

# Wexford County, Michigan Natural Hazard Mitigation Plan

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2023

**FEMA LETTER OF APPROVAL**

## ACKNOWLEDGEMENTS

The Wexford County Natural Hazard Mitigation Plan is prepared for Wexford County, Michigan and all the jurisdictions within it. Each jurisdiction is invited to be a continuing participant in future regular review and updates of the Plan. This plan is the culmination of an interdisciplinary and interagency planning effort that required the time, technical assistance and expertise of individuals within the following organizations:

PARTICIPATING ENTITY	REPRESENTATIVE	TITLE
<b>Wexford County Board of Commissioners</b>	Jason Mitchell	District 1 (Greenwood, Liberty, Manton, Cedar Creek (N. of 37 Rd.))
	Michael Musta	District 2 (Colfax, Hanover, Antioch, Boon (minus the Village of Harietta))
	Ben Townsend	District 3 (Wexford, Slagle, South Branch, Springville, Village of Harietta)
	Kathleen Adams	District 4 (Cherry Grove (W. of 52 Rd.), Henderson, Selma)
	Michael Bush	Vice Chair, District 5 (Cadillac Precinct 1)
	Julie A. Theobald	District 6 (Cadillac Precinct 2)
	Gary Taylor	Chair, District 7 (Cadillac Precinct 3)
	Jason Baughan	District 8 (Haring (minus Cadillac City), Cedar Creek (S. of 37 Rd.))
	Brian Potter	District 9 (Clam Lake, Cherry Grove (E. of 52 Rd.))
	Mike Bengelink	County Commissioner (former)
	Richard Harvey	Planning Commissioner, Boon Twp.
<b>Wexford Joint Planning Commission (WJPC)</b>	Beverly Monroe	Planning Commissioner, Liberty Twp.
	Paul Osborne	Planning Commissioner, Antioch Twp.
	Marli Wendel	Planning Commissioner, Slagle Twp.
	Donna Taylor	Planning Commissioner, South Branch Twp.
	Benedict Fleis	Planning Commissioner, Wexford Twp.
	Randy Brewer	Planning Commissioner, Springville Twp.
	Christina Vipond	Planning Commissioner, Hanover Twp.
	Robert Hall	WJPC Planning & Zoning Administrator
	Heather O'Connor	WJPC Recording Secretary
	Joe Porterfield	County Administrator/Equalization Director
<b>Wexford County</b>	Jami Bigger	Deputy County Administrator / Human Resources Director
	Randy Boike	Emergency Management Coordinator (current) / Wexford County Sheriff's Office
	Travis Baker	Emergency Management Coordinator (former) / Wexford 911
	Trent Taylor	Wexford County Sheriff
	Richard Doehring	Wexford County Sheriff's Office
	Karl Hanson	Road Commission Engineer/Manager
	Sarah Merz	GIS Analyst
	Duane Alworden	911 Director
	Brian Draper	Wex Express Transportation
	Marcus Peccia	City Manager
<b>City of Cadillac</b>	Antoinette (Tiyi) Schippers	Mayor Pro-Tem
	John Wallace	Community Development Director
	Mike Coy	Zoning Administrator
	Adam Ottjepka	Director of Public Safety
	Jake Paddock	DPW Supervisor
<b>City of Manton</b>	Jessica Schisser	Clerk
	Sam Cronkhite	Mayor
	Bill Bates	City Commissioner
PARTICIPATING ENTITY	REPRESENTATIVE	TITLE

Village of Buckley	Michael Guernsey	Buckley Fire Chief/ DPW Supervisor
Village of Harrietta		
Village of Mesick		
Antioch Township (WJPC)	Paul Osborne	WJPC
Boon Township (WJPC)	Richard Harvey	WJPC
Cedar Creek Township		
Cherry Grove Township (WJPC)	Ben Pearson	Supervisor
Clam Lake Township		
Colfax Township (WJPC)	Jason Nelson	Colfax-Greenwood Fire Dept.
	Rebecca Stoddard	Clerk
Greenwood Township	Alan Mohler	Township Supervisor
	Jason Nelson	Colfax-Greenwood Fire Dept.
Hanover Township (WJPC)	Christina Vipond	WJPC
Haring Charter Township		
Henderson Township		
Liberty Township (WJPC)	Beverly Monroe	WJPC; Township Supervisor
Selma Township (WJPC)	Mike Boyd	Township Supervisor
Slagle Township (WJPC)	Marli Wendel	WJPC
South Branch Township (WJPC)	Donna Taylor	WJPC
	Julie Cieslak	Clerk
Springville Township (WJPC)	Randy Brewer	WJPC
Wexford Township (WJPC)	Benedict Fleis	WJPC
	David Fox	Treasurer
Wexford Conservation District / North Country Cooperative Invasive Species Management Area (NC CISMA)	Tiffany Jones	District Manager
	Vicki Sawicki	NC CISMA Program Coordinator
Wexford Council on Aging	Erin Brotherton	Supervisor of Health Care Services
Cadillac Area Land Conservancy	Chris Gentry	Executive Director
District Health Department #10	Bret Haner	Emergency Preparedness Coordinator
Michigan State Police	Trooper Travis Thenikl	
	F/Lt. Matthew McCaul	Cadillac Post
	Mike Sobocinski	Hazard Mitigation Planning Analyst
Michigan Department of Natural Resources	Breton Baker	Forest Fire Supervisor – Cadillac Management Unit
US National Forest Service - Huron-Manistee National Forest	Ben Wagner	Deputy Fire Staff Officer
	Scott Peedle	USFS District Ranger, Cadillac/Manistee Ranger District
Buckley Community Schools	Jessica Harrand	Superintendent
Wexford-Missaukee Intermediate School District	Dave Cox	Superintendent

Prepared for: Wexford County Board of Commissioners

Prepared by: Wexford County Department of Emergency Management with assistance from:



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## I. INTRODUCTION

Hazard mitigation is defined as any action taken before, during, or after a disaster or emergency to permanently eliminate or reduce the long-term risk to human life and property from natural, technological and human-related hazards. Mitigation is an essential element of emergency management, along with preparedness, response and recovery.

Mitigation allows repairs and reconstruction to be completed after an incident occurs in such a way that does not just restore the damaged property as quickly as possible to pre-disaster conditions. It also ensures that such cycles are broken, that post-disaster repairs and reconstruction take place after damages are analyzed, and that sounder, less vulnerable conditions are produced. Through a combination of regulatory, administrative, and engineering approaches, losses can be limited by reducing susceptibility to damage. When successful, hazard mitigation will lessen the impact of a disaster on people, property, the environment and economy, and continuity of services through the coordination of available resources, programs, initiatives, and authorities.

A *hazard*, in the context of this plan, is an event or physical condition that has potential to cause fatalities; injuries; damage to personal property, infrastructure, or the environment; agricultural product loss; or interruption of business or civic life. The Wexford County Natural Hazard Mitigation Plan focuses on *natural* hazards such as heat, drought, wildfires, flooding, severe thunderstorms, high winds, tornado, hail, extreme winter weather, and invasive species. An exception is that it will also consider these technological and human-related hazards: potential dam failure and public illness outbreak. The following natural hazards were not included in the analysis for this Hazard Mitigation Plan: earthquakes, space weather, and subsidence. According to the information presented about these hazards in the Michigan State Police's 2019 Michigan Hazard Analysis report, there is very little risk of these events occurring in the Northwest Michigan area.

The main objective of the Wexford County Natural Hazard Mitigation Plan is to permanently eliminate or reduce long-term risks to people and property from natural hazards so that county assets such as transportation, infrastructure, commerce, and tourism can be sustained and strengthened. This can be accomplished through collaborative efforts/activities amongst agencies within the county to protect the health, safety, and economic interests of the residents and businesses through planning, awareness, and implementation.

Through the development of this Plan, a broad perspective was taken in examining multiple natural hazard mitigation activities and opportunities in Wexford County. Each natural hazard was analyzed from a historical perspective, evaluated for potential risk, and considered for possible mitigation.

Since the 2015 plan's adoption period, the county and municipalities have achieved the following key endeavor to address their priority mitigation strategy areas:

- Public education and awareness activities: Wexford County now participates in the CodeRED Emergency Communications Network, which is an electronic high-speed outbound notification service available to the general public. The system notifies a participant via their mobile phone (via text message) or land-line phone of public safety alerts.

Progress on the following hazard mitigation strategies from the 2015 plan has been "ongoing" by the county and municipalities:

- Wildfire
  - Acquire appropriate fire suppression equipment for responses
  - Consider wildland fire hazard reduction in building and zoning requirements
  - Acquire appropriate fire suppression equipment for response
- Extreme Winter Weather
  - Work with utility companies to clear vegetation near power lines and infrastructure
  - Continue enforcement of building code regarding snow load limits through the permitting process
- Severe Weather
  - Promote the anchoring of trailers and modular homes
- Flooding
  - Continue enforcement of building codes and soil erosion regulations
  - Promote flood-proofing of structures and damage reduction techniques

- Various
  - Incorporating the Plan's natural hazards mitigation concepts, strategies and policies into existing elements of local Master Plans
  - Public education and awareness activities

Section VI of this plan provides a list of hazard mitigation strategies for each natural hazard identified. Strategies were developed based on discussions with local officials, stakeholders and a review of FEMA best practices for hazard mitigation. Appendix C provides a review of mitigation strategies included in the 2015 plan and their current status. Mitigation strategies are intended to be action items completed during the 5-year timeframe in which the plan is active.

Wexford County recognizes the importance of reducing community vulnerability to natural hazards by developing and implementing this plan. This process will help ensure that Wexford County remains a vibrant, safe, enjoyable place in which to live, raise a family, continue to conduct business, and maintain a tourist base. The Plan serves as the foundation for natural hazard mitigation activities and actions within Wexford County, and will be a resource for building coordination and cooperation within the local communities for future mitigation and community preparedness based upon the following:

**Natural Hazards Mitigation Planning Goals**

<b>Goal 1: Increase local awareness and participation in natural hazards mitigation</b>
<b>Goal 2: Integrate natural hazards mitigation considerations into local planning processes</b>
<b>Goal 3: Utilize available resources and apply for additional funding for natural hazards mitigation projects</b>
<b>Goal 4: Develop and complete natural hazards mitigation projects in a timely manner</b>



## II. PLANNING PROCESS

The Stafford Act, as amended by the Disaster Mitigation Act of 2000, shifted the Federal Emergency Management Agency's (FEMA) scope of work to promoting and supporting prevention, or what is referred to as hazard mitigation planning. FEMA requires government entities to have a natural hazards mitigation plan in place and updated on a 5-year cycle as a condition for applying for grant funding related to natural hazard mitigation and remediation. Wexford County has a history of mitigation planning and adopted past Natural Hazard Mitigation Plans in 2007 and 2015. The local and county-government adoptions of the 2023 plan, along with FEMA approval, will reaffirm the eligibility of the county, as well as those local municipalities who participated in the planning process and adopted the county's plan, for federal funding.

The update of the County's plan was led by the Natural Hazards Task Force comprised of the County's Local Planning Team (LPT), which is facilitated by the Wexford County Emergency Management Coordinator. Team members consist of first responders and local, regional, and state public entities that ensure the readiness of County entities by recommending equipment purchases, training and exercises, and public education on preparedness issues. Networks Northwest staff assisted with the creation of the updated plan by providing meeting facilitation, conducting an online survey, and writing the plan. The Task Force generally met on a quarterly basis, with additional in-person public input meetings. All meetings were open to the public; notifications were made via postings on the Networks Northwest project page and via email invitations. The following is an outline of events for the development of the 2023 Wexford County Natural Hazard Mitigation Plan:

- On July 1, 2021, Travis Baker (former Wexford County Emergency Manager) attended a project kick-off meeting with regional county and tribal emergency managers, Networks Northwest, and Michigan State Police.
- An online public survey was made available from December 1, 2021 to March 31, 2022 to obtain input on community experiences, concerns and priorities regarding natural hazard mitigation in Wexford County. A total of 24 persons participated in the survey, as described in Table 1.

Table 1: Community Survey Participation

Survey Participant	Representative (if indicated in the survey)
Boon Township	Richard Harvey, Wexford Joint Planning Commission member
Charter Township of Haring	Elected Official
Cherry Grove Township	Supervisor
Colfax Township	Clerk
Liberty Township	Beverly Monroe, Supervisor
South Branch Township	Clerk
Springville Township	Administrator at Mesick Consolidated School District
Village of Buckley	Fire Chief/DPW Supervisor
City of Cadillac	City Manager, Public Safety Director, Mayor ProTem, Zoning Administrator, Community Development Director
City of Manton	City Clerk
Wexford County Government	County Administrator
Wexford County Sheriff's Office	Sheriff
Wexford County Road Commission	Engineer Manager
Wexford County Council on Aging	
MMR EMS Service	
Michigan State Police	
District Health Department #10	Bret Haner, Emergency Preparedness Coordinator

- LPT meetings where the Natural Hazard Mitigation Plan update work was discussed:
  - January 20, 2022 - Networks Northwest provided an introduction and timeline for the project, and presented the community profile information
  - April 21, 2022 – Networks Northwest held a public input meeting (combined with an LPT meeting) to present the hazard analysis, provide a summary of survey results, and engage community stakeholders in hazard identification
  - September 15, 2022 – Networks Northwest presented a partial draft plan, goals and objectives, and draft maps
  - November 17, 2022 and January 19, 2023 – discussion at the LPT meetings included the Hazard Mitigation Plan draft and next steps

- Networks Northwest staff and the Wexford County Emergency Management Coordinator also attended the Wexford Joint Planning Commission meeting on October 24, 2022 to explain the Hazard Mitigation Plan progress to date and obtain feedback on hazards of concern and the draft plan and strategies.
- On December 6, 2022, Networks Northwest staff and the Wexford County Emergency Management Coordinator held an additional community input session at the Wexford County Sheriff's Office Training Center to obtain feedback from community stakeholders to review and modify draft goals, objectives and strategies.

Additionally, county and regional agencies that share borders with Wexford County were invited to participate in the planning meetings and sent a copy of the plan in its draft form and again the approved plan. Those agency staff members are:

- Gregg Bird, Emergency Management Coordinator, Grand Traverse County
- Mike Thompson, Emergency Management Coordinator, Kalkaska County
- Linda Hartshorne-Shafer, Planning and Emergency Management Director, Missaukee County
- Mark Watkins, Emergency Management Director, Osceola County
- Patrick Maddox, Emergency Management Director, Lake County
- Alvin Rishel, Emergency Management Coordinator, Manistee County
- Rebecca Hubers, Emergency Management Coordinator, Benzie County
- Robert Carson, Regional Director of Community Development, Networks Northwest

During development of the plan, all Wexford County municipalities were provided the opportunity to participate in the online community survey as well as comment on plan drafts and other related materials. The draft plan was published openly on the Wexford County Emergency Management website, as well as the project page on Networks Northwest's website. The public was encouraged to review the draft plan and invited to submit suggestions and ideas for updates, changes to be considered during updates. Documentation of formal comment received via email is included in Appendix D.

Additionally, the public was notified of the draft plan availability through a direct mailing (to local government offices) and through published notices in the *Cadillac News* on March 25 and April 15, 2023 that the County's draft Natural Hazard Mitigation Plan was available for review and comment and that a public hearing would be held on plan at the County Board of Commissioner's Meeting on April 19, 2023.

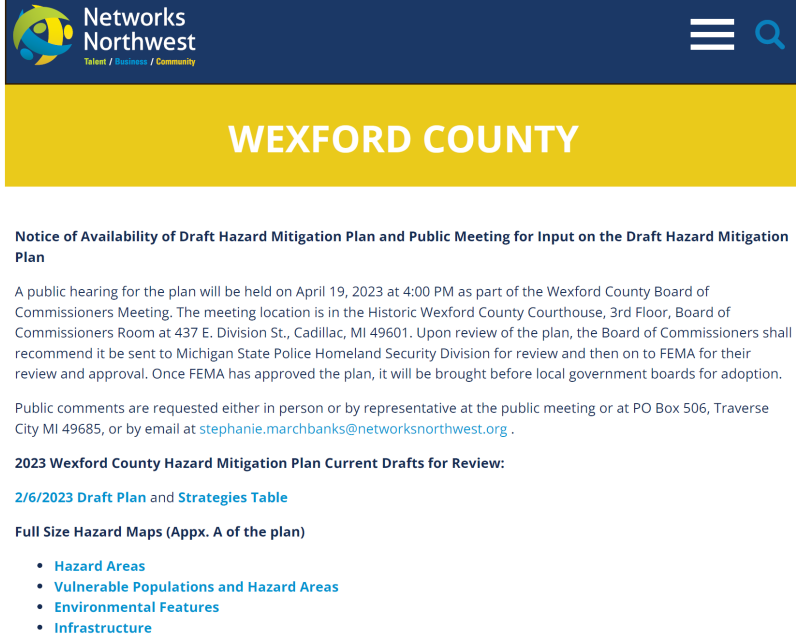
Figures 1 – 3 are images of websites indicating availability of the draft plan, as well as a copy of the newspaper notice.

Figure 1. Wexford County Website Image



Source: Wexford County, <https://wexfordcounty.org/> 4/10/2023

Figure 2. Networks Northwest Website Image



Source: Networks Northwest, <https://www.networksnorthwest.org/community/natural-hazard-mitigation/wexford-county.html> 4/10/2023

Figure 3. Notice for Public Hearing on Draft Plan

Source: Cadillac News, published March 25 and April 15, 2023

### III. COMMUNITY PROFILE

#### *Land Use/ Land Cover*

Wexford County is located in Northwest Lower Michigan, and is bordered by Grand Traverse County to the north, Kalkaska County to the northeast, Missaukee County to the east, Osceola and Lake Counties to the south, Manistee County to the west, and Benzie County to the northwest. Refer to the “Infrastructure” map in Appendix A illustrating the county’s main roads, water bodies and jurisdictions.

The county consists of 565 square miles of land area and is the 48<sup>th</sup> largest county in Michigan by total area.<sup>1</sup> Approximately 1.99% of the county area, or 11.44 square miles, consists of open water (Table 1).

About 50% of Wexford County is made up of rolling to steep glacial moraines, with most of the remainder undulating or nearly level glacial outwash plains. The highest point in Wexford County is *Briar Hill* at 1,706 feet elevation in Antioch Township, located east of the Village of Mesick.

Wexford County is served by six state/federal highways including US-131, Old US-131/Business US-131, M-115, M-55, M-37, and M-42. The Cadillac/Wexford Transit Authority, or WexExpress, is a door-to-door public transit service for residents and visitors of Wexford County. Additionally, the Wexford County Airport, owned by the City of Cadillac and Wexford County, is open to the public and is a general aviation airport. It is located two miles north of the City of Cadillac. Wexford County is also serviced by the Great Lakes Railway Company from Clare, Mt. Pleasant, Midland and points north to Traverse City, Yuma, and toward Petoskey. The railway north of Yuma (a settlement in Springville Township within Wexford County) has been removed.

The natural resources of Wexford County are vital to the economic health and quality of life of area residents. The abundance of quality public forest land and water resources make this area a popular tourism destination, particularly for hunting, fishing, skiing and snowmobiling.

Wexford County hosts a number of both motorized and non-motorized trail systems. Snowmobiles and off-road vehicles (ORVs) are authorized to use road shoulders on County road rights-of-way, and a number of motorized trails are available on the County’s public land. Trail opportunities for ORVs were expanded with Public Act 288 of 2016, which opens state forest roads to ORV use unless posted.

The County is divided between two major watersheds, or drainage areas: the Big Manistee River and the Muskegon River (Clam River/Lakes Cadillac/Mitchell). Much of the County is within the watershed of the Big Manistee River/Pine River. The Big Manistee River runs through the northern portion of the county. The Hodenpyl Dam, a hydroelectric dam owned and operated by Consumers Energy, constricts the flow of the river and forms the Hodenpyl Dam Pond in Springville Township. The dam structure is located just outside Wexford County, in westerly adjoining Manistee County. The streams in Wexford County are quality trout streams because of abundant groundwater discharge into the surface water resulting in cold water streams. The protection of groundwater and riparian zones is therefore important for maintaining and protecting the County’s fisheries. The Manistee has had a long standing reputation for being a top-quality trout stream, and provides cold water habitat for over 75 species of fish, including trout and salmon. There are a large number of named and unnamed feeder creeks to the Big Manistee River in the north central part of Wexford County, which represents artesian flow from groundwater moving north from the glacial hills toward the river.

The Pine River, a federally-designated Wild and Scenic River, runs through southwest Wexford County in South Branch Township. The lower 26-miles of the Pine River was designated a National Scenic River in 1992, has the fastest average flow of any river in lower Michigan, and is considered a premier top-quality stream (which Michigan once classified as a “Blue Ribbon Trout Stream”).

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<sup>1</sup> [https://data.census.gov/cedsci/profile/Wexford\\_County,\\_Michigan?q=0500000US26165](https://data.census.gov/cedsci/profile/Wexford_County,_Michigan?q=0500000US26165)

Major lakes in Wexford County include:

- Lake Mitchell (Cherry Grove and Selma Townships)
- Lake Cadillac (City of Cadillac)
- Hodenpyl Dam Pond (Springville Township)
- Long Lake (Haring Charter Township)
- Lake Gitchegumee (Village of Buckley & Hanover Township)
- Pleasant Lake (Selma Township)
- Stone Ledge Lake (Clam Lake Township)
- Lake Meauwataka / "Dayhuff Lake" (Colfax Township)
- Berry Lake (Clam Lake Township)
- Woodward Lake (Selma Township)
- Round Lake (Haring Township)

The forests of Wexford County include hemlock and other coniferous trees, such as red and white pine, spruce and fir, and deciduous trees, such as birch, beech, maple, basswood, and oak. Swamp and wetland vegetation patterns are also found along with a multitude of shrubs. As a result of intensive lumbering in the past, most of these forested areas are second growth and, to some degree, the original forest habitat patterns have been altered. Forest cover types represent the largest land cover in Wexford County. The three principal segments are the United States Manistee National Forest, the Michigan Pere Marquette State Forest and the large tracts of land owned by Consumers Energy along the Manistee River. All of these areas are under some type of woodland-wildlife-recreation management plan. <sup>2</sup>

The largest concentrations of people and businesses are located near the cities of Cadillac and Manton, followed by the Villages of Harrietta, Mesick and Buckley, and along major roadways.

According to the [2017 USDA Census of Agriculture](#), the county had 40,208 acres of land in farms for a total of 304 farms. This represents a 15% drop in the number of farms since the 2012 Census of Agriculture, which reported 357 farms in Wexford County. However, the average size of a farm in Wexford County was 132 acres, which represents a 17% increase since the 2012 Census of Agriculture.

About 48% of the market value of agricultural products sold in the county as of 2017 was from crops, with the remaining 52% from livestock, poultry and other animal products. Wexford County ranks 2<sup>nd</sup> out of 76 counties in the state for sales of Christmas trees and short rotation woody crops. Total crop sales for the county accounted for \$8,704,000, coming primarily from grains, oil seeds, dry beans and pea crops and Christmas tree/short rotation woody crops. Total animal product sales accounted for \$9,445,000, coming primarily from milk from cows and cattle/calves.

Per Table 2, the predominant land cover type in Wexford County is "Forested", which is comprised of deciduous forest, evergreen forest and mixed forest types. The second most prevalent land cover type is "Herbaceous and Shrub/Scrub", followed by "Wetlands" and "Agriculture" (a combination of cultivated crops and hay/pasture lands) at 9.32% and 9.31%, respectively. Developed land cover is found primarily in and around the cities of Cadillac and Manton; the villages of Harrietta, Mesick and Buckley; and along the primary roads.

Table 2: Wexford County Land Cover by Type

Land Cover Classification	Acres	Percent
Developed, High Intensity	767.84	0.21%
Developed, Medium Intensity	2,190.21	0.59%
Developed, Low Intensity	6,845.62	1.86%
Developed, Open Space	17,798.62	4.83%
Forested	209,684.98	56.93%
Herbaceous & Shrub/Scrub	54,259.25	14.73%
Wetlands	34,330.78	9.32%
Agriculture	34,299.38	9.31%
Open Water	7,324.55	1.99%
Barren Land	766.78	0.21%
<b>TOTAL</b>	<b>368,268.01</b>	

Source: Networks Northwest

The 2015 Wexford County Hazard Mitigation Plan indicated that 281,700 acres, or 76%, of the county was comprised of forested lands. Current data shows that 209,685 acres, or 57% of Wexford County is forested. While growth in the county

<sup>2</sup> Wexford County Recreation Plan 2019-2023 <https://wexfordcounty.org/wp-content/uploads/2019/10/Wexford-CO-Rec-Plan-2019-FINAL-with-appendices.pdf>

has remained steady, it has been noted that the type of growth is changing. Office and industrial development has largely stopped, commercial development has slowed, but residential development is occurring as quickly as plans can be approved. Housing of all types and prices is in demand, but many communities desire smaller units and multiple family units. This type of housing is especially important for the senior population and will likely be in demand for many years. The *Environmental Features* Map in Appendix A shows the intensity of development in the county in relation to natural features.

### Population

Wexford County is the 2<sup>nd</sup> most populated county in the ten county region of Northwest Lower Michigan (Table 3) and is the ranked 46 out of 83 counties in the state by population estimates.<sup>3</sup> The 2019 American Community Survey (ACS) estimated the county population to be 33,256 people. A comparison of the 2010 and 2019 ACS data indicates the population of Wexford County grew slightly between 2010 and 2019 by an estimated 1.8% (Table 3). The 2019 estimated population per square mile is approximately 58.9 persons.

Table 3: 2019 Estimated Regional Population by County, State

Jurisdiction	Population
Missaukee County	15,028
Kalkaska County	17,585
Benzie County	17,615
Leelanau County	21,652
Antrim County	23,206
Manistee County	24,457
Charlevoix County	26,188
Emmet County	33,104
<b>Wexford County</b>	<b>33,256</b>
Grand Traverse County	92,181
State of Michigan	9,965,265

Source: US Census, 2019 ACS 5-year Estimates

Wexford County is comprised of sixteen (16) townships, three (3) villages and two (2) cities. All communities - with the exception of the Village of Mesick, the City of Manton, and the Townships of Cherry Grove, Clam Lake, Slagle, South Branch, and Springville - experienced population increases between 2010 and 2019 (Table 4). The most populated community is the City of Cadillac, at an estimated 10,419 persons. Note that the population estimates for the villages are shown separately for informational purposes; however, those population count estimates are incorporated into the totals for the respective township in which the Village is located.

The second most populated community, at an estimated 3,530 persons, is Haring Township, located just north of the City of Cadillac. The township contains portions of the US-131 highway corridor, M-55 and BR/Old US-131.

The third most populated community is Cherry Grove Township, at 2,433 persons, located southwest of the City of Cadillac and contains portions of Lake Mitchell and M-55. Closely following is Clam Lake Township, at an estimated 2,427 persons. Clam Lake Township adjoins the City of Cadillac to the south and contains portions of US-131, BR-131, M-115, and M-55.

Figure 4 illustrates the locations of the communities in Wexford County and their associated population levels.

<sup>3</sup> [https://www.michigan-demographics.com/counties\\_by\\_population](https://www.michigan-demographics.com/counties_by_population)

Table 4: Population Estimates and Change by Municipality, 2010 and 2019

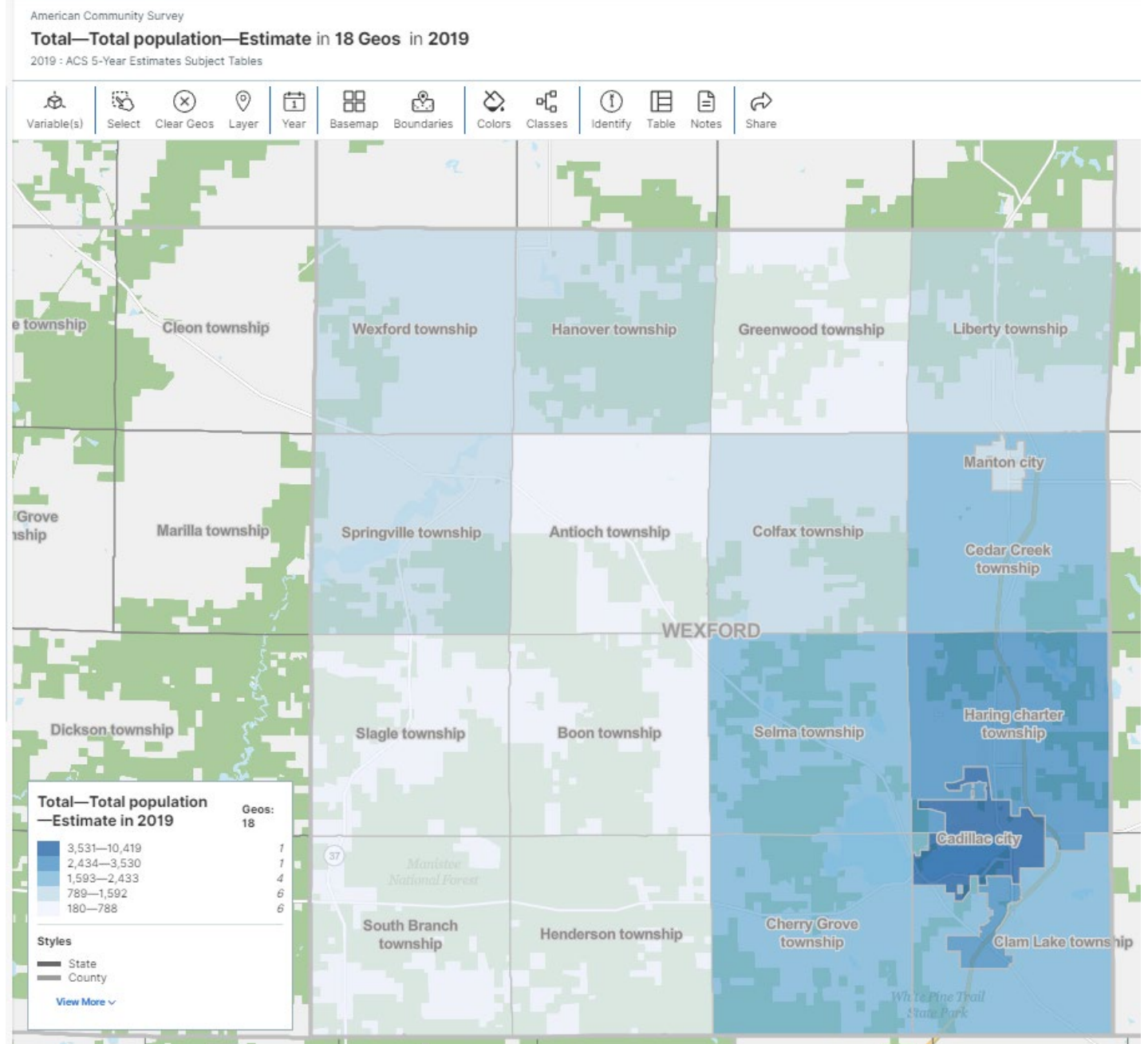
Municipality	2010 Est. Population	2019 Est. Population	Numeric Change	Percent Change	Jurisdiction Status
Village of Buckley	580	759	179	30.9%	P
Village of Mesick	454	366	-88	-19.4%	N
Village of Harrietta	113	154	41	36.3%	N
City of Cadillac	10,384	10,419	35	0.30%	P
Haring Township	3,167	3,530	363	11.50%	N
Cherry Grove Township	2,488	2,433	-55	-2.20%	P
Clam Lake Township	2,593	2,427	-166	-6.40%	N
Selma Township	2,196	2,202	6	0.30%	P
Cedar Creek Township	1,644	1,811	167	10.20%	N
Hanover Township	1,364	1,592	228	16.70%	P
Springville Township	1,780	1,583	-197	-11.10%	P
City of Manton	1,456	1,123	-333	-22.90%	P
Colfax Township	897	1,071	174	19.40%	P
Wexford Township	934	983	49	5.20%	P
Liberty Township	891	935	44	4.90%	P
Antioch Township	660	788	128	19.40%	P
Boon Township	571	744	173	30.30%	P
Greenwood Township	562	620	58	10.30%	P
Slagle Township	595	515	-80	-13.40%	P
South Branch Township	303	300	-3	-1.00%	P
Henderson Township	168	180	12	7.10%	N
<b>WEXFORD COUNTY</b>	<b>32,653</b>	<b>33,256</b>	<b>603</b>	<b>1.8%</b>	

Source: US Census, 2010 and 2019 ACS 5-year Estimates

\* 2023 Hazard Mitigation Plan Participation Status: P = a participant; N = a non-participant



Figure 4. Population by Municipality, 2019



Source: US Census, 2019 5-Year ACS Estimates

Like many northwest Michigan communities, Wexford County experiences an influx of seasonal residents and tourists throughout the year. However, the decennial Census and the American Community Survey only consistently and comprehensively track the permanent population. Networks Northwest's *2022 Seasonal Population Study for Northwest Lower Michigan* analyzed the 2020 seasonal population for the ten counties in northwest Michigan: Antrim, Benzie, Charlevoix, Emmet, Grand Traverse, Kalkaska, Leelanau, Manistee, Missaukee, and Wexford. The study collected data for permanent and part-time residents and overnight visitors in accommodations and short-term rentals (STRs) by county. Northwest Lower Michigan's permanent base population is 310,802 and expands to include its largest amount of part-time residents and overnight visitors in July at an estimated total of 676,052 persons, a 118% increase.

Wexford County is the least-seasonal county in the region, with the total population change of 42% between 40,879 in the month of February and 58,168 in July. The permanent population represents roughly 78% of the total population in the off-season and 61% of the total population in the on-season. The seasonal growth of the county is driven by people staying in traditional accommodation businesses (hotels, motels, bed & breakfasts, campgrounds, etc.). Table 5 illustrates the monthly estimated differences between the permanent population and seasonal residents/overnight visitors for the county.

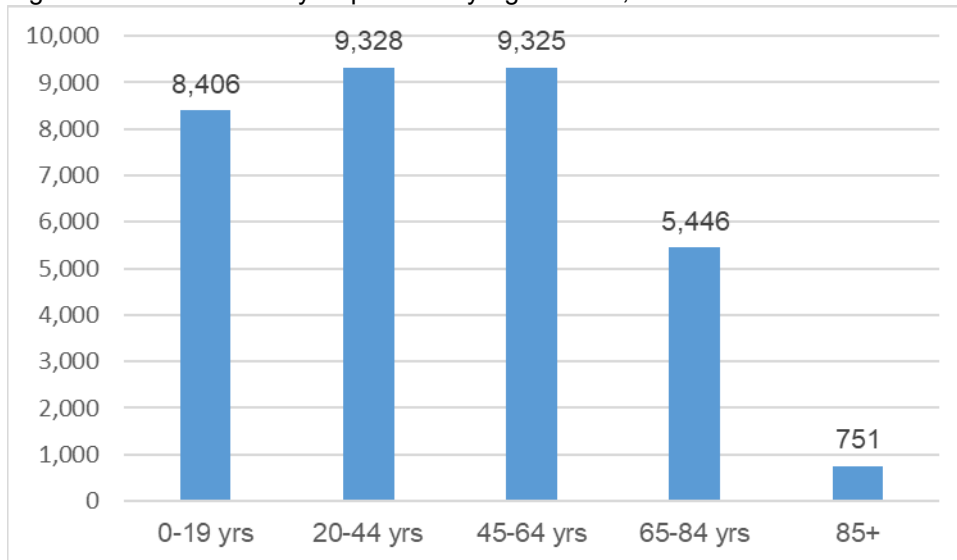
Table 5: Wexford County Seasonal Population Change by Month

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Avg.
<b>Permanent Population</b>	33,673	33,673	33,673	33,673	33,673	33,673	33,673	33,673	33,673	33,673	33,673	33,673	
<b>Part-Time &amp; Overnight Population</b>	7,799	7,206	10,952	11,196	19,258	22,637	24,495	24,388	19,273	13,028	11,297	7,737	14,939
<b>Total Population</b>	41,472	40,879	44,625	44,869	52,931	56,310	58,168	58,061	52,946	46,701	44,970	41,410	48,612
<b>Percent Change</b>	<b>23%</b>	<b>21%</b>	<b>33%</b>	<b>33%</b>	<b>57%</b>	<b>67%</b>	<b>73%</b>	<b>72%</b>	<b>57%</b>	<b>39%</b>	<b>34%</b>	<b>23%</b>	<b>44%</b>

## Age, Race & Disability

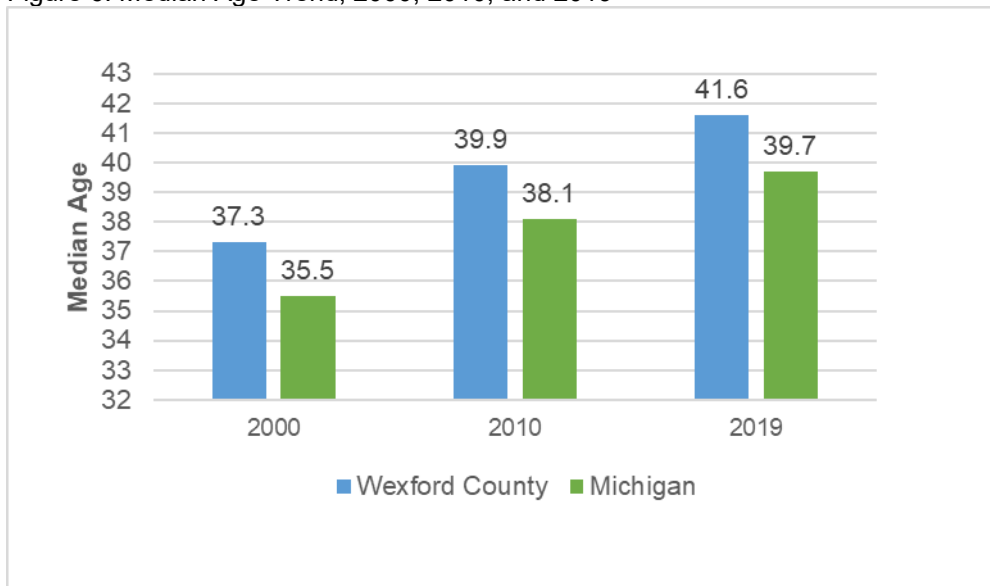
Understanding the age distribution and median age of Wexford County can help identify social, economic, and public service needs in the community. The county's total 2019 population is broken into age cohorts (analyzing which proportions of a municipality's population are in which stages of life). This gives a nuanced view of the makeup of a community. Figure 5 indicates the largest population cohorts are almost equal in size; the 20 to 44 year old group, at an estimated 9,328 persons, is followed very closely by the 45 to 64 age group at 9,325 persons. As shown in Figure 6, the median age (the midpoint where half the population is younger and half the population is older) of Wexford County is 41.6 years, which is slightly older than the State of Michigan (39.7 years). The youngest community in Wexford County is Colfax Township with a median age of 35.1 years; the oldest community in the county is Henderson Township with a median age of 55 years (Figure 7). US Census data indicates that the populations of Wexford County and the State of Michigan are in an aging trend since 2000 (Figure 6).

Figure 5: Wexford County Population by Age Cohort, 2019



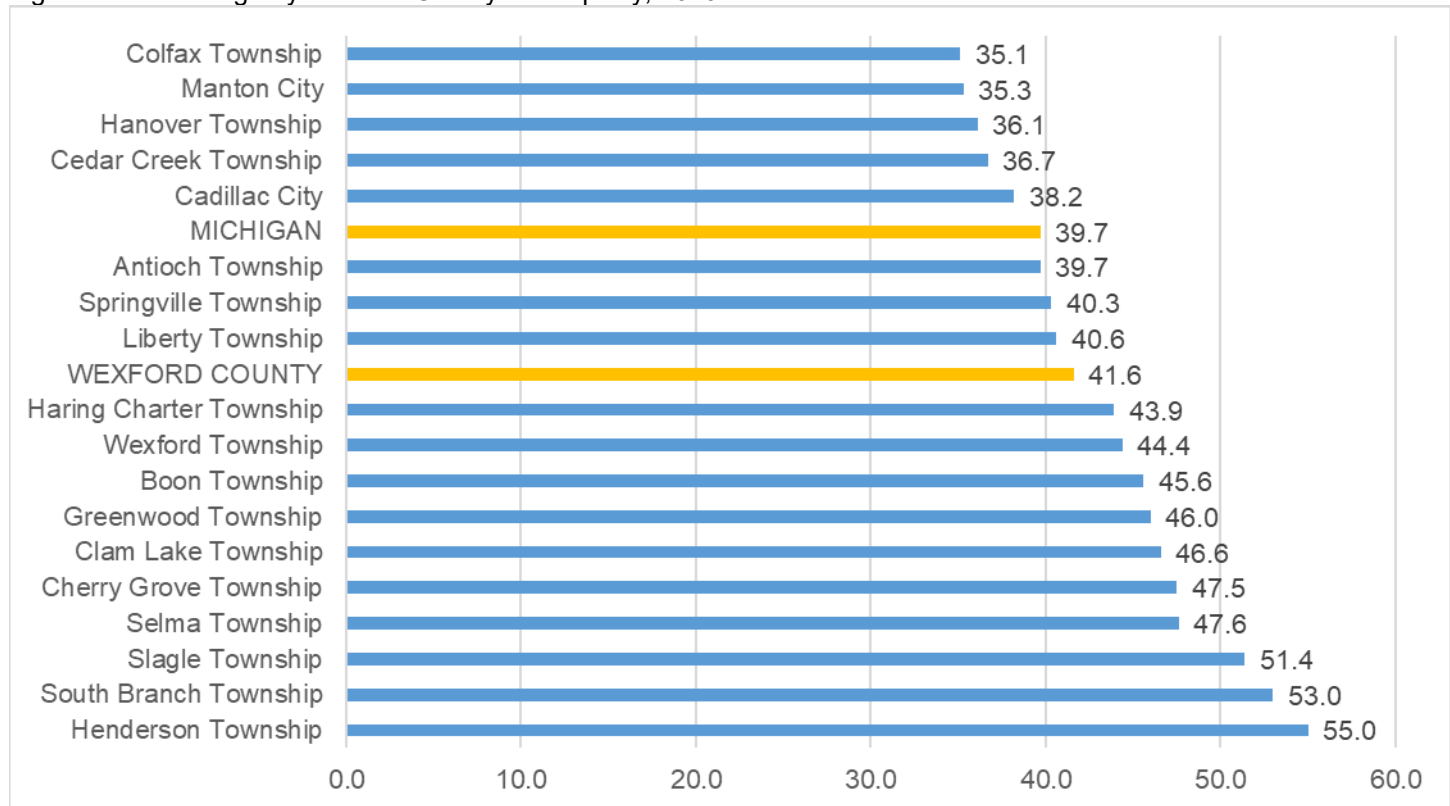
Source: U.S. Census Bureau, 2019 ACS 5-yr Estimates

Figure 6: Median Age Trend, 2000, 2010, and 2019



Source: U.S. Census Bureau, 2019 and 2010 ACS 5-yr Estimates; 2000 Decennial Census

Figure 7: Median Age by Wexford County Municipality, 2019



Source: U.S. Census Bureau, 2019 ACS Estimates

The US Census ACS 2019 ACS estimates indicate that the racial makeup of Wexford County is predominantly white (94.5%). 2.0% of the population is Hispanic or Latino; 2.0% is of two or more races; 0.5% is Black or African American; 0.5% is Asian; 0.4% is American Indian and Alaska Native; and 0.1% is Native Hawaiian and Other Pacific Islander.

Table 6 represents the number of persons with a disability by age group. An estimated 16.1% of Wexford County residents, or 5,325 persons, have one or more type of disability. An estimated 42% of all persons with a disability are of age 35-64. An estimated 50.2% of persons aged 75 years and over have a disability.

Table 6: Estimated Wexford County Persons with a Disability, 2019

Total Civilian Noninstitutionalized Population	33,062 persons
With one or more disability	16.1% (5,325 persons)
Age 0-17 with a disability	6.6%* (375 persons)
Age 18-34 with a disability	7.4%* (463 persons)
Age 35-64 years with a disability	17.5%* (2,263 persons)
Age 65-74 with a disability	26.8%* (968 persons)
Age 75+ with a disability	50.2%* (1,256 persons)

Source: US Census, 2019 ACS Estimates

\* Percentages are representative of estimates for each specific age cohort

## Housing Characteristics and Development Trends

The average household size for Wexford County residents is 2.54 persons, which is slightly higher than the State's average of 2.46. Wexford County has an estimated 12,963 total households as reported in the 2019 ACS 5-Year Estimates (Table 7). The Census defines a household as all the people who occupy a single housing unit, regardless of their relationship to one another. In 2019, an estimated 76.4% of those housing units were occupied (indicating physically occupied, principal residence housing units; Table 8). The City of Cadillac has the largest percentage of housing units of all municipalities in the county (29.4%) (Table 7).

The 2019 ACS also estimates that 74.7% of the county's household units are 1-unit, detached structures, which are commonly referred to as single-family homes. An estimated 14.6% are mobile homes, which can be at risk for damage/destruction from high wind storms and tornadoes. Furthermore, an estimated 55% of the County's residential units were built before 1980 (Table 8). Older homes that have not been renovated to meet modern building and zoning codes may also be more at risk to damages from severe weather, such as high winds, heavy snow events and flooding.

Table 7: Housing Units by Municipality, 2019

Municipality	2019 Housing Units (ACS)	Percent of Total
<b>Wexford County</b>	<b>16,960</b>	
<b>Buckley Village*</b>	285	1.7%
<b>Mesick Village*</b>	173	1.0%
<b>Harrietta Village *</b>	100	0.6%
<b>City of Cadillac</b>	4,987	29.4%
<b>Haring Township</b>	1,506	8.9%
<b>Cherry Grove Township</b>	1,379	8.1%
<b>Selma Township</b>	1,193	7.0%
<b>Springville Township</b>	1,039	6.1%
<b>Clam Lake Township</b>	1,006	5.9%
<b>Hanover Township</b>	786	4.6%
<b>Cedar Creek Township</b>	776	4.6%
<b>City of Manton</b>	585	3.4%
<b>Colfax Township</b>	564	3.3%
<b>Liberty Township</b>	494	2.9%
<b>Wexford Township</b>	477	2.8%
<b>South Branch Township</b>	463	2.7%
<b>Slagle Township</b>	425	2.5%
<b>Antioch Township</b>	415	2.4%
<b>Boon Township</b>	412	2.4%
<b>Greenwood Township</b>	317	1.9%
<b>Henderson Township</b>	136	0.8%

Source: US Census, 2019 ACS Estimates;

\* The number of housing units for each village is incorporated into the totals for the respective township in which each village is located

Table 8: Year Housing Structure Built

Year Built	Housing Units	Percentage of Units
<b>Built 2010 or later</b>	350	2%
<b>Built 2000 to 2009</b>	2,594	15%
<b>Built 1980 to 1999</b>	4,792	28%
<b>Built 1960 to 1979</b>	4,217	25%
<b>Built 1940 to 1959</b>	2,337	14%
<b>Built 1939 or earlier</b>	2,670	16%
<b>Total Housing Units</b>	<b>16,960</b>	

Source: US Census, 2019 ACS Estimates

Housing Tenure, Table 9, summarizes the status of housing units, whether occupied or vacant, as well as the median housing value (\$108,300) and the median gross rent (\$706). Of the 16,960 total housing units, 9,858 (87.1%) are occupied; the 23.6% of “vacant” housing units are homes that are either not occupied year-round, or were abandoned or unoccupied at the time of the Census survey.

Table 9: Housing Tenure, 2019

<b>Total housing units</b>	<b>16,960</b>	<b>%</b>
<b>Occupied housing units</b>	12,963	76.4%
<b>Owner-occupied</b>	9,958	87.1%
<b>Median Housing Value</b>	\$108,300	
<b>Renter-occupied</b>	3,005	12.9%
<b>Median Gross Rent</b>	\$706	
<b>Vacant housing units</b>	3,997	23.6%

Source: US Census, 2019 ACS Estimate

## Economic Profile

The 2021 Comprehensive Economic Development Strategy (CEDS) prepared by Networks Northwest is the product of a locally-based, regionally-driven economic development planning process to identify strategies for economic prosperity. The plan was prepared for the ten county region of northwest Lower Michigan. Table 10 provides a comparison of annual average wage for each county in the CEDS planning area for 2018. The average annual wage is represents that of workers within each county, not the residents in the county. Wexford County has the 4<sup>th</sup> highest average annual wage at \$40,586. Kalkaska County has the highest average annual wage, at \$50,971, followed by Grand Traverse County at \$44,562. It is likely that some residents of Wexford County travel to adjoining Grand Traverse County or Kalkaska County for work.

Table 10: Average Annual Wage by County, 2018

County	Average Annual Wage
Antrim	\$33,081
Manistee	\$33,821
Benzie	\$33,908
Missaukee	\$35,917
Leelanau	\$36,833
Emmet	\$40,258
Wexford	<b>\$40,586</b>
Charlevoix	\$44,558
Grand Traverse	\$44,562
Kalkaska	\$50,971

Source: 2021 Comprehensive Economic Development Strategy (CEDS) prepared by Networks Northwest

The Economic Profile of Antrim County is further described in Table 11. The table provides the county's industry makeup divided into 20 different North American Industry Classification Sectors (NAICS) as well as industry's establishments, jobs, percent distribution, and annual average wage. The industry with the largest percent distribution is "Other (includes private, utilities, management of business, and unallocated)" at 36.9% of jobs (no average annual wage data available), followed by "Manufacturing" at 19.4% (\$45,158 average annual wage), and "Retail Trade" at 10.3% (\$31,562 average annual wage). The industry with the highest annual average wage is "Finance and Insurance" at \$49,629.

Table 11: Wexford County Economic Distribution by Industry, 2018

Industry Description	Establishments	Jobs	Percent Distribution	Annual Average Wage
<b>Total Covered Employment</b>	<b>342</b>	<b>3,301</b>	<b>100.0%</b>	<b>\$35,917</b>
Agriculture, forestry, hunting	46	D	D	D
Mining	2	D	D	D
Construction	56	179	5.4%	\$37,107
Manufacturing	25	642	19.4%	\$45,158
Wholesale trade	9	101	3.1%	\$46,705
Retail trade	30	341	10.3%	\$31,562
Transportation, warehousing	26	245	7.4%	\$42,242
Information	5	7	0.2%	\$24,672
Finance and insurance	11	107	3.2%	\$49,629
Real estate, rental, leasing	6	9	0.3%	\$23,409
Professional, technical services	16	65	2.0%	\$38,753
Administrative, waste services	7	20	0.6%	\$19,026
Educational services	5	N/A	N/A	N/A
Health care, social assistance	34	N/A	N/A	N/A
Arts, entertainment, recreation	4	15	0.5%	\$13,908
Accommodation and food services	15	110	3.3%	\$13,518
Other services, excluding public admin.	31	94	2.8%	\$27,678
Public administration	14	151	4.6%	\$31,066
Other (includes private, utilities, management of business, and unallocated)	0	1,215	36.9%	N/A

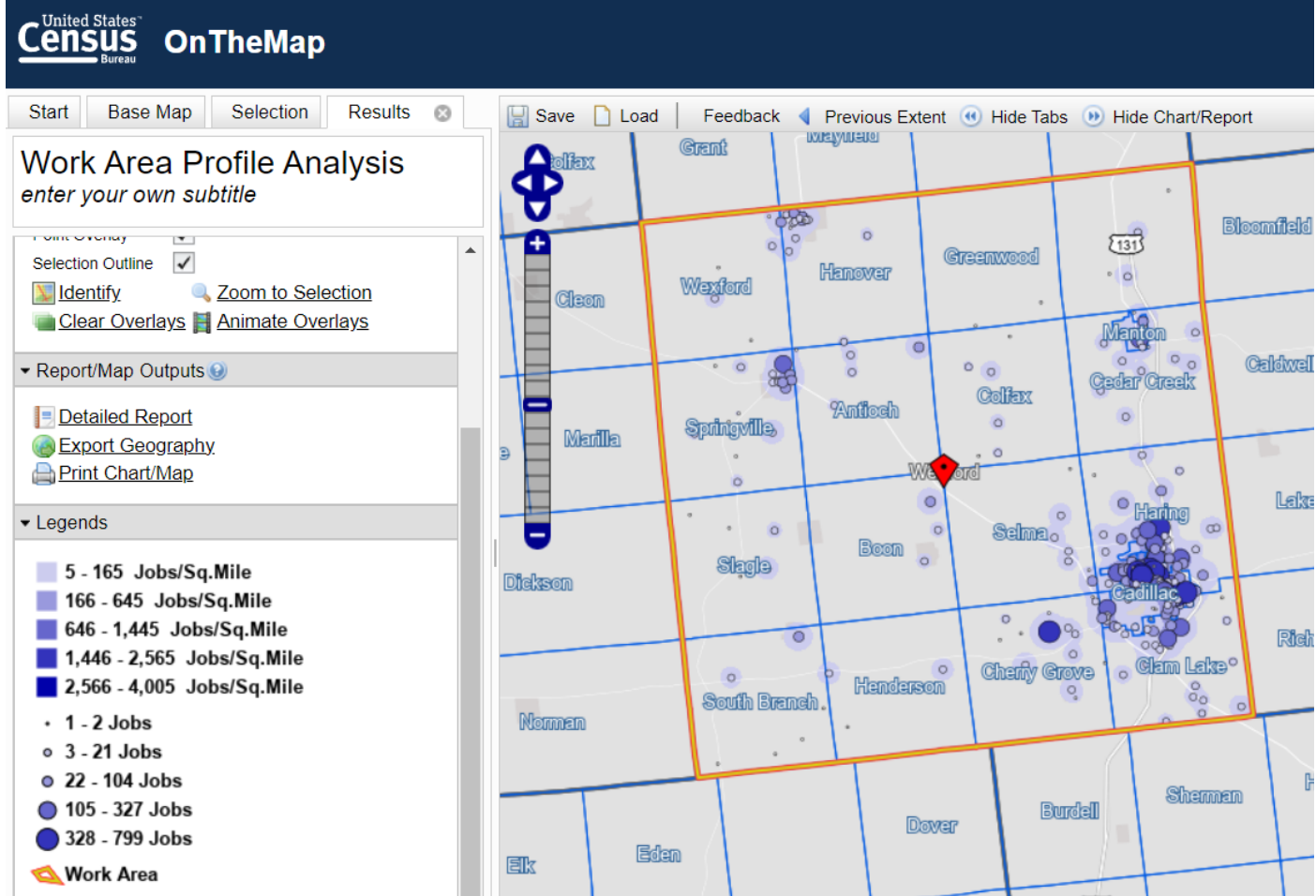
Source: 2021 Comprehensive Economic Development Strategy, Networks Northwest

\*D means limited industries of a sector that would disclose confidential information

Additionally, OnTheMap, an online interactive tool available from the US Census Bureau, allows for viewing of estimated job density within the county. This website is useful for emergency preparedness planning as related to response and potential impact to local economic activity areas. Figure 8 is a screenshot of the interactive map when completing an area profile analysis for all workers with primary jobs in the county in 2020. It appears the greatest density of jobs occurs in and around the City of Cadillac, including Haring Charter Township, Clam Lake Township and Cherry Grove Township. Other key areas of employment are in the Villages of Mesick and Buckley, and the City of Manton.



Figure 8. OnTheMap Web Image, 2020 Work Area Profile Analysis for Wexford County



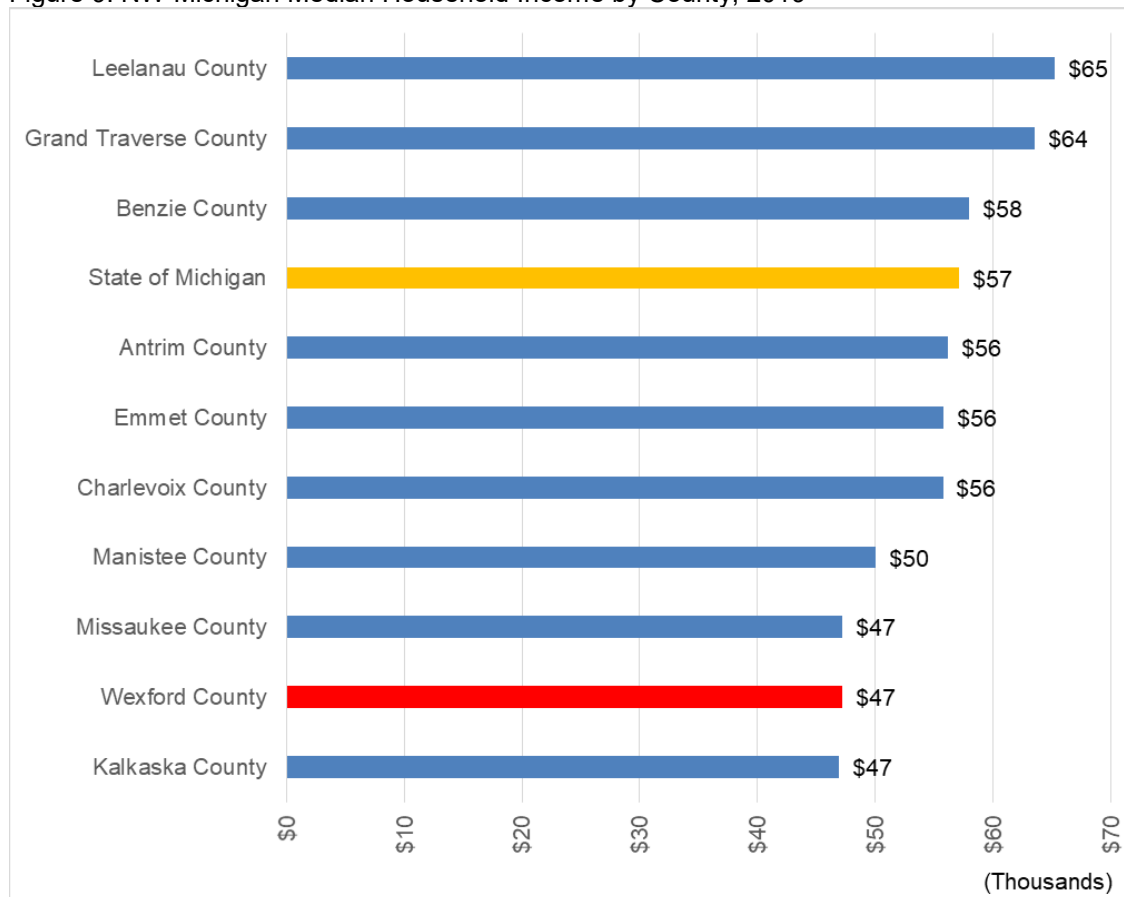
Source: US Census Bureau, OnTheMap

Figures 9 and 10 present a comparison of the median household income (MHI) across the ten county region, the State of Michigan, and local jurisdictions. Wexford County has the second lowest median household income (\$47,193) in the region, just ahead of Kalkaska County (\$46,898). The economic profile can be further described by considering the cost of housing, transportation, and other goods and services. The budgeting rule of thumb has been that a household should spend no more than 30 percent of its income on housing costs. Considering the MHI of Wexford County over twelve months, a household is earning \$3,933 per month. The US Census 2019 5-year ACS estimates that the median gross monthly rent is \$706 in Wexford County, which equates to 18 percent of the estimated median monthly household income.

However, according to the 2019 Northwest Michigan Target Market Analysis (conducted by LandUseUSA on behalf of Housing North and Networks Northwest), rents are far higher in Wexford County than what many renters can afford.<sup>4</sup> While the affordable rent for a renter earning the mean wage is \$753, the affordable rent for a full-time minimum wage worker is \$491. Anecdotally, post-COVID pandemic, the demand for housing is driving prices higher still. Home prices are also increasing where the cost to purchase a home is often as much as \$200/square foot or more.

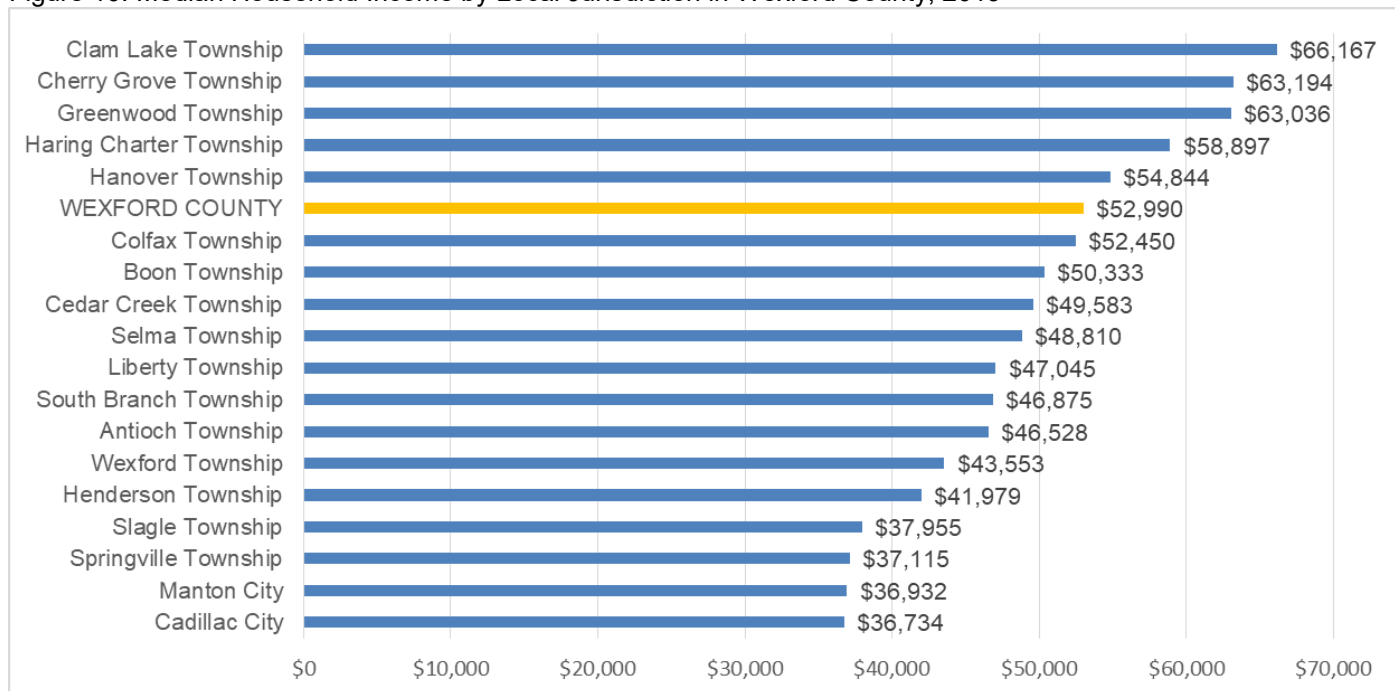
<sup>4</sup> [Wexford County 2020 Target Market Analysis Fact Sheet](#)

Figure 9: NW Michigan Median Household Income by County, 2019



Source: US Census Bureau, 2019 ACS 5-yr Estimates

Figure 10: Median Household Income by Local Jurisdiction in Wexford County, 2019



Source: US Census Bureau, 2019 ACS 5-yr Estimates

The following tables describe the population with the lowest incomes. It is estimated that 14.2% of all persons in the county are living at or below the poverty level (Table 12). The Census describes poverty thresholds differently based on the size of the family and the number of related children living together, as illustrated in Table 13.

Table 12: Wexford County Poverty Estimates, 2019

Poverty	Statistics
<b>All persons in poverty</b>	14.2% (4,665 persons)
<b>All families in poverty</b>	9.9% (873 families)
<b>Families with related children under age 18, in poverty</b>	19% (718 families)

Source: US Census, 2019 ACS 5-yr Estimates

Table 13: 2019 Federal Poverty Level Guidelines *\*For those with more than 8 persons, add \$4,420 for each additional person.*

Persons in family/household	Poverty guideline
<b>1</b>	\$12,490
<b>2</b>	\$16,910
<b>3</b>	\$21,330
<b>4</b>	\$25,750
<b>5</b>	\$30,170
<b>6</b>	\$34,590
<b>7</b>	\$39,010
<b>8*</b>	\$43,430

Financial hardship is further described in the United Ways of Michigan report entitled *ALICE in Michigan: A Financial Hardship Study*. ALICE, which is an acronym for Asset Limited, Income Constrained, Employed, are those households with income above the Federal Poverty Level, but below the basic cost of modern living, such as housing, child care, food, health care, technology and transportation. The ALICE threshold is described as, “*the average income that a household needs to afford the basic necessities... for each county in Michigan. Households earning below the ALICE Threshold include both ALICE and poverty-level households*” (ALICE, 2019). Table 14 identifies the percentage of households that are estimated to be considered ALICE and living below poverty thresholds for each county subdivision. These households likely would not have reserve savings to cover an emergency, such as impacts from a natural hazard event.

Table 14: 2019 Estimated Households in Poverty and ALICE<sup>5</sup> (No data is available for Henderson Township)

Wexford County Subdivision*	Total Households	% of HH in Poverty and ALICE
<b>Greenwood Twp.</b>	207	27%
<b>South Branch Twp.</b>	133	45%
<b>Boon Twp.</b>	268	34%
<b>Colfax Twp.</b>	349	33%
<b>Antioch Twp.</b>	293	42%
<b>Slagle Twp.</b>	232	54%
<b>Liberty Twp.</b>	356	44%
<b>Wexford Twp.</b>	368	45%
<b>Clam Lake Twp.</b>	868	21%
<b>Hanover Twp.</b>	584	35%
<b>Cedar Creed Twp.</b>	628	39%
<b>Manton City</b>	470	54%
<b>Cherry Grove Twp.</b>	948	30%
<b>Springville Twp.</b>	618	51%
<b>Haring Charter Twp.</b>	1,237	27%
<b>Selma Twp.</b>	884	44%
<b>Cadillac City</b>	4,433	53%
<b>WEXFORD COUNTY</b>	<b>12,876</b>	<b>39.9%</b>

<sup>5</sup> Michigan Association of United Ways. *ALICE in Michigan: A Financial Hardship Study*. 2021. <https://www.uwmich.org/alice-report>

## IV. Hazard Identification and Assessments

### Vulnerability Assessment

Natural hazard impact on the community can be understood by evaluating vulnerabilities for commonly agreed upon assets. A community's assets are defined broadly to include anything that is important to the character and function of a community and can be described very generally in the following categories:

- People
- Economy
- Built environment
- Natural environment

Vulnerable populations include the economically disadvantaged, elderly, homeless, and persons with a disability. Those that live unsheltered or in homeless encampments, assisted living facilities, mobile homes, or isolated residences are more susceptible to hazardous events. Vulnerable populations are represented on the Vulnerable Populations and Hazard Areas Map in Appendix A. Those locations included on the map were specifically discussed during public input sessions. There may be additional locations of vulnerable populations that are not listed.

The natural environment is the primary reason people choose to live and vacation northwest Michigan. Wexford County is home to plentiful forest lands, inland lakes, rivers and streams and all of the wildlife within them that are integral to the identity of the community. While natural resources are abundant, they are also vulnerable to many types of natural hazards. Northwest Lower Michigan has many sensitive wildlife and plant populations that require specific climates and habitats to survive. Damaged, destroyed, or changing natural environments may decrease the chances for certain species' survival.

Additionally, countywide critical infrastructure is represented on the Critical Infrastructure Map, shown in Appendix A. Wexford County Office of Emergency Management and community stakeholders identified the critical facilities and infrastructure on the base map. Table 15 lists critical infrastructure points in Wexford County.

Table 15: Critical Facilities and Infrastructure

Source: Wexford County Office of Emergency Management

<b>52</b>	<b>Commercial</b> <ul style="list-style-type: none"> <li>• Agriculture and Food Production Distribution (29)</li> <li>• Agriculture Processing, Packaging and Production (2)</li> <li>• Agriculture and Food Product Storage and Distribution Warehouse (1)</li> <li>• Agricultural Supply (1)</li> <li>• Wexford Civic Center in Cadillac</li> <li>• Banking Services (15 in Cadillac; 1 in Buckley; 1 in Manton; 1 in Mesick)</li> </ul>
<b>49</b>	<b>Communications</b> (cellular, radio, broadband, television broadcasting, landline telephone, etc.)
<b>41</b>	<b>Industry</b> <ul style="list-style-type: none"> <li>• Manufacturing (26 in Cadillac)</li> <li>• Chemical/Hazardous Materials Storage/Use (13 in Cadillac; 2 in Buckley; 1 in Manton)</li> </ul>
<b>35</b>	<b>Energy</b> <ul style="list-style-type: none"> <li>• Petroleum product sales (25)</li> <li>• Propane storage (1)</li> <li>• Electricity (7 Consumer Power/Solar Plants)</li> <li>• Natural Gas (2 DTE Natural Gas Lines in Cadillac)</li> </ul>
<b>29</b>	<b>Emergency Services</b> <ul style="list-style-type: none"> <li>• County (Emergency Mgmt., Sheriff's Office, Jail)</li> <li>• City of Cadillac and City of Manton Police Departments</li> <li>• Michigan State Police Post #71</li> <li>• Mobile Medical Response (3)</li> <li>• Buckley Rescue and Mesick Rescue Squad</li> <li>• Local Fire Depts. (12) <ul style="list-style-type: none"> <li>○ City of Cadillac</li> <li>○ City of Manton</li> <li>○ Village of Buckley</li> <li>○ Selma Township</li> <li>○ Cedar Creek Township</li> <li>○ Haring Charter Township</li> <li>○ Colfax-Greenwood Township</li> <li>○ Springville Township</li> <li>○ Slagle Township – Village of Harrietta</li> <li>○ Boon Township</li> <li>○ South Branch Township</li> <li>○ Cherry Grove Township</li> <li>○ Cadillac YMCA (emergency shelter site)</li> <li>○ Senior Centers in Manton and Cadillac (emergency shelter sites)</li> </ul> </li> </ul>
<b>11</b>	<b>Healthcare</b> <ul style="list-style-type: none"> <li>• Munson Hospital in Cadillac</li> <li>• Health practitioner/clinic (7 in Cadillac; 1 in Manton)</li> <li>• Homeless/safe house shelters (2 in Cadillac)</li> </ul>
<b>9</b>	<b>Government</b> <ul style="list-style-type: none"> <li>• Public water supply/storage (Buckley, Mesick, Manton, Cadillac, Haring Charter Twp.)</li> <li>• Wastewater facilities (Cadillac, Manton, Mesick, Haring Charter Twp.)</li> </ul>
<b>5</b>	<b>Dams</b> <ul style="list-style-type: none"> <li>• Hodenpyl Hydroelectric Dam in Mesick</li> <li>• Lake Billings Dam in Manton</li> <li>• Lakewood on the Green Dam in Cadillac</li> <li>• Lake Gitchegumee Dam in Buckley</li> <li>• Slagle Creek Dam in Harrietta</li> </ul>
<b>4</b>	<b>Transportation</b> <ul style="list-style-type: none"> <li>• Airports (Wexford County Airport; Eagles Landing in Harrietta)</li> <li>• Mass Transit (Indian Trails Bus Lines; Wex Express)</li> </ul>

## Historical Analysis

The Historical Analysis of Wexford County weather-related hazards uses information on impacts and losses from previous hazard events to predict potential impacts and losses during a similar event. Because of the frequency of these events, communities are more likely to have experience with and data on impacts and losses. Additionally, there have been seven federal- or state-declared disaster events that have involved Wexford County (Table 16). These events are included in the hazard analysis for individual event types.

Table 16: Presidential and Governor Declared Disasters / Emergencies for Wexford County

Date Declaration	Type of Incident	Affected Area	Type of Declaration/ Fed ID #
<b>March 2020</b>	COVID-19; Pandemic	Statewide & National	State of Emergency, National Emergency (3455), and Governor and Presidential Declared Major Disaster (4494)
<b>1/29/2019</b>	Extreme Cold	Statewide	Governor Declared Emergency
<b>4/12/2014</b>	Flooding	Isabella, Mecosta, Missaukee, Muskegon, Newaygo, Osceola, Roscommon and <b>Wexford Co.</b>	Governor Declared Disaster
<b>7/14/2008</b>	Thunderstorms, flooding	12 counties: Allegan, Barry, Eaton, Ingham, Lake, Manistee, Mason, Missaukee, Osceola, Ottawa, Saginaw, and <b>Wexford.</b>	Presidential Declared Major Disaster (1777) and Governor Declared Emergency
<b>9/4/2005 and 9/7/2005</b>	Hurricane (Katrina) Evacuation	Statewide (Declared due to the emergency conditions in the State of Michigan, resulting from the influx of evacuees from states impacted by Hurricane Katrina beginning on August 29, 2005.)	Governor Declared Disaster and Presidential Declared Emergency (3225)
<b>1/26-27/1978</b>	Blizzard, Snowstorm	Statewide	Presidential Declared Emergency (3057); Governor Declared Disaster
<b>3/2/1977</b>	Drought	Wexford and 43 other counties	Presidential Declared Emergency (3035)

Sources: FEMA <https://www.fema.gov/data-visualization/disaster-declarations-states-and-counties> and Michigan State Police [2019 Michigan Hazard Analysis \(MHA\) pub. 103](#)

## Hazard Descriptions

Wexford County is vulnerable to a wide range of natural hazards. Hazard events have the potential to impact local residents, economic drivers in the community, critical infrastructure and the built environment, and the natural environment. The Wexford County Emergency Services Department is challenged with managing these threats to protect life and property. This plan includes a profile for each natural hazard event the county is likely to face. Each profile includes the location, extent, previous occurrences, probability of future events, and vulnerability assessment.

- Location is the geographic areas within the planning area that are affected by the hazard, such as a floodplain. The entire planning area may be uniformly affected by some hazards, such as drought or winter storm. Location may be described in narrative and or through map illustrations.
- Extent is the strength, severity, or magnitude of the hazard. Extent can be described in a combination of ways depending on the hazard.
- Previous occurrences describe the history of previous hazard events within the county. This information helps estimate the likelihood of future events and predict potential impacts. The extent of historic events may be included when the data is available. Data is collected from the National Oceanic and Atmospheric Administration's (NOAA's) National Centers for Environmental Information (NCEI) online storm events database.
- Probability of future events is the likelihood of the hazard occurring in the future and can be described in a variety of ways. Probability may be defined using historical event frequencies or statistical probabilities.
- Vulnerability assessment accounts for the types and numbers of existing and future buildings, infrastructure, and critical facilities located in the identified hazard areas and provides an estimate of the dollar losses to vulnerable assets identified. Recorded injuries and deaths attributed to events are also noted.

Data for natural hazard events in Wexford County was compiled from several different sources. Weather event data was collected primarily from the National Centers for Environmental Information through the National Oceanic and Atmospheric Administration's (NOAA) website utilizing the following sections:

- Climate <https://www.weather.gov/wrh/Climate?wfo=apx> – Historical local observed weather data; Climate prediction and variability; local high impact event summaries
- NOAA Storm Event Database <https://www.ncdc.noaa.gov/stormevents/> - Data on record from January 1, 1950 to May 31, 2022; however, information for various events is limited and non-contiguous throughout the decades. The database provides local storm reports, damage reports, and recorded event descriptions. The event types on record for Wexford County include: Drought (*Drought*); Heat (*Heat*); Flooding (*Flood*, *Flash Flood*); Hail (*Hail*); Extreme Winter Weather (*Blizzard*, *Extreme Cold/Wind Chill*, *Heavy Snow*, *Ice Storm*, *Lake-effect Snow*, *Winter Storm*, *Winter Weather*); Tornado (*Tornado*); Thunderstorm and High Wind (*Thunderstorm Wind*, *High Wind*, *Strong Wind*) and Lightning (*Lightning*) events that resulted in a reported fatality, injury, and/or property or crop damage.

The [Michigan Hazard Analysis](#), completed by the Michigan Department of State Police in 2019, was used to collect data on wildfires that occurred on State of Michigan owned land between 1981 and 2018. Additionally, the 2021 USDA/USFS publication [Spatial Wildfire Occurrence Data for the United States, 1992-2018 \[FPA FOD 20210617\]](#) was used to collect data on wildfires that occurred on state/private or federally-owned land within the county.

The websites for the [National Inventory of Dams](#) and [MI-EGLE's Michigan Dam Inventory](#) were used to collect information on dams in the county.

Additionally, FEMA's webpage on [Disaster Declarations for States and Counties](#) was referenced for the most up-to-date data on Presidential- and Governor-Declared emergencies and disasters in Wexford County.

The NOAA Storm Events database is updated on a rolling basis (approximately every three months), and thus the database is always being added to. Search results indicate a total of 205 severe weather events were reported between 01/01/1950 and 12/31/2022 in Wexford County (22,663 days). There was a total of 176 days with an event; 1 day with an event and injury (the result of a tornado in 1974); and 46 days with an event and property damage. There were no days on record with "an event and crop damage" or "an event and a death". Those events, as well as the emergency declaration events, are included in the hazard analysis. The hazard analysis groups the events into the following categories, as shown in Table 17.

**Table 17: Reported Wexford County Natural Hazard Event by Type**

Type of Event	# of Events	Event Location	Time Interval or Year Event Recorded
<b>Wildfire</b>	510	476 On MDNR land in the county	1983-2018
		34 On Federal land in the county	1992-2018
<b>Extreme Winter Weather</b>	77	Countywide	1978*, 1997 - December 2022
<b>Thunderstorm Wind/High Wind</b>	70	Countywide	1956-2022 (* in 2008)
<b>Hail</b>	33	Countywide	1984-2022
<b>Flood/Flash Flood</b>	11	Countywide, City of Cadillac, City of Manton, Lake Cadillac, and areas along the Manistee River and its tributaries	2000-2014 (* in 2008 and 2014)
<b>Tornado</b>	8	Clam Lake Twp.; Haring Charter Twp., Cherry Grove Twp.; Liberty Twp.; Selma Twp., Village of Buckley	1963, 1968, 1974, 1976, 1980, 1989, 2006, 2010
<b>Extreme Cold / Wind Chill</b>	4	Countywide	2007, 2014, 2015, 2019*
<b>Drought</b>	2	Countywide	1977*, 2001
<b>Heat/Excessive Heat</b>	2	Countywide	2001, 2018
<b>Lightning</b>	1	Countywide	2000
<b>Public Health Emergency (COVID-19 Pandemic)</b>	1	Countywide	2020*

Sources: NOAA National Centers for Environmental Information Storm Events Database; MDNR; Michigan State Police-Dept. of Homeland Security; FEMA.

Note: \* indicates a state or federal event designation



## Economic Impact Analysis

The estimated economic impact of the previously described Wexford County natural hazard events that were *reported* to NOAA is \$2,492,000 in property damages and \$0 in crop damages (Table 18). It should be noted that many events, such as hail, likely cause numerous small amounts in property damage, but such damages often go unreported. The damages and impacts to property and life from hazard events recorded for Wexford County are as follows:

Table 18: Deaths, Injury/Illness and Damage Estimates by Event Type

Wexford County	Deaths	Injuries /Illness	Property Damage Estimate	Crop Damage Estimate
<b>Wildfire</b>	N/A	N/A	N/A	N/A
<b>Thunderstorms with Wind and Severe/High Winds</b>	0	0	\$406,500	\$0
<b>Extreme Winter Weather</b>	0	0	\$283,000	\$0
<b>Hail</b>	0	0	\$0	\$0
<b>Riverine and Urban Flood/Flash Flood</b>	0	0	\$982,000	\$0
<b>Tornado</b>	0	1	\$820,500	\$0
<b>Extreme Cold / Wind Chill</b>	0	0	\$0	\$0
<b>Drought</b>	0	0	\$0	\$0
<b>Heat/Excessive Heat</b>	0	0	\$0	\$0
<b>Lightning</b>	0	0	\$0	\$0
<b>Public Health Emergency (Pandemic)*</b>	124	8,587	N/A	N/A
<b>TOTAL</b>	<b>124</b>	<b>8,588</b>	<b>\$2,492,000</b>	<b>\$0</b>

Sources: NOAA's National Centers for Environmental Information; State of MI <https://www.michigan.gov/coronavirus/stats>

\* As of record on January 10, 2023.

Table 19 provides an overview of each potential hazard's impact on the permanent population and the estimated impact on the State Equalized Values (SEV) for real and personal property (residential and commercial). By law, SEV is equal to approximately one-half of the property's true market value. Population data is collected from the US Census, 2019 ACS data. Based on data from the 2022 Season Population Study for NW Lower Michigan, add an average of a 44% increase in the base population estimates to account for the seasonal population in the county throughout the year.

Table 19: Geographic and Economic Impact by Event

Hazard Event	Geography	Population Estimates	State Equalized Value
Extreme Winter Weather, Thunderstorm, Wind, Hail, Lightning, Tornado, Extreme Temperatures, Drought, Public Health Emergency	Wexford County	33,256	\$1,356,823,400
Riverine and Urban Flooding	Manistee River, Clam River, Pine River, Lake Mitchell, Lake Cadillac [Antioch, Springville, Wexford, Hanover, Greenwood, Liberty Haring, South Branch, Cherry Grove and Selma Townships; Cities of Cadillac and Manton; Village of Mesick]	26,508	\$232,677,805.80
Wildfire	Areas with pine forest – scattered throughout every community	33,256	\$239,862,486.90

Sources: 2019 ACS Estimates from the U.S. Census Bureau; Wexford County Equalization

Furthermore, mobile homes and campgrounds are areas where concentrations of people and property can be particularly vulnerable during a severe winter weather, thunderstorm, high wind, lightning, hail, tornado, wildfire, extreme temperatures, or public health incident. Their approximate locations in the county are indicated on the *Vulnerable Populations & Hazard Areas Map* in the Appendix. Table 20 lists the communities in Wexford County where these areas are located and the SEV for those properties

Table 20: Geographic and Economic Impact of Severe Weather on Vulnerable Population Areas

Vulnerable Population Areas	Geography	State Equalized Value
Campgrounds	Cities of Cadillac and Manton; Townships of Cedar Creek, Cherry Grove, Clam Lake, Greenwood, Haring, Liberty, Springville and South Branch	\$4,883,440
Mobile/Modular Homes	Cities of Cadillac and Manton; Townships of Clam Lake, Hanover, Haring, South Branch and Springville	\$39,798,403

## Extreme Winter Weather

National Weather Service defined as: *phenomenon (such as snow, sleet, ice, wind chill) that impacts public safety, transportation, and/or commerce*. The Extreme Winter Weather category includes the following subcategories: winter weather, winter storm, ice storm, heavy snow, blizzard, frost/freeze, and lake effect snow. Blizzards are the most perilous snowstorms and are characterized by low temperatures, strong winds, and enormous amounts of fine, powdery snow. Snowstorms have the potential to reduce visibility, cause property damage, and loss of life.

According to the 2019 Michigan Hazard Analysis, Michigan has 360 snowstorms with 0.1 average annual deaths, 0.1 average annual injuries, and \$1.9 million in average annual property and crop damage. Michigan experiences large differences in snowfall over short distances due to the Great Lakes. The average annual snowfall accumulation ranges from 30 to 200 inches with the highest accumulations in the northern and western parts of the Upper Peninsula. In Lower Michigan, the highest snowfall accumulations occur near Lake Michigan and in the higher elevations of northern Lower Michigan. For example, the average snowfall ranges from 141 inches in the Gaylord area to 101 inches in Traverse City in the northwest region of the Lower Peninsula.

Ice and Sleet Storms are storms that generate sufficient quantities of ice or sleet that result in hazardous conditions and/or property damage. Ice storms occur when cold rain freezes on contact with the surface and coats the ground, trees, buildings, and overhead wires with ice. Often times, ice storms are accompanied by snowfall, which sometimes causes extensive damage, treacherous conditions, and power loss. On the other hand, sleet storms are small ice pellets that bounce when hitting the ground or other objects. It does not stick to trees or wires, but can cause hazardous driving conditions. When electric lines are down, households are inconvenienced, and communities experience economic loss and the disruption of essential services.

According to the 2019 Michigan Hazard Mitigation Plan, Michigan has 16 average annual ice and sleet storm events with 0.2 average annual deaths, 0.5 average annual injuries, and \$11.4 million in average annual property and crop damage.

### Location

Extreme winter weather events are regional events that are not confined to geographic boundaries and can affect several areas at one time with varying severity depending on factors such as elevation and wind patterns. All of Wexford County is at risk to the occurrence and impacts from extreme winter weather; the county is more susceptible to lake-effect snow due to proximity to Lake Michigan.

One of the highest-impact snowstorms in recent memory pounded Northern Michigan on the night of March 2, 2012. Low pressure tracked from Missouri, to southern Lower Michigan, and on to eastern Canada, while rapidly strengthening. Precipitation surged northward into the region on the evening of the 2nd. This was primarily snow, except in parts of east central Lower Michigan (especially near Lake Huron), where temperatures were mild enough for rain. Snow wound down on the morning of the 3rd, and though somewhat blustery winds occurred behind the system on the 3rd, blowing snow was limited because the snowfall was so wet. Snow totals ranged from 6 to 14 inches across most of Northern Michigan. Higher amounts fell near and west of Grand Traverse Bay, with a maximum amount of 20 inches near Lake Ann. With relatively warm temperatures, the snow was very wet; Traverse City saw around a foot of snow during the night, with a low temperature of 33 degrees. The snow stuck to everything, with the weight of the snow downing many, many trees and power lines. Power outages were widespread, with an outright majority of Northern Michigan residents losing power at some time during or after the storm. In Benzie County, 95 percent of residents lost power. Outages lasted up to a week in some spots. Great Lakes Energy described it as the worst snowstorm (in regards to power outages) in 30 years. A number of counties and communities opened shelters to aid those without power or heat. Also included in the tree damage was substantial damage to fruit trees in the Grand Traverse Bay region, particularly cherry trees. These events accounts for \$600,000 in reported damages.

### Extent

Snowstorms can be measured based on snowfall accumulations or damages. The average total snowfall in Wexford County is 76.1 inches.<sup>6</sup> The most damage from a winter weather event in Wexford County occurred on March 2, 2012 with a reported \$250,000 in property damages caused by heavy snow. Extreme winter weather events have resulted in a total of \$283,000.

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<sup>6</sup> Source: Western Regional Climate Center, records from 1909-2016 <https://wrcc.dri.edu/cgi-bin/cliMAIN.pl?mi1176>

### Previous Occurrences

Since 1978, there have been 77 extreme winter weather events, including heavy snowstorms, ice storms, blizzards, winter weather, and winter storms reported in Wexford County (Table 21). In 1978, the State of Michigan received a Presidential Emergency Declaration for a snowstorm and blizzard. In recent years, the more common events are winter storms with moderate snowfall of 5-10 inches. Heavy snow, blizzards, and lake-effect snows have been less common. Nonetheless, extreme winter weather events are the most frequent recorded event with the potential to impact the entire county and cause widespread damage. Considering property damages, winter weather events are also the most costly events to occur in the county.

Table 21: Extreme Winter Weather Previous Occurrences in Wexford County

Event Type	Number of Events	Property Damage	Crop Damage	Event Year(s)
Winter Storm	41	\$ 23,000	\$ -	1997 - 2022
Heavy Snow	23	\$ 250,000	\$ -	1999 - 2012
Blizzard	5	\$ -	\$ -	*1978, 1997-1999, 2019
Ice Storm	5	\$ -	\$ -	2001, 2002, 2005, 2022
Winter Weather	1	\$ 10,000	\$ -	2006
Lake-Effect Snow	2	\$ -	\$ -	1997, 2010
<b>TOTAL</b>	<b>77</b>	<b>\$ 283,000</b>	<b>\$ 0</b>	

\* indicates a Governor- or Presidential-declared emergency or disaster

Source: NOAA - National Centers for Environmental Information; FEMA; Michigan State Police.

### Probability of Future Events and Vulnerability Assessment

Between the years 1997 and 2022, Wexford County has had 76 extreme winter weather events. This averages to about to about 3 events every year. Therefore, the probability of an extreme winter weather event occurring in future years is 100 percent. Heavy snow events have the potential of shutting down towns and businesses for a significant period of time. Blowing and drifting snow with blizzard conditions cause driving hazards. Ice damage may occur when high winds push lake and river water and ice past the shoreline, causing damage to public infrastructure and residential property.

During the winter months, the population is largely made up of the base permanent residents. However, there is increasing demand from seasonal residents to purchase property and retire or work remotely from highly desirable northern and coastal communities like those in Wexford County. Many aspects of the county, including natural wooded areas and proximity to lakes/ivers, are attractive to prospective buyers and the permanent population is expected to continue to grow. New residents, especially those locating in remote areas, increase the chance of risk to life and property. Winter-related events cause difficult driving conditions and in the event of an emergency, can make travel increasingly difficult for emergency personnel who may be more frequently dispatched to rural areas.

The public online community survey results indicated that extreme winter weather (i.e., blizzard, heavy snow, ice storm) as the fifth most likely type of natural hazard event that would have a major impact on the county's communities.

## Thunderstorms and Severe Winds

The National Weather Service defines a "Thunderstorm Wind" event as having winds, arising from convection (occurring within 30 minutes of lightning being observed or detected), with speeds of at least 50 knots (58 mph), or winds of any speed (non-severe thunderstorm winds below 50 knots) producing a fatality, injury, or damage. These storms can also produce lightning, heavy rain (that could cause flash flooding), hail (at least 3/4" diameter), or tornadoes. Severe thunderstorms can occur at any time in Michigan, although they are most frequent during the warm spring and summer months from May through September.

"Strong Wind" and "High Wind" events on record with the NWS are considered severe wind events. Strong Winds are non-convective winds gusting less than 50 knots (58 mph), or sustained winds less than 35 knots (40 mph), resulting in a fatality, injury, or damage. High Winds are sustained non-convective winds of 35 knots (40 mph) or greater lasting for 1 hour or longer, or gusts of 50 knots (58 mph) or greater for any duration (or otherwise locally/regionally defined).

Long-lived wind events associated with fast-moving severe thunderstorms are known as a *derecho* (pronounced similar to "deh-REY-cho"). According to the National Weather Service, a derecho is a widespread, long-lived wind storm that is associated with a band of rapidly moving showers or thunderstorms. Although a derecho can produce destruction similar to the strength of tornadoes, the damage typically is directed in one direction along a relatively straight swath. As a result, the term "*straight-line wind damage*" sometimes is used to describe derecho damage. By definition, if the wind damage swath extends more than 240 miles (about 400 kilometers) and includes wind gusts of at least 58 mph (93 km/h) or greater along most of its length, then the event may be classified as a derecho. A derecho often occurs during the spring or summer; however, it can occur any time of the year.

Severe windstorms can cause damage to homes and businesses, power lines, trees and agricultural crops, and may require temporary sheltering of individuals without power for extended periods of time.

### Location

Thunderstorms and severe wind are regional events that are not confined to geographic boundaries and can affect several areas at one time with varying severity depending on factors such as elevation and wind patterns. All of Wexford County is at risk to the occurrence and impacts from thunderstorms and severe winds.

The most damaging event occurred on August 2, 2015. A historic severe weather outbreak in northern Michigan, as multiple waves of severe thunderstorms crossed the region. A passing cold front would finally end the activity during the evening hours. This episode featured widespread straight-line wind damage in parts of northwest Lower Michigan, and the largest hail on record in northern Michigan in Ogemaw County. This event resulted in \$600,000 in property damages.

### Extent

Thunderstorms can be measured based on wind speed or damages. The average wind speed for wind events in Wexford County with a recorded wind speed in Wexford is 52 knots. Wexford County had a reported \$399,000 in property damages caused by thunderstorms and severe winds since 1990 (Table 22).

### Previous Occurrences

Since 1990, there have been a total of 62 thunderstorm/wind and high wind events reported in Wexford County. This is the second-most frequently occurring type of severe weather event in the county.

Table 22: Wexford County Thunderstorm and Wind Events Previous Occurrences

Event Type	Number of Events	Property Damage	Crop Damage	Event Year(s)
Thunderstorm Wind	7	\$0	\$0	1956-1985
Thunderstorm Wind	54	\$281,500	\$0	1990-2022
High Wind/Strong Wind	9	\$125,000	\$0	1998-2021
<b>TOTAL</b>	<b>70</b>	<b>\$406,500</b>	<b>\$0</b>	1956-2022

Source: NOAA: National Centers for Environmental Information

### *Probability of Future Events and Vulnerability Assessment*

Since 1956, Wexford County has had a total of 70 recorded “thunderstorm wind”, “high wind” or “strong wind” events. However, seven (7) of those 70 events occurred on record in 1956, 1960, 1964, 1965, 1976, and 1985 (2 events). After 1990, recorded events of this type on record occurred more consistently in the NOAA NCEI database. Due to the time span of these seven events over the 34 years prior to 1990, they are not considered in the probability estimate.

Since 1990, Wexford County has had 63 thunderstorm/wind and high wind events. This averages to about 1.97 events every year. The probability of an event occurring in a given future year is 100 percent. Additionally, the online community survey results indicate that high winds (or a tornado) was the second most likely type of natural hazard event that would have a major impact on the county’s communities.

Damage from straight line winds usually affects multiple counties through the loss of electricity from trees/tree limbs downing power lines; causing widespread property damage; and potentially exposing the public to severe injury or fatality due to flying debris. The magnitude and severity depend on the county population, seasonal activity, and the spread of development. During the summer months, the base population expands by as much as 73% due to the peak presence of seasonal homeowners and overnight visitors. Residents and visitors are attracted to both rural, sparsely populated natural areas as well as village and city centers throughout the year for outdoor recreation (motorized & non-motorized trails; year-round camping, hunting, swimming/boating) and festivals/special events.

Mobile homes and campgrounds were identified as specific areas of concern; their approximate locations in the county are indicated on the *Vulnerable Populations & Hazard Areas Map* in the Appendix. These are areas where concentrations of people and property can be particularly vulnerable during a severe winter weather, thunderstorm, high wind, lightning, hail, tornado, wildfire, extreme temperatures, or public health emergency.

Additionally, wind damage to trees and resulting road blockages/power outages is a specific hazard concern in heavily forested, rural communities in Wexford County, such as Greenwood Township.

## Hail

Hailstorms occur when a severe thunderstorm produces hail that falls to the ground. Hail is formed when the updrafts of the storm carries water droplets above the freezing level, where they form into rounded or irregular lumps of ice that range from the size of a pea to the size of a grapefruit. When the weight of the hail is no longer supported by the air, it falls to the ground and has the potential to batter crops, dent automobiles, and injure people and wildlife. Sometimes, large hail appears before a tornado since it is formed in the area of a thunderstorm that tornadoes are most likely to form.

According to the 2019 Michigan Hazard Mitigation Plan, Michigan has on average 191 hail storms, an expected annual statewide loss of about \$16.6 million, no deaths, and approximately 1 injury per year. Despite damaging hail occurring in every part of Michigan, the areas of the state most prone to severe thunderstorms (e.g. the Southern half of the Lower Peninsula) are also most prone to large and damaging hail. The majority of the hailstorms occur during the growing season from May through August when crops have the greatest potential to be damaged by hail.

According to the 2012 Michigan Hazard Analysis, the National Weather Service began recording hail activity in Michigan in 1967. The National Weather Service issues forecasts for severe thunderstorms with sufficient warning time to allow residents to take appropriate action to reduce the effects of hail damage to vehicles and some property. However, little can be done to prevent damage to crops. For example, during September 26-27, 1998, a line of severe thunderstorms moved across northern Lower Michigan producing hail up to 2" in diameter, destroying an estimated 30,000-35,000 bushels of apples at area farms, and damaging several homes and vehicles.

### *Location*

Hailstorms are regional events that frequently accompany thunderstorms, and are not confined to geographic boundaries. The severity of hailstorms may range across the affected areas. All of Wexford County is at risk to the occurrence and impacts from hailstorms. According to the National Weather Service, Wexford County is in an area of the United States that has on average two days of hailstorm events per year.

### *Extent*

According to the NOAA National Centers for Environmental Information, the approximate size of hail is described as follows in Table 23. If a thunderstorm produces hail that is 1 inch in diameter (quarter size) or larger, it is considered to be a severe thunderstorm.

Table 23: NOAA Hail Size Description

<u>Diameter</u>	<u>Size Description</u>
1/4"	Pea Size
1/2"	Mothball Size
3/4"	Penny Size
7/8"	Nickel Size
1" (Severe Criteria)	Quarter Size
1 1/4"	Half Dollar Size
1 1/2"	Walnut or Ping Pong Ball Size
1 3/4"	Golf Ball Size
2"	Hen Egg Size
2 1/2"	Tennis Ball Size
2 3/4"	Baseball Size
3"	Teacup Size
4"	Grapefruit Size
4 1/2"	Softball Size

The greatest extent hail reported in Wexford County was 2 inches diameter on July 25, 2012 during a hailstorm between Manton and Missaukee JCT, and on September 7, 2021 in Cadillac. According to the scale, hailstones of this size are equivalent to a hen egg.

### *Previous Occurrences*

Between 1984 and September 2022, Wexford County had 33 hailstorms reported to NOAA (Table 24). There are no reported property damages, crop damages, injuries or deaths attributed to hail in Wexford County.

Table 24: Wexford County Hail Events

Begin Location	Date	Magnitude (in.)
	6/17/1984	0.75
	7/23/1988	0.88
	3/27/1991	1.75
Cadillac	8/3/1993	0.75
S WEXFORD COUNTY	5/18/1996	0.75
CADILLAC	6/10/1996	0.88
BUCKLEY	4/6/1997	0.75
MANTON	7/16/1997	1.5
CADILLAC	8/23/1998	0.75
CADILLAC	8/23/1998	1
CADILLAC	5/12/2000	0.75
CADILLAC	6/8/2003	0.75
CADILLAC	6/8/2003	0.75
MANTON	5/24/2004	0.88
CADILLAC	6/27/2006	1.5
CADILLAC	7/9/2006	0.75
CADILLAC	10/2/2006	0.75
BAXTER	5/9/2007	0.88
CADILLAC	10/18/2007	0.75
MESICK	6/12/2008	1.75
MANTON	6/12/2008	0.75
CADILLAC	6/12/2008	0.88
LAKE CADILLAC	6/22/2008	0.75
CADILLAC	7/18/2010	0.75
LAKE CADILLAC	4/10/2011	0.75
MANTON	5/29/2011	0.88
MANTON	7/25/2012	2
CADILLAC	4/7/2020	1
CADILLAC	4/7/2020	0.75
MANTON	4/7/2020	1.25
CADILLAC	9/7/2021	2
CADILLAC	9/7/2021	1
YUMA	9/21/2022	0.75

Source: NOAA: National Centers for Environmental Information

#### *Probability of Future Events and Vulnerability Assessment*

With 33 hail events reported between 1984 and 2022, Wexford County has an 87% chance of a hailstorm event in a given year. All existing and future buildings, exposed infrastructure, and populations are at risk from hailstorms since hail causes damage to roofs, brick walls, glass, landscaping, crops, and cars. Manufactured homes and campground populations located throughout the county and are more susceptible to hail damage (refer to the Vulnerable Populations and Hazard Areas map in Appendix A). Hail can also damage roads, sidewalks, bridges, and above ground utilities. Hail has the potential to cause injury and death, and populations are advised to take shelter when an event occurs.

The magnitude and severity depend on the county population, seasonal activity, and the spread of development. During the summer months, the base population expands by as much as 73% due to the peak presence of seasonal homeowners and overnight visitors. Residents and visitors are attracted to both rural, sparsely populated natural areas as well as village and city centers throughout the year for outdoor recreation (motorized & non-motorized trails; year-round camping, hunting, swimming/boating) and festivals/special events.



## **Riverine and Urban Flooding**

Riverine flooding occurs when rivers, streams, and lakes overflow into adjacent floodplains due to prolonged, intense rainfall, rapid snowmelt or ice jams. Flooding can damage or destroy property, disable utilities, destroy crops and agricultural lands, make roads and bridges impassable, and cause public health and safety concerns. Floods occur in the early spring, but also occur in the winter due to ice jams, and during the summer or fall from severe thunderstorms. Flooding caused by severe thunderstorms has a greater impact on watercourses with smaller drainage areas.

Urban flooding occurs when water flows into low-lying areas because it does not have a place to go. This flooding occurs from a combination of excessive rainfall, snowmelt, saturated ground, and inadequate drainage, and is becoming more common in Michigan. Since development is occurring in floodplains, the natural landscape is unable to properly disperse the water. Urban flooding also has the potential to overflow onto docks or other structures with electricity running to them, which increases the risk for an electric shock drowning. Additionally, storm and sanitary sewers are unable to handle the water flows associated with storm events, which can result in sewer overflows and affect the water quality of nearby lakes and rivers, as well as structures with basements or shallow groundwater tables.

According to the 2019 Michigan Hazard Analysis, the most damaging hazard in Michigan, based upon estimated physical damages and known response/recovery costs, appears to be floods. The MSP reports that flooding events have a statewide expected annual loss estimated at more than \$100 million (\$25.69 million had previously been estimated in the 2014 Michigan Hazard Mitigation Plan, but Federal Disaster 4195 confirmed a higher magnitude more in line with earlier MDEQ estimates, as that Metro Detroit flood event was quite similar to Federal Disaster 1346 during the previous decade).

The MSP's 2019 Michigan Hazard Analysis indicates that the Northern Lower Peninsula averages 0.3 annual flooding events, with average annual property and crop damages of \$2,591,244 due to flooding.

### *Location*

The Manistee River flows through the northern portion of the county and is constricted at the Hodenpyl Dam in Springville Township. The Townships of Liberty, Greenwood, Hanover, Wexford and particularly Springville, as well as the Village of Mesick, are at risk from potential flooding along the Manistee River.

According to the National Inventory of Dams and EGLE's Michigan Dam Inventory, there are 10 major dams located in Wexford County, and 21 other minor dams in the county. The appended Wexford County Infrastructure Map illustrates the location of dams and their reported condition status. The details of the 10 major dams are provided in Table 25.

Table 25. Dams in Wexford County

Dam Name	Other Names	Location	Downstream Hazard Potential Class	Emergency Action Plan	EAP Updated	Inspection Date	Inspection Status	Owner Name
<b>Hodenpyl</b>		Springville Twp.	High	Yes	10/11/2019	9/30/2020	Not Available	Consumers Energy
<b>Lake Billings Dam</b>	aka Manton Upper Power Dam	City of Manton	Significant	Yes	2/24/2009	10/12/2021	Fair	City of Manton
<b>Wheeler Creek Dam</b>	Buckley Shores Inc. Dam	Hanover Twp.	Significant	Yes	8/8/2018	5/30/2018	Satisfactory	Lake Gitchegumee Property Own Assn
<b>Archie Castle's Dam</b>		Boon Twp.	Low	Not Required		1/1/1901	Failed	Mark Platz
<b>Brandy Brook Dam</b>		Selma Twp.	Low	Not Required		10/7/2019	Dam has not been inspected	Huron-Manistee National Forests
<b>Clam River Control Dam</b>	Cadillac-Mitchell Lake Level Control	City of Cadillac	Low	Not Required		4/11/2018	Satisfactory	Wexford County
<b>Kerr Upper Dam</b>		Hanover Twp.	Low	Not Required		8/24/1977		Marlin Kerr
<b>Manton Millpond Dam</b>	Millpond Dam	City of Manton	Low	Not Required		9/16/2011	Removed	City of Manton
<b>Norman Smith Dam</b>		Cherry Grove Twp.	Low	Not Required		10/21/2011		SAKK Investments LLC
<b>White Lake Dam</b>	Barnes Dam	Antioch Twp.	Low	Not Required		8/29/2016		Ronald White

The Hodenpyl hydroelectric dam is located in Springville Township in Wexford County, near the border with westerly adjoining Manistee County. The dam was commissioned in 1925, is owned by Consumers Energy (CE) and is considered a “High Hazard” potential dam, meaning that failure or dam misoperation will probably result in loss of human life. CE is required to maintain an Emergency Action Plan on file with the Federal Energy Regulation Commission (FERC). The hydro operating license issued by FERC to CE for the dam will expire in 2034. Future potential options for the dam include: 1) Relicense the dam, meeting all the new regulatory requirements, and continue to generate power; 2) Surrender the license and sell the dam to a third-party owner, who could maintain the dam structure and impoundment; 3) Remove the dam and return the river to its natural state; or 4) Replace the dam with an alternative structure.

From August – October 2022, CE and Public Sector Consultants held a local public engagement session regarding input on potential future plans for the dam; they also surveyed property owners located within 100 feet of CE property lines to obtain their feedback as well. In 2023, CE intends to provide their long-term hydro strategy, and between 2023 and 2034, the relicensing and/or retiring process will be underway, which will continue to include community engagement efforts. Refer to CE’s website for updated information about planning for the future of hydroelectric dams in Michigan: <https://www.consumersenergy.com/company/electric-generation/renewables/hydroelectric/hydro-future>

The Wheeler Creek Dam on Lake Gitchegumee in the Village of Buckley/Hanover Township is considered a “Significant Hazard” potential dam, as well as the Lake Billings Dam on Billings Lake in the City of Manton. An Emergency Action Plan and regular 3-year inspections by Michigan Dept. of EGLE are required for these dams. The most recent inspection for the Lake Billings Dam from 2021 indicates that the dam is in fair conditional overall, but there are several recommendations for monitoring and repair of deficiencies that do not currently pose an immediate threat to the safety of the dam but should be completed. The report provided the following recommendations listed in order of importance:

- Broken concrete along spillway walls should be removed, the underlying material and sheet pile wall inspected, backfill any areas disturbed, compact fill, and resurface areas with concrete. Monitor sheet piling walls for further seepage after work has been performed. This work should be completed by December 31, 2022.
- Annually review the Emergency Action Plan (EAP) with the Emergency Services Coordinator for Wexford County and update it as appropriate. In accordance with Part 315, provide a copy of the findings of the EAP review and any updates to the plan to the Dam Safety Program and the Wexford County Emergency Management Coordinator by December 31, 2022.
- Create an Operation and Maintenance Plan (O&M Plan). This should include routine maintenance, address repair procedures when required, and include operation of the spillway gates during flood conditions by June 30, 2022.
- Monitor cracks on concrete cap of sheet piling for further deterioration and consider resurfacing concrete where hairline cracks are visible.
- Routinely monitor embankments for wave erosion and animal burrows. Sloughs and burrows should be filled, compacted and seeded or ripped as needed.

The City of Cadillac is most at risk for urban flooding, due to the high amount of impervious surfaces in the City. The City of Cadillac, along with adjoining Clam Lake Township, Cherry Grove Township, Selma Township and Haring Charter Township are also at risk from riverine flooding due to the presence of Lake Mitchell, Lake Cadillac and the Clam River.

During the public input process for developing this plan, the following concerns were identified regarding flooding and/or erosion concerns. These areas are also indicated on the appended hazard area maps.

- The aging Clam River Control Dam, located where Lake Cadillac feeds into the Clam River in the City of Cadillac, is in need of a major retrofit within the next ten years. This infrastructure upgrade will aid in alleviating flooding and shoreline erosion issues that have occurred on the land surrounding the lake and the Clam River (affecting areas in the City of Cadillac, Clam Lake Twp., and Haring Charter Twp.)
- Shoreline erosion concerns along Lake Mitchell as well (affecting Cherry Grove Twp. and Selma Twp.)
- Properties located in the City of Cadillac, between Lake Street and the railroad, with Haynes St. bordering to the north and Pine St. to the south, have experienced seasonal flooding/ basement flooding. Activities from a former lumber mill northeast of Lake Cadillac resulted in sawdust/lumber waste deposited in the soil. This area includes property public and private commercial/office and residential property.
- Land that surrounds Lake Mitchell in Cherry Grove and Selma Township, much of which contains Part 303 State regulated wetlands
- Land along Slagle Creek (in Slagle and Boon Townships, including the Village of Harrietta), the Manistee River (in Liberty, Greenwood, Hanover, Wexford, and Springville Townships), and the Pine River (South Branch Twp.)
- Land near the Lake Billings Dam in the City of Manton/Cedar Creek Twp.
- Roads in Wexford Twp.
  - W4 Rd., located NE of N7 Rd.
  - N9 Rd. between W. County Line Rd. and W4 Rd.
  - Around the intersection of W. 2 ½ Rd. and N11 Rd.
  - N11 Rd. between W. 12 Rd. & W. 12 ½ Rd.
- Roads in Greenwood Twp.
  - Manistee River surrounded by the following roads: N 27 ½ Rd., E 2 ½ Rd., N 29 ½ Rd., and River Rd.
- Cedar Creek Twp. and Colfax Twp.
  - Road intersection of N37 Rd and E16 Rd.

### *Extent/Previous Occurrences*

There have been 11 flooding events that have occurred between 2000 and 2021 (Table 26), resulting in a total of \$980,000 of property damage. Nine of these events were flash floods; two were flooding events. Many of the events have occurred within the City of Cadillac, as well as in communities along the Manistee River in the northern portion of the county, and around Lake Cadillac/Lake Mitchell to the west of the City of Cadillac. Flooding is the most costly type of natural hazard event in Wexford County.

The most damaging event on record occurred between June 12 and 17, 2008, when heavy rainfall caused widespread flooding in southern Wexford County, with isolated flooding in the north, after to three to six inches of rainfall in a few hours either side of midnight. Numerous roads were washed out, especially on the northwest side of Lake Cadillac, and near and north of Mesick. One hundred and fifty homes were impacted by flood water. The flooding lingered for several days after the heavy rain event ended, mainly on the Manistee River and its larger tributaries. The Manistee River at Sherman established a new flood of record on the 14th, reaching 16.4 feet. Several homes just above Hodenpyl Dam Pond had to be evacuated. As a result of the flooding, the Governor declared a state of emergency for Manistee and Wexford Counties, along with other counties downstate. This flash flood event resulted in \$790,000 in reported property damages in Wexford County.

The second most damaging flood event occurred on April 14, 2014. A tardy spring thaw was enhanced by a widespread 1 to 2 inches of rain that fell on the 13th and 14th. Two areas of concentrated flooding occurred in Wexford County, with a number of road closures. One was along Lake Mitchell, just west of Cadillac. The other was along the Manistee River in far northern sections of the county. Water entered multiple homes at both location, along with properties along the Manistee River in the north section of the county. This flood event resulted in a reported \$110,000 in property damage.

Table 26: Wexford County Flood Events

Event Type	Begin Date	Begin Location	End Location	End Date	Property Damage
Flash Flood	5/12/2000	Cadillac	Cadillac	5/12/2000	\$0
Flash Flood	4/12/2001	Countywide	Countywide	4/16/2001	\$0
Flash Flood	5/15/2001	Countywide	Countywide	5/15/2001	\$0
Flash Flood	5/19/2001	West portion	West portion	5/20/2001	\$0
Flash Flood	5/9/2004	Cadillac	Cadillac	5/9/2004	\$20,000
Flash Flood	6/12/2008	Hoxeyville	Harlan	6/13/2008	\$750,000
Flood	6/13/2008	Harrietta	Meauwataka	6/17/2008	\$40,000
Flash Flood	7/25/2012	Haring	Sherman	7/25/2012	\$40,000
Flash Flood	7/27/2012	Cadillac	Lake Cadillac	7/27/2012	\$12,000
Flash Flood	11/17/2013	Lake Mitchell	Lake Cadillac	11/17/2013	\$10,000
Flood	4/14/2014	Lake Cadillac	Manton	4/15/2014	\$110,000

Source: NOAA: National Centers for Environmental Information

#### *Probability of Future Events and Vulnerability Assessment*

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 water or sewer lines causing water supply pollution, downed power lines, broken gas lines, fires, and the release of hazardous materials.

Since 2000, Wexford County has had eleven flash flood or flood events, which equates to a 52% chance that a flood event would occur in a given year. The magnitude and severity of a heavy rainfall event also depends on the population densities, seasonal activity, and the spread of development. During the warm or summer months, the population expands to include both the permanent resident base population and the seasonal short- and long-term population. The seasonal population is attracted to both rural, sparsely populated rural areas and urban activity centers.

Specific flood hazard areas were identified during public meetings and are identified on the Hazard Areas Map provided in Appendix A. The public online community survey results indicated that flooding was the third most likely type of natural hazard event that would have a major impact on the county's communities. Additionally, when survey participants were asked what types of infrastructure failures they were most concerned about being able to withstand a natural hazard event, all responses were related to the possibility of flooding:

- Utility/Electrical Outage (7) (Lake Mitchell may overflow if water level control dam is not powered)
- Failing bridges/culverts/roads (7)
- Failing dams (3)
- Water contamination (1)

Flood hazard information may be obtained from the Flood Rate Insurance Maps (FIRM) available for jurisdictions. In order to delineate potential flood plain areas (seasonal floodplains) for each jurisdiction, the appended hazard maps show surface water bodies, rivers and streams, State-regulated (Part 303) wetlands, watershed boundaries and areas with slope exceeding 30%. Digital Elevation Model data are from the Center for Geographic Information, Michigan Department of Information Technology.

#### *NFIP Participation Status*

FEMA's online National Flood Hazard Layer (NFHL) is a geospatial database that contains current effective flood hazard data, which support the National Flood Insurance Program (NFIP). Flood Insurance Rate Maps, or FIRMs, can be viewed for participating areas in the U.S. through the NFHL. The FIRMs aid in better understanding a property's level of flood risk and type of flooding in the area. The maps show the delineation of the 1% Annual Chance Floodplain Boundary (the "100-Year Flood Boundary") and the 0.2% Annual Chance Floodplain Boundary (the "500-Year Flood Boundary").

For a particular river, USGS collects river streamflow data over time, determines the largest flood in each year, and then calculate statistical data for that river. The more years of data available, the more accurate the estimates for the various

flood quantiles. As more years of data become available, the estimates become more refined, which can result in revisions to the quantiles and thus revised floodplain boundaries.<sup>7</sup> Urban development and installation of flood controls can also result in changes in streamflow data over time.

The NFIP provides flood insurance to property owners, renters and businesses, and having this coverage helps them recover faster when floodwaters recede. The NFIP also works with communities required to adopt and enforce floodplain management regulations that help mitigate flooding effects. There is no cost for communities to participate. NFIP information for Wexford County communities is provided in Table 27. Digital Flood Insurance Rate Maps are not currently available for NFIP participating communities in Wexford County. (Will they be available in the next 5 years?). Are there any residential properties that have suffered repetitive flood losses? (A NFIP-insured structure that has had at least 2 paid flood losses greater than \$1,000 each in any 10-year period since 1978.)

Table 27: Wexford County NFIP Participation Status and Related Information

Municipality	NFIP Participant	Floodplain Management Adoption*	FIRM Map Adoption	Current Effective Map Date	Reg-Emerg Date**	Community ID #	Implementation Method***	Appointed Designee****	Implementation of Damage Provisions*****
City of Cadillac	Y	Y	Y	8/3/1998	3/18/1996	260247#			
City of Manton	N								
Village of Buckley	N								
Village of Harrietta	N								
Village of Mesick	N								
Antioch Township	N								
Boon Township	N								
Cedar Creek Township	Y			NSFHA	9/26/2016	260935#	N/A		
Cherry Grove Township	Y			8/3/1998	7/28/1999	260938#			
Clam Lake Township	N			8/3/1998	8/3/1999	260939#			
Colfax Township	N								
Greenwood Township	Y			NSFHA	6/30/1997	260947#	N/A		
Hanover Township	N								
Haring Charter Township	N			8/3/1998	8/3/1999	260928#			
Henderson Township	N								
Liberty Township	N								
Selma Township	Y			8/3/1998	9/30/1998	260757#			
Slagle Township	N								
South Branch Township	N			8/3/1998	8/3/1999	260944#			
Springville Township	N								
Wexford Township	N								

Source: FEMA Community Status Book, accessed 4/6/2023

Notes:

\* Adoption of NFIP minimum floodplain management criteria via local regulation.

\*\* The date the community first joined the NFIP.

\*\*\* How local floodplain management regulations are implemented and enforced in Special Flood Hazard Areas.

\*\*\*\* The designee or agency that is appointed to implement the addressed commitments and requirements of the NFIP.

\*\*\*\*\* How participants implement the substantial improvement/substantial damage provisions of their floodplain management regulations after an event.

A Non-Special Flood Hazard Area (NSFHA) is an area that is in a moderate-to-low risk flood zone (Zones B, C, X Pre- and Post-FIRM). An NSFHA is not in any immediate danger from flooding caused by overflowing rivers or hard rains. However, it's important to note that structures within a NSFHA are still at risk. In fact, nearly 1 in 4 NFIP flood claims occur in these moderate- to low-risk areas! ([www.fema.gov](http://www.fema.gov))

<sup>7</sup> <https://www.usgs.gov/faqs/why-do-values-100-year-flood-seem-change-every-flood>

Additionally, Michigan State Police's *2019 Michigan Hazard Analysis* provides the following National Flood Insurance Statistics for Wexford County (Table 28):

Table 28: NFIP Statistics for Wexford County

Total Premium	Policies	A-Zone Policies	Total Coverage	Claims since 1978	Total Paid since 1978
\$38,792	39	22	\$7,372,300	7	\$20,098

## Lightning

Lightning is a random and unpredictable discharge of electricity in the atmosphere between the clouds, air, or ground to equalize the charged regions in the atmosphere. It is still being debated how the electrical charges build up in the clouds. Lightning generally occurs during thunderstorms; however, it can occur without a thunderstorm, such as during intense forest fires and heavy snowstorms. Lightning that occurs without nearby rain is most likely to cause forest fires.

### *Location*

Lightning is not confined to geographic boundaries and is a regional event. Since lightning occurs randomly, it is impossible to predict where lightning will occur and how severe it will be. All of Wexford County is at risk to the occurrence and impacts from lightning.

### *Extent/Previous Occurrences*

There has been one lightning event reported to NOAA for Wexford County. There were no injuries or fatalities.

On September 1, 2000 a series of evening thunderstorms across the northwest Michigan region produced lightning that was nearly continuous. One man was killed by the lightning (not in Wexford County) when he and his 9 year old son climbed a small hill behind a shopping mall to view the approaching lightning. The 40 year old father was struck and killed by a lightning bolt. His son was thrown to the ground, but only sustained minor injuries. Lightning that Friday night also disrupted numerous high school football games. Many games were cancelled or postponed until the following Saturday morning. Many of the schools which began play had lengthy delays and many waited an hour or more before fans and players could return to the field. This was widely covered by area newspapers and television stations. The cost of postponed games is not known.

Additionally, public input received as part of this plan development included instances of a communications tower in Wexford Township that has been repeatedly struck by lightning.

### *Probability of Future Events and Vulnerability Assessment*

Since there has been one lightning events that have occurred on record in the last 22 years, there is a 4.5% chance that a damaging lightning event would occur in a given year. However, not all lightning events may have been reported since events with injuries, deaths, and extensive damages tend to be the only ones reported. Therefore, the number of lightning events and damages are likely higher.

All existing and future buildings, exposed infrastructure, and populations are at risk from lightning events since it may cause structural and wildland fires, loss of electrical and telecommunications equipment, and damage to buildings or vehicles from falling trees struck by lightning. People that work outside or participate in outdoor recreation activities are at a higher risk to be struck by lightning.

The magnitude and severity depend on the county population, seasonal activity, and the spread of development. During the summer months, the base population expands by as much as 73% due to the peak presence of seasonal homeowners and overnight visitors. Residents and visitors are attracted to both rural, sparsely populated natural areas as well as village and city centers for outdoor recreation (motorized & non-motorized trails; year-round camping, hunting, swimming/boating) and festivals/special events.

The approximate locations of campgrounds in the county are indicated on the *Vulnerable Populations & Hazard Areas Map* in the Appendix. These are areas where concentrations of people and property can be particularly vulnerable during a severe winter weather, thunderstorm, high wind, lightning, hail, tornado, wildfire, extreme temperatures, or public health emergency.

## Tornado

A tornado is a violently rotating column of air that extends from a thunderstorm to the ground, and can occur anytime during the day and throughout the year. It can only be seen if water droplets, dust, and debris form a funnel. The funnel cloud can have winds that reach up to 300 miles per hour with an interior air pressure that is 10-20% below the surrounding atmosphere's pressure. The length of a tornado path has been reported up to 200 miles. Tornado path widths are generally less than one-quarter mile wide. These storms are the most violent of the atmospheric storms since they have the potential to destroy buildings, uproot trees, hurl objects, and cause loss of life.

According to the National Oceanic and Atmospheric Administration/National Weather Service's Storm Prediction Center, tornadoes cause approximately 60 deaths and hundreds of millions of dollars in property damage each year. According to the 2019 Michigan Hazards Plan, Michigan is located on the northern fringe of the nation's tornado belt and has a statewide expected annual loss of about \$19.6 million due to tornadoes. Michigan also has an average of 18 tornadoes, approximately 4 deaths, and approximately 50 injuries per year. Between 1999 and 2019, Michigan has had 314 reported tornado events with 52.9% as EF0 (weak) or EF1 (moderate), 38.9% reported as F0 or F1 (weak), 6.7% as EF2 (significant) or EF3 (severe), and 1.6% as F2 (strong). In Northern Michigan, tornados are most likely in the summer months, although some have occurred in the spring and fall.

### Location

Tornadoes are a regional event that are not confined to geographic boundaries and can affect several areas at one time. Also, the magnitude of tornadoes may range across the affected areas. All of Wexford County is at risk to the occurrence and impacts from tornadoes. It should be noted that it is impossible to predict where and with what magnitude a tornado will touchdown.

The eight tornadoes described in Table 30 have impacted different communities in Wexford County. The appended *Hazard Areas* map and *Vulnerable Populations and Hazard Areas* map show the estimated trajectories of the reported tornado events in the county.

### Extent

The Fujita Scale (Table 29) categorizes tornado severity based on observed damage. The six-step scale ranges from F0 (light damage) to F5 (incredible damage). As of February 2007, the National Weather Service uses the Enhanced Fujita Scale (EF Scale). This new scale ranges from EF0 to EF5. Based on the Enhanced Fujita Scale, Wexford County's most damaging tornados occurred on July 31, 1963 and June 7, 1974 with winds ranging from 110-137 mph, with damages totaling \$275,000. One injury occurred as a result of the 1974 tornado. No deaths were reported.

Table 29: Fujita and Enhanced Fujita Scale Comparison

Fujita Scale		EF Scale	
Fujita Scale	3-Second Gust Speed (mph)	EF Scale	3-Second Gust Speed (mph)
F0	45-78	EF0	65-85
F1	79-117	EF1	86-109
F2	118-161	EF2	110-137
F3	162-209	EF3	138-167
F4	210-261	EF4	168-199
F5	262-317	EF5	200-234

Source: FEMA

### Previous Occurrences

Since 1963, Wexford County has had 8 reported tornadoes, causing a total of \$820,500 in property damages and one injury (Table 30).



Table 30: Wexford County Tornado Events

Location	Date	Deaths	Injuries	Scale	Property Damage	Crop Damage
Haring Charter Twp, Clam Lake Twp.	7/31/1963	0	0	F2	\$250,000	-
Clam Lake Twp.	8/4/1968	0	0	F1	\$2,500	-
Cherry Grove Twp.	6/7/1974	0	1	F2	\$25,000	-
Liberty Twp.	6/15/1976	0	0	F1	\$25,000	-
Selma Twp.	7/7/1980	0	0	F0	\$0	-
Village of Buckley	10/15/1989	0	0	F1	\$250,000	-
Cherry Grove Twp.	10/4/2006	0	0	F0	\$260,000	-
Clam Lake Twp.	7/18/2010	0	0	EF0	\$8,000	-
<b>TOTAL</b>	<b>8 Tornadoes</b>	<b>0</b>	<b>1</b>	<b>F0 – F2</b>	<b>\$820,500</b>	<b>\$0</b>

Source: NOAA: National Centers for Environmental Information

#### *Probability of Future Events and Vulnerability Assessment*

Since there have been eight tornado events reported in the last 58 years, this indicates a 13.8% chance a tornado would occur in a given year. While the chance for a tornado is low, if an event occurs, there is potential for a higher magnitude tornado to touch down. Many of the reported historic events have caused property damage. Additionally, the public online community survey results indicate that high winds/ tornado was the second most likely type of natural hazard event that would have a major impact on the county's communities.

The magnitude and severity depend on the county population, seasonal activity, and the spread of development. During the summer months, the base population expands by as much as 73% due to the peak presence of seasonal homeowners and overnight visitors. Residents and visitors are attracted to both rural, sparsely populated natural areas as well as village and city centers throughout the year for outdoor recreation (motorized & non-motorized trails; year-round camping, hunting, swimming/boating) and festivals/special events.

The approximate locations of mobile homes and campgrounds in the county are indicated on the *Vulnerable Populations & Hazard Areas Map* in the Appendix. These are areas where concentrations of people and property can be particularly vulnerable during a severe winter weather, thunderstorm, high wind, lightning, hail, tornado, wildfire, extreme temperatures, or public health emergency.

The county utilizes the “Code Red” mass notification system for notification of tornado warnings and watches, along with other severe weather alerts. The system notifies a participant via their mobile or land-line phone. The National Weather Service may concurrently utilize their notification system when deemed necessary in severe weather event situations to send phone notifications to all users within signal of a cellular tower. Tornado sirens are no longer utilized in the county as they are not as effective or efficient as the Code Red system.

Cellular phone reception has been known to go down during wind storms, lightning strikes to cellular towers or as a result of high system demand in the peak summer tourism season. With this loss of communication, a backup system for communications is recommended, such as battery or solar powered NOAA weather radios. Additionally, local governments should pursue discussions with cellular utility providers regarding improvements to the cellular communications grid, such as additional towers or generator installation.

Wexford County Emergency Management Department maintains contracts with the eleven local fire stations in the county so that they may be utilized as temporary shelters in the event of an emergency. Additionally, the American Red Cross (ARC) can set up temporary shelters within 12-24 hours after an emergency event occurs; usually this is done within an existing structure. The Wexford County Senior Centers in Manton and Cadillac, as well as the Cadillac YMCA, can be utilized during the day hours for temporary heating/cooling shelters.

The ARC can also assist with organizing long-term shelters to house large amounts of people overnight; the Wexford Civic Center can hold about 4,000 people for this purpose if necessary. The Cadillac-Wexford Transportation Authority can be utilized for transporting people to shelters after an emergency.

## Extreme Temperatures

Prolonged periods of very high or very low temperatures are often accompanied by other extreme meteorological conditions, such as high humidity, drought, heavy snowfall, or high winds. Extreme heat or extreme cold primarily affect the most vulnerable segments of the population, such as the elderly, children, impoverished individuals, and people in poor health.

Nationwide, there have been approximately 175 deaths per year that are attributable to extreme heat according to the 2019 Michigan Hazard Analysis. The threats from extreme heat are heatstroke, sunstroke, muscle cramps, heat exhaustion, and fatigue. It is hazardous to livestock and agricultural crops, causes water shortages, exacerbates fire hazards, exacerbates respiratory problems, prompts excessive electrical energy demands, and causes infrastructure failures. Urban areas experience the most serious extreme heat with the combined high temperatures and high humidity that produce a heat-island effect.

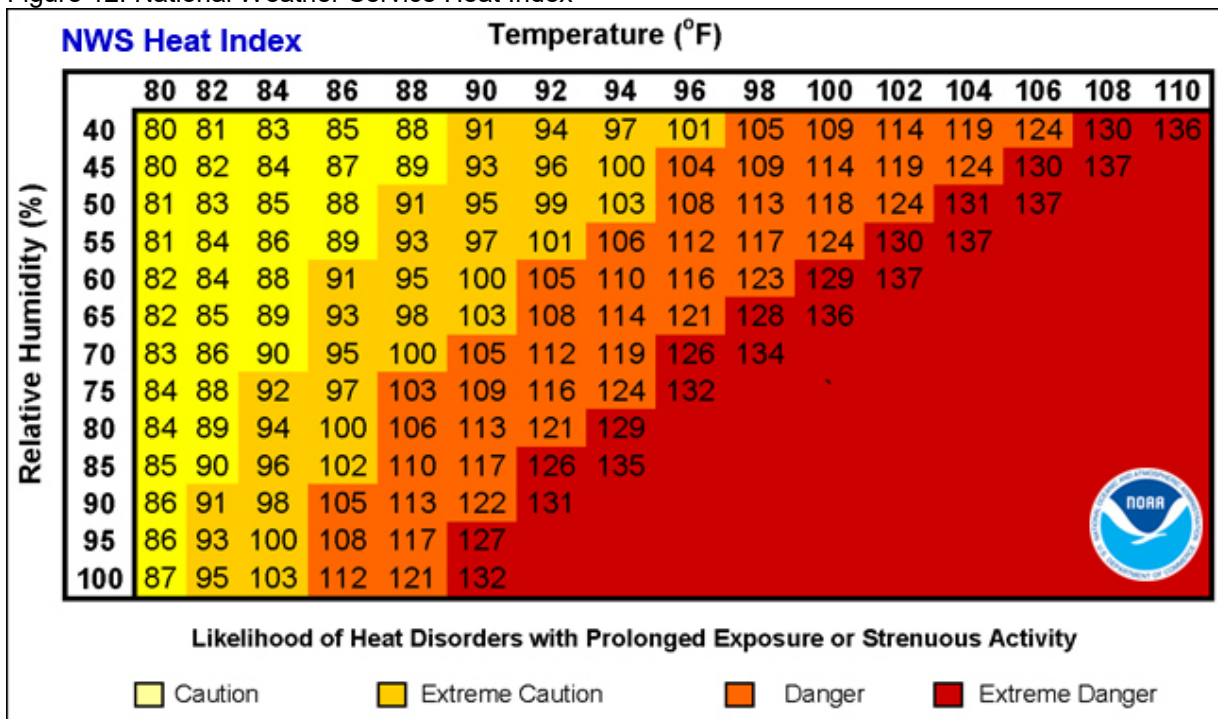
According to the 2019 Michigan Hazard Mitigation Plan, Michigan has 11 average annual extreme heat events with 0.4 average annual deaths and 41 average annual injuries.

In the United States, approximately 700 people die each year as a result of severe cold temperature-related causes according to the 2019 Michigan Hazard Analysis, with a significant number of deaths occurring due to illnesses or disease that are negatively impacted by severe cold weather, such as stroke, heart disease, and pneumonia. Exposure to extreme cold temperatures can be life threatening and can cause hypothermia and frostbite. According to the 2019 Michigan Hazard Mitigation Plan, Michigan has 35 average annual extreme cold events with 1 death, 9.4 average annual injuries, and \$6.4 million in average annual property and crop damage. Extreme cold affects transportation modes and power utilities, resulting in dead vehicle batteries and loss of power/heat.

### *Measuring Extreme Temperatures (Extreme Heat and Extreme Cold)*

Extreme heat is measured with the National Weather Service's Heat Index Chart (Figure 12). The chart uses relative humidity and air temperature to determine the likelihood of heat disorders with prolonged exposure or strenuous activity. Individuals are unable to shed excess heat from their bodies when they experience prolonged exposure to hot temperatures, which results in heat disorders.

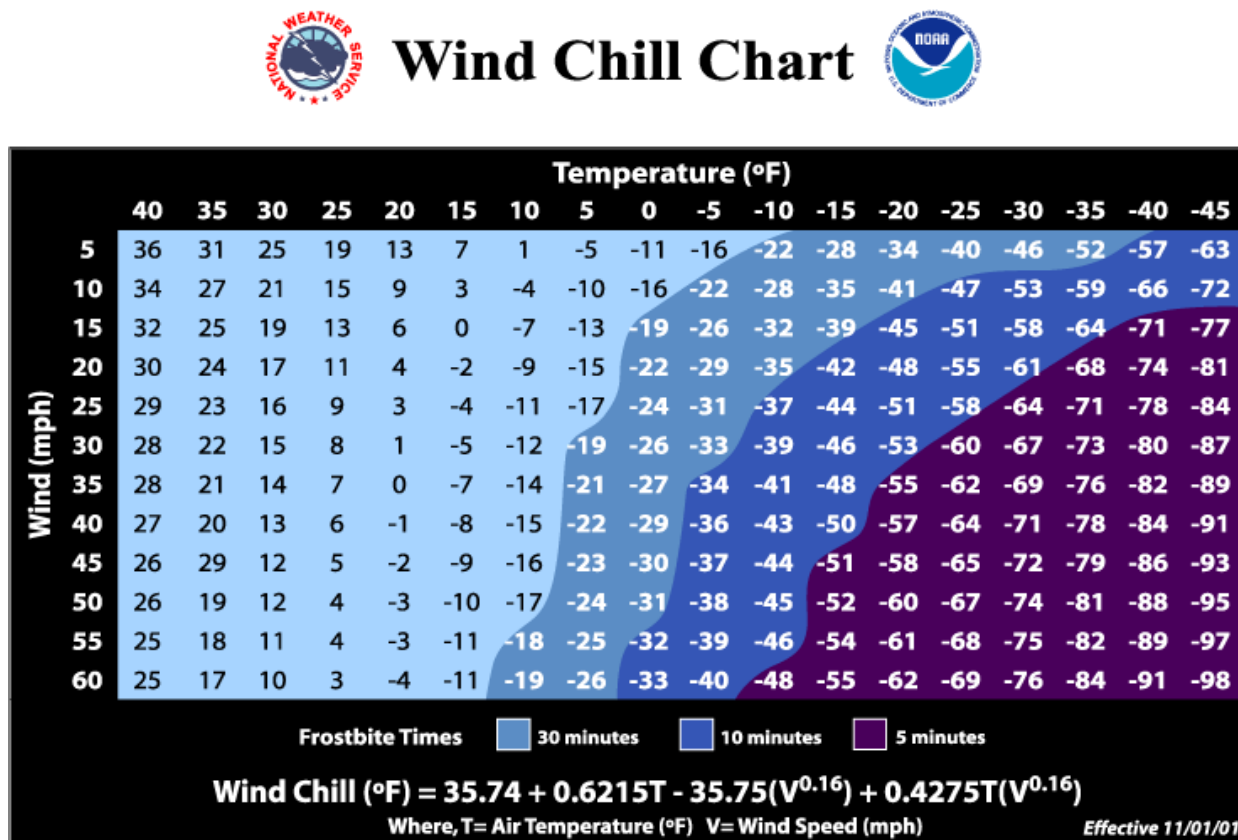
Figure 12: National Weather Service Heat Index



Source: National Weather Service

Extreme cold is measured with the wind chill index, which is a measure of the rate of heat loss from exposed skin caused by the combined effects of wind and cold. As the wind increases, heat is carried away from the body and reduces the external and internal body temperatures. Figure 13 shows the NOAA Wind Chill Chart as it corresponds to various temperatures and wind speeds.

Figure 13: National Weather Service Wind Chill Chart

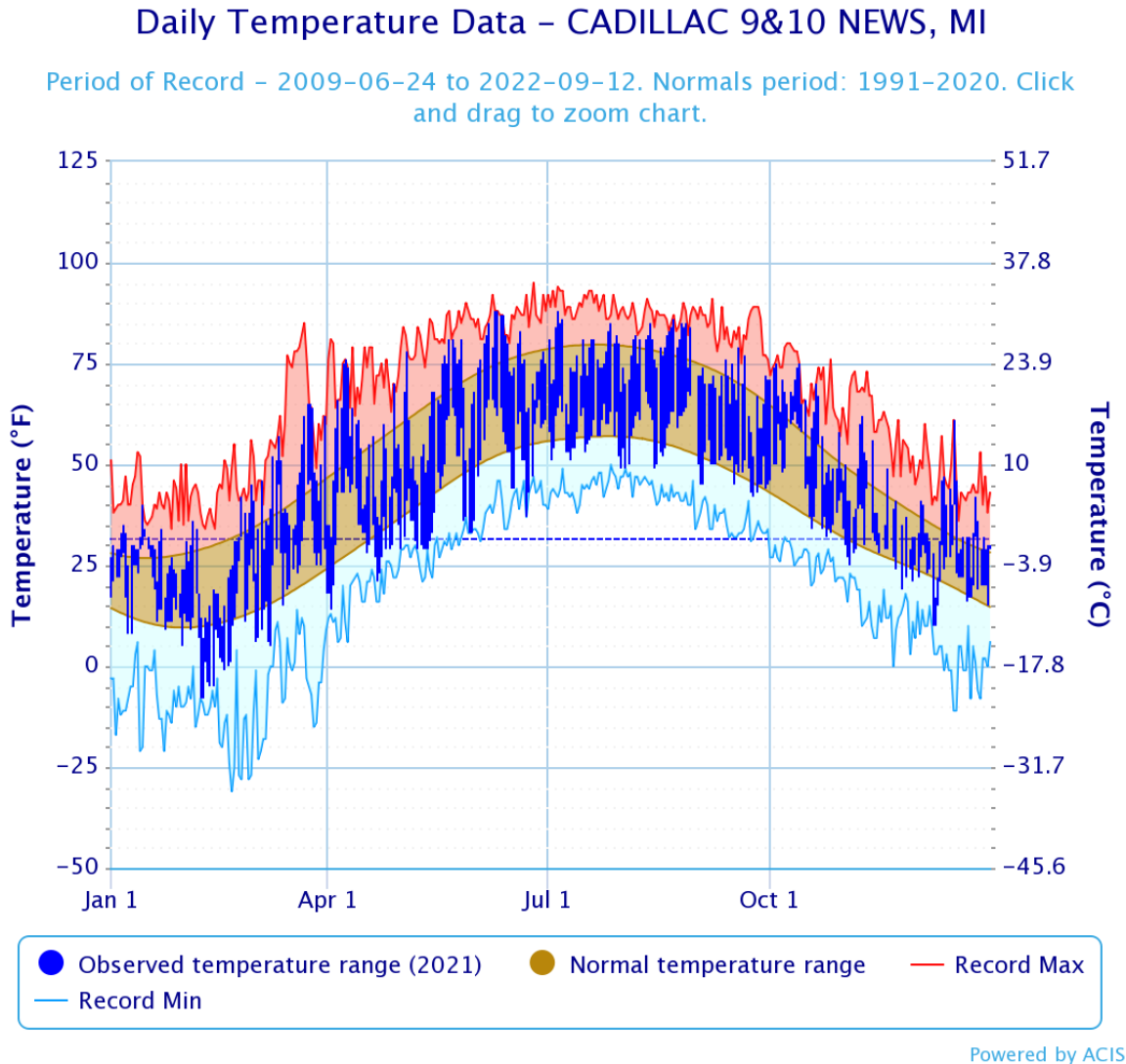


Source: National Weather Service

Figure 14 illustrates the observed daily temperature ranges at the Cadillac 9&10 news station for 2021. The dark blue line shows temperatures recorded between January 1 2021 and December 21, 2021. The red line above shows record high temperatures for that day, and the light blue line below indicates record low temperatures for that day on record since 1991. Several record temperatures were reached in 2021 for the following days:

- January 14: 40 degrees F.
- February 7: -8 degrees F. (record low)
- March 4: 46 degrees F.
- March 11: 57 degrees F.
- March 24: 65 degrees F.
- March 25: 64 degrees F.
- April 8: 76 degrees F.
- April 9: 74 degrees F.
- June 9: 88 degrees F.
- June 10: 88 degrees F.
- June 11: 87 degrees F.
- June 22: 37 degrees F. (record low)
- October 13: 75 degrees F.
- October 20: 70 degrees F.
- December 16: 61 degrees F.

Figure 14: Daily Temperature Data:



Source: NOAA Climate Data Online

***Location, Extent and Previous Occurrences***

Extreme temperatures are a regional event that are not confined to geographic boundaries and range in severity across the affected areas. All of Wexford County is at risk to the occurrence and impacts from extreme temperatures.

Wexford County has had two extreme heat events in 2001 and 2018. The events did not have any deaths, injuries, or property/crop damages. The heat events consisted of hot and humid conditions that caused outdoor events to be modified and attendance at outdoor events to be lower than normal.

The first instance of reported excessive heat occurred on August 1, 2001. Excessive Heat was also a problem the first two weeks in August across all of northern Michigan. Temperatures reach the mid to upper 90s, on average, a few days each year; however, for a 5 day (8/5 - 8/9) stretch overnight low temperatures failed to fall below the lower 70s in most areas. This very humid air mass was unusual for northern Michigan, an area which typically sees cool nighttime temperatures and for this reason has very few homes with air conditioners. No heat related deaths or injuries were reported; however, most outdoor events were modified due to the forecasts of hot and humid conditions. County fairs sent animals home, yet still there were livestock losses at fairs in Otsego and Alcona counties. Attendance at county fairs was well below normal and this was attributed to the heat. This period of excessive heat also brought on a drought event at the same time.

The second instance of reported excessive heat occurred on June 30, 2018. The month of June closed with one of the hottest days in recent memory. Highs were well into the 90s, including 99 at Alpena, and 98 at Traverse City and Gaylord. The National Weather Service office near Gaylord also hit 98; that was (by several degrees) the warmest reading

recorded at that location since observations began there in the late 1990s. Heat indices exceeded 105 degrees across most of northern Lower Michigan, and some locations exceed 110. The warmest reported heat index on the day was 114 near Indian River. An estimated 25 to 30 individuals visited local hospitals due to heat-related illnesses.

There have been three extreme cold events/wind chill events on record with NOAA for Wexford County - in 2007, 2014 and 2015 - as well as one Governor-declared statewide emergency for extreme cold in 2019. However, it should be noted that since cold temperatures typically occur during winter months, many events may have gone unrecorded.

The first reported event occurred on February 4, 2007. Exceptionally cold air surged into Northern Michigan. High temperatures on the 4th (Super Bowl Sunday) were around zero, with low temperatures that night from five to ten below zero. Gusty northwest winds produced hazardous wind chills of 20 to 30 below zero, along with blowing and drifting snow. Many area schools closed on the 5th, due to the extreme cold and poor road conditions.

The second instance of extreme cold/wind chill in the Great Lakes Region was in 2014 was the coldest since at least January 1994. Near- to below-zero temperatures were accompanied by blustery northwest winds. Away from the warming influence of Lake Michigan, wind chills sunk to 30 below zero or colder. The coldest wind chills observed were -44 near Cedarville, -39 near Engadine, -36 at Sault Ste Marie, and -33 at West Branch and Houghton Lake. All of these were reached in the morning hours of the 7<sup>th</sup>; school closings were widespread across northern Michigan on the 7th.

The third instance of extreme cold/wind chill occurred on February 19, 2015. Wind chills reached 30 to 40 below zero across part of northern Michigan, bottoming out at -43 near Cadillac early in the morning on the 19th.

The fourth instance of extreme cold/wind chill was the Governor Declared Emergency that occurred on January 29, 2019. Wind chills of 15 to 30 below zero were common in northern Lower Michigan. Wind chills were much colder in the UP, including -51 at Kinross, and -42 at Sault Ste Marie and Mackinac Island. The low temperatures caused schools to close.

#### *Probability of Future Events and Vulnerability Assessment*

There have been two extreme heat events on record with NOAA in Wexford County over the past 20 years: one in 2001 and one 2018. This indicates that there is 10% chance of another extreme heat occurring in a given year.

There have been four extreme cold/wind chill events on record for Wexford County between 2007 and 2021. This indicates that there is a 28.6% chance of another extreme cold event occurring in a given year. Since extreme cold events tend to occur during the winter months and are coupled with blustery winds and snowstorms, these events may have been reported as other hazards or not at all, which means there may have been more extreme cold events in the county.

Extreme heat and cold events are most likely to impact unsheltered populations (i.e., people at campgrounds, participating in outdoor recreation activities, and the homeless) as well as the elderly or disabled and persons living in poorly insulated structures. There are two homeless/safe house shelter sites in the county, located in Cadillac: New Hope Center and Oasis Family Resource Center.

Furthermore, the *Northwest Lower Michigan Coastal Resilience Atlas*, produced by the Land Information Access Association (LIAA), includes a Heat Vulnerability Assessment<sup>8</sup> of coastal communities. A community's vulnerability is their exposure to the hazard (determined by tree canopy and impervious surface coverage) + their sensitivity. Sensitivity is determined by the following factors:

- Persons > 65 years old
- Persons living alone
- Minority (non-white) persons
- Persons living below the poverty threshold
- People > age 25 with less than a high school education
- Disability status (i.e., ambulatory difficulty, mental disability)

While LIAA's study did not include Wexford County communities as they do not adjoin Lake Michigan, these demographic factors should be considered when developing future mitigation planning efforts to protect vulnerable populations in Wexford County from extreme temperature events.

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<sup>8</sup> Land Information Access Association. (2019). *Northwest Lower Michigan Coastal Resilience Atlas*. [http://www.resilientmichigan.org/nw\\_atlas.asp](http://www.resilientmichigan.org/nw_atlas.asp)



Drought

Drought is a normal part of the climate cycle. It is a slow-moving hazard, which causes people to underestimate the damage it can do, but losses from drought are as substantial as those from hurricanes, tornadoes and other faster-moving disasters. Drought causes losses to agriculture; affects domestic water supply, energy production, public health, and wildlife; and contributes to wildfire, to name a few of its effects.

Location

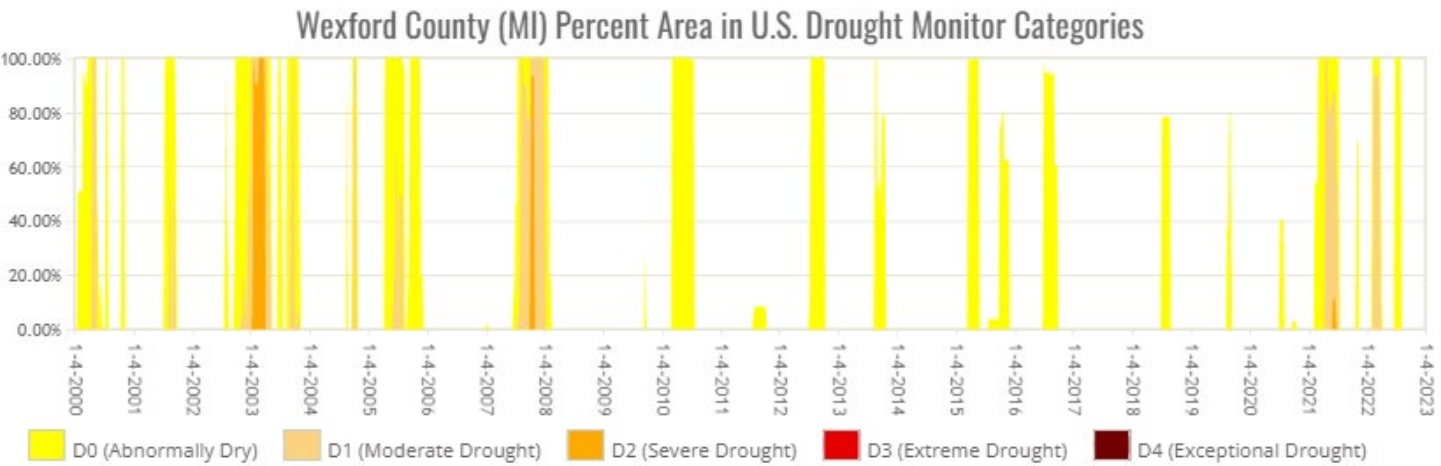
Drought is a regional event that is not confined to geographic boundaries and range in severity across the affected areas. All of Wexford County is at risk to the occurrence and impacts from drought.

Extent

The Palmer Drought Severity Index (PDSI) uses readily available temperature and precipitation data to estimate relative dryness. It is a standardized index that generally spans -10 (dry) to +10 (wet). Maps of operational agencies like NOAA typically show a range of -4 to +4, but more extreme values are possible. The PDSI has been reasonably successful at quantifying long-term drought.

The U.S. Drought Monitor (Figure 15) combines several input sources including the PDSI and the Standardized Precipitation Index to prepare a weekly map showing parts of the U.S. that are in drought. The map uses five classifications: abnormally dry (D0), showing areas that may be going into or are coming out of drought, and four levels of drought: moderate (D1), severe (D2), extreme (D3) and exceptional (D4) (Figure 16).

Figure 15: Wexford County Historical Drought Levels



Source: [US Drought Monitor](#)

Figure 16: U.S. Drought Categories and Historically Observed Impacts

Michigan

Category	Historically observed impacts
D0	Grass fires increase
	Lawns are brown; landscape and gardens are watered more frequently
D1	Most crops and vegetation are stressed; farmed Christmas trees are stressed
	Well levels decline
D2	Corn and soybean yields are low
	Mature trees are stressed
	Streamflow is extremely low, potentially too low to irrigate

Source: [US Drought Monitor](#)

### *Previous Occurrences*

There have been two instances of drought in Wexford County. The first was a Presidential Declared Emergency for drought problems in the State was enacted in 1977 and included Wexford County. The second occurred on August 1, 2001. It was preceded by a warmer than usual July 2001 with less than an inch of rainfall recorded in some areas. This lack of rain and warm conditions became serious during the first two weeks of August when little if any rain fell and temperatures jumped into the 90s. The stress on the crops was most noted in northern Michigan corn, but also hit hay crops to a lesser extent. As a result of the drought, the U.S.D.A. declared several counties disaster areas and granted farmers in counties where the crop losses were 30% or greater, special low interest loans.

### *Probability of Future Events and Vulnerability Assessment*

Between 1977 and May 2022 (45.4 years), there have been two drought events on record. This equates to a 4.4% annual chance for a drought event in Wexford County. In Northern Michigan's forested regions, drought can adversely impact timber production, agricultural production (particularly tree farms and animal farms) and some tourism and recreational enterprises. This can also cause a drop in income, which impacts other economic sectors.

Drought conditions also increase the risk for wildfire. Many portions of Wexford County are heavily forested and can be vulnerable to drought-related wildfire threats. Unpaved roads may also require applications to control dust, an expensive and short-term solution provided by County Road Commission. Additionally, the threat to water sources should also be considered. Many county residents rely on ground water wells for drinking water. Even drought events in category D1 experience water well level decline. Drought events combined with excessive heat can have severe impacts on vulnerable populations, such as the elderly and lower income populations.

## Wildfire

A wildfire is an unplanned, uncontrolled fire in grassland, brushland, or forested areas. Wildfires can occur in any forest or grassland type under dry conditions; however, some forest types are more susceptible to wildland fires. For example, jack and red pine forest stands have a high risk for wildfires, as they dependent on fire to provide all the right conditions for regeneration, while aspen and white pine forest stands have a moderate risk. The primary cause of wildfires is from human activities, specifically burning outdoor debris. Wildfires cause destruction to property and timber resources, and injuries or loss of life to wildlife and persons living or recreating in wildfire prone areas. Long-term effects include scorched and barren land, soil erosion, landslides/mudflows, water sedimentation, and loss of recreational opportunities.

Approximately 55% (20.4 million acres) of Michigan's total land area is forest cover. The vast forests provide Michigan with the largest state-owned forest system in the United States. In addition, Michigan has the fifth largest quantity of timberland acreage, with 19.3 million acres (including hardwoods and softwoods). That vast forest cover is a boon for both industry and recreation, and these areas have been gradually increasing in recent years. However, it also means that many areas of Michigan are vulnerable to wildfires.

Michigan's fire season starts in early spring, when leaves and grasses remain dry from fall and winter and trees are not yet green. Wildfires are often accompanied by drought where dry conditions increase the potential to burn. Often a thunderstorm will roll through and lightning will strike causing sparking of dry leaves and dead wood. High winds can then spread wildfire. Wildfires can become unpredictable in windy conditions or when the wind changes direction suddenly. Cooler nighttime temperatures often help suppress wildfires and the potential for wildfire; however Michigan has had several major fire events.

According to MDNR and U.S. Forest Service records, between 1910 and 1949, over 5.8 million acres of forest were burned in Michigan, an average of 145,000 acres per year. By comparison, it was reported that between 1950 and 1996, the MDNR and U.S. Forest Service were involved in suppressing over 46,100 wildfires that burned 390,000 acres of forest, which averages only 8,300 acres burned per year. This drastic reduction in the acres of timber burned was largely the result of (1) increased use of specialized equipment to suppress the fires, and (2) intensified efforts toward fire prevention.

However, lightning strikes are not the primary cause of wildfires in Michigan. Recently, only about 4% of all wildfire 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 of persons who live in the affected area or who are using recreational facilities in the area.

### *Location*

All of the county's communities and developed areas are vulnerable to wildfires since the community centers and rural residential developments interface with the high risk forest types (e.g. Red Pine, Eastern White Pine, and Jack Pine). Approximately 279,956 acres or 76% of Wexford County is forested. Red Pine comprises 32.9% of the county's forested land; Jack Pine comprises 3.39% and Eastern White Pine comprises 0.03%. Refer to the locations of pine forest shown on the *Hazard Areas Map* and *Environmental Features Map* in Appendix A.

### *Extent and Previous Occurrences*

Extent can be measured by the number of acres burned and the cost of property damage. Approximately 41% of the county's total acreage is managed by the National Forest Service and the Michigan Department of Natural Resources.

According to the *2019 Michigan Hazard Analysis* from the Michigan State Police, between 1981 and 2018 there were 467 reported wildfires on lands in Wexford County under MDNR jurisdiction. This is equal to 31.6 acres burned and 12.3 wildfires per year on MDNR land. Additionally, in the 10-county NW MI Region, Wexford is ranked second in the state for MDNR wildfire frequency (Kalkaska County is #1).

The MDNR responded to the "Bond Mill Pond Fire" on May 1, 2018 in Haring Twp., about 5 miles N/NW of Cadillac. An estimated 79 acres were burned, mostly involving state forest lands. The USFS provided helicopter support for fire suppression with a water drop. (Source: MSP's 2019 Michigan Hazard Analysis).

According to the 2021 USDA/USFS publication *Spatial Wildfire Occurrence Data for the United States, 1992-2018* [FPA\_FOD\_20210617], there were 34 fires that occurred on federal lands in Wexford County between 1992 and 2018, comprising about 141 acres of land burned.



Furthermore, the online community survey results received for this hazard mitigation plan update indicate that wildfire is the top natural hazard event that would have the largest impact on Wexford County. From a survey respondent in Cherry Grove Township: *“Large parcels of federal lands are forested in our township and could create a large fire.”* Additional public input received from communities as a part of the planning process included concerns about un-attended campfires and unpermitted bonfires as a wildfire risk factor on state and federal recreation lands.

#### *Probability of Future Events and Vulnerability Assessment*

There is a 100% chance in any given year that there will be a wildfire on MDNR or USFS lands, and a small chance there will be a wildfire on lands outside of these areas. Forest types (Red Pine, Eastern White Pine, and Jack Pine) within Wexford County are most susceptible to wildfires. With the exception of the City of Cadillac and Clam Lake Township, the remaining jurisdictions in Wexford County are heavily forested with pine and are therefore highly vulnerable to wildfire threats.

Additional factors that increase fire risk include dead or dying Ash trees as a result of disease/invasive species, invasive species itself, lightning strikes, and human factors such as falling power lines or the number of persons residing, camping, or traveling through the County. Historically, Michigan’s landscape has been shaped by wildfire; however, over the last several decades, the current landscape has transformed from wildland to residential development. With the increase in residential development in and around rural areas prone to wildfires, there is an increase in the potential for loss of life and property damage. Local fire departments have mutual aid agreements in order to provide additional coverage for rural, sparsely populated, or difficult to reach areas. Residential development in rural Wexford County is often isolated from town centers and emergency services. Many of these areas interface with public lands and local emergency services coordinate fire services with State and Federal fire protection agencies.

## **Public Health Emergency (Infectious Disease)**

Public health emergencies occur when there is a widespread and/or severe epidemic, contamination incident, bioterrorist attacks, or other situation that negatively impacts the health and welfare of the public. These emergencies include disease epidemics, large-scale food or water contamination incidents, extended periods without adequate water and sewer services, harmful exposure to chemical, radiological or biological agents, and large-scale infestations of disease-carrying insects or rodents. A common characteristic of public health emergencies is that they impact or have the potential to impact a large number of people either statewide, regionally, or locally in scope and magnitude. These health emergencies can occur as primary events or as secondary events from another hazard or emergency (e.g. flood, tornado, or hazardous material incident).

### *Location*

Public Health Emergency can be a worldwide, national, state or regional event that is not confined to geographic boundaries and range in severity across the affected areas. All of Wexford County is at risk to the occurrence and impacts from an infectious disease. Depending on the type of disease, different sectors populations are more susceptible.

### *Extent*

The extent of a public health emergency can be determined by the number of cases and deaths, and the amount of money spent to prepare for and respond to public health threats. In Wexford County, the District Health Department #10 works with local, state, and federal agencies to prepare for and respond to public health threats. It developed a comprehensive emergency preparedness program capable of responding to a variety of emergency situations with funds from the Centers for Disease Control. Additionally, according to the State of Michigan, as of January 10, 2023, there have been 8,587 cumulative cases of COVID-19 and 124 confirmed deaths due to COVID-19 in Wexford County. Those 80 years and older have the most deaths of any age group.<sup>9</sup>

### *Previous Occurrences*

Throughout the years, there have been many pandemics. For example, there was an outbreak of severe acute respiratory syndrome (SARS) in 2003. This virus was a new coronavirus that resulted in over 8,000 illnesses worldwide. Of these, 774 died. Since 2012, Middle East respiratory syndrome (MERS), a coronavirus, has been reported in 27 countries where there have been approximately 2,494 people infected and 858 deaths. In 2017, the World Health Organization (WHO) put SARS and MERS on its priority pathogen list to spur further research into coronaviruses. In March 2020, the State of Michigan fell under declarations for a State of Emergency, National Emergency (3455), and Governor and Presidential Major Disaster (4494) for the COVID-19 Pandemic.

### *Probability of Future Events and Vulnerability Assessment*

Naturally occurring pandemics may result in widespread precautions around the world. The Michigan District Health Department #10 that serves Wexford County created a pandemic plan that serves as a template for responding to a large-scale outbreak of influenza and other highly infectious respiratory diseases. That plan is being tested currently since COVID-19 appeared in January 2020. The response is ongoing to this pandemic. The elderly, immune-compromised, and low income populations are most vulnerable to public health emergencies.

The public online community survey results indicated an illness outbreak/pandemic (i.e., blizzard, heavy snow, ice storm) as the fourth most likely type of natural hazard event that would have a major impact on the county's communities.

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<sup>9</sup> <https://www.michigan.gov/coronavirus/stats>

## Invasive Species

The National Invasive Species Council defines an invasive species as, “A species that is not native and whose introduction causes, or is likely to cause, economic or environmental harm or harm to human health.” The Council was formed under Presidential Executive Orders 13112 and 13751 to prevent the introduction and spread of invasive species, and to support efforts to eradicate and control invasive species that are established throughout the United States. NOAA’s National Ocean Service identifies invasive species as “capable of causing extinctions of native plants and animals, reducing biodiversity, competing with native organisms for limited resources, and altering habitats.” There are a wide variety of species considered invasive. Known and monitored species include:

- Mammals
- Birds
- Insects
- Fish
- Crustaceans
- Mollusks
- Worms
- Plants
- Diseases

Invasive species harmful to Michigan and Wexford County may be either terrestrial invasive species (TIS) or aquatic invasive species (AIS). Terrestrial invasive include non-native, land-based plants, insects, animals and diseases that harm Michigan’s environment, economy, and human health. Aquatic invasive include non-native, water-dwelling plants, animals, and other organisms that have evolved to live primarily in water (aquatic habitats) rather than on land. Aquatic habitats are habitats that are covered with water all or part of every year. Michigan State Departments cooperated to prepare the Terrestrial Invasive Species State Management Plan and the 2013 Aquatic Invasive Species State Management Plan Update: *Prevention, Detection, and Management in Michigan Waters*. Each plan outlines a statewide strategy to reduce the environmental and economic damages caused by either TIS or AIS.

Non-native terrestrial and aquatic species are introduced to Michigan and the Great Lakes both intentionally and unintentionally. Aquatic invasive species are the result of unwanted fish and aquatic plants released from home aquariums, travelled across the ocean in ballast water carried by freighters, or entered from the ocean through human-built channels such as the Welland Canal. There are 32 AIS specifically listed in the State Management Plan. The State TIS Management Plan lists fourteen species including insects, mollusks, plants, mammals, a shrub, and a bird.

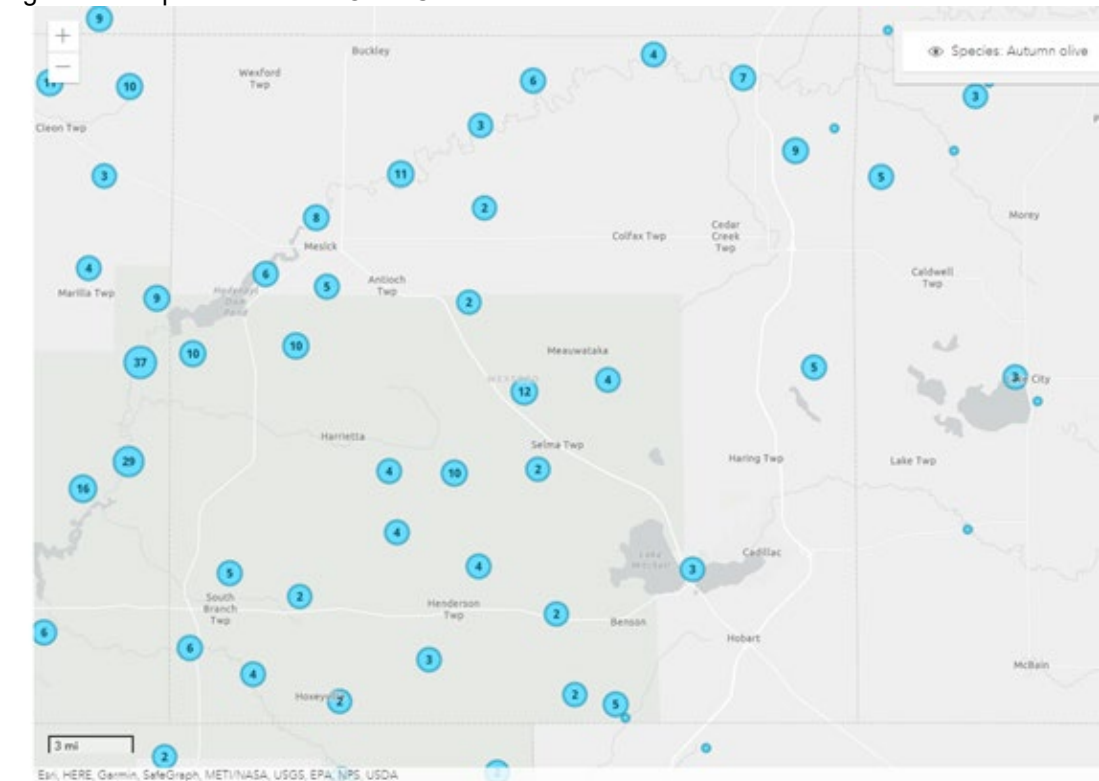
The Midwest Invasive Species Network (MISIN) is a regional effort to develop and provide early detection and response resources for invasive species. Among many tools and resources, the website ([misin.msu.edu](http://misin.msu.edu)) provides a catalog of species information and a report of occurrences submitted within each state. Animals, plants, and diseases are included in the catalog. The top five reported species in Michigan are: phragmites (invasive) with 63,018, garlic mustard with 18,368, autumn olive with 16,042, spotted knapweed with 15,436, and brown marmorated stink bug with 13,351.

### Location

Invasive species threaten those sensitive ecosystems and may be present in all Wexford County forest, wetland, farmland, grassland, aquatic, and urban environments. TIS and AIS designation generally applies, however, several upland species appear to be spreading to wetland and aquatic areas. Regular monitoring and reporting introductions detected is the only way to know where an invasive species has infested. The MISIN Species Observations shares reported detections by species name (common and scientific) and family type. Figure 17 below identifies reported Autumn Olive cases throughout the county. Many of the reported cases are along the Manistee River or Pine River.

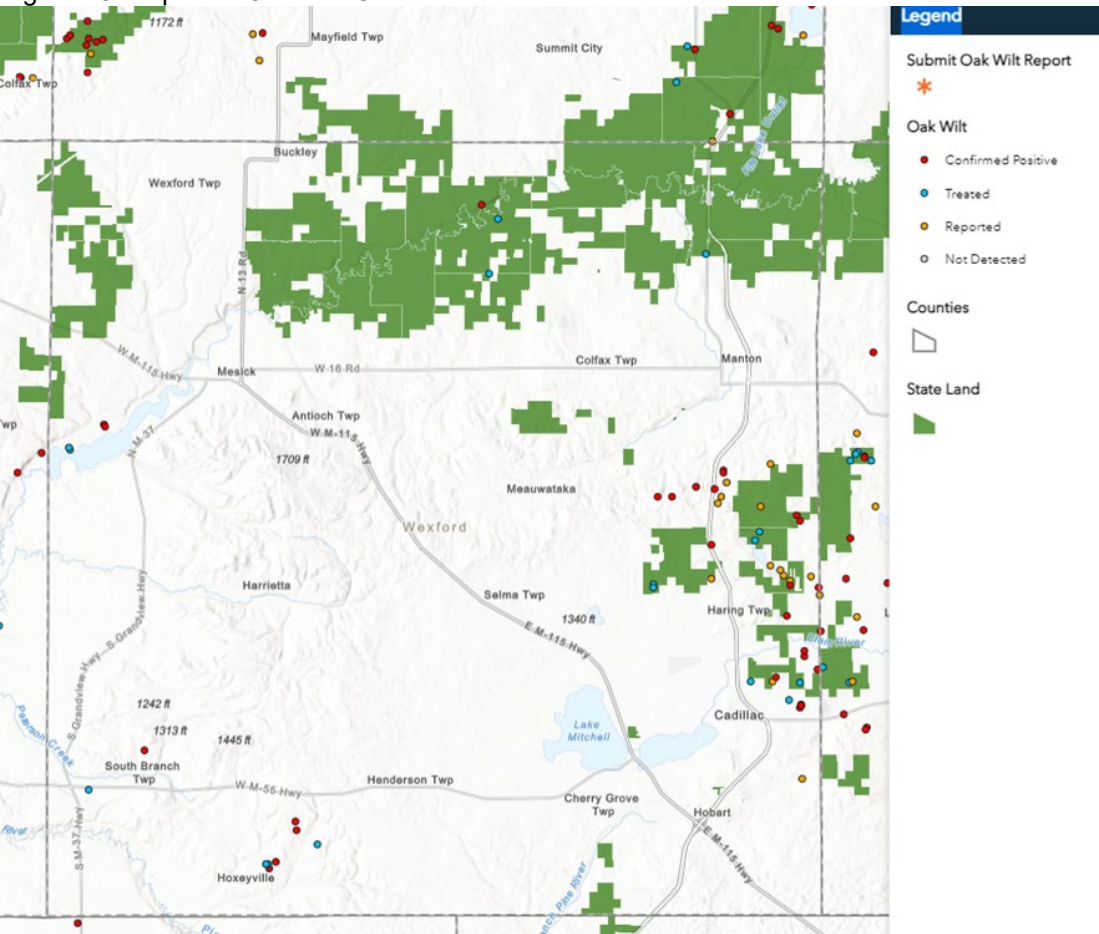
Figure 18 presents the MDNR interactive mapping resource “Look For Oak Wilt”, which allows users to submit and Oak Wilt Report throughout Michigan. Multiple numbers of Oak Wilt cases have been reported throughout Wexford County. These include trees confirmed positive for the disease, trees that have been treated, and reported cases. The reports of Oak Wilt disease are largely found in heavily forested areas and public lands in the northern, eastern and southwest portions of the county.

Figure 17: Reported Autumn Olive Cases



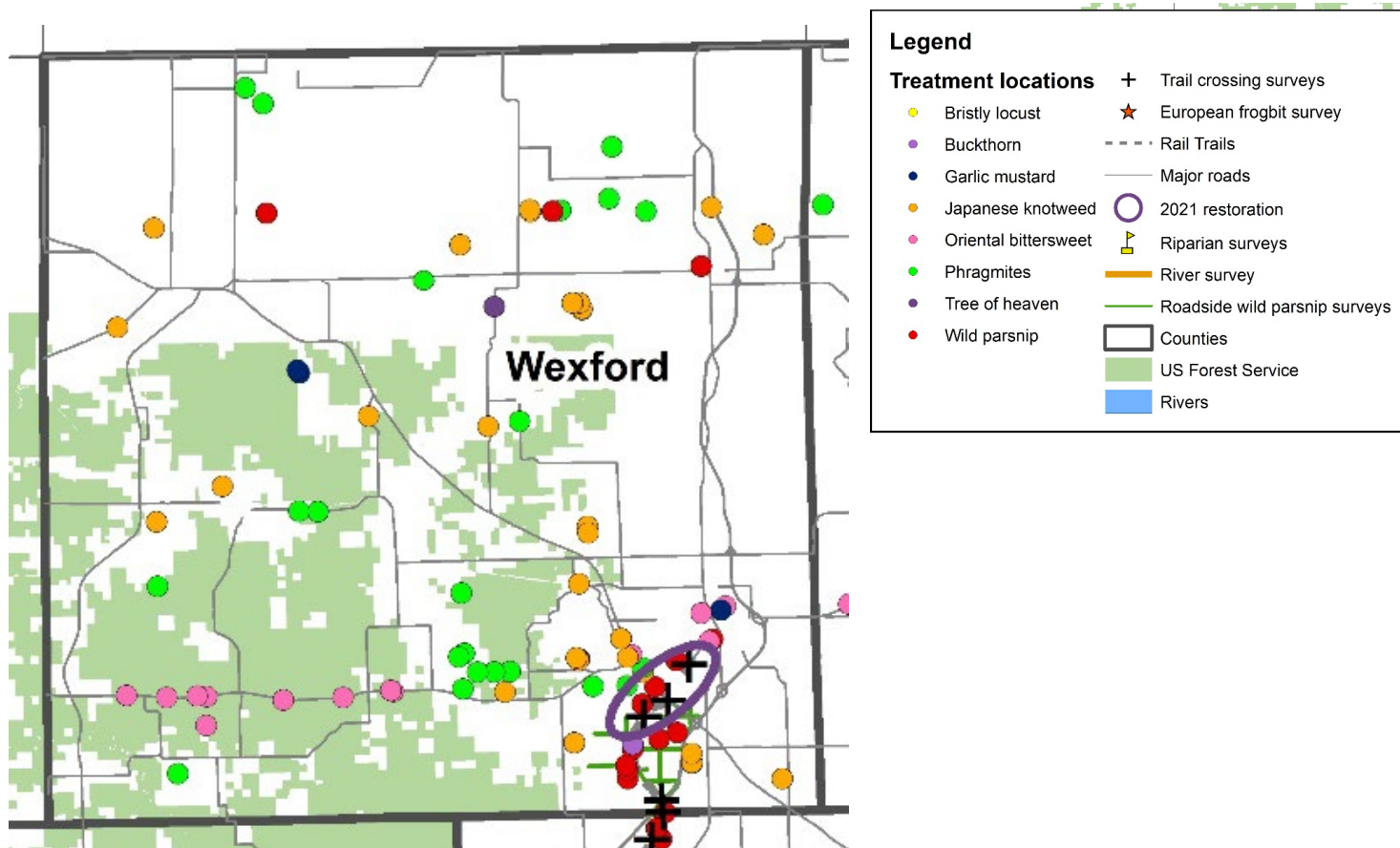
Source: MISIN Species Observations

Figure 18: Reported Oak Wilt Cases



Source: Michigan Department of Natural Resources, Look For Oak Wilt

Additionally, the North Country Cooperative Invasive Species Management Area (NC-CISMA) covers the six counties of Lake, Mason, Mecosta, Missaukee, Osceola, and Wexford. NCCISMA and its partners are committed to managing invasive species in northern Michigan through education, prevention, control, and restoration. The images below are excerpts from NC-CISMA's 2021 Annual Report, indicating invasive species treatment locations, surveying and restoration work in Wexford County.



### Extent

Invasive species impact on the county can be measured by its damaging effects. TIS cause billions of dollars in damage annually, are extremely costly to control, and often have irreversible ecological effects. Native habitats, agriculture lands and livestock, and the outdoor recreation economy are threatened or damaged by invasive species. *Michigan's Terrestrial Invasive Species State Management Plan* lists these state impacts:

- The State of Michigan estimates 42% of threatened or endangered species are considered at risk due to non-native species.
- Visitors spent over \$22 billion dollars in Michigan in 2014, supporting nearly 327,000 jobs (Tourism Economics 2014). Invasive species impact the use and beauty of Michigan's shorelines, trails and parks, which may result in a reduction in visitor spending and citizen enjoyment
- Michigan's Forest Products Industry supports 96,000 jobs and contributes more than \$20 billion to the state's economy each year (Michigan DNR 2015). Invasive forest pests including emerald ash borer, oak wilt and beech bark disease kill trees and significantly impact the value of urban properties, forests and timber resources. The estimated cost of treating or removing dead ash within developed land in Michigan's communities due to emerald ash borer was \$230 million in 2009<sup>10</sup>. A map of oak wilt cases in Wexford County is shown as Figure 18.

<sup>10</sup> Kovacs, K.F., R.G. Haight, D.G. McCullough, R.J. Mercader, N.W. Siegert and A.M. Liebhold. 2010. Cost of potential emerald ash borer damage in U.S. communities, 2009–2019. *Ecological Economics* 69: 569-578.

### Previous Occurrences

The Department of Environment, Great Lakes, and Energy oversees invasive species programs for the State. The State has produced prohibited and restricted species lists, watch lists, and state management plans for terrestrial and aquatic species. Many of the species listed in this plan are also listed as a prohibited or restricted species: it is unlawful to possess, introduce, import, sell, or offer that species for sale as a live organism, except under certain circumstances. A full list of prohibited and restricted species can be found at [Michigan.gov/invasives](https://www.michigan.gov/invasives).

The NC-CISMA and Wexford Conservation District are focused on habitat-specific management: planning to manage for the resource (the natural area), and restoration therefore will remove and control anything that is not supposed to be there. Additionally, maintaining awareness and proactively preparing for the spread of invasive species from southern geographies is an ongoing task.

Since 2006, the City of Cadillac has administered a milfoil management program on Lake Cadillac. In 2010, voters approved a three-year citywide millage to fund the program, which is designed to help improve recreational use in the lake while preserving the fragile balance that is required to keep the lake healthy. Lake Improvement Boards in the county, which are provided direction from the County Drain Commissioner, are charged with managing the water quality of highly used and valued inland lakes in Wexford County. The Lake Mitchell Improvement Board's proposed 2022-2023 budget for invasive species management (PLM Lake Management, Restorative Lake Science, and weed pickup & processing) is \$81,000. Eurasian milfoil treatment and management remains an ongoing issue for these lakes.

The following terrestrial species are causing significant harm:

- Japanese Knotweed, Giant knotweed and Bohemian knotweed, *Polygonaceae*, can be a concern to homeowners, and municipalities because of these plants' ability to grow into a structure's foundation, through sidewalks and road surfaces. These plants can also be spread by root fragments and stem sections. It can create monocultures that shade out desirable vegetation, creating poor habitats for native species. This is of particular concern along water bodies and has been shown to be extremely detrimental to waterways in the Eastern US.
- (Invasive) Phragmites is a large-scale clonal grass that rapidly colonizes wetlands. Phragmites crowds out native plants and alters habitat for native fauna. In doing so, Phragmites also alters human access to water resources and has adverse economic effects, including decreasing property value, inhibiting recreational use, and limiting populations of game species. It can become a fire hazard when it dries down.
- Cypress Spurge is an erect, herbaceous to semi-woody perennial with bright yellow-green flowers that turn to purple-red as they mature. Cypress Spurge is toxic to horses and cows.
- Black Swallow Wort is a rapidly growing, herbaceous perennial in the Milkweed family. However, Black Swallow Wort is toxic to animals and the monarch butterfly.
- Oriental Bittersweet is a vine plant that can strangle a tree and causes tree mortality. This impacts ecosystem health and economic health that is associated with trees' health.
- Autumn olive is very widespread in Michigan. It is spread by birds and is recolonizing old farm fields. Its value to wildlife is relatively low (low in protein and other nutrients compared to our natives). It also is known for its nitrogen-fixing abilities.
- Oak wilt is an infectious vascular disease which affects all species of oak. Red oaks get the disease more frequently and succumb more readily than white oak. The disease is spread via root grafts and by sap-feeding beetles.
- Beech bark disease is caused by the combination of the *Neonectria* fungus and beech scale. Beech scales are yellow, soft-bodied insects that are 0.5 to 1.0 mm long as adults. The insects, found on the tree trunk and branches, feed on sap in the inner bark. The minute wounds caused by the scale insects eventually enable the Nectria fungus to enter the tree. The Nectria kills areas of woody tissue.

The following aquatic species are causing significant harm:

- Didymo or "rock snot" is an aquatic diatom that is brown, tan, or yellow in color. Unlike most algae, it feels like wet cotton and is not slimy. Grows in rivers, streams, and lakes. It occurs particularly in cool, oligotrophic, clear water.
- Purple loosestrife is an herbaceous wetland perennial reaching 5 feet with reddish-purple flowers with five to seven petals are held in dense terminal cluster. Grows in moist soils, in wet meadows and prairies, shallow marsh, ditches, waste areas, and along lakes, ponds, streams, and rivers.
- Garlic mustard is an aquatic, herbaceous biennial, up to 4 feet in height. Forms round basal rosette the first year, flowers the second year and dies. Grows in forests, particularly floodplain forest, open wetlands, parking lots, campgrounds, paths, and roadsides.
- Eurasian watermilfoil is a submergent, aquatic perennial that reached 3-10 feet or more in length. Grows in ponds, lakes, and low-energy zones in rivers and streams.



- New Zealand mudsnail is an aquatic mollusk with an elongated shell 1/8 inch long with 7-8 whorls. Shell color varies from gray and dark brown to light brown. Grows in flowing freshwater with silt/sand to very brackish rivers; lives in water as deep as 60 feet in lakes or reservoirs.
- Red swamp crayfish is an aquatic crustacean with a dark red body and claws with spiky, bright red bumps, and black wedge-shaped stripe on underside. Grows in flowing to non-flowing freshwater or salt water; permanent ponds; areas of streams and ditches with organic debris; agricultural areas; wetlands.
- Zebra mussel is an aquatic mollusk with striped shells or dark or light shells with no stripes. Attach to objects (pipe, boats, etc) causing major damage as colonies can block pipes, affecting power plants and water-treatment facilities.

Many of the species listed here are monitored and managed by NC CISMA. However, the list of invasive species impacting the county is extensive and many established species are treated on a case-by-case basis. Other species of concern include:

- Honeysuckle (non-native)
- Glossy buckthorn
- Common buckthorn
- Wild parsnip
- Multiflora rose
- Periwinkle

#### *Probability of Future Events and Vulnerability Assessment*

The State TIS Management Plan provides a list of eleven terrestrial species on the watch list. The invasive species included on the watch list are priority species that have been identified as posing an immediate and significant threat to Michigan's natural resources. These species have either not been confirmed in Michigan, have very limited distribution or are localized. Early detection and timely reporting of occurrences of these species is crucial for increasing the likelihood of stopping an invasion and limiting negative ecological and economic impacts. This list is reviewed and updated periodically, and the most current list is available at [www.michigan.gov/invasives](http://www.michigan.gov/invasives).

#### Common Name   Scientific Name   Category

1. Asian longhorned beetle *Anoplophora glabripennis* Insect
2. Asiatic sand sedge *Carex kobomugi* Plant
3. Balsam woolly adelgid *Adelges piceae* Insect
4. Chinese yam\* *Dioscorea oppositifolia* Plant
5. Hemlock woolly adelgid\* *Adelges tsugae* Insect
6. Himalayan balsam\* *Impatiens glandulifera* Plant
7. Japanese stiltgrass\* *Microstegium vimineum* Plant
8. Kudzu\* *Pueraria montana* Plant
9. Mile-a-minute weed *Persicaria perfoliata* Plant
10. Nutria *Myocastor coypus* Mammal
11. Thousand Cankers Disease *Geosmithia morbida* *Pityophthorus juglandis* Tree Disease

The [Michigan Watch List: Aquatic Invasive Plants](#) and CAKE CISMA are also monitoring for additional species:

- Spotted lantern fly which impacts fruit and winery production. Winery and fruit production issues can impact agri-tourism.
- Hydrilla is an aquatic, perennial plant that forms dense mats in slow-moving water of lakes, ponds, stream, and rivers.
- European frog-bit is an aquatic, floating, herbaceous annual that forms large colonies, creating dense mats. Grows in open, still waters.
- Parrot feather water-milfoil is an aquatic, herbaceous perennial that can grow 6.5-16.5 feet in length and forms monotypic stands. Grows in lakes, ponds, slow streams, and mudflats, where the emergent form is found.
- Starry stonewort is an aquatic microalga which forms dense mats that cover lake bottoms. Grows in still or slow moving waters.
- Asian Carp (bighead, black, grass, and silver carp) are in direct competition with native aquatic species for food and habitat. Their rapid population increase is disrupting the ecology and food web of the large rivers of the Midwest.
- Beech leaf disease causes dark stripes or banding between leaf veins. A nematode (microscopic worm) is associated with symptoms. Ongoing research is investigating the possibility of other contributing microorganisms.

The North Country Cooperative Invasive Species Management Area (NCCISMA) and other partners protect, enhance, and promote Northwest Michigan's natural resources through invasive plant management, education, and outreach. Additionally, MSU Extension serves as an educational resource for agricultural pest and disease prevention and treatment, and Wexford Conservation District employs a Forester that can educate citizens about forest disease and pest prevention and treatment. Wexford County's natural resources are highly vulnerable to invasive animals, plants, and diseases. Significant natural features include forested areas such as the Pere Marquette State Forest and the Manistee National Forest, and water bodies such as Lake Cadillac, Lake Mitchell, the Manistee River and Pine River. The impact of the species listed on watch lists could be catastrophic for Wexford County's natural resources, agriculture, recreation, tourism, and economy.



## Impacts from Climate Change

*Climate* describes the average weather conditions for a particular location and over a long period of time. The changing climate impacts society and ecosystems in a broad variety of ways. For example, climate change can alter rainfall, influence crop yields, affect human health, cause changes to forests and other ecosystems, and even impact our energy supply. Climate-related impacts are occurring across the country by increasing the severity of storms and weather-related events. Natural disasters then have a direct impact on our economy.

According to a new comprehensive report from the World Meteorological Organization (WMO), “A disaster related to a weather, climate or water hazard occurred every day on average over the past 50 years – killing 115 people and causing \$202 million (US \$) in losses daily. The number of disasters has increased by a factor of five over the 50-year period, driven by climate change, more extreme weather and improved reporting. But, thanks to improved early warnings and disaster management, the number of deaths decreased almost three-fold<sup>11</sup>” (World Meteorological Organization, 2021).

The impacts of climate change already are, and continue to be, deep and widespread in the Great Lakes Region and Michigan as a whole. The National Climate Assessment (NCA) assesses the science of climate change and variability and its impacts across the United States, now and throughout this century. Chapter 21 of the NCA *Fourth National Climate Assessment Volume II: Impacts Risks, and Adaptation in the United States reports*, the Great Lakes influence regional weather and climate conditions and impact climate variability and change across the region. The lakes influence daily weather by:

- 1) Moderating maximum and minimum temperatures of the region in all seasons,
- 2) Increasing cloud cover and precipitation over and just downwind of the lakes during winter, and
- 3) Decreasing summertime convective clouds and rainfall over the lakes.

The Great Lakes Integrated Sciences and Assessments (GLISA) is one of 11 NOAA Regional Integrated Sciences and Assessments teams that focus on helping the nation prepare for and adapt to climate variability and change. A summary of findings from NCA and the GLISA report, *Climate Change in the Great Lakes Region*<sup>12</sup>, are provided to show the impacts of climate change throughout the state of Michigan.

### Temperature

Warm-season temperatures are projected to increase more in the Midwest than any other region of the United States.<sup>13</sup> Since 1951, annual average air temperatures have increased by 2.3°F (1.3°C) in the U.S., Great Lakes region. By mid-century (2050), average air temperatures are projected to increase by 3°F to 6°F (1.7°C to 3.3°C). By end of century (2100), average air temperatures are projected to increase by 6°F to 11°F (3.3°C to 6.1°C).

The frost-free season is projected to increase 10 days by early this century (2016–2045), 20 days by mid-century (2036–2065), and possibly a month by late century (2070–2099) compared to the period 1976–2005 according to the higher scenario (RCP8.5).<sup>14</sup>

### Precipitation

Since 1951, total annual precipitation has increased by 14% in the U.S., Great Lakes Region. Future projections suggest more precipitation on average, but not necessarily during all seasons (summer to be drier) and not for all locations depending on which model is used. Reduced lake ice cover and enhanced evaporation may lead to increased lake-effect snowfall in the near-term, but rising temperatures will cause more winter precipitation to fall as rain as opposed to snow across the region by late century.

From 1951-2017, the United States, Great Lakes Region, overall, has seen increases in average temperature, frost-free season, total precipitation, and heavy precipitation events.

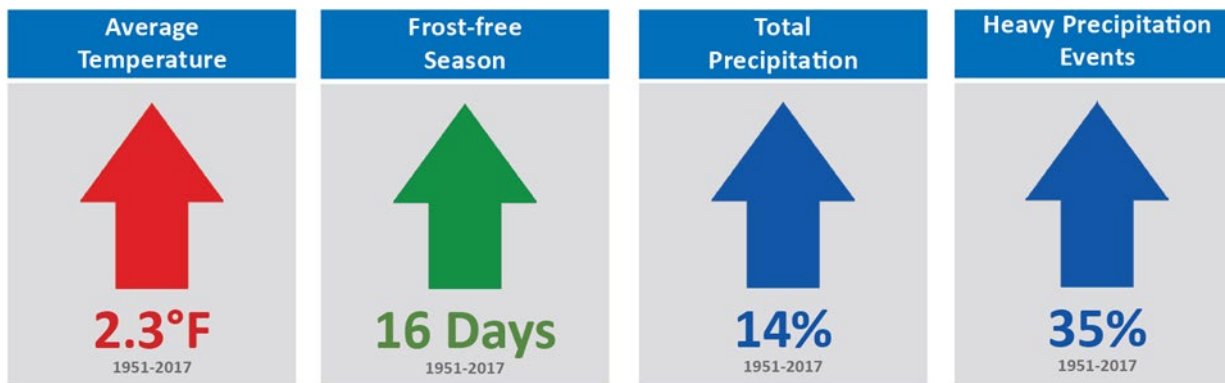
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<sup>11</sup> World Meteorological Organization. (2021, August 31). Retrieved from Weather-related disasters increase over past 50 years, causing more damage but fewer deaths: <https://public.wmo.int/en/media/press-release/weather-related-disasters-increase-over-past-50-years-causing-more-damage-fewer>

<sup>12</sup> (2/4/2019). Retrieved from Climate Change in the Great Lakes Region: <https://glisa.umich.edu/wp-content/uploads/2021/04/GLISA-2-Pager.pdf>

<sup>13</sup> Vose, R. S., D. R. Easterling, K. E. Kunkel, A. N. LeGrande, and M. F. Wehner, 2017: Temperature Changes in the United States. *Climate Science Special Report: Fourth National Climate Assessment, Volume I*. Wuebbles, D. J., D. W. Fahey, K. A. Hibbard, D. J. Dokken, B. C. Stewart, and T. K. Maycock, Eds., U.S. Global Change Research Program, Washington, DC, USA, 185–206. doi:10.7930/J0N29V45.

<sup>14</sup> Hibbard, K. A., F. M. Hoffman, D. Huntzinger, and T. O. West, 2017: Changes in Land Cover and Terrestrial Biogeochemistry. *Climate Science Special Report: Fourth National Climate Assessment, Volume I*. Wuebbles, D. J., D. W. Fahey, K. A. Hibbard, D. J. Dokken, B. C. Stewart, and T. K. Maycock, Eds., U.S. Global Change Research Program, Washington, DC, USA, 277–302. doi:10.7930/J0416V6X.



### *Snow, Ice Cover and Lake Temperature*

Summer lake surface temperatures have been increasing faster than the surrounding air temperatures, with Lake Superior increasing by 4.5°F between 1979 and 2006. Annual average ice cover on the Great Lakes shifted from higher amounts prior to the 1990s to lower amounts in recent decades. There remains strong year-to-year variability, and high ice years are still possible. Lake-effect snowfall has increased in northern areas and may continue to increase through mid-century.

### *Extreme Weather*

The frequency and intensity of severe storms has increased. This trend will likely continue as the effects of climate change become more pronounced. The amount of precipitation falling in the heaviest 1% of storms increased by 35% in the U.S. Great Lakes region from 1951 through 2017. More severe storms may have a negative economic impact due to resulting damages and increased costs of preparation, clean up, and business disruption.

The NCA *Fourth National Climate Assessment Volume II: Impacts Risks, and Adaptation in the United States* reports, “Climate change is transforming where and how we live and presents growing challenges to human health and quality of life, the economy, and the natural systems that support us. Risks posed by climate variability and change vary by region and sector and by the vulnerability of people experiencing impacts. Social, economic, and geographic factors shape the exposure of people and communities to climate-related impacts and their capacity to respond. Risks are often highest for those that are already vulnerable, including low-income communities, some communities of color, children, and the elderly” ([Ch. 14: Human Health, KM 2](#); [Ch. 15: Tribes, KM 1–3](#); [Ch. 28: Adaptation, Introduction](#)).

A vulnerability assessment can be found in the two-page report: *Climate Change in the Great Lakes Region* by GLISA. The report identifies key challenges from climate change such as:

- **Public Health**
  - Increased risk of heat waves and increased humidity may amplify the number of heat-related deaths and illnesses.
  - More storm activity and flooding, resulting in increased point- and non-point source pollution, will likely increase watershed contamination and water-borne illnesses, while warmer surface waters amplify the risk of toxic algal blooms and fish contamination.
- **Tourism and Recreation**
  - *Winter recreation/tourism are likely to suffer* due to reduced snow cover and shorter winters. Reduced lake ice cover and enhanced evaporation may lead to increased lake-effect snowfall in the near-term, but rising temperatures will cause more winter precipitation to fall as rain as opposed to snow across the region by late century.
  - Increasing temperatures and a longer summer season may *increase the demand for lake and beach use*.
  - Overall, *summer tourism may grow before temperature rise becomes unfavorable* for outdoor recreation.
  - *The fishing industry* (commercial and recreation) is likely to be impacted by the *decline of coldwater species of fish, such as lake trout and whitefish*.
- **Natural Environment**
  - Despite increasing precipitation, land surfaces in the region are expected to become drier overall due to increasing temperatures and evaporation rates.
  - More frequent summer droughts could affect soil moisture, surface water, and groundwater supply.
  - Increased evaporation rates and sustained levels of high or low water levels may change wetland areas in the region.
  - The rate of warming may *outpace the rate at which ecosystems are able to migrate and adapt*.

- *Wildlife populations better adapted to cold temperatures will continue to decline* as competing species migrate into the region with rising air and surface water temperatures.
- *Forest productivity will likely increase in the short term*, until other impacts of climate change such as increased drought, fire and invasive species present additional stressors to forests.

## V. Goals and Objectives

The mission of the Wexford County Natural Hazards Mitigation Plan is to protect the health and safety of the public and property in the County which includes prevention of injury, loss of life, property damage, breakdown in vital services like transportation and infrastructure, economic slumps, maintain tourist base, and liability issues. This is done by taking action to permanently eliminate or reduce the long-term risks from natural hazards.

Specific goals and objectives have been established based upon the community's natural hazards analysis, as well as input from the Task Force participants and the public through meetings, request for comments on the draft plan, and the presentation of the plan to local governments and the Local Emergency Planning Team.

### **Goal 1: Increase local awareness and participation in natural hazards mitigation strategies**

- Encourage cooperation and communication between planning and emergency management officials
- Encourage additional local governmental agencies to participate in the natural hazards mitigation process
  - Include Memorandum of Understanding (MOUs) between local government and county agencies
- Encourage public and private organizations to participate, *including organizations who advocate for individuals with functional or access needs (vulnerable populations)*

### **Goal 2: Integrate natural hazards mitigation considerations into the community's comprehensive planning process**

- Enforce and/or incorporate natural hazards mitigation provisions in building code standards, ordinances, and procedures
- Create or update ordinances to reflect building codes, shoreline protection rules, etc.
- Incorporate natural hazards mitigation into basic land use regulation mechanisms
- Develop community education programs and public warning systems
- Strengthen the role of the Local Emergency Planning Committee in the land development process
- Integrate natural hazards mitigation into the capital improvement planning process so that public infrastructure does not lead to development in natural hazards areas
- Encourage county agencies to assess local roads, bridges, dams, and related transportation infrastructure for natural hazards vulnerability

### **Goal 3: Utilize available resources and apply for additional funding for natural hazards mitigation**

- Provide a list of desired community mitigation measures to the State for possible future funding
- Encourage the application for project funding from diverse entities

### **Goal 4: Develop and complete natural hazards mitigation projects in a timely manner**

- Encourage public and business involvement in natural hazards mitigation projects

## VI. Mitigation Strategies and Priorities

### Types of Mitigation Strategies

The mitigation planning regulations requires that each participating jurisdiction identify and analyze a comprehensive range of specific mitigation actions and projects to reduce the impacts of the hazards identified in the risk assessment. The emphasis is on the impacts or vulnerabilities identified in the risk assessment, not on the hazards themselves. The types of mitigation actions can be classified into the following types:

- Local Plans and Regulations
- Building and Infrastructure Projects
- Natural Systems Protection
- Education and Awareness Programs

Furthermore, a set of evaluation criteria was developed to determine which mitigation strategies were best suited to address the identified problems in Wexford County.

- The measure must be technically feasible.
- The measure must be financially feasible.
- The measure must be environmentally sound and not cause any permanent, significant environmental concerns.
- The measure must be acceptable to those participating in the strategy and/or primarily affected by the strategy.

By anticipating future problems, the County can reduce potential injury, structure losses, loss of utility services such as electric and internet connectivity, and prevent wasteful public and private expenditures. The County Infrastructure, Vulnerability, and Hazard Maps in Appendix A can assist with the determining future problem areas.

### *Emergency Warning System Coverage*

Integrated Public Alert & Warning System (IPAWS): FEMA's national system for local alerting that provides authenticated emergency and life-saving information to the public through mobile phones using Wireless Emergency Alerts, to radio and television via the Emergency Alert System, and on the National Oceanic and Atmospheric Administration's Weather Radio.

Mobile warning system: Wexford County uses the CodeRED Emergency Communications Network, which is an electronic high-speed outbound notification service available to the general public. The system notifies a participant via their mobile or land-line phone. The National Weather Service may concurrently utilize their mobile warning notification system when deemed necessary in severe weather event situations to send phone notifications to all users within signal of a cellular tower.

Radio warning system: Wexford County uses radio channels 580 AM and 103.5 FM for emergency weather alerts. Additionally, NOAA Weather Radio All Hazards is a nationwide network of radio stations broadcasting continuous weather information directly from the nearest National Weather Service office. NWR broadcasts official Weather Service warnings, watches, forecasts and other hazard information 24 hours a day, 7 days a week.

Tornado/Severe Weather Systems: The IPAWs and Code Red notification systems are primarily used to notify the public in the event of a potential or current severe weather event. The City of Cadillac also operates a tornado siren.

Flood warning system: For dam failures/flooding downstream an active warning system is pre-determined utilizing geographic boundary information and the CodeRED Emergency Communications Network and IPAWS alerts.

- The Federal Energy Regulatory Commission requires hydroelectric facilities to be able to quickly notify residents and visitors of any developing emergency at the plants. As westerly adjoining communities in Manistee County are located downriver of the Hodenpyl Dam, sirens are located in Manistee County near: the Tippy Dam (downstream of the Hodenpyl Dam in Manistee County), the High Bridge U.S. Forest Service boat launch, the Hodenpyl Dam, and the Red Bridge U.S. Forest Service boat launch. In an emergency, the sirens would only be used if the threat of a dam failure is imminent at one of the facilities. At that time, anyone on or near the river should evacuate at once to high ground. Additional information would be provided on local radio and television stations. The siren systems are tested each August and December.

Wexford County Emergency Management Department maintains agreements with following facilities in the county so that they may be utilized as public shelters in the event of an emergency (Table 31).

**Table 31. Emergency Shelter Sites in Wexford County**

Emergency Shelter Site Name	Street Address	City	ZIP	Generator?	Overnight Accommodations?
Boon Township Fire	204 Myrtle ST	Boon	49618	No	No
Buckley Fire	106 S Industrial DR	Buckley	49620	No	No
Cadillac Fire Department	200 N Lake ST	Cadillac	49601	No	No
Haring Township Fire	505 Bell AVE	Cadillac	49601	No	No
Selma Township Fire	4299 S 35 RD	Cadillac	49601	No	No
Cherry Grove Township Fire	4830 E M-55 HWY	Cadillac	49601	No	No
YMCA	9845 Campus DR	Cadillac	49601	Yes	Yes
Cadillac Senior Center	601 Chestnut ST	Cadillac	49601	Yes	No
The Wexford Civic Center “The Wex”	1320 N Mitchell ST	Cadillac	49601	Yes	Yes
USFS - Huron-Manistee National Forest Headquarters	1755 S Mitchell ST	Cadillac	49601	No	No
Slagle-Harrietta Fire	108 W Gatson AVE	Harrietta	49638	No	No
Cedar Creek Fire	2530 N 41 1/2 RD	Manton	49663	No	No
City of Manton Fire	402 N Michigan AVE	Manton	49663	No	No
Colfax-Greenwood Fire	4950 N 31 RD	Manton	49663	No	No
Manton Senior Center	302 W Main St	Manton	49663	Yes	No
Springville Township Fire	4785 N M-37 HWY	Mesick	49668	No	No
South Branch Fire	10510 E M-55 HWY	Wellston	49689	No	No

### Mitigation Strategies

Strategies were developed based on discussions with local officials and a review of FEMA best practices for hazard mitigation. The strategies table is grouped according to purpose. Purpose types include: Awareness & Preparation, Shelters, Building & Development, Utilities & Technology, and Environment & Natural Resources. The table also includes: a description of each strategy; what natural hazards they address; where the strategy applies; who is responsible for implementing the strategy; how the strategy will be implemented (what resources are available to apply the strategy); when the strategy could feasibly begin; the level of priority; and what type of strategy it is. Strategies are intended to be action items completed during the 5-year timeframe in which the plan is active. Some long-term strategies extend beyond the 5-year timeframe due to feasibility or level of difficulty. Appendix C provides a review of mitigation strategies included in the 2016 plan and their current status.

### Funding the Implementation of the Strategies

To assist with the funding of the proposed natural hazards mitigation strategies, a list of potential financial assistance entities and programs to help fund the implementation projects of the Plan is provided. Other general informational resources are also provided to assist with education and outreach efforts. Each potential entity, program, and resource is assigned a letter code, and the appropriate letter(s) is listed on under the Resources column of the strategies table. The resources table for how the strategies may be implemented is included following the Mitigation Strategies table below.

*See the strategies table included as a separate document*

## VII. Implementation

Hazard mitigation is any action taken before, during, or after a disaster to permanently eliminate or reduce the long-term risk to human life and property from natural and technological hazards. Mitigation is an essential element of emergency management, along with preparedness, response, and recovery. Emergency management includes four phases: actions to mitigate a disaster, a community prepares for a disaster; responds when it occurs; and then there is a transition into the recovery process. The process is cyclical and mitigation measures are evaluated and adopted constantly. The evaluation improves the preparedness posture of the County for the next incident, and so on. When successful, mitigation will lessen the impacts of natural hazards to such a degree that succeeding incidents will remain incidents and not become disasters.

### Plan Review, Monitoring, and Evaluation

This Plan is intended to be a resource for building coordination and cooperation within a community for local control of future mitigation and community preparedness. The County Board will lead the implementation of the Natural Hazards Mitigation Plan with assistance from the Emergency Management Coordinator and the Administration. The LPT is an inter-agency partnership and will collaborate to accomplish the goals and objectives of the Plan. The LPT meets on a regular basis to carry out its duties and has expanded its role to function as the Natural Hazards Task Force. The Natural Hazards Task Force will be responsible for monitoring and implementing the mitigation plan. Staff support will be provided by the Wexford County Emergency Management Office and will coordinate with the County Board of Commissioners.

Natural Hazards Task Force will perform an annual review of the Wexford County Hazard Mitigation Plan and consider the list of mitigation strategies identified in the plan. The Task Force will identify projects that have been completed and identify new projects to be completed. The following agencies have been encouraged to actively participate in revising, updating, and maintaining the plan.

- Wexford County Government Staff
- Township, city and village governments
- Wexford Conservation District
- Wexford County Drain Commissioner
- Wexford County Road Commission
- District Health Department #10
- North Country Cooperative Invasive Species Management Area
- Cadillac Area Land Conservancy
- Networks Northwest
- Michigan State University Extension
- Michigan Department of Environment, Great Lakes, and Energy
- Michigan Department of Natural Resources
- Federal Emergency Management Agency
- U.S. Forest Service
- U.S. Environmental Protection Agency
- U.S. Army Corps of Engineers
- U.S. Department of Agriculture Natural Resources Conservation Service
- Insurance Companies
- Real Estate Companies

In addition, the local communities have indicated to the county emergency manager that they will follow the county's lead in identifying mitigation projects and developing grant applications to fund those projects. Land use issues associated with those projects will be handled by each jurisdiction that have an adopted Master Plan and regulate zoning in the project area. Community planning services are provided by the professional staff of each municipality within the county that provide planning and zoning. The respective planners assist communities in developing plans and zoning ordinances, provides resource information and technical assistance, and convenes communities to address land use issues of common interest.

The Wexford County Building Department issues construction code permits (building, electrical, mechanical, and plumbing permits) for all areas of Wexford County except for Cedar Creek Township, the City of Cadillac, and the City of Manton; those communities issue their own building permits. Additionally, the County Building Department administers and enforces the Soil Erosion and Sedimentation Control program for Wexford County, pursuant to Part 91 of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended (Except for the City of Cadillac).



## **Plan Integration**

Wexford County, all townships, cities, and villages in Wexford County, as well as local and state agencies will consider integrating information from the hazard mitigation plan into their comprehensive and operations plans. The Wexford Joint Municipal Planning Commission is in the process of updating their Master Plan in 2023.

All natural hazards mitigation planning could be pursued using Michigan Public Act 226 of 2003, the Joint Municipal Planning Act. This Act provides for joint land use planning by cities, villages, and townships, and allows two or more municipalities' legislative bodies to create a single joint planning commission to address planning issues. This tool helps with planning for the "big picture" issues such as natural hazards that cross jurisdictional boundaries.

The intent of this legislation is for local governments to consider the following:

- Individual units of government modifying their ordinances simultaneously to include language that would incorporate aspects of protection
- Developing an overlay zoning district that would cross jurisdictional boundaries which would be incorporated into existing independent units of government's zoning ordinances
- Forming a new joint (multi-jurisdictional) planning commission or zoning board
- Sharing zoning administration and enforcement activities

The Wexford Joint Planning Commission was created to provide planning and zoning to the following ten participating municipalities: Antioch Township, Boon Township, Cherry Grove Township, Greenwood Township, Hanover Township, Liberty Township, Selma Township, Slagle Township, South Branch Township, Springville Township, and Wexford Township.

The following communities provide planning and zoning services for their respective communities: the City of Cadillac, Village of Buckley, Village of Harrietta, Village of Mesick, Cedar Creek Township, Clam Lake Township, and Haring Charter Township.

There is no zoning in Colfax, Greenwood, or Henderson Townships. Wexford County does not administer planning and zoning services for local governments, nor does it have a County Planning Commission.

As part of the education and outreach aspect of the hazard mitigation effort, communities with planning and zoning in the county will be encouraged to adopt zoning regulations that minimize the effect of natural hazards.

## **Five Year Plan Review and Update**

The Stafford Act, as amended by the Disaster Mitigation Act of 2000, requires the Wexford County Hazard Mitigation Plan to be updated, adopted, and re-submitted for Federal Emergency Management Agency (FEMA) approval every five years. The plan will be reviewed by the Natural Hazards Task Force every five years in alignment with federal regulations. The update will include determining changes in the county, such as changes in development, an increase in exposure to hazards, an increase or decrease in the communities' capability to address hazards, addition and/or removal of mitigation actions and strategies, reviewing goals, and a change in federal or state legislation. Upon plan review and update completion, the plan will be sent to the State Hazard Mitigation Officer at the Michigan State Police for final review and approval in coordination with FEMA. When the plan has received an "approved pending adoption" status from FEMA, the Wexford County Board of Commissioners can review, approve, and adopt the plan. In order to properly update the plan, Wexford County will need to seek funding from appropriate state and federal agencies.

## **Continued Public Involvement**

Wexford County is committed to keeping the public involved in the implementation and update of the Hazard Mitigation Plan. Copies of the plan will be available at the county libraries, county clerk's office, and all township offices, and will be posted on the community websites and/or regional planning agency website. The Emergency Management Office will be responsible for keeping a record of public comments on the plan.





## APPENDIX B. Community Survey Results

## APPENDIX C. Previous Plan Strategies and Comments

## APPENDIX D. Meeting and Plan Input Documentation