCKEEN	OCEANA PLANNING COMMISSION
RON CHRISTIANS	OCEANA COUNTY BOARD OF COMMISSIONERS

Synopsis:

An advertised opportunity for public input and engagement. Communications regarding this opportunity also promoted the Community Hazards online survey. No members of the public were in attendance. Discussion included the following topics:

- summary of hazard mitigation “what” and “why”
- review of survey results, to-date
- review of hazard rating and ranking system
- discussion of community locations/areas that experience natural hazards
- vulnerable populations

August 24, 2021: Oceana County LEPC Meeting

Attendees:

TROY MALONEY	OCEANA COUNTY EMERGENCY MANAGEMENT – EMERGENCY MANAGER
ARLENE KOLBE	LAKESHORE HOSPITAL
LIANNA DOERR	DHHS
STEPHEN CARLSON	WMSRDC
CONNIE FERGUSON	GRAY & COMPANY
LYNDA HERREMANS	OCEANA CONSERVATION DISTRICT
JIM HARREMA	LIFE EMS
MICHELLE MARTIN	OCEANA COUNTY DRAIN COMMISSION
BRET HANER	DISTRICT HEALTH DISTRICT #10

Synopsis:

Review and discussion of updated hazard ratings and rankings.

April 25, 2023: Oceana County LEPC Meeting

Attendees:

TROY MALONEY	OCEANA COUNTY EM
DANIELLE ROBERTS	OCEANA COUNTY MEDICL CARE FACILITY
LIANNA DOERR	DHHS
JIM HARREMA	LIFE EMS
LINDA HERREMANS	OCEANA COUNTY CONSERVATION DISTRICT
BRET HANER	DISTRICT HEALTH DISTRICT #10
RYAN SCHILLER	OCEANA COUNTY SHERIFF'S OFFICE
DAVID NOBLES	OCEANA COUNTY CERT/MRC/AUXCOMM
DAVID ROBERTSON	OCEANA COUNTY AUXCOMM
RAY HASIL	MASON-OCEANA 911
DIRK WILSON	GRAY & COMPANY
STEPHEN CARLSON	WMSRDC
ZACK VANDERWALL	WM COMMUNITY MENTAL HEALTH

Synopsis:

Review and discussion of updated hazard ratings and rankings.

July 25, 2023: Oceana County LEPC Meeting

Attendees:

TROY MALONEY	OCEANA COUNTY EM
JIM HARREMA	LIFE EMS
STEPHEN CARLSON	WMSRDC

Synopsis:

Due to a miscommunication, the regularly scheduled LEPC meeting was not well attended. Regardless, those in attendance held a productive conversation regarding hazards and potential mitigation actions.

September 28, 2023: Oceana County Board of Commissioners Meeting & Public Comment Opportunity

Attendees:

TROY MALONEY	OCEANA COUNTY EMERGENCY MANAGEMENT
STEPHEN CARLSON	WMSRDC
TRACY BYARD	OCEANA COUNTY ADINISTRATOR
ROBERT WALKER	OCEANA COUNTY COMMISSIONER, BOARD OF COMMISSIONERS CHAIRPERSON
PHIL MORSE	OCEANA COUNTY COMMISSIONER
PAUL ERICKSON	OCEANA COUNTY COMMISSIONER
CRAIG HARDY	OCEANA COUNTY COMMISSIONER
TIM BEGGS	OCEANA COUNTY COMMISSIONER

Synopsis:

An advertised opportunity for public input and engagement. No members of the public were in attendance. Communications to promote this opportunity invited review and comment of draft sections of this plan that were posted to the WMSRDC website https://wmsrdc.org/program/hazard-mitigation/. WMSRDC staff provided the Oceana County Board of Commissioners with information regarding the hazard mitigation plan and held a useful conversation about mitigating hazards in Oceana County.

RESOURCES

Many resources, documents, and websites were researched and referenced during the development of this plan. The following were most helpful during this process:

Michigan Hazard Mitigation Plan (2019)

Michigan Hazard Analysis (2019) and Supplemental (2020)

Michigan Historical Markers https://www.michigan.gov/mhc/historical-markers

Michigan Department of Environment Great Lakes and Energy (EGLE) (water/wastewater, GIS data)

Michigan Department of Natural Resources https://www.michigan.gov/invasives

Michigan GIS Open Data https://gis-michigan.opendata.arcgis.com/

Michigan Transportation Asset Management Council
https://www.mcgi.state.mi.us/mitrp/tamcDashboards/reports/pavement

National Register of historic places https://www.nps.gov/subjects/nationalregister/index.htm

US Census: American Community Survey & Decennial Census

US Drought Monitor https://droughtmonitor.unl.edu/

NOAA National Centers for Environmental Information (NCEI a.k.a. NCDC) Storm Events Database

National Weather Service – Beach Hazards https://www.weather.gov/greatlakes/beachhazards_stats

NFIP Community Status Book https://www.fema.gov/flood-insurance/work-with-nfip/community-status-book

NFIP Policy Information https://nfipservices.floodsmart.gov/reports-flood-insurance-data

FEMA Comprehensive Economic Development Strategy and Hazard Mitigation Plan Alignment Guide

US Department of Agriculture Census of Agriculture County Profile (2017)

NFIP Flood Insurance Rate Maps

USGS topographic maps

USDA Oceana County Soil Survey (1996)

Climate and Economic Justice Screening Tool https://screeningtool.geoplatform.gov/en/

American Red Cross (shelters)

National Inventory of Dams https://nid.sec.usace.army.mil/#/

Multi-Resolution Land Characteristics Consortium Land Cover Data Sheet www.mrlc.gov/data

Michigan Fire Inspectors Society Foundation

United Way of Michigan (ALICE statistics)

Michigan Sea Grant https://www.michiganseagrant.org/

Oceana County Master Plan (2023 update draft)

Oceana County Hazard Analysis (2000)

Oceana County Community Wildfire Protection Plan (2014)

Oceana County Equalization Report (2022)

Ludington Area Shoreline Land Use and Resiliency Plan (2020)

MLive (news) https://www.mlive.com/

WZZM 13 (news) https://www.wzzm13.com/

Shoreline Media (news) www.shorelinemedia.net

ARTICLES & PUBLIC NOTICES

Articles and public notices published during the Oceana County Hazard Mitigation Plan Update planning process.

June / July 2021 – WMSRDC print newsletter

LOCAL GOVERNMENT AND SPECIAL PROJECTS

Hazard Mitigation Grant Awarded

According to the Federal Emergency Management Agency (FEMA), hazard mitigation is any sustainable action that reduces or eliminates long-term risk to people and property from future disasters. Mitigation planning breaks the cycle of disaster damage, reconstruction, and repeated damage.

WMSRDC has experience working with local communities on hazard mitigation dating back to the early 2000's. This planning tradition is set to continue, thanks to a grant from FEMA accepted by WMSRDC in June. Over the next two years, WMSRDC will work within the counties of Lake, Mason, and Oceana to update existing county-wide hazard mitigation plans. Each county will be armed with an advisory team to help guide the process by helping to identify and assess hazards and prioritize potential mitigation measures.

This effort will help communities within Lake, Mason and Oceana mitigate hazards (including natural, man-made, and other hazards) by identifying potential hazards and mitigation strategies, as well as help communities be eligible to access various sources of federal assistance, such as the Building Resilient Infrastructure and Communities (BRIC) program.

The WMSRDC office is open. Staff is currently working a hybrid of in-person and remotely.

Coastal Zone Reforestation Grant Closes Successfully

Thanks to a Great Lakes Restoration Initiative (GLRI) grant through the United States Forest Service (USFS), WMSRDC has facilitated the planting of over 290 trees and 4,300 tree seedlings. This will allow for the interception of up to 286,622 gallons of runoff annually. That is more than twice the obligation of the grant requirement.

Stormwater reduction is an important ecological service that trees provide but one that is seldom considered. The water those trees absorb does not end up creating flash flows that cause erosion, flooding, or damage to infrastructure, and the presence of trees provide many benefits. The benefits include shade, screening of viewsheds, aesthetic quality, cooling of urban landscapes, pollution mitigation, habitat for wildlife along with the targeted runoff reduction of this grant.

WMSRDC worked with private, state, and municipal partners to meet the region's goal. WMSRDC partnered with five state parks (Ludington, Charles Mears, Silver Lake, Muskegon, and Hoffmaster) as well as, the Muskegon Conservation District and the City of Muskegon to achieve the results. WMSRDC is grateful to the USFS and the GLRI grant program for the opportunity to successfully provide these services.

June / July 2021 Page 7

LOCAL GOV'T SERVICES & SPECIAL PROJECTS

Hazard Mitigation Planning Update

Efforts to update the hazard mitigation plans for Lake, Mason, and Oceana counties continue. In March, WMSRDC staff coordinated with each county's emergency manager to send letters to all local units of government. The letters served to notify local units of the plan updates over the next 12 to 16 months and to seek their participation in the process.

The plans will enable counties, and local municipalities that participate in the planning process, to apply for funding to lessen or prevent the effects of natural hazards. The Federal Emergency Management Agency (FEMA) requires these plans to be updated every five years.

Feedback from each community within the county is critical to the quality of this effort. Opportunities for input will be made available through the WMSRDC website. Communities that choose to participate will be notified when opportunities arise. There is no cost or obligation associated with participation. However, failure to participate may jeopardize a community's eligibility for hazard mitigation funding or projects in the future.

If your community wishes to participate, and has not yet responded to the aforementioned letter, please appoint a point of contact for your community by sending a name and email address to scarlson@wmsrdc.org. Questions and concerns regarding the hazard mitigation plan updates may also be sent to that address, or directed to your county's emergency manager.

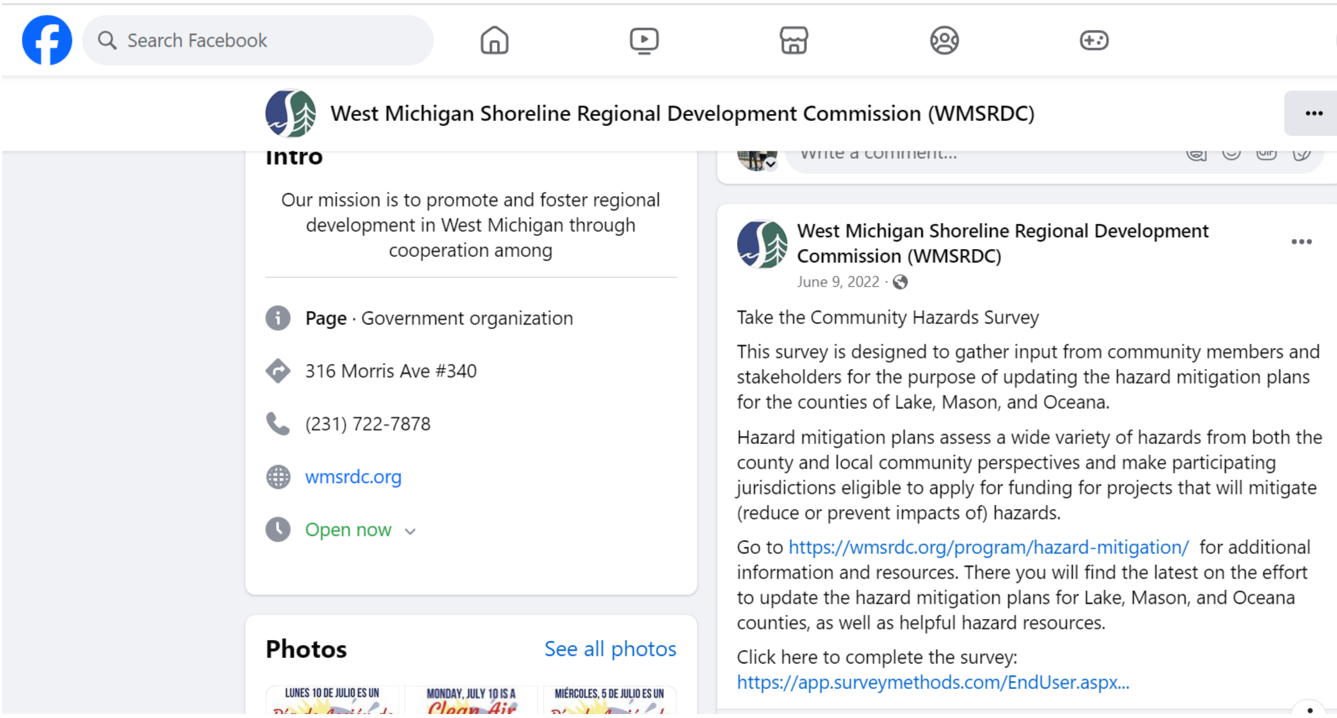
Local Planning Clearinghouse

As a regional planning and development organization, WMSRDC serves a wide variety of roles. One perhaps lesser-known role is to provide a clearinghouse for local planning efforts. In Michigan, local governments that are creating or updating master planning and recreation planning must notify the local regional planning agency when they are engaging in the activity, and they must provide a copy of the plan to the regional planning agency when it is complete. This may be in the form of a paper copy, a digital copy sent via email, or a link to the plan online.

In the coming months, WMSRDC will step up its "clearinghouse game." A project page will appear on the WMSRDC website to provide information about the status of community master and recreation plans within the region, links to those plans (if available), and instructions on how to submit plans to WMSRDC. This public-facing clearinghouse will facilitate awareness for planning and be a resource for communities and interested individuals.

"...a lesser-known role of WMSRDC is to provide a clearinghouse for local planning efforts."

June 2022 – WMSRDC Facebook posting



Search Facebook

West Michigan Shoreline Regional Development Commission (WMSRDC)

Write a comment...

Intro

Our mission is to promote and foster regional development in West Michigan through cooperation among

Page · Government organization

316 Morris Ave #340

(231) 722-7878

wmsrdc.org

Open now

Photos See all photos

LUNES 10 DE JULIO ES UN

MONDAY, JULY 10 IS A

MIÉRCOLES, 5 DE JULIO ES UN

West Michigan Shoreline Regional Development Commission (WMSRDC)

June 9, 2022 ·

Take the Community Hazards Survey

This survey is designed to gather input from community members and stakeholders for the purpose of updating the hazard mitigation plans for the counties of Lake, Mason, and Oceana.

Hazard mitigation plans assess a wide variety of hazards from both the county and local community perspectives and make participating jurisdictions eligible to apply for funding for projects that will mitigate (reduce or prevent impacts of) hazards.

Go to https://wmsrdc.org/program/hazard-mitigation/ for additional information and resources. There you will find the latest on the effort to update the hazard mitigation plans for Lake, Mason, and Oceana counties, as well as helpful hazard resources.

Click here to complete the survey:
https://app.surveymethods.com/EndUser.aspx...

LOCAL GOV'T SERVICES & SPECIAL PROJECTS

Community Hazards Surveys Available

WMSRDC, in partnership with local emergency management leaders, is working to update hazard mitigation plans for the West Michigan counties of Lake, Mason, and Oceana.

Hazard mitigation is any sustainable action that reduces or eliminates long-term risk to people and property from future disasters. Mitigation planning breaks the cycle of disaster damage, reconstruction, and repeated damage. Hazard mitigation includes long-term solutions that reduce the impact of disasters in the future. Once hazard mitigation plans are approved by the Federal Emergency Management Administration and adopted locally, communities become eligible to apply for pre-disaster and post-disaster mitigation funding.

Public input is essential to identifying and planning for local hazards. An online survey has been created to collect comments from community members, leaders, and stakeholders. The survey may be accessed through the WMSRDC website: https://wmsrdc.org/project/hazard-mitigation-plan-updates/

The survey will be open through the summer, though participants are encouraged to complete the survey as soon as possible. In addition, public hearings will be held in Lake, Mason, and Oceana counties to provide additional opportunities for public input later in 2022. Once dates are identified, public notices will be published in local newspapers and noted on social media and the WMSRDC website.

Erosion at a residence on the Lake Michigan Shoreline in the City of Norton Shores, Muskegon County.

Muskegon River Watershed Tree Plantings

WMSRDC is wrapping up the most recent tree planting grant within the Muskegon River Watershed. A total of 265 trees have been planted in the cities of Muskegon and Roosevelt Park, and the townships of Cedar Creek and Dalton in Muskegon County, as well as the City of Fremont in Newaygo County. The grant is provided by the U.S. Forest Service in partnership with the Muskegon River Watershed Assembly.

Earlier this summer final monitoring of the tree plantings was completed and of the 265 trees planted only 17 did not survive. The trees that did not survive will be replaced later this fall with funds provided by this grant. Native Michigan type trees such as maple, oak, tulip tree, eastern redbud, serviceberry, dogwood, sycamore, arborvitae, linden, river birch and poplars were planted within parks in Muskegon County including Beegle Field, Campbell Field, Marsh Field, Margaret Elliot Drake Park, Padley Park, and Sheldon Field. Trees were also planted at Cedar Creek Township Hall and

See Trees continued on page 7

Public Meeting Notice #1 – Published August 18, 2022

AFFIDAVIT OF PUBLICATION

State of Michigan

In the Matter of Mitigation

COUNTY OF OCEANA ss.

Mike Hrycko
being first duly sworn, says that he is the Publisher of Oceana's Herald-Journal, a newspaper published in the English language for the dissemination of local or transmitted news and intelligence of a general character and legal news, which is a duly qualified newspaper, and that annexed hereto is a copy of a certain order taken from said newspaper, in which the order was published on the following dates:

August 18, 2022

Subscribed and sworn to before me this 3rd day of November, 2023.

Michelle J. Piotrowski, Notary Public, Mason County, Michigan
Acting in Oceana County.

My commission expires 12/18, 20 26

NOTICE OF PUBLIC HEARING

REGARDING HAZARD MITIGATION

Are you concerned about natural hazards? The West Michigan Shoreline Regional Development Commission (WMSRDC), in cooperation with Oceana County Emergency Management, has begun the process of updating the Oceana County Hazard Mitigation Plan. Public input is requested regarding hazards that pose a threat to people and property in Oceana County. A public hearing to discuss Hazard Mitigation and receive input from community members will take place at 11:00 AM on August 23, 2022 at the County Services Building located at 844 S. Griswold Street, Hart, MI 49420. In addition, an online "Community Hazards Survey" and information about the Hazard Mitigation plan update are available at www.wmsrdc.org. Questions? Please contact Stephen Carlson at scarlson@wmsrdc.org.

April - June 2023 – WMSRDC print newsletter

Economic Development: EDA Projects in the Region

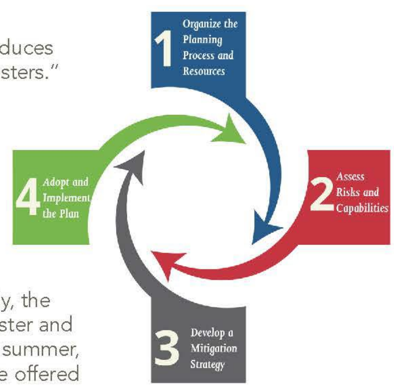
A core component of the WMSRDC economic development program is to provide technical assistance to local communities within the counties of Lake, Mason, Muskegon, Newaygo, and Oceana. This includes helping communities navigate the U.S. Department of Commerce, Economic Development Administration (EDA) grant application process; from vetting ideas, to crafting applications, to accepting and managing grants. Over the past year, WMSRDC assisted numerous communities in applying for and receiving EDA funding assistance. These are the current EDA-funded projects within the WMSRDC region:

Orchard in Oceana County that will be impacted by the multiple EDA grants currently ongoing in the county

- **City of Muskegon Heights**
  - Industrial Parks Master Plan
- **Oceana County**
  - Workforce & Economic Diversification Study
- **City of Hart**
  - Wastewater System Improvements
- **Lake County**
  - Economic Diversification Initiative

EDA offers many funding opportunities, which may be researched at https://www.eda.gov/funding/funding-opportunities. Please contact WMSRDC early and often to discuss your community's economic development ideas, find the right funding program, and make your application to EDA a success!

Local Government Services: Hazard Mitigation Update



The definition of hazard mitigation is "any sustainable action that reduces or eliminates long-term risk to people and property from future disasters." Mitigation planning seeks to break the cycle of disaster damage, reconstruction, and repeated damage and includes long-term solutions that reduce the impact of disasters in the future.

WMSRDC is currently helping the counties of Lake, Mason, and Oceana update their respective countywide hazard mitigation plans. Each plan and planning process is designed to be "multi-jurisdictional," meaning those local communities participate in the planning process. Once the plan is approved by the Federal Emergency Management Administration (FEMA) and adopted locally, the countywide plan will become eligible to apply to FEMA for pre-disaster and post-disaster hazard mitigation funding. Throughout the spring and summer, communities within the counties of Lake, Mason, and Oceana will be offered opportunities to participate in the hazard mitigation planning process.

In addition, there will be an announced review period near the end of the summer to offer the public an opportunity to review the proposed draft hazard mitigation plans. The plans are anticipated to be completed and adopted by each county before the end of calendar year 2023.

Public Meeting Notice #2 – September 2023

AFFIDAVIT OF PUBLICATION

State of Michigan

In the Matter of Hazard Mitigation Meeting

COUNTY OF OCEANA ____________ ss.

Mike Hrycko
being first duly sworn, says that he is the Publisher of Oceana's Herald-Journal, a newspaper published in the English language for the dissemination of local or transmitted news and intelligence of a general character and legal news, which is a duly qualified newspaper, and that annexed hereto is a copy of a certain order taken from said newspaper, in which the order was published on the following dates:

September 21, 2023	______, 2023
______, 2023	______, 2023
______, 2023	______, 2023

Subscribed and sworn to before me this 21st
day of Sept., 2023.

Michelle J. Piotrowski, Notary Public, Mason County, Michigan
Acting in Oceana County.

My commission expires 12/18, 20 26

HAZARD MITIGATION PUBLIC MEETING

Public input is requested for the Oceana County Hazard Mitigation Plan, which is being updated by Oceana County Emergency Management with assistance from the West Michigan Shoreline Regional Development Commission (WMSRDC). Draft sections of the plan are available for public review at https://wmsrdc.org/program/hazard-mitigation/overview/. The public is invited to comment on these sections at the Board of Commissioners regular meeting on September 28th at 11:30 A.M. in the boardroom of the Oceana County Building located at 100 S. State Street, Hart, Michigan 49420. Written comments may also be emailed to scarlson@wmsrdc.org prior to the meeting. Please direct any questions to Stephen Carlson at (231) 722-7878 ext 110.

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WMSRDC

July-September 2023 – WMSRDC print newsletter

Environmental: NOAA Regional Partnership Update

Sweeter Road and Little Cedar Creek crossing during pre-restoration monitoring and after construction.

In 2020, WMSRDC entered the Lake Michigan Rivers and Coastal Wetlands Regional Partnership with the National Oceanic and Atmospheric Administration (NOAA). Since then, the Little Cedar Creek, Stony Creek, and White River projects were selected for funding. All projects have completed design plans and are at differing stages in the implementation process. At Little Cedar Creek, the 500 feet of instream habitat restoration and the culvert replacement at Sweeter Road stream crossing have been completed. The additional culvert replacement at Michillinda Road crossing began construction at the beginning of September. The White River project will replace three road stream crossings in Swinton Creek and one in Cushman Creek and restore 1,080 feet of instream habitat in Swinton Creek. This work is set to begin this fall. The Stony Creek project at Marshville Dam Park includes dam remnant removal, removal of two old bridges and three culverts, a bridge replacement, and 500 feet of instream habitat replacement. This work is anticipated to begin in the spring of 2024.

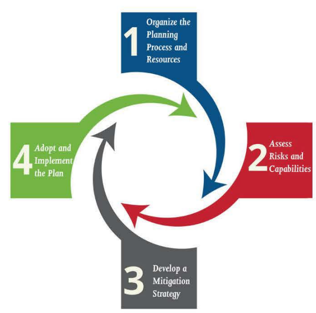
To complete all anticipated construction activities and post-monitoring efforts, WMSRDC has collaborated with NOAA to extend the project deadline through September 2024. Project partners for the three projects include Muskegon County Road Commission, Oceana County Road Commission, Grand Valley State University Annis Water Resources Institute, Conservation Resource Alliance, Oceana County Parks, watershed groups, and private landowners.

Local Government Services: Hazard Mitigation

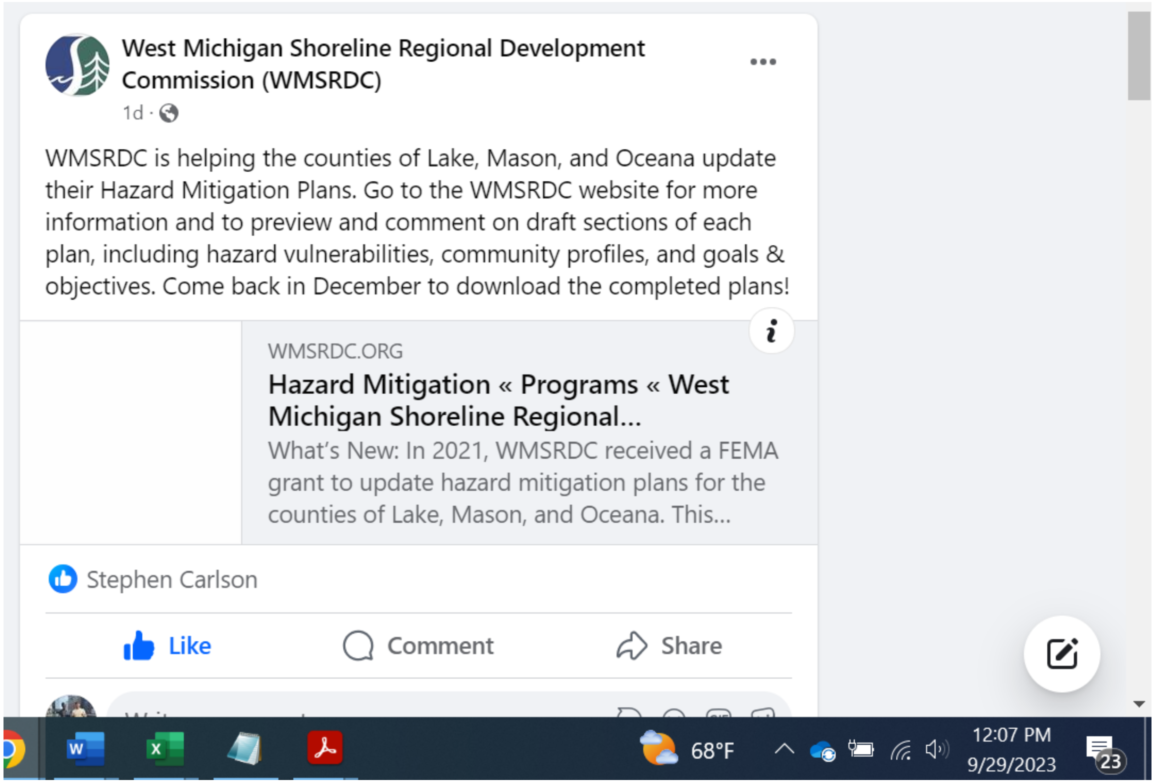
WMSRDC is nearing completion of a project to update Hazard Mitigation Plans for the counties of Lake, Mason, and Oceana. With FEMA-approved plans in place, each county and each local community that participated in the planning process will be eligible to adopt the county plan and become eligible to apply for federal pre-disaster and post-disaster funding.

The WMSRDC website wmsrdc.org/program/hazard-mitigation/ currently hosts draft sections for public review. Local officials in the counties of Lake, Mason, and Oceana are especially encouraged to review and provide input on these materials to ensure their community will at least have the option to become eligible for mitigation funding.

Hazard mitigation is any sustainable action that reduces or eliminates long-term risk to people and property from future disasters. Mitigation planning seeks to break the cycle of disaster damage, reconstruction, and repeated damage. Hazard mitigation includes long-term solutions that reduce the impact of disasters in the future.



<u>September 2023 – WMSRDC Facebook posting</u>



Appendix F:

Potential Hazard Mitigation Funding Sources

This Appendix provides a compendium of federal, state, and private sector funding sources for hazard mitigation projects, and is intended to serve as a tool for local communities to use in developing funding "packages" to implement hazard mitigation projects in support of their hazard mitigation plan. It is NOT the "be-all, end-all" information source for hazard mitigation project funding. Rather, it is intended to serve as a roadmap to other, more detailed information sources such as the Federal Assistance Listing, federal and state-agency web sites, and private philanthropic organization web sites. Information in this section was compiled by personnel in the MSP/EMHSD and included in the 2019 Michigan Hazard Mitigation Plan.

Funding sources open to local governments or that directly or indirectly benefit local governments, are listed in this compendium. Those programs that benefit a designated group only (i.e., Indian Tribes) are not included, nor are those programs for which a State Agency is the only eligible applicant. (However, it is possible that projects could be funded under a partnership arrangement with a State Agency. Such requests would have to be directed in writing to that agency.) The mere availability of funding for mitigation projects does not guarantee success. "Grantsmanship"—the ability to formulate projects, determine probable costs, identify probable funding sources, coordinate with project "partners", and write successful project proposals—is an essential skill for today's emergency management professionals. Someone in the community has to have the "vision" to identify potential projects, handle the mechanics of obtaining funding, and then see the project through to fruition. Grantsmanship is both an art and science. There are definite right and wrong ways to prepare project proposals. That is the science part of the equation. However, it is the "art" involved—the ability to see what others might not and then have the wherewithal to make something happen—that makes some communities successful and others not. Fortunately, technical assistance in proposal development and grant writing is available from a variety of sources. Many local communities may have their own Grants Coordinator on staff or under contract to assist local agencies in grant-related activities. Guidance on developing and writing grant proposals is also included within this section.

Two types of problems frequently appear when mitigation efforts are being considered. The first is when a planner or emergency manager doesn't even consider many mitigation possibilities because an area's hazards may seem too large-scale, expensive, or technically demanding for the resources of his or her community to address. On the other hand, you may have dared to "dream big" and produced a lengthy "wish list" of excellent hazard mitigation ideas for your community, but now you need to determine whether any of these solutions are realistically achievable within the technical and financial limits of your community's emergency management program. This section is intended to encourage planners to dare to "think big" in creating their ideas for hazard mitigation projects, and then to be able to realistically assess the feasibility of implementing these projects. This section hopes to enable you to explore a wider range of possibilities for gaining the technical and financial capabilities needed to implement your project ideas. Before you give up a great idea that you were bold enough to envision, you should read through this section to see if, just maybe, there is a way to assemble all the funding and technical requirements that will make it work. There may be cases where a proposal is rejected as almost but not quite feasible, because it lacks that last bit of funding or technical expertise that would ensure its viability for the community, and everyone wonders if there weren't some source of funding or expertise that could have provided the project with the last little "push" it needed to get rolling. Hopefully, the reader will gain more ideas and capability to implement his or her mitigation ideas as a result of this section.

"Start at Home"
(Local Sources of Funding and Technical Assistance for Hazard Mitigation Projects)

The hierarchy of emergency management functions in the United States is arranged so that assistance from higher levels of the hierarchy serves to supplement local resources when they would otherwise be exhausted. It is therefore important to ensure that local resources really are being fully utilized before appealing to state or federal government for assistance. It is also at the local level that the clearest picture is seen of what types of projects are needed, and for what purposes. Frequently, a great amount can be accomplished at the local level alone, as emergency managers learn to build partnerships and find creative ways to accomplish mitigation-oriented tasks in coordination with other types of community improvement projects.

It is good to assess what capabilities your community currently possesses with which to carry out your mitigation project ideas, and what resources will be needed from other sources. It is essential to consider the nature of the mitigation project and its scope. Who will it affect in the community? Who will benefit the most from it? Answering these questions will often point to local people and organizations who can be asked to assist or participate in implementing the mitigation project.

Some mitigation strategies involve local ordinances or construction and safety codes. This sort of project would call for the mobilization of political and popular support to achieve the mitigation objective. Some strategies may entail a public education or awareness campaign that would involve local schools, community centers, or newspapers. Other projects may be physical construction or renovation projects that require engineering expertise and lots of funding to implement. The building of local partnerships and community awareness and support often is required for all these types of projects, and so this section will present many ideas emergency managers will want to explore from the outset. It is frequently the case that the amount of assistance available locally is far greater than that which is available from outside the community.

Building Community Awareness and Support through Volunteer Resources and Organizations

It is important to have community members aware of hazards so that they are less likely themselves to act in ways that increase risks to themselves or others, or to the community's property and environment. Community awareness and support has not only an educational and political component to it, however. Every community contains people with a wide variety of skills and knowledge, and a willingness to help out in circumstances where they see a need for it. Advice, technical expertise, labor, and even funds might be available through the donations of community members who have come to believe in the importance of the mitigation objective that has been proposed. Individuals may be able to volunteer their knowledge and skills, labor, power, and money to support a good project. Local businesses may be willing to donate labor, materials, or funds for projects that benefit them. Many wealthy persons have been known to contribute generously to causes they believe in-especially if it benefits the community in which they live and work. More information on this aspect of fundraising can be found at http://staff.lib.msu.edu/harris23/grants/index.htm.

Contributions and volunteerism need not occur individually but can be achieved through local community organizations that are able to inform their members about the need for the project and coordinate their members' efforts to promote the project's success. Many local organizations will be glad to participate in worthy local causes, and such participation helps strengthen their cohesion and sense of community as well. Local organizations are often experienced at fundraising, and frequently have members of local political importance who can be vital to the success of a mitigation project. Emergency managers should consider what kinds of local organizations are present in the community and how to involve them or their members in support of the proposed mitigation project.

The Use of Public/Private Partnerships

Emergency managers should also identify who the most important for-profit institutions are in the local community. Major employers, financial institutions, and insurance companies may all have an interest in supporting a mitigation project that benefits the community. (Such support is often needed to gain state or federal support for the project as well.) Often, large companies already have a corporate giving program or an associated foundation that will provide assistance. Utilities and transportation service providers should similarly be investigated to see if they can assist. A large number of insurance organizations can be found listed at http://www.aiadc.org/.

Assistance Through Creative Coordination with Other Projects and Local Government Functions

Many mitigation projects have elements of overlap with other projects or coincide in some way with established goals of the community, some of its residents, or one of its governmental agencies. Emergency managers who have an ability to identify common elements that his/her mitigation project shares with other community or organizational activities will often be able to find ways to coordinate his/her mitigation efforts with those of the related activities. In some cases, the process may be very formal, as when a mitigation project is being linked in with some ongoing government function or project. In other cases, there may merely be some small alteration of an existing project to include mitigation goals (or to avoid interference with such goals). A local government has many types of activities that often affect hazard mitigation prospects in the community, such as capital improvement projects, and initiatives for community and economic development. It may be that, after examining each other's projects, the emergency manager and some other local official will find that the two are mutually beneficial, and some degree of coordination can help everyone's resources go farther. In some cases where all that is needed is some staff time or technical advice, it may be very easy for mutual assistance to occur.

Sometimes, an important mitigation project may deserve some sort of distinct local government support mechanism. This could involve the use of government bonds to support the project, the formation of a benefit assessment district, or the adjustment of the municipal budget to provide funding for the project. In such cases, the emergency manager will benefit greatly from whatever popular and political support were gained through the building of community awareness. More information on government bonds can be found through the Michigan Municipal Bond Authority. Please see the website at https://www.michigan.gov/documents/dleg/016077-121-1753_37602_37604---001_220892_7.html.

Nonprofit Organizations and Foundations

Foundations can be investigated through the Council of Michigan Foundations (www.cmif.org) or The Foundation Center (http://fdncenter.org). There are more web sites on foundations at http://staff.lib.msu.edu/harris23/grants/privcomm.htm. Some foundations are private and some are company sponsored. The National Science Foundation has an Earthquake Hazards Mitigation Program and a Natural and Technological Hazards Mitigation Program. In addition, Michigan has a number of community foundations, a list of which can be found at the website listed above. If there is no such foundation for your area, perhaps one can be organized.

Not-for-profit organizations (and grant making public charities) may also be interested in helping, and at the very least tend to be excellent sources of information, advice, and favorable publicity that almost any project can benefit from. By talking with a variety of professionals, the local emergency manager will be able to assemble a lengthy list of professional organizations pertinent to local mitigation projects. Here are some examples:

- Advocates for Highway and Auto Safety
- American Institute of Architects
- American Planning Association
- American Public Works Association, Emergency Management Committee
- American Society for Civil Engineers
- Association of Contingency Planners
- Association of State Dam Safety Officials
- Association of State Floodplain Managers
- Building Officials and Code Administrators International (BOCA) – International Code Council (ICC)
- Building Seismic Safety Council
- Business and Industry Council for Emergency Planning and Preparedness
- Earthquake Engineering Research Institute
- Engineers Without Borders USA
- Institute for Business and Home Safety
- Insurance Institute for Highway Safety
- Insurance Services Office – Verisk Analytics, Inc.
- International Assn of Emergency Managers (IAEM)
- International City/County Management Association
- Michigan Assn of County Drain Commissioners
- Michigan Fire Chiefs Association
- Michigan State Firemen's Association
- Michigan Stormwater-Floodplain Association
- Multidisciplinary Center for Earthquake Engineering Research (MCEER)
- National Association of State Foresters
- National Emergency Mgmt Association (NEMA)
- National Conference of States on Building Codes and Standards
- National Fire Protection Association
- National Lightning Safety Institute (NLSI)
- National Assn of Abandoned Mine Land Programs
- State and Local Emergency Management Data Users Group (FEMA: HAZUS User Groups)
- U.S. Fire Administration

In the local section of this funding overview, local volunteer assistance was mentioned. It may also be possible to involve state or national volunteer groups as well. A good place to start is by contacting Michigan Voluntary Organizations Active in Disaster (MIVOAD). The National American Red Cross, religiously affiliated organizations (such as the Salvation Army or Southern Baptists Disaster Relief Services), or charitable organizations such as the United Way may also be of assistance in some cases.

Governmental Assistance

Much of the information collected here on state and federal sources of assistance can be found on the Internet. The simplest way to access information on federal government assistance is through the Federal Assistance Listing. Its web address is http://www.beta.SAM.gov. The program listings included in this document are organized by the reference numbers used by the Federal Assistance Listing, to make it easy for anyone to locate the program in the federal catalog.

Unfortunately, the State of Michigan has no such catalog of assistance programs, making it necessary to search through information from many state agencies' web sites to come up with a list of programs. A good place to start such a general search is the Michigan Government Home Page at http://www.michigan.gov/. Click on the State Departments tab and then go to the specific agency desired.

For this document, searches were narrowed by focusing on activities that had a clear emphasis on, or applications toward, hazard mitigation and emergency management. However, it is possible that extra assistance may be obtained through programs not included here. As described in the section on local funding, it is sometimes possible to find areas where mitigation concerns overlap with other subjects, and to coordinate both concerns in existing projects funded from other sources. Consider the special features of your community that might be affected by hazards. Programs dealing with housing, farms, fisheries, natural resources, parks and wildlife, for example, may in some way be applicable to a hazard mitigation goal in your community. There are many state and federal programs and projects dealing with pollution, the environment, conservation, and economic development. Upon discussion, their administrators might approve some mitigation components in these programs/projects, or at least ensure that hazards are not worsened by program/project implementation.

Consider also the special assistance that may be available because of the presence of particular institutions or government-owned resources. The presence of a university or military installation often means many more resources that a community can use. Such institutions are often willing, able, and eager to also provide assistance on technical matters involving hazard mitigation projects which benefit their surrounding communities whenever the chance arises. Many universities have "extension" programs whose purpose is to find and provide such beneficial services. Many technical and engineering projects can be assisted by special research grants gained through partnering with colleges and universities, or by requesting the expertise of an organization such as the U. S. Army Corps of Engineers.

Projects dealing with school (and college) improvements may have mitigation components included in them. Other institutional facilities such as prisons, nursing homes, and health care providers should also have an interest in supporting mitigation projects that affect them. Additional funding may be available in some cases when a project involves the protection of designated historic districts or other areas of cultural or economic significance. Hazards that threaten businesses and tourism might merit funding from programs whose goal is economic development (or business attraction and retention).

In addition, areas of the community that have concentrations of persons from particular ethnic groups may provide an opportunity for organizations serving that group to become involved in mitigation projects that help maintain or improve its inhabitants' quality of life. There are a number of federal programs that make assistance available to Indian tribes, for example. Consultation with any such groups in your area might reveal useful means of facilitating or promoting mitigation projects.

More Information

There are many books and documents that give more advice on ways to collect funding information, write grant proposals, and so on. The Foundation Center has a number of libraries throughout Michigan that have extensive grants and funding information. Below is a list of the general locations, with web sites. A complete list with address, phone and contact information can be found at http://staff.lib.msu.edu/harris23/grants/michigan.htm.

Using Environmental and Economic Development Programs in Commercial Flood Acquisition, Relocation, and Infrastructure-Oriented Hazard Mitigation Projects*

*NOTE: A number of federal or state administered environmental and economic development programs could possibly be used in concert with other funding sources to develop a funding "package" for implementing hazard mitigation projects. Such a project would undoubtedly be multi-objective in nature. That is, the purpose of the project would include not only hazard vulnerability reduction, but also enhancement of the environment or the community's economic development posture. When assembling such a funding "package", it is important to be flexible and creative. Projects that achieve more than one objective are almost always more desirable and beneficial than are projects that simply achieve a reduction in the community's hazard vulnerability. Although they are more difficult and take longer to implement, multi-objective projects and partnerships can help build lasting bridges between governmental agencies and between government and the private sector. Those bridges, in turn, can lead to enhanced coordination and cooperation in future community endeavors, and better integration of hazard mitigation principles and practices in day-to-day public and private sector activities.

Examples of possible commercial flood acquisition/relocation or infrastructure mitigation projects might include:

- Strengthening infrastructure that services commercial and industrial areas to prevent failure and loss of critical services.
- Creating new business sites so that existing businesses in the floodplain can be more easily relocated to less hazardous areas within the community.
- Cleaning up "brownfields" and making them into productive business sites so that businesses in the floodplain or other hazardous areas can relocate to them.
- Floodproofing or elevating existing businesses to prevent flood-related damage and negative economic impacts for the community.
- Stabilizing river and stream banks and road crossings to prevent sedimentation, reduce flood potential, and prevent the loss of roadway or other community infrastructure due to collapse from flooding.
- Constructing wetlands and retention and detention basins to manage stormwater and create wildlife habitat and environmental conservation areas.
- Stabilizing the Great Lakes shoreline property to prevent erosion, sedimentation, and possible physical damage to commercial and residential structures.
- Acquiring and demolishing waterfront structures and then using the site for other, more appropriate uses such as park and recreation land or less vulnerable commercial activities.

(See the MDEQ Clean Michigan Initiative web site for a listing of implemented multi-objective projects that have a mitigation component: https://www.michigan.gov/deq/0,4561,7-135-3307_3515-314499--,00.html.)

STATE AGENCY HAZARD MITIGATION FUNDING PROGRAMS

The following page presents a table that summarizes Michigan programs potentially available to support hazard mitigation activities.

STATE AGENCY HAZARD MITIGATION FUNDING PROGRAMS **Funding Sources for Hazard-Specific Measures**	Drought	Earthquake	Extreme Temperatures	Wildfire	Dam Failure	Riverine Flooding	Great Lakes Shoreline Flooding and Erosion	Subsidence	Hail	Lightning	Severe Wind	Tornadoes	Ice and Sleet Storms	Snowstorms	FINANCIAL ASSISTANCE	TECHNICAL ASSISTANCE
MICHIGAN DEPARTMENT OF AGRICULTURE																
Conservation Reserve Enhancement Program (CREP)						X	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 (USEPA) (see CFDA 66.461)						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	
Snowmobile and ORV Trail Improvement Program						X	X								X	
Outdoor Recreation and Legacy Partnership Program						X	X			X	X	X			X	
Land and Water Conservation Fund						X	X			X	X	X				
Community Forestry Program											X	X	X		X	X
MICHIGAN DEPARTMENT OF STATE POLICE																
Emergency Management Performance Grants (see CFDA 97.042)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Flood Mitigation Assistance (see CFDA 97.029)						X	X								X	
Hazard Mitigation Grant Program (see CFDA 97.039)	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 (see CFDA 97.048)		X		X		X	X	X			X	X			X	
Presidential Declared Disaster Assistance - Disaster Housing Operations For Individuals And Households (CFDA 97.049)	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 (see CFDA 97.050)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Disaster Grants-Public Assistance (Presidentially Declared Disasters) (see CFDA 97.036)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Pre-Disaster Mitigation (see CFDA 97.047)			X	X		X	X				X	X			X	
Severe Loss Repetitive Program (see CFDA 97.110)						X	X								X	
Repetitive Flood Claims (see CFDA 97.092)						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 and 14.228 in CFDA) Some are Disaster Resilience (DR) grants.						X	X								X	
Urban Land Assembly						X	X								X	
MICHIGAN STATE HOUSING DEVELOPMENT AUTHORITY																
CDBG Housing Resource Fund (Inc HOME) (CFDA 14.239)						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 Program	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	

FEDERAL AGENCY HAZARD MITIGATION FUNDING PROGRAMS

(FROM THE FEDERAL ASSISTANCE LISTING)

Federal Assistance Listing: Index of Agencies

Agency Code	Agency
10	U.S. Department of Agriculture
11	U.S. Department of Commerce
12	U.S. Department of Defense
14	U.S. Department of Housing and Urban Development
15	U.S. Department of the Interior
47	National Science Foundation
59	Small Business Administration
66	U.S. Environmental Protection Agency
81	U.S. Department of Energy
97	Department of Homeland Security

FEDERAL HAZARD MITIGATION FUNDING SOURCES **Funding Sources for Hazard-Specific Measures**	**Drought**	**Earthquake**	**Extreme Temperatures**	**Wildfire**	**Dam Failure**	**Riverine Flooding**	**Gt Lakes Shoreline Flooding / Erosion**	**Subsidence**	**Hail**	**Lightning**	**Severe Wind**	**Tornadoes**	**Ice and Sleet Storms**	**Snowstorms**	FINANCIAL ASSISTANCE	TECHNICAL ASSISTANCE
10.054 Emergency Conservation Program	X					X					X	X			X	
10.069 Conservation Reserve Program						X					X	X			X	X
10.202 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	
10.417 Very Low Income Housing Repair Loans/Grants			X	X		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 Guarantees										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
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	
11.478 Center for Sponsored Coastal Ocean Research Coastal Ocean Program							X								X	
12.101 Beach Erosion Control Projects							X								X	

FEDERAL HAZARD MITIGATION FUNDING SOURCES **Funding Sources for Hazard-Specific Measures**	**Drought**	**Earthquake**	**Extreme Temperatures**	**Wildfire**	**Dam Failure**	**Riverine Flooding**	**Gt Lakes Shoreline Flooding / Erosion**	**Subsidence**	**Hail**	**Lightning**	**Severe Wind**	**Tornadoes**	**Ice and Sleet Storms**	**Snowstorms**	FINANCIAL ASSISTANCE	TECHNICAL ASSISTANCE
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	
14.239 HOME Investment Partnerships Program						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	

FEDERAL HAZARD MITIGATION FUNDING SOURCES **Funding Sources for Hazard-Specific Measures**	**Drought**	**Earthquake**	**Extreme Temperatures**	**Wildfire**	**Dam Failure**	**Riverine Flooding**	**Gt Lakes Shoreline Flooding / Erosion**	**Subsidence**	**Hail**	**Lightning**	**Severe Wind**	**Tornadoes**	**Ice and Sleet Storms**	**Snowstorms**	FINANCIAL ASSISTANCE	TECHNICAL ASSISTANCE
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 Mgmt 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	
97.036 Disaster Grants - Public Assistance (Presidentially Declared Disasters)	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 Technical 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 Federal Disaster 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	
97.050 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	

Key FEMA programs dedicated specifically to hazard mitigation projects

Hazard Mitigation Grant Program

The Hazard Mitigation Grant Program (HMGP) was created by Section 404 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act (PL 93-288, as amended). The HMGP provides funding for states and local communities to implement long-term hazard mitigation measures that reduce or eliminate risk to people and property from natural hazards and their effects. Funding for Michigan's HMGP is made available following a federal Major Disaster Declaration in the state. The amount available to the State for HMGP projects is based on 15% of the federal funds expended on the Public and Individual Assistance programs for the disaster, with an option to increase that amount to 20% with an approved "enhanced" state mitigation plan in place. The objective of the HMGP is to protect lives and property and significantly reduce or eliminate future disaster expenditures.

HMGP grants can be awarded to eligible applicants throughout the state, regardless of the boundaries of the disaster declaration. Eligible applicants include state agencies, local governments, certain private non-profit organizations, and Indian Tribes or authorized tribal organizations. Federal funds are available for up to 75% of eligible project costs ONLY for those applicants that have in place or are covered under an approved hazard mitigation plan that meets the requirements of the federal Disaster Mitigation Act (DMA) of 2000. The remainder of the cost for the project is the responsibility of the applicant.

The HMGP can be used to fund projects to protect either public or private property. Examples of the types of projects that can be funded by the HMGP include, but are not limited to:

- Voluntary acquisition or elevation of flood-prone structures
- Stormwater management projects that reduce flood risk
- Protective measures for utility infrastructure
- Vegetation management for dune restoration or wildfire prevention
- Construction of safe rooms
- Retrofitting structures for wind protection
- Development of community hazard mitigation plans (or the update of an existing hazard mitigation plan)

Applicants must apply for the HMGP through the MSP/EMHSD. The MCCERCC will set priorities for the HMGP following a disaster declaration. Based on those priorities, notification of available funding will be made to appropriate entities and organizations. The MCCERCC will review and prioritize eligible applications. Selected formal project applications will then be submitted by the MSP/EMHSD to FEMA for final funding approval. Following a disaster declaration, prospective applicants, if not notified of available HMGP funds, may want to contact their local office of emergency management to see if HMGP funds are available. For additional information about the HMGP contact Matt Schnepp, State Hazard Mitigation Officer, by phone at (517) 284-3950 or by e-mail at schneppm1@michigan.gov.

Flood Mitigation Assistance Program

On September 23, 1994, the National Flood Insurance Reform Act (NFIRA) was signed into law. The purpose of the NFIRA is to improve the financial condition of the National Flood Insurance Program (NFIP) and to reduce the federal expenditures for federal disaster assistance to flood damaged properties. With the passage of the NFIRA, Congress authorized the establishment of a federal grant program to provide financial assistance to states and local communities for flood mitigation planning and activities. (Note: Flood mitigation is defined as any action taken before, during or after a flood to permanently eliminate or reduce the long-term risk to human life and property.) FEMA has designated this as the Flood Mitigation Assistance Program (FMAP). Under the FMAP, FEMA provides assistance to states and local communities for activities that will reduce the risk of flood damage to structures insurable under the NFIP.

The FMAP is a state administered, cost-sharing program through which the States and communities can receive grants for flood mitigation activities. FEMA encourages the State to assist the local community in prioritizing mitigation activities outlined in their hazard mitigation plan and to fund projects that will greatly reduce the risk of flood damage to buildings, manufactured homes and other NFIP-insurable structures. Mitigation of substantially damaged and repetitive loss structures is a high priority.

Mitigation measures under the FMAP are funded on a 75% federal / 25% non–federal basis. (Note: Unless by special appropriation of the Michigan Legislature, no state funding will be used for the 25% match. Contributions of other state agencies may be used as an in-kind contribution toward the 25% match.)

Applications for FMAP grants are made via the federal E-Grants system. The MCCERCC reviews all of the applications received and prioritizes applications. FEMA makes final project selections and approvals. For additional information about the FMAP contact Matt Schnepp, State Hazard Mitigation Officer, by phone at (517) 284-3950, facsimile at (517) 333-4987, or e-mail at schneppm1@michigan.gov.

Pre-Disaster Mitigation Program

The Pre-Disaster Mitigation Program (PDMP) provides funding to states and local communities for cost-effective hazard mitigation activities that complement a comprehensive mitigation program and reduce injuries, loss of life, and damage and destruction of property. The PDMP was authorized by Section 203 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act, as amended by Section 102 of the Disaster Mitigation Act of 2000. The PDMP is an annually appropriated, nationally competitive grant program.

States, local communities, and Indian Tribes can receive grants for mitigation activities such as planning and the implementation of projects identified through the evaluation of natural hazards. FEMA will set priorities for each appropriation of the PDMP. Eligible activities for the PDMP may include:

- Voluntary acquisition or elevation of flood-prone structures
- Stormwater management projects that reduce flood risk
- Protective measures for utility infrastructure
- Vegetation management for dune restoration or wildfire prevention
- Construction of safe rooms
- Retrofitting structures for wind protection
- Development of community hazard mitigation plans (or the update of an existing hazard mitigation plan)

Mitigation measures under the PDMP are funded on a 75% federal / 25% non–federal basis. (Note: Unless by special appropriation of the Michigan Legislature, no state funding will be used for the 25% match. Contributions of other state agencies may be used as an in-kind contribution toward the 25% match.) Grants to small and impoverished communities may receive a federal cost share of up to 90% of the total cost to implement eligible PDMP activities.

Applications for PDMP grants are made via the federal E-Grants system. The MCCERCC reviews all of the applications received and prioritizes applications. The MCCERCC priority order is a factor in the national competitive grant review and scoring process. FEMA makes final project selections and approvals. For additional information about the PDMP contact Matt Schnepp, State Hazard Mitigation Officer, by phone at (517) 284-3950 or by e-mail at schneppm1@michigan.gov.

Building Resilient Infrastructure and Communities

The Building Resilient Infrastructure and Communities (Bric) program aims to categorically shift the federal focus away from reactive disaster spending and toward research-supported, proactive investment in community resilience. Examples of BRIC projects are ones that demonstrate innovative approaches to partnerships, such as shared funding mechanisms, and/or project design.

For example, an innovative project may bring multiple funding sources or in-kind resources from a range of private and public sector partners. Or an innovative project may offer multiple benefits to a community in addition to the benefit of risk reduction.

Through BRIC, FEMA continues to invest in a variety of mitigation activities with an added focus on infrastructure projects benefitting disadvantaged communities, nature-based solutions, climate resilience and adaption, and adopting hazard resistant building codes.

Project Prioritization Criteria

A project will be evaluated based on the following criteria:

- The project demonstrates sound hazard mitigation techniques.
- The project is listed in the applicable local hazard mitigation plan.
- The project supports the Michigan Hazard Mitigation Plan.
- The project meets the required eligibility criteria.
- The project is suitable for funding under the HMGP, FMAP, or PDMP rather than other funding programs.
- The project is consistent with the MCCERCC approved strategy for the federally declared disaster (if applicable).
- The project completely or substantially solves the problem.
- The project provides a permanent or long-term solution.
- The project is likely to be cost-effective based on physical damages prevented. (NOTE: structures that were officially designated as "repetitive loss properties" or "severe repetitive loss properties" have already been identified from an NFIP perspective as meriting flood mitigation activities, and Michigan has tended to agree with and actively support such classifications and efforts, as described earlier in this appendix under the subsection called "Repetitive Losses.")
- The project will not create negative environmental effects.
- The project is consistent with other projects, initiatives, and state agency priorities.
- Communities with the highest risk.
- Communities with the greatest number of repetitive loss properties.
- Communities with the greatest number of NFIP insured structures.
- Communities with the most intense development pressures.
- Communities with the largest increases in population and/or physical development.
- Communities that have the ability to successfully implement hazard mitigation projects within the required timeframes.
- Communities that have expressed interest in hazard mitigation activities.

Project Eligibility Criteria

FEMA considers a project eligible for HMGP, FMAP, or PDMP funding only if the project:

- Conforms to the State Hazard Mitigation Plan.
- Conforms to environmental laws and regulations.
- Is cost-effective.
- Solves a problem independently or constitutes a functional portion of a solution.
- Cannot be funded by another program.
- The applicant community is a member, in good standing, of the NFIP (flood related projects only).

*Note – technical study type projects may be eligible for funding if they are accompanied by a second project (phase II) for construction measures that are developed and determined eligible by the study project (phase I).

Eligible Project Types

Following is a list of potentially eligible project types as outlined in federal guidance (this list is not all inclusive):

- **Acquisition of real property** in a hazard area; **physical relocation of structures** from a hazard area.
- **Elevation of structures** in compliance with federal, state and local ordinances.
- **Retrofit of structures** – wet or dry floodproofing (according to local code and building standards, compliant with NFIP standards); high wind bracing; seismic strengthening of structures or their non-structural components; application of wildfire resistant materials; and structural fire safety measures.
- **Minor structural flood risk reduction measures** – debris basins; stormwater detention basins or infiltration wells; culvert upgrades; diversions; flapgates or floodgates; localized flood risk reduction system to protect critical facilities.
- **Vegetation management** – natural windbreaks; living snow fences; shoreline stabilization; natural stabilization; wildfire defensible space, etc.
- **Phase I or II design, engineering or feasibility study** for complex mitigation projects that are reasonably expected to be funded and implemented.

Explanation: Complete Solution
Approved projects should either completely solve a site-specific problem or be an element of a larger solution where there is assurance of project completion.

Explanation: Long-term Solution
Mitigation measures funded under the HMGP, FMAP, and PDMP are intended to provide a long-term or permanent solution. Ideally, the measure would be effective for the life of the property being protected. (For example, erecting an emergency berm on a beach to prevent wave damage to structures is a short-term solution, as opposed to a long- term solution such as elevation or relocation of the structures.)

Explanation: Cost Effective
For a project to be considered cost effective, the benefits gained by completing the project must be greater than the cost of the project. Cost effectiveness should take into account the following:

- The cost to complete the project.
- The life of the project.
- Past damages that have resulted from the situation that will be mitigated as a result of the project.
- The frequency and extent of damage that is likely to occur if the project is not completed.
- Annual costs of maintaining the project.

Explanation: Environmental Effects
All HMGP, FMAP, and PDMP projects must be in conformance with applicable environmental laws and regulations, including but not limited to:

- The National Environmental Policy Act.
- The National Historic Preservation Act.
- The Endangered Species Act.
- Executive Order 11988, Floodplain Management.
- Executive Order 11990, Protection of Wetlands.
- Executive Order 12898, Environmental Justice.

(Note: a project should not create an environmental problem or shift a hazard to a new location.)

Explanation: Consistent with Other Initiatives
HMGP, FMAP, and PDMP projects should be complementary to other mitigation projects, initiatives, and state agency priorities. At a minimum, projects should not undermine other identified mitigation priorities and activities.

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