HOUGHTON COUNTY

2020-2025 Hazard Mitigation Plan

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SECTION 1: Introduction

This section provides a general introduction to the 2020 Houghton County Hazard Mitigation Plan. It consists of the following four subsections:

- Background
- Purpose
- Scope
- Authority

Background

Natural hazards, such as floods, severe winter storms, and wildfires are naturally occurring physical phenomena caused either by the rapid or slow onset of events which can have a negative effect on humans and the environment. Every year in the United States, natural hazards threaten lives and livelihoods and result in billions of dollars in damage.

Hazard mitigation is any action taken before, during, or after a disaster to eliminate or reduce the risk to human life and property from natural, technological or human-related hazards. This is accomplished through coordination of resources, programs, and authorities. When successful, mitigation will lessen the impacts to such a degree that future events will remain only incidents and not become disasters.

Hazard Mitigation: Any sustained action taken to reduce or eliminate the long-term risk to human life and property from hazards

Mitigation is an essential part of the emergency management process. When a disaster strikes and a community responds, often the focus on repairs and reconstruction is mainly to restore damaged property to pre-disaster conditions as quickly as possible. These efforts expedite a return to "normalcy," yet replication of pre-disaster conditions leaves the community vulnerable to the same hazards, resulting in a cycle of damage, reconstruction, and damage again. Hazard mitigation allows this cycle to be broken by ensuring that post-disaster repairs and reconstruction take place after damages are analyzed and that sounder, less vulnerable conditions are produced.

Mitigation planning allows a community to identify potential hazards, assess vulnerability/risk, and develop prioritized mitigation strategies to deal with those hazards long before an event occurs. The hazards and vulnerabilities are determined based on historical events, incidents in nearby communities, and scientific data and trends. Mitigation measures can be implemented systematically, based on assessed priorities, or, in the worst case, through repair and reconstruction after a hazard event occurs.

Houghton County is vulnerable to a wide range of natural, technological, and human-related hazards, including flooding, infrastructure failure, structural fires, winter storms, subsidence, and

hazardous material spills due to transportation accidents. While the threat from hazardous events may never be fully eliminated, there is much to be done to lessen their potential impact upon the community. The Houghton County Hazard Mitigation Plan (hereinafter referred to as "Hazard Mitigation Plan") is the logical first step toward incorporating hazard mitigation principles and practices into the routine government activities and functions of Houghton County and its municipalities. At its core, the Hazard Mitigation Plan recommends specific actions to protect its residents from losses due to hazards that pose the greatest risk. These mitigation actions go beyond simply recommending structural solutions to reduce existing vulnerabilities. They also include local policies on community growth and development, incentives for natural resource protection, and public education activities are examples of other actions considered to reduce Houghton County's future vulnerabilities to identified hazards. The Hazard Mitigation Plan is designed to be a living document, with implementation and evaluation procedures included to help achieve meaningful objectives and successful outcomes over time.

Disaster Mitigation Act of 2000 and National Flood Insurance Reform Act of 2004
To reduce natural disaster losses, the U.S. Congress passed the Disaster Mitigation Act of 2000 (42 U.S. Code § 5165) to invoke new and revitalized approaches to mitigation planning. Section 322 of this Act emphasizes the need for state and local government to closely coordinate on mitigation planning activities and makes the development of a hazard mitigation plan a specific eligibility requirement for any local government applying for federal mitigation grant funds. These funds include the Hazard Mitigation Grant Program (HMGP), the Flood Mitigation Assistance (FMA) Program, and the Pre-Disaster Mitigation (PDM) Program, all of which are administered by the Federal Emergency Management Agency (FEMA) under the Department of Homeland Security.

This Hazard Mitigation Plan was prepared in coordination with FEMA, the Emergency Management and Homeland Security Division of the Michigan State Police, and the Houghton County Emergency Manager to ensure that it meets all applicable Disaster Mitigation Act planning requirements. The Local Mitigation Plan Review, found in Appendix G, provides a summary of FEMA's current minimum standards of acceptability and notes the location within the Hazard Mitigation Plan where each planning requirement is met.

Purpose

The general purpose of this Hazard Mitigation Plan is to:

- Protect life and property by reducing the potential for future damages and economic losses that result from natural hazards;
- Qualify for additional grant funding;
- Speed recovery and redevelopment following future disaster events;
- Demonstrate a firm local commitment to hazard mitigation principles; and
- Comply with federal and state legislative requirements for local hazard mitigation plans.

Scope

Beginning in March 2019, this plan was updated as required by the Emergency Management and Homeland Security Division of the Michigan State Police and FEMA. After review of FEMA's requirements for local hazard mitigation plan updates, the Local Planning Team (LPT) reviewed and analyzed each section of the plan and determined that each section needed to be updated to some degree to meet the requirements.

This plan will be updated and maintained to continually address those hazards determined to be of high and moderate risk through the detailed risk assessment for Houghton County (see Section 6: *Risk Assessment*). Other hazards that post low or negligible risk will continue to be evaluated during future updates to the Hazard Mitigation Plan, but they may not be fully addressed until they are determined to be of high or moderate risk to Houghton County.

The geographic scope (i.e. planning area) for the Hazard Mitigation Plan includes the entire area of Houghton County.

Authority

Houghton County has adopted this Hazard Mitigation Plan in accordance with the authority and adoption powers granted to counties as defined by the State of Michigan (MI Const., Article VII § 2). The plan has also been adopted by Houghton County's participating municipal jurisdictions under the authority granted to cities, townships, and villages as defined by the State of Michigan (MI Const. Article VII § 22 & 34). Local resolutions to adopt the plan are compiled in Appendix H.

This plan was developed in accordance with current state and federal rules and regulations governing local hazard mitigation plans. The document shall be monitored and updated on a five-year basis to maintain compliance with the following legislations:

- Section 322, Mitigation Planning, of the Robert T. Stafford Disaster Relief and Emergency Assistance Act, as enacted by Section 104 of the Disaster Mitigation Act of 2000 (P.L. 106-390) and by FEMA's Interim Final Rule published in the Federal Register on February 26, 2002, at 44 CFR Part 201.
- National Flood Insurance Act of 1968, as amended 42 U.S. Const 4001 et seq; and
- Michigan General Statutes: Emergency Management Act 390 of 1976.

SECTION 2: Planning Process

This section of the Hazard Mitigation Plan describes the mitigation planning process completed by Houghton County. It consists of the following nine subsections:

- Overview of Hazard Mitigation Planning
- History of Hazard Mitigation Planning Houghton County
- Preparing the 2020 Plan
- The Planning Team
- Local Planning Team Meetings
- Involving the Public
- Involving Stakeholders

Overview of Hazard Mitigation Planning

Local hazard mitigation planning is a process of organizing community resources, developing the goals for hazard mitigation in the county, identifying and assessing local hazard risks, and determining how best to minimize/manage those risks. The process results in a hazard mitigation plan that identifies special mitigation actions that achieve both short- and long-term planning objectives for a community-based vision. Plan maintenance procedures are established for routine monitoring of implementation progress, as well as evaluation and enhancement of the plan itself. These procedures ensure that Houghton County's Plan remains a current, dynamic, and effective planning document over time.

Mitigation planning offers many benefits to the local community such as:

- Protect public safety and prevent loss of life and injury.
- Reduce harm to existing and future development.
- Maintain community continuity and strengthen the social connections that are essential for recovery.
- Prevent damage to the community's unique economic, cultural, and environmental assets.
- Minimize operational downtime and accelerate recovery of government, organizations, and businesses after a disaster.
- Reduce the costs of disaster response and recovery and exposure for first responders.
- Help accomplish other community objectives, such as capital improvements, resource protection, open space preservation and green infrastructure installation, and economic resiliency.

Having a hazard mitigation plan will increase awareness of hazards, risk, and vulnerabilities; identify actions for risk reduction; focus resources on the greatest risks; and communicate priorities to state and federal offices.

History of Hazard Mitigation Planning in Houghton County

Houghton County's first formal hazard mitigation planning efforts started in 2005 with preparation of the County's first FEMA-approved Hazard Mitigation Plan. These efforts were in response to the Federal Disaster Mitigation Act of 2000, a new requirement at the time to obtain funds through FEMA. The initial plan was led by the mitigation planning team, named *Houghton County Ad-hoc Committee* and organized by the *Houghton County Emergency Measures Office*. The committee included planning professionals from the Western U.P. Planning and Development Region (WUPPDR), the County Emergency Coordinator, engineering professionals, and representatives from the Houghton County Board of Commissioners and Road Commission. The final plan was adopted on November 22, 2005 by the Houghton County Board of Commissioners and the governing bodies of participating jurisdictions shortly thereafter. FEMA approved the plan in Fall 2005, validating it until 2010.

In 2012, Houghton County contracted with WUPPDR again to update the 2005 plan. This plan update began with a review of the 2005 plan and gathering new data and information from local sources, the State, and Michigan Technological University to update the hazard risks to municipalities within the County. The Ad-hoc Committee then met to identify new projects to address existing and newly identified hazards. A public meeting was held during the planning process on August 13, 2013. The final plan was adopted by Houghton County Board of Commissioners on October 8, 2013 and subsequently adopted by the participating jurisdictions.

Preparing the 2020 Plan

Hazard mitigation plans are required to be updated every five years in order to remain eligible for certain State and Federal mitigation funding. In preparation of the 2020 Hazard Mitigation Plan update, Houghton County and WUPPDR determined the best approach would be for WUPPDR to apply to be a subrecipient of grant funding to assist the County to update its plan. WUPPDR followed the mitigation planning process recommended by FEMA (Local Mitigation Planning Handbook, March 2013) and the Michigan State Police.

44 CFR Requirement

201.6(c)(1): The plan shall include documentation of the planning process used to develop the plan, including how it was prepared, who was involved in the process and how the public was involved.

This section of the Hazard Mitigation Plan provides a description of the process that was used to develop the 2020 plan update. For information about how previous versions of this plan were developed it will be necessary to review the previous versions of this plan.

Plan update and review procedures were established in the previous versions of this plan and were used, in addition to the requirements discussed above, to prepare the 2020 update. These procedures provide the general guidelines for updating and reviewing the plan on a five-year

basis. These procedures also state that the plan will be evaluated for effectiveness and appropriateness by addressing the following questions:

A. Do Hazard Mitigation Plan goals and objectives continue to address current and expected conditions?
B. Has the nature or magnitude of risks changed?
C. Are current resources enough and appropriate for Hazard Mitigation Plan implementation?
D. Are there any implementation problems that impede the action plan?
E. What implementation outcomes have been completed?
F. Have other agencies, organizations, and jurisdictions participated as proposed in the previous plan?

These questions were considered and addressed by the local planning team. Each section of the updated plan includes information on the plan was reviewed and updated with the identified results. The State of Michigan Hazard Mitigation Plans adopted in 2014 and 2019 were reviewed extensively to incorporate relevant material into the Houghton County Hazard Mitigation Plan update.

The planning process included several steps that were completed over the course of several months. These steps are illustrated in Figure 2.1.

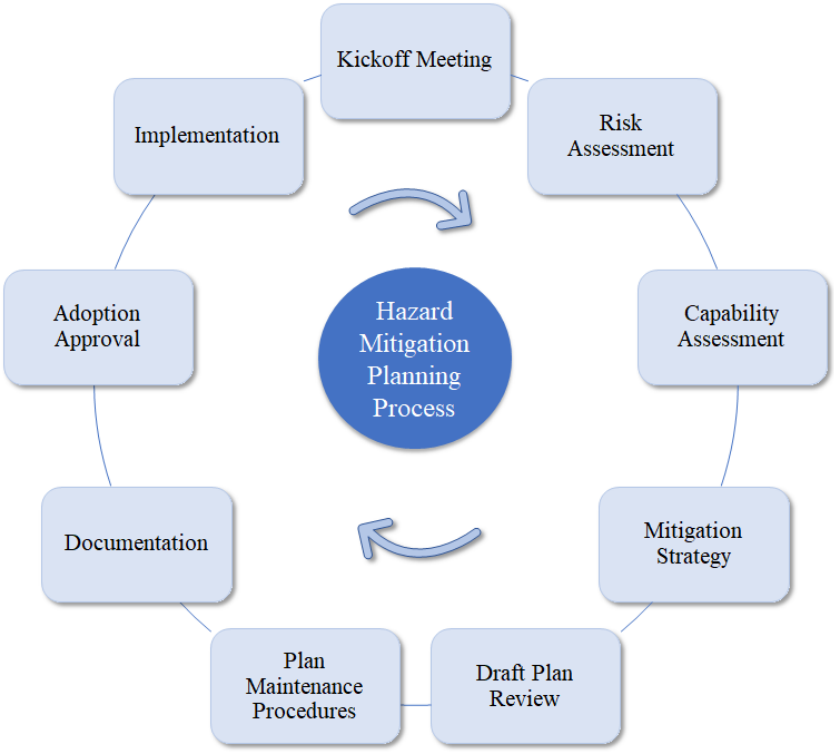


Figure 2.1: Hazard Mitigation Planning Process

Each step of the planning process illustrated in Figure 2.1 resulted in outcomes that make up the Hazard Mitigation Plan. These work elements have been integrated into this document and are further explained here for introductory purposes:

The *Community Profile,* located in Section 3, provides a general overview of Houghton County and includes information on relevant topics such as geography, transportation, environment, population, demographics, housing, infrastructure, and land use. Specifics about declared disasters in the county can also be found.

The *Risk Assessment,* in Section 6 identifies, analyzes, and assesses overall risk to hazards in Houghton County. Hazards exclusive to individual jurisdictions in the *Risk Assessment* strive to identify unique vulnerabilities, as well as prioritize and rank county-wide hazards from high to low risk.

Hazard Mitigation, found in Section 7, determines the capability of a local jurisdiction to implement a comprehensive mitigation strategy and identify potential opportunities to establish or enhance mitigation policies, programs or projects. Capabilities are detected by identifying existing strengths and weaknesses with ongoing government activities that have a direct impact on the community's vulnerability to hazards. This helps to identify what gaps or shortfalls need to be addressed and which positive mitigation measures already in place should continue to be supported. Coupled with the Risk Assessment, the Capability Assessment helps identify and target meaningful mitigation actions for incorporation in the Mitigation Strategy portion of the Hazard Mitigation Plan. Together, The *Community Profile, Risk Assessment, and Capability Assessment* help to determine the Hazard Mitigation Plan goals. A meaningful *Mitigation Strategy* based on accurate background information is developed, adopted, and implemented with these three components.

Mitigation Strategies, also found in Section 7, consist of a comprehensive strategy that looks to develop over-arching goals addressing both hazard mitigation and economic, environmental, and social factors. Mitigation Action Plans, in Section 8, were created for each jurisdiction, identifying specific plans for action to reduce or eliminate the impacts of natural hazards. Both sections make the plan comprehensive by identifying long-term and short-term goals that will influence day-to-day decision making and project implementation.

The plan's maintenance schedule is embedded in the action plan in Section 8 and describes in detail the procedures as a final action item for Houghton County to keep up to date with the Hazard Mitigation Plan.

The Planning Team

To guide the development of this plan update, Houghton County's Emergency Management Coordinator convened a local planning team (LPT). While remaining consistent with the initial plan developed, it was important to reach out to more stakeholders to get a representative sample of critical facility staff, local officials, emergency personnel, and citizens. The LPT coordinated

together on all aspects of the plan development process. Additional participation and input from county residents and other identified stakeholders were sought through the distribution of surveys and the facilitation of a meeting to receive public comment.

Jurisdictional Involvement

All units of government in Houghton County have participated in the development of the 2020 Houghton County Hazard Mitigation Plan as required for pre-disaster federal mitigation funds under Section 104 of the Disaster Mitigation Act of 2000 (42 U.S. Const. 5165). These same jurisdictions also participated in the 2005 and 2012 Plan updates.

Table 2.1: Participating Local Units of Government and their representatives

Jurisdiction	Name	Title
Houghton County	Chris VanArsdale	Emergency Manager
City of Hancock	William Lepisto	Hancock Fire Chief
City of Houghton	Eric Waara	City Manager
Village of Calumet	Caleb Katz	Village Administrator
Village of Copper City	David Strang	Village President
Village of Lake Linden	Dan Sarazin	Bootjack Fire Chief
Village of Laurium	Robert Kyllonen	Village Chief of Police
Village of South Range	Justin Marier	Village President
Adams Township	Gerald Heikkinen	Township Supervisor
Calumet Charter Township	Tim Gasperich	Township Supervisor
Chassell Township	David Mattson	Township Supervisor
Duncan Township	Barton Kennedy	Duncan Township Fire Chief
Elm River Township	John Reynolds	Township Supervisor
Franklin Township	Mary Sears	Township Supervisor
Hancock Township	Kenneth Moyle	Township Supervisor
Laird Township	Patrick McLaren	Township Supervisor
Osceola Township	Stephen Klein	Tamarack City Fire Chief
Portage Charter Township	Bruce Petersen	Township Supervisor
Quincy Township	Glenn North	Township Supervisor
Schoolcraft Township	Joel Keranen	Township Supervisor
Stanton Township	Marvin Heinonen	Township Supervisor
Torch Lake Township	Brian Cadwell	Township Supervisor

Houghton County Local Planning Team

The participants listed in Table 2.2 represent the members of the Houghton County Local Planning Team who participated in the development of the Plan. The planning process was led at the county level by the Houghton County Emergency Coordinator. WUPPDR provided a team of planners and a Geographic Information Systems coordinator to facilitate LPT meetings. Committee members are listed alphabetically by agency/jurisdiction.

Table 2.2: Houghton County Local Planning Team

Name	Agency/Jurisdiction
Chris Van Arsdale	Houghton County Emergency Management Coordinator
Stanley Vitton	Houghton-Hancock Wastewater Treatment Board Member
Mark Halonen	Koppers
Gerald Primeau	Mercy EMS
Peter Baril	Western U.P. Health Department

Local Planning Team Meetings

The preparation of the Plan required a series of meetings for facilitating discussion and initiating data collection efforts with local officials. The meetings also prompted continuous input and feedback from local officials throughout the drafting stages of the Plan.

Below is a summary of the key meetings of the Local Planning Team. Copies of the agendas, sign-in sheets, and handout materials for all meetings can be found in Appendix F.

First Local Planning Team Meeting

The first meeting of the Local Planning Team was held on May 16, 2019, during which the mitigation plan update process was presented. The intent of this meeting was to inform team members and guests about the planning process and requirements according to the law. The meeting also served to initiate the preliminary data collection efforts for the risk and capability assessment tasks associated with the plan's development.

Second Local Planning Team Meeting

The second Local Planning Team meeting was held on August 20, 2019. The meeting began with a detailed presentation by WUPPDR on the findings of the risk assessment and public survey. By providing the county and municipal officials with a more thorough understanding of hazard risks in their communities, along with the survey results, the audience was prepared for the next step in the update process: to review the expired mitigation planning goals and list specific mitigation actions designed to reduce future impacts of the identified hazards.

To summarize, the following general findings were presented and discussed at the second LPT meeting.

Risk Assessment Findings:

- The total projected asset counts and values were assessed for public institutions in Houghton County. The 5 highest value assets are the following: (1) Michigan Technological University - $766M, (2) Houghton County Sheriff Department - $10M, (3) U.S. Coast Guard station - $4M, (4) Hancock City Hall and Police - $4M, (5) Calumet Village Hall, Police, and Fire Department - $4M. The full list may be found in Table 3.7 of Section 3.

- The top 5 hazards in Houghton County based on the quantitative prioritized risk assessment are: (1) Public Health Emergency, (2) Snowstorms and Blizzards, (3) Riverine and Urban Flooding, (4) Infrastructure Failures & Secondary Technological Hazards, and (5) Invasive Species.

Capability Assessment Discussion

Houghton County and Chassell and Osceola Township actively participate in the National Flood Insurance Program (NFIP). Franklin Township registered for the NFIP on January 28, 2019, and as of November 12, 2019 has emergency coverage until such time as it is inducted in the regular program. The City of Houghton registered for Non-Special Flood Hazard Area (NSFHA) on February 19, 2019. Schoolcraft Township registered on October 11, 2019, but only has limited emergency coverage. Torch Lake Township registered with NFSHA on August 28, 2019 and has limited emergency coverage. Adams Township filed to participate in the NFIP on May 13, 2019 and has limited emergency coverage. City of Hancock has resolved to participate in the program, but so far has not registered.

- City of Hancock, City of Houghton, Village of Calumet, Village of Lake Linden, and Calumet Charter Township have adopted and implement/enforce a comprehensive plan, building codes, and zoning ordinances.
- Both cities of Houghton and Hancock have adopted a Storm-water Management Plan.
- Local units of government in Houghton County have varying degrees of administrative and technical capability, with adequate staff resources to implement local government programs.

Review of Existing Mitigation Plan Goals, Objectives, and Actions

The existing goals from the 2013 Houghton County Hazard Mitigation Plan were presented to the Local Planning Team during the second meeting. The committee agreed that these goals were still appropriate for what Houghton County means to accomplish. The goals are listed in Section 7 of this plan.

Prior to the second meeting, each municipality was asked to send updates on their current mitigation actions from 2013, and to develop any new actions that should be included in the plan. The group spent time brainstorming ideas and discussing these possible new actions.

Involving the Public

Public participation is one of the fundamental components of Houghton County's community-based mitigation planning process. Individual citizen involvement provides the Local Planning Team with a greater understanding of local concerns and ensures a higher degree of mitigation success by developing community buy-in from those directly affected by the hazards in the region. Public awareness is a key part of the overall mitigation strategy aimed at making communities safer from the potential risks that hazard effects.

For the 2020 plan update, public input was sought using multiple methods: (1) public and government/institutional surveys; (2) posting the draft on the WUPPDR website and at government offices and the Portage Lake District Library; and (3) a public meeting with opportunity for comments prior to adoption.

Houghton County encouraged more open and widespread public and stakeholder participation through the publication of newspaper advertisements, draft comment period, and public meeting to receive comments. Local officials and institutions were also engaged to fill out a different survey to glean information about their respective organizations.

These media advertisements and survey tools provide local units of government, residents, businesses, academic organizations, and other private interests in Houghton County the opportunity to be involved and offer input throughout the planning process.

Summary of Public Participation Survey

The 2019 Houghton County Hazard Mitigation Public Survey received 136 responses. All jurisdictions in Houghton County were represented except for the village of Copper City and Duncan Township. A majority, 81.6%, said they or someone in their household experienced a hazard in the last 5 years. Most had experienced flooding at 78.3%, while the second most common hazard experienced was a windstorm at 10.4%. Respondents were also asked whether they had taken actions to make their home or community more resistant to hazards. Over half of them (55%) said yes, while 45% said no. Additional responses pertained to property located in the floodplain, flood frequency, flood insurance, and effective ways to receive hazard emergency information. A summary of the public survey results is available for review in Appendix E.

Summary of draft locations

A list of locations where the draft plan was located is available in Appendix E.

Summary of Public Meeting and Comments Received

A summary of the public meeting and comments received are available for review in Appendix E.

Involving Stakeholders

A range of stakeholders were invited and encouraged to participate in the Houghton County Hazard Mitigation Plan by joining the Local Planning Team meetings. The invitations were sent to the following individuals:

- Chris Van Arsedale, Houghton County Emergency Management Coordinator
- Roy Britz, Michigan Technological University Public Safety & Emergency Management
- Kevin Coppo, Houghton County Sheriff's Office, Houghton County 911
- Albert Koskela, Houghton County Board Chair
- Brian McLean, Houghton County Sheriff

- Randal Danison, Michigan State Police
- Brian Cadwell, Michigan Technological University Public Safety
- Dan Bennett, Michigan Technological University Emergency Management
- Melody Snyder, Aspirus Keweenaw Hospital
- Gerald Primeau, Mercy EMS
- Sally Santeford, Search and Rescue & Community Member
- Peter Baril, Western U.P. Health Department
- Dan Sarazin, Bootjack Fire/Rescue
- Mark Halonen, Koppers
- Kevin Keranen, UP Health System Portage Hospital
- Kevin Harju, Houghton County Road Commission
- Todd Fox, Search and Rescue, Houghton 911
- Dennis Hext, Houghton County Airport
- Jonathan Stone, Stanton Twp. First Responders, Michigan Technological University EMS

SECTION 3: Community Profile

This section of the Hazard Mitigation Plan provides a general overview of Houghton County. It consists of the following seven subsections:

- Geography, Environment, and Land Use
- Population and Demographics
- Housing and Infrastructure
- Employment and Industry
- Police, Fire, and Emergency Services
- Critical Facilities & Cultural Assets
- Disaster Declarations

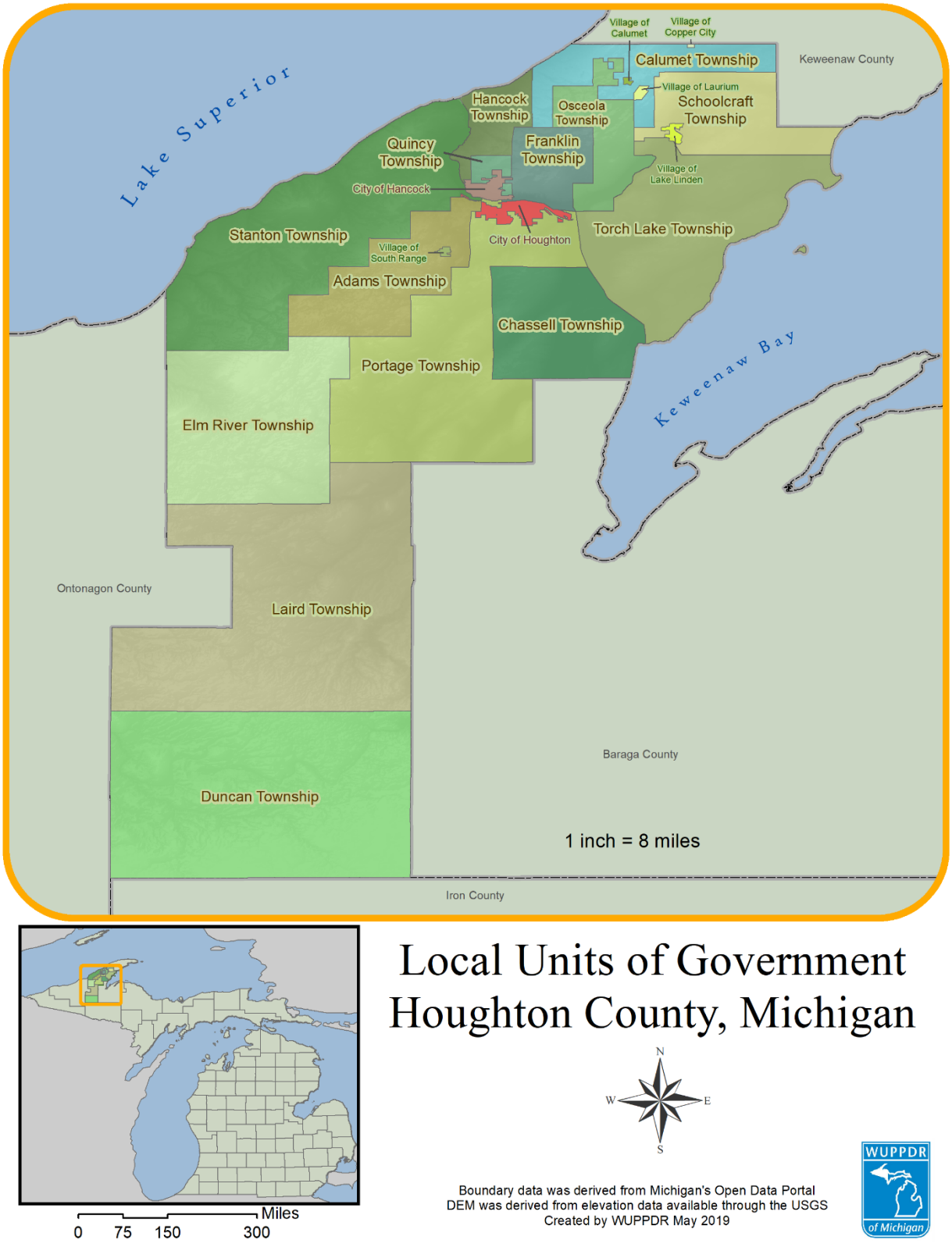
Geography, Environment, and Land Use

Houghton County is in the northwestern portion of Michigan's Upper Peninsula, on the southern coast of Lake Superior. Over half of the county lies on the Keweenaw Peninsula, which is up to 50 miles wide that extends 75 miles out into the lake. The county is intersected by the Portage Waterway, which runs west-east across the northern part of the county and is connected to Lake Superior on both ends. The county was organized in 1848 and named after Douglass Houghton, Michigan's first geologist, who confirmed the existence of copper in the Keweenaw Peninsula. The City of Houghton serves as the county seat and is the county's most populous city with 7,882 residents in 2017 (*American Community Survey, 2017*). **Map 3.1** shows a map of Houghton County with the location of its townships and municipalities.

Houghton County's total land area is 1,071 square miles. The land is comprised mostly of highlands, upland plains, and lake-border plains. Over 80% of the land is covered by forests, mainly of upland hardwoods. The county contains 923 miles of rivers and streams, 31 square miles of lakes/ponds, and 50 miles of Lake Superior shoreline. The area's topography varies between 600- and 1,600-feet above sea level.

Houghton County lies within the Lake Superior Basin, which has a typical humid continental climate characterized by cold, dry winters and warm, humid summers. However, the lake exerts a strong microclimate influence on the immediate shoreline, generally resulting in cooler summers and milder winters than those experienced a few miles inland. This is due to the effect of Lake Superior on air temperatures and the prevailing westerly winds.

The moderating effect of the lake is experienced in spring and summer months when the cool water tends to level out temperature extremes and reduces the likelihood of frost. Another effect of the lake is the formation of considerable cloudiness when cold air passes over the lake in late fall and early winter. This causes early and heavy snow possibilities, referred to as the "lake effect". Both these effects lessen as one moves away from the Lake Superior shoreline.



Map 3.1: Houghton County Townships and Municipalities

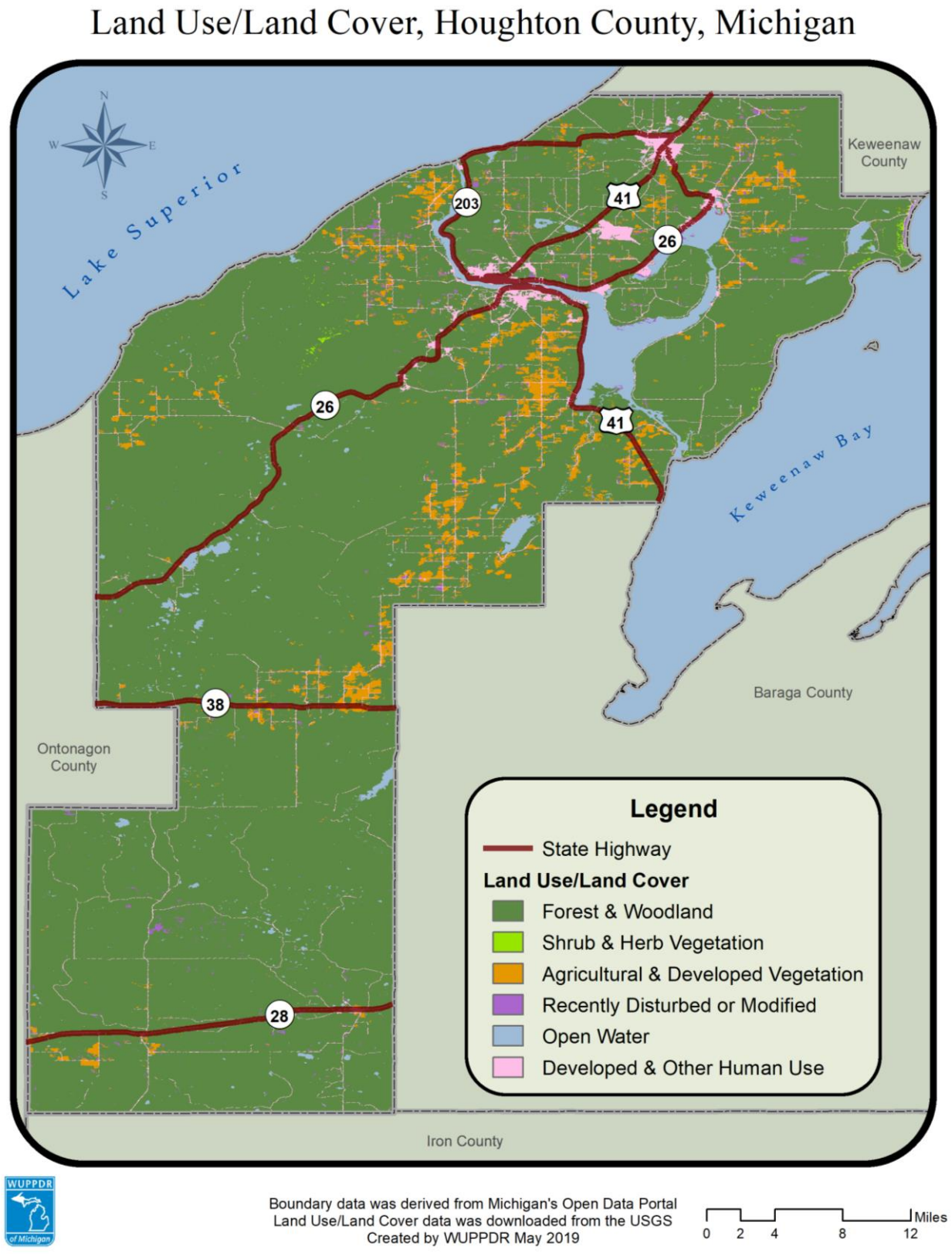
Average temperatures in January are a low 11 degrees Fahrenheit and high of 24 degrees Fahrenheit. In July, average temperatures are a low of 52 and a high of 73 (*NOAA-NCDC: 1981-2010 Normals, Hancock/Houghton Co. Airport*). Annual rainfall precipitation averages 28 inches, while average snowfalls vary widely from 200-300 inches. The large amount of winter snowfall often results in heavy spring runoffs. Weather conditions can vary greatly from the northern to the southern portions of the County. The growing season in Houghton County is 119 days.[1]

Land use and development in Houghton County (**Map 3.2**) is directed by planning and/or zoning regulations in the following municipalities: City of Hancock, City of Houghton, Village of Calumet, Village of South Range, Calumet Township, Chassell Township, Duncan Township, and Portage Township. Residential development, which is about 3% of county land use, is concentrated in established communities in the northern part of the county, with the largest numbers in Houghton/Hancock and Calumet/Laurium. Waterfronts are typically dominated by residential development, except for more rural areas of the county where road access is unavailable.

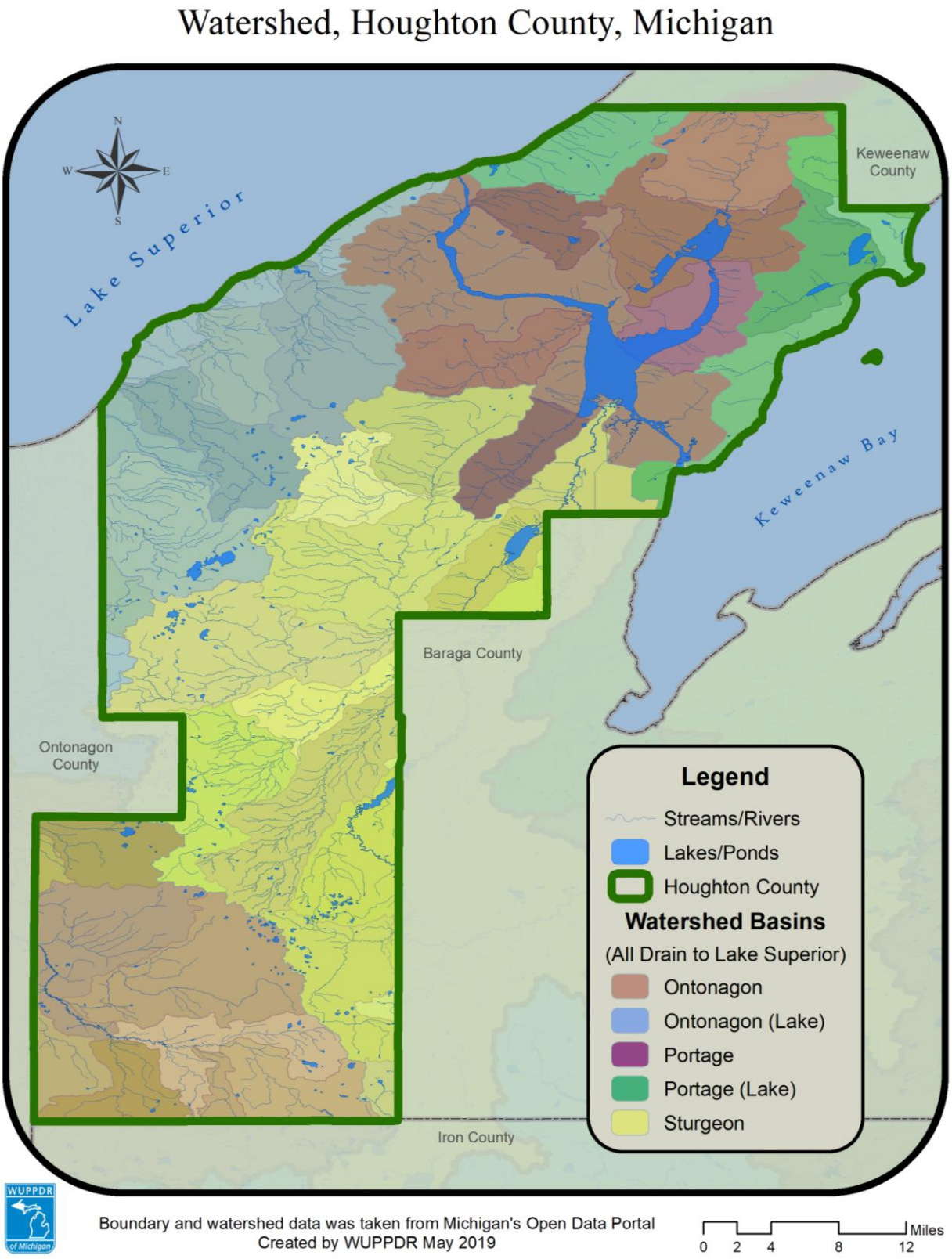
Approximately 89% of the land use/cover in Houghton County is forest and woodland. The Ottawa National Forest covers 23% of the entire county and occupies most of the land in Laird and Duncan Townships. The Copper Country State Forest is made up of three large parcels in Elm River, Laird, Portage, and Chassell Townships. Two small portions of the Baraga State Forest are in Chassell and Torch Lake Townships. Additionally, F.J. McLain State Park and Twin Lakes State Park occupy nearly 600 acres. Altogether, 30%, or 202,912 acres, of Houghton County is part of a state or national forest, park, or recreational area.

Houghton County's major rivers, all within the Lake Superior basin, are the Sturgeon, Otter, Trap Rock, Salmon-Trout, Pilgrim, Graveraet, Elm, Misery, Silver, Jumbo, and Ontonagon. The rivers are all within the Lake Superior basin (**Map 3.3**). There are five watershed sub-basins within the county including: Ontonagon, Keweenaw Peninsula, Sturgeon, Dead-Kelsey and Lake Superior. Geologically, Houghton County lies within a complex of glacial till and outwash deposits. The bedrock geology and glacial activity have played key roles in shaping the present topography. Much of the landscape is dissected by drainage ways.

[1] Frost Dates Calculator, The Old Farmer's Almanac. www.almanac.com/gardening/frostdates/zipcode/49931



Map 3.2: Land Use/Cover in Houghton County



Map 3.3: Watersheds in Houghton County

Population and Demographics

Houghton County is comprised of 14 townships, two incorporated cities, and five incorporated villages. In addition, it has numerous unincorporated small former mining communities where populations remain concentrated. These communities are remnants of much larger settlements founded during the copper mining era. The county's total 2017 population is 36,333 with approximately half of this population located north of the Portage Waterway (**Table 3.1**). Population distribution is influenced largely by Michigan Technological University, whose students comprise nearly 20 percent of the population. The density of Houghton County is approximately 36 persons per square mile.

Since the last Hazard Mitigation Plan update, the county's population remained relatively the same, with only a 0.5% decrease. The City of Houghton, Elm River Township, Stanton Township, Hancock Township, Quincy Township, Calumet Village, Torch Lake Township, Copper City Village, and Lake Linden Village all had population increases.

Table 3.1: Municipal and Township Populations for Houghton County, 1960-2017

Municipality	U.S. Census (Decennial)					American Community Survey (estimates)		
	1960	1990	2000	2010	1960-2010 Change	2012	2017	2012-2017 Change
Adams Township	2,767	2,388	2,747	2,573	-7.0%	2,563	2,532	-1.2%
Calumet Charter Township	9,192	7,015	6,997	6,489	-29.4%	6,479	6,346	-2.1%
Chassell Township	1,423	1,686	1,822	1,812	27.3%	1,973	1,925	-2.4%
Duncan Township	451	304	280	236	-47.7%	219	175	-20.1%
Elm River Township	254	159	169	177	-30.3%	184	354	92.4%
Franklin Township	1,249	1,164	1,320	1,466	17.4%	1,552	1,444	-7.0%
Hancock Township	143	287	408	461	222.4%	529	583	10.2%
Laird Township	598	582	634	555	-7.2%	425	416	-2.1%
Osceola Township	1,958	1,878	2,280	1,888	-3.6%	1,929	1,549	-19.7%
Portage Charter Township	7,699	2,941	3,156	3,221	-58.2%	3,204	3,190	-0.4%
Quincy Township	319	223	251	270	-15.4%	264	314	18.9%
Schoolcraft Township	2,145	2,037	1,863	1,839	-14.3%	1,766	1,689	-4.4%
Stanton Township	993	1,184	1,268	1,419	42.9%	1,234	1,375	11.4%
Torch Lake Township	1,441	1,553	1,860	1,880	30.5%	1,879	1,985	5.6%
Calumet Village	1,139	818	879	726	-36.3%	745	819	9.9%
Copper City Village	293	198	205	190	-35.2%	194	255	31.4%
Lake Linden Village	1,314	1,203	1,081	1,007	-23.4%	1,036	1,094	5.6%
Laurium Village	3,058	2,268	2,126	1,977	-35.3%	2,200	2,147	-2.4%
South Range Village	760	745	727	758	-0.3%	713	664	-6.9%
City of Hancock	5,022	4,547	4,323	4,634	-7.7%	4,627	4,574	-1.1%
City of Houghton	3,398	7,498	7,010	7,708	126.8%	7,692	7,882	2.5%
Houghton County	35,654	35,446	36,016	36,628	2.7%	36,519	36,333	-0.5%

Source: U.S. Census and ACS

According to the American Community Survey (ACS) for 2017, the median age for persons in Houghton County is 32.9 years. Nearly 16% of the county population is comprised of persons that are 65 years old and over. The poverty rate for persons residing in Houghton County is 21.4%. People identifying as White constitute 93.4% of Houghton County, followed by Asian, or Asian Americans making up 2.9%. **Table 3.2** displays the most recent estimates for demographic data on race distribution for Houghton County.

Table 3.2: Race and Ethnicity Percentages in Houghton County, 2017[2]

Race	People	Percent
White	33,948	93.4
Black	279	0.8
American Indian/Alaska Native	116	0.3
Asian	1,059	2.9
Pacific Islander	15	0.05
Other Race	124	0.3
Two or More Races	792	2.2
Total Latinx Population (*ethnicity*)	**543**	**1.5**

Housing and Infrastructure

In 2017, there were 18,724 housing units in Houghton County, a 0.6% increase from 2012. Of these, 13,157 are inhabited, comprised of 9,013 owner occupied units (70.5%) and 4,144 renter occupied units (29.5%). The unoccupied housing is presumably for seasonal or recreational use. The average household size for the county is 2.7 persons. The median home value in Houghton County in 2017 was $102,400 for owner-occupied units, a 19.5% increase from 2012.

Schools

Schools are some of the largest institutions in the county and could potentially see great impacts from the hazards discussed in this plan. Houghton County is comprised of nine separate public-school districts, which are all part of the Copper Country Intermediate School District. **Table 3.3** shows the school districts, grade levels, number of students, and number of instructors at each of the schools in Houghton County[3].

Two institutions of higher education are in the county. Michigan Technological University (MTU) is in the City of Houghton and has by far the larger student body, with 7,203 students in the 2018-19 academic year. MTU is also the largest employer in the county and the Western Upper Peninsula, with over 1,600 employees in 2019. Finlandia University is a private liberal arts college in Hancock with around 500 students.

[2] Data based from the 2013-2017 American Community Survey 5-year Estimates.
[3] MI School Data. Student Enrollment Counts and Staffing Information. www.mischooldata.org/

Table 3.3: Schools in Houghton County, 2019

School District/School Name	Location	Grades	Students	Instructors
Adams Township Schools				
South Range Elementary School	South Range	K-6	233	16
Jeffers High School	Painesdale	7-12	247	15
Public Schools of Calumet, Laurium, & Keweenaw				
Horizons Alternative School	Mohawk	9-12	66	5
CLK Elementary School	Calumet	K-5	707	38
Washington Middle School	Calumet	6-8	377	28
Calumet High School	Calumet	9-12	513	27
Chassell Township Schools				
Chassell K-12 School	Chassell	K-12	259	17
Dollar Bay-Tamarack City Area Schools				
Thomas R. Davis Elementary School	Dollar Bay	K-6	186	9
Dollar Bay High School	Dollar Bay	7-12	151	14
Elm River Township School				
Elm River Township School	Winona	K-6	4	2
Hancock Public Schools				
Gordon G. Barkell Elementary School	Hancock	K-5	329	23
Hancock Middle School	Hancock	6-8	180	19
Hancock Central High School	Hancock	9-12	194	17
Houghton-Portage Township School District				
Houghton Elementary School	Houghton	K-5	638	36
Houghton Middle School	Houghton	6-8	338	17
Houghton Central High School	Houghton	9-12	449	30
Lake Linden-Hubbell Public Schools				
Lake Linden-Hubbell Elementary School	Lake Linden	K-6	215	18
Lake Linden-Hubbell High School	Lake Linden	7-12	210	17
Stanton Township Public Schools				
E.B. Holman School	Atlantic Mine	Pre-K-8	172	9

Public Works

Houghton County has a Road Commission with multiple facilities, staff, and equipment resources. The Commission is responsible for county roadways and does not plow state and federal highways in winter. Most municipalities have public works departments for maintenance and development of transportation and other infrastructure. Townships, villages, and both cities also have staff for maintenance of facilities and utilities. All such agencies are resources for implementation of related mitigation actions.

Water and Wastewater Facilities

Many Houghton County residents live in rural areas that are not serviced by public sewer and/or

water. The contamination of individual wells and the failure of individual septic systems presents the potential for public health emergencies. Properly locating, constructing, maintaining, and monitoring groundwater wells is critical to the prevention of waterborne illnesses. The Western U.P. Health Department Environmental Health Division evaluates proposed well locations and issues well construction permits for residential lots and small businesses. They also provide other services which include options for well water testing, existing water supply inspections, well log and abandoned well tracking, and general consultation.

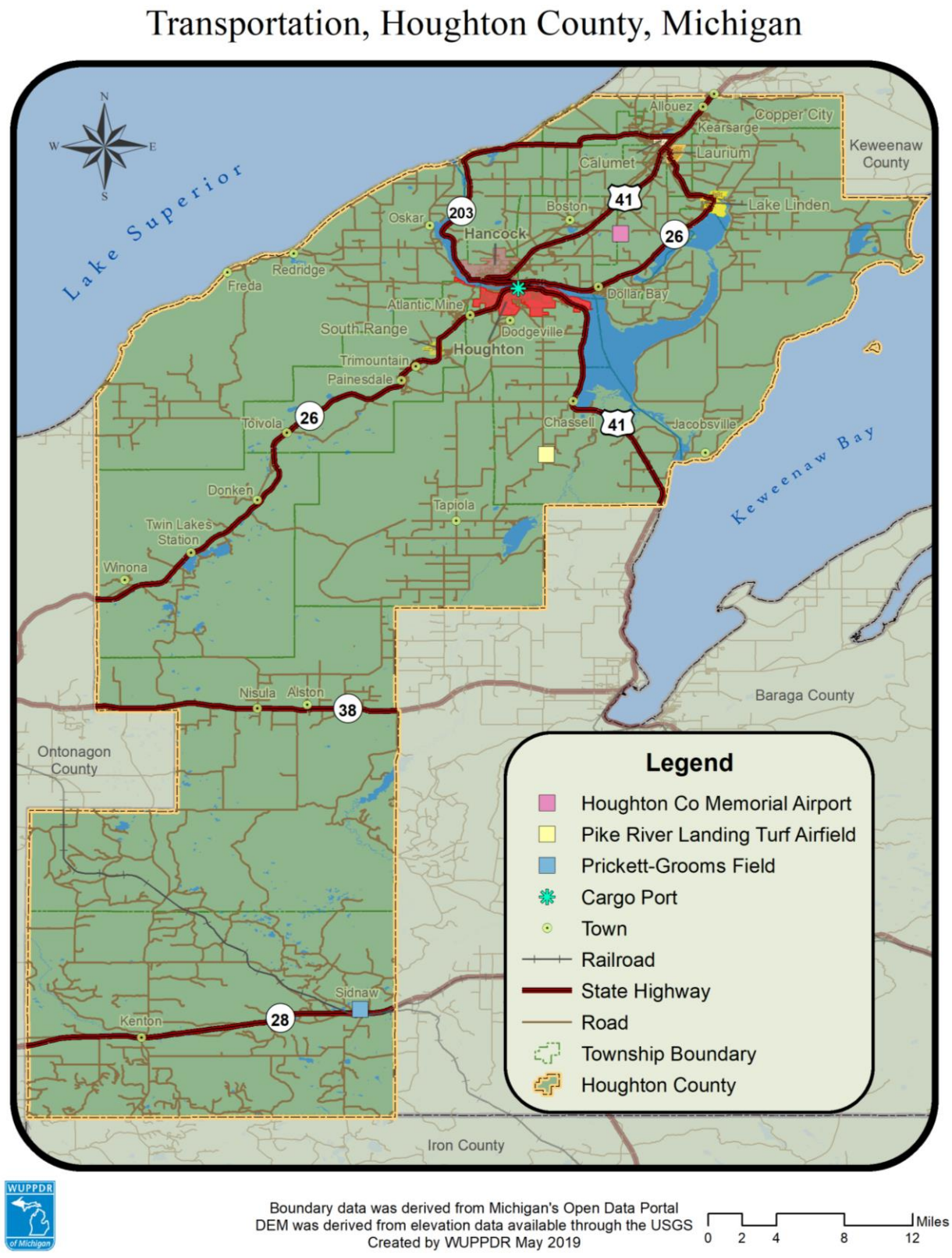
Public water and wastewater facilities in Houghton County are variable across jurisdictions. The source for the city of Houghton's water is the submerged delta of the Pilgrim River which was buried under stamp sand mining wastes. The groundwater treatment plant utilizes three wells that range in depth. Water is pumped from the aquifer to the facility where it is filtered and treated. The City uses about 1.1 million gallons of water per day and sells approximately 10 million gallons of water per year to Portage Township.

The Portage Lake Water and Sewage Authority (PLW&SA) was established in 1964 by the cities of Hancock and Houghton for the purpose of constructing and operating a joint use wastewater treatment facility. The facilities that were constructed included a lift station for each city to convey wastewater to a common site and a wastewater treatment plant located on the south shore of Hancock.

Roads

Transportation networks are vital to Houghton County - not only for local transportation but for encouraging tourism and serving industry. Houghton County is crossed by several major State and US highways (**Map 3.4**). Thirty-four miles of US Highway 41, which starts in the northernmost part of the Keweenaw Peninsula and runs 1,990 miles to Miami, Florida, are in Houghton County. Highway M-26 starts in Copper Harbor in Keweenaw County and runs southwest until it intersects US 45, approximately five miles beyond Mass City in Ontonagon County. Forty-six miles of M-26 are in Houghton County, although a four-mile stretch is shared with US 41. Twelve miles of M-38 traverse central Houghton County, passing through Nisula en route from Baraga to Ontonagon. M-28, which spans virtually the entire Upper Peninsula, runs from Interstate 75 in the east to US 2 at the City of Wakefield in the west. Fifteen miles of M-28 cross southern Houghton County, passing through the communities of Kenton and Sidnaw. In addition to these major routes, there are 858 miles of roads owned and maintained by the Houghton County Road Commission and about 100 miles of city and village streets.

The Houghton County Road Commission operates from six locations including their headquarters in Ripley and garages in Calumet, Trimountain, Elo, Alston, and Kenton. The county also contains many miles of seasonal roads with a number in southern Houghton County being built and maintained by the U.S. Forest Service. Each incorporated community owns and maintains the local street networks within its limits. Highways in Houghton County are maintained by the Michigan Department of Transportation.



Map 3.4: Houghton County Transportation

Portage Lake Lift Bridge

Historically, the Portage Lake and the Portage River provided a natural pathway across the Keweenaw Peninsula, dividing it almost in half. In the 1860s the current ship canal, referred to as the Portage Waterway, was completed connecting Lake Superior via Portage Lake on the east to Lake Superior on the west. Completion of this canal made the Keweenaw an island rather than a peninsula.

In 1875, a bridge was built to connect Houghton and Hancock (located on opposite sides of Portage Lake). This bridge was rebuilt and underwent major repairs before the current Portage Lake Lift Bridge was built in 1959. This bridge now spans the waterway and is recognized as the heaviest aerial lift bridge in the world. The unique double deck bridge has two levels for traffic. The upper level is for vehicular traffic and the lower level was originally used for trains. Trains no longer run in the Keweenaw, but snowmobiles use the lower level during the winter months as part of the State mandated trail system. The Portage Lake Lift Bridge is a vital link providing the only land entrance to the northern portion of Houghton County and Keweenaw County. A committee has met regularly since 2008 to plan for outages that may occur. Three complementary plans were created – the most recent in 2013 – to address various elements of an outage, and the plans are periodically reevaluated and updated.

Rail

Although rail service played a critical role in the development and economic growth of the Keweenaw Peninsula, most of the tracks that connected population centers, mines, and ports have been removed. Today these corridors serve as snowmobile, off-road vehicle, hiking, and biking trails around the county.

Houghton County is still served by one privately owned short line operator, the Escanaba & Lake Superior Railroad (E&LS). The E&LS has track and log landings in the southern portion of the County and it is part of its line that ends at Mass City. The E&LS also maintains tracks from Sidnaw east to Nestoria that connect to the Canadian National Railway (CN) and are currently used for car storage. The line has been conditionally approved for abandonment. The E&LS also maintains trackage rights over the CN line from Nestoria to Baraga. Though Houghton County track is only used for storage, some logs are shipped out of the CN yards located in L'Anse.

The Northwoods Rail Transit Commission (NRTC) represents 13 counties in northeastern Wisconsin and seven counties in the U.P, including Houghton County. The Mission of the NRTC is to sustain and enhance safe, reliable and efficient rail service critical to the businesses, communities and economies in northern Wisconsin and the Upper Peninsula of Michigan. The Commission meets regularly to advocate for continuation and growth of rail service in the region.

Ports

Domestic port facilities are available in Houghton and Hancock. The Portage Waterway provides refuge to ships and boats seeking an alternate route when Lake Superior seas do not allow safe passage around the Keweenaw Peninsula. Ships up to 600 feet in length can navigate the

waterway, with the limit being the 104-foot vertical clearance of the Portage Lake Lift Bridge. The Houghton County Marina is just east of the Lift Bridge on the Hancock side.

Only one commercial port is currently in operation in Houghton County: Mattila's Rock and Dock in west Hancock. This port currently receives approximately 2 to 3 ships per year. Isle Royale National Park operates the Ranger III passenger ferry from its port in Houghton. Houghton also has moorings for larger vessels and regularly has stop overs from Coast Guard, research, and training vessels. Houghton has also received cruise ships on several occasions in the last ten years and is looking into becoming a more frequent destination for future cruise ships. The Portage Waterway is also home to approximately a dozen commercial fishing vessels.

Airports

Houghton County Memorial Airport (CMX) is located four miles northeast of Hancock at an elevation of 1,095 feet. The county owns the un-towered airport, which operates year-round. The airport maintains two paved runways: the primary runway 13/31, which is 6,501 feet long and the secondary runway, 7/25, extends 5,196 feet. SkyWest (United Airlines) provides two daily non-stop commercial flights to Chicago-O'Hare. The airport also offers fuel, parking and hangars, airframe, and power plant service, and flight instruction. Aircraft operations average 44 flights per day, with 37% being local general aviation, 30% transient general aviation, 19% commercial, 13% air taxi service, and less than one percent military. Prickett-Grooms Field Airport (6Y9) is in southern Houghton County, one-mile northeast of Sidnaw at 1,372 feet. It is privately owned and operated. The 2,000-foot turf runway is rough and in poor condition, becoming soft when wet. The airport is closed November through April and when snow-covered, since the runway is not plowed. The Prickett-Grooms Field airport has no facilities and provides no services except free parking and camping on the field. It sees an average of 160 operations per year, all of which are transient general aviation.

Transit

Indian Trails Bus Company serves Houghton and Hancock with daily direct trips to Green Bay, Wisconsin. Transfers can be made in Escanaba, Michigan to buses headed for other destinations. Both the cities of Houghton and Hancock operate transit systems. Houghton Public Transit provides both scheduled and on-demand services for the City of Houghton. Hancock Public Transit provides on-demand bus service in the City of Hancock. Lamers Bus Lines in Houghton offers charter bus service. Taxicab service is available in the Calumet, Hancock, and Houghton areas. Ride-sharing services (e.g., Lyft) have also recently began services in the Houghton/Hancock area.

Employment and Industry

In 2017, the median household income for Houghton County was $41,379 and median per capita income was $19,623. The state unemployment rate for 2017 was 7.4%, and for Houghton County the rate was 6.8%. 21.4% of people in Houghton County are reportedly below the federal poverty level.

Today, educational and health care services have replaced mining as the major sources of employment. As mentioned earlier, Houghton County hosts two universities, Michigan Technological University and Finlandia University. The county has also become a popular place for retirees and summer cottages. The growing tourism industry is built around the area's historical resources, unique geology, and many outdoor recreational opportunities. Lake Superior, the numerous inland lakes and streams, abundant forests, the various trail systems, and an annual average of 200 inches of snow make the county a destination for summer and winter recreation enthusiasts alike. Development and economic growth in the area significantly decreased from 1920-1970 but since 1990 has been on an upward trend. **Table 3.4** provides an overview of employment in Houghton County for 2016 by economic sector.

Table 3.4: Employment by Sector in Houghton County, 2016

Employment Sector	Percentage
Educational Services	21.8
Healthcare & Social Assistance	13.2
Retail Trade	11.5
Accommodation & Food Service	11.3
Manufacturing	9.0
Construction	5.4
Professional, Scientific, Tech Services	4.4
Other services, except public administration	4.3
Finance & Insurance	4.0
Public Administration	3.2
Information	2.0
Arts, Entertainment, Recreation	2.0
Agriculture, Forestry, Fishing, Hunting	1.6
Admin Support, Waste Management Services	1.5
Transportation & Warehousing	1.5
Real Estate, Rental & Leasing	1.4
Wholesale Trade	1.1
Utilities	0.5
Mining, Quarrying, Oil, Gas Extraction	0.3

Source: ACS

Police, Fire, and Emergency Services

Police, fire, and other emergency agencies are vital community resources not only for emergency response but for implementation of mitigation actions.

Police

Houghton County is serviced by several police organizations, both state and local. Michigan State Police District 8, which covers the entire Upper Peninsula, has headquarters in Marquette County. Eighth District Post 87 is located along US 41 in Calumet and covers both Houghton and Keweenaw Counties.

The Houghton County Sheriff's Department is based in the City of Houghton. The office is responsible for patrolling Houghton County's 1,071 square miles, maintaining the jail facilities, patrolling 30 square miles of water with its marine patrol, operating the work camp, and performing civil process. Local police departments are present in the Village of Laurium, the Village of Lake Linden, the City of Houghton, and the City of Hancock. The Department of Public Safety and Police Services has primary responsibility for maintaining a safe and secure environment at Michigan Technological University.

Fire

There are 22 separate volunteer fire departments that serve Houghton County, as shown in **Table 3.5.**

Table 3.5: Fire Departments in Houghton County

Fire Department	Location	Service Area		Staff*
		Sq. mi	Population	
Adams Township VFD	Atlantic Mine	40	3,500	24
Calumet Village FD	Calumet	1	1,000	27
Calumet Charter Township Fire/Rescue	Calumet	40	8,348	20
Chassell VFD	Chassell	49	2,000	20
Dollar Bay VFD	Dollar Bay	30	2,500	25
Hancock FD	Hancock	2	4,547	22
Houghton FD	Houghton	4	6,067	19
Hubbell VFD	Hubbell	3.6	1,105	22
Hurontown FD	Houghton	119	2,270	15
Lake Linden VFD	Lake Linden	40	1,203	14
Laurium FD	Laurium	1	2,268	18
Ripley VFD	Ripley	4	375	17
South Range VFD	South Range	4	727	15
Tamarack City VFD	Hubbell	11	520	14
Bootjack FD	Lake Linden	70	700	20
Otter Lake VFD	Pelkie	60	800	15
Quincy-Franklin-Hancock VFD	Hancock	41	2,000	29
Laird VFD	Nisula	36	500	20
Twin Lakes-Elm River FD	Toivola	93	208	17
Toivola VFD	Toivola	75	350	11
Stanton Township VFD1	Houghton	65	1,000	20
Duncan Township VFD	Sidnaw	300	450	16

*Staff includes paid and part-time staff and volunteers.

Medical

Two hospitals are in Houghton County. The UP Health System - Portage medical complex is a three-story, 165,000-square-foot facility located on Quincy Hill in Hancock. The UP Health System - Portage complex includes an Emergency Department (Level III Trauma Center) and Walk-In Care Service offering 24-hour physician coverage, 30 inpatient beds, and a long-term

care facility with 44 beds. Aspirus Keweenaw Hospital in Laurium offers surgery, an Emergency Department (Level III Trauma Center), radiology, physical therapy, pediatrics, respiratory therapy, intensive care, coronary care, labor and delivery, laboratory services, and outpatient specialty clinics. The hospital has 49 beds total.

Mercy EMS is a paramedic/advanced life support (ALS) service that covers Houghton and Keweenaw Counties. They also help when needed outside of the area. They employ 31 emergency medical technicians (EMTs) and paramedics — 14 full-time and 17 part-time. The agency operates seven ambulances (five ALS equipped and two BLS ambulances), one non-transporting response vehicle, and a snowmobile and rescue sled. Duncan Township is serviced by Bay Ambulance out of the Village of Baraga, also an ALS service. Valley Mid Flight provides air services (both fixed wing and rotary) out of the Houghton County Airport for critical care patients. Critical care patients are also regularly transported to the UP-Health System – Marquette Hospital by Mercy EMS for advanced care.

In addition to Mercy EMS, Houghton County has seven Medical First Responder agencies: Adams Township, Bootjack, Chassell, Dollar Bay, Michigan Technological University EMS, Otter Lake, and Stanton Township. These non-transporting agencies are dispatched for quick response in addition to the transporting agencies.

The Western U.P. District Health Department services Houghton County from its office in Hancock. The department is responsible for addressing and preventing public health emergencies within Houghton, Baraga, Gogebic, Keweenaw, and Ontonagon counties. The Health Department does this by providing State mandated public health services, such as restaurant inspections, foodborne illness investigation, sewage and well inspections, beach monitoring, and mercury detection.

Coast Guard

The U.S. Coast Guard patrols the area waterways from its station in Dollar Bay. The station is a small boat station with an Aids to Navigation team. Its primary missions are search and rescue, law enforcement, and maintaining local Aids to Navigation (such as buoys, markers, and lighthouses).

Office of Emergency Measures

The Houghton County Office of Emergency Measures located in the Houghton County courthouse promotes emergency and disaster education and awareness. The office ensures interagency coordination before, during, and after disasters or emergencies.

Siren Coverage

Houghton County is serviced by eight functional sirens, all near population centers. The sirens are currently used for fire emergencies, not as public warning systems. **Table 3.6** shows the siren locations, range, and estimated population coverage.

Table 3.6: Siren Locations in Houghton County

VFD/Community	Siren	Remote Activation	Range (radius)(mi)	Est. Population Covered	Location
Adams Township VFD	Yes	No	2.0	2000	On top of Atlantic Mine Fire Hall
Chassell VFD	Yes; 3-phase	No	4.5	700	22115 7th St., Chassell
Dollar Bay VFD	Yes	No	2.0	350	48649 Main St., Dollar Bay
Houghton	Not Functional	N/A	City-wide	6000	Roof of Dee Stadium
Hubbell VFD	Yes	Yes	2.0	600	On top of the Community Hall
Hurontown VFD	Yes	N/A	-	-	On top of the Fire Station
Otter Lake VFD	Not Functional	N/A			On top of the Fire Station
South Range VFD	Yes		2.0	120	On top of the Fire Hall in South Range
Tamarack	Yes	No	2.0	50	51733 Tamarack St., Tamarack City (old Fire Station)
Twin Lakes VFD	Yes	No	3.0	100	23840 M-26, Twin Lakes

Critical Facilities and Cultural Assets

Even a slight chance of exposure to hazards is too great a threat to the delivery of services offered by the maintenance and operation of a community's critical facilities. A critical facility provides services and functions essential to a community, especially during and after a disaster. Examples of critical facilities requiring special consideration include:

- Police stations, fire stations, critical vehicle and equipment storage facilities, and emergency operations centers needed for response activities before, during, and after an incident
- Medical facilities, including hospitals, long term care facilities, blood banks, and health care facilities (including those storing vital medical records) likely to have occupants who may not be sufficiently mobile to avoid injury or death during an incident
- Schools and day care centers, especially if designated as shelters or evacuation centers

- Power generating stations and other public and private utility facilities vital to maintaining or restoring normal services to impacted areas before, during, and after an incident
- Drinking water and wastewater treatment plants
- Structures or facilities that produce, use, or store highly volatile, flammable, explosive, toxic, and/or water-reactive materials

For a critical facility to function, building systems and equipment must remain operational. Furthermore, it must be supplied with essential utilities (typically power, water, waste disposal, and communications, but occasionally natural gas or steam). The loss of municipal utilities has prevented some critical facilities from functioning during and immediately after major flooding, and in some cases, loss of municipal water and waste disposal has prevented facilities from operating for weeks after an event.

In addition, this section has been modified to include cultural assets of importance to Houghton County. Understanding and inventorying the important and visited locales of Houghton County provides a more thorough understanding of assets to the community that go beyond basic infrastructure. This section not only highlights tourism potential and important economic development projects for the future, but also shows the community's rich history, culture, and vitality.

Table 3.7: Critical Facilities in Houghton County

Facility Name	Location	Est. Value
Emergency Services		
Elm River Township Hall and Fire Department	Elm River	$0.5M
Hubbell Fire Department	Hubbell	$0.5M
Dollar Bay Fire Department	Dollar Bay	$0.5M
Adams Township Fire Department	Atlantic Mine	$0.5M
Torch Lake Township Hall and Fire Department	Hubbell	$0.5M
U.S Coast Guard Station	Dollar Bay	$4M
Village Hall, Police, and Fire Department	Lake Linden	$1M
City Hall and Police Department	Houghton	$3M
Franklin Township Hall and Fire Department	Hancock	$2M
Hancock City Hall and Police	Hancock	$4M
Hancock Fire Department	Hancock	$2M
Houghton County Sheriff's Office	Houghton	$10M
Houghton Fire Department	Houghton	$2M
Quincy Township Hall and Fire Department	Hancock	$2M
Calumet Village Hall, Police, and Fire Department	Calumet	$4M
Calumet Township Fire Department	Calumet	$0.5M
Laurium Fire Department	Laurium	$3M
Laurium Village Hall Police	Laurium	$1M
Michigan State Police Post	Calumet	$2M

Equipment Storage Facilities		
County Road Commission Garage	Trimountain	$1M
County Road Commission Garage	Kenton	$1M
County Road Commission Garage	Alston	$1M
County Road Commission Garage	Elo	$1M
County Road Commission Garage	Houghton/Hancock	$3M
City of Hancock Garage	Hancock	$3M
City of Houghton Garage	Houghton	$3M
County Road Commission Garage	Calumet/Laurium	$1M
Medical Facilities		
Western U.P. District Health Department	Hancock	$3M
County Medical Care Facility	Houghton	
Aspirus Keweenaw Hospital	Laurium	
The Lighthouse at Hancock Health and Rehab	Hancock	
The Bluffs	Houghton	
U.P. Health Systems Portage Hospital	Hancock	
Portage Health Adult Day Center	Hancock	
Green Tree Health and Rehab	Hubbell	
Portage House Assisted Living	Houghton	
Gardenview Assisted Living	Calumet	
Oak House Group Home	Hancock	
Rice Home	Atlantic Mine	
Omega House	Houghton	
Copper Country Mental Health	Houghton	
Daycare Centers/Schools		
Michigan Technological University	Houghton	$766M
Finlandia University	Hancock	
Gogebic Community College	Houghton	
Right Start Kids Academy	Hancock	
Centennial Child Development Center: Preschool	Calumet	
CLK Preschool: Preschool and Best Start	Calumet	
Little Gippers Child Development Center: Early Head Start	Calumet	
Dollar Bay Child Development Center: Early Head Start	Dollar Bay	
Lake Linden Preschool: Preschool and Best Start	Lake Linden	
Ryan Center: Early Head Start and Preschool	Hancock	
Rod Liimatainen Center (BHK Child Development): Early Head Start and Preschool	Houghton	
Little Red School House: Early Head Start	Houghton	
South Range Preschool	South Range	
South Range Elementary School	South Range	
Jeffers High School	Painesdale	
Horizons Alternative School	Mohawk	

CLK Elementary School	Calumet	
Washington Middle School	Calumet	
Calumet High School	Calumet	
Chassell K-12 School	Chassell	
Thomas R. Davis Elementary School	Dollar Bay	
Dollar Bay High School	Dollar Bay	
Elm River Township School	Winona	
Gordon G. Barkell Elementary School	Hancock	
Hancock Middle School	Hancock	
Hancock Central High School	Hancock	
Houghton Elementary School	Houghton	
Houghton Middle School	Houghton	
Houghton Central High School	Houghton	
Lake Linden-Hubbell Elementary School	Lake Linden	
Lake Linden-Hubbell High School	Lake Linden	
E.B. Holman School	Atlantic Mine	
Waste/Utility/Drinking Water/Wastewater Services		
Houghton Water Treatment Plant	Houghton	
Waste Management	Houghton	
Portage Lake Water and Sewer Authority	Houghton	
Houghton County Solid Waste Transfer Station	Atlantic Mine	
Other Notable/Vulnerable Structures		
Calumet Armory	Calumet	
Calumet Colosseum	Calumet	
Chassell Township Hall	Chassell	
Houghton County Airport	Hancock	
Osceola Township Hall	Dollar Bay	
Pricket Grooms Airport	Watton	
Schoolcraft Township Hall	Lake Linden	
Stanton Township Hall	Houghton	
Houghton County Marina	Hancock	
Dee Stadium	Houghton	
Houghton County Arena	Hancock	
Houghton County Courthouse	Houghton	
Houghton County Fairgrounds Driving Park	Hancock	
Lakeview Manor	Hancock	
Isle Royale National Park Service Headquarters	Houghton	
Portage Lake Lift Bridge	Houghton/Hancock	
Portage Township Hall	Houghton	
Calumet Township Hall	Calumet	
Keweenaw National Historical Park Headquarters	Calumet	

Cultural Assets

There are several State and National Registries' of Historic Sites in Houghton County:

- *Calumet and Hecla Historic District*: The Calumet and Hecla Historic District is roughly bounded by Hecla and Torch Lake railroad grade, Calumet Avenue, Mine and Depot Streets. The district contains structures associated with the copper mines worked by the Calumet and Hecla Mining Company and is maintained by the Keweenaw National Historical Park.

The Quincy Mine #2 Shafthouse (left) and the Hoist House (right). The steam hoist, still located inside, is the largest steam hoist in the world. (Photo: Keweenaw National Historical Park, Dan Johnson)

- *Quincy Mining Company Historic District*: The district site (*pictured above*) represents an extensive set of copper mines and properties, including the Quincy Mining Company Stamp Mills, the Quincy Dredge Number Two, and the Quincy Smelter. The Quincy Mine is now a popular tourist attraction with visitors receiving nearly 25,000 guided tours of the Hoist House and the 7th level of the mine during the summer.

- *Keweenaw National Historical Park:* Established in 1992, the park celebrates the life and history of the Keweenaw Peninsula. As of 2009, it is a partly privatized park made up of two primary units, the Calumet Unit and the Quincy Unit, and 21 cooperating "Heritage Sites" located on federal, state, and privately-owned land in and around the Keweenaw Peninsula. The National Historic Park consists of 1,870 acres in the Calumet and Quincy Units. The National Park Service currently owns six buildings and 142 acres in the two units. Heritage sites are found in Baraga, Houghton, Keweenaw, and Ontonagon counties.

- *Big Traverse Bay Historic District:* The site was originally a logging camp owned by the Hebard Lumber Company, dating from the last two decades of the 19th century. A substantial number of Finnish emigres moved into the area, working in the lumber, mining, or fishing industries. By 1920, Big Traverse Bay had developed into a primarily fishing community. In the 1950s, construction of a breakwater and changes to the harbor

resulted in the demolition of several houses, as well as a footbridge across the river. The community remains an active, and relatively isolated, fishing community.

- *Calumet Theatre:* The site is located at 340 Sixth St. and is also known as the Calumet Opera House. In 1898 the prosperous community of Calumet commissioned an opera house be built by local architect Charles K. Shand. Today, the Calumet Theatre is home to as many as 60 theatre-related events a year, with an estimated 18,000 people attending.
- *Redridge Steel Dam: (pictured below)* The Redridge Steel Dam is a steel dam across the Salmon Trout River in Redridge, Houghton County, Michigan. Completed in 1901, it is a flat slab buttress dam constructed of steel, a relatively rare material for construction of dams, which are typically earthenworks, concrete, or masonry. Most sources indicate it was one of only three such dams constructed in the United States. Ownership of the dam was transferred to Stanton Township in 1992.

The image above was found at the Library of Congress HAER archive entry with the original caption: "VIEW LOOKING AT UPSTREAM SIDE OF DAM. HAER MICH,31-BEHIL,1-1" It is a part of the Historic American Engineering Record collection of photos. Redridge Steel Dam, Houghton County, Mi, image taken by Jet Lowe, HAER photographer, in July 1978.

Disaster Declarations

Since 1965, Houghton County has experienced a total of seven presidential disaster declarations, shown in **Table 3.8**. Two new disasters occurred since the completion of the 2013 plan. The county has also experienced additional emergencies and disasters that were not severe enough to require federal disaster relief through a presidential declaration.

Table 3.8: Presidential Disaster Declarations for Houghton County, 1965-2019

Event	Declaration Date	Declaration Number
Drought	March 2, 1977	3035
Blizzards and Snowstorms	January 27, 1978	3057
Severe Freeze	May 10, 1994	1028
Flooding	May 6, 2002	1413
Hurricane Katrina Evacuation*	September 7, 2005	3225
Flooding	June 18, 2013	4121
Severe Storms, Flash Flooding, Landslides, and Mudslides	August 2, 2018	4381

*This declaration applied to all 83 counties in Michigan for Emergency Protective Measures only (to aid in direct relief efforts for Hurricane Katrina evacuees).

Source: Federal Emergency Management Agency

SECTION 4: Hazard Identification

The United States and its communities are vulnerable to a wide array of hazards that threaten life and property. Upon review of the natural hazards suggested under FEMA planning guidance and the State of Michigan's Hazard Mitigation Plan, Houghton County has identified twenty-six (26) hazards that are addressed in this Hazard Mitigation Plan. Following the State of Michigan's listed hazards, the 2020 update features two new hazards (Fog and Invasive Species). The plan has also been reorganized so that the most closely related hazards are in the same section of the plan. The hazard analysis component of this plan now includes three major divisions that correspond to three major hazard classifications: Natural, Technological, and Human-Related Hazards. Each of these three major sections have been further organized so that readers and responders can more easily find information about hazards that are closely related. The three major hazard divisions and subsections addressed in this plan include:

- **Natural Hazards**
  - **Weather Hazards**
    - Extreme Temperatures
    - Fog
    - Hail
    - Ice and Sleet Storms
    - Lightning
    - Severe Winds
    - Snowstorms and Blizzards
    - Tornadoes
  - **Hydrologic Hazards**
    - Dam Failure
    - Riverine and Urban Flooding
    - Shoreline Flooding and Erosion
    - Drought
  - **Ecological Hazards**
    - Wildfires
    - Invasive Species
  - **Geologic Hazards**
    - Earthquakes
    - Subsidence (Ground Collapse)
- **Technological Hazards**
  - **Industrial Hazards**
    - Scrap Tire Fires
    - Structural Fires
    - Hazardous Materials: Fixed Site Incidents
    - Hazardous Materials: Transportation Incidents

44 CFR Requirement

201.6(c)(2)(i): The risk assessment shall include a description of the type, location, and extent of all natural hazards that can affect the jurisdiction. The plan shall include information on previous occurrences of hazard events and on the probability of future hazard events.

    - Petroleum and Natural Gas Incidents
  - **Infrastructure Hazards**
    - Infrastructure Failure and Secondary Technological Hazards
    - Transportation Accidents
- **Human-Related Hazards**
  - Civil Disturbances
  - Public Health Emergencies
  - Sabotage and Terrorism

Some of these hazards are interrelated (i.e., snowstorms can consist of ice and sleet storms) and some consist of hazardous elements that are not listed separately (i.e., extreme hot temperatures can lead to drought conditions). It should be noted that some hazards, such as snowstorms and blizzards, may impact a large area yet cause little damage, while other hazards, such as a tornado, may impact a small area yet cause extensive damage. **Table 4.1** provides a brief description of the hazards listed above.

Table 4.1: Descriptions of Identified Hazards

Hazard	Description
NATURAL HAZARDS	
WEATHER	
Extreme Temperatures	Prolonged periods of very low or very high temperatures, often exacerbated by conditions such as high humidity with lack of rain or heavy snowfalls with high winds. Extreme cold is classified as any period of low temperatures or wind chill of -35°F or colder. Extreme heat is characterized by a combination of very high temperatures and humid conditions. Temperatures and the heat index values meet or exceed 90°F.
Fog	Condensed water vapor in cloudlike masses lying close to the ground and limiting visibility. Fog itself is not a hazard, but it is the interaction between humans and fog that can be a dangerous situation. However, freezing fog can cause direct harm by causing slickness on roadways and serious transportation accidents.
Hail	Hail is a type of precipitation that is formed when updrafts in thunderstorms carry raindrops upwards to parts of the atmosphere where temperatures are below freezing. The water freezes and can form ice pellets that can range from pea sized to as large as grapefruits.
Ice and Sleet Storms	Ice storms (freezing rain) are the result of cold rain that freezes upon contact with a cold surface and results in accumulation of at least

	0.25" of ice on exposed surfaces. Sleet is small ice pellets that fall from the sky and bounce when hitting the ground or other surfaces.
Lightning	The random and unpredictable discharge of electrical energy resulting from the buildup of positive and negative charges within a thunderstorm. It creates a "bolt" when charge buildup is strong enough.
Severe Winds	Sustained non-tornadic, forceful winds of 58-mph or greater for any duration of time. Includes thunderstorm winds which can cause similar damage as high winds. Also known as straight line winds.
Snowstorms and Blizzards	A snowstorm is a period of rapid accumulating snow accompanied by high winds, low visibility, and cold temperatures. This includes lake-effect and heavy snowfall. It can also consist of a "wintry mix" of snow, sleet, ice, and freezing rain. Blizzards are the most dangerous of all winter storms. It combines low temperatures and heavy snow with winds of at least 35-mph. This reduces visibility to only a few yards.
Tornadoes	A tornado is a violently rotating column of air that extends from the base of a thunderstorm and has contact with the ground. It is hard to see unless it forms a condensation funnel made up of water droplets, dust, and debris. The funnel may have winds that range from 40 to 300-mph and interior air pressure that is 10 to 20 percent below that of the surrounding atmosphere.
HYDROLOGIC	
Dam Failure	The collapse, breach, or other failure of a dam structure resulting in downstream flooding. Dam failure can result in severe property damage and loss of life.
Riverine and Urban Flooding	Overflowing of rivers, streams, drains, and lakes due to excessive rainfall, rapid snowmelt, or ice. Floodplains, the lands that are adjacent to rivers, streams, and lakes, are becoming more highly developed, increasing the potential for serious flooding. Urban flooding is due to the combination or excessive rainfall and/or snowmelt, saturated ground, and inadequate drainage. It usually involves low-lying areas that collect runoff waters even though they are not adjacent to drains or bodies of water.
Shoreline Flooding and Erosion	While shoreline flooding and erosion are natural processes along Lake Superior, during periods of high water, flooding and erosion are more frequent. Strong, onshore winds can also cause shoreline flooding and erosion due to vertical rise of water above normal level and increased wave action.

Drought	A drought occurs when there has been a prolonged period of well-below average precipitation. Common effects of drought include crop failure, water supply shortages, and fish/wildlife mortality. Drought conditions can be worsened by high temperature, winds, and low humidity.
ECOLOGICAL	
Wildfires	An uncontrolled fire in grass, brush, or forested areas.
Invasive Species	A species that has been introduced by human action to a location where it did not previously occur naturally. It can establish a breeding population in its new location without further intervention by humans and becomes a pest by threating local biodiversity. It can also cause human health impacts, significant economic costs, and/or harmful ecological effects. Species can include animals, plants, and other organisms (e.g., microbes).
GEOLOGIC	
Earthquakes	Shaking or trembling of the Earth's crust caused by the breaking and shifting of rock beneath the surface. Also caused by an abrupt release of slowly accumulating strain resulting in ground shaking, surface faulting or ground failures.
Subsidence (Ground Collapse)	Ground settling or sudden sinking due to subsurface movement of earth materials. Depressions, cracks, and sinkholes in the ground surface that can threaten people and property. The greatest risk of subsidence in Michigan is associated with underground mining or improper stabilization of mine openings.
TECHNOLOGICAL HAZARDS	
INDUSTRIAL	
Scrap Tire Fires	A large, uncontrolled fire that burns scrap tires that are being stored for recycling or reuse.
Structural Fires	Any instance of uncontrolled burning resulting in structural damage to residential, commercial, industrial, institutional, or other properties in developed areas.
Hazardous Materials: Fixed Site Incidents	An uncontrolled release of hazardous materials from a **stationary location** that can pose a risk to health, safety, property, and the environment. This is a particular risk for locations that store or have higher quantities of hazardous materials. This includes, but is not limited to, industrial businesses, agriculture, universities, and hospitals.

Hazardous Materials: Transportation Incidents	An uncontrolled release of hazardous materials during **transport** that can pose a risk to health, safety, property, or the environment. Hazardous materials are transported over highway, railway, seaway, airway, and pipeline systems.
Petroleum and Natural Gas Incidents	The uncontrolled release of petroleum, natural gas, or hydrogen sulfide, a poisonous by-product.
INFRASTRUCTURE	
Infrastructure Failure and Secondary Technological Hazards	Infrastructure failure is a failure of critical public or private transportation or utility infrastructure resulting in temporary loss of essential functions and/or services. This includes electric power, water, storm drainage, communications and transportation. If infrastructure failure results from a natural hazards event, it is termed a **secondary** or **cascading technological hazard.**
Transportation Accidents	A crash or accident involving air, land, or water-based commercial passenger carrier resulting in death or serious injuries.
HUMAN-RELATED HAZARDS	
Civil Disturbances	A public demonstration or gathering, or an uprising in a prison or other institution that results in some disruption of essential community function. Includes rioting, looting, arson, or other unlawful behavior. May be the result of labor disputes, controversial judicial proceedings, resource shortages, or perceived unjust injury or death of a person held in high regard.
Public Health Emergencies	A situation that presents a danger or negatively impacts the general health and wellbeing of the public. Examples include disease epidemics, water contamination, harmful exposure to chemical, radiological, or biological agents, or infestation of disease carrying insects or rodents. May also be considered a secondary event caused by other emergencies (e.g., floods).
Sabotage and Terrorism	An intentional, unlawful use of force or violence against persons or property to intimidate or coerce the government, civilian population, or any segment for political, social, or religious objectives.

Data Sources

Michigan Hazard Mitigation Plan, Emergency Management and Homeland Security Division, Michigan Department of State Police.
www.michigan.gov/documents/msp/MHMP_480451_7.pdf

National Climatic Data Center (NCDC), U.S. Department of Commerce, National Oceanic and Atmospheric Administration (NOAA). www.ncdc.noaa.gov

National Centers for Environmental Information Storm Events Database, U.S. Department of Commerce, NOAA. www.ncdc.noaa.gov/stormevents

National Severe Storms Laboratory (NSSL), U.S. Department of Commerce, NOAA. www.nssl.noaa.gov

National Weather Service (NWS), U.S. Department of Commerce, NOAA. www.nws.noaa.gov

Storms Events Database, National Centers for Environmental Information (NCEI), U.S. Department of Commerce, National Oceanic and Atmospheric Administration. www.ncdc.noaa.gov/stormevents

Storm Prediction Center, NOAA/NWS. www.spc.noaa.gov

SECTION 5: Hazard Analysis

This section of the Plan describes the hazards identified by Houghton County to pose a threat to people and the property located within the county and its participating jurisdictions. Further, an assessment of risk has been developed which includes hazard descriptions and background, climate change considerations, notable historical occurrences[4], and the probability of occurrences for each hazard. Information has also been included regarding local jurisdictions or critical facilities where the hazard vulnerability is higher than that of the county. Readily available online information from reputable sources such as Federal and State agencies were also evaluated to supplement information from these key sources. Once the hazards have been analyzed, conclusions on hazard risk are presented. This includes the extent of each hazard as it pertains to Houghton County and the priority risk index which assigns a risk level to each hazard in the county. The hazards listed in Section 4 were identified and analyzed.

Study Area

To a large extent, historical records are used to identify the level of risk within the planning area – with the methodological assumption that the data sources cited are reliable and accurate. This section also provides a series of maps that illustrate the location and spatial extent for those hazards within Houghton County and its participating jurisdictions that have a recognizable geographic boundary (i.e., hazards that are known to occur in certain areas of Houghton County, such as the 100- and 500-year floodplains, shoreline erosion areas, etc.). For those hazards not confined to a specific geographic area, such as thunderstorms and tornadoes, general information on the applicable intensity of these events across the entire planning area is provided.

Natural Hazards: Weather Hazards

The following outline summarizes the significant weather hazards covered in this section:

1. Extreme Temperatures
2. Fog
3. Hail
4. Ice and Sleet Storms
5. Lightning
6. Severe Winds
7. Snowstorms and Blizzards
8. Tornadoes

Weather hazards are the primary hazards in most areas, and they are of growing concern due to climate change. Climate change is a significant variation in either the mean state of climate or in its variability, persisting for an extended period. Most authorities predict rising temperatures in

[4] Historical occurrences for hazards were sourced from NOAA's Storm Events Database, unless indicated otherwise.

all areas, with warm temperatures coming from the equator and pushing various flora and fauna further north in the Northern Hemisphere. Along with these temperatures come overall changing weather patterns, causing events such as more frequent storms and severe winters that fluctuate towards either extreme, warm with light snowfall or cold with heavy snowfall.

In Houghton County, weather hazards vary greatly by season and from year to year. In winter, Houghton County has a reputation for heavy and frequent snowfalls, especially in the interior and at high elevations. Residents are acclimated to severe winter weather. Transportation during a major precipitation event and collapsing roofs are the most common exposure to winter hazards. When it is not winter, thunderstorms, hail, high winds, and extreme temperatures are more variable and less location dependent. Due to the variably and inability to control these types of storm events, effective response plans are the best mitigation.

For weather hazards and, particularly, in Houghton County, it may make sense to think in terms of two parts of the year: winter and non-winter. A general distinction can be made between the "winter weather risk season" and the "non-winter weather risk season." The winter weather risk season is defined in terms of historically documented events involving extreme cold and significant snowstorms.

Extreme Temperatures

Hazard Description

Temperature extremes are broken down into two categories: extreme heat or extreme cold. In both instances there are extended periods of either abnormally low or high temperatures worsened by conditions such as high humidity with lack of rain or heavy snowfalls with high winds. Both extremes can last for weeks without any advance warning and in the middle of a seemingly normal weather pattern. Extreme heat and extreme cold can cause loss of life in vulnerable population (e.g., elderly, young children, impoverished individuals, and those in poor health), damage to infrastructure, and disruptions to schools and businesses.

Extreme heat (or a "heat wave") - temperatures above 90°F - occurs occasionally during late May to early September, in the Upper Peninsula. Individuals working outdoors, the elderly, and children need to be accounted for during oppressively hot conditions. Extreme hot temperatures also put a strain on the energy demands for an area, as air conditioning becomes a necessity for vulnerable populations. The National Weather Service (NWS) devised the Heat Index as a mechanism to better inform the public of heat dangers, The Heat Index Chart, shown in **Figure 5.1**, uses air temperature and humidity to determine the heat index or apparent temperature. The major threats of extreme heat are heat exhaustion and heatstroke (a major medical emergency). **Table 5.1** shows the dangers associated with different heat index temperatures.

Figure 5.1: NOAA's National Weather Service Heat Index Chart

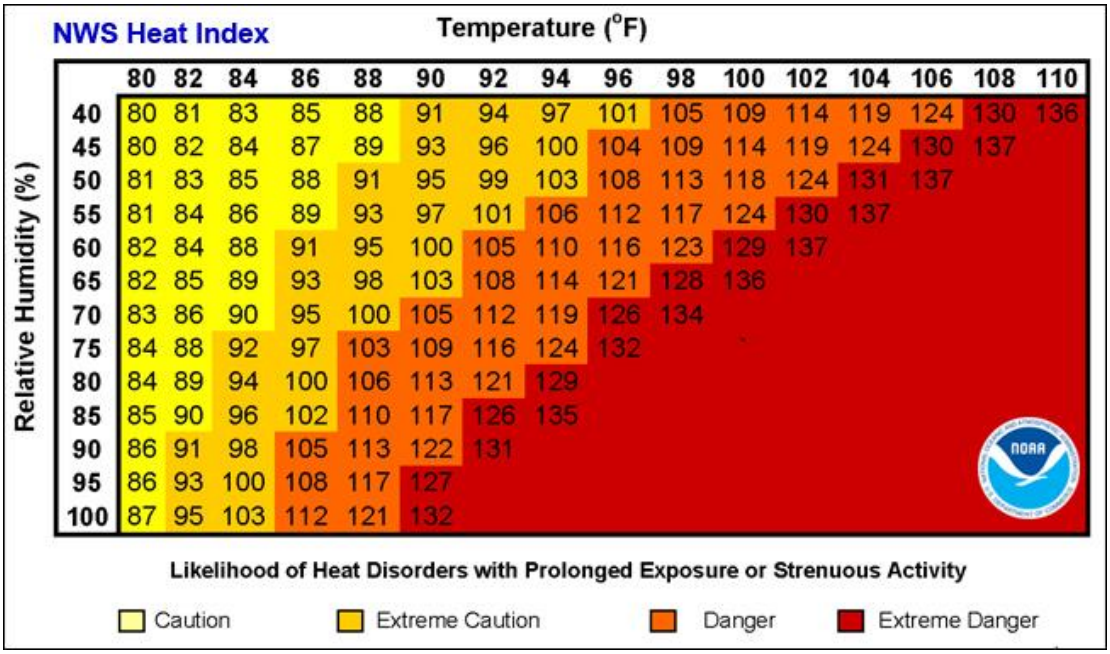


Table 5.1: Heat Index and Related Heat Disorders

Heat Index (°F)	Possible Heat Disorders
80°F - 90°F	Possible fatigue with prolonged exposure and/or physical activity.
90°F - 105°F	Heat exhaustion, heat cramps, and heat stroke possible with prolonged exposure and/or physical activity.
105°F -130°F	Heat exhaustion and heat cramps likely; heat stroke possible with prolonged exposure and/or physical activity.
130°F or higher	Heat stroke exceedingly likely with continued exposure.

Source: NOAA – National Weather Service

Extreme cold is primarily associated with the wintery months of October through May in the Upper Peninsula and categorized by temperatures plunging near or below 0°F. Periods of extreme cold are risky for those in both rural and urban areas. An extreme cold event to the NWS can refer to a single day of extreme or record-breaking sub-zero temperatures. Extended or single day extreme cold temperatures can be hazardous to people and animals, and cause problems with buildings infrastructure and transportation. **Table 5.2** lists the threats associated with extreme cold, such as hypothermia, which is a medical emergency and is a concern for individuals living in inadequately insulated or heated apartments or rooms. Loss of life can occur with this situation. Damage to buildings and pipelines can also occur in bitter cold conditions, resulting in expensive repairs and potential days of business and school shutdowns.

Table 5.2: Cold Hazards Associated with Extreme Cold Temperatures

Cold Hazard	Definition
Wind Chill	Temperature based upon how wind and cold feel on exposed skin. As wind increases, it draws heat from the body, which drives down skin temperature and internal body temperature. Animals are also affected by wind chill.
Frostbite	Damage to body tissue when exposed to cold temperatures for a long period of time. A wind chill of -20°F will cause frostbite in 30 minutes. Frostbite is most susceptible to fingers, toes, ear lobes, and the tip of the nose. Signs of frostbite include loss of feeling and a white or pale appearance.
Hypothermia	A condition that occurs when body temperature falls below 95°F and, if not properly treated, can result in death. Warning signs include uncontrollable shivering, memory loss, disorientation, slurred speech, drowsiness, and exhaustion. Most commonly occurs in very cold temperatures, but it can also occur at cool temperatures (above 40°F) if an individual is not properly clothed.

Climate Change Considerations

Certain indicators of climate change in Michigan and Houghton County have already been observed. In Michigan, new heat records outnumbered new cold records by 3 to 1 during the 1990s and 6 to 1 in the 2000s. Frequency of extreme heat events are expected to increase in the future. Although Michigan's winter season has been shortening, there have been lessened differences in temperature between polar and temperate regions (due to warming of the arctic and polar regions) can make it easier for a polar weather front to swing southward across the United States. Instances of persistently cold temperatures, ice storms, freezing rain, and heavy snowstorms are affecting the state with increasing rapidity.

Historical Occurrences

From 1996-2019, 24 extreme cold events were reported in Houghton County where wind chill temperatures can reach 30°F to 40°F below 0°F. 14 events caused area schools to close due to the extreme cold. There were two incidences of extreme heat. One was on July 31, 2006 when temperatures throughout the county were above 90°F and accompanied by dew points around 70°F, sending heat indices into the 100°F to 105°F degree range. The other extreme heat incident in Houghton County was part of a larger Upper Michigan heat wave. From July 13 to 19, 2013, there was a stretch of very warm conditions, where high temperatures came with oppressive humidity. Dew points were in the lower 70°Fs, which resulted in heat indices around 100°F degrees. The highest temperature recorded over the week in Houghton was 89°F. For all events, Houghton County incurred no recorded damages.

Occurrence Probability and County Vulnerability

The probability of an extreme temperature event is low to high as it can occur anytime during the year. The frequency of occurrence for extreme cold events is one event per year while for extreme heat, the probability of future occurrence is very low. There were no extreme heat

events in the past 10 years. While there is a likelihood that these events will occur any given time during the year, severity is low countywide as resident behaviors are effective in limiting damage to life and property.

All Houghton County communities are vulnerable to both extreme heat and cold events. Vulnerability to extreme heat primarily impacts the elderly and persons with pre-existing health problems who live in housing with inadequate ventilation or cooling systems. Extreme heat can also have impact demand on electric utilities and may cause power outages to critical facilities. Critical facilities vulnerable to the extreme cold include drinking water services, such as the Houghton Water Treatment Plant and Portage Lake Water and Sewer Authority. If water mains were to break, these facilities would be unable to provide water to residents.

Fog

Hazard Description

Fog forms near the ground when water vapor condenses into tiny liquid droplets that remain suspended in the air. Many different processes can lead to the formation of fog, but the main factor is saturated air. Two ways that air can become saturated are by cooling it to its dew point temperature or by evaporating moisture into it to increase its water vapor content. Fog itself is not a hazard because it does not actually apply destructive forces, but the interaction between humans and fog can be a dangerous situation, sometimes resulting in disastrous consequences. However, freezing fog (a hazard that the National Weather Service does issue special statements for) can cause direct harm by causing slickness on roadways and thus leading to serious transportation accidents.

Fog has played a contributing role in several multi-vehicle accidents over the past several years. It can be very dangerous because it reduces visibility. Although some forms of transport can penetrate fog using radar, road vehicles must travel slowly and use more lights. Localized fog is especially dangerous because it catches drivers by surprise.

Morning fog is a common occurrence along the Portage Waterway (Photo: Chuck Ritola)

Historical Occurrences

From 1996 to 2018, six dense fog events occurred in Houghton County. There were no reported incidences of freezing fog. While no property damages or injuries were reported as a result from these events, the low visibility was attributed to longer commute times in the area. Fog is especially prevalent on the Portage Waterway and Lake Superior shoreline and is dependent on the right conditions.

Occurrence Probability and County Vulnerability

While only three dense fog events were reported in the past 10 years (a frequency of 0.3 events per year), fog is a common occurrence in Houghton County. It does typically dissipate by mid-morning. There is an assumption that the county is uniformly exposed to fog hazards. Only when fog and humans interact on transportation corridors, people and facilities become vulnerable to fog. The Houghton County Airport is a critical facility that is vulnerable to fog events due to its location on an upland area. Limited visibility due to fog prevents airplanes landing at the airport, causing delays or cancellations.

Hail

Hazard Description

Hail is produced by thunderstorms when strong updrafts among the clouds carry water droplets above the freezing level and cause the formation of ice pellets around some nucleus, such as a water crystal or a speck of dust. Frozen droplets gradually accumulate on the ice crystals until having developed enough weight and they fall in the form of a ball or irregularly shaped ice masses greater than 0.75 inches in diameter. They are typically accompanied by heavy rains. Falling hailstones batter crops, home roofs, dent autos, and injure wildlife and people. Approximately $1 billion in damages occur annually across the United States. In Michigan, there is usually at least one intense hailstorm per year that causes significant damages. Unfortunately, for many hailstorms, the total property damages go unreported.

As a product of strong thunderstorms, the size of hail is usually proportional to the intensity of the storm cell that generates it. As a thunderstorm passes over, hail usually falls near the center of the storm, along with the heaviest rain. Sometimes, strong winds occurring at high altitudes in the thunderstorm can blow the hailstones away from the storm center, causing an unexpected hazard at places that otherwise might not appear threatened. Whether in predictable locations or not, instances of hail can be very localized – to an area as small as a few city blocks.

Hail reported in Michigan range in size from a pea (¼” diameter) to a golf ball (1 ¾” diameter), but hailstones larger than baseball (2 ¾” diameter) have occurred with the most severe thunderstorms. **Table 5.3** provides official classifications of hail magnitude as often used in weather reporting and event records.

Table 5.3: Hail Size Reference

Descriptive Size of Hail	Size in Diameter (inches)	Descriptive Size of Hail	Size in Diameter (inches)
Pea	¼”	Golf ball	1 ¾”
Marble or mothball	½”	Hen’s egg	2”
Penny or Dime	¾”	Tennis ball	2 ½”
Nickel	0.9”	Baseball	2 ¾”
Quarter	1”	Teacup	3”
Half-dollar	1 ¼”	Softball	4”
Walnut/Ping-pong ball	1 ½”		

Historical Occurrences

A hail event may occur anywhere throughout the county and is not confined to any geographic boundaries. Often accompanying thunderstorms, these events are typically widespread. **Table 5.4** provides an overview of hail events in Houghton County from 1955-2018 and **Map 5.1** provides an overview of the reported location of the hail event. From 2010-2019, 13 days with hail events were recorded. The most significant hailstorm event in Houghton County occurred on July 8, 2007 where severe thunderstorms produced hail up to 1.75 inches and damaging winds. The hail stripped leaves off trees and resulted in significant vehicle damage. Total estimated property damage was $10,000.

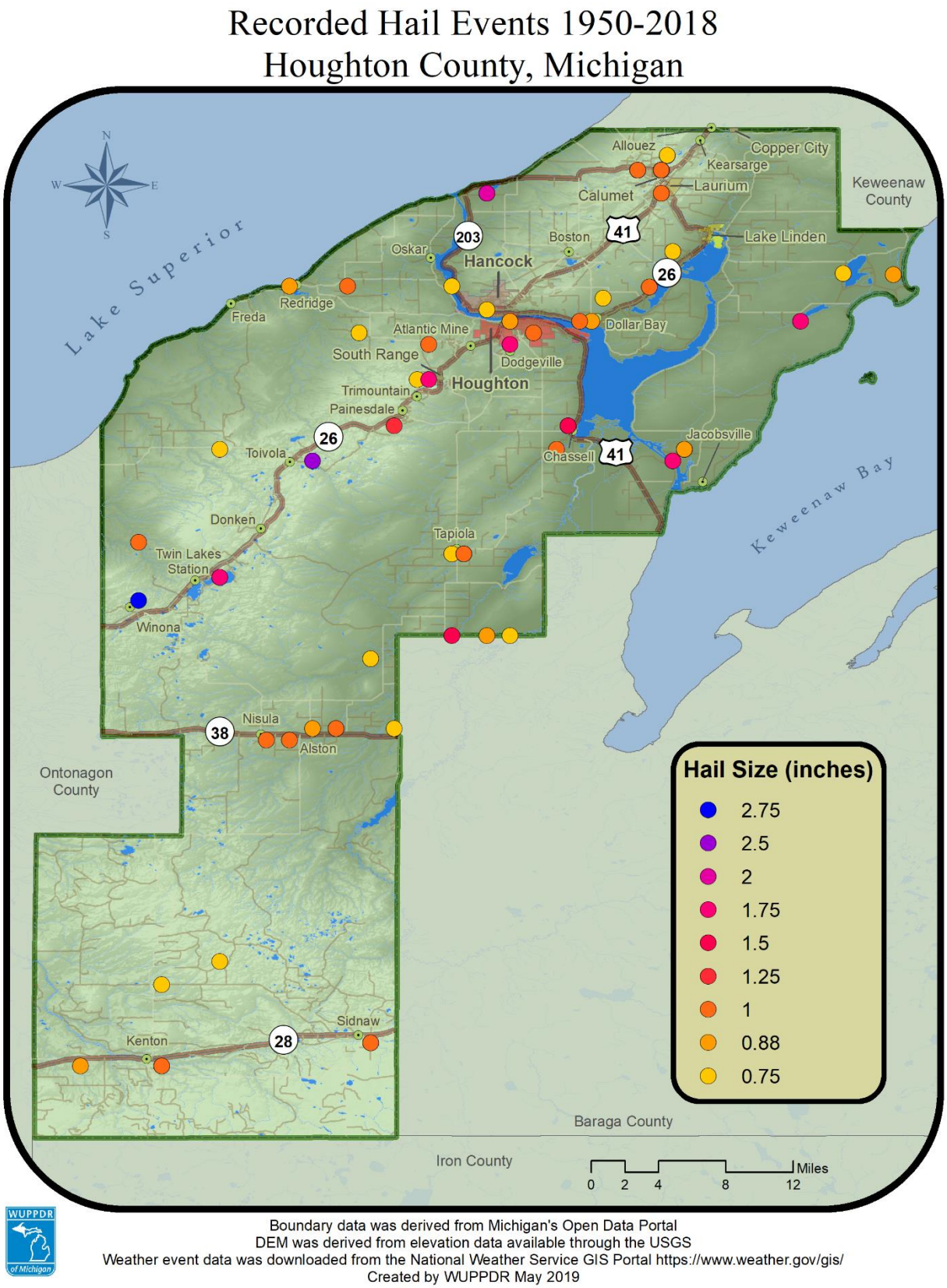
Table 5.4: Reported Hail Events by Size, 1955-2018

Hail Size Reported	Number of Events
¾”	26
0.9”	10
1”	22
1 ¼”	2
1 ½”	1
1 ¾”	6
2”	1
2 ½”	1
2 ¾”	1
TOTAL	70

Occurrence Probability and County Vulnerability

The frequency of a hail event is approximately 1.3 events per year (13 days with hail events in the past 10 years). Thus, probability of a hail event in a single year is highly likely, but the severity of damages due to a hailstorm is low to moderate. There are no known areas within the county that have an unusual risk from hail, but some communities may have structures that are more vulnerable to hail damage than others. Damage to homes and buildings, such as broken

windows, dented roofs, and damaged siding, is frequently reported; critical facilities in all Houghton County municipalities are vulnerable to receive similar damage from hail. However, hail should not negatively impact the services a facility provides.



Map 5.1: Hail Events in Houghton County

Ice and Sleet Storms

Hazard Description

Severe winter weather hazards can include ice and sleet storms. Although these two types of winter storms have been combined for the purpose of this plan, ice and sleet storms are two different phenomena. Ice storms, also known as freezing rain, coat roads, trees, power lines, and buildings with thick, heavy, and slick surfaces. Ice storms are sometimes incorrectly referred to as sleet storms. Sleet is small frozen raindrops or ice pellets that bounce when hitting the ground or other objects. Sleet is less dangerous than ice storms as it does not stick to trees and wires but can still cause hazardous driving conditions if there is sleet of sufficient depth.

Ice storms are the result of cold rain that freezes on contact with a surface, coating the ground, trees, overhead wires, and other exposed objects with ice, sometimes causing extensive damage. When electric lines are downed due to ice, power may be out for several days. Massive traffic accidents and power outages from downed tree limbs and utility lines are common when an ice storm occurs. Often, ice storms are accompanied by snowfall, in which the ice is camouflaged and covered up by snow, creating treacherous transportation conditions. Both storms occur when the temperature is close to 32°F but are far more severe when the temperature is in the 20s.

Climate Change Considerations

Climate change will likely cause an increase in the number of ice and sleet storm events. Average temperatures in and around the winter months are closer to the freezing point and at the temperature at which ice and sleet events typically occur. Instead of winter arriving and precipitation turning into snow, Michigan winters have involved many thawing episodes followed by refreezing which cause treacherous ice cover on frozen surfaces, weigh down cables and tree branches, and cause infrastructure failures. Even though Michigan winters have been shortening a bit over time[5], winters remain hazardous because the increasing level of precipitation more often takes the form of a major snow event and provides more moisture for refreezing after the warmer thawing periods occur.

Historical Occurrence

Ice storms usually have a regional effect and groups of counties are usually affected instead of just one county when they occur. In Houghton County, three ice storms and one sleet storm were recorded from 1996 to 2018. They are listed in **Table 5.5**, including estimated property damages.

[5] Andresen, J., S. Hilberg, K. Kunkel, 2012: Historical Climate and Climate Trends in the Midwestern USA. In: U.S. National Climate Assessment Midwest Technical Report. http://glisa.msu.edu/docs/NCA/MTIT_Historical.pdf.

Table 5.5: Reported Ice and Sleet Storms in Houghton County, 1996-2018

Date	Type of Storm	Description and Location	Property Damages
04/04/1999	Ice Storm	Ice accumulations around a half inch thick around tree branches in Houghton and Copper Harbor. Minor traffic accidents due to slick roads.	No reported damages.
12/30/2004 to 01/01/2005	Ice and Sleet Storm	Quarter inch or more of ice on roadways and a half inch to an inch of sleet throughout southern Houghton County.	No reported damages
04/26/2017	Ice Storm*	Public reports of one quarter to one half inch of ice accumulation from freezing rain over portions of northern Houghton County. Icing caused tree damage and coated roads making travel hazardous. Prompted many school closings on April 27.	$50,000

*Reported as winter weather in NOAA Storm Events Database

Occurrence Probability and County Vulnerability

Only one ice storm was reported in the past 10 years (2010-2019). With a frequency of 0.1 events per year, the probability of an ice storm in Houghton County is low. However, due to their infrequency, these events can be damaging as people are typically unprepared. Facilities with large concentrations of employees, such as local schools and universities, are more vulnerable during an ice or sleet storm due to temporary closures. Heavy volumes of employee traffic in and out of a facility may contribute to transportation mishaps on area roadways. Transportation and electric infrastructure are also vulnerable to ice storms, causing icy roadways or potential for power and communication outages.

Lightning

Hazard Description

The discharge of electricity from a thunderstorm is called lightning. It is a random and unpredictable product of a thunderstorm's energy. Lightning strikes when a thunderstorm's electric potential (the difference between its positive and negative charges) becomes great enough to overcome the resistance of the surrounding air. In the United States, approximately 100,000 thunderstorms occur each year and each of those storms generates lightning. It is not uncommon for a single thunderstorm to produce hundreds or even thousands of lightning strikes.

Lightning is often perceived as a minor hazard, but it damages many structures and kills and injures more people in the United States each year, on average, than tornadoes and hurricanes.

From 2005-2014, Michigan ranked seventh in the nation in lightning fatalities[6]. Because it is virtually impossible to provide complete protection to individuals and structures from lightning, this hazard will continue to be a problem for Michigan's residents and communities. However, lightning deaths, injuries, and property damage can be reduced through a combination of public education, human vigilance, technology, proper building safety provisions, and simple common sense.

2013 lightning damage to St. Anne's Church in Calumet (Photo: Keweenaw Heritage Center)

Historical Occurrence

Based on the frequency of cloud-to-ground flash density map from 2008-2017[7], Houghton County experiences approximately 1.5 to 3 strikes per square mile per year. There have been two lightning damage events in Houghton County. Lightning struck and caused damage to the steeple tower of the Keweenaw Heritage Center at St. Anne's Church in Calumet on two separate occasions. The first was on May 11, 2011, causing a reported $20,000 in damages. The second was on September 1, 2013, where the lightning strike blew holes into the tower. The roof and underlying wood were shattered. Property damage to the steeple tower was estimated at $5,000. Lightning of a lower level does occur, but these events usually do not have any recordable damage.

Occurrence Probability and County Vulnerability

The probability of occurrence for future lightning events that cause damage in Houghton County are low, even with a frequency of 0.2 events per year. The county is in an area that has low lightning strike density. Although the likelihood of the lightning event causing damage to human life or property is negligible, when a damaging event does occur its severity is extreme at the discharge site.

Most injuries and deaths due to lightning strikes occur on open fields and under trees. Houghton County park and recreation areas contain most of these hazard-prone features and may contribute to or intensify the effects of lightning. Each municipality in the county has an equal vulnerability to lightning strikes as there is really no way to pinpoint exactly where, when, and to what extent lightning will cause damage. Critical facilities in the county are protected by lightning strikes through grounding and other protective measures. However, electrical substations, transformers, and power lines are still vulnerable to lightning strikes. A more specialized study will need to be done to determine what facilities in the county are a higher risk and might need greater protection.

[6] "Lightning Deaths the Last 10 years, Mapped," The Weather Channel, July 22, 2015. https://weather.com/storms/severe/news/lightning-deaths-by-state-2005-2014 .

[7] Vaisala National Lightning Detection Network. www.vaisala.com/en/products/data-subscriptions-and-reports/data-sets/nldn

Severe Winds

Hazard Description

Severe wind, or straight-line winds, sometimes occurs during severe thunderstorms and other weather systems and can be very damaging to communities. Severe winds with velocities over 58 mph may be confused with tornado occurrence. Locally, lesser events termed high winds and thunderstorm winds can cause similar damage as severe winds. Severe winds can cause damage to homes and businesses, power lines, trees, and agricultural crops. Large scale power failures, with hundreds to thousands of customers affected, are common during straight-line wind events. Power outages can result in a need to shelter persons left without power for extended periods of time.

These wind events also have the potential to cause loss of life from breaking and falling trees, property damage, and flying debris, but tend not to cause as many deaths as tornadoes do. However, property damage from straight line winds can be more widespread than tornadoes, usually affecting multiple counties at a time. It is not rare to see severe wind events that produce wind-speeds of 60 and 70 miles per hour. Along the Great Lakes shoreline, high winds of lower magnitude occur regularly, as do hurricane-velocity gusts (over 74 miles per hour).

Microbursts are localized but powerful wind gusts that typically occur from a single storm. Microbursts result in what is often referred to as straight-line wind damage and usually result in damage like a brief, weak tornado. Derechos are usually large-scale storm systems that travel hundreds of miles and are many miles long. Damages from derechos can stretch statewide and often exceeds 250 miles in length. Derechos are most common in Michigan during the warmer half of the year. Wind speeds in derechos can exceed 100 mph at times. In the Upper Peninsula, a derecho can be expected once every 4 years.

Historical Occurrence

Historically in Houghton County, windstorms are rarely a singular event. They usually accompany other severe weather – particularly thunderstorms and occasional blizzards. The largest wind gust recorded in Houghton County from 1955-2018 was 80 knots or 92 miles per hour. This was recorded twice. The first was on August 1, 2002 near Houghton where a metal roof was peeled off a warehouse, an empty semi-trailer was overturned, and numerous trees and power lines were blown down. The second incident was on June 27, 2005 near Hancock where a wind downburst uprooted many trees on Highway M-203. A roof was also blown off a camper. For both instances, no damage estimate was provided.

From 1955-2018, 141 severe wind events were reported in Houghton County (**Map 5.2**). **Table 5.6** summarizes the total property and crop damages that these events caused. 54 of the total severe wind events caused some level of property damages. A high wind event on November 11, 1998 downed many trees in the county and caused an estimated $1 million in timber (crop) damages.

Table 5.6: Severe Wind Event Totals in Houghton County, 1955-2018

Number of Events	Total Property Damage	Total Crop Damage	Injuries	Deaths
142	$389,000	$1,000,000	0	0

Other severe wind events that caused significant monetary damage in the past 10 years include:

- July 1, 2011: Severe **thunderstorm winds** of 65-75 mph reported throughout Houghton County causing a significant amount of damage. Reports of downed trees, powerlines, shed, and playground equipment blown over. Near Calumet, a metal building housing a travel trailer was destroyed and a drill shop roof near the elementary school, owned by the Keweenaw National Historic Park, sustained significant damage. Near Laurium, there was significant damage to a home on Mine Street. Windows were partially broken, and a garage door was bowing inward. The garage was also shifted one inch off its foundation. In total, reported property damage was $71,500.
- July 21, 2016: Severe **thunderstorm winds** of up to 90 mph reported throughout southern Houghton County. Extensive tree damage was reported at Emily Lake Campground, where fallen trees damaged 2 campers and 1 car. There were no injuries. In Toivola, there was widespread tree damage, some which blocked Highway M26. In Jacobsville, trees down reportedly on cars and structures. Total property damage was estimated at $115,000.

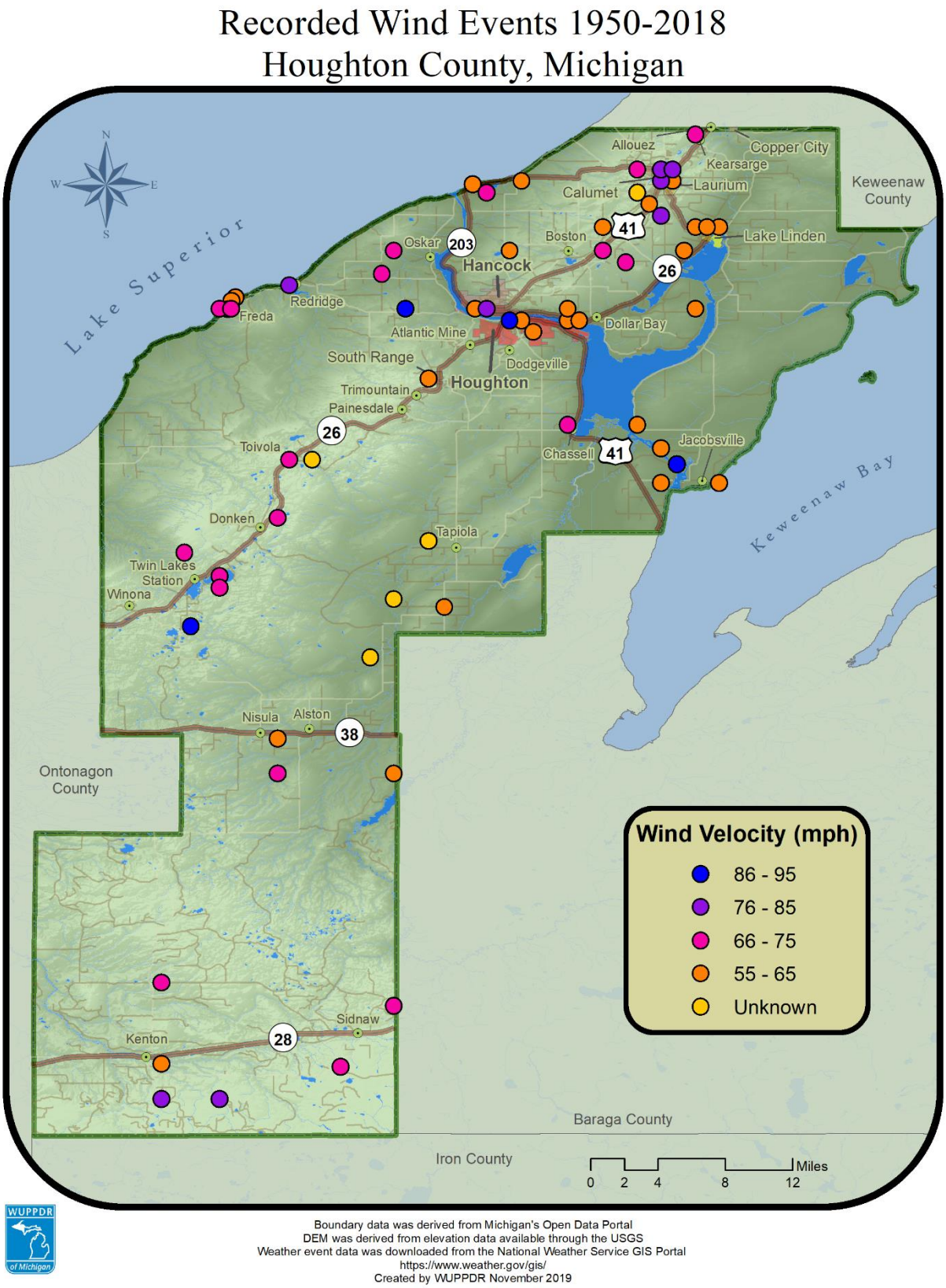
Storm damage in Jacobsville on July 21, 2016. (Photo: Annika Maki)

- December 5, 2017: **High winds** resulted in fallen trees throughout Laurium and Calumet. One landed on a house. Winds were reported to be near 60 mph. Total property damage reported at $30,000.
- August 27, 2018: **Thunderstorm winds** throughout northern Houghton County. Winds of up to 70 mph downed trees throughout the area. In Liminga, there was an estimated 200 trees downed. Trees also fell in Houghton, Hancock, and on power lines in Lake Linden. Estimated property damage was $47,000.

Occurrence Probability and County Vulnerability

From 2010 to 2019, there were 34 days with a severe wind event, a frequency of 3.4 events per year. Future damage severity potential is highly variable and site-specific, but difficult to predict. Probability and vulnerability are both highest along the Lake Superior shoreline on the northwest side of the county (Hancock and Calumet Charter Townships) and in upland areas, especially those surrounding the Portage Waterway.

Critical infrastructure, such as power and communication lines, are vulnerable to damage from severe wind events. Fallen trees can damage these lines, causing electrical and communication outages. Additionally, trees on roadways can delay emergency response capabilities. Flights coming in and out of the Houghton County Airport are vulnerable to delays or cancellations due to severe wind events.



Map 5.2: Wind Events in Houghton County

Snowstorms and Blizzards

Hazard Description

Snowstorms are a period of rapid snow accumulation that is usually accompanied with high winds and cold temperatures. This event can be very dangerous for a community over a period of days or weeks. Heavy snows can shut down towns and cities for several days if snow is persistent and cannot be cleared in a timely fashion. Rural areas may have inaccessible roads for some time but often have residents that are more equipped to independently deal with power outages and temporary isolation. Roof failures may occur as the weight of snow and area of snow can cause damage to homes and buildings.

Blizzards are the most dramatic of all snowstorms, as they are characterized by low temperatures and strong winds of over 35 miles per hour. Most blizzard snow is in the form of fine, powdery particles that are wind-blown in such great quantities that, at times, visibility is reduced to only a few feet. Blizzards have the potential to result in property damage and loss of life. The cost of clearing snow can be enormous.

Some areas suffer greater flood risks because thick snow cover can rapidly melt off during rainstorms, causing rapid drainage of water towards cities and into drains and rivers. Partially melted snow and ice may cause blockages within these water channels, causing waters to back up or divert sideways and over banks where they damage property and roadways.

As a result of being surrounded by the Great Lakes, Michigan experiences large differences in snowfall over relatively short geographic distances. The Western Upper Peninsula experiences the most snowstorms and snowfall in Michigan each year. One reason for this is the "lake effect," a process by which cold winter air moving across Lake Superior picks up moisture from the warmer lake waters, resulting in larger snowfall amounts. Due to weather patterns, severity of different types of snowstorms varies somewhat throughout the county. *Lake effect snow* is almost exclusively focused on areas close to Lake Superior. *System snow* results from weather fronts moving across the country.

Climate Change Considerations

The effect of climate change upon Michigan is expected to cause an increase in the amount of severe precipitation events. Even though the length of Michigan winters has been decreasing, the season remains intense. During the winter months, the increase in precipitation means that snowfall events will tend on average to be more intense. More snowfall is likely to happen during any single event (e.g., eight or more inches, higher snowdrifts, larger transportation disruptions, canceled school sessions, etc.).

Historical Occurrence

Residents of Houghton County are accustomed to major snow events, which occur regularly every winter. From 1996-2018, the county has experienced 348 recordable winter weather events (blizzard, heavy snow, lake effect snow, winter storm, and winter weather). Note that some winter weather events list freezing rain in addition to snow. **Table 5.7** summarizes the total

number of snowstorm events and associated deaths of injuries. Of these storms, four events had reported property damages. Snowstorm events with property damages are listed below:

- January 29, 1996: **Blizzard** conditions throughout Houghton County, with whiteout conditions due to blowing and drifting snow on the evening of the 29th. Wind gusts reached 45 mph at the Houghton County Airport. The next day (January 30), heavy **lake-effect snowstorms** moved into the area. 22 inches was measured in Bumbletown (15 miles NE of Houghton). The heavy snow caused a Houghton County Road Commission garage roof to collapse. Estimated property damage was reported at $25,000.
- April 4, 2007: **Blizzard** conditions throughout Houghton County, with whiteout conditions and blowing snow. Wind gusts of 40-50 mph were reported at the Houghton County Airport. The strong winds and heavy snows downed trees across roadways and powerlines south of Houghton. Schools and many businesses were closed following the storm. Reports of 38 inches of snow in Painesdale and 22 inches in Laurium with 3 inch per house snowfall rates. Estimated property damage was reported at $10,000.
- November 19, 2016: **Lake effect snow** and strong winds throughout the county. Between 2 to 4 inches of snow was reported. Wind gusts of up to 60 mph caused considerable blowing and drifting snow and power outages throughout the county. Winds were strong enough to snap a one-foot diameter pine tree near its base in Laurium. Reported property damages at $1,000.
- November 9, 2018: Heavy **lake effect snow** and strong winds (reported near 50 mph) caused three to four-foot snow drifts within Houghton County. 12 inches of snow in approximately seven hours was reported by a NOAA weather observer in Kearsarge. This weather event also contributed to a fatal car crash on US 41, where a car failed to stop at a highway intersection and was struck by a logging truck. Estimated property damage was reported at $20,000.

Table 5.7: Snowstorms by Type in Houghton County, 1996-2018

Snowstorm Type	Number of Events	Total Property Damage	Injuries	Deaths
Blizzard	22	$35,000	0	0
Heavy Snow	47	$0	0	0
Lake Effect Snow	42	$0	0	0
Winter Storm	92	$21,000	0	1[A]
Winter Weather	173	$52,000	0	0
TOTAL	376	$108,000	0	1

[A] Death is listed as indirect

Houghton High School working to clear snow from a major blizzard on February 24, 2019 (Photo: Remi Murrey with TV6 News)

Occurrence Probability and County Vulnerability

The probability of a snowstorm event in Houghton County is very high. In the past ten years, there were 210 days with a snowstorm related event – a frequency of 21 events per year. However, the vulnerability of the community is moderate to low due to the preparedness of residents and their properties. Each municipality in the county has an equal susceptibility to snowstorms and blizzards and most storms impact the entire county and the western U.P.

Depending on type of snow (wet, heavy versus fine, powdery snow), snowstorms and blizzards may result in a variety of infrastructure problems. Snow accumulations on above-ground electrical lines often create power outages, which can vary from several hours to days. Dangerous driving conditions frequently occur during and shortly after severe snowstorms and blizzards. Some state and county roads in experience drifting snow, which can result in greater vulnerability to accidents. When transportation is disrupted, schools close, emergency services are delayed, some businesses close, and some government services are delayed. More rural areas in the county may experience impassable roads, preventing emergency services from reaching residences in rural locations such as Duncan and Laird Townships.

Tornadoes

Hazard Description

A tornado is an intense rotating column of wind extending from the base of a severe thunderstorm to the ground. Tornadoes are high-profile hazards that can cause catastrophic damage to either a limited or an extensive area. A strong tornado can level everything in its path. Tornadoes can have winds of more than 300 miles per hour and can have widths of over one mile.

The mean national annual death toll due to tornados is 87 persons. Death and injuries associated with tornadoes have declined since the 1950s, thanks to advances in severe weather forecasting, but tornadoes can still be deadly. Although tornado deaths have decreased, tornado damages have increased in recent years, since a larger part of the country's land area contains developments with each passing year. Property damage resulting from tornadoes totals hundreds of millions of dollars every year.

Note that winds are invisible until they pick up enough material that can allow their patterns to be seen and it is this carried material that provides a tornado with a visible form that is easy to recognize. Funnel clouds can be invisible except for the liquid, dust, and debris that they carry. Therefore, a tornado can be present but not yet discernable to nearby persons.

Tornado intensity is measured on the Fujita and Enhanced Fujita Scale, which examines the damage caused by a tornado on homes, commercial buildings, and other man-made structures. Tornado magnitudes prior to 2005 were determined using the traditional version of the Fujita scale (**Table 5.8**). After 2005, the Enhanced Fujita Scale (**Table 5.9**) was utilized. The Enhanced Fujita Scale rates the intensity of a tornado based on damaged caused, not by its size. The size of the tornado is not necessarily an indication of its intensity.

Tornados in Michigan are most frequent in the spring and early summer when warm, moist air from the Gulf of Mexico collides with air from the polar regions to generate thunderstorms. These thunderstorms often produce the violently rotating columns of wind known as funnel clouds. Winds that converge from different directions, heights, or at different speeds are the source of the spinning pattern that gets concentrated as distinct funnels of wind. Michigan lies at the northeastern edge of the nation's primary tornado belt, which extends from Texas and Oklahoma through Missouri, Illinois, Indiana, and Ohio.

In Michigan, tornadoes occur more frequently in the southern half of the Lower Peninsula than any other area of the state. This area could be referred to as Michigan's "tornado alley." Since 1996, Michigan has averaged about 16 tornadoes per year.

Table 5.8: Fujita Scale with associated damages

F-Scale Number	Intensity	Wind Speed	Type of Damage
F0	Gale Tornado	40-72 MPH	Some damage to chimneys; branches break off trees; shallow-rooted trees blown over; damages to signs.
F1	Moderate Tornado	73-112 MPH	Peels surface off roofs; mobile homes pushed off foundations or overturned; moving cars pushed off roadways.
F2	Significant Tornado	113-157 MPH	Considerable damage. Roofs torn off homes; mobile homes demolished; large trees snapped or uprooted; light objects can turn into missiles.
F3	Severe Tornado	158-206 MPH	Roofs and some walls torn off well-constructed homes; most trees uprooted.
F4	Devastating Tornado	207-260 MPH	Well-constructed homes leveled; structures with weak foundations blown away; cars thrown; large objects can turn into missiles.
F5	Incredible Tornado	261-318 MPH	Strong frame homes lifted off foundations and carried considerable distances; automobile sized missiles can fly over 100 meters; trees debarked; steel reinforced concrete structures damaged.

Source: Storm Prediction Center

Table 5.9: Enhanced Fujita Scale with associated damages

EF-Scale Number	Intensity Phrase	3 Second Wind Gust	Type of Damage
EF0	Gale	65-85 MPH	Some damage to chimneys; branches break off trees; shallow-rooted trees blown over; damages to signs.
EF1	Moderate	86-110 MPH	Peels surface off roofs; mobile homes pushed off foundations or overturned; moving cars pushed off roadways.
EF2	Significant	111-135 MPH	Considerable damage. Roofs torn off homes; mobile homes demolished; large trees snapped or uprooted; light objects can turn into missiles.
EF3	Severe	136-165 MPH	Roof and some walls torn off well-constructed homes; most trees uprooted.
EF4	Devastating	166-200 MPH	Well-constructed homes leveled; structures with weak foundations blown away; cars thrown; large objects can turn into missiles.
EF5	Incredible	Over 200 MPH	Strong frame house lifted off foundations and carried considerable distances; automobile sized missiles can fly over 100 meters; trees debarked; steel reinforced concrete structures damaged.

Source: Storm Prediction Center

Climate Change Considerations

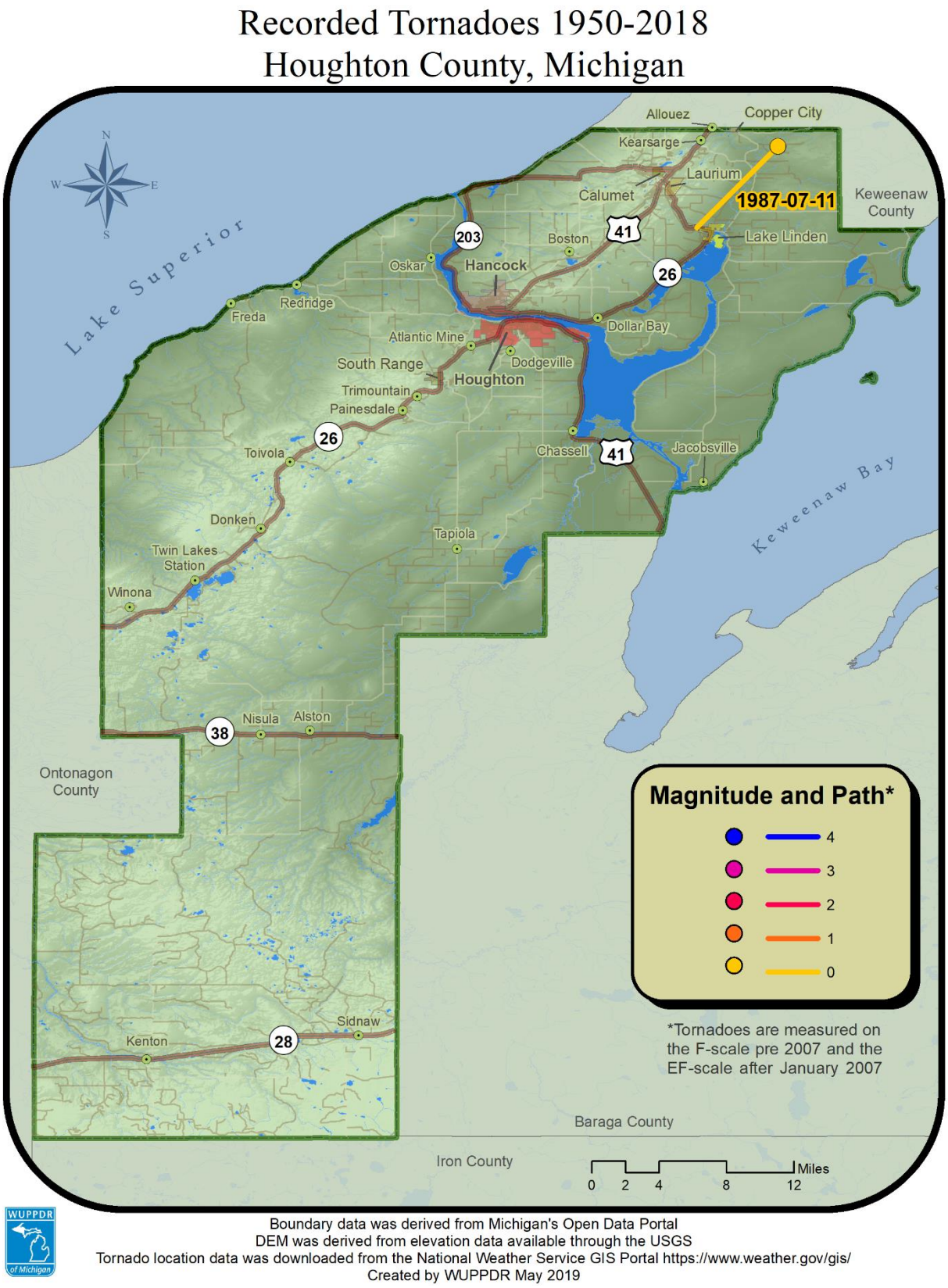
According to NOAA, there is no known way to predict whether or how climate change is affecting thunderstorm and tornado frequency or severity. These types of weather events involve a different scale of phenomenon than climate change and the models of the latter have not yet been able to predict local trends in the former.

Historical Occurrences

From 1950-2018, there has only been one tornado reported in Houghton County. The tornado occurred on July 11, 1987 and was rated an F0. While there are no specific details besides location (**Map 5.3**) about the tornado event itself, it did cause an estimated $2,500 in property damages.

Occurrence Probability and County Vulnerability

In Houghton County, tornadoes occur with such infrequencies that the probability of such an event is very low. However, if an event were to occur, the region's vulnerability to tornadoes is very high due to their unpredictability and the lack of preparedness in the county. Because a tornado can hit anywhere in the county, all critical facilities are vulnerable to being hit. Schools throughout the county are a concern due to the large number of people present and their potential to being used as a storm shelter.



Map 5.3: Tornadoes in Houghton County

Hydrological Hazards

The following outline summarizes the significant hydrological hazards covered in this section:

1. Flood Hazards
    a. Dam Failures
    b. Riverine and Urban Flooding
    c. Shoreline Flooding and Erosion
2. Drought

Michigan residents are greatly impacted by flooding. The section, **Riverine and Urban Flooding**, focuses on inland areas, mapped floodplains, and urban areas. Not all flooding occurs within recognized floodplain areas or adjacent to rivers and lakes. In some cases, melting snow or other runoff waters pool in low-lying areas, damaging structures and obstructing roads and other infrastructure. In other cases, some type of breakdown in an area's pumping or drainage infrastructure may result in a damaging flood. **Urban flooding** typically occurs in well-developed urban or suburban areas. It tends to occur due to either a breakdown in stormwater infrastructure or inadequate planning and design.

Many flood mitigation activities have taken place in recent decades, including separation of combined sewer systems, installation of backflow preventers in houses, and dredging, expansion, and redesign of drainage systems. Throughout the state, communities have learned lessons from previous flood occurrences and taken steps to mitigate flood impacts in the future. More importance is now placed on the preventative role in coordinating land development plans with existing knowledge of local floodplains, wetlands, sewer capacity, and upstream development and hydrology.

Overlap with Other Sections of Hazard Analysis

Hydrological hazards stem from precipitation patterns, which are affected by the types of events described in **Weather Hazards** sections on thunderstorms, severe winter weather, and extreme temperatures. Thunderstorms, snowstorms, and ice/sleet storms produce precipitation that can cause or exacerbate flooding – either immediately or when frozen precipitation melts. Additionally, ice can build up and block critical parts of drainage-ways and cause flooding. During extreme temperatures, freeze events have caused flooding when pipes and water mains have broken, while heat waves may worsen the impact of drought.

Technological Hazards can inhibit smooth functioning or drainage on water supply infrastructure and may cause or worsen flooding or drought hazards. For example, sewer pumping, and lift stations can go out of operation during a power failure and cause flooding to occur or a reduction in water supply.

Dam Failures

Hazard Descriptions

Dams are structures that stretch across a stream or other water body in order to control its flow or to convert the energy within the water into more convenient forms, such as electricity. The impounded waters may be used for flood control, fire and farm ponds, power generation by hydroelectricity (about 10% of US power production), irrigation diversion, fish and waterfowl habitat, water reservoirs, livestock watering, habitat improvement, recreation, mine waste retention, mine tailings and navigation[8]. Some dams have become obsolete and should be removed to restore the natural water flow through the area. Otherwise, neglected dams will eventually fail, and would then be likely to cause a flash flood downstream, through the sudden release of their impounded waters. Some dams are constructed by wildlife instead of humans but can pose similar risks.

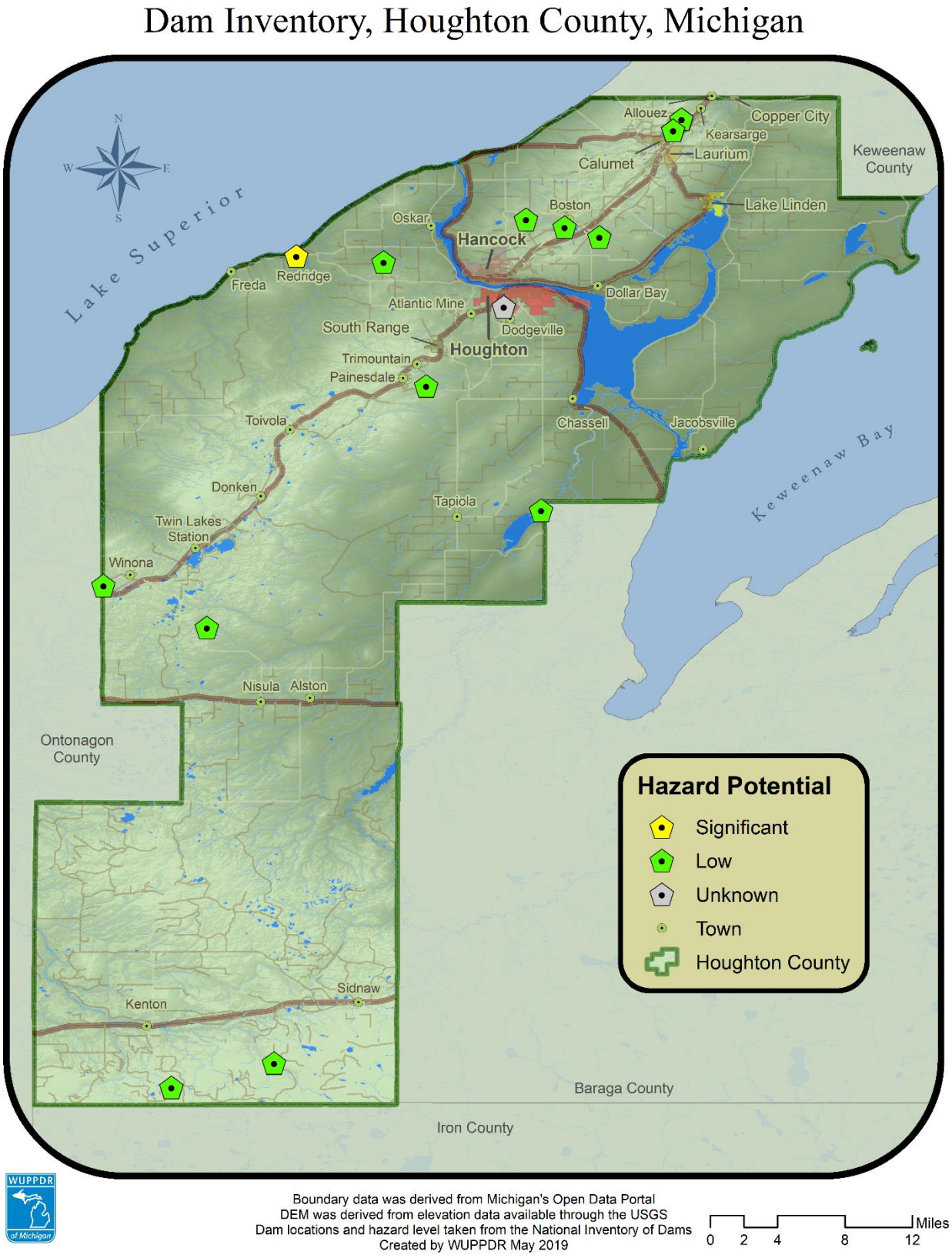
Dam failure is the breach or collapse of an impoundment resulting in flooding downstream. Dam failure can result in loss of life and in extensive property or natural resource damage for miles downstream from the dam. Failure can occur not only during flood events which cause overflowing of the dam, but also due to poor operation, lack of maintenance, and vandalism. Most dam failures are considered catastrophic because they occur unexpectedly, with no time for evacuation. As of 2014, there has been approximately 287 dam failures in Michigan since 1888[9].

Dams are officially classified into three categories of risk, based upon a wide array of potential impacts that can result from a dam's failure. The categories are as follow:

1. Low hazard potential dam: Failure or mis-operation results in no probable loss of human life and low economic and/or environmental losses. Losses are principally limited to the owner's property.
2. Significant hazard potential dam: Failure or mis-operation results in no probable loss of human life but can cause economic loss, environmental damage, disruption of lifeline facilities, or can impact other concerns.
3. High hazard potential dam: Failure or mis-operation will probably cause loss of human life.

Houghton County has several dams within its boundaries that have been built for power generation, water reservoirs, and recreation. The National Inventory of Dams (NID) lists 16 dams located in Houghton County (**Map 5.4**) with an average age of 60 years. All are of low to moderate hazard potential except for the Redridge Dam in Stanton Township which is listed as having a significant hazard potential. In addition to dams listed on the NID, there are additional dams on small creeks and rivers throughout the county (**Table 5.10**). There are also numerous beaver dams throughout the county which have not been inventoried. Beaver dam locations are typically reported by residents and done in an informal manner with the road commission due to the dams' threat to roadways.

[8] Hungarian Falls Dam, Keweenaw Geoheritage. www.geo.mtu.edu/KeweenawGeoheritage/The_Fault/Dam.html
[9] Michigan Department of Environment, Great Lakes, and Energy (EGLE)



Map 5.4: Dams in Houghton County (NID)

Table 5.10: Dams in Houghton County

Dam Name	River
Boston Pond Dam	Boston Creek
Lower Dam	E Br Ontonagon River
Redridge Dam	Salmon Trout River
Little Rice Lake Dam	Giles Creek
Kissam Dam	Tributary to Schlot Creek
Otter Lake Dam	Sturgeon River
Nordine Dam	Walton Creek
Gooseneck Creek Dam	Gooseneck Creek
Vitton Dam	Boston Creek
Homestake Copper Dam	Slaughterhouse Creek
Calumet Lake Dam	Slaughterhouse Creek
Huron Creek Dam	Unnamed Tributary
Redridge Steel Dam	Salmon Trout River
Lake Roland Dam	Misery River
Larson Dam	Tributary to Pike Bay
Manning Dam	Tributary to Pike Bay
Ollila Dam	Tributary to Pilgrim River
Olson Dam	Tributary to Hammel Creek
Pike Lake Dam	Beaver Creek
Sleepy Dam	Sleepy Creek
Tamarack Dam	Mc Gunns Creek
Usitalo Dam	Tributary to Little Otter River
Winona Dam	Sleepy Creek
Bear Lake Dam	Bear Lake Outlet
Chassell Sportsmen Dam	Tributary to Otter River
Elm River Tower Dam	Tributary to Shawmut Creek
Folk Dam	Tributary to Schlot Creek
Harter Dam	Tributary to Lake Superior
Jarvi Dam	Tributary to Jarvi Creek
Papworth Dam	Tributary to Pilgrim River
McCallum Creek Dam	McCallum Creek
Lake Superior Land Co Dam	Tributary to Lake Superior
Peterson Dam	Tributary to Lake Superior
Otter Lake Diversion Dam	Sturgeon River
Adams Township Wastewater Facility Dam	Tributary to Pilgrim River

Two dams in Houghton County, Calumet Lake and Huron Creek, have significant hazard potentials and immediate needs for repair which are described below.

Calumet Lake Dam

Calumet Lake is northwest of the M-203 and US-41 intersection in Calumet Township. The dam is located on the northeast side of the lake and at the discharge point to Slaughterhouse Creek. According to EGLE, the historical dam, installed in 1920, is no longer safe and have requested that the Township make recommended upgrades. The current structure is undersized and not capable of conveying the State required discharge of the dam of 230 cubic feet per second. The upgrade should mitigate the risk of dam failure and the possible resulting damage to water mains, roads, and wetlands downstream from the dam. There is also a shallow potable water transmission main that runs along the north side of Calumet Lake's embankment. If the dam were to fail and erode the shore, the water line would be damaged and approximately 2,800 customers could potentially experience little to no water pressure until repair. Almost 200 customers would also out of potable water service for an extended period. This significant failure would require an emergency (and expensive) contractor to repair the damage due to the lack of capacity (available workers) by the Michigan American Water Company. The upgrades should construct and replace the existing dam with a control structure capable of managing a 100-year storm event discharge.

Huron Creek Dam

The Huron Creek Dam is an earthen embankment located within the City of Houghton at the intersection of Huron St and an unnamed, unimproved road. The impoundment of Huron Creek created a 10-acre pond. In 2005, a small outlet control structure was installed to help maintain an optimal surface water elevation for wetland mitigation. The structure consists of 6-inch pipe and a sub-gradient weir box that is not designed to control large rain events. Currently most of the water from Huron Creek flows over the earthen dam and is not discharged through the weir box, which causes physical damages to the embankment, flow surges, and even dam failures. This occurred during a disastrous flood event on June 18, 2018. While the danger to human life is low, there is a large commercial district, state highway, popular playground, and health clinic downstream. A retired landfill exists in the large commercial district, where a leachate collection system was installed to prevent leachate from spilling into Huron Creek. This area of also has steep embankments which are susceptible to erosion and, in the case for the 2018 flood, resulted in losses to multiple buildings, damage to the collection system, and to the playground area where the creek discharges. The Huron Creek Dam upgrades should aim to mitigate the earthen dam and embankment failure, the potential for flashy flow, and the damages associated with these failures to the downstream areas listed above.

Historical Occurrence

The Redridge Dam was labeled a significant hazard in 2001 because the failure of the downstream steel dam would place the road and homes below the dam at risk. The upper portion (13 feet) of the timber crib was removed in fall 2004 to lower the reservoir to comply with a requirement from the Michigan Department of Environment and Great Lakes (EGLE). If

additional efforts are required by the EGLE, outside financial assistance for Stanton Township will be needed.

Occurrence Probability and County Vulnerability

Failure of the Prickett and Prickett Intake and Powerhouse Dams on the Sturgeon River in Baraga County – a major power generation structure – has a low probability but can have moderate-severity impacts on downstream locations in Portage Charter and Chassell Townships. As required by the Federal Energy Regulatory Commission (FERC), evacuation plans are in place for those affected by failure of power generation dams with annual exercises and plan reviews taking place with the dam owner and local emergency management. If there were a dam failure, it would be a high severity issue for these communities. Other jurisdictions are not as vulnerable, with low probability of experiencing a dam failure.

A vulnerability analysis for dam failure has not been conducted for all dams in Houghton County and dams that affect the county due to insufficient data. Dam-breach analysis and mapping dam breach inundation areas are the most appropriate means for examining the impact to people, property, and critical facilities. As individual dam failure analysis and inundation mapping become more available, Houghton County intends to add this information and include a vulnerability analysis in future hazard mitigation plan updates.

Riverine and Urban Flooding

Hazard Description

Riverine flooding is defined as a periodic occurrence of overflow of streams and rivers resulting in an inundation of the adjacent floodplain. While flooding of land adjacent to streams and rivers is a natural occurrence, floodplains typically are not left in the natural state. Development in and near floodplains have increased the potential for serious flooding because rainfall that used to soak into the ground or take several days to reach a river or stream via natural drainage now quickly runs off streets, parking lots, and rooftops, through man-made channels and pipes that may or may not be adequately maintained.

Riverine and urban floods are caused by prolonged, intense rainfall, snowmelt, ice jams, dam failures, or any combination of these factors. Bank overflows are natural and may occur on a regular basis on river systems that drain large geographic areas and many river basins. Floods on large river systems may extend several days. Many areas of Michigan are subject to riverine flooding.

Most riverine flooding occurs in early spring and is the result of excessive rainfall and/or the combination of rainfall and snowmelt. Ice jams are another cause of flooding in winter and early spring. Log jams can also cause streams and rivers to be clogged up and backed-up waters to overflow the stream's banks. Either ice jams or log jams can cause dangerous flash flooding to occur if the makeshift dam-effect caused by the ice or logs suddenly gives way. Severe

thunderstorms may cause flooding during the summer or fall, although these are normally localized and have more impact on areas with smaller drainage areas.

Urban flooding may involve low-lying area that collect runoff waters even though they are not adjacent to drains or bodies of water. It is usually due to the combination of excessive rainfall and/or snowmelt, saturated ground, and inadequate drainage. With no place to go, the water will find the lowest elevations – areas that are not in a floodplain. This risk does vary with topography, soil types, runoff rates, drainage basin size, drainage channel sizes, and impervious ground surfaces in each area. Other kinds of urban flooding stem from undersized or poorly designed sewer systems that cannot always process the amounts of precipitation and runoff that affects an area or inadequately maintained systems with blockages or broken pipes.

Both kinds of flooding can damage or destroy public and private property, disable utilities, make roads and bridges impassible, destroy crops and agricultural lands, cause disruptions 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 secondary dangers include potential disease outbreak, widespread animal death, broken sewer lines causing water supply pollution, downed power lines, broken gas lines, fires, and the release of hazardous materials.

Climate Change Considerations

One of the Michigan trends connected with climate change is to experience increasing amounts of precipitation. This precipitation is considered more likely to take the form of acute and severe weather events. This includes larger proportions of snow precipitation occurring in snowstorm events and cause more extensive snow accumulation, which may add to the drainage burdens of the normal melting and rainfall patterns of the spring season. Both spring and summer flood risks are likely to worsen, as are ice jam related flood risks.

Historical Occurrence

Several areas in Houghton County are susceptible to riverine and urban flooding. Riverbanks and many areas with inadequate culverts and ditches become overburdened, resulting in certain degrees of flooding and washouts. Contributing to the problem, areas such as Houghton and Hancock have steep grades that increase the velocity of runoff and threat of erosion. To deal with these risks, storm sewer upgrades, drain management, and culvert replacements are ongoing.

From 1996-2019, there have been 12 flooding events in Houghton County. Four of these events have reported property damages. Two of these events were severe enough to result in disaster declarations from the State of Michigan and FEMA. All minor flood events are listed in **Table 5.11**.

Table 5.11: Summary of Minor Floods in Houghton County, 1996-2019

Date	Type of Flood	Description and Location	County Property Damages
04/12/2002	Riverine Flooding	Local flooding on the Sturgeon River due to significant snowpack melting and heavy rainfall.	No damages reported
05/11/2003	Riverine Flooding	Significant rainfall in Hancock (2.6 inches) resulted in the Sturgeon and Trap Rock Rivers flooding.	$2.0 million
04/18/2004	Riverine Flooding	Heavy rainfall and runoff resulted in minor flooding along the Sturgeon River from Alston to Chassell and along the Trap Rock River in Lake Linden.	No damages reported
07/16/2006	Flash Flooding	Estimated 4-inches of rain fell in Laurium with street and basement flooding reported. 3-inches of rain reported at Houghton County Airport, with a washout of M-203 in Calumet Charter Township.	$5,000
04/20/2008	Riverine Flooding	Sturgeon River went above flood stage near Chassell and onto nearby roadways. Remained at flood stage for 6 days.	No damages reported
10/27/2017	Riverine Flooding	Heavy rains caused flooding on the Trap Rock River and onto Woodbrush Road in Calumet. Also, water on Bootjack Road near Silver Creek in Jacobsville.	$3,000
04/08/2019	Riverine Flooding	Significant snowpack melt and moderate rainfall contributed to minor flooding along the Sturgeon River.	No damages reported
04/18/2019	Riverine Flooding	Significant snowpack melt and moderate to heavy rainfall caused flooding around the Sturgeon River. Several houses and barns in Chassell had rising water around them, but no structures were flooded. Sections of the Sturgeon River Road and Rajala Road were reported to be under water. Some culverts in Hubbell were clogged, which led to the closure of Highway M-26 due to water over the road.	No damages reported
05/20/2019	Riverine Flooding	Heavy rains of 1 to 3 inches caused minor flooding of the Escanaba River in Humboldt and the Sturgeon River in Alston.	No damages reported

Significant flooding events in Houghton County, including those with disaster declarations are the following:

Late April 2013: Rapid melting of late season snowpack caused moderate flooding of roads throughout Houghton County, especially along the Sturgeon River from Alston to Chassell for 3 days. Flooding of basements were also reported. Governor Rick Snyder issued a disaster declaration on May 7. There were $2.9 million in property damage due to flooding, mainly to roadway infrastructure.

Agate St. Houghton taken on June 22, 2018 after a major precipitation event (Photo: Melissa Lubinski)

June 17, 2018: Widespread and catastrophic **flash flooding** throughout Houghton County resulted from 3 to nearly 7 inches of heavy rainfall. The NOAA Precipitation Frequency Atlas indicated a 1000-year recurrence interval for the rainfall amounts received during this event. Numerous homes and businesses were flooded throughout the area, particularly in Houghton/Hancock where one fatality occurred when a basement collapsed on a home on Canal Road. Michigan Governor Rick Snyder issued a disaster declaration for Houghton County the day after the flooding occurred. Recovery events are still ongoing in the county. Damage estimates are currently over $100 million.

Portage Canal in Houghton on June 22,2018 after a major precipitation event. (Photo: Christopher Edwards)

July 21, 2018: Heavy rainfall (3 to 4 inches in six hours) caused **flash flooding** throughout Houghton County. Several roads were washed out, including those that had been repaired following floods in June. Governor Snyder issued a second disaster declaration. Damages estimated to be approximately $1 million. President Donald Trump declared a major disaster for June and July flooding in areas affected by severe storms, flooding, landslides, and mudslides[10].

Flood Insurance in Houghton County

In Houghton County, only Chassell and Osceola Township participate in the FEMA National Flood Insurance Program (NFIP). The NFIP makes federally supported flood insurance available to homeowners, renters, and business owners in communities that adopt and enforce floodplain ordinances. Most other communities in Houghton County do not regularly experience severe flooding. Other communities in the county have not been affected by flooding to the extent that participation would be considered necessary and participation is not a prerequisite for property owners to purchase flood insurance from private insurers. However, following the June 17, 2018 flooding, the City of Houghton, Adams Township, and Franklin Township have applied to participate in this program. There are currently no repetitive loss or severe repetitive loss properties in Houghton County.

During a flood hazard assessment, FEMA develops for NFIP a Flood Insurance Study and Flood Insurance Rate Map (FIRM). The FIRM is used by lenders to determine flood insurance requirements and by insurance agents to determine flood insurance premium rates for specific properties. The FIRM includes areas within the 100-year flood boundary, which are termed "Special Flood Hazard Areas" (SFHAs). A 100-year flood does not refer to a flood that occurs every 100 years but refers to a flood level with a one percent or greater chance of being equaled or exceeded in any given year. Currently the only jurisdiction in Houghton County with an identified SFHA is Chassell Township. In Chassell, the Sturgeon River floods annually – some years worse than others. Osceola Township has no SFHAs. Nevertheless, Osceola is affected by flooding associated with drainage ditches in the community of Dollar Bay and is interested in improving capacity and flow to alleviate this problem. Franklin Township registered for the NFIP on January 28, 2019, and as of November 12, 2019 has emergency coverage until it is inducted in the regular program. The City of Houghton registered for NSFHA (Non-Special Flood Hazard Area) on February 19, 2019. Schoolcraft Township registered on October 11, 2019, but only has limited emergency coverage as of November 12, 2019. Torch Lake Township registered with NFSHA on August 28, 2019 and has limited emergency coverage. Adams Township filed to participate in the NFIP on May 13, 2019 and has limited emergency coverage as of November 12, 2019. City of Hancock resolved to participate in the program, but as of now has not registered.

[10] White House Release. (2018, August 3). "President Donald J. Trump Approves Michigan Disaster Declaration." www.whitehouse.gov/briefings-statements/president-donald-j-trump-approves-michigan-disaster-declaration-2/

Occurrence Probability and County Vulnerability

While the frequency of flooding is low (0.7 events per year based on 7 days with a flooding event reported in the past ten years), riverine and urban flooding is a moderate risk in Houghton County. However, with impacts from climate change, flooding frequency and severity may increase. Riverine and urban flooding have a variable severity depending on location within the county.

While flooding can impact a variety of critical facilities, identifying which specific critical facilities or populations are most vulnerable to riverine and urban flooding is limited due to the lack of available data. However, municipalities and critical facilities throughout the county are vulnerable to flood impacts. Steep slopes throughout the county contribute to flood vulnerability by accelerating surface water runoff into nearby rivers, streams, and lakes. Many populated areas in the county are located at the base of steep hills, such as the Cities of Houghton and Hancock, making them vulnerable to flooding during rain events. Combined with impervious surfaces (e.g., roadways, parking lots, and other hard surfaces), populated areas become even more vulnerable to flooding.

Additionally, sewer and water treatment plants and well and septic systems are vulnerable to riverine and urban flooding. Any homes and business or industry facilities that rely on well or septic service may experience operational problems that force closure of the facility. If flood waters cover well heads, the well water is considered contaminated and no longer safe for human consumption. If grinder pumps in septic systems are inundated with water, the septic may overflow causing additional human health issues.

Shoreline Flooding and Erosion

Hazard Description

Michigan has over 3,200 miles of coastline (the longest freshwater coastline in the world), and about 4.7 million persons live in the state's 41 shoreline counties, which includes Houghton County. Flooding and erosion along the Lake Superior shoreline are typically a result of high-water levels, storm surges, or high winds. These are natural processes that can occur at normal or even low water levels. However, during periods of high water, flooding and erosion are more frequent and serious, causing damage to homes, businesses, roads, water distribution and treatment facilities, and other structures in coastal communities. Seiches, which can drive lake water inland over large areas and may be caused by a storm surge, occur when windstorms and differences in atmospheric pressure temporarily tilt the surface of a lake up at one end. Water levels can rise to more than 10 feet. When the wind stops, lake water rebounds to the other side of the lake. This back and forth action, or oscillation, can occur for hours or even days[11].

[11] Michigan Sea Grant. "Surges and Seiches." www.michiganseagrant.org/lessons/lessons/by-broad-concept/earth-science/surges-and-seiches-2/

Shoreline erosion hazards typically involve the loss of property as sand or soil is removed by water action and carried away over time. Erosion effects that are experienced along rivers may be included in this category of hazard.

Lake Superior levels have fluctuated since prehistoric times and accurate measurements of this change are available for the last 160 years. According to the U.S. Army Corp of Engineers, the peaks of this fluctuation have been higher during this century than they were in the past. Current lake levels are over a foot or a half of meter above the average annual (1918-2018). The modern range of fluctuation between periods of high and low water is 1-meter.

The land in the Great Lakes region is slowly recovering from the last glacial period when ice loaded and depressed the land surface. The land is rebounding from the weight of the former glaciers at different rates. The outlet channel to Lake Superior at Sault Ste. Marie is rising more rapidly than most other points along the U.S. shore, resulting in a tilting of the lake. The amount of inundation is greatest at Duluth, Minnesota where as much as 5.4 meters of inundation has occurred over the past 2,000 years. Maximum inundation over this period for the Michigan shore occurred near Ontonagon where as much as three meters is noted.

Climate Change Considerations

Higher and lower water levels result from natural changes in climate in the region and will continue to occur. However, the impact from climate change on the magnitude and frequency of water-level change remains uncertain. Lake Superior water levels will continue to fluctuate, but the periods where it is either above or below average water levels may become prolonged.

Shoreline erosion at McLain State Park, 2016 (Photo: Michigan DNR)

Historical Occurrence

In Houghton County, there are several high-risk erosion areas identified by the EGLE (Appendix B). These areas have mandatory and recommended setback regulations in place to mitigate losses due to erosion. There has been only one reported shoreline flooding and erosion event in Houghton County. On September 9, 2014, northerly winds with gusts of up to 40 miles per hour and over resulted in high waves and significant erosion along the shoreline at McLain State Park in Hancock Township. There were no reported damages.

Occurrence Probability and County Vulnerability

Erosion is an ongoing and unavoidable process – one that has very high probability but low severity. Approximately two miles or 7% of the county's Lake Superior shoreline are officially designated as high-risk areas and long stretches of adjacent shoreline are also continually threatened by this hazard. However, the shoreline of Lake Superior is not static and with

fluctuating lake levels, communities along the shoreline are vulnerable to shoreline flooding and erosion. The most susceptible communities are Calumet Charter, Hancock, Schoolcraft, Stanton, and Torch Lake Townships due to their proximity to Lake Superior. These areas are relatively undeveloped, so critical facilities are not at risk of being susceptible to shoreline flooding or erosion. Additionally, the imminent risk of property damage is minimal. Even damage to the natural environment is generally gradual and a result of a natural process.

Drought

Hazard Description

Drought is a water shortage caused by unusual hydrologic conditions such as lack of rainfall and it generally lasts for an extended period, usually a season or more in length. Drought can be a normal part of an area's climate, including areas that have very high or low average rainfall. The level of precipitation or runoff associated with a drought is substantially below an area's norms. The severity of a drought depends not only on its location, duration, and geographical extent, but also on an area's water supply needs for human activities and vegetation.

Drought differs from other natural hazards in several ways. First, there is no exact beginning and end point that is obvious for a drought; the effects may accumulate slowly and linger even after the event is believed to be over. Second, the lack of clearly visible and universal standards to define a drought can make it difficult to confirm in a timely manner if a drought exists and its degree of severity. Third, drought impacts are often less obvious than other natural hazards. Fourth, most communities do not have any contingency plans in place for addressing drought. This lack of pre-planning can hinder support for drought mitigation capabilities.

The severe impacts from droughts on communities and regions include water shortages for human consumption, power generation, industrial and agricultural use, and recreation; drop in quantity and quality of agricultural crops; lower water quality in lakes, rivers, and other water bodies; increase in wildfires; decline in land values; increase in insect infestation, plant disease, and wind erosion, and; possible human impacts such as food shortages, extreme heat, fire, and other health-related problems such as diminished sewage flows and increased pollutant concentrations in surface waters.

Despite thousands of miles of rivers and streams and its surrounding Great Lakes, Michigan can still experience occasional drought conditions. Most common are agricultural droughts, with severe soil-moisture deficits, which have serious consequences for crop production, particularly when coupled with extreme summer temperatures. Also, various water bodies, both inland lakes and the Great Lakes, cyclically go through periods of low-water levels. Michigan has emerged from its latest such period and is now experiencing high water levels.

Climate Change Consideration

While the effect of climate change on Michigan has involved an overall increase in precipitation, and drought severity in the state has generally been decreasing over the past 50 years, there will

still be drought events and dryer seasonal phases, especially in areas that are locally more susceptible. Shorter duration seasonal droughts are expected to worsen during the warmer half of the year, even though overall annual averages of precipitation have increased. With enough planning and water infrastructure, the climate change effects upon this hazard may be beneficial overall for a short period of time.

Historical Occurrence

Although Houghton County has not had a localized drought severe enough to be recorded, the United States Midwest has been significantly affected by drought in five years since 1981. These wide-ranging droughts have little long-term impact on wild flora and fauna, and since Houghton County has little cultivated land, drought does not significantly affect agriculture. Although stream and reservoir levels may drop, the county has not faced a critical power shortage resulting from interruption of hydroelectric generation (the power grid has a high degree of regional interconnectivity). The county does have drinking water sources dependent on Lake Superior, but temporary droughts have not diminished groundwater reserves to a notable degree. However, even a minor drought is one of the primary factors of wildfire potential and is a major hazard for that reason alone.

Occurrence Probability and County Vulnerability

Countywide risk of other drought effects is minimal, with low probability of a recordable (moderately severe) drought but much higher incidence of less severe conditions. If a drought were to occur, all communities are vulnerable to drought effects, such as low water supplies in groundwater and drinking wells. Severe droughts can negatively affect drinking water supplies and impact critical facilities. Possible losses to infrastructure include the loss of potable water.

Ecological Hazards

The following outline summarizes the significant ecological hazards covered in this section:

1. Wildfires
2. Invasive Species

These types of hazards deal with biological ecosystems and their effects on human economy and the built environment. The most well-known ecological hazard is wildfire, which occur both naturally or, more frequently, are human caused and become dangerous when they threaten humans that live in areas where the disaster event takes place. Wildfires can cause damage and threats to human health and life. Ecological hazards must also be dealt with to maintain Michigan's environmental and recreational quality of life, as well as the important economic sectors that are closely connected with them (such as tourism, recreation, agriculture, and natural resource extraction).

Wildfires

Hazard Description

Forests cover approximately 55% (20.4 million acres) of Michigan's total land area and provide Michigan with the largest state-owned forest system in the U.S. Additionally, Michigan has the fifth largest quantity of timberland acreage, which includes 19.3 million acres of softwood and hardwoods. While vast forest cover is a boom for industry and recreation, it also makes many areas of Michigan highly vulnerable to wildfires.

Michigan's landscape has significantly changed over the last several decades due to wildland development and thus potential danger from wildfires have become more severe. Increased development in and around rural areas has increased the possibility for loss of life and property from wildfires. Although most wildfires are small (a few acres), any one wildfire can burn out of control under the right conditions and multiply annual burned acreage. There are not enough fire suppression forces available in rural areas to protect every structure from a disastrous wildfire.

Most Michigan wildfires occur close to where people live and recreate. The most immediate dangers from wildfires are the potential injury or deaths of persons who live or recreate in the affected area and the destruction or homes, timber, and wildlife. Long-term effects included scorched and barren land, loss of wildlife habitat, soil erosion, landslides, water sedimentation, and loss of recreational opportunities.

According to the Michigan Department of Natural Resources (MDNR), the main cause of wildfires (47%) in Michigan is burning yard debris, such as grass clippings, leaves, and trash. Most wildfires occur in the spring when days are dry and windy with abundant dead vegetation left after the snow melts. These conditions can spread a wildfire quickly because there is less

moisture in the air and the wind carries burning debris to other areas. The dead vegetation makes for good wildfire fuel[12].

Climate Change Considerations

The average wildfire seasons has extended 78 days longer across the United States, and large wildfires burn more than twice the area they did in 1970[13]. Changes in climate have led to hot, dry conditions that may increase fire activity. While there has been an overall increase in precipitation in Michigan, there will still be drought events and drier seasonal phases. Shorter duration seasonal droughts are expected to worsen in the warmer half of the year, which may affect wildfire occurrence. Development trends in Michigan seem to involve increases in wildfire risk over time, and annual cycles of summer drought have been projected by many climate analysts in the coming decades.

Historical Occurrence

Approximately 80% of Houghton County is forest cover. This is an asset for both industry and recreation but leaves the county vulnerable to wildfires (**Map 5.5**). From 1981 to 2018, the MDNR reported 192 wildfires in the county on areas under MDNR jurisdiction (about 5.1 wildfires per year). About 1,212 acres were burned.

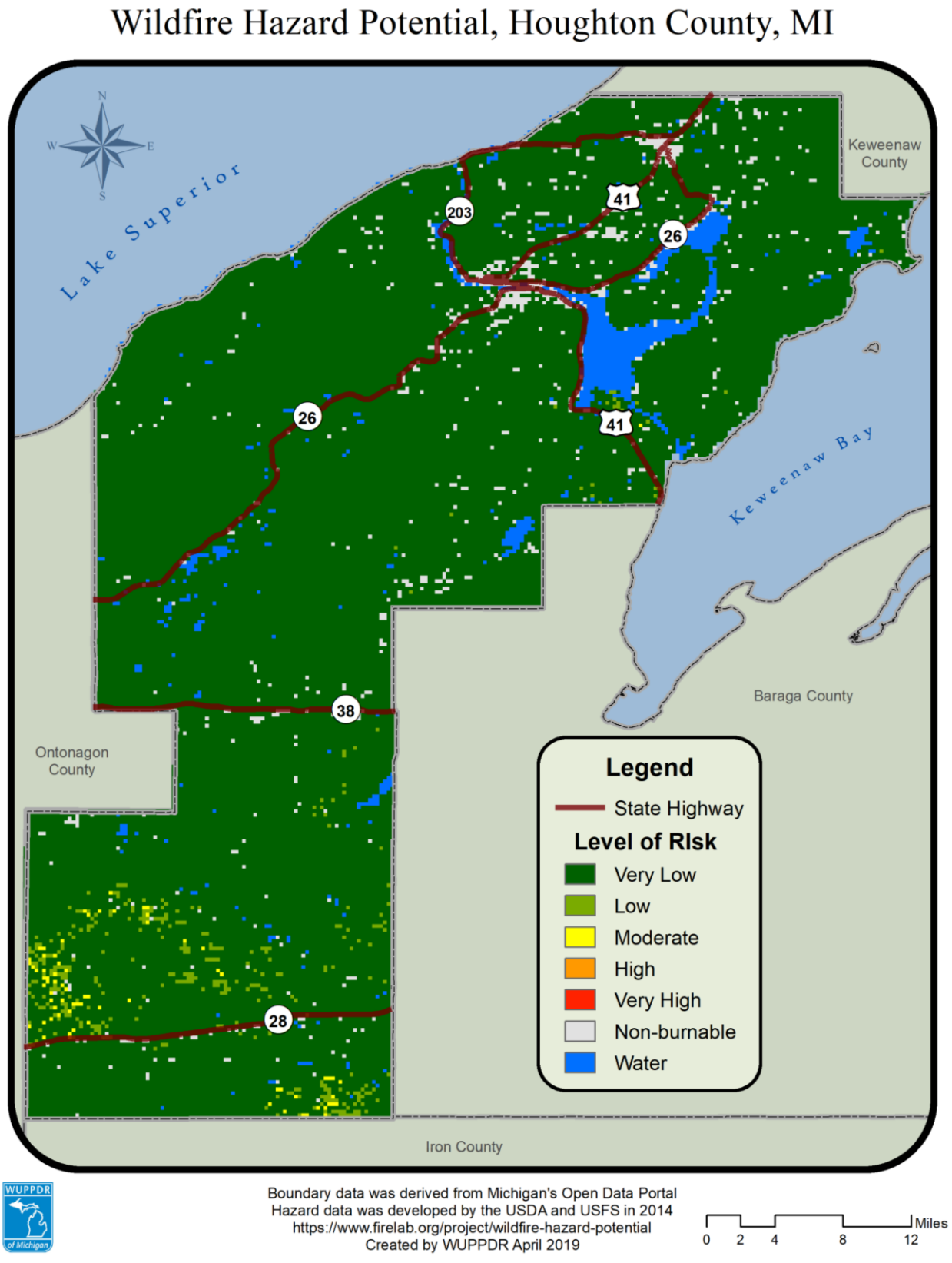
One significant wildfire event has occurred in Houghton County:

- *June 6, 2000*: A brush fire started on a blueberry farm near Rice Lake in Torch Lake Township got out of control and burned over 350 acres before being contained the following day. Firefighters from the MDNR and 15 local fire departments, plus two aerial water tankers, were called in to fight the blaze. Brisk winds pushed the fire to within one-quarter mile of homes along the shoreline of Lake Superior, forcing the evacuation of over 20 homes and cottages. Fortunately, in this incident no structures were lost, and no injuries were reported.

Occurrence Probability and County Vulnerability

Houghton County has an ongoing risk of wildfires due to the tremendous amount of forest cover and urban infringement in rural areas. Development in rural areas can intensify overall damage from wildfires. All areas of the county have some vulnerability to wildfire, but extent varies greatly by location. Homes and other built infrastructure, such as roads and power lines, in rural townships are more vulnerable to wildfires due to their proximity to undeveloped areas.

[12] Michigan Department of Natural Resources. "Wildfires." www.michigan.gov/michiganprepares/0,4621,7-232-65025_65201---,00.html
[13] Center for Climate and Energy Solutions. "Wildfires and Climate Change." www.c2es.org/content/wildfires-and-climate-change/



Map 5.5: Wildfire Hazard Potential in Houghton County

Invasive Species

Hazard Description

An invasive species is defined as a species that is 1) non-native to the local ecosystem and 2) whose introduction causes or is likely to cause economic or environmental harm, or harm to human health. Invasive species can be plant, animals, and other organisms (e.g., microbes). Human actions are typically the cause of invasive species' invasion; it is not a natural shift in a species distribution. Nationally, the current environmental, economic, and health costs associated with invasive species were estimated as exceeding the costs of all other natural disasters combined.

Invasive species can be transported into an ecosystem in many ways, such as on animals, vehicles, ships, commercial goods, produce, and clothing. Although some non-native species are used to prevent erosion, provide fishing and hunting opportunities, and as ornamental plants and pets, occasionally a non-native organism flourishes too well and causes unwanted economic, ecological, or human health impacts. "Invasive" or "nuisance" are used to describe such species.

A plant or animal that causes little damage to agriculture or natural ecosystems in one area may cause significant problems in another. Certain non-native species are very successful in their new habitats because they out-compete native plants or animals and have no natural controls (predators, diseases, etc.) in their new area. Hundreds of new species from other countries are introduced intentionally or accidentally to the U.S. each year. Transportation efficiencies make it possible for invasive species to travel around the globe in hours and make it possible for organisms to survive transportation from one continent to another. At least 200 well-known, high-impact, non-native species presently occur in the U.S.

As more adaptable and generalized species are introduced to environments already impacted by human activities, native species are often at a disadvantage to survive in what was previously a balanced ecosystem. While invasive species primarily cause environmental damage and degradation, there are situations in which serious threats to public health and well-being can occur due to animal disease or plant/animal infestation. Invasive species can also create serious public safety threats; some invasive insects can cause significant damage to trees (disease or death) and may lead to partial/total tree collapse.

Terrestrial species are likely to have more public awareness than aquatic ones. Although there have been well-publicized aquatic species of concern (e.g., zebra mussels, Asian carp), people tend to be more aware of the impacts of terrestrial species, unless their recreational or business activities are impacted by aquatic species.

Climate Change Considerations

Due to the lengthening of Michigan's growing season, species that had been previously found only in warmer areas to the south have started to appear. As seasonal temperatures fluctuate, invasive species can establish themselves in previously inhospitable climates. While the definition of invasive species specifically refers to species introduced by humans, to distinguish

these patterns from naturally occurring ones, species transported by human action can be more likely to survive as climatic changes occur.

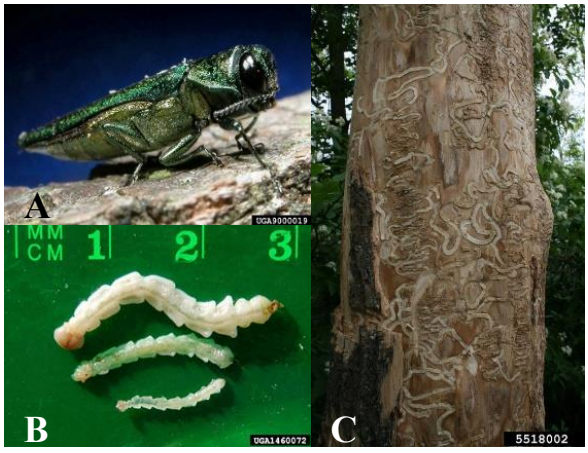
Historical Occurrence

Due to Houghton County's large amount of forest coverage, lakes, and rivers, both terrestrial and aquatic species have been found throughout the County. There have been over 3,800 reported locations of invasive species, most of which are terrestrial invasive plants[14], and 219 invasive species reported[15]. The Keweenaw Invasive Species Management Area (KISMA) is a partnership between many organizations throughout Houghton, Keweenaw, and Baraga Counties as well as Ottawa National Forest. The goal is to facilitate cooperation and education among federal, state, tribal, local groups and landowners in prevention and management of invasive species across land ownership boundaries.

The following are some examples of reported invasive species that have been found or threaten the local ecosystem in Houghton County:

Invasive Insects

Emerald Ash Borer (*Agrilus planipennis*): First discovered in southeastern Michigan near Detroit in 2002, this exotic beetle has killed hundreds of millions of ash trees throughout the U.S. Adult emerald ash borers (EAB) feed on ash foliage but cause little damage. However, the larvae feed on the inner bark of the ash trees, disrupting the tree's ability to transport water and nutrients. Many trees lose approximately 30 to 50 percent of their canopy in one year and the tree is often killed after 2-3 years of infestation. Most devastation has occurred in southeast Michigan, where about 20 million trees have been killed. EAB was first reported within Houghton County in 2008[16].



Emerald ash borer adult (a), larvae (b), and damage (c) to ash trees. (David Cappaert (a, b) and Troy Kimoto (c))

Gypsy moth (*Lymantria dispar*): Typically found on oak and aspen leaves, the Gypsy moth defoliates trees, leaving trees vulnerable to diseases and other pests. The damaged can lead to tree mortality. When there are large populations of gypsy moths, tree debris (e.g., branches and twigs) and frass (tree sawdust) may occur, disrupting outdoor recreation.

[14] Midwest Invasive Species Information Network. Data Map by State and County. www.misin.msu.edu
[15] Early Detection & Distribution Mapping System. www.eddmaps.org
[16] Emerald Ash Borer Story Map. www.aphis.usda.gov/aphis/maps/plant-health/eab-storymap

Spotted Wing Drosophila *(Drosophila suzukii)*: The Spotted Wing Drosophila (SWD) is a small vinegar fly with the potential to damage many fruit crops. It was first detected in Michigan in late September 2010. Unlike most other vinegar flies that require damaged fruit to attack, SWD causes damage when the female flies cut a slit and lay eggs in healthy fruit. This insect is a pest of most berry crops, cherries, grapes and other tree fruits, with a preference for softer-fleshed fruit. Given the propensity for this insect to spread and its potential to infest fruit, it is important to learn about monitoring and management of SWD to minimize the risk of larvae developing in fruit and affecting fruit marketability[17].

Adult Female Spotted Wing Drosophila (Hannah Burrack, North Carolina State University)

Invasive Plants

Wild parsnip (*Pastinaca sativa):* Wild parsnip has been found in Michigan since 1838 and was originally introduced to the U.S. as a food source. It is commonly found growing in open areas, fields, roadsides, and disturbed areas and can grow in a variety of soil types and moisture levels. Wild parsnip can spread through seeds carried by wind, water, and equipment. This kind of parsnip is also a human health hazard. The sap found in the stem, leaves, and flowers contain a chemical that increases skin sensitivity to sunlight and cause severe rashes or blisters. Wildlife and domesticated animals are also vulnerable.

Spotted knapweed (*Centaurea stoebe*): Spotted knapweed is commonly found on dry sandy soil in disturbed areas near roads and abandoned farms or in dry dunes or prairies. It was introduced into the U.S. in the 1890s from Eurasia and can outcompete native plants due to its ability to emit a chemical into the soil that is toxic to surrounding plants. While it is considered an invasive weed, it is also known for the honey that bees make from its nectar (Star Thistle Honey).

Invasive Aquatic Plants

Eurasian watermilfoil (*Myriophyllum spicatum*): Eurasian watermilfoil (EWM) is an aquatic plant that was found in Michigan freshwater lakes during the 1960s. EWM has spread quickly throughout all U.P. counties. Stem fragments, which can be attached to fishing lines or boats,

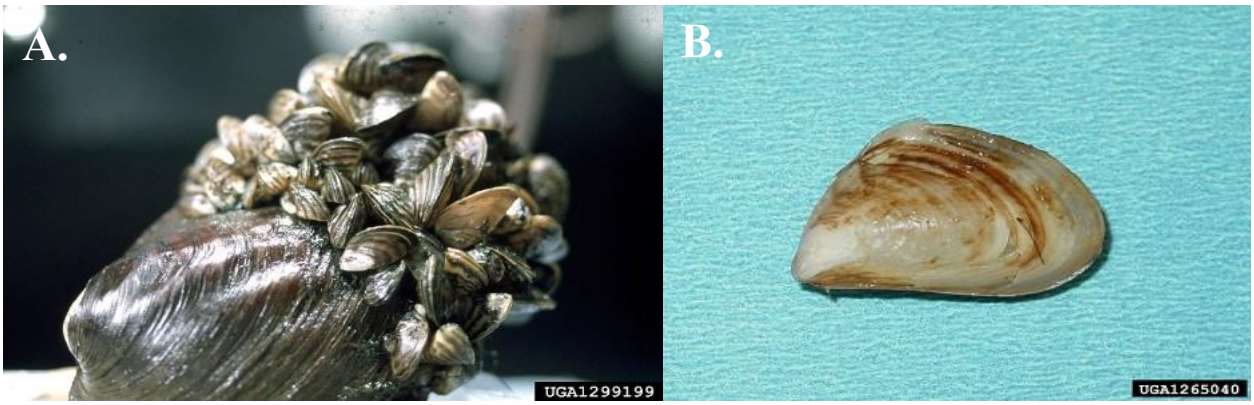
Eurasian watermilfoil (Chris Evans, University of Illinois)

[17] Isaacs, R. et al. (2010). Spotted Wing Drosophila. MSU Extension Bulletin E-3140. Michigan State University. www.canr.msu.edu/ipm/uploads/files/E-3140.pdf

can take root and form a new colony after being transported from one water body to another. It forms thick underwater vegetation mats that shade out native plants and impedes recreational activities, such as swimming, fishing, and boating. Prime EWM habitat include lakes that have been disturbed by watershed runoff, shoreline construction, or stressed by pollution. If a lake has a healthy population of native aquatic plants, EWM has a hard time establishing itself in the lake.

Purple loosestrife (*Lythrum salicaria*): Purple loosestrife thrives in shorelines, roadsides, and wetlands. It is a perennial invasive plant and can spread quickly, replacing native vegetation which reduces food, shelter, and nesting sites for turtles, birds, frogs, and other wildlife. Seeds can germinate in water, but it prefers shorelines that are not always flooded. Purple loosestrife was first introduced to the U.S. in the 1800s from Europe as an ornamental plant and for bee keeping. It has since spread to every U.S. state.

Invasive Aquatic Species

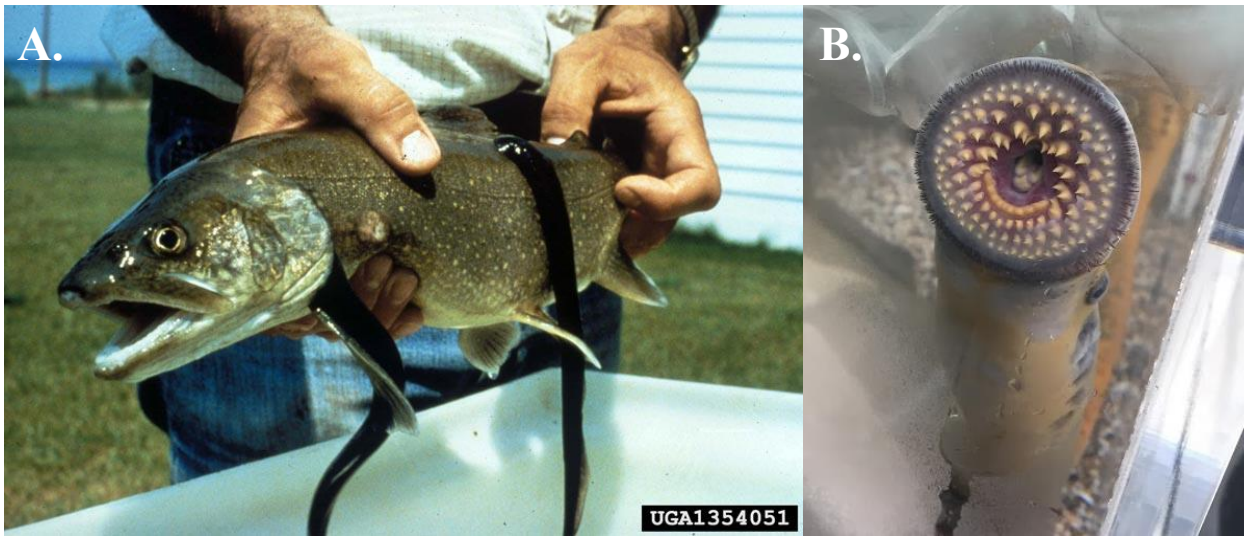


Zebra mussel (A; Randy Westbrooks, Invasive Plant Control, Inc.) and quagga mussel (B; Amy Benson, USGS)

Dreissenid Mussels (including Zebra Mussels and Quagga Mussels); family *Dreissenidae*: Dreissenid mussels have been present in the Great Lakes since the late 1980s and were transported to the area via ballast waters from shipping barges. Both mussels can attach to hard surfaces, clogging water intake pipes and fouling other hard-shelled animals such as clams. Zebra mussels have significantly reduced plankton populations, as mussels filter large volumes of water for food, which can deplete food resources of larval and planktivorous fishes like smelt and alewife. This also results in an increase in water clarity and an increase in aquatic plants. Clear water is aesthetically pleasing, but the clarity indicates that there have been drastic changes at the base of the food web. While more attention has been given to the zebra mussels, quagga mussels have a large spatial extent in the Great Lakes as it can tolerate colder and deeper waters than zebra mussels.

Sea lamprey (*Petromyzon marinus*): Sea lamprey were first discovered in the Great Lakes in the 1800s and its introduction into Lake Superior has caused serious decline in fish populations and an alteration of the ecosystem. The lamprey uses its suction cup like mouth to latch onto the skin of a fish and scrapes away tissue with its sharp probing tongue and hooked teeth. Secretions in the lamprey's mouth prevent the victim's blood from clotting and the lamprey sucks the blood from the fish. Victims typically die due to excessive blood loss or infection. The sea lamprey has

played a significant role in the decline of Lake Superior lake trout, a key predator fish, which has allowed other invasive fish species, such as the alewife, to explode in population. Control efforts to mitigate the impacts of lamprey have been used, but it is still present in the Great Lakes.



Sea lamprey attached to a fish (A; U.S. Fish and Wildlife Service) and mouth (B; Angela Yu)

Occurrence Probability and County Vulnerability

The probability of future occurrence for invasive species for Houghton County is high and will rise due to the continual transport of goods and expanding global trade. This has created opportunities for many organisms to be transported to and establish themselves in new countries and regions. There are several invasive species that have yet to be found in Houghton County or surrounding area, but once established, they are hard to eradicate because most people will not notice their presence until the damage is already done.

The entire population is vulnerable to invasive species because the hazard primarily impacts the environment. The destruction that invasive species have on woodlands and water features ultimately impacts humans by diminishing the positive features that nature offers and diminishing our food supply. A widespread insect infestation, such as from the Emerald ash borer, can create serious public safety threats due to dead and dying trees being fire prone (due to their dry, brittle nature) or to partial/total collapse due to high winds or ice/snow accumulation. The falling trees or limbs can bring down power lines, cause damage to public and private structures, and cause injuries or death. Transportation infrastructure is also vulnerable to damage as tree debris can fall onto roadways and trails, blocking commuters, trail users, and emergency response vehicles.

Geological Hazards

The following outline summarizes the significant geological hazards covered in this section:

1. Earthquakes
2. Subsidence (Ground Collapse)

Although some states recognize "landslides" as an additional hazard, Michigan's geology and history tends to make it more prone to land subsidence instead. Michigan's two main vulnerabilities to ground movement are therefore identified in the sections on earthquakes and subsidence hazards.

Earthquakes

Hazard Description

Earthquakes range in intensity from slight tremors to great shocks. They may last from a few seconds to several minutes or come as a series of tremors over a period of several days. Earthquakes usually occur without warning; however, scientists cannot yet predict exactly when or where an event will occur. Earthquakes tend to strike repeatedly along faults, which are formed where tectonic forces in the Earth's crust cause the movement of rock bodies against each other. Risk maps have been produced which show areas where an earthquake is more likely to occur.

Most areas of the country are subject to earthquakes, and they occur thousands of times a year. Most earthquakes are minor tremors and result in little or no loss of life, property, or essential services. However, earthquakes are dangerous because they can cause severe and sudden loss and devastation without warning. Deaths and injuries are caused indirectly through the collapse of structures. Earthquakes are measured by their magnitude (amount of energy released at the epicenter) and intensity (measure of damage done at one location; essentially the same as "severity" as classified throughout this plan). The Richter Magnitude Scale is commonly used to determine earthquake magnitude, and the Modified Mercalli Intensity Scale is used for intensity. A 5.0 on the Richter Scale is a moderate event, while an 8.0 is a catastrophic event. The Mercalli Intensity Scale describes 12 increasing levels from imperceptible to catastrophic.

Michigan is not located in an area subject to major earthquake activities. Although there are faults in the bedrock of Michigan, they are now considered relatively stable. Earthquakes risks in Michigan are generally low, which means structures or utilities are not necessarily built to withstand even small seismic events. Due to low risk, Michigan may be more vulnerable to an earthquake because of poor preparation.

Historical Occurrence

No severely destructive earthquake has ever been documented in Michigan. However, several mildly damaging earthquakes have been felt since the late 1700s. Earthquake tremors have been felt in the Michigan Territory, with the earliest recorded in 1811. Up to nine tremors from the

New Madrid Seismic Zone, which runs from Cairo, Illinois through New Madrid, Missouri to Marked Tree, Arkansas, were reportedly felt in Detroit. Since then, there has been only questionable activity in the Upper Peninsula, occurring in the Keweenaw Peninsula in 1905, 1906, and 1908. While there were explosions and ground shaking felt as far away as Marquette, it is believed to have been from pillars collapsing in local mines.

Occurrence Probability and County Vulnerability

There is a very low – nearly zero – probability of an earthquake occurring anywhere in Houghton County. However, because of the Keweenaw Fault, which runs up the spine of the peninsula and past minor incidents resulting from mining, the possibility of an earthquake cannot be completely ruled out. Due to the low probability of an earthquake, no critical facilities nor municipalities are considered vulnerable from the impacts of an earthquake.

Subsidence (Ground Collapse)

Hazard Description

Subsidence is depressions, cracks, and sinkholes in the ground surface that can threaten people and property. When there is a collapse or lowering of a land surface, it can be caused by a variety of natural or human-induced activities. Natural subsidence occurs when the ground collapses into underground cavities due to the dissolution of limestone or other soluble materials, such as salt and gypsum, by groundwater. Overtime, the dissolution of rock into the groundwater can create a void that may be subject to sudden and catastrophic collapse, causing a sinkhole. Human-induced subsidence is caused mainly by groundwater withdrawal, drainage of organic soils, and underground mining. In the U.S., these activities have caused more than 17,000 square miles of surface subsidence, with groundwater withdrawal as the primary culprit.

In Houghton County, the greatest risk of subsidence is associated with underground mining. Mine subsidence is a geologic hazard that can occur with little or no warning. It occurs when the ground surface collapses into underground mine areas. Strain from geological movements, additional surface loading, and vibrations from truck traffic and other industrial machinery can cause the ground above and around old mines to sink and collapse. Industrial or residential developments that are near or above active or abandoned mines are threatened by subsidence due to their proximity to underground cavities. Mine subsidence can cause damage to buildings, disrupt underground utilities, and be a potential threat to human life.

The legacy of underground mining can be felt throughout the state, especially in the Upper Peninsula. Many of the underground mining areas, whether active or abandoned, are vulnerable to subsidence in some form. Unfortunately, records of abandoned mines are unreliable and sometimes non-existent; it is often difficult to determine exactly where the mines were located. Many areas throughout the state may have been developed over abandoned mines and may not be aware of it. While underground mining has fueled economic growth in many parts of the state, it has left a legacy or threat of subsidence. Old abandoned mines will eventually begin to

collapse under their own weight or human neglect and oftentimes can swallow up whatever is built upon them.

Historical Occurrence

Michigan has a rich mining heritage and a wide variety of mineral resources, most notable of which are copper ore, iron ore, sand, gravel, coal, salt, oil, and gas. Underground mining has occurred on a significant scale throughout Michigan's history. Michigan's Lake Superior region has been home to significant copper mining operations since the mid-1800s. Local mining activity ended in 1960s, when the last shipment of copper was sent out.

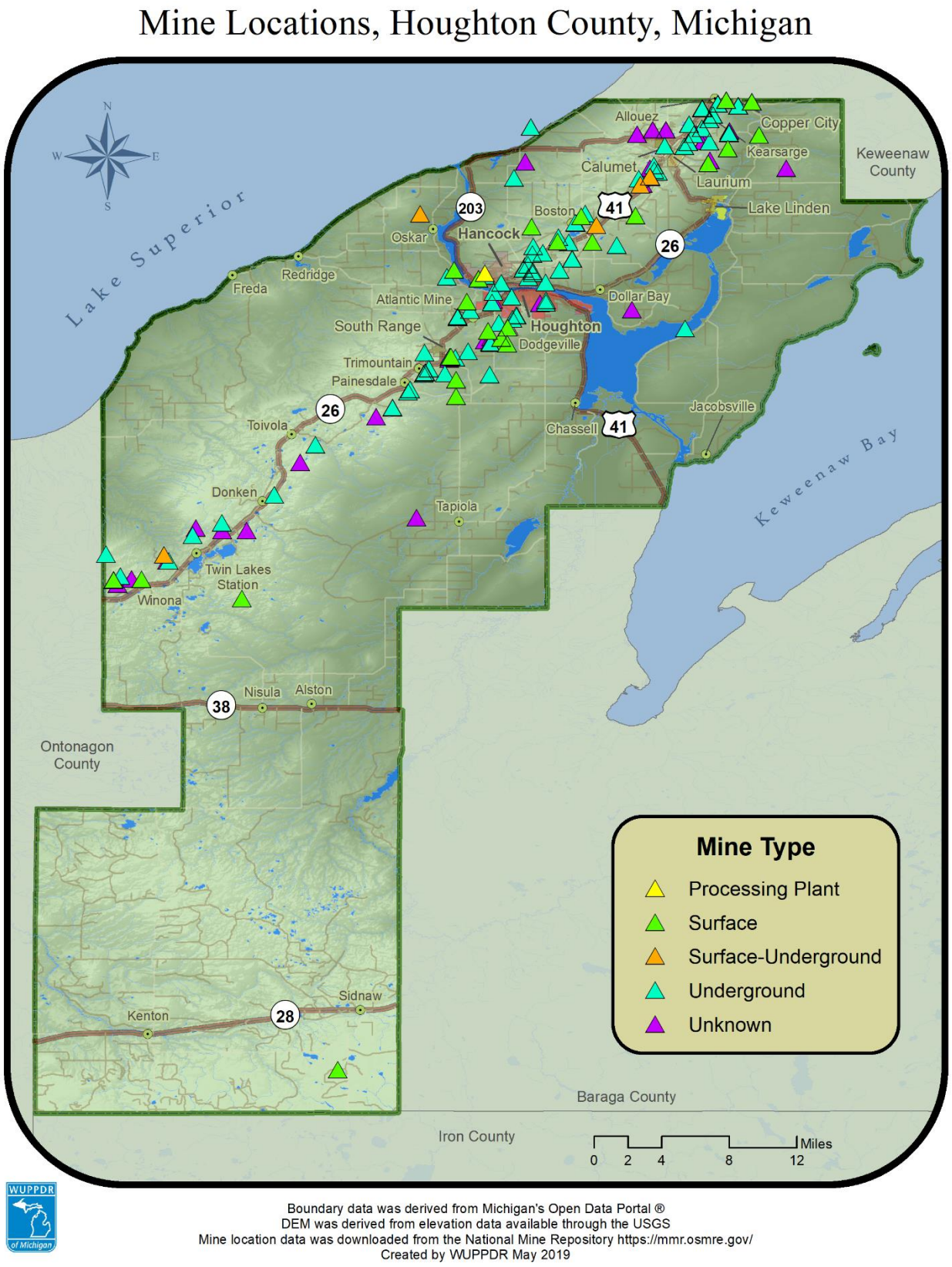
There are over 800 underground mines in Michigan, with more than 2,300 or other openings. Many mines were opened in the 1840s and even though a county mine inspector has inspected many mine sites, some are still unknown and/or unmarked.

There are limited records of the locations of shafts, and the extent of underground mines and their proximity to surface to the surface may be unknown. A Michigan Abandoned Underground Mine Inventory was completed in late 1998[18]. This inventory includes information about the location of shafts and mine extent however copies of the report are limited to the MDNR and County Mine Inspectors. Distribution is limited to prevent the materials from becoming guides to potentially dangerous locations.

Occurrence Probability and County Vulnerability

Probability of a significant subsidence event in Houghton County is low based on known past incidents but is highest in historic mining areas generally clustered around the population centers (**Map 5.6**). The general area most likely to experience and is most vulnerable to subsidence is a swath along the US 41 corridor from Quincy Mine in Quincy Township to Kearsarge location (Calumet Township), where historic mining operations were most prevalent. Thus, most of the townships in Houghton County north of the Portage Lake Lift Bridge are subject to this threat, as are the "Range Towns" clustered along M-26 in Adams, Elm, and Portage Townships in the southern portion of the county. The possibility of unknown occurrences may mean probability is higher than expected. Risks from subsidence appear to have increased, as time passes, and wear and stress continues to accumulate on aging mining structures. Severity ranges from moderate to extreme depending on the site affected.

[18] Michigan Underground Abandoned Mine Inventory. https://researchworks.oclc.org/archivegrid/data/717282963



Map 5.6: Mine Locations by Type in Houghton County

Technological Hazards: Industrial Hazards

The following outlines the significant industrial hazards that are covered in this section:

1. Scrap Tire Fires
2. Structural Fires
3. Hazardous Materials: Fixed Site Incidents
4. Hazardous Materials: Transportation Incidents
5. Petroleum and Natural Gas Incidents

This section covers many related types of events that stem from breakdowns or weaknesses in industry and the built environment. Unlike ordinary fires and wildfire events, scrap tire fires are a special case of industrial hazard as these types of fires involve toxic smoke and chemical residues that have more in common with hazardous material incidents. This is also the case for structural fires, as it considers various types of large fires that occur among important buildings or structures. This hazard analysis focuses on larger-scale fires that have greater potential to affect an entire community, either through a fire's magnitude or through the vital nature of the facilities or resources that it affects.

The other hazards listed, specifically dealing with hazardous materials, cover a wide array of extremely hazardous substances across diverse situations that typically involve industrial or warehousing operations. Fixed site incidents include a consideration of fire-related industrial accidents and explosions, even if these did not involve a hazardous substance. The emphasis is on events of a relatively large magnitude, particularly those that resulted in a community states of emergency, evacuations, impairment or loss of economically significant or critical facilities, or multiple causalities.

Overlap with Other Sections of Hazard Analysis

Various types of structural, scrap tire, and industrial fires may be caused by other large-scale disaster events, such as lightning strikes which cause direct ignition of structure fires and the destruction caused by tornadoes could also lead to a fire. Additionally, wildfires have a clear potential to ignite structures and scrap tire piles. A structural fire involving a critical facility has the potential to cause infrastructure failures, energy emergencies, flooding, wildfires, dam failures, and transportation accidents.

Scrap Tire Fire

Hazard Description

A scrap tire fire is a large uncontrollable fire that burns scrap tires being stored for recycling or reuse. Scrap tire fires are dangerous because they can require significant resources to control and extinguish, often beyond the capability of local fire departments. Furthermore, the extreme heat from the fire can convert a standard automobile tire into about two gallons of oily residue. This residue can leach into soil or runoff into surrounding waterways, creating an environmental

hazard. Scrap tire fires may also require temporary evacuation of some residences and businesses and even close roadways.

Michigan generates approximately 10 million scrap tires each year. Whole tires are banned from disposal in Michigan landfills due to their associated problems. Stockpiled tires can be breeding grounds for mosquitoes and can be homes to snakes and other small mammals. Although responsible means of tire storage and disposal have become more common, tire dumps of the last 40 years still present environmental and safety hazards.

Historical Occurrence

There are no licensed scrap tire facilities in Houghton County and no record of historical fires related to scrap tires. However, there are two registered non-compliant sites: Keweenaw Scrap Metal facilities in Franklin Township and Adams Township. The Adams Township site emerged as a prospective company collecting scrap tires with the intention of recycling them into other products. When this operation failed to materialize, the tires remained onsite.

Occurrence Probability and County Vulnerability

There have been no known scrap fire tire incidents in Houghton County. An additional but unknown risk exists due to the possibility of unknown and unlicensed storage areas. Occurrence Probability and County Vulnerability is low due to heavy regulation of scrap tire collection sites. However, the severity of the possible event is high as a small mistake on either a registered or unregistered site can spark a severe fire – particularly where regulation is nonexistent. Because of the low Occurrence Probability and County Vulnerability, the associated vulnerability is also low. Additionally, the locations of the non-compliant sites are not near critical facilities.

Structural Fires

Hazard Description

In terms of average annual loss of life and property, structure fires are by far the most common and significant hazard facing communities in Michigan and across the country. Structural fires cause more property damage and loss of life than all types of natural disasters combined. These fires include any fire in or on a building or other structure, even if the structure itself was not damaged. Direct property losses due to fire exceed $9 billion per year nationwide and much of that figure is the result of structural fires. In 2017, there were 13,523 structure fires statewide resulting in over $415 million in losses and 104 deaths. Most deaths are due to structural fires in homes. In Michigan, residential fires account for 72.4% of all structural fires and cause nearly 82% of fire fatalities.

Structural fires can cause displacement and homelessness, in addition to serious injuries, death, and economic losses. Fire departments typically handle the small-scale structural fires that only impact a single home or two on their own or with assistance from surrounding departments. Therefore, emergency management authorities are primarily focused on disaster level events involving multiple or major structures such as hotels, college residence halls, urban area fires,

and major employers and community facilities (e.g., schools and hospitals). Structural fires occur more frequently than other Michigan hazards and often cause more deaths, injuries, and property damage.

Historical Occurrence

Michigan Tech and Finlandia University present additional challenges. Michigan Tech has three dormitories which houses a total of 2,060 students, the Daniell Heights Apartments which has 343 apartments, and Hillside Place Apartments that house 224 students. Finlandia has one dormitory that has a capacity of 182 students. While past fire incidents at these schools have been minor, the potential for disaster remains, especially considering the large population that would require evacuation and long-term sheltering in the event of a large-scale fire.

A fire in a burn barrel is blamed for a multiple structure fire on June 11, 2019 in Portage Township. (Photo: Keweenaw Report[19])

Students live not only on campus but in congregate housing facilities throughout Houghton, Hancock and other nearby communities. Many students live in large, older homes. An early 2000s fire resulting in the tragic death of one Michigan Tech student at the Phi Kappa Theta Fraternity House in Houghton underscored the importance of ensuring that these homes meet current fire codes and that evacuation procedures have been established for the upper levels of these homes.

[19] Fire destroyed barn & log home. (2019, June 12) *Keweenaw Report*. www.keweenawreport.com/news/local-news/fire-destroys-barn-log-home/

In addition to student housing, several other multi-unit housing complexes in the urban areas of the County pose higher risk. Recently, on August 17, 2012, a fire occurred at the Heritage Manor senior housing complex in Houghton that required evacuation of the residents followed by long-term repairs and reconstruction of the facility, mainly due to water damage.[20] The fire was believed to have started in the kitchen area of a unit on the top floor. Firefighting was exacerbated by lack of a sprinkler system. Luckily no injuries or deaths occurred, and the emergency response system worked as intended. The building has since been reconstructed and incorporates greater fire security including sprinklers.

Rural areas face a similar high risk of structure fires but for different reasons. In Elm River Township, for example, limited fire response resources are nearby, but police and ambulance response times typically exceed 30 minutes. This distance of these support services and more extensive firefighting capability (including modernized equipment with appropriate storage) exacerbates the severe nature of rural structure fires. It is common for multiple fire departments to be needed for a single structure fire in order to have enough personnel, equipment, and water supply trucks. Most of the county does not have municipal water systems and therefore no fire hydrants.

Many structure fires occurring along the Portage Waterway are complicated by a lack of water based firefighting equipment, especially in urban areas where access is blocked by buildings on either side of the burning structure. There have been many cases where access to the water would have made firefighting not only more effective but also safer for firefighters and could potentially have saved a structure.

Structural fires are of special concern in Houghton County because many of the buildings were built in the early 1900s or before. Many of these older homes, as well as numerous camps and cabins in the woods, are heated by wood-burning stoves or have old wiring, placing them at additional risk. Homes also fall vacant and become dilapidated over time, decreasing maintenance and monitoring and increasing fire risk, which becomes an even greater problem with absentee property ownership.

Occurrence Probability and County Vulnerability

The probability of a structure fire is very high with potentially extreme severity throughout the County. Severity is highest in the cities and villages with large housing complexes. The County has multiple fire departments with mutual aid agreements in place to respond to structural fires. Education and operational fire detectors can often mitigate the loss from this type of hazard. Frequency of fires is 94 per year based on 2008 occurrences. Property loss in 2008 was over $1.6 million.

Due to an older housing stock, compact development in downtown areas, and remote development, Houghton County is vulnerable to fire. Certain zoning ordinances can help reduce vulnerability to fires by improving safety and reduce potential losses from fires. Examples

[20] Fire at Senior Center in Houghton County. (2012, August 17). *ABC10*. https://abc10up.com/2012/08/17/fire-at-senior-center-in-houghton-county/

include property setbacks and road widths to allow easy emergency vehicle access. Vulnerability to structural fires is high for low-density rural areas due to long travel or response times by responders. Additionally, rural fire departments find it difficult to recruit and sustain volunteer firefighters as the population ages. Also required training has greatly increased which has made recruitment and retention of firefighters more difficult.

Hazardous Materials: Fixed Site Incident

Hazard Description

As new technologies have developed, hazardous materials are present in quantities of concern in business and industry, agriculture, universities, hospitals, utilities, and other facilities. Hazardous materials, if released, pose a potential risk to life, health, property, or the environment due to their chemical, physical, or biological nature. Examples of hazardous materials include corrosives, explosives, flammable materials, radioactive materials, poisons, oxidizers, and dangerous gases.

Hazardous materials are highly regulated by federal and state agencies to reduce the risk to the public and environment. Despite precautions to ensure careful handling during the manufacture, transport, storage, use, and disposal of these materials, accidental releases do occur. Areas at highest risk are within a one to five-mile radius of identified hazardous material sites.

Historical Occurrences

There are only a few facilities within Houghton County with supplies of Extremely Hazardous Substances that require reporting under the Superfund Amendments and Reauthorization Act (SARA) Title III (**Map 5.7**). Title III identifies what steps facilities, the State, and local communities must take to protect the public from hazardous materials accidents. Two facilities within Houghton County are required to report under Title III: Warm Rain and Koppers.

There are various hazardous materials stored in small quantities used for transportation, manufacturing, and sale throughout the County. Some of these materials include diesel, propane, gasoline, and batteries.

Over five million tons of native copper was extracted from the Keweenaw Peninsula between 1868-1968, and more than half was processed in Lake Linden. During this time, the village was the site of the largest copper milling operation in North America with large-volume stamping mills. At the eight mills, copper was extracted by crushing or “stamping” the rock into smaller pieces, grinding the pieces, and driving them through successively smaller meshes. The crushed rock particles, called “tailings” were then discarded along with mill processing water. About 200 million metric tons of tailings (also called stamp sands) were dumped into Torch Lake, filling about 50% of the lake’s volume[21]. Wastes were also released into the atmosphere, the lake’s

[21] Urban, N.R. et al. (2018). “Integrated Assessment of Torch Lake Area of Concern: Summary”, Michigan Sea Grant: Michigan Technological University, Houghton, MI. www.michiganseagrant.org/wp-content/uploads/2019/02/Urban-MacLennan-Perlinger-2018-Torch-Lake-SeaGrant-FinalReport.pdf

tributaries, and on to the land around the lake. The Environmental Protection Agency (EPA) estimates contaminated sediments to be 70 feet thick in some areas, and surface sediments contain up to 2,000 parts per million (ppm) of copper[22]. These sediments became the object of reclamation from 1910s-1950s, adding another layer of processing to the original stamp sands. The tailings were dredged, re-ground, and then treated in leaching and flotation units placed in Lake Linden, Tamarack City, and Mason. The processing used chemicals including ammonia and xanthates causing more waste to form as a metal rich sludge, which was then dumped back into Torch Lake.

After copper facilities were shut down in 1970, pollution concerns surfaced a few years later when residents noticed the presence of tumors on fish. Researchers with Michigan Tech and the MDNR investigated and determined that the evidence pointed to the mining deposits. In the 1980s the EPA designated Torch Lake and surrounding sites as an Area of Concern (AOC) and listed them on the National Priorities List (also known as Superfund). Remediation efforts have mainly focused on the mine tailings in the lake but not on removing the sources of polychlorinated biphenyls (PCBs) or mercury.

Pictured above is the Quincy Dredge #2, located in Torch Lake just south of Hubbell and across the street from the stamp mill. Photograph by Daniel Woodrum, May 2018

In 1972, an estimated 27,000 gallons of cupric ammonium carbonate were released into the north end of the lake from storage vats at the Lake Linden Leaching Plant. Barrels have been found at several sites along the shoreline of the lake. The only active industry on the Torch Lake shoreline

[22] "Superfund Site: Torch Lake Houghton County, MI." EPA. https://cumulis.epa.gov/supercpad/SiteProfiles/index.cfm?fuseaction=second.redevelop&id=0503034

is the Koppers Inc, which produces copper carbonate from various raw materials that contain copper.

During the early 1980s, Peninsula Copper Industries released processing water containing 2,400 times the local sewage authority's allowable limits for copper and 100 times the limit for ammonia, into the Tamarack lagoon system. As a result, Torch Lake has a complex mixture of pollutants, human, and ecosystem health threats[23]. Populations vulnerable to the legacy pollution and dumping include about 4,000 people living within one mile of Torch Lake.

A former power plant site in the Torch Lake Township, south of the Village of Lake Linden, is also being remediated by the EPA due to presence of a variety of chemicals. These sites suffer from long-term contamination but do not present acute current threats. EPA is also investigating underground storage tanks in the Village of Lake Linden. These tanks can leak over time, with released products presenting health threats.

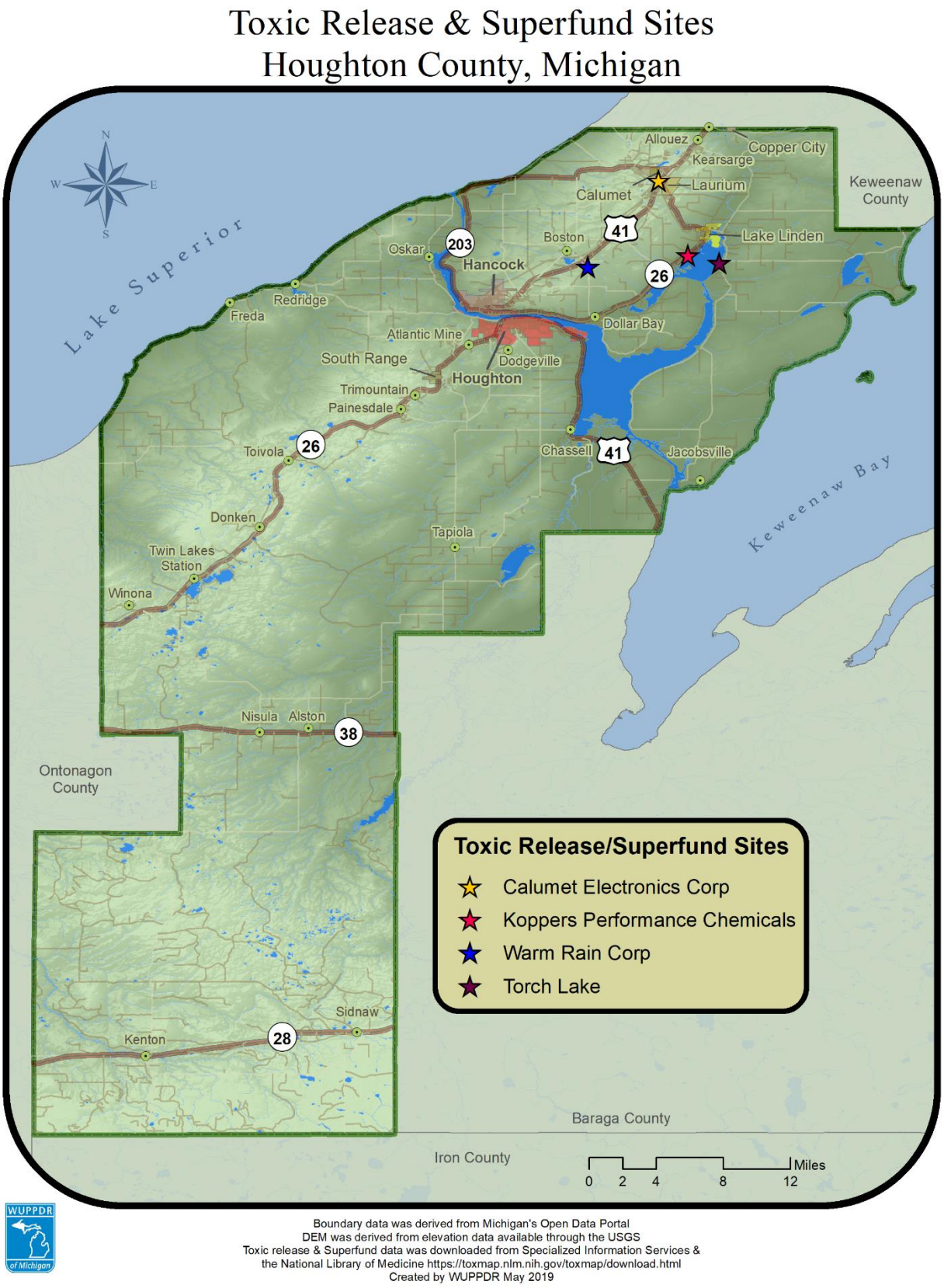
On July 2, 2012, near a private residence on the Portage Canal in Chassell Township, two flasks of mercury totaling up to one-half liter were found in the water about 30 feet away from shore. One flask was missing a seal, resulting in mercury being spilled on the lakebed. Subsequently EGLE, EPA, and Western Upper Peninsula Health Department undertook inspection, testing, and remediation of the site. A beach in the Village of Lake Linden was also closed within the past few years due to the EPA's discovery of mercury and lead in test bore drillings done in relation to the adjacent Superfund site. The substances were likely to have been dumped in an isolated incident in the past. The site was subsequently cleaned up to eliminate significant public health threat and environmental impact. However, the incident illustrates the potential for hazard materials incidents in situations not normally associated with fixed sites.

On September 30, 2019, the Western Upper Peninsula Health Department issued a health warning after test results of high levels of heavy metals including polychlorinated biphenyls (PCBs), lead and mercury were reported at the Julio scrapyards in Ripley[24]. Asbestos was also found in the soil. In 2018 the surrounding area had been sampled as part of the Torch Lake Abandoned Mining Wastes project. The area is of concern due to its proximity to state ORV trail activity which may disturb the asbestos in the soil.

Occurrence Probability and County Vulnerability

Probability of a new fixed-sited incident is very low, but severity, if an event were to occur, can range from moderate to high. Probability of exposure to legacy pollution from historic mining operations is high in certain areas with variable extent especially those surrounding Torch Lake. Municipalities that are vulnerable to a fixed site incident include Franklin, Schoolcraft, and Torch Lake Townships and the Village of Calumet (where known toxic release and superfund sites are located).

[23] Urban, N.R. et al. (2018)
[24] Neese, G. (2019, October 2). "WUPHD issues health warning for Julio scrap yards." *Daily Mining Gazette*. www.mininggazette.com/news/2019/10/wuphd-issues-health-warning-for-julio-scrap-yards/



Map 5.7: Superfund Site and SARA Title III Facilities in Houghton County

Hazardous Materials: Transportation Accident

Hazard Description

Due to the extensive use of chemicals in society, all modes of transportation – highway, rail, air, marine, and pipeline – are carrying thousands of hazardous materials shipments daily through local communities. A transportation accident involving any one of those hazardous material shipments could cause a local emergency affecting many people. Areas at greatest risk are those within one to five miles from major transportation routes.

Michigan has had numerous hazardous material transportation accidents that affected the immediate vicinity of an accident site or a small portion of the surrounding community. Since 2010, the U.S. Department of Transportation recorded 3,515 hazardous material incidents in Michigan.[25] They are effectively dealt with by local and state emergency responders and hazardous material response teams. Large-scale or serious hazardous material transportation incidents that involve a widespread release of harmful material can adversely impact the life safety and/or health and well-being of those in the area surrounding the accident site. Statistics show that most hazardous material transportation incidents are the result of an accident or other human error. Rarely are they caused simply by mechanical failure.

Michigan has had relatively few large-scale, serious hazardous material transportation incidents, but has had numerous small-scale material transportation incidents that required a response by local fire department and hazardous material teams, and many events also required evacuations and other protective actions.

Historical Occurrences

Highway M-28 through Houghton County is a major transportation route for trucks traveling to and from Canada. The types and amounts of hazardous materials transported on trucks traveling this route are often unknown. While there are State and Federal restrictions on the transport of hazardous materials, this information is not required to be passed on to the local units of government potentially affected by a transportation accident. However, the county Emergency Manager occasionally receives notices for passage of hazardous materials trucks passing through the county. Houghton

On February 3, 2018, a tanker truck overturned and spilled over 4,000 gallons of fuel near Chassell. Pictured above is a photograph of the clean-up process, led by the EPA.

[25] Incident Statistics. Pipeline and Hazardous Materials Safety Administration, U.S. Department of Transportation. www.phmsa.dot.gov/hazmat-program-management-data-and-statistics/data-operations/incident-statistics

County has many miles of shoreline susceptible to shipping accidents on Lake Superior and along the Portage Waterway.

In October 2003, a Great Lakes freighter spilled fuel oil during an internal fuel transfer about 25 miles west of Eagle Harbor. About 1,300 gallons were lost with about 800 gallons of dime-sized tar balls washing up on shore about four miles south of the Portage Waterway north entry.

On February 3, 2018 a tanker truck on US 41 at the Sturgeon River Bridge was involved in a multi-vehicle accident causing the truck to overturn. One of the people in the car accident suffered a fatality. The tanker was carrying clear diesel fuel and gasoline that leaked onto the road surface and migrated onto the frozen surface of the Sturgeon River. The release volume was estimated at 4,000 gallons of gasoline and 400 gallons of diesel.

Occurrence Probability and County Vulnerability

In Houghton County, the probability of a hazardous materials transportation accident is low based on history, but there is a considerable risk. This is due to the high volume of trucking traffic passing through the county and proximity to major shipping lanes. Areas most vulnerable and have a higher probability of experiencing an accident are corridors near major transportation routes, including US 41, M-26, and M-38, and the immediate shorelines of Lake Superior and the Portage Waterway. Damage estimates for the previous events are unavailable, but potential severity of an event could range from low to extreme.

Petroleum and Natural Gas Incidents

Hazard Description

Often overlooked as a hazard because most petroleum and natural gas infrastructure in the state is underground, these pipelines pose a real threat to many Michigan communities. Petroleum and natural gas pipelines can leak or fracture, causing property damage, environmental contamination, injuries, and even loss of life. Most pipeline accidents that occur in Michigan are caused by third party damage to pipelines, often due to construction or some other activity that involves trenching or digging operations. Many structures are located right next to pipelines and thus may be at risk. Pipelines can also cross through rivers, streams, and wetlands, thus posing the possibility of extensive environmental damage in the event of a major failure.

Michigan is both a major consumer and producer of natural gas and petroleum products. Michigan is the largest residential liquefied petroleum gas market in the nation due mostly to high residential and commercial propane consumption. The state has a single petroleum refinery but a large network of product pipelines. More than 78% of the overall home heating market uses natural gas as its primary fuel. Michigan also has the greatest underground natural gas storage capacity in the nation and supplies natural gas to neighboring states during high-demand winter months. The state has a highly developed and extensive gas and petroleum network, representing every sector of the two industries – from wells and production facilities, to cross-county

transmission pipelines that bring the products to market, storage facilities, and finally to local distribution systems.

While petroleum and natural gas industries have historically had a satisfactory safety record, and pipelines are the safest form of transportation for these products, the threat of fires, explosions, ruptures, and spills still exists. In addition to these hazards, there is a danger of hydrogen sulfide (H_2S) release. Hydrogen sulfide is not only an extremely poisonous gas but is also explosive when mixed with air at temperatures of 500 degrees Fahrenheit or above.

Northern Natural Gas has a large natural gas pipeline that delivers natural gas to markets in Houghton County and surrounding areas in conjunction with SEMCO Energy (**Map 5.8**). The pipeline runs in two locations in Houghton County: west to east across Duncan Township and north from Baraga County to Calumet. There are several propane storage facilities in Houghton County including Peninsula Gas in Calumet, U.P. Propane in Chassell, and Ferrellgas in Houghton.

Historical Occurrence

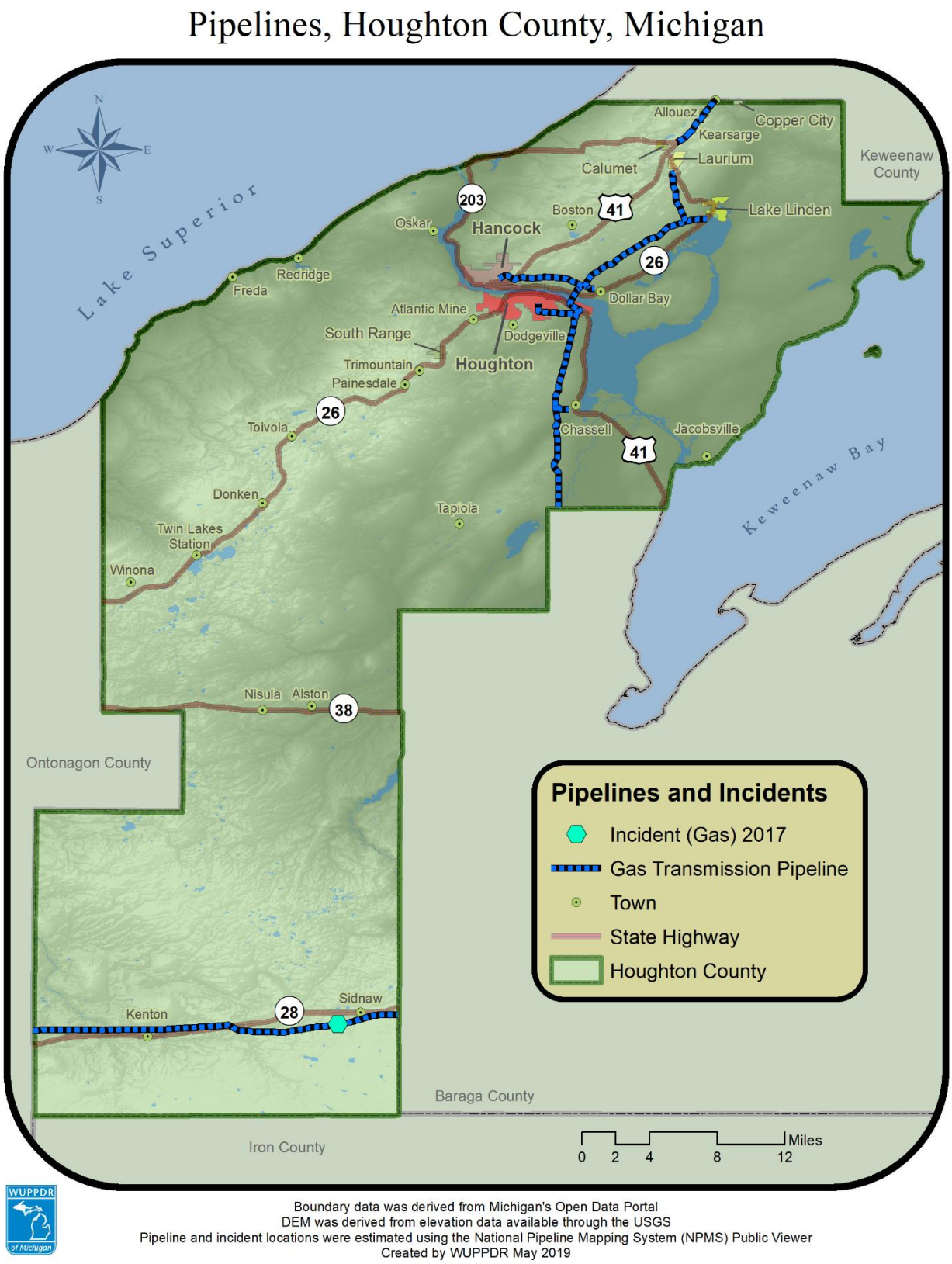
There is risk of a natural gas pipeline incident in Houghton County due to aging transmission lines, impact from neighboring construction, or sabotage. However, no historical occurrences have been recorded. Nearby in Baraga County, the Village of L'Anse has had a natural gas incident on December 23, 2016. A driver fell asleep, left the roadway, and impacted a natural gas gateway station, disrupting natural gas service in the village for four days. Incidents like this (loss of natural gas service) would have a larger impact on the community than the initial fire and resulting explosion.

Natural gas transmission lines present the greatest risk due to their remoteness. Though it is not uncommon for minor pipeline leaks to occur, the probability of a significant incident is low, and the same is true for petroleum events. A single-tank petroleum explosion could happen on any site where one is located, but probability of either type of fuel event is otherwise very low in rural areas away from natural gas lines. Severity in most areas would be low to moderate. Consequences of a natural gas pipeline leak are mostly ecological or environmental, as pipelines are located underground and generally in sparsely developed areas, but evacuations are necessary for residents in the immediate surroundings due to the possibility of inhalation or an explosion.

Occurrence Probability and County Vulnerability

Probability of a propane incident is low throughout though possible where storage facilities exist in Calumet Charter and Chassell Townships and in the City of Houghton; severity would generally be expected to be low to moderate. Natural gas gateway station disruptions and natural gas outages would have a larger scale impact and have a low to medium probability of occurrence. However, due to the proximity to roadways and general lack of crash barriers near natural gas gateway stations, if an incident were to occur like the 2016 event, the severity of an event would range from moderate to severe on the surrounding community. Because of the pipeline that traverses Houghton County, Calumet, Chassell, Portage, Franklin, Osceola, and Schoolcraft Townships, along with the Cities of Houghton and Hancock, and the Village of

Laurium and Calumet, are vulnerable to a natural gas incident. This impacts a wide variety of critical facilities including, but not limited to, schools, hospitals, and emergency response facilities. For the public, it is most important to be aware of the signs that may indicate a gas leak in or near their home and to use the MISS DIG phone service whenever any sort of excavation, construction, or digging activities are being considered that may disturb the ground. The MISS DIG service can advise about whether a location requires special treatment due to the presence of any underground infrastructure, including pipelines. By doing so, this can prevent and lower the vulnerable of municipalities and facilities to pipeline incidents.



Map 5.8: Pipeline Location and Incident in Houghton County

Infrastructure Hazards

The following list summarizes the broad types of infrastructure problems covered in this section:

1. Infrastructure Failure and Secondary Technological Hazards
2. Transportation Accidents

Although various industrial hazards involve certain types of infrastructure (e.g., pipelines) and their breakdown, the section titled infrastructure failures and secondary technological hazards focuses on the interruptions in critical life-sustaining infrastructure, such as electricity and water supplies. For example, an electrical black out affects all sectors of a community including communications, commerce, government, education, health care, public safety, emergency services, food and water supply, and sanitation.

While technical systems become more efficient, they sometimes become more vulnerable to failures. Many systems operate close to their full capacity for maximum efficiency during normal (everyday) operations. When something in the operating environment changes dramatically, as in the case of a disaster or other disruption, the system has issues operating outside relatively narrow parameters. The system then becomes more vulnerable to failure.

The section on transportation accidents involves any of the major modes of transportation systems within the county.

Infrastructure Failures and Secondary Technological Hazards

Hazard Description

Michigan's citizens are dependent on public and private utility infrastructure to provide essential services, such as electric power, fuel for heating, water, sewage disposal and treatment, storm water drainage, communications, and transportation. When one or more of these utility systems fail due to disaster or other causes, it can have devastating consequences, even over a short period of time. When infrastructure failures occur due to a natural hazard event, this is considered a secondary or cascading technological hazard. For example, during power outages, people can die in their homes during periods of extreme heat or cold if immediate mitigation actions are not taken. When water or wastewater treatment systems in a community are inoperable, serious public health issues can arise and actions must be taken immediately to prevent outbreaks of diseases. If storm water drainage systems fail, serious flooding can occur impacting homes, businesses, and roads. The impact on the transportation system would have a larger overall impact to the county as a loss of roads has the secondary impact of disrupting emergency response. The loss of natural gas service can quickly impact large areas. While alternatives for power generation or water supply can be found, there are very few alternatives for loss of natural gas service – especially for large facilities. If a loss of natural gas occurs in conjunction with loss of power, the impact on the community in the winter could be devastating.

All these situations can lead to disastrous public health and safety consequences if immediate actions are not taken. It is the most vulnerable members of society (i.e., the elderly, children, impoverished individuals, and people in poor health) who are most heavily impacted by an infrastructure failure. If the failure involves one or more systems, whole communities and possibly entire regions can be severely impacted.

The risk of infrastructure failure grows each year, as physical and technological infrastructure becomes more complex and the interdependency between various facets of infrastructure (e.g., pipelines, telecommunications lines, and roads) become more intertwined. Additionally, increased usage aging infrastructure requires an increasing level of maintenance at a time when funding is often reduced. As a result, large-scale disruptions in various components of infrastructure are likely. Major disruptions could lead to widespread economic losses, reduce security, and lower quality of life.

Most of the hazards considered in this plan may cause an infrastructure failure. Many types of infrastructure failures in the county are critical due to the remote communities and the harsh seasonal climate. If the county were to lose services, such as power, natural gas, water treatment, or phone/broadband connectivity, significant impacts on everyday life of the citizens would result. The most common types of infrastructure failure are water treatment failure and power outages, which are minor interruptions of everyday life, but if outages are prolonged, it has the potential to cause severe problems. While power outages are usually of a short duration—up to a few hours—the implications of an extended outage could affect the health and safety of the community.

Historical Occurrences

The Upper Peninsula Power Company (UPPCO) and REA Co-Op provide electric service to northern Houghton County, while We Energy provides power to the southern portion of the county. Because of this, any loss of to the grid for the area can affect the entire region. Due to the rural nature of the county, trees can fall on power lines in remote locations causing a delay in restoration of service. Trimming trees adjacent to power lines is one way to decrease this risk and is regularly undertaken. Water and wastewater systems, and phone service can also be affected by failure due to aging facilities. Creating redundant systems and outfitting them with generators lessens the impact of such failure. Frequency of power outages is estimated at two per year based on previous incidents.

Failure of the Portage Lift Bridge is the single largest infrastructure threat to the county. The longest outage was on August 4, 2010 where the bridge was stuck in the fully raised position for four hours due to a mechanical failure. While there are mitigation plans in place when the bridge does fail, any failures can still cause a significant impact throughout the area. According to Michigan Department of Transportation (MDOT) 2017 traffic counts, an annual average of 30,581 vehicles per day cross the Portage Lift Bridge[26]. Any incident preventing passage over the bridge would separate people on the north side from the mainland and would leave those on

[26] MDOT 2017 Traffic Counts.
https://mdot.maps.arcgis.com/apps/webappviewer/index.html?id=e48aa2a7804845c4aee71fd7344db54a

the south side without access to medical services (both local hospitals are on the north side of the bridge). A bridge outage could take considerable time to fully resolve depending on the nature of the incident. The impact of the outage would be considerable within all municipalities and townships north of Laird, with impact increasing as proximity to the bridge increases. A bridge failure or malfunction will result in substantial secondary impacts beyond transportation (e.g., economic, emergency response, public safety, food and fuel supplies, etc.).

Occurrence Probability and County Vulnerability

Probability of infrastructure failure is low to high, based mainly on two or more power outages per year. Numerous factors contribute to the impact from infrastructure failure, including types of services affected, weather conditions, response capabilities, time of year, and time of day. Occurrence Probability and County Vulnerability is similar countywide, but the severity from failures may be more pronounced in urban areas, specifically near the Portage Lift Bridge, where communities are more reliant on commuting and systems served by utilities. Necessary contingency planning is required and established through a group of emergency responders and municipal officials that continue to meet regularly.

All municipalities and critical facilities are vulnerable to infrastructure failures. Loss of electrical power, natural gas, or water treatment can cause an immediate significant threat to life, safety, and public health. Some facilities in Houghton County have partial or complete backup power sources (e.g. standby generators), such as hospitals, Michigan Technological University, and some fire/police stations.

Transportation Accidents

Hazard Description

Transportation accidents can occur on land, air, or water. The one commonality all transportation accidents share is the potential for mass casualties. Although automobile crashes tragically kill many hundreds of Michigan residents each year, this analysis focuses on the types of accidents that are large enough in scale to potentially cause an emergency of disaster-level situation. A major land transportation accident in Michigan has the potential to create a local emergency or to seriously strain or overwhelm local response and medical services. Accidents can involve a commercial intercity or tour passenger bus, a local public transit bus, school bus, or multiple passenger cars. Air transportation accidents can result in large numbers of deaths and injuries, and major victim identification and crash scene management problems. Water transportation accidents that can involve marine passenger ferries, may require significant underwater rescue and recovery efforts that few local jurisdictions are equipped to handle. If any of these accidents were to occur in a rural community, an event can easily overwhelm the available resources in these areas.

Michigan has 19 airports with commercial passenger service[27], 82 local bus transit systems serving 89 million passengers, 19 marine passenger ferry services and 3 intercity rail passenger corridors composed of 586 miles of track and serving 22 communities[28]. Houghton County is serviced by an Indian Trails regional passenger bus service, which provides inter- and intrastate transportation. Other transportation services provided in Houghton County include the following: school buses, casino buses, municipal public transit services in Houghton/Hancock, and commercial air passenger services at the Houghton County Memorial Airport (CMX).

Historical Occurrence

While there have been minor transportation accidents within the county, there is no history of a large passenger transportation accident in Houghton County.

Occurrence Probability and County Vulnerability

The probability of a large-scale passenger transportation accident is low and overall low volume of commercial passenger traffic implies that any potential accident would be isolated and small-scaled. However, if an accident were to occur, the severity would be high, particularly in communities that are located along major transportation routes in Houghton County. Still, vulnerability to even a small, isolated event can be considered high since mitigating potential accidents is difficult due to their unpredictability. With a commercial bus transportation stop, the Houghton County Airport, and an influx of tourists throughout the year, the entire county is vulnerable to transportation accidents and it can affect many people. Emergency response plans, awareness of hazardous intersections and roadways, and exercises with responding agencies and medical facilities are ways to mitigate and this type of hazard.

Human-Related Hazards

The following list summarizes the significant human-related hazards covered in this section:

1. Civil Disturbances
2. Public Health Emergencies
3. Sabotage and Terrorism

Although civil disturbances are usually handled at the state or local level, some types of unrest may be related to broader patterns of criminal activities. In the state plan, the hazard now shifts beyond the emphasis on prisons, which had been a part of its earlier planning documents and considers civil disturbance events that are rooted in other human circumstances. The most probable circumstances may involve reaction to other emergency or disaster events, which are poorly handled by responders or governmental agencies. There are few recent historical records of such incidences escalating to the point of a civil disturbance emergency in Michigan.

[27] Commercial Service Airports. Michigan Department of Transportation Aeronautics. www.michigan.gov/aero/0,4533,7-352-79155_79156_79388---,00.html
[28] MDOT Public Transportation. www.michigan.gov/mdot/0,4616,7-151-11056---,00.html

Public health emergencies have taken on new importance recently, with the rise in concern about global pandemic illnesses. Travel is so rapid and widespread that quickly detecting and containing outbreaks of serious, even lethal, contagious diseases has been considered necessary and given higher priority by numerous levels of government and their partnering agencies. Various natural and technological hazards have the potential to cause significant public health concerns. For example, weather hazards, such as extreme temperatures, flooding, and drought, can affect the quality of drinking water in an area and increase the risk of contagious illness and food contamination.

Terrorism is one of the potential causes of widespread threats to public health and safety, as well as certain types of civil disturbance. In many cases, it may not be immediately clear if an incident was motivated by political causes, some other form of protest, criminal enterprises, or personal neurosis. It is recommended that human-related hazards be studied together since terrorism and civil disturbances can lead to public health and safety emergencies and other hazards covered in this plan, such as infrastructure failures, transportation accidents, and hazardous materials incidents.

Civil Disturbances

Hazard Description

Civil disturbances, though rare, typically involve protests, hooliganism, riots, and insurrection. Places that may be subject to or impacted by these types of disturbances include government buildings, military bases, universities, businesses, power plants, and critical service facilities, such as police and fire stations.

Protests, including political protests and labor disputes, usually contain some level of formal organization or shared discontent. They are usually orderly, lawful, and peaceful. However, some may become threatening, disruptive, and even deliberately malicious. When protests become malicious and there is destruction of property, interruption of services, interference with lawful behaviors, use of intimidation or civil rights violations, and threats/actual acts of violence, then it is considered a civil disturbance.

Another kind of civil disturbance is hooliganism, which is relatively unorganized and involves individual or collective acts of deviance inspired by the presence of crowds. Individuals take advantage of situations where there is anonymity and confusion, allowing them to behave in an unlawful or unusually expressive way that is normally considered publicly unacceptable. These individuals may be under the influence of illegal drugs and alcohol and may include criminals and persons with mental illnesses who may either be reacting with extreme hostility to the crowding, noise, and disorder. Common problems include destruction of property, assault and disorderly conduct, and criminal victimization.

Hooliganism and protests that become disorderly may result in riots. Riots may stem from motivations of protest but lack organization. These events tend to involve violent gatherings of

persons whose level of shared values and goals are not alike to allow their collective concerns or efforts to unite in a relatively organized manner.

Lastly, insurrection involves the deliberative collective effort to disrupt or replace the established authority of a government or its representatives by persons within a society or under its authority. A prison uprising may fall into this category but may also be classified as a riot or protest.

Historical Occurrence

There have been no recorded civil disturbance events in Houghton County in recent history. Houghton County is home to several universities and federal, state, and local offices. Historically, there have been large-scale strikes during the mining days, but in recent years public demonstrations have been small-scale peaceful protests.

Occurrence Probability and County Vulnerability

The risk for a civil disturbance exists in Houghton County because of governmental, educational, and other activities in the area. The Houghton County Courthouse, Michigan Technological University, and municipal centers have a greater vulnerability for these kinds of events compared to other critical facilities. The probability of an incident is very low throughout the county but perhaps slightly higher in urban areas like Houghton and Hancock.

Public Health Emergencies

Hazard Description

A public health emergency is the result of widespread and/or severe epidemic, contamination incident, or other situation that presents a danger to or otherwise negatively impacts the general health and well-being of the public. These kinds of emergencies can be a primary event or a secondary one caused by another disaster or emergency such as a flood or hazardous materials incident. Public health emergencies include disease epidemics, food or water contamination, extended periods without adequate water and sewer services, and harmful exposure to chemical, radiological, or biological agents. The greatest emerging public health threat is the intentional release of a radiological, chemical, or biological agent with the potential to adversely impact many people. The common characteristic of most public health emergencies is that they adversely impact, or have the potential to adversely impact, many people. Its potential scope and magnitude can be localized, regional, or statewide. However, with modern travel a highly contagious disease could spawn a national health emergency.

Michigan has had several large-scale public health emergencies in recent history, but nothing that has caused widespread severe injury or death. There have been instances of infrastructure failure (widespread loss of water and sewer service in northern Michigan in 1994) and disease threats (foot-and-mouth disease and West Nile encephalitis virus). No area in Michigan is immune to public health emergencies and areas with high population concentrations are more vulnerable to the threat. Additionally, more vulnerable members of society – elderly, children,

impoverished individuals, and persons in poor health – are at higher risk than the general population.

The Western Upper Peninsula Health Department (WUPHD) works towards promoting community health through control of environmental health hazards and addressing the health needs of vulnerable population groups. The department is responsible for addressing and trying to prevent public health emergencies within Houghton, Baraga, Gogebic, Keweenaw, and Ontonagon counties. The Health Department does this by providing State-mandated public health services, such as restaurant inspections, foodborne illness investigation, sewage and well inspections, beach monitoring, and mercury clean-ups.

Exposure to Hazardous Materials

Exposure to hazardous materials can occur through accident, deliberate action, misuse of a product, or through natural means. Most common risks of exposure to materials are chemical in nature but can also be biological or radiological. Many hazardous materials are used in industry or in households. Household hazardous wastes come from everyday products that are used in the home, garden, or yard. Oil-based paints, antifreeze, household cleaners, and pesticides are a few examples. Household hazardous wastes are corrosive, toxic, flammable, or reactive. When hazardous waste is improperly disposed of, such as in the trash, down the sink, or into a storm drain, it poses a threat to water quality, human health, and wildlife. Electronic waste that is improperly handled can pose human and environmental risk of exposure to lead and mercury. In addition to electronic waste, lead and mercury exposure may be due to legacy use of these heavy metals in household items such as paint, thermometers, dental fillings, and electric switches. Exposure to lead and mercury have long lasting negative health effects, such as memory loss, tremors, neuromuscular changes (e.g., weakness, atrophy), and lack of coordination of movements amongst other symptoms.

A natural exposure to a hazardous material is in the form of radon. Radon is a cancer-causing radioactive gas that moves up through soil and is trapped inside buildings. It cannot be smelled or seen and is the second leading cause of lung cancer in the U.S. Exposure to radon is possible in Houghton County. Testing kits are offered at no cost at the Western U.P. Health Department. If radon is detected above 4 picocuries per liter (pCi/L), follow-up testing and resistance techniques should be installed. Mitigation includes sealing cracks and venting gasses from the home.

Individual Wells

Many Houghton County residents live in rural areas that are not serviced by public sewer and/or water. The contamination of individual wells and the failure of individual septic systems presents the potential for public health emergencies. Coliform bacteria, high nitrates, and arsenic in water wells are common public health risks. Coliform bacteria are associated with animal wastes, sewages, and surface water. Nitrates are a naturally occurring form of nitrogen found in soil and groundwater. High concentrations of nitrates in drinking water can be toxic to infants and young animals. Elevated nitrate concentrations in groundwater and wells are typically associated with excessive fertilizers, sewage disposal systems, farm runoff, municipal wastewater and sludge,

and industrial wastes. Arsenic is also naturally occurring; exposure to high levels of arsenic poses serious health effects because it is a known human carcinogen.

Public water and sewer facilities

Public water and sewer facilities are prone to disruptions such as broken or frozen lines that cause a loss in service, or system pressure loss that requires boil-water advisories due to potential water contamination. Any disruption in service is typically a secondary hazard because of an external triggering event. Extreme cold, subsidence, flooding, lack of maintenance, and sabotage are a few examples of disruptions in water or sewer service. Disruptions are not just an inconvenience to residents. In health care facilities, the loss of water and sewer service can have a significant impact on patient care.

Drug and Substance Abuse Epidemic

As defined by the CDC, an epidemic is "the occurrence of more cases of disease than expected in a given area or among a specific group of people over a particular period of time."[29] While it is not an infectious disease outbreak, deaths due to drug overdoses are now greater than deaths due to car crashes in Michigan.[30] The state has the 14th highest overdose death rate in the country. In 2017, there were 2,686 drug overdose deaths in Michigan and was 12.1% higher than drug overdose deaths in 2016[31]. Deaths due to synthetic opioids, such as fentanyl and tramadol, increased by 48.5% from 2016 to 2017. Most Michigan counties are underequipped to address the needs for people who have an opioid addiction and effects from this drug epidemic. This includes a lack of nearby drug treatment programs, medication-based treatment services, and transportation capability to get people who want help the necessary services they need.

Climate Change Considerations

Climate change has the potential to affect human health by increasing the occurrence of vector-borne diseases such as malaria, Lyme disease, and West Nile virus. Warmer temperatures, shorter/milder winters, and earlier spring seasons can result in an increasingly hospitable environment for carriers of these diseases. Ticks and the bacterium that causes Lyme disease have higher survival rates in warmer, milder winters.

Historical Occurrence

The most likely public health threat in Houghton County is influenza-type illnesses, which is the most common communicable disease, with an average mortality rate of 14.2 per 100,000

[29] Epidemic Disease Occurrence. Center for Disease Control and Prevention. www.cdc.gov/csels/dsepd/ss1978/lesson1/section11.html
[30] Kristen, K. (2019, May 9). "Opioid addiction: Michigan counties struggle to meet the need for treatment." *Michigan News – University of Michigan.* https://news.umich.edu/opioid-addiction-michigan-counties-struggle-to-meet-the-need-for-treatment/
[31] Drug Overdose Deaths in Michigan, 2016-2017. Michigan Department of Health and Human Services. www.michigan.gov/documents/mdhhs/Drug_Overdose_Deaths_MI_2016-2017_649230_7.pdf

Western U.P. residents from 2015-2017[32]. Michigan's average mortality rate is 14.3. However, influenza, which can be widespread, rarely becomes a public health emergency.

There is potential in Houghton County, as in all areas, for a larger disease outbreak as an isolated event or secondary hazard to flooding or another type of incident. U.P. Health System - Portage and Aspirus Keweenaw hospitals each have an infection isolation room and a 24-hour emergency department. However, while awareness and planning have been carefully considered, an epidemic of enough magnitude could significantly overwhelm the facilities that are equipped to deal with this type of emergency. Shortages of supplies, hospital rooms, and medical professionals due to a disease outbreak or pandemic can cause significant harm to the public.

Isolated incidents of hazardous materials contamination may also pose a localized public health threat as exemplified by the 2012 Chassell mercury spill detailed in the Hazardous Materials – Fixed Site section. This incident was determined to have had no significant public health impact. However, sites such as a local manufacturer, could release hazardous substances that may present an airborne public health threat. EPA Superfund and other remediation sites, including those detailed in the Hazardous Materials – Fixed Site section, are being addressed as potential public health contamination threats.

There is no recent history of widespread public health emergencies in Houghton County. Small incidences of flu outbreaks and similar sicknesses do occur, but the extent of the emergencies have been limited. There is potential in Houghton County for infectious disease outbreaks, such as chlamydia, hepatitis C, and Lyme disease (highest number of cases in Dickinson County to the south)[33]. Houghton County has vaccination rates below the state average, which increases the risk of diseases to the population (both vaccinated and not)[34]. The County is also at risk for substance abuse, foodborne illnesses, and water contamination emergencies. The potential for disease outbreaks and contamination may be isolated events or as events secondary to flooding or other incidents. Alcohol abuse is of concern in the Upper Peninsula. In Michigan, the top five counties with the highest binge drinking rates are in the Upper Peninsula[35].

Of increasing threat are opioid and meth-related issues. In the Upper Peninsula there is a high rate of children born with neonatal abstinence syndrome (NAS) because of addiction[36]. In the Upper Peninsula, babies are treated for NAS at a higher rate than anywhere else in Michigan—29 per 1,000 births in 2016. There are no NICU treatment centers in the county to deal with a rising concern of addicts and those seeking treatment. The Upper Peninsula Substance

[32] Michigan Department of Health and Human Services, Community Health Information. www.mdch.state.mi.us/pha/osr/chi/IndexVer2.asp

[33] Upper Peninsula Community Health Needs Assessment 2018. www.wupdhd.org/wp-content/uploads/2018/08/Upper-Peninsula-Community-Health-Needs-Assessment-2018-Second-Edition-1.pdf

[34] Michigan Department of Health and Human Services, County Quarterly Immunization Report Card. (2019, September 30). www.michigan.gov/documents/mdch/Houghton_447449_7.pdf

[35] Tanner, K. (2015, April 2015). "Where is binge drinking the highest?" *Detroit Free Press.* www.freep.com/story/opinion/contributors/raw-data/2015/04/24/binge-drinking-us-county/26332545/

[36] Kovanis, G. (2018, May 3). "The tiniest addicts: How UP babies became part of the opioid epidemic." *Detroit Free Press*. www.freep.com/story/news/local/michigan/2018/05/03/opioid-epidemic-drug-addicted-babies/335398002/

Enforcement Team (UPSET) is a multi-jurisdictional narcotics task force that serves all 15 Upper Peninsula's counties and assists any local or state police in fugitive apprehension. They are the only federally trained and certified Clandestine Lab Team in the Upper Peninsula dealing with methamphetamine response. In 2016, UPSET West was formed to support an increased UPSET team, which targets the Western Upper Peninsula in increased narcotics enforcement. Since 2016, UPSET West detectives have made 48 felony arrests, but are fighting a growing meth supply as heroin supply decreases[37]. In Houghton County specifically, there have been multiple arrests related to the sale, production, and distribution of narcotics that involve UPSET.

Another less urgent issue is that of dilapidated buildings, or brownfield structures, which are abundant in many jurisdictions in Houghton County. These structures are often associated with asbestos, a component of past insulation materials which has been found to cause health problems, and with other hazards.

Occurrence Probability and County Vulnerability

Public health emergencies can arise from a wide range of causes and exhibit varying levels of severity. In Houghton County, the probability of a public health emergency is highly likely as some health emergencies are currently occurring in the county (i.e., opioid and meth-related health emergencies). The severity of a public health emergency is unpredictable and could potentially be extreme, particularly as the population ages in the county. A large magnitude epidemic could overload medical facilities that are inadequately prepared to deal with this type or scale of emergency. The remoteness of the county could also be problematic during a large-scale emergency.

Vulnerable locations include any public gathering area such as schools, long-term care facilities, medical facilities, public water, sewer, and electrical facilities, individual wells and septic systems, restaurants, etc. Almost all local communities in Houghton County have at least one of these vulnerable critical facilities. The entire population of Houghton County is vulnerable to public health emergencies, particularly the elderly and those with weakened immune systems. These population groups are more vulnerable to disease outbreaks than healthier individuals.

Public health emergencies have secondary impacts that may create further vulnerable situations that were otherwise not expected. For example, an influenza outbreak could result in large percentages of employees taking sick leave or mandated quarantine action, removing workers from their place of employment and thus impacting productivity in the economy or in emergency response capacity. Any hazardous event that would have secondary public health implications would significantly disrupt or halt the normal business activities of an impacted community. However, these measures should be taken if it lessens or slows the impact of a public health emergency.

[37] UPSET West reducing heroin supply, meth use growing. (2019, February 14). *Keweenaw Report*. www.keweenawreport.com/featured/upset-west-reducing-heroin-supply-meth-use-growing/

Sabotage and Terrorism

Hazard Description

Terrorism is the use of violence by individuals or groups to achieve political goals by creating fear, while sabotage is any kind of deliberate action, such as obstruction, disruption, or destruction, for political or military gain. Both can take many forms, including the following: bombings; assassinations; organized extortion; use of nuclear, chemical, and biological weapons; information warfare, such as hacking or release of classified information; ethnic, religious, and gender intimidation (hate crimes); advocacy for overthrowing local, state, or federal government, and; the disruption of legitimate scientific research or resource-related activities (eco-terrorism). The goal of terrorists is to frighten as many people as possible, not necessarily to cause the greatest damage possible. Media coverage allows terrorists to affect a much larger population than those who are directly attacked.

Since the previous update of this plan, the likelihood of a cyberterrorism attack has increased dramatically. A cyberterrorism attack is the use of the internet to conduct attacks on others to achieve political or ideological gains through threat or intimidation. This includes large-scale disruption to critical computer systems, allowing them to not only come under attack, but also be used to conduct attacks. Inadequate security can facilitate access to computers causing service disruption and resulting in economic losses and potential public disorder.

Sabotage and terrorism are long-established strategies that are practiced by many groups in many nations. The U.S. is not only threatened by international terrorists or saboteurs, but also by home-grown domestic terrorist groups including, but not limited to, racist, ecological, and extreme anti-abortion groups. Non-terrorist criminal activity may resemble terrorism or sabotage, but it lacks a political objective. These crimes are typically routine, individual crimes, but they may impact large portions of the population. Some of these attacks may require resources that are not available to local law enforcement agencies. Non-terrorist criminal activities may include mass shootings, random sniper attacks, infrastructure sabotage, and cyberattacks.

1. **Nationalist terrorists** act in support of a culture or ethnic group. Typically, they are fighting on behalf of national populations that wish to have an independent government but are currently ruled by another country. They tend to direct their attacks against the "occupying power" but may also attack other nations that support their enemies. These terrorists claim to speak for their entire national group, but usually only represent a small minority of extremists.
2. **Religious extremist terrorists** are violent adherents of a specific religion. They tend to be especially committed because they believe their violent actions are supported by their deity. Religious terrorists see themselves fighting a battle of ultimate good against pure evil, in which any action is justified.
3. **Left wing terrorists** attempt to force society to change to match their goals and values. They tend to target the government, power institutions, and symbols of authority. Socialist and Communist terrorists of this type were a threat in the late 1960s and 1970s but have weakened in recent decades.

4. **Right wing terrorists** see themselves as fighting for traditional values against an invading group and/or against a tyrannical government. In the U.S., these terrorists are associated with anti-immigration, white supremacy, anti-government, and Christian Identity movements. Only the most extreme elements of these movements have become terrorist, but they have carried out a substantial portion of the recent attacks. Right wing groups tend to target members of hated ethnic or religious minorities, or government employees.
5. **Single-issue terrorists** are not committed to an all-encompassing belief system, but rather are intensely concerned with one cause. Common causes for these terrorists include animal-rights, environmentalism, and opposition to abortion. They tend to target property or individuals rather than attempting to cause massive casualties.

Because sabotage and terrorism objectives are so widely varied, the potential targets are also widely varied. Virtually any public facility, place of public assembly, or business engaged in controversial activities can be considered a potential target. Large computer systems operated by government agencies, financial institutions, large businesses, healthcare facilities, and universities are at risk.

Since the previous update of the plan, the likelihood of a cyberterrorism event has increased dramatically. Cyberterrorism is an electronic attack using one computer system against another. Inadequate security can facilitate access to critical computer systems, allowing them to be used to conduct attacks and cause major disruption. There are generally no direct effects on the built environment, but it may cause service disruption which could result in significant economic losses and cause public disorder. Documenting and understanding the services that are reliant on computer systems can work to mitigate the consequences of cyberterrorism.

Historical Occurrence

Although few sabotage or terrorism events have occurred in Houghton County, the area is not immune to this problem. Michigan Technological University is a premier science and engineering research university and is susceptible to attacks on its offices, labs and computer systems. An early 2000s bomb on campus was ultimately linked to eco-terrorism.

At 3:30 am on November 5, 2001, Michigan Tech public safety officers discovered two bombs on the Michigan Tech campus while they were on routine patrol. The bombs consisted of five-gallon containers, filled with a presumably flammable liquid, attached to ignition devices. One bomb was found outside of the U.J. Noblet Forestry Building, and one was outside of the adjacent U.S. Forest Service laboratory. Local law enforcement officials evacuated a four-block area and performed a thorough search of all other campus buildings. The Michigan State Police Bomb Squad in Negaunee and agents from the FBI and the federal Alcohol, Tobacco, and Firearms agency in Marquette were called in, and the bombs were disarmed by 2:00 pm without incident. Though no one has claimed responsibility for planting the devices, members of eco-terrorism groups were suspected. Self-identified members of the Earth Liberation Front had sent threatening e-mails to the university earlier in the year after it was announced that Michigan Tech had received a two million-dollar grant for research that included genetic manipulation of

trees. The Earth Liberation Front and its sister organization, the Animal Liberation Front, have used similar methods to damage or destroy genetic research projects at other educational institutions around the country, including Michigan State University's Agriculture Hall where $900,000 in fire and water damage was caused by arsonists in 1999.

On September 17, 2019, Temple Jacob synagogue in Hancock was vandalized with spray-painted swastikas and SS bolts. A discussion group of residents representing a variety of religions met to discuss ways to foster communities to work together. Temple president David Holden noted that other groups have dealt with bigotry in the area as well. Temple Jacob had already been making security upgrades and training people in the wake of the Pittsburgh synagogue shooting.[38] Hancock police forwarded their report to the FBI office in Marquette[39]. Temple Jacob is the oldest continuously active synagogue in the Upper Peninsula.

Occurrence Probability and County Vulnerability

Houghton County has experienced sabotage/terrorist events and remains vulnerable as a center for governmental, educational, and multicultural activities. While Michigan Tech has responded to threats at its facilities by installing security cameras, much of the campus and the County are not under constant surveillance, resulting in some continuing risk. Furthermore, the Portage Lake Lift Bridge, as a critical structure and high-value target, is recognized as at special risk of sabotage. Probability of sabotage/terrorism is low based on past events, but severity is case-specific and impossible to predict, though any event resulting in closure of the Lift Bridge would have severe and wide-ranging consequences.

[38] Neese, G. (2019, October 4). "Interfaith group seeks ways to find unity after graffiti." *Daily Mining Gazette.* www.mininggazette.com/news/2019/10/interfaith-group-seeks-ways-to-find-unity-after-graffiti/
[39]Neese, G. (2019, September 24). "Temple Jacob graffiti report forwarded to FBI." *Daily Mining Gazette*. www.mininggazette.com/news/2019/09/temple-jacob-graffiti-report-forwarded-to-fbi/

SECTION 6: Risk Assessment

The hazard profiles presented in the *Hazard Analysis* section were developed using best available data and result in what may be considered principally a qualitative assessment as recommended by FEMA in its "How-to" guidance document titled Understanding Your Risks: Identifying Hazards and Estimating Losses (FEMA Publication 386-2). It relies heavily on historical and anecdotal data, literature review, stakeholder input, and professional and experienced judgment regarding observed and/or anticipated hazard impacts. It also carefully considers the findings in other relevant plans, studies and technical reports.

This section will include the following components:

- Differential Vulnerability
- Hazard Extent
- Hazard Profiling Concept of Planning
- Hazard Priority Risk Index and Ranking
- PRI Results
- Hazard Summary

Differential Vulnerability

Currently, there is no reliable way to accurately estimate costs associated with hazards that affect Houghton County. Vulnerability analysis for identified hazards on critical facilities in the county have not been conducted due to insufficient data. Additionally, numerous variables can affect the vulnerability of the county to hazards, including climate, location, scale, and time of day. Time of year also affects vulnerability. The population in many jurisdictions varies by season, and response capabilities are sometimes compromised in winter.

Although Houghton County is susceptible to many types of hazards, each jurisdiction varies in its level of vulnerability to certain hazards. Vulnerability to most fire hazards, weather hazards, flooding due to spring runoff, and all technological and societal hazards have been determined to be similar for all of Houghton County. Subsidence is of note because it can occur in most jurisdictions, but the most at-risk areas are in scattered locations. **Table 6.1** provides a summary of hazards within the County and notes especially high vulnerabilities for each jurisdiction. Countywide hazards and others that affect most but not all jurisdictions equally, such as subsidence and petroleum/natural gas incidents, are generally not noted for specific jurisdictions.

Table 6.1: Differential Vulnerabilities by Jurisdiction in Houghton County

Jurisdiction (Population)	Extreme Temperatures	Fog	Hail	Ice & Sleet Storms	Lightning	Severe Winds	Snowstorms & Blizzards	Tornadoes	Dam Failures	Riverine & Urban Flooding	Shoreline Flooding & Erosion	Drought	Wildfires	Invasive Species	Earthquakes	Subsidence	Scrap Tire Fires	Structural Fires	Hazardous Materials: Fixed Site Incidences	Hazardous Materials: Transportation Incidents	Petroleum & Natural Gas Incidents	Infrastructure Failures & Secondary Tech. Hazards	Transportation Accidents	Civil Disturbances	Public Health Emergencies	Sabotage & Terrorism
Houghton County (36,333)	X		X	X	X	X	X							X	X					X		X		X	X	X
Adams Township (2,532)													X			X	X									
Calumet Charter Township (6,346)						X			X		X					X					X					
Calumet Village (819)																X		X								
Copper City Village (255)																										
Laurium Village (2,147)																X										
Chassell Township (1,925)									X	X											X					
Duncan Township (175)													X								X					
Elm River Township (354)													X													
Franklin Township (1,444)										X						X	X				X					
Hancock Township (583)							X				X										X					

Jurisdiction (Population)	Extreme Temperatures	Fog	Hail	Ice & Sleet Storms	Lightning	Severe Winds	Snowstorms and Blizzards	Tornadoes	Dam Failures	Riverine & Urban Flooding	Shoreline Flooding & Erosion	Drought	Wildfires	Invasive Species	Earthquakes	Subsidence	Scrap Tire Fires	Structural Fires	Hazardous Materials: Fixed Site Incidences	Hazardous Materials: Transportation Incidents	Petroleum & Natural Gas Incidents	Infrastructure Failures & Secondary Tech. Hazards	Transportation Accidents	Civil Disturbances	Public Health Emergencies	Sabotage & Terrorism
Laird Township (416)													X													
Osceola Township (1,549)										X						X					X					
Portage Charter Township (3,190)									X							X					X					
Quincy Township (314)																X					X					
Schoolcraft Township (1,689)										X	X					X					X					
Lake Linden Village (1,094)																			X		X					
Stanton Township (1,375)						X			X		X		X													
Torch Lake Township (1,985)											X								X							
City of Hancock (4,574)										X						X					X					
City of Houghton (7,882)									X	X											X					

Hazard Extent

Table 6.2 describes the extent of each hazard identified in Houghton County. The extent of a hazard is its severity or magnitude, as it relates to the county.

Table 6.2: Hazard Extent in Houghton County

Weather Hazards	
Extreme Temperatures	Extreme heat event extent is measured through the heat index, which is temperature in relation to the percentage of humidity. The highest heat index was recorded on July 31, 2006, where heat indices ranged from 100-105 degrees Fahrenheit. Extreme cold extent is generally measured through the wind chill temperature index. The coldest temperatures recorded in Houghton County was from January 27-28, 2014, where wind chills of 30-40 degrees (F) below zero temperatures were reported. It should be noted that future events may be much hotter or colder than these incidences.
Fog	The extent of fog is measured by area and number of roads and vehicles affected by a fog event, as fog itself is not hazardous.
Hail	Hail extent is defined by the size of the hail stone. The largest hail stone reported in Houghton County was 2.75 inches on March 6, 1992. It should be noted that future events may exceed this.
Ice and Sleet Storms	The extent of ice and sleet storms can be classified by meteorological measurements and by evaluating its societal impacts.
Lightning	The frequency of cloud-to-ground lightning flashes per square mile can be used as a method to measure extent. Houghton County receives approximately 1.5 to 3 strikes per square mile per year. Greater strikes per square mile per year are possible in the future.
Severe Winds	The extent of a severe wind event is measured by speed of wind recorded. The highest wind speed recorded from the NCEI data was 92 mph (80 knots), which was recorded twice. First on August 1, 2002 near Houghton, then again on June 27, 2005 in Hancock. Note that future event may result in stronger winds.
Snowstorms and Blizzards	The extent of winter storms can be measured by the amount of snowfall received (in inches). From 1955-2019, Houghton County has experienced 23 blizzard events, totaling $26,000 in recorded damage. The most expensive event occurred on January 29-31,1996 when 16 inches fell, and the weight of the snow caused the roof to collapse on the Houghton County Road Commission garage.

Tornadoes	Tornado hazard extent is measured by historic tornadoes per county in Michigan provided by the NCEI and MSP, as well as the Fujita/Enhanced Fujita Scale (Tables 5.8 and 5.9). The historic tornado map indicated that one tornado has been observed in Houghton County between 1996 and 2017. The tornado was reported as an F0 (July 11, 1987). However, a greater frequency and/or stronger tornado may affect the county in the future.
Hydrological Hazards	
Dam Failures	Dam Failure extent is defined using the Michigan Department of Environment, Great Lakes, and Energy under Dam Safety criteria. Of the 16 dams in the county, 88% are state regulated, And only one of them is classified as significant risk hazard potential. A significant hazard potential indicates that if the dam were to fail there would be no loss of life, but could cause economic loss, environmental damage, disruption of lifeline facilities, or can impact other concerns. Although no dam failures have been reported, a future event may occur.
Riverine and Urban Flooding	Flood extent in Houghton County is measured by the duration and magnitude of an event. In June of 2018, 3-7 inches of rain fell in one hour which, according to the NOAA Precipitation Frequency Atlas, resulted in a 1000-year recurrence interval for rainfall amounts of the magnitude.
Shoreline Flooding and Erosion	The extent of erosion can be defined by the rate (in feet) of erosion that occurs according to the Michigan Department of Environment, Great Lakes, and Energy – Coastal Management. Approximately 4% of the County's Lake Superior shoreline are officially designated as high-risk areas with other neighboring areas being continually threatened due to rising lake levels. It should be noted that areas may experience a higher rate, and thus great extent, of erosion in future years.
Drought	Drought extent is defined by the U.S. Drought Monitor classifications, which included abnormally dry, moderate drought, severe drought, extreme drought, and exceptional drought (in ascending order). The most severe drought condition is exceptional. However, Houghton County has not received this ranking in the ten-year reported history. However, in the same period, the county was part of a lengthy drought incident from 2011 to 2012 (12 months).
Ecological Hazards	
Wildfires	Extent of a wildfire is determined by the annual average of total acres burned. The largest and only wildfire in Houghton County was on June 6, 2000 where 350 acres were burned in Torch Lake Township.

Invasive Species	The extent of invasive species is largely dependent on the preferred habitat of the species as well as the species' ease of movement and establishment. Invasive species magnitude ranges from nuisance to widespread killer. In Houghton County, terrestrial species such as the emerald ash borer and spotted winged drosophila can have a significant economic impact on forest-based tourism, logging, and farming.
Geological Hazards	
Earthquakes	Earthquake extent can be measured by the Modified Mercalli Intensity (MMI) scale and the distance of the epicenter from Houghton County. It was determined that this hazard does not threaten Houghton County.
Subsidence (Ground Collapse)	Subsidence is measured by total displacement of material volume from the event, as well as monetary damages.
Technological (Industrial) Hazards	
Scrap Tire Fires	Extent is measured by the area affected, monetary damages incurred., as well as type of tire products involved.
Structural Fires	Structural fire hazard extent is measured in area affected, time required to extinguish the fire, and incurred monetary damages.
Hazardous Materials: Fixed Site Incidents	Measured by the spatial extent of the event and volume of material lost. Additionally, material type, wind speed and direction and terrain factors impact extent.
Hazardous Materials: Transportation Accident	Extent is measured by volume of material lost, as well as proximity to major transportation routes. Hazard extent is also influenced by material type, terrain and wind speed and direction.
Petroleum and Natural Gas Incidents	Extent is measured by the spatial extent of an incident, and volume of material lost.
Infrastructure Hazards	
Infrastructure Failures and Secondary Technological Hazards	Hazard extent is measured by the type of failure and duration and what cascading effects are because of the hazard.
Transportation Accidents	Extent of a transportation accident can be measured by type of transportation involved and location of accident. While minor accidents have occurred in Houghton County, there have not been any large-scale transportation accidents.
Human Related Hazards	
Civil Disturbances	Extent is measured by potential economic losses through damage to or disruption of operations of governmental facilities or other commercial businesses.
Public Health Emergencies	Public health emergency extent is measured by percentage of the population affected by the hazard. If the health emergency is a pandemic, the extent depends on how easily the illness is spread,

	mode of transmission, and amount of contact between infected and uninfected individuals.
Sabotage and Terrorism	Extent is measured by the area affected by the hazard, type of facility threatened, and the potential number of injuries or fatalities resulting from an event.

Hazard Profiling Concept of Planning

The method used to rank the hazards, vulnerabilities and risks includes the following:

- A public survey that was released for 30 days online with paper copies being made available at the county clerk's office, public library, and the post office.
- A public comment period after the final draft was released and before plan adoption
- Government and institution survey released for added input into the plan.
- Houghton County emergency manager reviewed the profile and ranked the overall risk for the county.
- Members of the Local Planning Team reviewed and ranked the risks for their communities.
- The risk profile was circulated among the staff at the Western U.P. Planning & Development Region for comment.

A risk assessment identifies the characteristics and potential consequences of a disaster, how much the community could be affected by the disaster, and the impact on community assets.

Technical expertise is necessary to estimate the costs of each potential hazard. The value of property in Houghton County and its communities can, at a minimum, provide an overview of property that can be affected by hazards. **Table 6.3** shows the State Equalized Value (SEV) of properties in Houghton County by location and class. Vulnerability estimates that are provided in this plan were based on a most likely scenario.

Table 6.3: State-Equalized Value for Houghton County, 2019

******Real ($) *******						Total Real ($)	Personal ($)	Total Real & Personal ($)
Township/ City **	Agriculture	Commercial	Industrial	Residential	Timber-Cutover			
Adams	-	7,205,377	2,319,560	43,807,465	-	53,332,402	9,048,161	62,380,563
Calumet	-	20,660,339	2,493,532	101,451,240	1,215,507	125,820,618	10,120,514	135,941,132
Chassell	2,913,400	2,868,000	-	73,560,300	-	79,341,700	1,823,500	81,165,200
Duncan	690,294	1,128,791	-	17,517,912	2,038,603	21,375,600	1,713,648	23,089,248
Elm River	-	1,973,423	176,919	31,176,924	110,739	33,438,005	2,773,909	36,211,914
Franklin	618,903	5,989,888	1,673,693	41,401,020	-	49,683,504	3,585,143	53,268,647
Hancock	-	465,554	-	37,102,550	-	37,568,104	1,937,253	39,505,357
Laird	2,739,895	500,869	-	17,749,765	3,356,040	24,346,569	425,480	24,772,049
Osceola	620,488	5,177,845	2,565,345	49,913,258	529,096	58,806,032	2,856,647	61,662,679
Portage	4,748,674	13,847,154	3,465,263	113,329,006	4,149,347	139,539,444	9,909,073	149,448,517
Quincy	-	811,599	152,000	10,115,693	-	11,079,292	728,766	11,808,058
Schoolcraft	1,734,637	4,093,400	-	57,745,534	2,415,239	65,988,810	1,467,003	67,455,813
Stanton	1,799,300	622,900	211,100	80,082,118	231,700	*82,947,118	1,562,835	84,509,953
Torch Lake	687,777	3,353,430	1,085,625	129,724,068	4,088,155	138,939,055	2,020,271	140,959,326
City of Hancock	-	51,389,964	892,891	78,032,197	-	130,315,052	7,170,494	137,485,546
City of Houghton	-	61,010,282	609,769	98,820,945	-	*160,440,996	7,850,178	168,291,174
					County Total Real and Personal			$1,277,955,176

* Stanton includes Developmental Property of $484,100 and City of Houghton includes Development Property of $1,794,422.
** Townships include all villages within.

Hazard Priority Risk Index and Ranking

In order to draw some meaningful planning conclusions on hazard risk for Houghton County, the results of the hazard profiling process were used to generate countywide hazard classifications according to a "Priority Risk Index" (PRI). The purpose of the PRI, described further below, is to categorize and prioritize all potential hazards for Houghton County as high, moderate or low risk. Combined with the asset inventory and quantitative vulnerability assessment provided in the next section, the summary hazard classifications generated through the use of the PRI allows for the prioritization of those high hazard risks for mitigation planning purposes, and more specifically, the identification of hazard mitigation opportunities for Houghton County jurisdictions to consider as part of their proposed mitigation strategy.

The prioritization and categorization of identified hazards for Houghton County is based principally on the PRI, a tool used to measure the degree of risk for identified hazards in a planning area. The PRI is used to assist the Houghton County Local Planning Team (LPT) in gaining consensus on the determination of those hazards that pose the most significant threat to Houghton County based on a variety of factors. The PRI is not scientifically based but is rather meant to be utilized as an objective planning tool for classifying and prioritizing hazard risks in Houghton County based on standardized criteria. The application of the PRI results in numerical values that allow identified hazards to be ranked against one another (the higher the PRI value, the greater the hazard risk). PRI values are obtained by assigning varying degrees of risk to five categories for each hazard (probability, impact, spatial extent, warning time and duration). Each degree of risk has been assigned a value (1 to 4) and an agreed upon weighting factor, as summarized in **Table 6.4**.

To calculate the PRI value for a given hazard, the assigned risk value for each category is multiplied by the weighting factor[40]. The sum of all five categories equals the final PRI value, as demonstrated in the example equation below:

PRI VALUE = [(PROBABILITY x .30) + (IMPACT x .30) + (SPATIAL EXTENT x .20) +

(WARNING TIME x .10) + (DURATION x .10)]

According to the weighting scheme, the highest possible PRI value is 4.0. Applying the weighting scheme to Houghton County, the highest score of 3.2 was given to riverine and urban flooding as well as public health emergencies. Prior to being finalized, PRI values for each identified hazard were reviewed and accepted by the members of the LPT.

There are no NFIP-insured structures that have been repetitively damaged by floods in Houghton County.

It should be noted that due to data gaps in the region, FEMA's Hazus was unable to be utilized in estimating potential losses from hazards. To improve model accuracy and future hazard

[40]Beyond the Basics: Best Practices in Local Mitigation Planning http://mitigationguide.org/task-5/steps-to-conduct-a-risk-assessment-2/3-analyze-risk/

mitigation planning, Houghton County will seek to update hazard data with flood boundaries, flood depth grids, and asset inventories.

Key Definitions for Prioritized Risk Index Categories

Probability – a guide to predict how often a random event will occur. Annual probabilities are expressed between 0.001 or less (low) up to 1 (high). An annual probability of 1 predicts that a natural hazard will occur at least once per year.

Magnitude/Severity – indicates the impact to a community through potential fatalities, injuries, property losses, and/or losses of services. The vulnerability assessment gives information that is helpful in making this determination for each community.

Warning Time – plays a factor in the ability to prepare for a potential disaster and to warn the public. The assumption is that more warning time allows for more emergency preparations and public information.

Duration – relates to the span of time local, state, and/or federal assistance will be necessary to prepare, respond, and recover from a potential disaster event.

Table 6.4: Priority Risk Index Summary Table

PRI Category	Degree of Risk			Assigned Weighting Factor
	Level	Criteria	Index Value	
Probability	Unlikely	Less than 1% annual probability	1	30%
	Possible	Between 1 and 10% annual probability	2	
	Likely	Between 10 and 100% annual probability	3	
	Highly Likely	100% annual probability	4	
Impact	Minor	Very few injuries, if any. Only minor property damage and minimal disruption on quality of life. Temporary shutdown of critical facilities	1	30%
	Limited	Minor injuries only. More than 10% of property in affected area damaged or destroyed. Complete shutdown of critical facilities for more than one day.	2	
	Critical	Multiple deaths/injuries possible. More than 25% of property in affected area damaged or destroyed. Complete shutdown of critical facilities for more than one week.	3	
	Catastrophic	High number of deaths/injuries possible. More than 50% of property in affected area damaged or destroyed. Complete shutdown of critical facilities for 30 days or more.	4	
Spatial Extent	Negligible	Less than 1% of area affected	1	20%
	Small	Between 1 and 10% of area affected	2	
	Moderate	Between 10 and 50% of area affected	3	
	Large	Between 50 and 100% of area affected	4	
Warning Time	More than 24 hours	Self-explanatory	1	10%
	12 to 24 hours	Self-explanatory	2	
	6 to 12 hours	Self-explanatory	3	
	Less than 6 hours	Self-explanatory	4	
Duration	Less than 6 hours	Self-explanatory	1	10%
	Less than 24 hours	Self-explanatory	2	
	Less than one week	Self-explanatory	3	
	More than one week	Self-explanatory	4	

PRI Results

Table 6.5 summarizes the degree of risk assigned to each category for all initially identified hazards based on the application of the PRI. Assigned risk levels were based on the detailed hazard profiles developed for this section, as well as input from the Local Planning Team (LPT). The results were then used in calculating PRI values and making final determinations for the risk assessment.

Table 6.5: Summary of PRI Results for Houghton County

Hazard	Category/Degree of Risk					
	Probability	Impact	Spatial Extent	Warning Time	Duration	PRI Score
Weather Hazards						
Extreme Temperatures	Highly Likely	Limited	Large	More than 24 hours	Less than one week	3.0
Fog	Highly Likely	Minor	Small	Less than 6 hours	Less than 6 hours	2.4
Hail	Highly Likely	Minor	Small	Less than 6 hours	Less than 6 hours	2.4
Ice and Sleet Storms	Likely	Minor	Large	12 to 24 hours	Less than 6 hours	2.3
Lightning	Highly Likely	Minor	Small	Less than 6 hours	Less than 6 hours	2.4
Severe Winds	Highly Likely	Limited	Small	Less than 6 hours	Less than 24 hours	2.8
Snowstorms and Blizzards	Highly Likely	Critical	Large	12 to 24 hours	Less than one week	3.4
Tornadoes	Unlikely	Critical	Negligible	Less than 6 hours	Less than 6 hours	1.9
Hydrological Hazards						
Dam Failures	Possible	Critical	Small	6 to 12 hours	Less than 24 hours	2.4
Riverine and Urban Flooding	Highly Likely	Critical	Moderate	6-12 hours	Less than one week	3.3
Shoreline Flooding and Erosion	Highly Likely	Limited	Small	Less than 6 hours	More than one week	3.0
Drought	Possible	Minor	Large	Less than 6 hours	More than one week	2.5
Ecological Hazards						
Wildfires	Likely	Limited	Small	12-24 hours	Less than 24 hours	2.3

Hazard	Category/Degree of Risk					
	Probability	**Impact**	**Spatial Extent**	**Warning Time**	**Duration**	**PRI Score**
Invasive Species	Highly Likely	Limited	Large	More than 24 hours	More than one week	3.1
Geological Hazards						
Earthquakes	Unlikely	Critical	Small	Less than 6 hours	Less than 6 hours	1.9
Subsidence (Ground Collapse)	Highly Likely	Limited	Small	Less than 6 hours	Less than 6 hours	2.7
Technological (Industrial) Hazards						
Scrap Tire Fires	Unlikely	Minor	Small	Less than 6 hours	Less than 24 hours	1.6
Structural Fires	Highly Likely	Critical	Small	Less than 6 hours	Less than 24 hours	3.1
Hazardous Materials: Fixed Site Incidents	Likely	Minor	Small	12-24 hours	More than one week	2.2
Hazardous Materials: Transportation Accident	Possible	Limited	Small	Less than 6 hours	More than one week	2.4
Petroleum and Natural Gas Incidents	Possible	Limited	Moderate	Less than 6 hours	Less than one week	2.5
Infrastructure Hazards						
Infrastructure Failures & Secondary Technological Hazards	Likely	Critical	Moderate	Less than 6 hours	More than one week	3.2
Transportation Accidents	Highly Likely	Critical	Negligible	Less than 6 hours	Less than 6 hours	2.8
Human Related Hazards						
Civil Disturbances	Unlikely	Minor	Negligible	Less than 6 hours	Less than 24 hours	1.4
Public Health Emergencies	Highly Likely	Catastrophic	Moderate	12 to 24 hours	More than one week	3.6
Sabotage and Terrorism	Unlikely	Catastrophic	Negligible	Less than 6 hours	Less than one week	2.4

The conclusions drawn from the hazard profiling process for Houghton County, including the PRI results and input from the LPT, resulted in the classification of risk for each identified hazard according to three categories: High Risk, Moderate Risk and Low Risk (**Table 6.6**). For purposes of these classifications, risk is expressed in relative terms according to the estimated impact that a hazard will have on human life and property throughout all of Houghton County. A more quantitative analysis to estimate potential dollar losses for each hazard has been performed separately and is described in the Vulnerability Assessment section. It should be noted that although some hazards are classified below as posing low risk, their occurrence of varying or unprecedented magnitudes is still possible in some cases and their assigned classification will continue to be evaluated during future updates.

Table 6.6: Conclusions on Hazard Risk for Houghton County

High Risk	Public Health Emergency Snowstorms and Blizzards Riverine and Urban Flooding Infrastructure Failures & Secondary Technological Hazards Invasive Species Structural Fires Shoreline Flooding and Erosion Extreme Temperatures
Moderate Risk	Transportation Accidents Severe Winds Subsidence (Ground Collapse) Petroleum and Natural Gas Incidents Drought Sabotage and Terrorism Hazardous Materials: Transportation Accident Dam Failures
Low Risk	Lightning Hail Fog Wildfires Ice and Sleet Storms Hazardous Materials: Fixed Site Incidents Earthquakes Tornadoes Scrap Tire Fires Civil Disturbance

Hazard Summary

Although many of the hazards identified can and do occur throughout Houghton County, the highest priority hazards include:

Public Health Emergency

Snowstorms and Blizzards

Riverine and Urban Flooding

Infrastructure Failures and Secondary Technological Hazards

Invasive Species

Shoreline Flooding and Erosion

Extreme Temperatures

Hazard mitigation activities will focus on mitigating loss due to these priority hazards in Houghton County while also considering activities that may mitigate loss due to lower ranking hazards.

SECTION 7: Hazard Mitigation

This section of the Hazard Mitigation Plan provides the blueprint which Houghton County and its municipal jurisdictions can follow to reduce potential exposure and losses identified as concerns in the Risk Assessment portion of this plan. The Local Planning Team and the Emergency Manager reviewed the risk assessment to identify and develop these actions. This section includes:

- Overview of Mitigation Strategy Development
- Review and Update of Mitigation Goals and Objectives
- Capability Assessment
- Mitigating Hazard in Houghton County
- Mitigation Resources
- Updating the 2020 Houghton County Hazard Mitigation Plan

Overview of Mitigation Strategy Development

In formulating Houghton County's mitigation strategy, a wide range of activities were considered in order to help achieve the general countywide goals in addition to the specific hazard concerns of each participating jurisdiction (again, for more details on the specific activities discussed and considered by the Local Planning Team (LPT), please see the summary of the second Mitigation Advisory Committee meeting in Section 3: Planning Process). In general, hazard mitigation actions are commonly broken into four different categories and were thoroughly explained and discussed at the Mitigation Strategy LPT Meeting:

Local Plans and Regulations (LPR) – These actions include government authorities, policies or codes that influence the way land and buildings are being developed and built.

Structure and Infrastructure Projects (SIP) - These actions involve modifying existing structures and infrastructure to protect them from a hazard or remove them from a hazard area. This could apply to public or private structures as well as critical facilities and infrastructure. This type of action also involves projects to construct human made structures to reduce the impact of hazards.

Natural Systems Protection (NRP) – These are actions that minimize damage and losses and preserve or restore the functions of natural systems.

Education and Awareness Programs (EAP) – These are actions to inform and educate citizens, elected officials, and property owners about hazards and potential ways to mitigate them.

The intent of the Mitigation Strategy Section is to provide Houghton County and its municipal jurisdictions with the goals that will serve as the guiding principles for future mitigation policy and project administration, along with a listing of proposed actions deemed necessary to meet those goals and reduce the impact of natural hazards. It is designed to be comprehensive and strategic in nature.

In being comprehensive, the development of the strategy included a thorough review of all hazards and identifies far-reaching policies and projects intended to not only reduce the future impacts of hazards, but also to assist the county and municipalities achieve compatible economic, environmental and social goals. In being strategic, the development of the strategy ensures that all policies and projects are linked to established priorities and assigned to specific departments or individuals responsible for their implementation with target completion deadlines. When necessary, funding sources are identified that can be used to assist in project implementation.

The first step in designing the mitigation strategy includes the identification of countywide Mitigation Goals. Mitigation Goals represent broad statements that are achieved through the implementation of more specific, action-oriented objectives listed in each jurisdiction's Mitigation Action Plan. These actions include both hazard mitigation policies (such as the regulation of land in known hazard areas through a local ordinance), and hazard mitigation projects that seek to address specifically targeted hazard risks (such as the acquisition and relocation of a repetitive loss structure).

The second step involves the identification, consideration and analysis of available mitigation measures to help achieve the identified mitigation goals. This is a long-term, continuous process sustained through the development and maintenance of this plan, beginning with the LPT during the first meeting. Alternative mitigation measures will continue to be considered as future mitigation opportunities become identified, as data and technology improve, as mitigation funding becomes available, and as this Plan is maintained over time.

The third and last step in designing the Mitigation Strategy is the creation of the local Mitigation Action Plans (MAPs), which are provided separately in Section 8: Actions Plan. The MAPs represent plans for action and are the most essential outcome of the mitigation planning process. They include a prioritized listing of proposed hazard mitigation actions (policies and projects) for each of Houghton County's local jurisdictions along with accompanying information such as those agencies or individuals assigned responsibility for their implementation, potential funding sources and an estimated target date for completion. The MAPs provide those individuals or agencies responsible for implementing mitigation actions with a clear roadmap that also serves as an important tool for monitoring progress over time. The cohesive collection of actions listed in each jurisdiction's MAP also can serve as an easily understood menu of mitigation policies and projects for those local decision makers who want to quickly review their jurisdiction's respective element of the countywide Hazard Mitigation Plan.

In preparing their own individual Mitigation Actions Plans, each jurisdiction was given the opportunity to consider their overall hazard risk and capability to mitigate natural hazards as recorded through the risk and capability assessment process, in addition to meeting the adopted countywide mitigation goals and the unique needs of their community. Prioritizing mitigation actions for each jurisdiction was based on the following five (5) factors: (1) effect on overall risk to life and property; (2) ease of implementation; (3) political and community support; (4) a general economic cost/benefit review, and; (5) funding availability.

Review and Update of Mitigation Goals

The goals of the Houghton County Hazard Mitigation Plan were crafted early in the planning process through a facilitated discussion and brainstorming session with the LPT (for more details, please see the summary of the second LPT meeting in Section 3: Planning Process). Each of the following goal statements represent a broad target for Houghton County and its jurisdictions to achieve through the implementation of their own specific Mitigation Action Plans. These goals were reviewed at the LPT (August 2019) and confirmed to still be valid with few changes for the 2020 Houghton County Hazard Mitigation Plan.

Goal 1	Work to improve existing local government policies and codes to reduce the impacts of natural hazards.
Goal 2	Design and implement specific mitigation measures to protect vulnerable public and private properties.
Goal 3	Increase the protection of critical facilities and infrastructure from hazard threats through retrofit projects for existing facilities and innovative design standards for new facilities.
Goal 4	Enhance public education programs to promote community awareness of natural hazards and the hazard mitigation techniques available to reduce their impact.
Goal 5	Improve stormwater management through enhanced local government programs, policies and practices.
Goal 6	Enhance the county's evacuation and sheltering procedures through increased coordination between Houghton County, its municipalities, partner agencies, and the State of Michigan.
Goal 7	Increase the County's emergency management capabilities through sustained system and technology improvements.
Goal 8	Promote volunteer involvement in emergency preparedness and response through increased citizen awareness and training activities.

Note: A stated objective of the Disaster Mitigation Act of 2000 is to improve the coordination of risk reduction measures between state and local government authorities. Linking local and state mitigation planning goals is an important first step. It has been determined by the Houghton County LPT that the above goal statements are consistent with the State of Michigan's current mitigation planning goals as identified in the State Hazard Mitigation Plan promulgated by the Michigan Emergency Management and Homeland Security Division of the Michigan State Police.

Capability Assessment

The purpose of conducting a capability assessment is to determine the ability of a local jurisdiction to implement a comprehensive mitigation strategy, and to identify potential opportunities for establishing or enhancing specific mitigation policies, programs or projects. As in any planning process, it is important to try to establish which goals, objectives and/or actions

are feasible, based on an understanding of the organizational capacity of those agencies or departments tasked with their implementation. A capability assessment helps to determine which mitigation actions are practical and likely to be implemented over time given a local government's planning and regulatory framework, level of administrative and technical support, amount of fiscal resources and current political climate.

A capability assessment has two primary components: an inventory of a local jurisdiction's relevant plans, ordinances, or programs already in place; and an analysis of its capacity to carry them out. Careful examination of local capabilities will detect any existing gaps, shortfalls or weaknesses with ongoing government activities that could hinder proposed mitigation activities and possibly exacerbate community hazard vulnerability. A capability assessment also highlights the positive mitigation measures already in place or being implemented at the local government level, which should continue to be supported and enhanced if possible, through future mitigation efforts.

The capability assessment completed for Houghton County and its participating municipalities serves as a critical planning step and an integral part of the foundation for designing an effective multi-jurisdictional hazard mitigation strategy. Coupled with the Risk Assessment, the Capability Assessment helps identify and target meaningful mitigation actions for incorporation in the Mitigation Strategy portion of the Hazard Mitigation Plan. It not only helps establish the goals for Houghton County to pursue under this Plan, but also ensures that those goals are realistically achievable under given local conditions.

Planning and Regulatory Capability

Planning and regulatory capability is based on the implementation of plans, ordinances and programs that demonstrate a local jurisdiction's commitment to guiding and managing growth, development, and redevelopment in a responsible way while maintaining the general character of the community. It includes emergency response and mitigation planning, land use and transportation planning, zoning and building code enforcement, as well as protecting environmental, historical, and cultural resources. Some conflicts may arise, but these planning initiatives generally present significant opportunities to integrate mitigation principles into the local decision-making process.

Table 7.1 below provides a summary of relevant local plans, ordinances and programs already in place or under development for Houghton County's participating local governments. A checkmark (✓) indicates that the given item is currently in place, or it is currently being developed for future implementation. Local governments will integrate, as appropriate, the data, information and hazard mitigation goals and actions from this mitigation plan into other planning mechanism, such as those listed in Table 7.1.

Table 7.1: Relevant Plans, Ordinances, and Programs in Houghton County

MP - Embedded in Master Plan* *CO* - Under county plan*

Jurisdiction	Land Use Plan	Stormwater Management Plan	Master Plan	Asset Management Plan	Watershed Management Plan	Recreation Plan	Recreation and Natural Resource Conservation Plan	Emergency Operations Plan	Disaster Recovery Plan	Capital Improvements Plan	Historic Preservation Plan	Zoning Ordinances	Building Code	National Flood Insurance Program
Houghton County	✓ MP*		✓			✓		✓	✓		✓			
City of Hancock	✓ MP*	✓	✓			✓		✓		✓ MP*		✓	✓	✓
City of Houghton	✓ MP*	✓	✓	✓	✓	✓ MP*	✓	✓		✓		✓	✓	✓
Village of Calumet	✓ MP*		✓			✓ MP*		✓		✓		✓		
Village of Copper City								✓						
Village of South Range								✓				✓	✓ Co*	
Village of Lake Linden						✓		✓				✓		
Village of Laurium								✓				✓	✓	
Adams Township								✓						✓
Calumet Charter Township						✓		✓				✓		
Chassell Township						✓		✓						✓
Duncan Township								✓						
Elm River Township								✓						
Franklin Township		✓				✓		✓					✓ Co*	✓
Hancock Township								✓						
Laird Township								✓						
Osceola Township						✓		✓						✓
Portage Charter Township						✓		✓						
Quincy Township								✓						
Schoolcraft Township								✓						✓
Stanton Township								✓						
Torch Lake Township								✓						✓

Mitigating Hazards in Houghton County

The following is an overview of potential activities by category for Houghton County. A more detailed list of activities, responsible parties, and estimated costs are mapped out in Section 8: Action Plan.

Local Plans and Regulations

The purpose of these actions is to include government authorities, policies or codes that influence the way land and buildings are being developed and built. Several activities can be implemented at the local level, including:

- Building Codes
- Planning and Zoning
- Open Space Preservation
- National Flood Insurance Program

Building Codes: Building codes are an effective way to address many hazards identified in this plan. Through building code enforcement all new and improved buildings can be built or rehabilitated to withstand the impacts of certain hazards such as snow load, high winds, extreme temperatures and flooding.

In 1999 the State of Michigan amended the process of code adoption under the State Construction Code Act (Act 230). This Act now requires municipalities to administer and enforce the statewide codes, including the Michigan Building Code 2003, Michigan Plumbing Code 2003, Michigan Mechanical Code 2003, and Michigan Residential Building Code 2003, all developed by the International Code Council (ICC); and the National Electrical Code 2002, published by the National Fire Protection Association. The language does not permit local communities to modify the State codes. In Houghton County, the County is responsible for all electrical, mechanical, and plumbing code enforcement and for building code enforcement in all jurisdictions except the City of Hancock, Portage Charter Township, and Stanton Township, which maintain local control of building codes. Thorough inspection of property during and after construction ensures that builders are incorporating all the current standards and requirements in effect.

Planning and Zoning: Planning and zoning guides indicate where development should occur based on suitability and compatibility, keeping development away from sensitive areas such as floodplains and wetlands and thereby protecting property from certain types of natural hazards. Master plans are a primary way for a local unit of government to guide future development within their community. Through a planning process that reviews a community's background, current land use, and projected needs, guidance can be given to future development. Master plans serve only as a guide and do not regulate land use.

Zoning regulations are the primary tool to implement comprehensive plans and control land use. By identifying different zones or districts, a community can guide development within its boundaries. Zoning puts restrictions on use, lot size, setbacks, etc., but can be combined with more creative regulations such as a planned unit development option that allows more flexibility

in the development process. Zoning is enforced by the local unit of government and should be based on a comprehensive plan for the community. Houghton County completed a new Master Plan in 2018 which includes an updated land use plan for the county. The City of Houghton is in the process of updating its latest Master Plan for 2019-2023 and the City of Hancock adopted their five-year Master Plan in July 2018.

Land conservation is another good tool for communities to use for reducing the risks of stormwater runoff and sewer overflows.

Open Space Preservation: Open space preservation is a way to keep hazardous areas free from development and is especially effective in floodplain areas. Prohibiting new development in hazard-prone areas is the best way to mitigate future problems. An additional benefit to open space preservation is the maintenance of agricultural areas, green space/parks, and the installation of green infrastructure to mitigate stormwater runoff. While single-purpose gray stormwater infrastructure—conventional piped drainage and water treatment systems—is designed to move urban stormwater away from the built environment, green infrastructure reduces and treats stormwater at its source while delivering environmental, social, and economic benefits. Comprehensive plans can help identify suitable areas to preserve through any number of means including acquisition, donation by developers, easement or regulated setbacks/buffers where development is restricted.

National Flood Insurance Program: The National Flood Insurance Program aims to reduce the impact of flooding on private and public structures. It does so by providing affordable insurance to property owners, renters and businesses and by encouraging communities to adopt and enforce floodplain management regulations. These efforts help mitigate the effects of flooding on new and improved structures.

Natural Systems Resource Protection

Natural Systems Resource Protection mitigation activities are a way to enable land to function in a natural way. There are many benefits to naturally functioning watersheds, floodplains and wetlands, which can include:

- Reduction in runoff from rainwater and snowmelt
- Infiltration and velocity control during overland flow
- Filtering of excess nutrients, pollutants and sediments
- Floodwater storage
- Water quality improvement
- Groundwater recharge
- Habitat availability and regeneration

- Recreation and aesthetic qualities

Many natural areas have historically been affected by development and will be affected by development in the future, there are several ways to protect and restore the environment through hazard mitigation. Resource protection activities can include:

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

Wetland Protection: Wetlands are a valuable resource that provides mitigation functions including storage of floodwaters and pollutant filtration, regulate overland flow, as well as habitat for fish, wildlife, and plants. As a result, wetlands are regulated in Michigan by Part 303, Wetland Protection, of the Natural Resources and Environmental Protection Act (Act 451 of 1995). EGLE administers the permit program. In Michigan a permit is required to: deposit fill material in a wetland; dredge or remove soil or minerals from a wetland; construct, operate, or maintain any use or development in a wetland; or drain surface water from a wetland. Wetlands are specifically defined under the Act, and certain activities are exempted under the Act.

Local units of government can play a role in wetland protection and should serve as stewards over their water resources. Wetland protection measures can be implemented on a local level, and public education is a key to protecting this valuable resource.

Bioswales are vegetated, or mulched channels that provide treatment and retention as they move stormwater from one place to another. Vegetated swales slow, infiltrate, and filter stormwater flows. As linear features, they are particularly well suited to being placed along streets and parking lots.

Erosion and Sedimentation Control: Surface water can easily erode soil in large exposed areas including farmlands, construction sites, and forested areas. In addition to exposed areas, erosion often occurs along stream banks and shorelines with high velocity currents and wave action. The erosion carries sediments and deposits them downstream where they can cause problems to storm sewers, culverts and ditches by reducing the capacity of the systems. Erosion also results in sediment in the water which reduces light and oxygen in the water. Heavy metals and other contaminants are the reason that sediment is identified as the number one nonpoint source pollutant for aquatic life.

Erosion and sedimentation can be controlled through phased construction, minimization of clearing, and stabilization of bare ground with vegetation, and other means. Sediment can be captured onsite with traps and filters, and water velocity can be slowed by terraces, temporary cover, constructed wetlands, and impoundment.

Part 91, Soil Erosion and Sedimentation Control, of the Natural Resources and Environmental Protection Act (NREPA), PA 451 of 1994, as amended, regulates only earth change activity (primarily construction projects disturbing one or more acres of land or that which is within 500 feet of the water's edge of a lake or stream). Part 31, Water Resources Protection Act, of NREPA addresses most other sources of sediment. In Houghton County, the Houghton County Drain Commissioner is the enforcing official. Locally, municipalities may adopt additional protection measures dependent on state laws via the NREPA or Planning and Zoning Enabling Acts.

Areas of the Torch Lake Superfund site have been covered with natural vegetation in the hopes that the sites will return to a natural function and will cease ongoing wind and water erosion of the sands.

River Restoration: History has proven that returning streams and adjacent land to a natural condition reduces erosion. The restoration of vegetation along stream banks protects the water by:

- Reducing the amount of sediment (and pollutants) entering the water.
- Provides habitat for wildlife.
- Slows the velocity of water, thus reducing flood damage and erosion.
- Provides recreational opportunities and aesthetic value.
- Reduces long-term maintenance costs.

Best Management Practices: Non-point source pollutants including fertilizers, pesticides, animal wastes, chemicals, and sediment are washed away by storm water and distributed in storm sewers, ditches, and streams. The term "best management practices" (BMPs) refers to the design, construction and maintenance practices and criteria that minimize the impact of stormwater runoff.

Dumping Regulations: Dumping regulations attempt to regulate the disposal of solid matter that can end up in streams and wetlands. Solid waste can pollute water, obstruct water flow, and reduce the ability of the stream or wetland to clean storm water. The dumping of waste materials such as garbage is illegal, but the dumping of yard waste, such as leaves and branches, can also affect a watercourse. Waste can block culverts, creating earthen dams that can fail during heavy rain events. Public information should be a central focus of a dumping enforcement program.

Urban Forestry: Damage caused by wind, ice, and snowstorms is often due to their impact on trees. Downed trees and branches can upset power lines, damage buildings, and harm property under them. An urban forestry program can reduce the damage potential of trees through maintenance and monitoring. Through better tree selection, proper pruning and evaluation, communities can also mitigate damage caused by downed trees.

Farmland Protection: Farmland protection's purpose is to provide ways to keep prime, unique or important agricultural land intact. Farmland is being converted to nonagricultural uses at an alarming rate which results in residential development that needs more infrastructure, increased storm water runoff, and emergency services capacity. Farmland protection parallels open space protection in that it keeps the land open for future generations but also helps with storm water runoff, ecosystem maintenance, and scenic enhancement.

The Michigan Farmland and Open Space Preservation Act (PA 116) is a law that works to preserve farmland by offering incentives to farmers who are willing to participate. According to the Michigan Department of Agriculture and Rural Development (MDARD), the law, which was passed in 1974, enables a farm landowner to enter into a development rights agreement with the state. The agreement is designed to ensure that the land remain in agricultural use for a minimum of 10 years. In return, the farm owner may be entitled to income tax benefits and exemption from special assessments on the land. Today, 3.3 million acres of land, or 9% of Michigan's total land area, is protected under this program[41]. In June 2019, MDARD issued a ruling opening farmland in the state preservation program to large-scale solar development, with several important caveats, including landowners not being able to claim tax credits under PA 116 until the panels are uninstalled[42].

Emergency Services

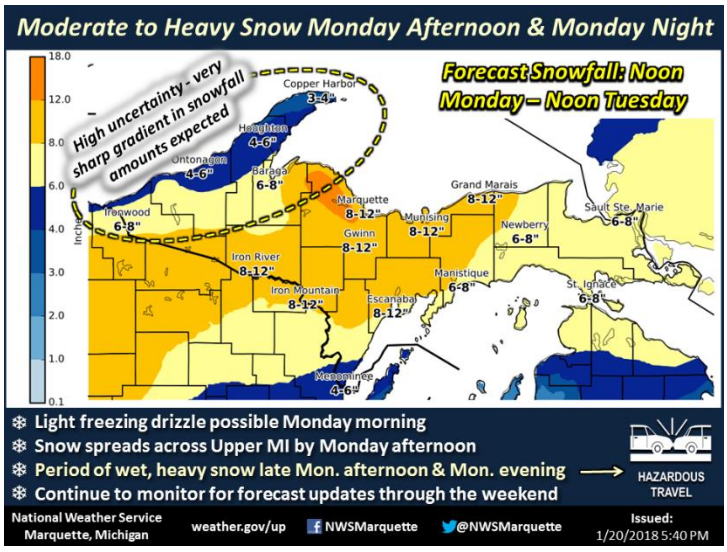
Local emergency services authorities, resources, and facilities throughout Houghton County are documented in Section 3 of this plan. Although all authorities are effective in conducting their internal and incident response activities, there is an opportunity to further educate the public about their operations – for example, through dissemination of hazard-related materials. Furthermore, several agencies lack necessary equipment to meet their responsibilities in areas of local government operations such as public works and planning. Inadequate funding sources will make this a continuing problem.

Emergency services provide protection for people both during and after a disaster. A thorough emergency services program addresses all hazards and involves all response departments and facilities. In Michigan, emergency services are supervised by the Michigan State Police Emergency Management and Homeland Security Division and coordinated through county emergency management offices. Several components pertain to emergency services, including:

- Threat Recognition
- Warning
- Response
- Critical Facilities Protection
- Post-Disaster Recovery and Mitigation

[41] Farmland and Open Space Preservation Frequently Asked Questions. MDARD. https://www.michigan.gov/mdard/0,4610,7-125-1599_2558-10312--,00.html
[42] Policy for Allowing Commercial Solar Panel Development on PA 116 Lands. MDARD. https://www.michigan.gov/documents/mdard/MDARD_Policy_on_Solar_Panel_and_PA116_Land_656927_7.pdf

Threat Recognition: The first step in responding to a hazard is being aware that there is potential for an event to occur. With a threat recognition system, adequate warnings can be disseminated, and other response actions can be undertaken. Flood threats can be evaluated by measuring rainfall, soil moisture, and stream flows upstream and then calculating flood levels for downstream locations. Discerning the time and height of a potential flood crest will allow more efficient evacuations. Some rivers have gauges that establish threat levels. Under threat conditions, the National Weather Service (NWS) may issue flash flood watches for affected areas. The NWS is the agency that predicts meteorological threats and can issue public warnings.



National Weather Service in Marquette issuing a heavy snowfall warning on January 20, 2018

Warning: After a threat is identified, the Office of Emergency Measures (OEM) notifies municipalities and other agencies that an event is possible or occurring. Early notification is key to distribute information to all affected parties. The NWS notifies the public using two levels: *Watch* and *Warning*. *Watch* refers to conditions that are right for flooding, thunderstorms, tornadoes or winter storms. *Warning* refers to a flood, tornado, etc. has started or has been observed. A more specific warning may be disseminated in a few ways, including:

- Warning sirens (outdoor and on public safety vehicles)
- Via commercial radio or TV (news and weather channels)
- NOAA Weather Radio (where available)
- Mass telephone notification
- Tone activated receivers in key facilities
- Door to door contact
- Mobile public address systems via text
- Internet/e-mail notification

All the systems have their limitations because they reach only certain audiences. TV and radio can provide information, but this method of notification is only effective if people have them on. NOAA radio will only reach those with access to a weather radio. Outdoor warnings can indicate to tune into another information source such as TV or radio, but this type of warning has limited reach and may not be heard by people indoors or in noisy environments. Door-to-door contact is time consuming but preferred when there is enough lead time for an incident. The best warning system is a redundant system that provides notification via numerous methods in order to reach as much of the population as necessary.

The warning system should also include information as to the response action to take, such as staying indoors during a tornado warning or staying off roads in the event of a severe winter storm.

Response: Effective response, in combination with threat recognition and warnings, is another way for a community to mitigate hazard impact. A community typically coordinates an incident response through an emergency operations center (EOC) that assists the Incident Commander in the field with resources, expertise, etc. as part of the Emergency Action Plan (EAP). An EAP ensures that the community responds efficiently and appropriately to an incident. EAPs need to be regularly updated in order to keep names and contact information current.

Response activities may include a variety of agencies, offices, and measures such as closing streets and bridges, shutting off power to threatened areas, ordering an evacuation and opening evacuation centers, monitoring water levels, and implementing security measures.

Critical Facilities Protection: Critical facilities are the vital facilities that keep a community functioning as identified in Section 3. Critical facilities must be prepared to respond during an emergency. Most critical facilities will have their own response plan in place, and the facilities are also included in municipal emergency action plans. The best protections are early warning, response planning, and coordination in the event of an emergency.

Post-Disaster Recovery and Mitigation: Communities must be prepared for recovery and mitigation of future problems after an incident. While the primary focus is on recovery, it is also important to recognize mitigation methods to prevent the incident from reoccurring at the same magnitude. During recovery, several actions take place including patrolling, cleanup, providing services, monitoring impact, and regulating reconstruction. During this recovery time, mitigation activities can include undertaking public information efforts aimed at educating residents on how to protect themselves in the future, evaluating reconstruction methods including the addition of mitigation measures, and seeking funding for recovery efforts.

Structure and Infrastructure Projects

Structure and infrastructure projects are intended to protect people and infrastructure from damage due to natural hazards. Such projects are typically used to manage and control flood waters. The complexity and cost of structural projects can vary greatly and are dependent on individual circumstances. Structural projects are undertaken where non-structural measures would not be effective. Structural projects may include:

- Reservoirs and Detention Areas
- Roadway and Road Crossings Improvements
- Levees, Floodwalls, and Seawalls
- Drainage and Storm Water Improvements/Maintenance
- Channel improvements

Because of the construction costs, maintenance and impacts of structural projects, they are often undertaken and funded by larger agencies with coordination at the local level. Agencies

including the Michigan Department of Natural Resources, U.S. Army Corps of Engineers, and the USDA Natural Resources Conservation Service are often involved in structural projects.

Reservoirs and Detention Areas: Reservoirs are intended to protect development downstream by temporarily storing flood waters. The reservoirs hold water behind dams or in storage/detention basins until flood waters subside. The detained water is then released downstream at a rate the river or stream can accommodate. Reservoirs are built to address existing problems or may be built to handle increased runoff from new development.

Roadway and Road Crossings Improvements: Flooding can often affect accessibility by inundating roadways, culverts, bridges, driveways, and other transportation infrastructure. There are several things that can be done to maintain access when alternative access is not available, including elevating the roadbed, enlarging culverts to increase channel capacity, or replacing culverts with bridges. A concern when undertaking these types of improvements is the impact to downstream locations from increased capacity of the water system when it is no longer constricted up stream.

Upgraded culverts can mitigate flooding problems by increasing the flow capacity of streams as they pass under roadways.

Levees, Floodwalls and Seawalls: One of the most popular flood control measures is the construction of an earth levee or concrete floodwall to protect property. The purpose of these structures is to keep a stream within its channel by providing higher "banks." Levees require extensive design in order to address large floods, erosion, river access and views, and cost of construction and maintenance. Seawalls are often used to protect from erosion due to storm surges along Lake Superior's edge. Seawalls are built along a property edge and are designed to protect a property from the storm surges. Along the Great Lakes they can be significantly impacted by ice movement during the winter months and often have difficulty resisting lake forces.

Drainage and Storm Water Improvements/Maintenance: Human-made ditches and storm sewers assist in guiding runoff where surface drainage is inadequate. These systems allow water to be conveyed quickly to other locations; thus, they are most appropriate where the receiving location has adequate capacity. Storm sewer improvements may include installing new sewers, enlarging pipes, and preventing back flows. Other improvements in combination with drainage enhancements may include wetland detention, vegetated trenches, and practices that reduce the quantity and velocity of runoff. It is also important to maintain storm water and drainage systems. This involves keeping channels, ditches, and culverts cleared of debris; maintaining overgrowth; and remediating stream bank erosion sites. Debris can be any number of things, from tree limbs and branches to illegally dumped trash. Maintenance of public drainage systems is the responsibility of government agencies. The city or township must perform routine maintenance on these drainage systems or they (or residents in the watershed) may petition the

County Drain Commission to establish a county drain which after approval by the County Board of Commissioners, then becomes the county's responsibility to maintain.

Channel Improvements: Channel improvements are another method of increasing the capacity of streams, thereby allowing more water to travel at a faster rate. Improvements can be made through dredging, "channelization," or diversion. Dredging increases the capacity of a stream by removing material at the bottom. Channelization refers to the straightening, widening, and/or deepening of a stream. Diversion is the practice of creating a new channel to send floodwaters to an alternative location.

The Houghton County Road Commission maintains a future project list and continues to identify and upgrade inadequate culverts and problem roadways as needed. The communities of Houghton, Hancock, Lake Linden, Hubbell, Ripley, Dollar Bay, and Painesdale regularly experience high runoff related to steep topography and should continue upgrades that assist in management of these conditions.

Education and Awareness Programs

Education and awareness programs are a mitigation strategy that has broad reaching impact across both the public and private sectors. Activities that provide local officials, property owners, renters, businesses, and other parties with information about how to protect themselves and others from potential hazards may have the greatest impact of all mitigation strategies. Information empowers people to protect their own property and lives.

There are many ways to get information out to the public affected by hazards through community outreach. Community outreach is informing the public through news media, community newsletters, direct mailings, presentations, displays, signs, the internet, brochures, technical assistance, and other outlets. Because methods are diverse, it is best to analyze each community to find out how people obtain information and use that knowledge to build an outreach plan. While in some communities a local newsletter is distributed, other communities may rely on a newspaper to get information.

While public information on hazards is important, it is also vital to provide people with methods to address the hazard. Outreach projects should include information on hazards, safety, health, and property protection measures at the local level. Community offices and libraries are good places to distribute printed information (e.g., books and pamphlets) and increasing internet use indicates web distribution is also an effective way to disseminate information. Information on a website can easily be linked to an infinite number of available resources.

Technical assistance can further assist people in protecting their property. Assistance can be in the form of hazard identification assistance or property protection assistance. Resources for technical assistance may include direction from building department staff or FEMA Flood Map clarification with assistance from community staff.

In Houghton County and its local jurisdictions, education is the key to hazard mitigation. By providing individual citizens with the information and tools necessary, much can be done to further mitigation efforts in the county. An ongoing education program and availability of

limited technical assistance could provide the public with the ability to protect themselves and their property.

Mitigation Resources

There are two types of resources: existing institutional establishments, such as government agencies and continuing programs, and funding sources to undertake specific projects. The following list is intended to provide examples of funding sources for both current and future mitigation projects and should not be considered comprehensive. Potential new sources for mitigation funding should be added as identified. Project specific funding options are included in the respective Action Items identified in Section 8. The following mitigation funding and resources can be found with further detail in Appendix C.

Federal		
Economic Development Administration	U.S. Department of Agriculture	U.S. Department of Transportation
Federal Emergency Management Agency	U.S. Department of Energy	U.S. Small Business Administration
U.S. Army Corps of Engineers	U.S. Department of Health & Human Services	U.S. Department of Housing and Urban Development
U.S. Department of the Labor		

State		
Environment, Great Lakes, and Energy	Michigan Department of Natural Resources	Michigan Economic Development Corporation
Michigan Department of Transportation		

Other - Local		
Copper County Habitat for Humanity - Homeownership Program	Baraga-Houghton-Keweenaw Community Action Agency	Superior Watershed Partnership and Land Conservancy
Hancock Salvation Army	Habitat for Humanity Menominee River	Superior Health Foundation
Duck Lake Riparians' Association	Keweenaw Community Foundation	Portage Health Foundation
Keweenaw Land Trust	Keweenaw Economic Development Alliance	Western Upper Peninsula Planning & Development Region (WUPPDR)

Other - National		
Community Restoration and Resiliency	National Low-Income Housing Coalition	Rebuilding Together
Grants for Indigenous Peoples	Planning for Post Disaster Recovery	Volunteer Organizations Active in Disasters (VOAD)

Updating the 2020 Houghton County Hazard Mitigation Plan

This section is intended to provide discussion on how communities will continue public participation in the plan maintenance process. It will also contain a description of plan monitoring, evaluating, and updating for keeping the plan current and updated within five years.

Throughout of the development of the 2020 Houghton County Hazard Mitigation Plan, the County has made a concerted effort to collect feedback from the public, local government, and agencies. Moving forward residents will continue to be notified of any plan updates and be invited to provide feedback through the incorporation of hazard mitigation into other planning documents.

The Hazard Mitigation Plan will be updated every five years in order to address changing priorities and remain eligible for FEMA mitigation funding programs. The Emergency Manager will convene a Local Planning Team representing local agencies and concerned parties to evaluate progress and update the plan in accordance with FEMA regulations. The Committee will review the plan to determine the sections that need to be updated or modified based on changing conditions or alterations in State or Federal requirements. It is recommended that public participation will include surveys, charettes, and other community presentations at regularly scheduled meetings. Goals, objectives, and strategies will also be reviewed to determine whether they thoroughly address new or changing conditions.

The Emergency Manager with monitor and evaluate the plan implementation overtime to assess the effectiveness of the plan at achieving its stated goals. They will work with Houghton County to update the plan within five years based on public feedback, the Local Planning Team and State Hazard Mitigation Officer recommendations. The public will also be notified of any plan updates (interim or within five years), and copies will be made available at all local government offices and online.

SECTION 8: Action Plan

This section highlights the five-year action plan set out by the Local Planning Team for Houghton County to reduce the community's vulnerability and risk to local hazards based on their capability. The final step in the mitigation process is to build upon the general recommendations for mitigation activities suggested in Section 7 and identify specific action items for Houghton County and its communities. All the activities identified in this section are consistent with the following mitigation goals identified in Section 7:

Goal 1: Protect lives and property within Houghton County from all known hazards while focusing on priority hazards.

Goal 2: Identify feasible projects throughout the County that will help mitigate future problems.

Goal 3: Be proactive in protecting public facilities and critical facilities through proper maintenance and upgrades.

Goal 4: Educate citizens to encourage self-help and mitigation of hazards on private property.

Projects vary from structural measures to education and are prioritized based on impact to persistent, known hazards and potential resources available to complete the project. Although projects are prioritized on a countywide basis, this does not limit the county's or a local community's ability to pursue identified projects as funding becomes available. A number of the projects are ongoing action activities that will be accomplished as time and resources permit. Identified action items include a short description of the activity, the responsible agency or agencies, timeline, projected costs if available, and ways that Houghton County and its citizens will benefit.

Cost-benefit consideration, both financial and otherwise, is a major factor in the prioritization of action items. As a result, action priorities are not entirely consistent with the rankings in the Hazard Analysis section. In addition, a potential event that is anomalous within its hazard category may warrant action regardless of the rank of that general hazard type.

Past Mitigation Accomplishments

Tables 8.1 and **8.2** below summarize the status of the mitigation action items from the 2005 and 2013 Hazard Mitigation Plans.

Table 8.1: 2005 Hazard Mitigation Action Items

2005 Item	Status in 2013
Sturgeon River Road Bank Stabilization	Not Completed
Flood Mitigation – Storm Drainage Sewer Upgrades	Not Completed
Drainage Improvements and Maintenance	Not Completed
Mine Shaft Safety	Ongoing
Secure Redridge Dam	Completed
Update Stormwater Management Plan and Flood Maps	Ongoing
Development of a Multi-hazard Mitigation Plan for Michigan Tech	Completed
Improved Emergency Response, Equipment, and GIS System	Not Completed
Bridge Approaches for Emergency (Temporary) Bridge	Not Completed
Portable Water Treatment System	Not Completed
Updated Shoreline Erosion Map and Identify Future Mitigation Activities	Not Completed
Public Information / Education Program	Ongoing
Review Plans and Development Regulations	Ongoing
Insurance	Ongoing

Table 8.2: 2013 Mitigation Action Items

2013 Item	Status
Portage Lake Span Bridge	Not Completed
Sturgeon River Road Bank Stabilization	Ongoing
Flood Mitigation – Storm Drainage Sewer Upgrades	Ongoing
Drainage Improvements and Maintenance	Not Completed
Mine Shaft and Stope Safety	Ongoing
Update Stormwater Management Plan and Flood Maps	Ongoing
Retrofit Underground Pipes	Ongoing
Improved Emergency Response, Equipment, and GIS System	Not Completed
Bridge Approaches for Emergency (Temporary) Bridge	Not Completed
Improved Firefighting Capability	Ongoing
Portable Water Treatment System	Not Completed
Updated Shoreline Erosion Map and Identify Future Mitigation Activities	Not Completed
Acquire and Distribute Sump Pumps for Residences	Deleted
Public Information / Education Program	Ongoing
Close and remediate Pedersen/Lahti Landfill	Completed
Review Plans and Development Regulations	Ongoing
Insurance	Ongoing

Some action items are carried over from the 2013 Hazard Mitigation Plan including several ongoing activities that will continue indefinitely. Two projects have been completed – most notably securing the Redridge Dam and developing a Hazard Mitigation Plan for Michigan Tech. The other items were and are dependent on funding that has not been available. Finally, items were added to improve preparedness for an outage of the Portage Lake Lift Bridge. No large-scale changes in land development have occurred in Houghton County since 2005. Most construction has been incremental within or adjacent to already-developed areas. Houghton County, the City of Houghton, and Portage Township have recently completed, are in progress of completing, or have explored, respectively, new master plans. None of these are expected to have a major effect on land use in the County. Note that action item costs are estimated.

Action Item 1: **Disaster Recovery Plan**

The Federal Emergency Management Agency (FEMA) works to ensure that communities have the tools needed to make informed decisions to reduce risks and vulnerabilities and to effectively respond and recover. Effective pre-disaster planning is an important process that allows a comprehensive and integrated understanding of community objectives. Pre-disaster planning also connects community plans to guide post-disaster decisions and investments.

Responsible Agency:	Houghton County Emergency Manager, the local emergency planning team, and local units of government
Deadline:	2021
Cost:	$5,000
Potential Funding Sources:	Pre-Disaster Mitigation Grant Program (FEMA)
Benefits:	The ability of a community to successfully manage the recovery process begins with its efforts in pre-disaster preparedness, mitigation, and recovery capacity building. These efforts result in resilient communities with an improved ability to withstand, respond to, and recover from disasters. Pre-disaster recovery planning promotes a process in which the whole community fully engages with and considers the needs and resources of all its members. The community will provide leadership in developing recovery priorities and activities that are realistic, well planned, and clearly communicated.

Action Item 2: Sturgeon River Road Bank Stabilization

The Houghton County Road Commission has an approximately four-mile segment of primary road adjacent to the Sturgeon River in Chassell Township that floods regularly in the spring. There are eight identified locations that need extensive erosion control measures to prevent washing out and loss of access for residents. This project was the top priority in the 2005 plan and ongoing in 2013 but lacked enough funding to complete.

Responsible Agency:	Houghton County Road Commission

Deadline:	2022
Cost:	$750,000
Potential Funding Sources:	FEMA Pre-Disaster Mitigation Program, FEMA Hazard Mitigation Grant Program, Army Corps of Engineers, and Houghton County Road Commission
Benefits:	The project will protect the roadway from erosion as well as the two center piers of the 180-foot span bridge that are being scoured during high discharges. Access to the 14 residences on the dead-end road will be secured under this project.

Action Item 3: Flood Mitigation – Storm Drainage Sewer Upgrades

Houghton County municipalities have several severely deteriorated storm drainages within their built-up communities. These drainage systems enclose seasonal and permanent waterways and have been built haphazardly, many by residents who have filled in ditches with scrap material and undersized pipe materials over the past 100 years. These drainages need upgrading that alleviates ongoing maintenance and flooding problems. Some of the most severe problems are in Chassell, Dollar Bay, Mason, Ripley, Houghton, Hubbell, and Lake Linden. This project was a high priority in the 2005 plan but lacked enough funding.

Responsible Agency:	Houghton County Road Commission and municipal public works
Deadline:	Ongoing
Cost:	Varies by project; staff time
Potential Funding Sources:	FEMA Pre-Disaster Mitigation Program, FEMA Hazard Mitigation Grant Program, and organization/agency operating budgets
Benefits:	Improvements will alleviate ongoing problems caused by improperly constructed storm systems exacerbated by heavy spring runoff conditions. Work will largely fix/replace or otherwise improve storm sewer carrying capacity and will address health concerns related to the location of system discharge.

Action Item 4: Green Infrastructure Installation

Green infrastructure is a cost-effective, resilient approach to managing wet weather impacts that provides many community benefits. While single-purpose gray stormwater infrastructure—conventional piped drainage and water treatment systems—is designed to move urban stormwater away from the built environment, green infrastructure reduces and treats stormwater at its source while delivering environmental, social, and economic benefits.

Stormwater runoff is a major cause of water pollution in the region. When rain falls on roofs, streets, and parking lots in cities and communities bordering Lake Superior, the water cannot soak into the ground as it should. Stormwater drains through gutters, storm sewers, and other

engineered collection systems and is discharged into nearby water bodies. The stormwater runoff carries trash, bacteria, heavy metals, and other pollutants from the built landscape. Higher flows resulting from heavy rains also can cause erosion and flooding in streams, damaging habitat, property, and infrastructure.

Responsible Agency:	Houghton County
Deadline:	2022
Cost:	Varies by project
Potential Funding Sources:	FEMA Pre-Disaster Mitigation Program, FEMA Hazard Mitigation Grant Program, Department of Natural Resources Land and Conservation Fund, EGLE Coastal Zone Management Program, and organization/agency operating budgets
Benefits:	When rain falls in natural, undeveloped areas, the water is absorbed and filtered by soil and plants. Stormwater runoff is cleaner and less of a problem. Green infrastructure uses vegetation, soils, and other elements and practices to restore some of the natural processes required to manage water and create healthier urban environments. At the city or county scale, green infrastructure is a patchwork of natural areas that provides habitat, flood protection, cleaner air, and cleaner water. At the neighborhood or site scale, stormwater management systems that mimic nature soak up and store water.

Action Item 5: Drainage Improvements and Maintenance

As an ongoing project in the county, the Houghton County Road Commission has had an active role in upgrading roads and replacing inadequate culverts in response to previous problems and to mitigate future problems. Houghton County would upgrade up to 40 culverts (including ditching and road restoration) along county roads that are susceptible to flooding every three- or four-years during spring runoff. The County and municipalities should also continue to maintain and upgrade current systems as needed while monitoring beaver dam problems.

In addition to County Road projects, numerous areas along M26 north of the Portage Lake Lift Bridge (in and around Hancock, Ripley, Dollar Bay, Hubbell, Tamarack City, and Lake Linden) and south of the bridge (in and around South Range, Trimountain and Painesdale) are in need of drainage assessment, planning and improvements to deal with runoff problems.

Funding has not been available to accomplish these actions since their inclusion in the 2005 plan.

Responsible Agency:	Houghton County Road Commission and municipal public works
Deadline:	Ongoing
Cost:	Varies by project; staff time

Potential Funding Sources:	FEMA Pre-Disaster Mitigation Program, FEMA Hazard Mitigation Grant Program, and organization/agency operating budgets
Benefits:	Inspection and maintenance of the existing drainage system will prevent flooding caused by plugged culverts and upgrading of culverts will ensure mitigation of future problems in areas where materials are washed into waterways regularly during spring flood conditions. Studies and improvements for the M-26 corridor will address ongoing spring runoff problems.

Action Item 6: Mine Shaft and Stope Safety

An ongoing program of mine safety that includes capping and other measures should be implemented. As funding is available, the County will prioritize and address hazardous shafts and stopes. Shafts should be closed off at their openings, whereas stopes should be identified and mitigated through internal supports and/or closure of overlying land. Mine shaft and stope safety were included in the 2005 and 2013 plans and is an ongoing process, but in this incarnation, the dollar amount needed for each cap has been significantly increased to allow for the full range of case-by-case projects. Cost of other mitigation components is unknown and varies case by case.

Responsible Agency:	Houghton County, including Mine Inspector; City of Hancock and Houghton
Deadline:	Ongoing
Cost:	$20,000 minimum for protective measures and up to $75,000 for capping per shaft/opening
Potential Funding Sources:	FEMA Hazard Mitigation Grant Program and DOI Abandoned Mines Reclamation Program
Benefits:	Action to address the numerous abandoned mines throughout the Copper Country is necessary to protect people and property. The long history of mining has led to a persistent problem with mine shaft openings, shafts that are reopening due to improper capping (with materials such as rotting logs and rusting cars), and unidentified stopes that needs to be addressed.

Action Item 7: Update Stormwater Management Plans

Due to changing land use, climate change, and ongoing upgrades to storm systems in the County, stormwater management plans should be updated to address changing conditions. Management plans should incorporate updated FEMA maps when available.

Responsible Agency:	Houghton County and local jurisdictions
Deadline:	Ongoing
Cost:	Staff time
Potential Funding Sources:	FEMA and organization/agency operating budgets

Benefits:	The County and municipalities will benefit by being able to make informed decisions based on accurate storm water management plans that incorporate upgrades that are completed, underway, or planned.

Action Item 8: Retrofit Underground Drinking Water Infrastructure

Aging and un-insulated pipes should be identified and replaced or retrofitted as work is done on underground utilities. More urgent replacements should be done as separate projects as soon as possible. The latter is the case for a 1938 water line serving Adams Township and Portage Charter Township.

Responsible Agency:	Municipal Departments of Public Works
Deadline:	Ongoing
Cost:	Variable
Potential Funding Sources:	FEMA Pre-Disaster Mitigation Program, FEMA Hazard Mitigation Grant Program, USDA Rural Development, and local
Benefits:	Residents and municipalities will benefit from prevention of infrastructure failure due to burst pipes.

Action Item 9: Improved Emergency Response, Equipment, and GIS

Conduct ongoing reviews of response plans and programs to keep emergency contacts up to date, ensure critical facility information is current, and to identify and incorporate new and improved methods of warning and response. Continue development and maintenance of County GIS that is coordinated with the 911 system (addressing and access road/parcel mapping have been undertaken since 2005) and all departments so resources and hazard evaluations can be comprehensively addressed. Adequacy of shelter facilities, response equipment, and training can be evaluated during ongoing reviews of response plans and updated as needed.

Responsible Agency:	Houghton County Office of Emergency Measures
Deadline:	Ongoing – incorporate into annual emergency plan revision process
Cost:	Staff time
Potential Funding Sources:	FEMA, DHS State Homeland Security Grant Program, Firefighter Assistance Grants, U.S. Department of Health and Human Services, and U.S. Department of the Interior
Benefits:	Emergency plans that are up to date and incorporate all available methods of warning and response will be most effective in emergency situations thus mitigating loss from hazards. These plans serve as an effective tool in determining equipment needs on an annual basis while an integrated Geographic Information System will provide a comprehensive

	inventory of County assets for hazard and emergency management.

Action Item 10: Bridge Approaches for Emergency (Temporary) Bridge

Bridge approach preparation on the north and south side of the Portage Canal would ease installation of a portable, temporary bridge in the event of a Lift Bridge failure. Temporary approaches or ramps would allow access to and from the north side of the bridge for emergency services. This action item was proposed in 2013 and has been carried over due to funding needs.

Responsible Agency:	Houghton County Office of Emergency Measures
Deadline:	Ongoing
Cost:	$250,000
Potential Funding Sources:	Congressional appropriation (Army Corps of Engineers), DHS State Homeland Security Grant Program, and FEMA Port Security Grant Program
Benefits:	If the Portage Lift Bridge were to fail, both northern Houghton and Keweenaw County would be without land access. The two hospitals in the area are located on the north side of the bridge, leaving the south side without local medical services until access was restored. If permanent approaches are ready in the event of a failure, a temporary/portable bridge can quickly be installed.

Action Item 11: Inpatient care facility and other recommendations to address substance abuse public health crisis

Residential treatment centers are a crucial part of the continuum of care in addressing substance abuse. With the increase in the amount of addiction-related deaths, there is a real need for residential treatment centers. Currently the one inpatient drug treatment center in Houghton County is Phoenix House in Calumet which only accepts adult men. They also provide outpatient services in Calumet and Hancock. The Great Lakes Recovery Center has a coed facility in Marquette and a female residential facility in Sault Ste Marie. There is no adolescent treatment facility in the Upper Peninsula and no transitional housing services in the western Upper Peninsula to provide Sober Living Homes for those in recovery. Sober Living Homes (SLH) are a pivotal part of the recovery process and extremely important to the long-term recovery of those who have gone through treatment for addiction. The value of sober living homes has been verified through several industry studies, and the combination of SLHs and Intensive Outpatient Programs (IOPs) is proven to have a high rate of success. There are only two peer recovery coaches, which guide people through treatment, for the entire six-county region.

Working with the responsible agencies listed below and other community partners such as Houghton County Communities That Care, (1) a female inpatient facility can be built in Houghton County to meet the needs stated above and staffed with master level counselors and licensed therapists. An adolescent outpatient program (2), transitional housing for sober living

(3), and peer recovery coaches (4) are other identified needs for the county and the greater region. The biggest barrier to the success of this project is staffing.

Responsible Agency:	Houghton County with many partner organizations such as Dial Help, Great Lakes Recovery Center, Phoenix House, Dept. Health and Human Services, Copper Country Mental Health, Western UP Health Department
Deadline:	Ongoing
Cost:	Varies by each of the four projects
Potential Funding Sources:	Medicaid, Department of Health and Human Services,
Benefits:	A comprehensive approach to the public health substance abuse crisis would have social, economic, environmental, and community wide benefit.

Action Item 12: Improved Firefighting Capability

Wildfires are a significant hazard throughout the Western Upper Peninsula, and Houghton County is no exception. Rural fire departments often lack enough funding to respond effectively to these incidents, and those departments are in the areas where wildfire response needs are most urgent. Funding to support staff training and capacity building would help to alleviate this problem. This need was indicated specifically by Elm River and Laird Townships. Elm River is one of the many rural and heavily forested townships in the county. Dry hydrants would also aid response to both wildfires and structure fires, as indicated specifically by Portage Charter Township.

Responsible Agency:	Local jurisdictions and fire departments; Houghton County Office of Emergency Measures
Deadline:	Ongoing
Cost:	Variable
Potential Funding Sources:	FEMA (including Assistance to Firefighters Grant Program), USDA Rural Development, and local
Benefits:	Funding for staffing rural fire departments will prevent site-specific fires from becoming catastrophic events, protecting residents and natural resources in the process.

Action Item 13: Update Shoreline Erosion Map and Identify Future Mitigation Activities

Shoreline erosion has been an ongoing problem along Lake Superior in Houghton County. Current Michigan EGLE erosion studies were last updated in 1982, and new studies are needed to analyze the forces currently at work along Houghton County shoreline and to ensure that current setbacks are adequate for new developments. Potential mitigation activities can be determined with thorough evaluation of current erosion patterns. This work is dependent on direct state assistance which has not been available since the 2005 plan.

Responsible Agency:	Houghton County and Michigan EGLE

Deadline:	Ongoing
Cost:	Staff time
Potential Funding Sources:	State of Michigan-EGLE and others unknown
Benefits:	Updated information will enable Houghton County and its residents to identify changing erosion patterns due to the forces of Lake Superior. Changing lake levels make this a priority concern; while levels are down, steps should be taken to identify methods to protect property when lake levels rise.

Action Item 14: Community Shelter(s)

Residents of many areas of Houghton County do not have adequate shelter in the event of a severe weather event such as a snowstorm or other emergency preventing return to residences. The City of Houghton, having a concentrated population, has the greatest need for such a facility, which would be equipped with supplies to sustain occupants for the duration of the event. A shelter could also house displaced residents during an outage of the Portage Lift Bridge. This purpose may be served as a secondary function of an existing facility. One jurisdiction, Calumet Charter Township, is in the process of equipping a shelter (at the Calumet Colosseum).

Responsible Agency:	Houghton County OEM and local municipalities
Deadline:	Ongoing
Cost:	Unknown
Potential Funding Sources:	FEMA Hazard Mitigation Grant Program; City of Houghton
Benefits:	A shelter will accommodate residents in a carefully controlled way to prevent chaos in the event of a disaster.

Action Item 15: Identify and Inventory Datasets for Quantitative Hazard Analysis

Through the hazard mitigation planning process there were many data gaps identified including flood depth grids for rigorous hydrological modeling, structural and wild fire events, abandoned mine status, age and estimated value of all critical facilities, comprehensive asset inventory, dam inundation modeling for Baraga County's high hazard dams that border Houghton County, and updated flood erosion maps for current and rising lake levels.

Responsible Agency:	Houghton County Office of Emergency Measures and local municipalities; Department of Natural Resources; Local Volunteer Fire Departments
Deadline:	Ongoing
Cost:	Unknown
Potential Funding Sources:	FEMA Hazard Mitigation Grant Program
Benefits:	Comprehensive risk assessment including both qualitative and quantitative analysis.

Action Item 16: Dam Mitigation in Houghton County

Two dams in Houghton County, Calumet Lake and Huron Creek, have significant hazard potentials and immediate needs for repair. The main purpose is to protect lives and property by reducing the potential for future damages and economic losses. Both proposed projects at Calumet Lake and Huron Creek Dams are to construct control structures capable of conveying flood waters of Slaughterhouse and Huron Creek respectively to prevent the overtopping and failure of the earthen embankments.

Responsible Agency:	Houghton County Office of Emergency Measures, DNR, EGLE, Calumet Township, City of Hancock
Deadline:	2021
Cost:	$250,000
Potential Funding Sources:	Pre-Disaster Mitigation Fund – FEMA and Local Match
Benefits:	The proposed projects will benefit adjacent and downstream landowners, businesses, and the community.

Action Item 17: Public Information/Education Program

Public information is the key to mitigating many of the potential hazards in Houghton County. Several projects can help to educate the public on potential hazards and how to protect themselves from hazards. Recommended projects include preparing and gathering education materials on hazards affecting Houghton County and how people can help with mitigation. These materials should be organized and made available at government offices, schools and other easily accessible public facilities as well as on the internet. Topics to focus on include safe open burning (indicated as a concern in Hancock Township); community hazard awareness, preparedness, and resiliency; invasive species, and; the implications of an outage of the Portage Lift Bridge (a concern throughout central and northern Houghton County).

Responsible Agency:	Houghton County Office of Emergency Measures, DNR, MSU Extension, and American Red Cross
Deadline:	Ongoing
Cost:	Unknown; staff time, cost of materials, and printing
Potential Funding Sources:	Organization/agency operating budgets, FEMA, DHS Homeland Security Grant Program, Michigan Invasive Species Grant Program, and other federal and state sources
Benefits:	Organizing locally applicable materials and making them available to the public ensures that the message is getting out. Through use of newspapers and the internet, the public is easily informed, and the message can be made consistent. This action item helps inform the public and assists people who want to learn more about property protection and how to reduce their risk.

Action Item18: Review Plans and Development Regulations

Houghton County's Emergency Manager will work with the County Board and County Planning Commission to ensure hazard mitigation is included in ongoing county planning activities. During updates to County plans and regulations, the County will consider actions and recommendations that divert new development from identified hazards, include development standards that ensure adequate fire and emergency access, require buried utility lines, and promote open space requirements that protect properties from flooding.

As local land use plans, comprehensive plans, zoning, building codes, and other plans and regulations become due for revision, appropriate hazard mitigation provisions will be considered and incorporated.

Responsible Agency:	Houghton County Planning Commission and OEM
Deadline:	Ongoing as plans and ordinances are reviewed
Cost:	Staff and commission time
Potential Funding Sources:	Organization/agency operating budgets
Benefits:	Citizens of Houghton County will benefit from plans that protect new development from known hazards and by awareness of methods of protecting their lands from known priority hazards.

Action Item 19: Adopt Hazard Mitigation Plan and Update Regularly

By adopting the Houghton County Hazard Mitigation Plan, the County and its municipalities recognize the need to incorporate hazard mitigation activities into everyday decisions at the County and local level. The Emergency Manager, in coordination with the Emergency Operations Plan updated, will be reviewed annually to determine whether revisions are needed.

The Hazard Mitigation Plan will be updated every five years in order to address changing priorities and remain eligible for FEMA mitigation funding programs. The Emergency Manager will convene a Hazard Mitigation Committee representing local agencies, municipalities, townships, and concerned parties to evaluate progress and update the plan in accordance with FEMA regulations. The Committee will review the plan to determine the sections that need to be updated or modified based on changing conditions or alterations in State or Federal requirements. Goals, objectives, and strategies will also be reviewed to determine whether they thoroughly address new or changing conditions.

The Emergency Manager will work with Houghton County to update the plan based on Hazard Mitigation Committee and State Hazard Mitigation Officer recommendations. The public will be notified of any plan updates, and copies will be made available at all local government offices and online if feasible. The public will be provided with and notified of comment opportunities during all interim and five-year plan updates.

Responsible Agency:	Houghton County Office of Emergency Measures
Deadline:	Ongoing

Cost:	Staff time
Potential Funding Sources:	FEMA and organization/agency operating budgets
Benefits:	The adoption of the Hazard Mitigation Plan commits Houghton County and its communities to working on mitigation efforts within its boundaries. Through implementation of mitigation strategies in the Plan, the County and municipalities will be actively working to prevent future problems within Houghton County.

Appendix

Appendix A: County Capability Snapshot

Appendix B: Shoreline Erosion Maps for Houghton County

Appendix C: Mitigation Funding and Resources

Appendix D: County Letter to Commit Match

Appendix E: Public Participation

Appendix F: Meeting Materials

Appendix G: State Document Review

Appendix H: Plan Adoption

Appendix A: County Capability Snapshot

Houghton County

2020-2025

Hazard Mitigation Plan

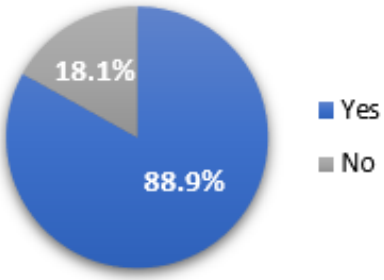
FAST FACTS

Area: 1,017 sq. miles	**Climate:** humid continental	**Growing Season:** 119 days	**Population:** 36,333
Housing: 13,157 units	**Average Household Income:** $41,379	**Poverty Rate:** 21.4%	**Disability:** 11.4%

PUBLIC SURVEY SUMMARY

Respondents are very concerned about flooding from precipitation or snowmelt, snowstorms and blizzards and invasive species. In the last five years, most households have experienced flooding at 78.3%; the second most common hazard experienced was windstorm at 10.4%. Respondents were asked whether they had taken actions to make their home or community more resistant to hazards. Over half (55%) said yes. Information on property located in the floodplain, flood frequency, and flood insurance was also collected. According to the responses, the most effective ways to receive hazard emergency information are by the internet - social media, radio, and phone.

Percentage of Households That Experienced a Hazard in the Past 5 years



DISASTER DECLARATIONS

Houghton County has experienced seven presidential declarations since 1965. Two have occurred since the 2013 plan. Other emergencies and disasters not declared by the president have impacted the county. Listed below are declarations from 1965-2019.

Presidential Disaster Declarations

Event	Declaration Date
Drought	March 2, 1977
Blizzards and Snowstorms	January 27, 1978
Severe Freeze	May 10, 1994
Flooding	May 6, 2002
Hurricane Katrina Evacuation	September 7, 2005
Flooding	June 18, 2013
Severe Storms, Flooding, Landslides, and Mudslides	August 2, 2018

Source: FEMA

HAZARD RANKING

Hazards are ranked using a "Priority Risk Index" (PRI) to categorize and prioritize county wide hazards. Risk is the estimated impact a hazard will have on human life and property. PRI helps to prioritize high risk hazards for mitigation planning purposes and to recognize mitigation opportunities in the planning area.

High Risk

- Public Health Emergency
- Snowstorms & Blizzards
- Riverine and Urban Flooding
- Infrastructure Failures & Secondary Technological Hazards
- Invasive Species
- Structural Fires
- Shoreline Flooding & Erosion
- Extreme Temperatures

Moderate Risk

- Transportation Accidents
- Severe Winds
- Subsidence (Ground Collapse)
- Petroleum and Natural Gas Incidents
- Drought
- Sabotage and Terrorism
- Hazardous Materials: Transportation Accident
- Dam Failures

Low Risk

- Lightning
- Hail
- Fog
- Wildfires
- Ice and Sleet Storms
- Hazardous Materials: Fixed Site Incidents
- Earthquakes
- Tornadoes
- Scrap Tire Fires
- Civil Disturbance

ACTION PLAN

A 5-year action plan set out by the Local Planning Team to reduce the community's vulnerability and risk to local hazards based on their capability. Identified specific action items for Houghton County and its communities. All activities are consistent with the following mitigation goals:

Goal 1: Protect lives and property within Houghton County from all known hazards while focusing on priority hazards;

Goal 2: Identify feasible projects throughout the County that will help mitigate future problems;

Goal 3: Be proactive in protecting public facilities and critical facilities through proper maintenance and upgrades;

Goal 4: Educate citizens in order to encourage self-help and mitigation of hazards on private property.

Action Item	Deadline	Cost
Disaster Recovery Plan	2021	$5,000
Sturgeon River Road Bank Stabilization	2022	$750,000
Storm Drainage Sewer Upgrades	Ongoing	Varies
Green Infrastructure Installation	2022	Varies
Drainage Improvements and Maintenance	Ongoing	Varies
Mine Shaft and Stope Safety	Ongoing	$20,000-$75,000
Update Stormwater Management Plans	Ongoing	Staff time
Retrofit Underground Pipes and Drinking Water Infrastructure	Ongoing	Variable
Improved Emergency Response, Equipment & GIS System	Ongoing	Staff time
Bridge Approaches for Emergency (Temporary) Bridge	Ongoing	$120,000
Inpatient care facility and other recommendations to address substance abuse public health crisis	Ongoing	Varies
Improved Firefighting Capability	Ongoing	Varies
Update Shoreline Erosion Map and Identify Future Mitigation Activities	Ongoing	Staff time
Community Storm Shelter	Ongoing	Unknown
Identify and Inventory Datasets for Quantitative Hazard Analysis	Ongoing	Unknown
Dam Mitigation in Houghton County	2021	$250,000
Public Information/Education Program	Ongoing	Unknown
Review Plans and Development Regulations	Ongoing	Staff and commission time
Adopt Hazard Mitigation Plan and Update Regularly	Ongoing	Staff time

DATA SOURCES

Michigan Hazard Mitigation Plan, Emergency Management and Homeland Security Division, Michigan Department of State Police: www.michigan.gov/documents/msp/MHMP_480451_7.pdf

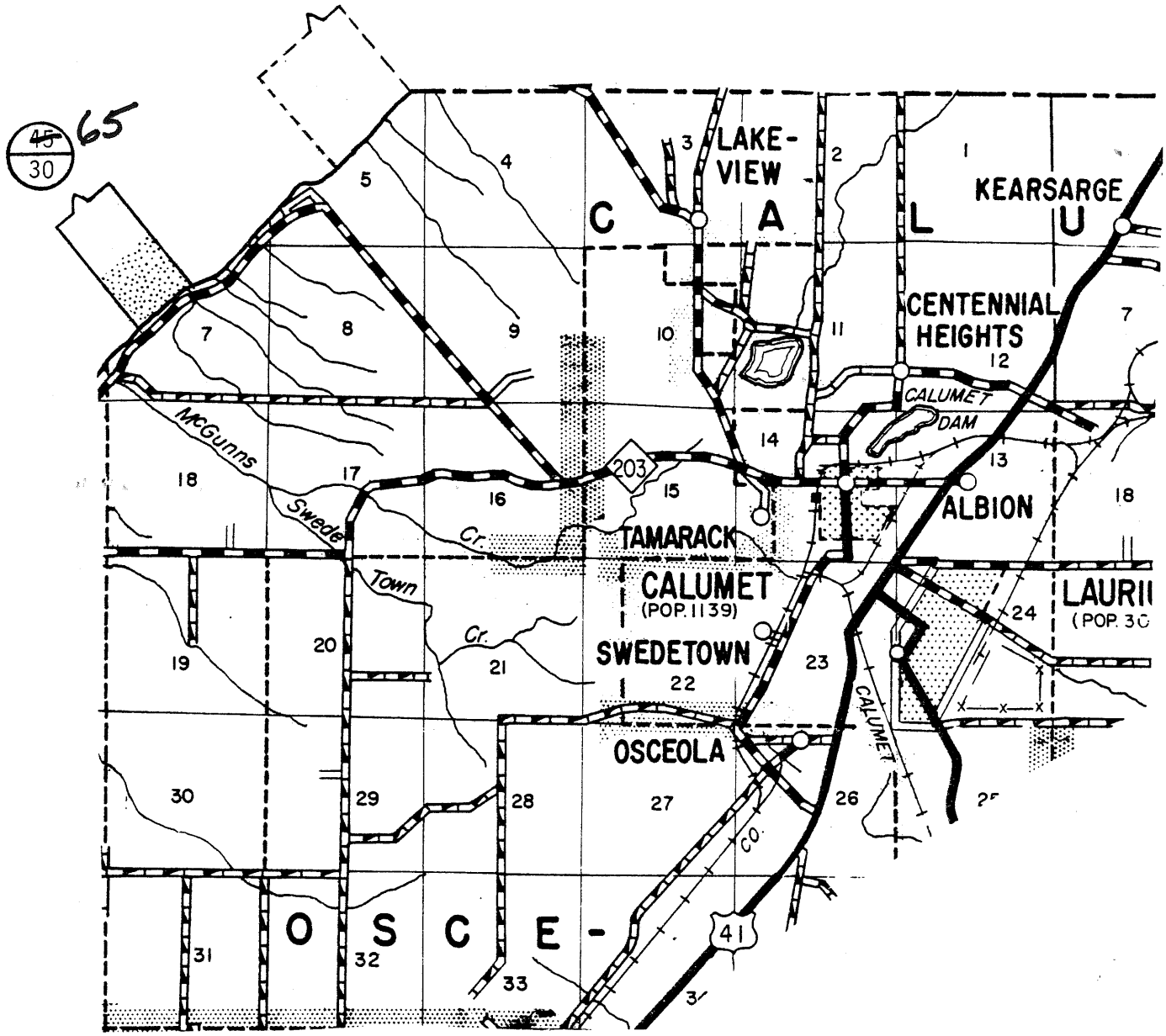
National Climatic Data Center (NCDC), U.S. Department of Commerce, National Oceanic and Atmospheric Administration: www.ncdc.noaa.gov

National Centers for Environmental Information Storm Events Database, U.S. Department of Commerce, National Oceanic and Atmospheric Administration: www.ncdc.noaa.gov/stormevents

Appendix B: Shoreline Erosion Maps for Houghton County

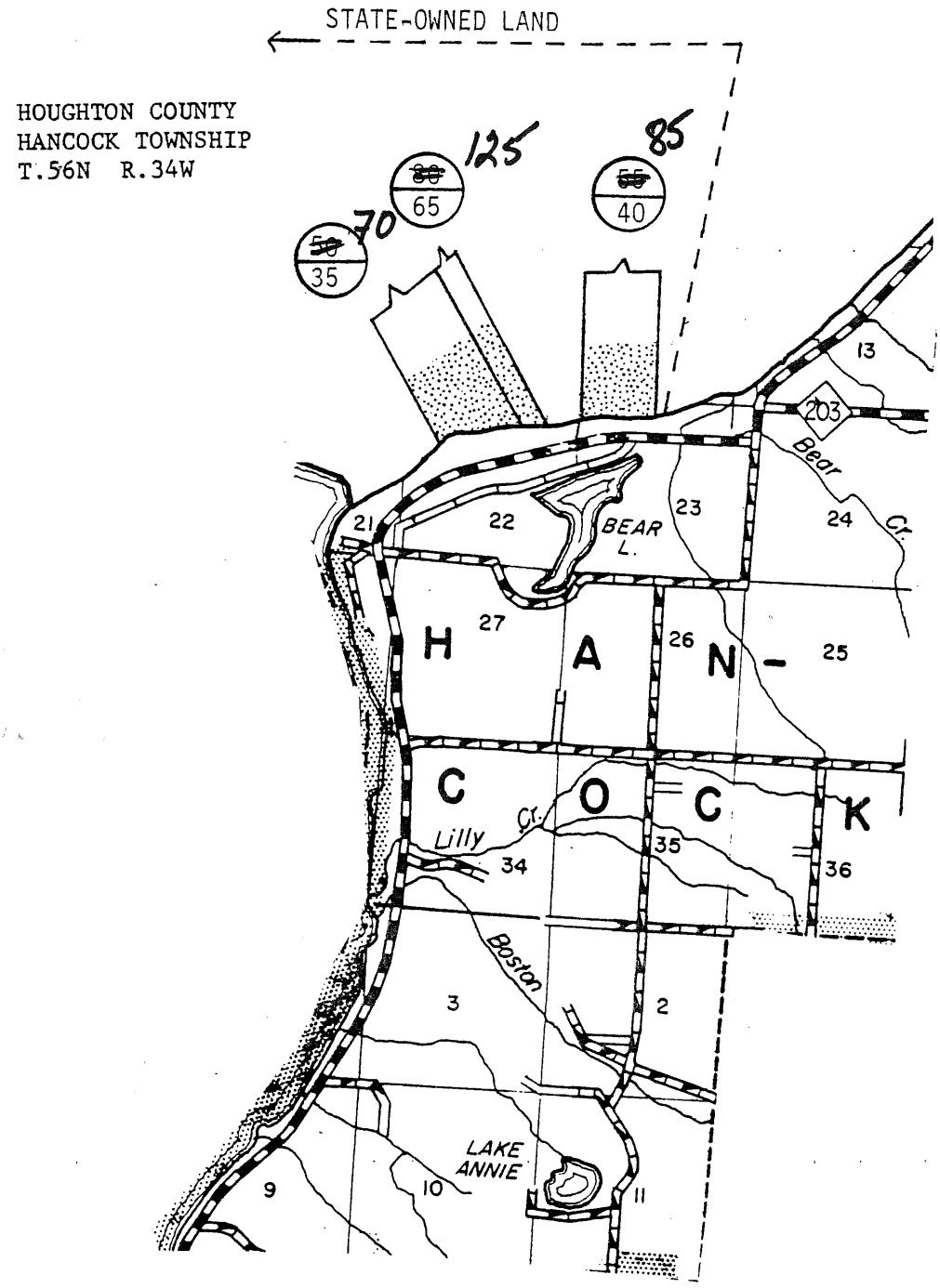
Houghton County
Calumet Township
T.56N R.33W

NO RATES AVAILABLE--
AREA REQUIRES FURTHER STUDY



WIDE SHADED BAND
DEMARKS HIGH RISK
EROSION AREA

60-year projected recession distance
30-year projected recession distance

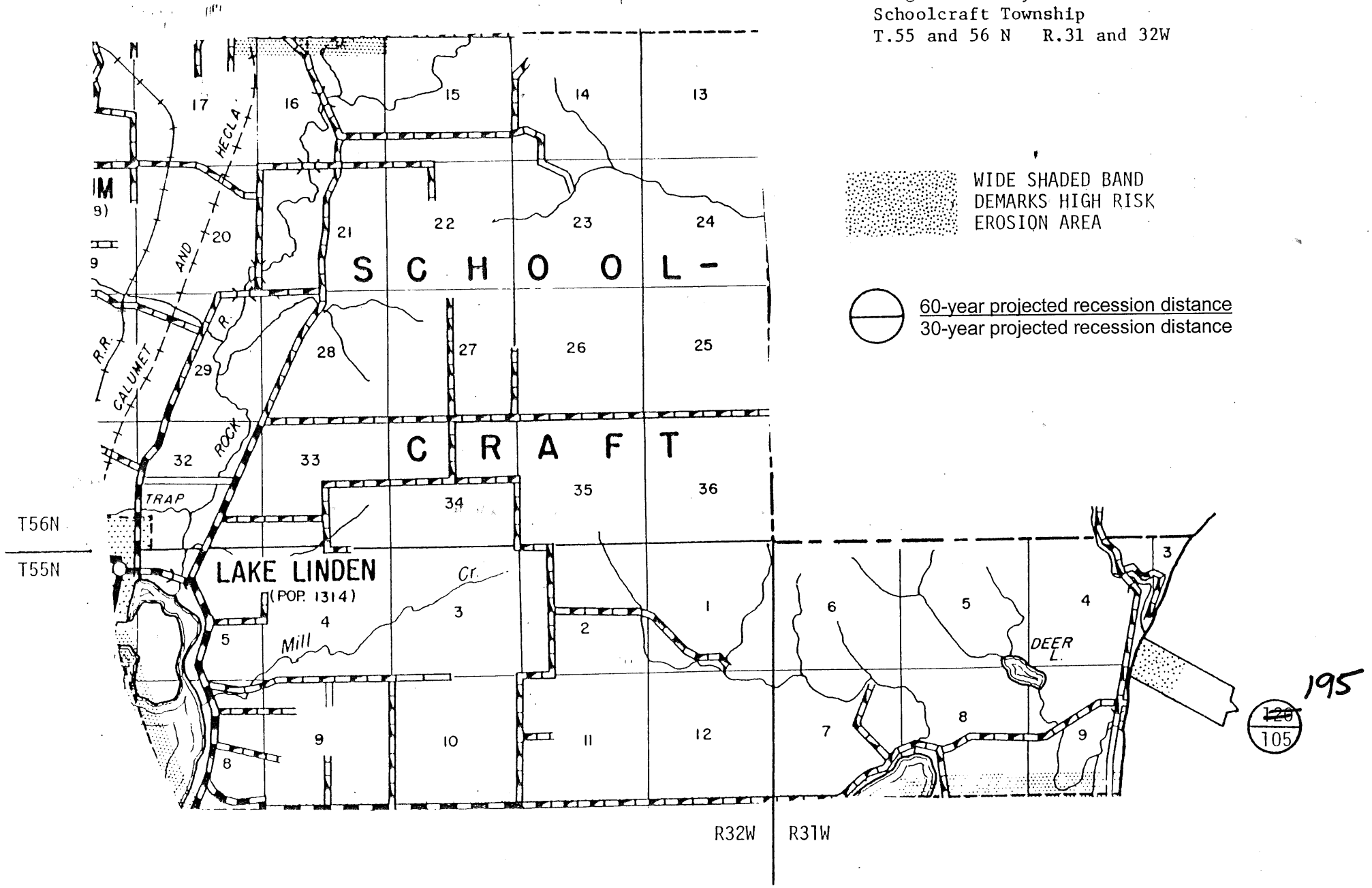


WIDE SHADED BAND
DEMARKS HIGH RISK
EROSION AREA

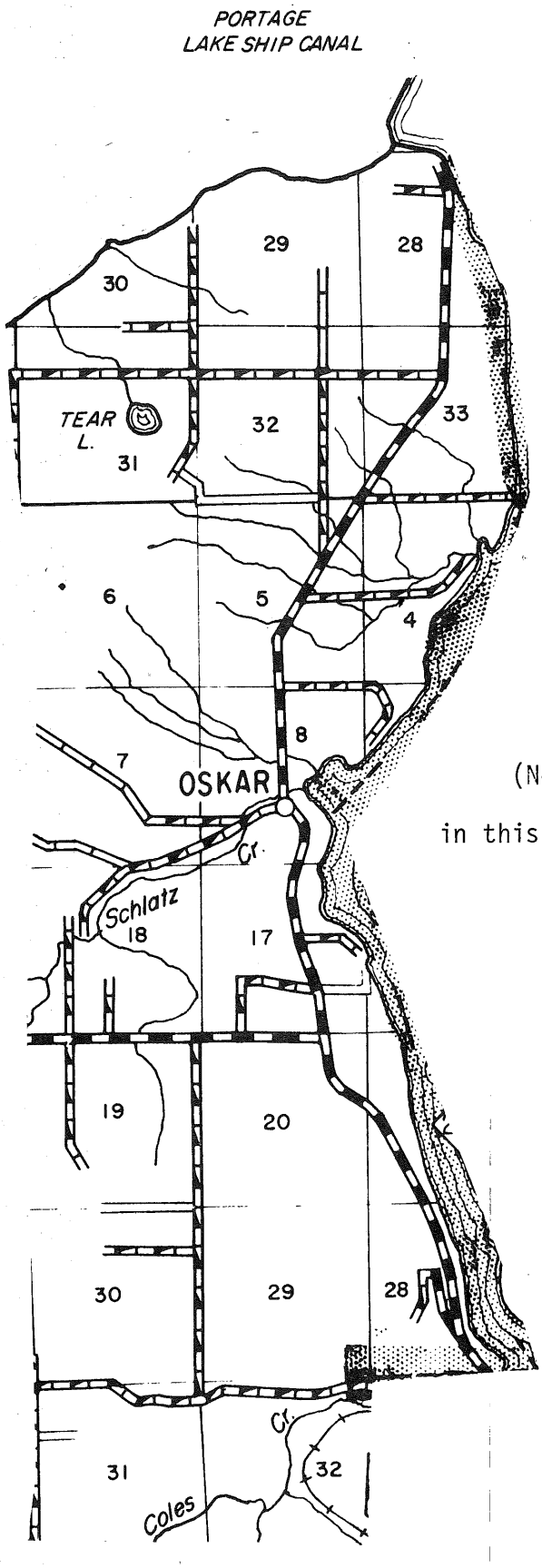
60-year projected recession distance
30-year projected recession distance

1982

Houghton County
Schoolcraft Township
T.55 and 56 N R.31 and 32W



Houghton County
Stanton Township (North Part)
T.55 and 56N R.34W

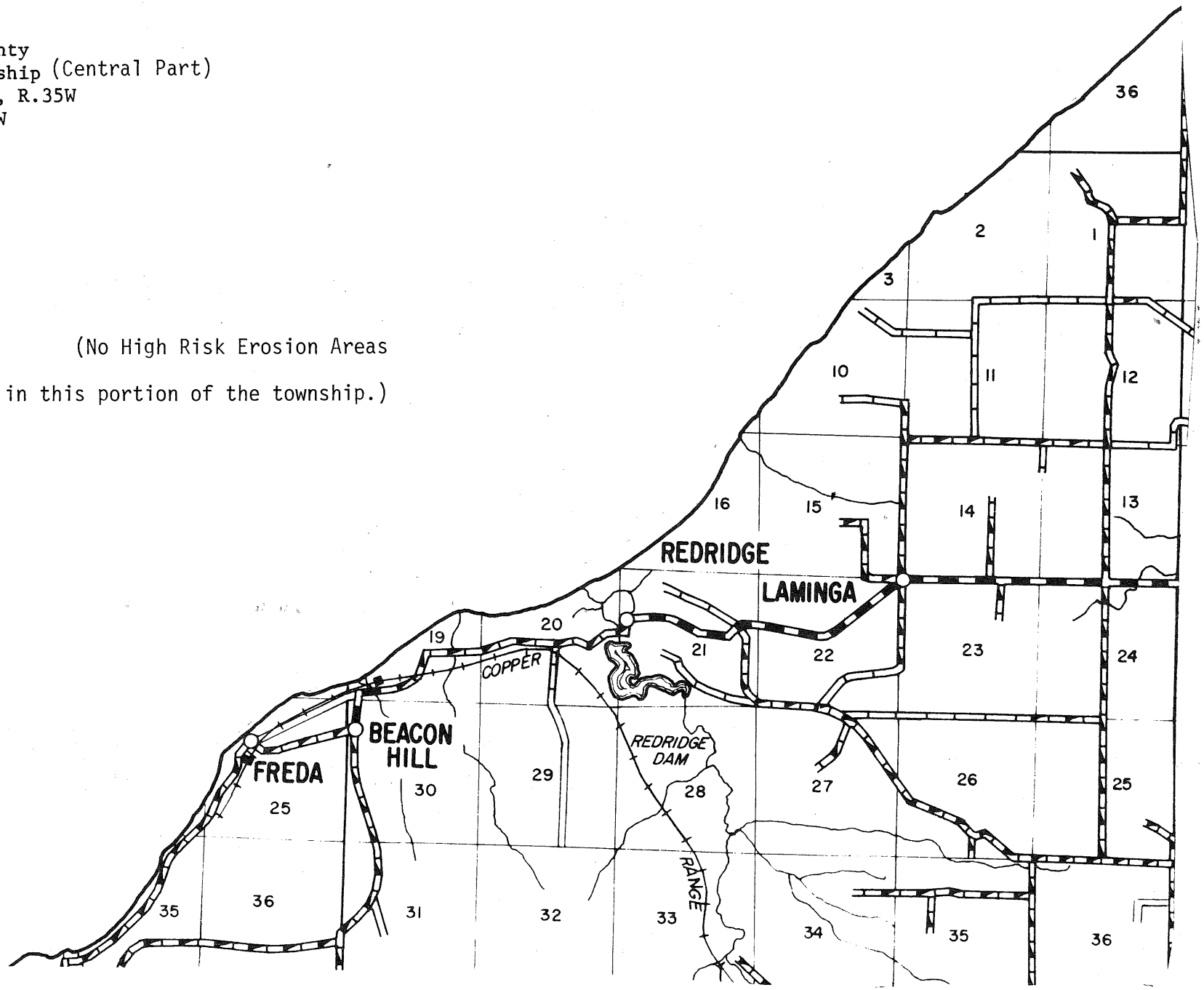


(No High Risk Erosion Areas in this portion of the township.)

Houghton County
Stanton Township (Central Part)
T.55N R.36W, R.35W
T. 56N R.35W

(No High Risk Erosion Areas

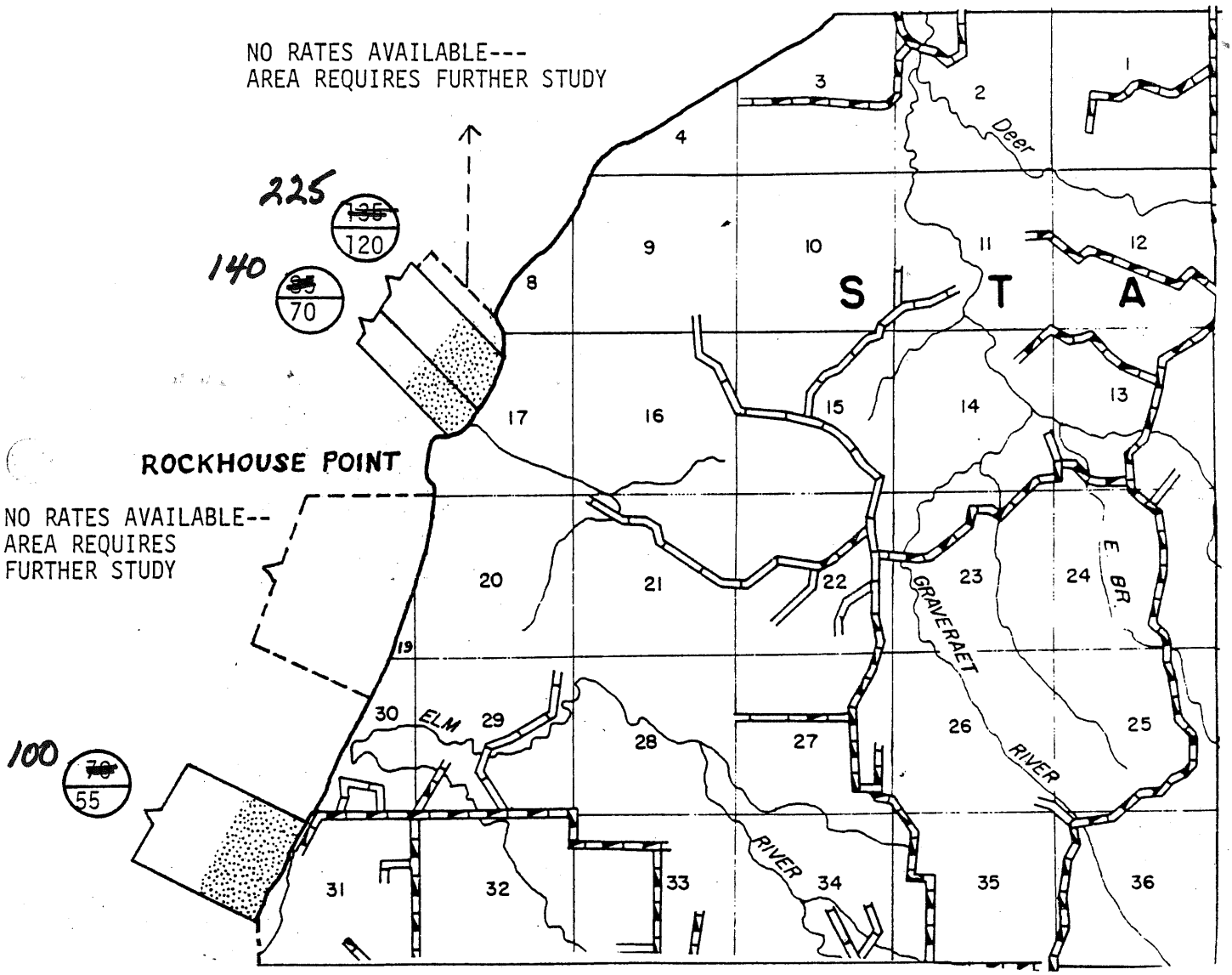
in this portion of the township.)



1982

Amended June 1983

Houghton County
Stanton Township (South Part)
T.54N R.36W

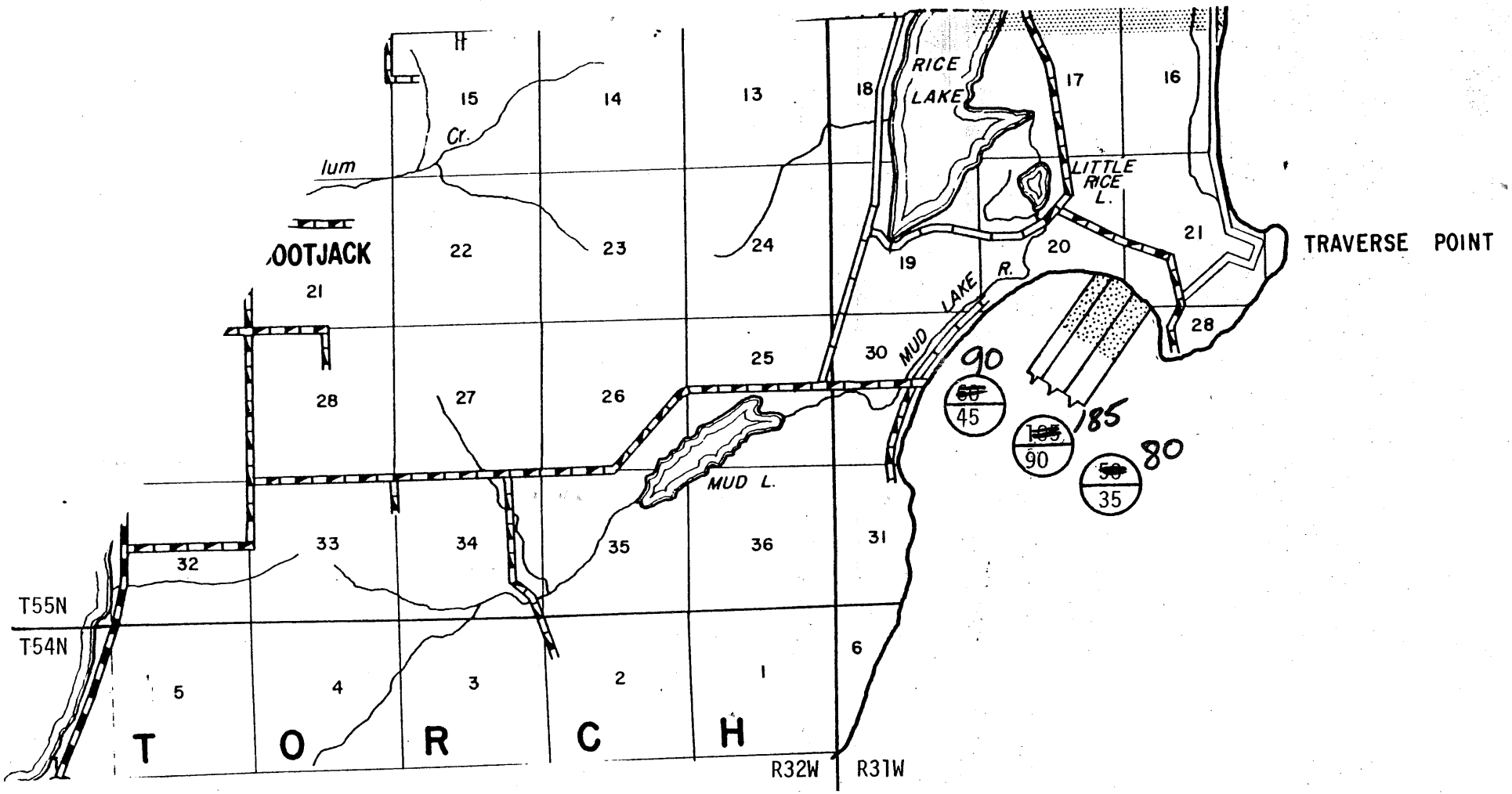


WIDE SHADED BAND
DEMARKS HIGH RISK
EROSION AREA

60-year projected recession distance
30-year projected recession distance

1982

Houghton County
Torch Lake Township (North Part)
T. 54 and 55 N R.31 and 32W

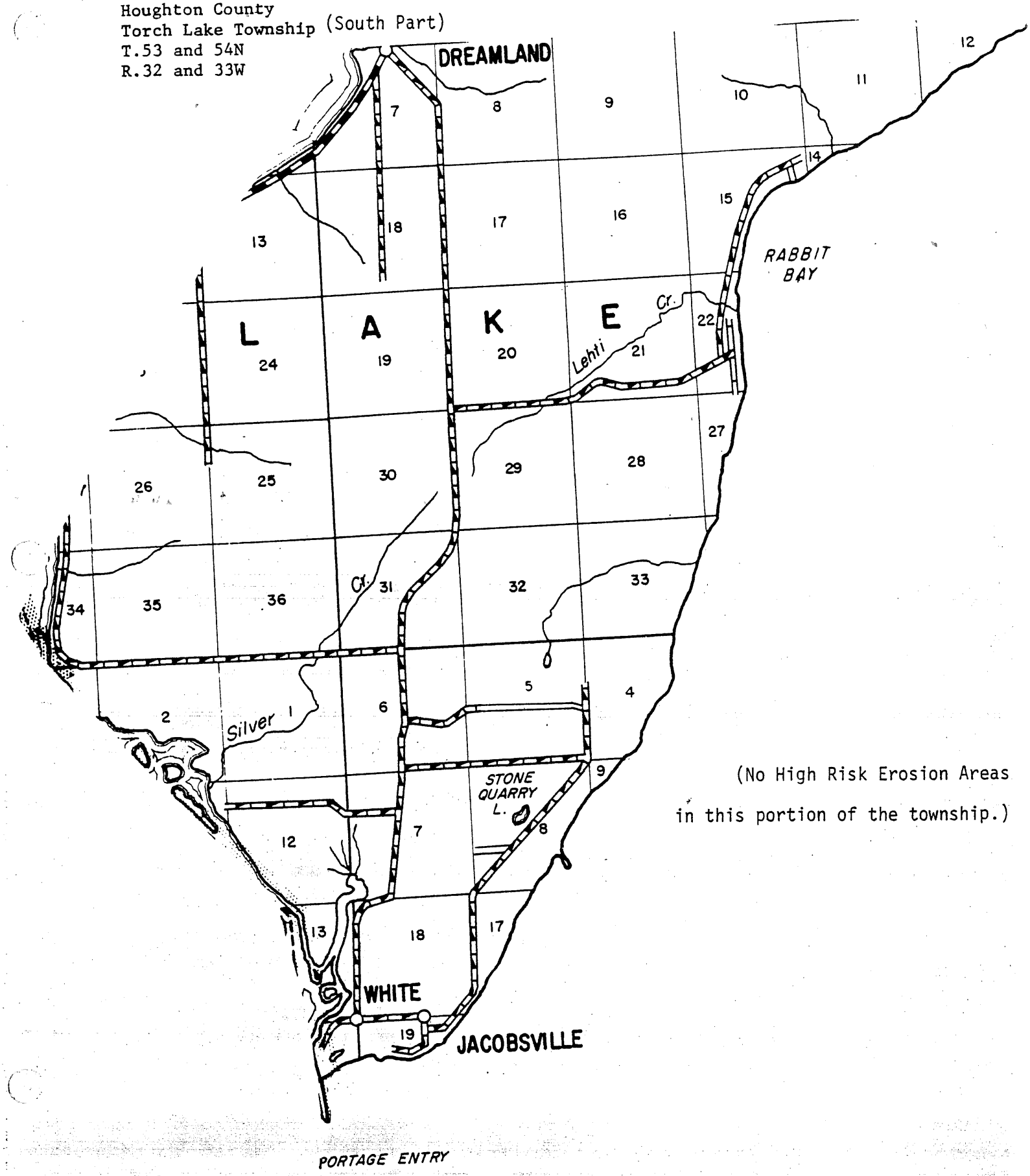


WIDE SHADED BAND
DEMARKS HIGH RISK
EROSION AREA

60-year projected recession distance
30-year projected recession distance

1982

Houghton County
Torch Lake Township (South Part)
T.53 and 54N
R.32 and 33W



(No High Risk Erosion Areas in this portion of the township.)

Appendix C: Mitigation Funding and Resources

Mitigation Funding & Resources **Created: October 31th, 2019**

Federal Resources

Economic Development Administration (EDA): Provides grants and technical assistance to generate new employment, help retain existing jobs and stimulate industrial and commercial growth.

Economic Development Assistance: The U.S. Dept. of Commerce solicits applications from applicants in rural and urban areas to provide investments that support construction, non-construction, technical assistance, and revolving loan fund projects under EDA' Public Works and Economic Adjustment Assistance programs.

Additional Information: https://www.grants.gov/web/grants/view-opportunity.html?oppId=279842

Planning Program & Technical Assistance Programs: Develop Economic Development plans, studies, and analysis to build capacity, resiliency, and prosperity, particularly in an economically distressed area or region.

Additional Information: https://www.grants.gov/web/grants/view-opportunity.html?oppId=301960

Post-Disaster Economic Recovery: EDA and the International Economic Development Council (IEDC) provide several case studies and tools to assist in post-disaster recovery.

Additional Information: https://eda.gov/programs/disaster-recovery

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Regional Innovation Strategies: Funding is available for capacity-building programs that provide proof-of-concept and commercialization assistance to innovators and entrepreneurs and for operational support for organizations that provide essential early-stage funding to startups. Under the RIS Program, EDA is soliciting applications for two separate competitions: the 2019 i6 Challenge; and the 2019 Seed Fund Support (SFS) Grant Competition.

Additional Information: https://www.eda.gov/files/oie/ris/EDA-2019-RIS-Program-NOFO-FINAL.pdf

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Restore Your Economy: This website provides guidance on what to do after a disaster to plan for economic recovery and navigate the federal system post-disaster. Within the Disaster Planning for Economic Recovery Section, this resource provides step-by-step guidance on how to assess and create a plan for economic recovery.

Additional Information: https://restoreyoureconomy.org/

Environmental Protection Agency (EPA): Protect human and environmental health

Brownfields Program: Sub-programs include funding to conduct research and to provide training and technical assistance to communities, Targeted Brownfield Assessments, through funding to clean up and sustainably reuse contaminated properties.

Additional Information: https://www.epa.gov/brownfields

College/Underserved Community Partnership Program: Students in various courses work with communities to solve different issues by matching local needs to university resources. Students provide technical assistance through internships and capstone projects to help communities gain access to resources.

Additional Information: https://www.epa.gov/environmentaljustice/collegeunderserved-community-partnership-program

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Environmental Justice Small Grants: EJSG program awards grants that support community-driven projects designed to engage, educate, and empower communities to better understand local environmental and public health issues and develop strategies for addressing those issues, building consensus in the community, and setting community priorities.

Additional Information: https://www.epa.gov/environmentaljustice/environmental-justice-small-grants-program

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Small Growth in Small Towns & Rural Communities: Provides links to multiple resources targeted to increase sustainability in small towns and rural areas.

Additional Information: https://www.epa.gov/smartgrowth/smart-growth-small-towns-and-rural-communities

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Federal Emergency Management Agency (FEMA): coordinates the response efforts to disasters when local and state resources are overwhelmed.

Assistance to Firefighters Grants: Grants awarded to fire departments, state fire training academies, and emergency medical service organizations.

Additional Information: https://www.fema.gov/assistance-firefighters-grant

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Community Rating System: Voluntary incentive program for community floodplain management activities that exceed the minimum National Flood Insurance Program requirements. As a reward, flood insurance premiums are discounted for activities that reflect a reduce flood risk. Activities: (1) reduce flood damage to insurable property; (2) strengthen and support the insurance aspects of the NFIP; (3) encourage a comprehensive approach to floodplain management.

Additional Information: https://www.fema.gov/national-flood-insurance-program-community-rating-system

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Disaster Assistance: May be provided as financial or direct assistance to individuals and families whose property has been damaged or destroyed from a federally declared disaster.

Additional Information: https://www.fema.gov/disaster-assistance-available-fema

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Floodplain Management Assistance Program: Nationally competitive grants for the development of comprehensive flood mitigation plans and the implementation of flood mitigation projects to eliminate repetitive losses.

Additional Information: https://www.michigan.gov/msp/0,4643,7-123-72297_60152_69727_69730_69734-15282--,00.html

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Hazard Mitigation Grant Program: Implement long-term, cost-effective mitigation actions to eliminate/reduce risk to life and property after a Federal disaster declaration. The amount of funding made available is a percentage of total disaster costs and will vary with each disaster. A project does not have to be in a declared county to be eligible.

Additional Information: https://www.michigan.gov/msp/0,4643,7-123-72297_60152_69727_69730_69734-15282--,00.html#Hazard_Mitigation

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National Flood Insurance Program: Community participation in the National Flood Insurance Program is mandatory for homeowners, business owners, and renters to purchase flood insurance. Insurance claims can be paid if a federal disaster in not declared by the president. Cost of insurance is based where property is located in the floodplain (Special Flood Hazard Area).

Additional Information: https://www.fema.gov/news-release/2006/07/20/fact-sheet-national-flood-insurance-program-nfip

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Port Security Grant Program: Supports the building, sustainment, and delivery of core capabilities essential to achieving the National Preparedness Goal of a secure and resilient nation.

Additional Information: https://www.fema.gov/port-security-grant-program

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Pre-Disaster Mitigation Program: Pre-disaster planning and direct hazard mitigation projects to cost-effectively reduce overall risk to the population and structures.

Additional Information: https://www.michigan.gov/msp/0,4643,7-123-72297_60152_69727_69730_69734-15282--,00.html

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U.S. Army Corps of Engineers (USACE): public engineering, design, and construction management

Continuing Authorities Program: Under the Continuing Authorities Program (CAP), the USACE is authorized to plan, design, and construct certain types of water resource and ecosystem restoration projects without additional and specific congressional authorization. The purpose is to implement projects of limited scope and complexity. Each authority has specific guidelines and total program and per-project funding limits.

Additional Information: https://www.nae.usace.army.mil/Missions/Public-Services/Continuing-Authorities-Program/

Floodplain Management Services: Educate individuals on flood hazards and the actions they can take to reduce property damage and prevent the loss of life. Foster public understanding of the options for dealing with flood hazards and promote prudent use and management of the nation's floodplains

Additional Information: Contact Detroit District Area Office: (313) 226-5013

Hazard Mitigation Team (Silver Jacket Team): The Michigan Silver Jackets Team is an interagency team dedicated to creating a collaborative environment to bring together Federal, State, local, and other stakeholders to develop and implement solutions to natural hazards and mitigation by combining available agency resources, which include funding, programs, and technical expertise. The Michigan Silver Jackets Team has been functioning for years, but a team charter was formalized in 2016.

Additional Information: https://silverjackets.nfrmp.us/State-Teams/Michigan.cfm

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Levee Safety Program: Assess the integrity and viability of levees to ensure that levee systems do not present unacceptable risks to the public, property, and environment. Risk communication activities will be initiated for the state in the fiscal year 2019.

Additional Information: https://www.lre.usace.army.mil/Missions/Civil-Works/Levee-Safety-Program/

State Planning Assistance: Provide assistance in preparing comprehensive plans for the development, utilization, and conservation of water and related land resources. Typical studies do not include a detailed design for project construction. The program can encompass many types of studies dealing with water resources issues.

Additional Information:
https://www.lre.usace.army.mil/Portals/69/docs/Navigation/STAKEHOLDERMTGS/9%20FEB%2012%20-%20Planning%20Assistance%20to%20States%20Fact%20Sheet.pdf

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U.S. Department of Agriculture (USDA): develops and executes federal laws related farming, forestry, rural economic development, and food.

Business & Industry Loan: This program bolsters the availability of credit by guaranteeing loans from local financial institutions (credit unions, banks, etc.) for rural businesses.

Additional Information: https://www.rd.usda.gov/programs-services/business-industry-loan-guarantees

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Community Connect Grants: This program helps fund broadband deployment into rural communities where it is not yet economically viable for private sector providers to deliver service.

Additional Information: https://www.rd.usda.gov/programs-services/community-connect-grants

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Community Facilities Direct Loan & Grant Program: This program provides affordable funding (low-interest loans, grants, or a combination) to develop essential community facilities in rural areas. An essential community facility is defined as a facility that provides a critical service to the local community for the orderly development of the community in a primarily rural area and does not include private, commercial or business undertakings.

Additional Information: https://www.rd.usda.gov/programs-services/community-facilities-direct-loan-grant-program

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Disaster – Supplemental Nutrition Assistance Program (D-SNAP): Can be authorized by the Food and Nutrition Service during a presidentially declared disaster with individual assistance. The state must request approval to activate the program. The program allows people who don't normally qualify for the Supplemental Nutrition Assistance Program (SNAP) eligible.

Additional Information: https://www.fns.usda.gov/snap/dsnap/state-agencies-partners-resources

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Emergency Community Water Assistance Grants: Provides grants to rural communities who have a decline in quantity or quality of water. Funds can be used to help reduce or eliminate pollution of water resources and to improve planning for and management of solid waste sites.

Additional Information: https://www.rd.usda.gov/programs-services/emergency-community-water-assistance-grants

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Emergency Conservation Program: Funding for farmers and ranchers to repair damages to their land from wind erosion, floods, hurricanes, or other natural disasters. The disaster must create new conservation issues, and the land must be returned to a productive agricultural state.

Additional Information: https://www.fsa.usda.gov/programs-and-services/conservation-programs/emergency-conservation/index

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Emergency Forest Restoration Program: Provides payments to eligible nonindustrial private forest landowners to implement emergency measures to restore damages produced by a natural disaster.

Additional Information: https://www.fsa.usda.gov/programs-and-services/disaster-assistance-program/emergency-forest-restoration/

Emergency Watershed Protection Program: Provides technical and financial assistance to preserve life and property threatened by excessive erosion and flooding from natural disasters. Owners, managers, and users of public, private, or tribal lands are eligible.

Additional Information:
https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/landscape/ewpp/

Emergency Watershed Protection Program – Floodplain Easements: Purchase floodplain easements as an emergency measure to restore, protect, maintain, and enhance floodplain functions.

Additional Information:
https://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/programs/landscape/ewpp/?cid=nrcs143_008216

Foods for Disaster Assistance: For mass feeding sites facilitated by disaster relief agencies. Possibility of delivering food directly to households in need. The program requires a governor's request and a presidential emergency or disaster declaration.

Additional Information: https://www.fns.usda.gov/disaster/usda-foods-disaster-assistance

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Mutual Self-Help Housing: Provides grants to qualified organizations to help them carry out local self-help housing construction projects. Grant recipients supervise groups of very-low- and low-income individuals and families as they construct their own homes in rural areas.

Additional Information: https://www.rd.usda.gov/programs-services/mutual-self-help-housing-technical-assistance-grants

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Re-connect Program: Provides grants and loans to buy infrastructure and install equipment needed to provide reliable broadband service.

Additional Information: https://www.rd.usda.gov/files/ReConnect_Program-Factsheet.pdf

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Rural Business Development Grants: Support targeted technical assistance, training, and other activities leading to the development or expansion of small and emerging private businesses in rural areas. Programmatic activities are separated into enterprise or opportunity type grant activities.

Additional Information: https://www.rd.usda.gov/programs-services/rural-business-development-grants

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Rural Economic Development Innovation: Rural communities and regions may apply for technical assistance to implement economic development planning projects. Through Rural Economic Development Innovation, the REDI initiative, USDA, and the cooperators will score, review, and select applications on a competitive basis.

Additional Information: https://www.rd.usda.gov/files/RD_REDI_FactSheet_6519.pdf

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Rural Economic Development Loan and Grant Program: The purpose of the program is to promote rural economic development and job creation projects.

Additional Information: https://www.rd.usda.gov/programs-services/rural-economic-development-loan-grant-program

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Rural Energy for America Program: Provides guaranteed loan financing and grant funding to agricultural producers and rural small businesses for renewable energy systems or to make energy efficiency improvements.

Additional Information: https://www.rd.usda.gov/programs-services/rural-energy-america-program-renewable-energy-systems-energy-efficiency

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Rural Microentrepreneur Assistance: Provides loans and grants to Microenterprise Development Organizations (MDOs) to help microenterprises startup and grow through a Rural Microloan Revolving Fund and provide training and technical assistance to microloan borrowers and micro-entrepreneurs.

Additional Information: https://www.rd.usda.gov/programs-services/rural-microentrepreneur-assistance-program

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U.S. Department of Energy: concerned with policies regarding energy and safe handling of nuclear materials

Tribal Energy Loan Guarantee Program: The Tribal Energy Loan Guarantee Program (TELGP) is a partial loan guarantee program that can guarantee up to $2 billion in loans to support economic opportunities to tribes through energy development projects and activities. Can guarantee up to 90 percent of the unpaid principal and interest due on any loan made to a federally recognized Indian tribe for energy development. The tribal borrower will be required to invest equity in the project and all project debt will be provided by non-federal lenders.

Additional Information: https://www.energy.gov/lpo/tribal-energy-loan-guarantee-program

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Weatherization Assistance Program: The U.S. Department of Energy (DOE) Weatherization Assistance Program reduces energy costs for low-income households by increasing the energy efficiency of their homes while ensuring their health and safety. The program supports 8,500 jobs and provides weatherization services to approximately 35,000 homes every year using DOE funds. Through weatherization improvements and upgrades, these households save, on average, $283 or more every year according to a national evaluation of the program. Since the program began in 1976, WAP has helped improve the lives of more than 7 million families through weatherization services.

Additional Information: https://www.energy.gov/eere/wipo/weatherization-assistance-program

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U.S. Department of Health and Human Services (HHS): protects the health of all Americans and provides essential human services

Small Health Care Provider Quality Improvement Program: The purpose of the Rural Quality Program is to support planning and implementation of quality improvement activities for rural primary care providers or providers of health care services serving rural residents. These activities include providing clinical health services to residents of rural areas by funding projects that coordinate, expanded access, contain costs, and improve the quality of essential health care services. The program goal is to promote the development of an evidence-based quality improvement culture and to promote the delivery of cost-effective, coordinated health care services in primary care settings.

Additional Information: https://www.grants.gov/web/grants/view-opportunity.html?oppId=307894

U.S. Department of Housing and Urban Development (HUD): provide housing with fair and equal access and community development assistance

Disaster Assistance Resources: HUD offers many disaster resources and partners with Federal and state agencies to implement disaster recovery assistance.

Additional Information: https://www.hud.gov/info/disasterresources

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Rural Capacity Building for Community Development and Affordable Housing: Enhances the capacity and ability of local governments, Indian tribes, housing development organizations, rural Community Development Corporations, and rural Community Housing Development Organizations (CHDOs), to carry out community development and affordable housing activities that benefit low- and moderate-income families and persons in rural areas.

Additional Information: https://www.hudexchange.info/programs/rural-capacity-building/

Rural Gateway: The Rural Gateway is an information clearinghouse providing technical assistance, training workshops, and peer learning and resource sharing to support rural housing and economic development.

Additional Information: https://www.hudexchange.info/programs/rural/

U.S. Department of the Interior (DOI): responsible for management and conservation of most federal land and natural resources

Invasive and Noxious Plant Management: Funds may be used on public, State county, and private lands for approved projects that prioritize and target undesirable plant species or group of species to be controlled or contained within a specific geographic area.

Additional Information:
https://beta.sam.gov/fal/cf4feb36160a4f11ab376036796925b4/view?keywords=Invasive%20and%20Noxious%20Plant%20Management&sort=-relevance&index=cfda&is_active=true&page=1

Plant Conservation and Restoration Management: Provides leadership in identifying, maintaining, and restoring Western native plant communities on public lands. Focus on more diverse forbs and grasses for the restoration of wildlife habitats and rehabilitation after wildfires. Improve habitat for western big-game winter range and migration corridors, and recovery of lands damaged by wildfire.

Additional Information:
https://beta.sam.gov/fal/c64ad5b621574cf38ea11ccd164e43ce/view?keywords=Plant%20Conservation%20and%20Restoration%20Management&sort=-relevance&index=cfda&is_active=true&page=1

U.S. Department of Labor (DOL): improve working conditions, advance opportunities for profitable employment and assure work-related benefits and rights

Disaster Unemployment Assistance: Financial assistance to individuals whose employment or self-employment has been lost or interrupted as a direct result of a major disaster and who are not eligible for regular employment insurance benefits.

Additional Information: https://oui.doleta.gov/unemploy/disaster.asp

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U.S. Department of Transportation (DOT): responsible for helping to maintain and develop transportation systems and infrastructure

Emergency Relief Program: Fund for the repair or reconstruction of Federal-aid highways and roads on Federal lands which have suffered serious damage as a result of natural disasters or catastrophic failures from an external cause. Supplements the commitment of resources by States, their political subdivisions, or other Federal agencies to help pay for unusually heavy expenses resulting from extraordinary conditions.

Additional Information: https://www.fhwa.dot.gov/programadmin/erelief.cfm

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U.S. Small Business Administration (SBA): advocates, aids, assists, and protects the interests of small business concerns

Disaster Loans: Provides low-interest disaster loans to businesses of all sizes, private non-profit organizations, renters, and homeowners. Eligible costs must not be covered by personal insurance or FEMA and include repair or replaced real estate, personal property, machinery & equipment, inventory and business assets that have been damaged or destroyed along with economic losses.

Additional Information: https://www.sba.gov/funding-programs/disaster-assistance

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Economic Injury Disaster Loans: Small businesses, small agricultural cooperatives, or private nonprofit organization in a declared disaster area who have suffered substantial economic injury, may be eligible for an Economic Injury Disaster Loan.

Additional Information: https://disasterloan.sba.gov/ela/Information/EIDLLoans

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Home and Personal Property Loans: Homeowners, renters and/or property owners in declared disaster areas may apply for a loan to help recover from disaster-related damages.

Additional Information:
https://disasterloan.sba.gov/ela/Information/HomePersonalPropertyLoans

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Lender Match: The Lender Match program does not provide loans directly to businesses. Instead, it reduces the risk for participating financial institutions by guaranteeing their loans to small businesses-making it easier for them to obtain loans at competitive rates.

Additional Information: https://www.sba.gov/funding-programs/loans

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Military Reservists Economic Injury Loans: Provides funds to help an eligible small business meet its ordinary and necessary operating expenses that it could have met, but is unable to, because an essential employee was called-up to active duty in his or her role as a military reservist.

Additional Information: https://disasterloan.sba.gov/ela/Information/MREIDLLoans

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State Resources

Environment, Great Lakes, and Energy (EGLE): Supports a sustainable environment, healthy communities, and vibrant economies

Brownfield Redevelopment Grants: Brownfield redevelopment grants provide funding to local units of government and other public bodies to investigate and remediate known sites of environmental contamination, which will be used for identified economic redevelopment projects.

Additional Information: https://www.michigan.gov/egle/0,9429,7-135-3307_3515-151085--,00.html

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Brownfield Redevelopment Loans: Brownfield redevelopment loans facilitate the redevelopment of brownfield properties by providing low-interest loans to local units of government and other public bodies to investigate and remediate sites of known or suspected environmental contamination.

Additional Information: https://www.michigan.gov/egle/0,9429,7-135-3307_3515-151086--,00.html

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Drinking Water Contaminant Remediation Grants: For drinking water infrastructure, grants shall be awarded to drinking water systems for contaminant remediation efforts or connection to an alternate system.

Additional Information: https://www.michigan.gov/egle/0,9429,7-135-3307_3515-492719--,00.html

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Michigan Aquatics Invasive Plant Control Grant Program: The grants will assist with the prevention, detection, eradication, and control by chemical, physical, or biological methods of aquatic invasive plant species within Michigan inland lakes.

Additional Information: https://www.michigan.gov/egle/0,9429,7-135-3307_3515-498017--,00.html

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Nonpoint Source Pollution Control Grants – Clean Michigan Initiative: To provide funding to implement the physical improvements in approved watershed management plans intended to restore impaired waters and protect high-quality waters. Practices must address specific sources of nonpoint source pollution identified by Michigan's Nonpoint Source Program Plan. Physical improvements are structural and vegetative best management practices.

Additional Information: https://www.michigan.gov/egle/0,9429,7-135-3307_3515-314499--,00.html

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Nonpoint Source Pollution Control Grants – Federal Clean Water Action Section 319: To provide funding to implement nonpoint source activities identified in EGLE-approved watershed management plans. Implementation activities must address specific sources of nonpoint source pollution identified by Michigan's Nonpoint Source Program Plan.

Additional Information: https://www.michigan.gov/egle/0,9429,7-135-3307_3515-314500--,00.html

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Planning and Construction Grants: Michigan Coastal Management (MCM) Program provides grant funds to promote vibrant and resilient coastal communities. Approximately $700,000 for planning and on-the-ground, site-specific projects are available annually in partnership with the National Oceanic and Atmospheric Administration.

Additional Information: https://www.michigan.gov/egle/0,9429,7-135-3307_3515-314490--,00.html

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Scarp Tire Cleanup Grants: To assist property owners and local units of government with the proper removal of abandoned scrap tires and scrap tires at collection sites. Priority will be given to scrap tires accumulated prior to January 1, 1991, and to collection sites that pose an imminent threat to public health, safety, welfare, or the environment.

Additional Information: https://www.michigan.gov/egle/0,9429,7-135-3307_3515-314505--,00.html

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Scarp Tire Law Enforcement Grants: To issue grants for projects that will result in restricting the illegal dumping or improper disposal of scrap tires.

Additional Information: https://www.michigan.gov/egle/0,9429,7-135-3307_3515-495979--,00.html

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Scarp Tire Market Development Grants: To issue grants for projects that will result in the development of increased markets for scrap tires.

Additional Information: https://www.michigan.gov/egle/0,9429,7-135-3307_3515-314506--,00.html

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Source Water Protection Grants: To provide matching funds to public water supply systems for the development and implementation of a source water protection program to help prevent drinking water sources from becoming contaminated. These funds can be used to develop a Surface Water Intake Protection Program for systems utilizing surface water or to develop a Wellhead Protection Program for those systems that use groundwater sources.

Additional Information: https://www.michigan.gov/egle/0,9429,7-135-3307_3515-314515--,00.html

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State Revolving Loan Fund: Provides low-interest loans for water pollution control projects.

Additional Information: https://www.michigan.gov/egle/0,9429,7-135-3307_3515-314509--,00.html

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Strategic Water Quality Initiatives Fund: Provides low-interest loans for water pollution control projects involving the on-site upgrade or replacement of failing septic systems or for the removal of groundwater or stormwater from sanitary or combined sewer leads.

Additional Information: https://www.michigan.gov/egle/0,9429,7-135-3307_3515-314512--,00.html

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Substantial Public Health Risk Project Grants: For projects to address a substantial public health risk from treatment system failure.

Additional Information: https://www.michigan.gov/egle/0,9429,7-135-3307_3515-492720--,00.html

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Volunteer River, Stream, and Creek Cleanup Grants: Provides funding to local units of government for volunteer cleanups of rivers, streams, and creeks to improve Michigan waterways of human-made trash.

Additional Information: https://www.michigan.gov/egle/0,9429,7-135-3307_3515-314495--,00.html

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Michigan Department of Natural Resources (DNR): Maintains natural resources such as parks, state forests, and recreation areas.

Michigan Invasive Species Grant Program: To address strategic issues of prevention, detection, eradication and control for both terrestrial and aquatic invasive species in Michigan. Annually, $3.6 million in funding is available.

Additional Information: https://www.michigan.gov/invasives/0,5664,7-324-71276_92000---,00.html

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Michigan Department of Transportation (MDOT): Maintains all interstate, US and state highways in Michigan.

Emergency Relief: Assists with replacing or repairing roadways or roadway structure damage on ALL federal aid highways (major collectors and above) resulting from a catastrophic failure or natural disaster. Also includes debris removal and emergency protective measures such as traffic control and detour signing.

Additional Information:
https://www.michigan.gov/documents/mdot/FHWA_Emergency_Relief_program_outline_Michigan_022113_418318_7.pdf

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Rural Task Force Program: The money is provided within two funding sources: Surface Transportation Program (STP) Rural for improving the federal aid system; and Transportation Economic Development Fund (TEDF) Category D for building an all-season network.

Additional Information: https://www.michigan.gov/mdot/0,4616,7-151-9621_17216_54903-227096--,00.html

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State Infrastructure Bank Loan Program: Provide loans to public entities for eligible transportation improvements to meet urgent project financing demands.

Additional Information:
https://www.michigan.gov/documents/mdot/Guidelines_for_Applicants_623329_7.pdf

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Michigan Economic Development Corporation (MEDC): Collaborates with other economic partners to assist businesses grow and develop strategies.

Michigan Business Development Program: Provide grants, loans, and other economic assistance to businesses for highly competitive projects in Michigan that create jobs and/or provide investment.

Additional Information:
https://www.michiganbusiness.org/4a7f60/globalassets/documents/reports/fact-sheets/michiganbusinessdevelopmentprogram.pdf

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Michigan Community Revitalization Program: Promotes community revitalization.

Additional Information:
https://www.michiganbusiness.org/49a841/globalassets/documents/reports/fact-sheets/communityrevitalizationprogram.pdf

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Other

Local Resources & Programs

Baraga County Community Foundation: Funding and scholarships available to address community needs. Provide support for non-profits and volunteer organizations in Baraga County.

Additional Information: http://baragacountyfoundation.org/

Baraga, Houghton, and Keweenaw Community Action Agency: Has programs such as Western Upper Peninsula Food Bank, weatherization, emergency programs, Commodity Supplemental Food Program (CSFP), The Emergency Food Assistance Program (TEFAP), transportation, furnace and chimney cleaning/minor roof repairs and much more.

Additional Information: 926 Dodge St. Houghton, MI 49931 | (906) 482-5528
http://www.keweenaw.org/list/member/community-action-agency-houghton-71 ;
http://bhkcaa.org/index.html

Copper County Habitat for Humanity - Homeownership Program: For families and individuals in need of decent, affordable housing. Application selection based on level of need, willingness to partner with Habitat for Humanity and the ability to repay mortgage through an affordable payment plan.

Additional Information: https://www.habitat.org/us-mi/houghton/copper-country-hfh

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Dickinson Iron Community Action Agency: Focus and coordinate all available resources that empower individuals to obtain the opportunities to become self-sufficient. Provides 14 different human services including in-home senior services, transportation, weatherization, nutrition and food services. Reach out to the agency to see what other services they provide.

Additional Information: https://www.dicsami.org/

Duck Lake Riparians' Association: (Gogebic County) Improve, conserve, and safeguard overall welfare of the air, water, and shorelines of Duck Lake in Gogebic County. Assists local government in development and administration of regulations to protect the environment and promote social and recreational activities.

Additional Information: http://www.ducklakeriparians.org/index.cfm

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Gogebic Ontonagon Community Action Agency: Provides food, weatherization, housing, and community development programs. Visit their website or call the agency to find out more.

Additional: http://www.gocaa.org/index.cfm?fuseaction=dep_list

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Gogebic Salvation Army Service Extension: Disaster and emergency response services are provided by a committee of volunteers through the Salvation Army:

Additional Information: Tom Bremer (715) 554-0177

Habitat for Humanity Menominee River: Build and repair homes in Iron and Dickinson County. Make home improvements such as repairs and replacements of roofs, furnaces, water heaters, septic systems, and siding.

Additional Information: http://www.habitatmr.com/index.html

Hancock Salvation Army: Provides emergency financial assistance and disaster services for Houghton, Keweenaw, and Ontonagon counties.

Additional Information: https://centralusa.salvationarmy.org/hancock

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Ishpeming Salvation Army: Provides emergency financial assistance and disaster services to Baraga County

Additional Information: (906) 486-8121

Keweenaw Community Foundation: Strengthen all aspect of the Keweenaw and assist donors in achieving their philanthropic goals. Various grant applications are available.

Additional Information: http://keweenawcommunityfoundation.org/

Keweenaw Economic Development Alliance: Private-public partnership local economic development organization serving Baraga, Houghton, and Keweenaw Counties. Provides leadership and staffing to implement the Keweenaw Economic Dev. Strategic Plan with the goals of fostering business growth, improving infrastructure, revitalizing our communities, developing and attracting talent, and enhancing cultural and recreational opportunities.

Additional Information: https://kedabiz.com/about/

Keweenaw Land Trust: Focus on protection of land, water, and quality of life through conservation, stewardship, and education. Current projects include preservation of wetlands, watersheds, and natural habitat, conservation easements. and educational outreach.

Additional Information: http://www.keweenawlandtrust.org/about.php

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Lake Superior Community Development Corp: Non-profit Native Community Development Financial Institution. Loan programs available to assist with access to home mortgages and decent, safe, and sanitary housing for low- and very-low-income individuals.

Additional Information: https://www.lakesuperiorcdc.com/

Portage Health Foundation: Offers grants and sponsorships for projects implementing and promoting health education, health research, community health, healthcare leaders and access to care. Also raises funds to help those in need after disasters.

Additional Information: http://phfgive.org/grants.php

Superior Health Foundation: Assists in meeting unmet health needs through education, programs, and research on illness prevention and health promotion. Several grants are provided through the foundation for non-profit health-centered organizations.

Additional Information: http://superiorhealthfoundation.org/

Superior Watershed Partnership and Land Conservancy: Implements a variety of conservation and public education projects including pollution prevention, invasive species removal and prevention, water quality and stormwater management, habitat protection and restoration, native plant restoration, climate change adaptation planning and implementation, alternative energy and energy conservation, land protection, watershed restoration, and education programs.

Additional Information: https://superiorwatersheds.org/projects

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Western U.P. Planning & Development Region (WUPPDR): Offers planning support for the counties of Baraga, Gogebic, Houghton, Iron, Keweenaw, and Ontonagon. Services and technical assistance on Hazard Mitigation planning are available. Additionally, information on mitigation and community development funding and resources is also provided.

Additional Information: https://www.wuppdr.org/

Other

National Resources & Programs

Community Restoration & Resiliency: Keep America Beautiful Community Restoration and Resiliency Fund benefits Keep America Beautiful Affiliates that serve communities directly affected by natural and environmental disasters. The fund provides immediate and long-term support for initial and ongoing cleanup efforts and helps rebuild vital public spaces: parks, greenways, community gateways, Main Street/downtown areas, open spaces, and more. Funds will help improve resiliency physically — as green infrastructure — and socially — to build community.

Additional Information: https://www.kab.org/

Grants for Indigenous Peoples: Seventh Generation Fund is an Indigenous identity-based organization dedicated to the self-determination of Native Peoples and tribal sovereignty. It mobilizes financial, technical, and informational resources directly to Native communities to empower action. Grant awards in several categories ranging from $250 to $50,000. An organization may apply for a single large grant per year, with the possibility of additional Traveling Song Initiative or Mini-Grants.

Additional Information: http://www.7genfund.org/apply-grant

National Low-Income Housing Coalition: The National Low-Income Housing Coalition is dedicated solely to achieving socially just public policy that assures people with the lowest incomes in the United States have affordable and decent homes.

Additional Information: https://nlihc.org/issues/disaster

Planning for Post Disaster Recovery - Next Generation: American Planning Association provides tools and guidance with briefing papers, case studies, a comprehensive report, and model pre-event recovery ordinance.

Additional Information: https://www.planning.org/research/postdisaster/

Rebuilding Together: Rebuilding Together helps people and communities in need by bringing together its national network of local Rebuilding Together affiliates, corporate and individual donors, skilled trades individuals and associations, and almost 100,000 volunteers each year.

Additional Information: www.rebuildingtogether.org

Voluntary Organizations Active in Disasters: Association of organizations that mitigate and alleviate disaster impact. The website has a list of national partners that provide various services and programs for communities affected by disasters.

Additional Information: https://www.nvoad.org/voad-members/national-members/

Produced by: Western U.P. Planning & Development Region

Appendix D: County Letter to Commit Match

November 26, 2018

Jerald Wuorenmaa, Executive Director
Western Upper Peninsula Planning and Development Region (WUPPDR)
400 Quincy St 8th Floor
Hancock, MI 49930

Dear Mr. Wuorenmaa:

Houghton County understands that WUPPDR intends to apply, or already has, for Federal Emergency Management Agency (FEMA) funding to update the Houghton County Hazard Mitigation Plan beginning in late 2018 or early 2019. The funding source, the Hazard Mitigation Grant Program, requires a nonfederal local share of at least 25 percent of the total project budget.

As the County will benefit significantly from this project through a plan of action to mitigate future hazards and disasters, as well as through establishment of eligibility for future FEMA pre- or post-disaster funding, the County Board commits to a local cost share not to exceed $3,000. This amount may be provided through in-kind services (facilitated and documented with assistance from the County Emergency Manager), a cash contribution, or a combination of both.

Houghton County looks forward to working with you to complete its Hazard Mitigation Plan update.

Sincerely,

Eric Forsberg, Administrator

Appendix E: Public Participation

2019 Houghton County Hazard Mitigation Public Opinion Survey

We need your help!

Houghton County is currently updating their five-year hazard mitigation plan as required by the Federal Emergency Management Agency (FEMA). A committee and staff in Houghton County are working with the Western Upper Peninsula Planning & Development Region (WUPPDR) to update the County's Hazard Mitigation Plan. Hazard mitigation is any action taken before, during, or after a disaster to eliminate or reduce the risk to human life and property from natural, technological, or human-related hazards. This survey provides an opportunity for you to share your knowledge and participate in the hazard mitigation planning process. The information you provide will help us better understand your hazard concerns and can lead to mitigation activities that help lessen the impact and risk of future hazard events to your community.

You can either fill out the attached paper survey or participate online at:
https://www.surveymonkey.com/r/HoCoHazMitPublicInput

Although participation in this survey is optional, we strongly encourage you to respond. All responses will be kept confidential. **Please respond by Friday, July 12.** If you have questions regarding this survey or would like to learn about more ways that you can participate in the planning process, please contact:

Rachael Pressley, Assistant Regional Planner
WUPPDR
(906) 482-7205 ext. 116
rpressley@wuppdr.org

Paper surveys can be dropped off at the county clerk's office or mailed to:
Rachael Pressley
Western U.P. Planning and Development Region (WUPPDR)
400 Quincy St., 8th Floor
Hancock, MI 49930

Thank you for your time and participation!

Key Definitions:

Hazard - Something that is potentially dangerous or harmful, often the root cause of an unwanted outcome.
Mitigation - The action of reducing the severity, seriousness, or painfulness of something.
Risk - A situation involving exposure to danger; the possibility that something unpleasant or unwelcome will happen.
Vulnerability - The quality or state of being exposed to the possibility of being attacked or harmed, either physically, emotionally, financially, etc.

1. Where do you live in Houghton County?

☐ City of Houghton	☐ Osceola Township	☐ Franklin Township
☐ City of Hancock	☐ Portage Charter Township	☐ Adams Township
☐ Village of Calumet	☐ Chassell Township	☐ Calumet Charter Township
☐ Village of Copper City	☐ Duncan Township	☐ Hancock Township
☐ Village of South Range	☐ Elm River Township	☐ Laird Township
☐ Village of Lake Linden	☐ Quincy Township	☐ Stanton Township
☐ Village of Laurium	☐ Schoolcraft Township	☐ Torch Lake Township

☐ Outside Houghton County; please specify: _____

2. During the past five (5) years, have you or someone in your household directly experience a hazard in Houghton County, such as a severe windstorm, flood, or other type of hazard?

☐ Yes ☐ No

If yes, which of hazards have you or someone in your household experienced in the past five (5) years?

3. How concerned are you about the following hazards affecting your home and community?

Hazards	Very Concerned	Somewhat Concerned	Neutral	Not Very Concerned	Not Concerned
WEATHER HAZARDS					
Extreme Weather Temperatures (hot/cold)	☐	☐	☐	☐	☐
Fog	☐	☐	☐	☐	☐
Hail	☐	☐	☐	☐	☐
Ice and Sleet Storms	☐	☐	☐	☐	☐
Lightning	☐	☐	☐	☐	☐
Severe Winds (Windstorms)	☐	☐	☐	☐	☐
Snowstorms and Blizzards	☐	☐	☐	☐	☐
Tornados	☐	☐	☐	☐	☐
GEOLOGIC HAZARDS					
Earthquakes	☐	☐	☐	☐	☐
Landslide /Mudslide	☐	☐	☐	☐	☐
Subsidence (sink holes or ground collapse)	☐	☐	☐	☐	☐

Hazards	Very Concerned	Somewhat Concerned	Neutral	Not Very Concerned	Not Concerned
HYDROLOGICAL HAZARDS					
Dam Failure	☐	☐	☐	☐	☐
Drought	☐	☐	☐	☐	☐
Flooding due to precipitation event or snowmelt	☐	☐	☐	☐	☐
Shoreline Flooding and Erosion	☐	☐	☐	☐	☐
ECOLOGICAL HAZARDS					
Invasive Species (Emerald Ash Borer/Asian Carp)	☐	☐	☐	☐	☐
Wildfires	☐	☐	☐	☐	☐
INDUSTIRAL HAZARDS					
Scrap Tire Fires	☐	☐	☐	☐	☐
Structural Fires	☐	☐	☐	☐	☐
Hazardous Materials, Fixed Site (e.g. buildings or industrial site)	☐	☐	☐	☐	☐
Hazardous Materials, Transportation-Related (e.g. waste spill from traffic accident)	☐	☐	☐	☐	☐
Petroleum/Natural Gas Pipeline Incident (e.g. rupture/leak resulting in outage)	☐	☐	☐	☐	☐
INFRASTRUCTURE HAZARDS					
Infrastructure failure & resulting hazards (e.g. power outage)	☐	☐	☐	☐	☐
Transportation Accidents (car crashes)	☐	☐	☐	☐	☐
HUMAN RELATED					
Civil Disturbances (rioting)	☐	☐	☐	☐	☐
Public Health Emergencies (disease epidemic)	☐	☐	☐	☐	☐
Sabotage/Terrorism	☐	☐	☐	☐	☐
Other: _____	☐	☐	☐	☐	☐
Other: _____	☐	☐	☐	☐	☐
Other: _____	☐	☐	☐	☐	☐

4. Have you taken any actions to make your home or community more resistant to hazards?

☐ Yes ☐ No

IF YES, please explain:

5. Is your home located in a floodplain? ☐ Yes ☐ No ☐ Don't know

6. Does your street or home flood regularly during significant rain events? ☐ Yes ☐ No

IF YES, provide cross street name and/or specific location(s) on street:

7. If your street or home **does flood regularly** during significant rain events, how many times did it flood in the past 12 months?

☐ 1 time ☐ 2 times ☐ 3 times ☐ 4 times ☐ 5 or more times

8. Do you have flood insurance? ☐ Yes ☐ No; ***please indicate reason(s) below*** ☐ Don't know

- ☐ Not Located in a floodplain
- ☐ Too expensive
- ☐ Property never floods
- ☐ Property is elevated or otherwise protected
- ☐ Insurance company will not provide
- ☐ Never considered / didn't know about it
- ☐ Other (specify):

_____

9. What are the most effective ways for you to receive information during or immediately following a hazard emergency?

- ☐ Newspaper
- ☐ Television
- ☐ Radio
- ☐ Internet – Social Media (Facebook or Twitter)
- ☐ Internet – Government Website Postings
- ☐ Mailings
- ☐ Public Forums / Meetings
- ☐ Other (specify): _____

_____

_____

10. In your opinion, what are some steps or projects your local government could take to reduce or eliminate the risk for future hazard damages to your community?

10. Several community-wide activities can reduce our risk from hazards. In general, these activities fall into one of six broad categories. Please tell us how important you think each one is for your community to consider doing:

Category	Very Important	Somewhat Important	Not Important
1. **Prevention** Administrative or regulatory actions that influence the way land is developed and buildings are built. Examples include planning & zoning, building codes, open space preservation, and floodplain regulations.	☐	☐	☐
2. **Property Protection** Modification or removal of existing buildings to protect them from a hazard. Examples include government purchase, relocation, raised elevation, and structural retrofits (updates).	☐	☐	☐
3. **Natural Resource Protection** Preservation or restoration of the functions of natural systems while minimizing hazard losses. Examples include floodplain protection, forest management, and slope stabilization.	☐	☐	☐
4. **Structural Projects** Modification of the natural conditions for or progression of a hazard. Examples include dams, levees, seawalls, detention/retention basins, channel modification, retaining walls, and storm sewers.	☐	☐	☐
5. **Emergency Services** Protection of people and property during and immediately after a hazard event. Examples include warning systems, evacuation planning, emergency response training, and protection of emergency facilities.	☐	☐	☐
6. **Public Education and Awareness** Informing of citizens about hazards and the techniques they can use to protect themselves and their property. Examples include outreach, school education, library materials, and demonstration events.	☐	☐	☐

Please feel free to provide any additional comments in the space provided:

THANK YOU FOR YOUR PARTICIPATION!

PRESS RELEASE

Western Upper Peninsula Planning and Development Region
400 Quincy St., 8th Floor
Hancock, MI 49930
906-482-7205
info@wuppdr.org

Release Date: June 14, 2019

Houghton County Hazard Mitigation Plan – Public Input Survey

Hazard mitigation is any action taken before, during or after a disaster to eliminate or reduce the risk to human life and property from natural, technological, or human-related hazards. Officials in Houghton County along with the Houghton County Emergency manager are contracting the Western Upper Peninsula Planning & Development Region to update the County-wide Hazard Mitigation Plan.

We are asking that any Houghton County resident take a short online survey. The paper survey and flyers with the online-link are available at the city and township halls, county clerk's office, public libraries, as well as www.wuppdr.org/surveys and will be available until Friday, July 12, 2019.

The survey link is as follows:

https://www.surveymonkey.com/r/HoCoHazMitPublicInput

The information you provide will help us better understand local hazard concerns and can lead to mitigation activities that should help lessen the impact of future hazard events in your community.

For more information or for a paper survey contact:

Rachael Pressley, rpressley@wuppdr.org
WUPPDR Project Coordinator
1-906-482-7205, ext. 116

BARAGA, HOUGHTON, & KEWEENAW COUNTY HAZARD MITIGATION PLANS – PUBLIC INPUT SURVEYS

June 14, 2019 | Featured, Local News | Leave a comment | 177 Views

The following press release was issued by WUPPDR:

Hazard mitigation is any action taken before, during or after a disaster to eliminate or reduce the risk to human life and property from natural, technological, or human-related hazards.

Officials in Baraga, Houghton, and Keweenaw County along with the Emergency managers are contracting the Western Upper Peninsula Planning & Development Region to update each of these County Hazard Mitigation Plans.

We are asking that any Baraga, Houghton, and Keweenaw County resident take a short online survey. The paper survey and online-link is available at the city and township halls, county clerk's office, public libraries, as well as
www.wuppdr.org/surveys and will be available until Friday, July 19, 2019.

The survey links for each County are as follows:
Baraga: ***https://www.surveymonkey.com/r/BaragaHazMitPublicInput***
Houghton: ***https://www.surveymonkey.com/r/HoCoHazMitPublicInput***
Keweenaw: ***https://www.surveymonkey.com/r/KewCoHazMitPublic***

The information you provide will help us better understand local hazard concerns and can lead to mitigation activities that should help lessen the impact of future hazard events in your community.

For more information or for a paper survey contact:
Rachael Pressley, ***rpressley@wuppdr.org***
WUPPDR Project Coordinator
1-906-482-7205, ext. 116

June 14, 2019

Submit a Story

1. Tech Team Wins iOme Challenge
2. Houghton County Hazard Mitigation Plan – Public Input Survey
3. Concrete Canoe Finishes 10th at Nationals
4. Continuous Improvement Connection
5. Job Posting

Houghton County Hazard Mitigation Plan – Public Input Survey

by Western Upper Peninsula Planning and Development Region

Hazard mitigation is any action taken before, during or after a disaster to eliminate or reduce the risk to human life and property from natural, technological, or human-related hazards. Officials in Houghton County, along with the Houghton County Emergency manager, are contracting the Western Upper Peninsula Planning and Development Region to update the County-wide Hazard Mitigation Plan.

We are asking that any Houghton County resident take a **short online survey**. The paper survey and flyers with the online-link are available at the city and township halls, county clerk's office, public libraries, as well as **http://www.wuppdr.org/surveys** and will be available until Friday, July 12, 2019.

The information you provide will help us better understand local hazard concerns and can lead to mitigation activities that should help lessen the impact of future hazard events in your community.

For more information or for a paper survey email **Rachael Pressley**, WUPPDR Project Coordinator (or call 482-7205, ext. 116).

Results of 2019 Houghton County Hazard Mitigation Survey – Summary

The 2019 Houghton County Hazard Mitigation Public Survey received 136 responses. Printed copies of the survey were available to residents at a variety of locations through the county. The survey was also accessible online with notices published in the Daily Mining Gazette, the Keweenaw Report, and Michigan Technological University's Tech Today.

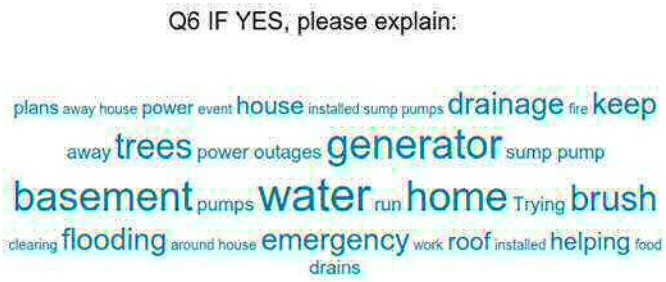
All the respondents were residents of Houghton County with a majority (30.2%, or 41 people) living in the City of Houghton. Almost all jurisdictions in Houghton County were represented in the survey results, except for the Village of Copper City and Duncan Township.

When asked if they or someone in their household directly experienced a hazard in Houghton County over the last five years, 81.6% (111 people) said yes. The most mentioned hazard that their household experienced was flooding at 78.3% (90 people), and the second most common hazard experienced was a windstorm at 10.4% (12 people). The word cloud below was generated from the results of survey question 3:

Q3 IF YES, which hazard(s) have you or someone in your household experienced in the past five (5) years?

Respondents were asked how concerned they were about potential hazards that could affect their home and community in the next five years. Almost 88% were very concerned or somewhat concerned about flooding due to precipitation event or snowmelt. The other top hazards that concerned citizens in Houghton County were snowstorms and blizzards (78%), invasive species (75%), shoreline flooding and erosion (73%), severe winds (73%), and infrastructure failure and secondary hazards (71%). The respondents were either not very concerned or not concerned at all about earthquakes (85%), civil disturbances (75%), fog (64%), sabotage or terrorism (62%), and scrap tire fires (55%),

Respondents were also asked whether they had taken actions to make their home or community more resistant to hazards. Over half of them (55%) said yes, and then responded to the next question with their explanation. The word cloud below was generated from the results of the survey question 6:



3% of the responses confirmed that their home is located on a floodplain, while 97 people (72%) said no and 34 (25%) said they did not know. However, over 22% (31 people) stated that their street or home floods regularly with significant rain events. The survey went on to ask them specific cross streets and how many times it flooded in the past year. Out of 53 people who answered:

1 time	23 (43.4%)
2 times	13 (24.5%)
3 times	7 (13.2%)
4 times	4 (7.6%)
5 or more times	6 (11.3%)

Most of the respondents reported not having flood insurance (96.3%; 129 people), A few did not know if they had flood coverage (2.2%; 3 people). The top reasons listed for not having coverage was because they were not located in a floodplain (55.3%), their property is elevated or otherwise protected (30.9%), property does not flood (21.1%), and it is too expensive (14.6%).

When asked what the most effective ways were to receive information during or immediately following a hazard emergency, 97 people (71.9%) said they utilize social media and 90 (66.7%) said the radio. Other responses say will use their phone (49.6%), government websites (41.5%), television (35.6%), and newspaper (17%).

Over 102 people gave their opinion of steps or projects local government could take to reduce or eliminate the risk for future hazard damages. These data are attached to this document for review. As expected, many respondents felt that each of the six broad risk reduction categories were extremely important. However, under property protection more than half (54%) people said that it was ‘somewhat important’.

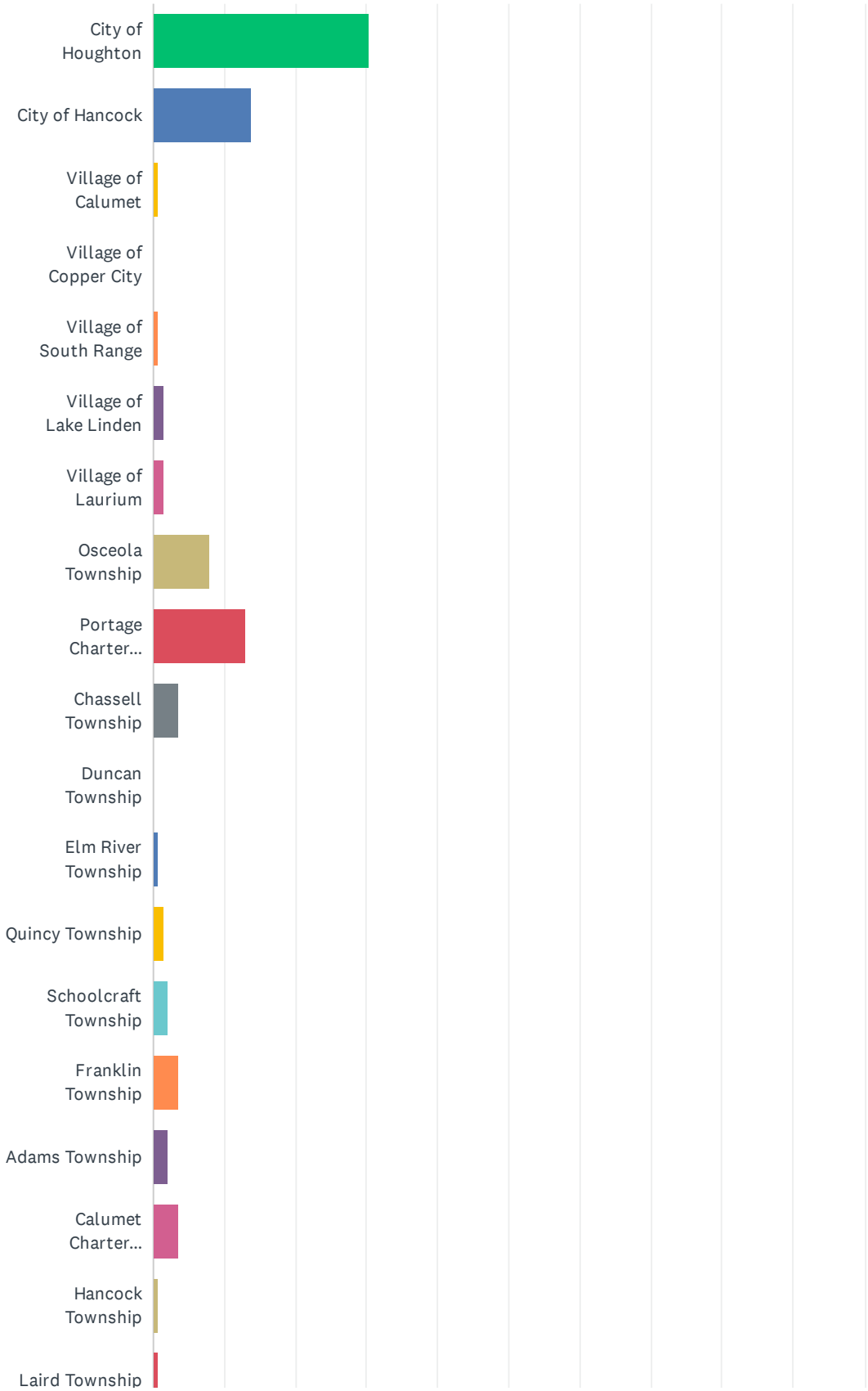
The last question in the survey was an additional comment box for the LPT containing 28 responses. These data are also attached to this survey summary.

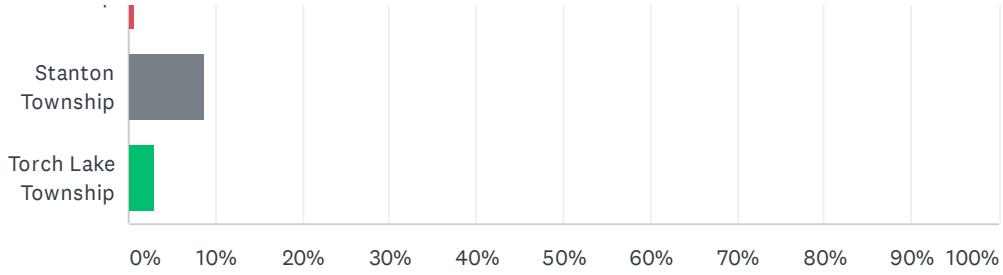
Attached:

Q14 In your opinion, what are some steps or projects your local government could take to reduce or eliminate the risk for future hazard damages to your community? 102 Comments

Q1 Where do you live in Houghton County?

Answered: 138 Skipped: 0



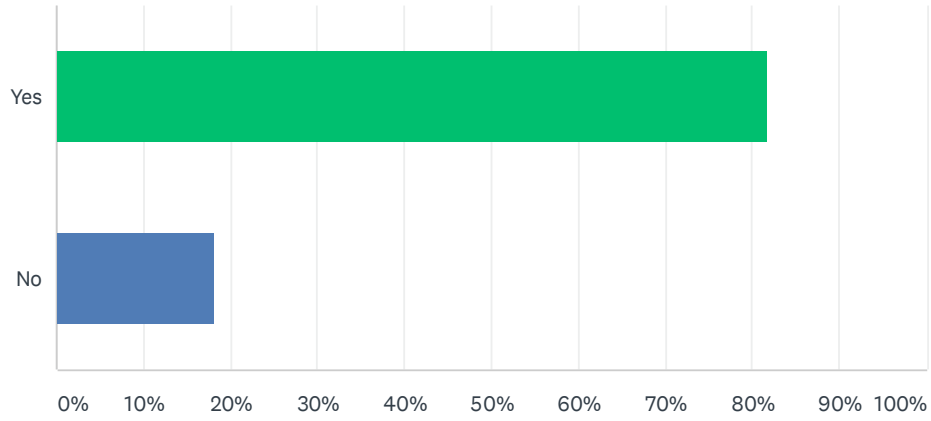


ANSWER CHOICES	RESPONSES	
City of Houghton	30.43%	42
City of Hancock	13.77%	19
Village of Calumet	0.72%	1
Village of Copper City	0.00%	0
Village of South Range	0.72%	1
Village of Lake Linden	1.45%	2
Village of Laurium	1.45%	2
Osceola Township	7.97%	11
Portage Charter Township	13.04%	18
Chassell Township	3.62%	5
Duncan Township	0.00%	0
Elm River Township	0.72%	1
Quincy Township	1.45%	2
Schoolcraft Township	2.17%	3
Franklin Township	3.62%	5
Adams Township	2.17%	3
Calumet Charter Township	3.62%	5
Hancock Township	0.72%	1
Laird Township	0.72%	1
Stanton Township	8.70%	12
Torch Lake Township	2.90%	4
TOTAL		138

#	OUTSIDE OF HOUGHTON COUNTY; PLEASE SPECIFY	DATE
	There are no responses.	

Q2 During the past five (5) years, have you or someone in your household directly experienced a hazard in Houghton County, such as a severe windstorm, flood, or other type of hazard?

Answered: 138 Skipped: 0



ANSWER CHOICES	RESPONSES	
Yes	81.88%	113
No	18.12%	25
TOTAL		138

Q3 IF YES, which hazard(s) have you or someone in your household experienced in the past five (5) years?

Answered: 117 Skipped: 21

#	RESPONSES	DATE
1	June 17, 2018 Fathers Day Flood	8/22/2019 12:18 PM
2	Flooding, high winds, heavy snowfall, escaped jail inmate, lift bridge failure, downtown structure fire	8/22/2019 12:15 PM
3	The flood in June 2018, major rainstorm the week of July 14, major rainstorm in June 2016, windstorm at the end of June/early July 2018, major blizzard February 2019.	7/23/2019 11:03 AM
4	Flooding, Fire, Wind Damage	7/23/2019 8:18 AM
5	We were here for the flood.	7/19/2019 1:50 PM
6	flooding	7/19/2019 1:11 PM
7	Flooding of basement	7/19/2019 10:04 AM
8	Flooding from the sliding of the ravines	7/19/2019 9:35 AM
9	flood	7/19/2019 9:01 AM
10	none	7/19/2019 8:58 AM
11	Father's Day Flood	7/19/2019 8:37 AM
12	Severe storm, winds, lightning, flooding and washout in June, 2018. And, of course, the annual blizzards that snow us in.	7/19/2019 8:30 AM
13	Bad road due to flooding	7/19/2019 8:12 AM
14	Flood	7/19/2019 8:00 AM
15	Flood, Blizzard	7/19/2019 7:51 AM
16	flood	7/19/2019 7:33 AM
17	Flooding	7/19/2019 7:17 AM
18	Flood	7/19/2019 7:08 AM
19	Flood This might have been a better question with checkbox as not everyone knows what types of hazards count. We had a blizzard and severe thunderstorms . Does that count?	7/19/2019 6:35 AM
20	water in basement from Father's Day flood 2018	7/19/2019 6:26 AM
21	Windstorm, flood	7/19/2019 6:19 AM
22	2018 Flood	7/16/2019 11:54 AM
23	Father's Day Flood 2018 affected our yard driveway, and garage	7/7/2019 9:33 PM
24	flooding	6/29/2019 12:57 PM
25	Flood	6/26/2019 3:30 PM
26	Flood, windstorm	6/24/2019 12:37 PM
27	Flood	6/23/2019 9:34 PM
28	flood	6/22/2019 11:32 AM
29	Wind and storm	6/21/2019 10:49 PM
30	High winds, falling lines	6/21/2019 10:29 PM
31	2018-06-17 Flood	6/21/2019 9:31 PM
32	Flood and windstorm	6/21/2019 6:04 PM
33	Flood, blizzard, wind storm	6/20/2019 7:41 PM
34	Flood	6/20/2019 4:21 PM
35	Extreme stormwater/flooding	6/20/2019 4:14 PM

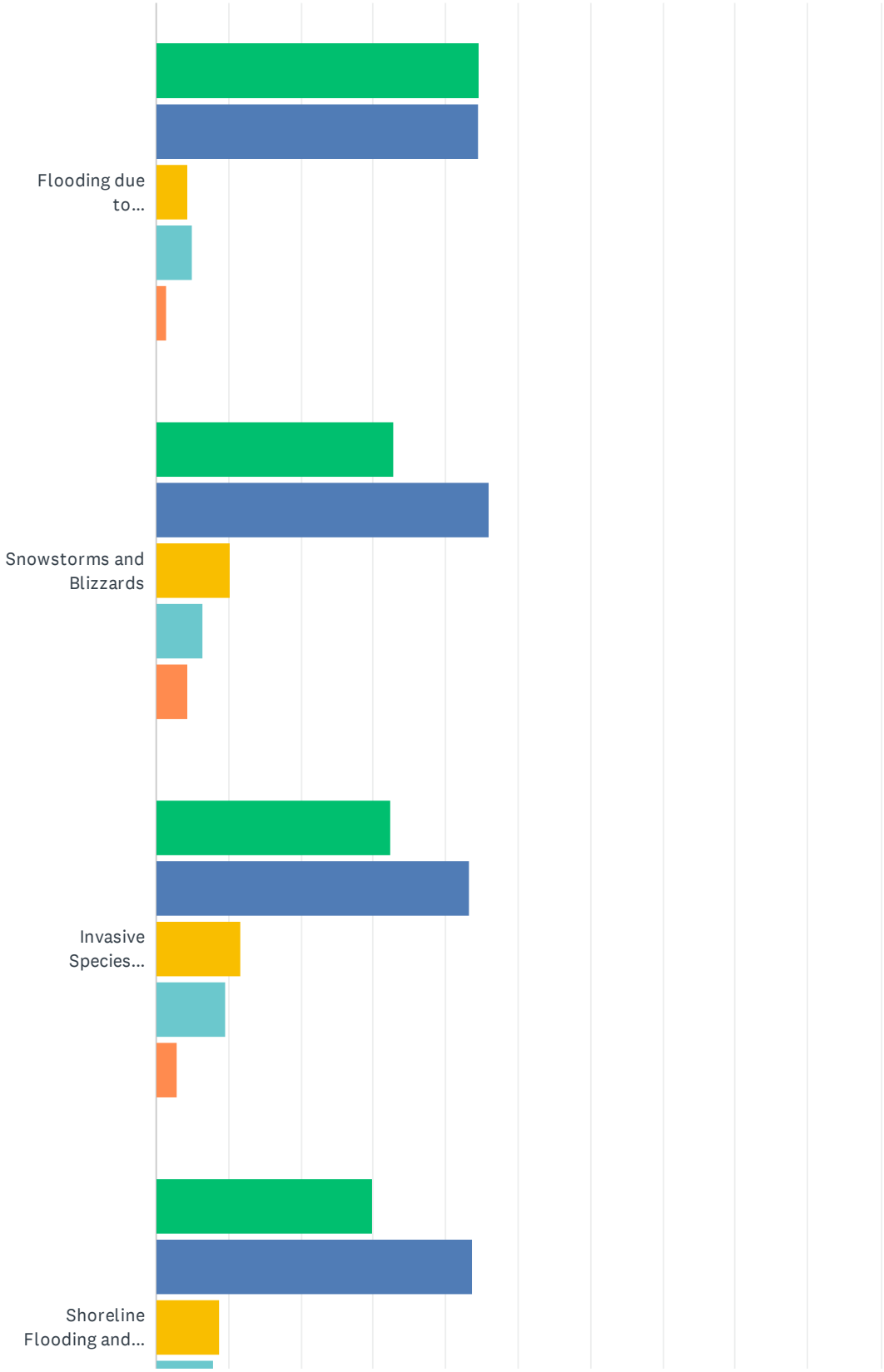
36	Flood, blizzard	6/20/2019 4:03 PM
37	Flooding on Fathers Day 2018.	6/20/2019 12:01 AM
38	severe rainstorm	6/18/2019 4:52 PM
39	wind and flood, contaminated water	6/18/2019 7:41 AM
40	Flood, Blizzard	6/17/2019 3:40 PM
41	Flooding and road damage/failure.	6/17/2019 3:36 PM
42	Slight flood damage to basement and flood damage to front of property (the road washed out at the end of our property line).	6/17/2019 1:02 PM
43	flooding	6/17/2019 11:51 AM
44	windstorm	6/17/2019 10:04 AM
45	Flood	6/17/2019 8:42 AM
46	flood	6/17/2019 8:04 AM
47	The 2019 Flood in Houghton County	6/17/2019 7:48 AM
48	Spring clean up dust from road sand and salt mix.	6/15/2019 9:14 PM
49	Flooding	6/15/2019 5:09 PM
50	windstorm flood	6/15/2019 8:54 AM
51	Flood	6/15/2019 6:45 AM
52	flood, blizzard	6/14/2019 10:20 PM
53	Father’s Day flood 2018	6/14/2019 8:27 PM
54	Gloodinh	6/14/2019 7:08 PM
55	Snow so deep our family wasn’t able to leave our house. Roads weren’t plowed for a full day and no one was able to enter or leave Painesdale.	6/14/2019 6:48 PM
56	Flood and storm damage.	6/14/2019 6:41 PM
57	Flash flood	6/14/2019 5:53 PM
58	Flood, snow storms	6/14/2019 4:45 PM
59	flood, windstorm, blizzard, power outage	6/14/2019 4:27 PM
60	flooding	6/14/2019 3:57 PM
61	Flood last June	6/14/2019 3:49 PM
62	Flooding	6/14/2019 3:26 PM
63	flooding	6/14/2019 3:09 PM
64	Flood	6/14/2019 2:55 PM
65	Flood	6/14/2019 2:45 PM
66	Flooding in our home as a result of the 2018 Father’s Day storms.	6/14/2019 2:43 PM
67	flood, windstorm	6/14/2019 2:13 PM
68	fathers day flood	6/14/2019 1:00 PM
69	Flooded basement from the June 2018 Father's Day Flood	6/14/2019 12:44 PM
70	Flooding	6/14/2019 12:23 PM
71	Blizzards	6/14/2019 11:53 AM
72	flooding in basement	6/14/2019 11:35 AM

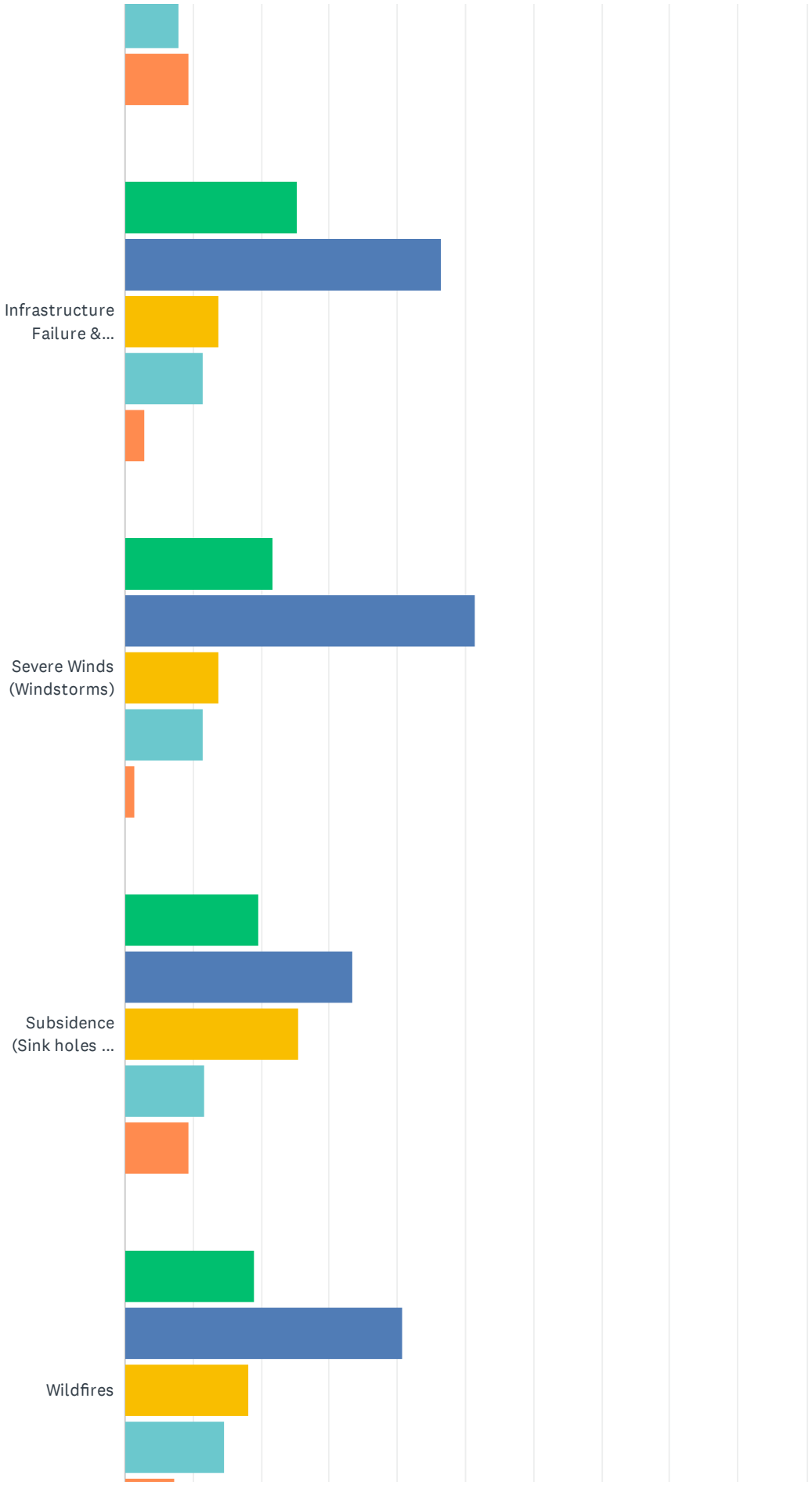
73	Minor flooding in basement in June 2018.	6/14/2019 11:35 AM
74	Flood	6/14/2019 11:19 AM
75	Flooding including lots of raw sewage	6/14/2019 10:52 AM
76	Severe windstorm	6/14/2019 10:46 AM
77	Downed trees on roads, road flooding, septic problems	6/14/2019 10:42 AM
78	windstorm, flood	6/14/2019 9:51 AM
79	Windstorm and extremely heavy rain. Blizzard.	6/14/2019 9:42 AM
80	Road wash out due to flood last year	6/14/2019 9:35 AM
81	Flood damage from Father's Day rainstorm in 2018	6/14/2019 9:34 AM
82	None	6/14/2019 9:30 AM
83	june flooding	6/14/2019 9:15 AM
84	NA	6/14/2019 9:15 AM
85	Father's Day Flood	6/14/2019 9:15 AM
86	Ripley creek flood/rock slide	6/14/2019 9:09 AM
87	Flood	6/14/2019 9:07 AM
88	Flooding, Father's Day Flood 2018	6/14/2019 9:02 AM
89	flooding	6/14/2019 8:51 AM
90	Flooding of June 2018, intense snow	6/14/2019 8:43 AM
91	Flood	6/14/2019 8:41 AM
92	High winds, lightning, blizzards, power outages, pollen, mosquitoes, bad roads, car-deer encounters, people driving while texting, reckless driving, wolves and mountain lions in my backyard, cybercrime/ identity theft, emerald ash borer and other invasive species.	6/14/2019 8:36 AM
93	Straight line damaging winds	6/14/2019 8:33 AM
94	flooding	6/14/2019 8:32 AM
95	Flash flood	6/14/2019 8:23 AM
96	Flood, high winds, heavy and speeding traffic	6/14/2019 8:17 AM
97	We live off of Agate Street, which was destroyed by the June 17 flood.	6/14/2019 8:14 AM
98	flood, severe windstorm, blizzard with power outages	6/14/2019 8:14 AM
99	Flooding, sink holes, high winds	6/14/2019 8:11 AM
100	Flood	6/14/2019 8:10 AM
101	Flood	6/14/2019 8:04 AM
102	flood	6/14/2019 8:01 AM
103	Flood, neighbors house was struck by lightening, Wind - neighbors metal roof trim blew off	6/14/2019 8:00 AM
104	wind storms and floods	6/14/2019 7:48 AM
105	Flooding with sink holes on Agate St, but my street itself (9th Ave) was spared, so maybe that does not count.	6/14/2019 7:37 AM
106	Flood	6/14/2019 7:31 AM
107	Flood 2018	6/14/2019 7:30 AM
108	Flooding; severe winter storm	6/14/2019 7:30 AM
109	Severe wind	6/14/2019 7:29 AM

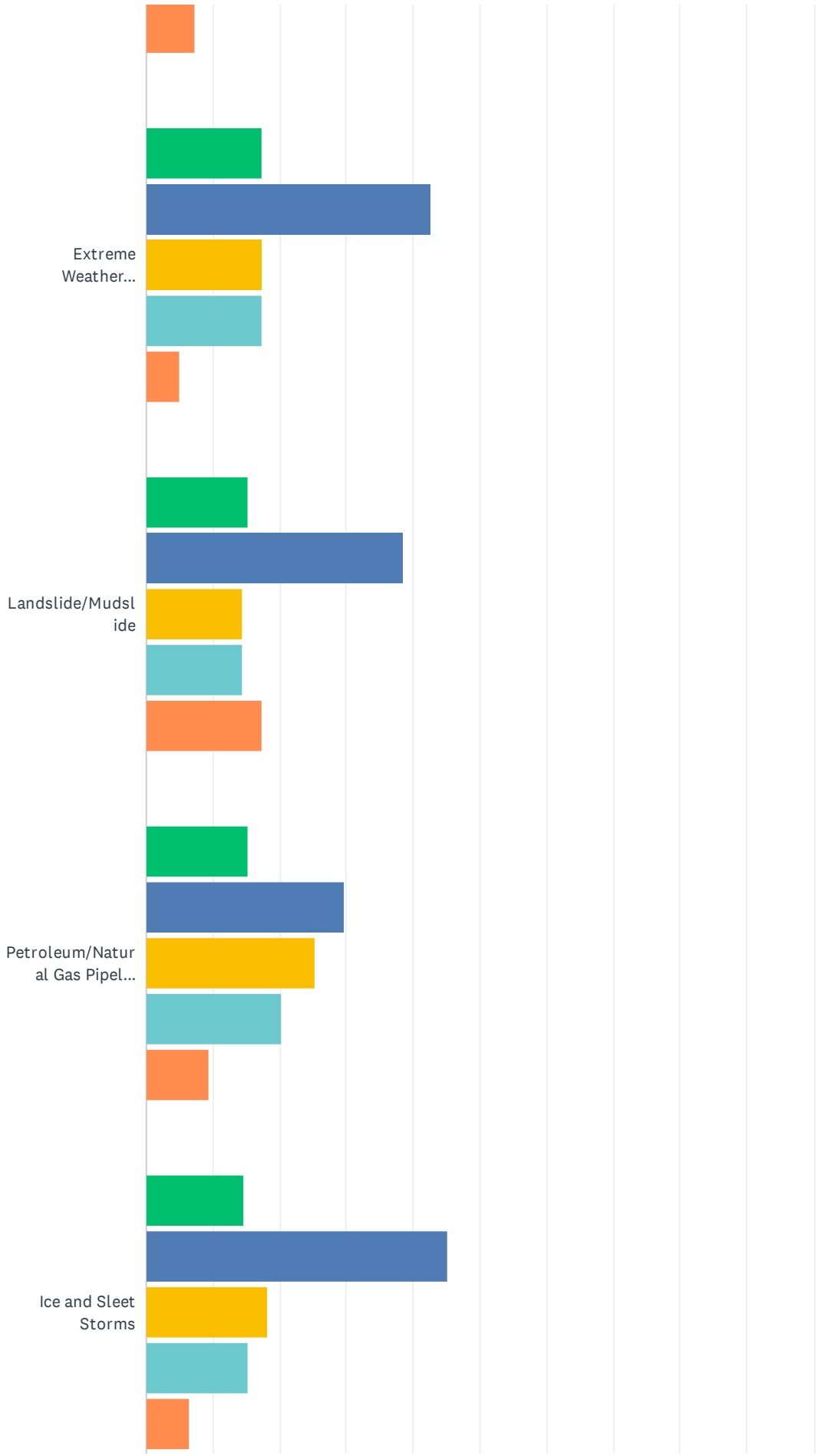
110	Father’s Day flood	6/14/2019 7:26 AM
111	flood	6/14/2019 7:23 AM
112	Sewage	6/14/2019 7:22 AM
113	Pond flooding and road damage	6/14/2019 7:13 AM
114	Flood	6/14/2019 7:05 AM
115	Flood	6/14/2019 7:02 AM
116	Flood	6/14/2019 6:54 AM
117	NA	6/14/2019 6:53 AM

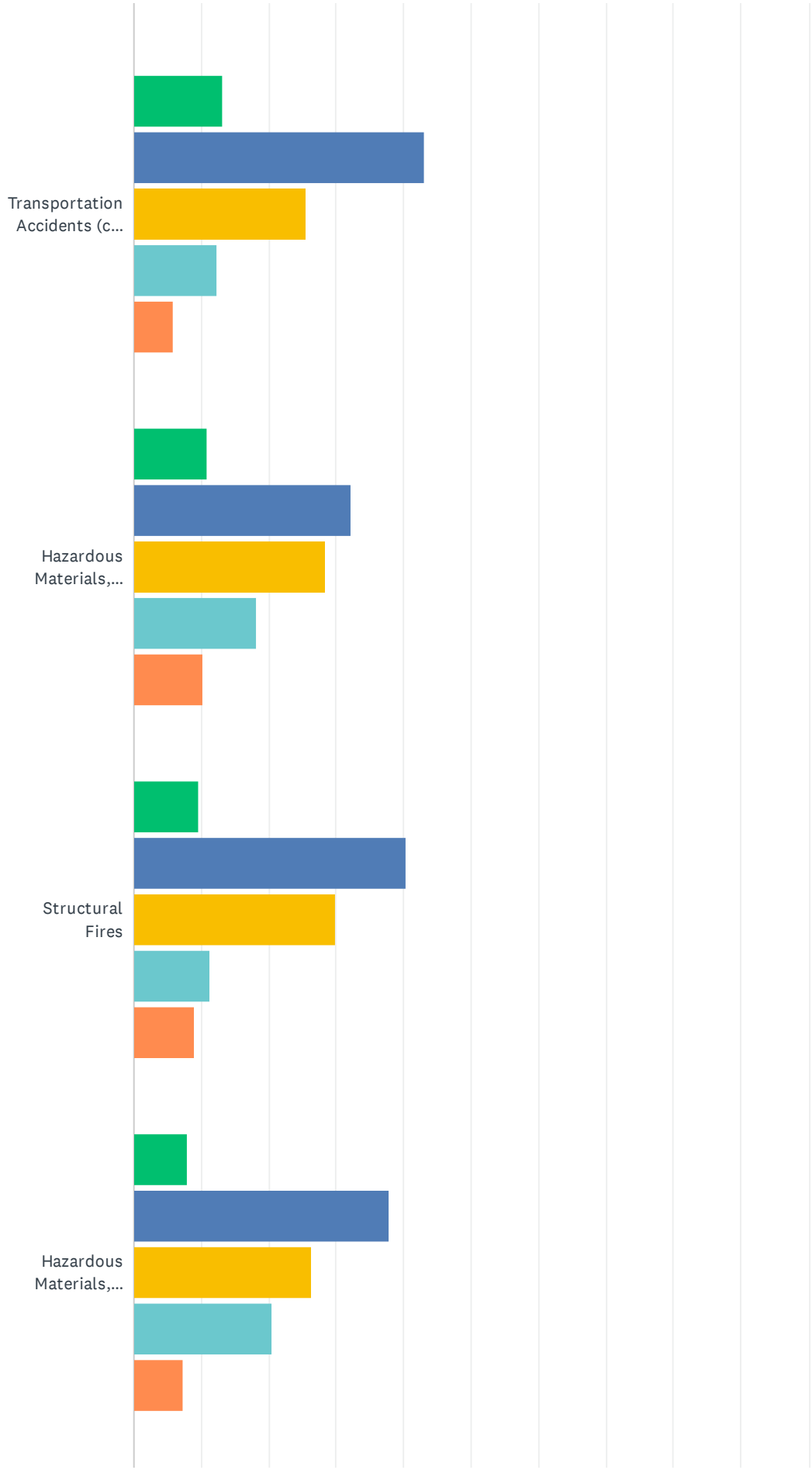
Q4 How concerned are you about the following hazards affecting your home and community in the next five (5) years?

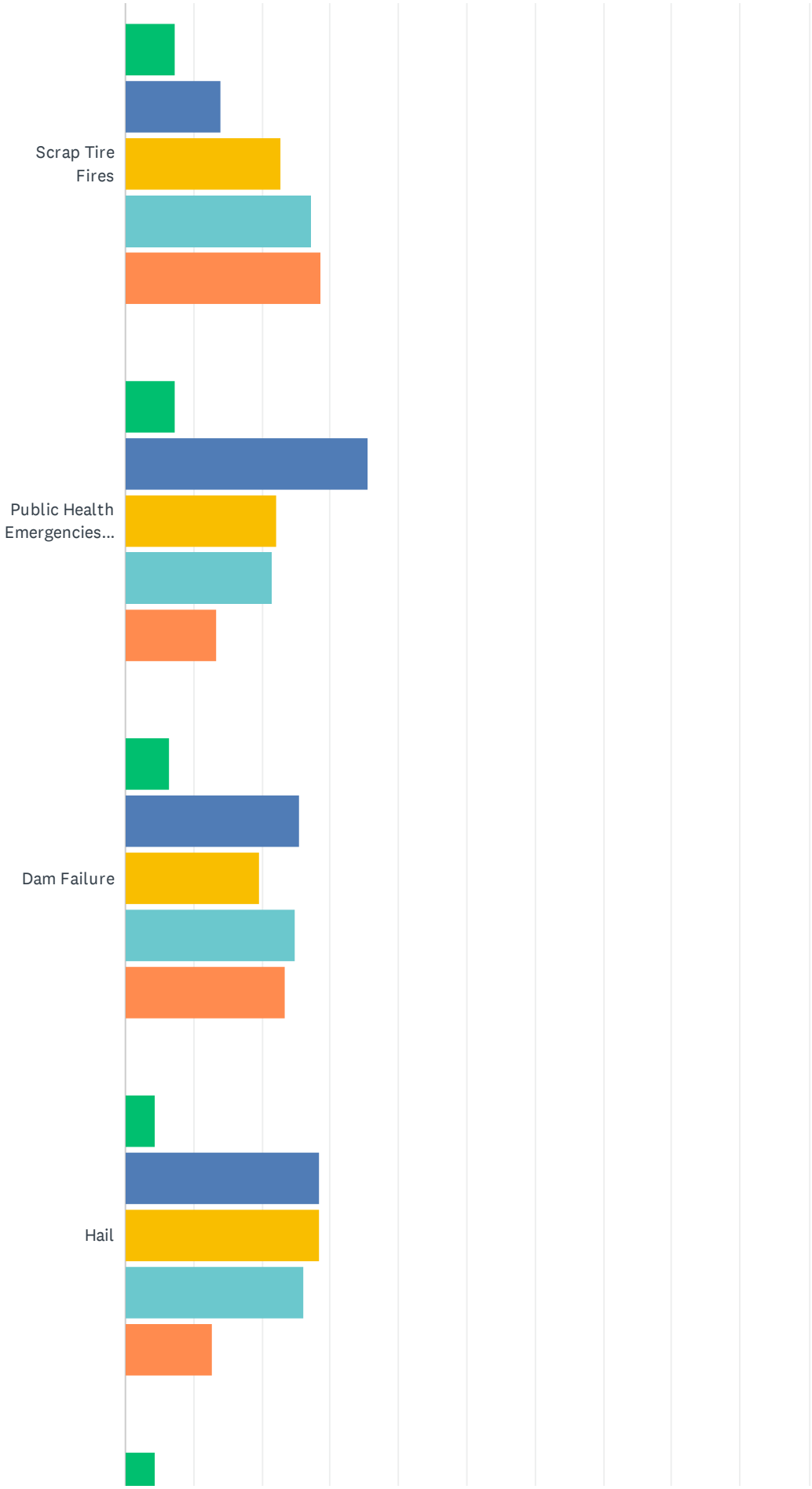
Answered: 138 Skipped: 0

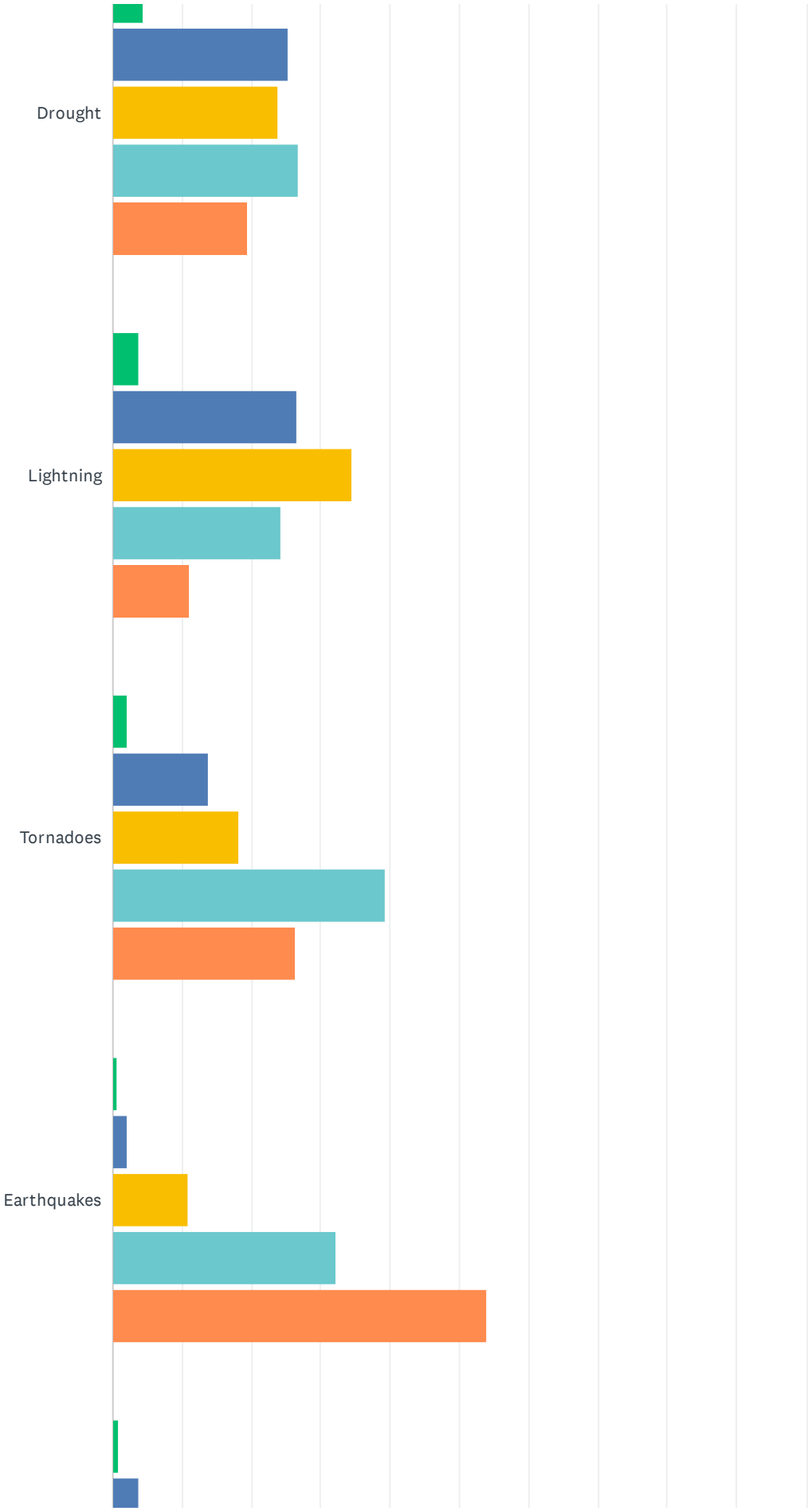


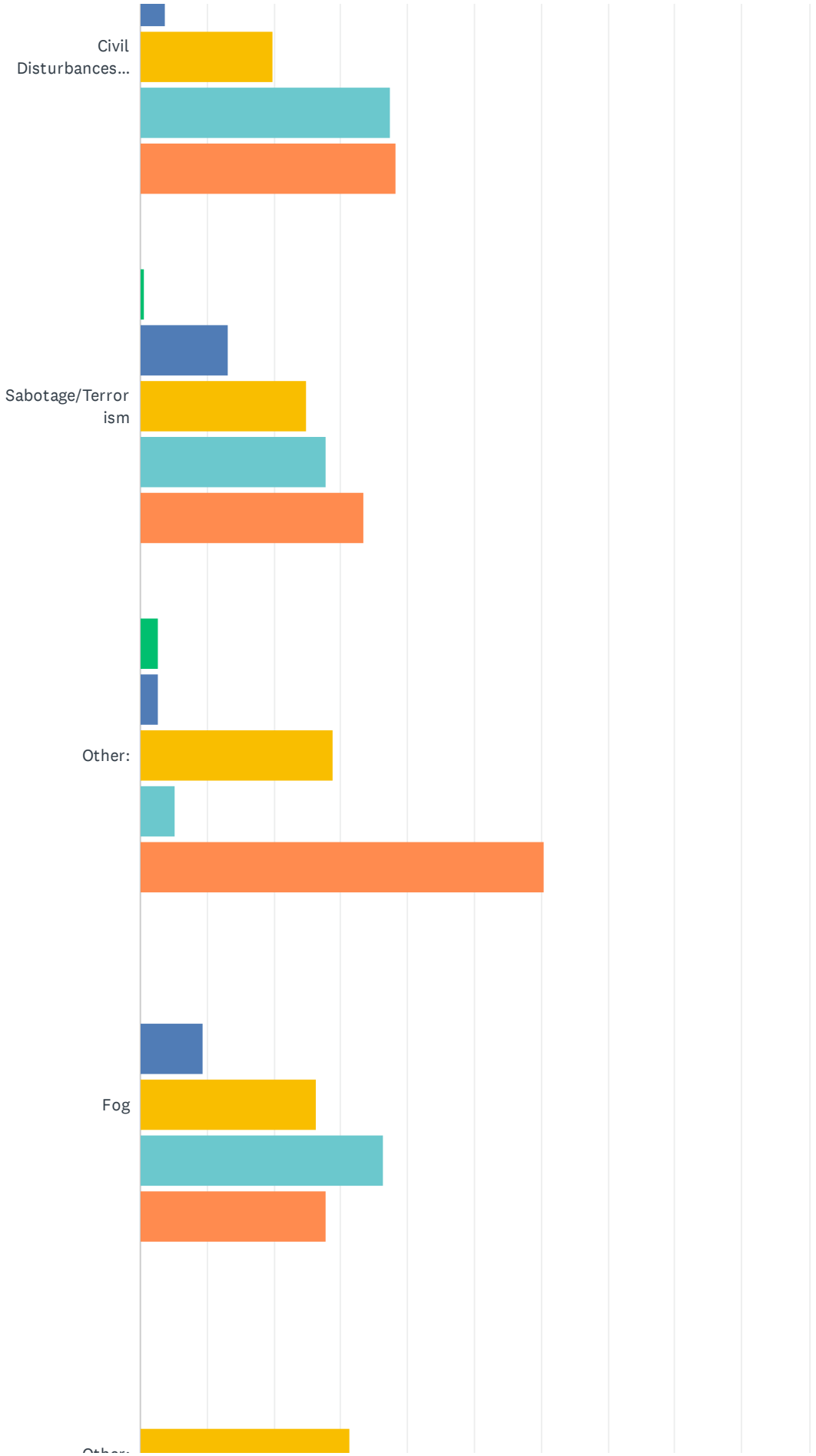

Infrastructure Failure &...
Severe Winds (Windstorms)
Subsidence (Sink holes ...
Wildfires

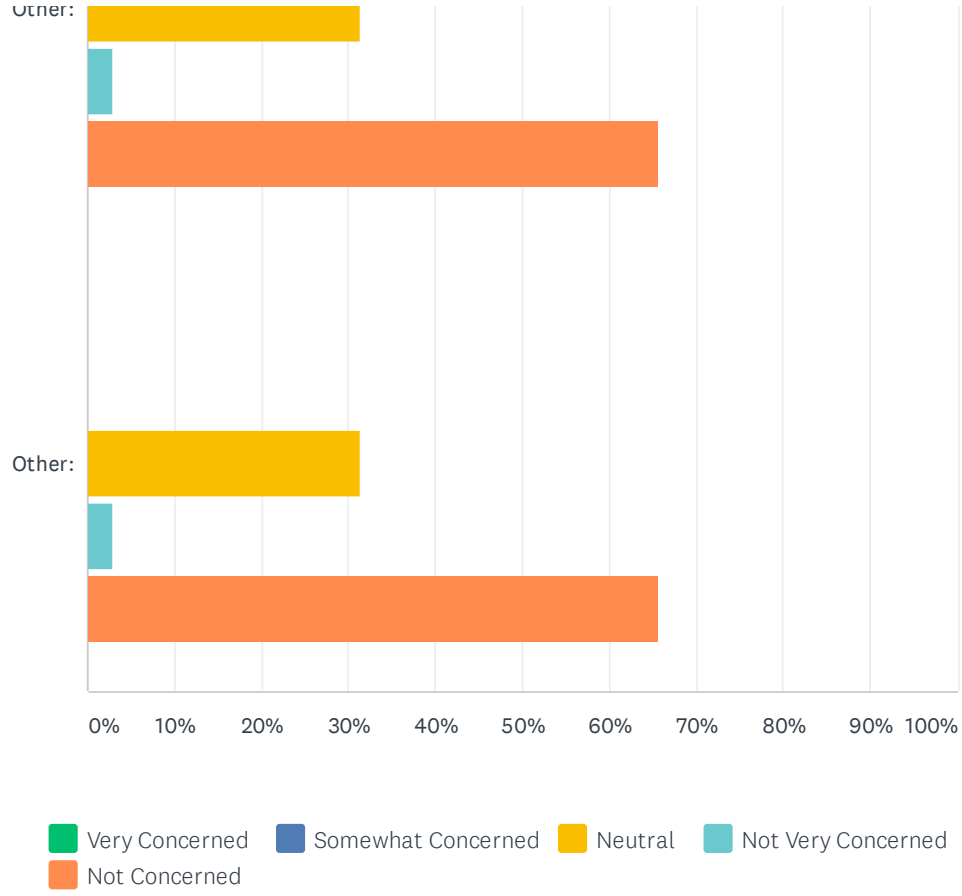

Extreme Weather...
Landslide/Mudslide
Petroleum/Natural Gas Pipel...
Ice and Sleet Storms


Transportation Accidents (c...
Hazardous Materials,...
Structural Fires
Hazardous Materials,...


Scrap Tire Fires
Public Health Emergencies...
Dam Failure
Hail


Drought
Lightning
Tornadoes
Earthquakes


Civil Disturbances...
Sabotage/Terrorism
Other:
Fog


Other:
Other:
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Very Concerned
Somewhat Concerned
Neutral
Not Very Concerned
Not Concerned

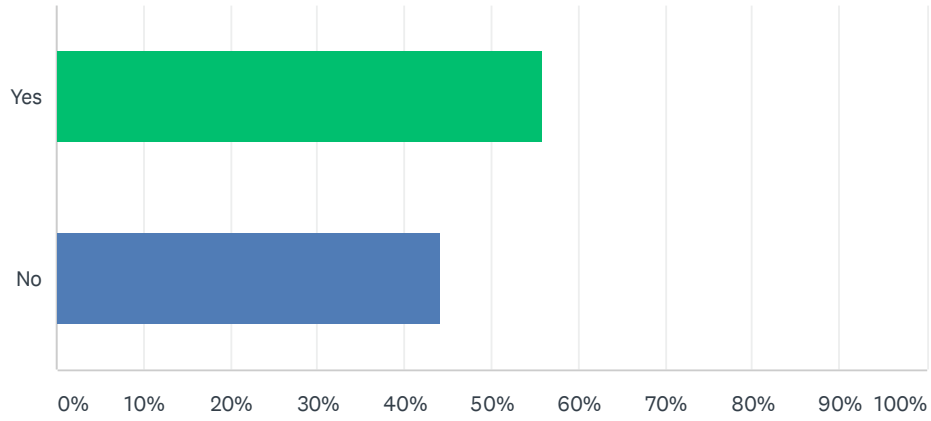
	VERY CONCERNED	SOMEWHAT CONCERNED	NEUTRAL	NOT VERY CONCERNED	NOT CONCERNED	TOTAL	WEIGHTED AVERAGE
Flooding due to precipitation event or snowmelt	44.53% 61	44.53% 61	4.38% 6	5.11% 7	1.46% 2	137	1.74
Snowstorms and Blizzards	32.85% 45	45.99% 63	10.22% 14	6.57% 9	4.38% 6	137	2.04
Invasive Species (Emerald Ash Borer/Asian Carp)	32.35% 44	43.38% 59	11.76% 16	9.56% 13	2.94% 4	136	2.07
Shoreline Flooding and Erosion	29.93% 41	43.80% 60	8.76% 12	8.03% 11	9.49% 13	137	2.23
Infrastructure Failure & resulting hazards (e.g. power outage)	25.36% 35	46.38% 64	13.77% 19	11.59% 16	2.90% 4	138	2.20
Severe Winds (Windstorms)	21.74% 30	51.45% 71	13.77% 19	11.59% 16	1.45% 2	138	2.20
Subsidence (Sink holes or ground collapse, mine-related or not)	19.71% 27	33.58% 46	25.55% 35	11.68% 16	9.49% 13	137	2.58
Wildfires	18.98% 26	40.88% 56	18.25% 25	14.60% 20	7.30% 10	137	2.50
Extreme Weather Temperatures (hot/cold)	17.39% 24	42.75% 59	17.39% 24	17.39% 24	5.07% 7	138	2.50
Landslide/Mudslide	15.22% 21	38.41% 53	14.49% 20	14.49% 20	17.39% 24	138	2.80
Petroleum/Natural Gas Pipeline Incident (e.g. rupture/leak resulting in outage)	15.22% 21	29.71% 41	25.36% 35	20.29% 28	9.42% 13	138	2.79
Ice and Sleet Storms	14.60% 20	45.26% 62	18.25% 25	15.33% 21	6.57% 9	137	2.54
Transportation Accidents (car crashes)	13.14% 18	43.07% 59	25.55% 35	12.41% 17	5.84% 8	137	2.55
Hazardous Materials, Fixed Site (e.g. buildings or industrial site)	10.95% 15	32.12% 44	28.47% 39	18.25% 25	10.22% 14	137	2.85
Structural Fires	9.70% 13	40.30% 54	29.85% 40	11.19% 15	8.96% 12	134	2.69
Hazardous Materials, Transportation-related (e.g. waste spill from traffic accident)	8.03% 11	37.96% 52	26.28% 36	20.44% 28	7.30% 10	137	2.81
Scrap Tire Fires	7.35% 10	13.97% 19	22.79% 31	27.21% 37	28.68% 39	136	3.56
Public Health Emergencies (disease epidemic)	7.41% 10	35.56% 48	22.22% 30	21.48% 29	13.33% 18	135	2.98
Dam Failure	6.57%	25.55%	19.71%	24.82%	23.36%		

	9	35	27	34	32	137	3.33
Hail	4.48% 6	28.36% 38	28.36% 38	26.12% 35	12.69% 17	134	3.14
Drought	4.48% 6	25.37% 34	23.88% 32	26.87% 36	19.40% 26	134	3.31
Lightning	3.68% 5	26.47% 36	34.56% 47	24.26% 33	11.03% 15	136	3.13
Tornadoes	2.19% 3	13.87% 19	18.25% 25	39.42% 54	26.28% 36	137	3.74
Earthquakes	0.73% 1	2.19% 3	10.95% 15	32.12% 44	54.01% 74	137	4.36
Civil Disturbances (rioting)	0.74% 1	3.68% 5	19.85% 27	37.50% 51	38.24% 52	136	4.09
Sabotage/Terrorism	0.73% 1	13.14% 18	24.82% 34	27.74% 38	33.58% 46	137	3.80
Other:	2.63% 1	2.63% 1	28.95% 11	5.26% 2	60.53% 23	38	4.18
Fog	0.00% 0	9.49% 13	26.28% 36	36.50% 50	27.74% 38	137	3.82
Other:	0.00% 0	0.00% 0	31.43% 11	2.86% 1	65.71% 23	35	4.34
Other:	0.00% 0	0.00% 0	31.43% 11	2.86% 1	65.71% 23	35	4.34

#	OTHER (PLEASE SPECIFY & RATE YOUR CONCERN)	DATE
1	Chemical contamination of water. DoD recently reported presence of dangerous chemicals in drinking water in Houghton. https://www.militarytimes.com/2019/07/14/heres-an-updated-map-of-military-sites-where-dod-found-cancer-causing-chemicals-in-the-drinking-water/	7/19/2019 8:35 AM
2	I rated these for my home rather than my community , i would rate a couple slightly differently for home vs community	7/19/2019 6:35 AM
3	Unvaccinated persons as vectors for disease - Very Concerned	7/16/2019 11:54 AM
4	Mass shootings	6/21/2019 10:49 PM
5	long term power outage in winter, or nat. gas outage for some unexpected reason	6/18/2019 4:52 PM
6	lack of concern for climate change and living sustainably	6/14/2019 10:20 PM
7	cyber attack - somewhat concerned, mass shootings - somewhat concerned,	6/14/2019 4:27 PM
8	Portage Lake Lift Bridge failure.	6/14/2019 2:43 PM

Q5 Have you taken any actions to make your home or community more resistant to hazards?

Answered: 138 Skipped: 0



ANSWER CHOICES	RESPONSES	
Yes	55.80%	77
No	44.20%	61
TOTAL		138

Q6 IF YES, please explain:

Answered: 85 Skipped: 53

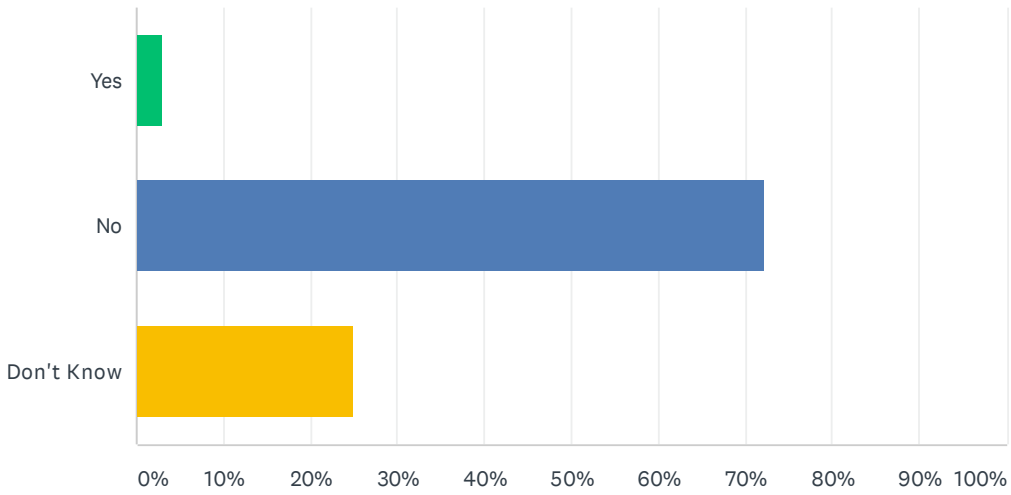
#	RESPONSES	DATE
1	Professor -> senior design civil engineer. Projects on various hazards in Houghton County	8/22/2019 12:18 PM
2	Installed standby generator	8/22/2019 12:15 PM
3	Routing water around our house to prevent flooding with drains, helping people clean up around their homes after the 2018 flood, removing lawn and installing garden beds for better water absorption in our lawn.	7/23/2019 11:03 AM
4	Carbon Monoxide and smoke detectors	7/23/2019 8:18 AM
5	Clearing drains, cutting trees, clearing brush	7/22/2019 8:06 AM
6	Replaced windows, moved items in basement from areas that might become flood-damaged.	7/19/2019 1:50 PM
7	Basement water related repairs for future prevention	7/19/2019 10:04 AM
8	try to keep basement dry, sealed, and mold free	7/19/2019 9:01 AM
9	Flashlights, water, and food preparation,.	7/19/2019 8:58 AM
10	N/A	7/19/2019 8:37 AM
11	Training others in first aid, CPR, mass casualty and emergency response. Reduced encroachment of trees/bushes/flammable materials from around house to mitigate fire concerns. Developed family response plans to the events that present the most risk to family members. Developed kits for family response to disaster, to include post-evacuation food/water/hygiene needs. Generally, fire prevention work done through volunteering at the local Fire Department.	7/19/2019 8:30 AM
12	5KW emergency generator	7/19/2019 8:24 AM
13	A generator	7/19/2019 7:17 AM
14	Trim trees and brush near roofline. Improve drainage away from house.	7/19/2019 7:08 AM
15	None taken	7/19/2019 6:19 AM
16	Recently purchased after renting, and I really don't have a clear idea of what to do. I need an assessment and education!	7/16/2019 11:54 AM
17	Helped with sandbagging a home on Coles Creek	7/7/2019 9:33 PM
18	Try to keep water away.	6/29/2019 12:57 PM
19	In our work, we are helping get grants to fund green stormwater infrastructure. In our personal lives, we keep a small rotating stockpile of food, fuel, and other supplies to be self-sufficient for several days in the event of a disaster.	6/26/2019 3:30 PM
20	New roof.	6/24/2019 12:37 PM
21	Home preparedness items (food, water)	6/24/2019 10:45 AM
22	Sealed the basement, updated wiring, replaced roof, planned for emergency events.	6/23/2019 9:34 PM
23	Helped sandbagging and clearing drainage canals, trim trees, installed cameras to monitor possible flooding and sump pump	6/21/2019 10:49 PM
24	Trimming branches over house.	6/21/2019 10:29 PM
25	Participation in Keweenaw Resiliency task force, seeking outside state and federal assistance with recovery and resiliency planning.	6/20/2019 4:14 PM
26	Trying to live more off grid and sustainably	6/20/2019 4:03 PM
27	Have disposed of most hazardous style and gone to vinegar and water or similar	6/20/2019 1:30 PM
28	I have a generator for my home for electrical failure due to storms. I also am a member of the volunteer fire department and serve the community in any emergencies that may occur.	6/20/2019 12:01 AM
29	going to get solar panels with battery backup capability, have wood boiler in basement.... but need power to run the pumps!	6/18/2019 4:52 PM

30	Dug down and trenched the basement, installed drain tile to give the water an outlet. Keep flashlights and lanterns and have gas grills and stoves and camping gear to subsist in long term power outages. Have a water filter/hand pumped, to get drinking water from just about any source.	6/18/2019 7:41 AM
31	Firefighter and Emergency Medical Responder	6/17/2019 3:36 PM
32	Seal basement windows and put up plastic basement window shield to repel water from going into the basement.	6/17/2019 1:02 PM
33	lots of insulation	6/17/2019 10:04 AM
34	Made basement repairs.	6/17/2019 8:42 AM
35	Removing partially empty old paint cans.	6/15/2019 9:14 PM
36	Preparedness supplies, first aid.	6/15/2019 5:09 PM
37	kept trees and brush away from house (wildfire) make sure things outdoor can not blow away have alternate way to heat the house (power outage)	6/15/2019 8:54 AM
38	participated in a shooter role play with campus security	6/14/2019 10:20 PM
39	Have bademenr pump and fans/dehumidifiers. Keep surrounding area freer of potential combustibles, have plan for family to leave area if need be.	6/14/2019 7:08 PM
40	Had all our windows repacked to avoid wind driven rain leaks.	6/14/2019 6:41 PM
41	Road grading	6/14/2019 5:53 PM
42	Erosion control, places for water to run, tree trimming	6/14/2019 4:45 PM
43	participated in training and exercises to respond to natural and anthropogenic hazards, purchased backup power generation, made home evacuation plans	6/14/2019 4:27 PM
44	replaced damaged roof; tried to patch leaky foundation	6/14/2019 3:57 PM
45	Sand bags and drain cleaning. I now own a dehumidifier. Everything in my basement is up on pallets or in plastic totes.	6/14/2019 3:26 PM
46	We keep the furnace running in the winter when we are away so the pipes won't freeze and the roof shoveled so it won't collapse from the weight of snow. We also keep dry brush and dead trees away from our house in case of fire.	6/14/2019 2:55 PM
47	Insulated our house and pipes to protect from extreme weather. Removed sentimental and valuable items out of the basement in the event of flooding. Took down or trimmed trees and branches to prevent damage during storms.	6/14/2019 2:43 PM
48	sited home properly, keep emergency supplies ready, have weapons and ammo	6/14/2019 2:13 PM
49	better drainage paths for surface water runoff, generator for heating reasons if power outage in winter	6/14/2019 1:00 PM
50	Basement and foundation repairs	6/14/2019 12:44 PM
51	Removal of seven diseased trees	6/14/2019 12:23 PM
52	looked into higher wind ratings for new shingles (but have not re-roofed yet)	6/14/2019 11:35 AM
53	Moved to a more secure house!	6/14/2019 11:35 AM
54	Protests, sump pump, 2 dehumidifiers,	6/14/2019 11:19 AM
55	Have dealt with governing officials to dredge ditches and Trying to get sewage problem addressed	6/14/2019 10:52 AM
56	Repeatedly requested Houghton County Road Commission help with crumbling roads - to no avail!	6/14/2019 10:42 AM
57	Reading the paper; staying informed; preparing to contribute to civic discussion	6/14/2019 9:39 AM
58	Have generator for power outtages in winter. An outage in winter that lasts 24 hours could bring my home temp below freezing. Need ability to run furnace. I also have prepared auxiliary heat	6/14/2019 9:30 AM

	in form of propane.	
59	trying to route any overflow from the creek away from structures	6/14/2019 9:09 AM
60	Not sure what action to take	6/14/2019 9:07 AM
61	Corrected water run off problem	6/14/2019 8:56 AM
62	Basement supersump system put in after flooding 12 years ago	6/14/2019 8:55 AM
63	fixed road and cleaned up excess brush	6/14/2019 8:51 AM
64	Installed sump pump, partial rain gutters, & sewer drain screens	6/14/2019 8:43 AM
65	Draining tiles	6/14/2019 8:41 AM
66	Purchased a generator, removed trees around my house, drive defensively, stay home in bad weather.	6/14/2019 8:36 AM
67	Reduce fire hazard by mowing and brush hogging near farm. Reduce straight line wind damage to out building by bolstering closures on west side doors.	6/14/2019 8:33 AM
68	cleaning culverts to allow water to runn off faster, reducing flooding.	6/14/2019 8:32 AM
69	Preventative maintenance, new roof on home, planting vegetation to help reduce flooding and soil erosion, emergency rations and gear kit, educational sessions on how to prep/react to a disaster, communications and meeting plan, an emergency kit for the dog	6/14/2019 8:32 AM
70	clearing the property of brush, improving watershed from the property, improving home sustainability (deck removal, roof repairs), accepting a community leadership role, involvement with schools	6/14/2019 8:17 AM
71	Common sense preparation - water and canned food, a heat source, etc.	6/14/2019 8:14 AM
72	bought a back-up generator, work with watershed restoration group	6/14/2019 8:14 AM
73	New roofing and gutters	6/14/2019 8:10 AM
74	Increase number of portable and installed sump pumps. Purchased a whole house generator.	6/14/2019 8:04 AM
75	We rerouted our run-off trail because of the flood last year. We had water in our basement and some again this year.	6/14/2019 8:01 AM
76	After living on 901 3rd st in Hancock for 18 years and after the city made some changes to the storm drainage our basement started collecting water. A lot of water, 4-5 inches a day. We installed a sump pump and that has helped tremendously, however, if the power ever goes out, the sump pump would not work. Another resident by Hill street and 4th street experienced the same thing. Something changed with how the water is routed underground for there to be such a huge change. The change occured in 2008.	6/14/2019 8:00 AM
77	Changed the grade around the house to divert water better. Recaulked flashing on the roof and siding.	6/14/2019 7:48 AM
78	I have a generator for power outages; I remove invasive species when I see them (buckthorn on my property; report purple loose strife on highways when I see it).	6/14/2019 7:37 AM
79	No	6/14/2019 7:30 AM
80	Backup generator; large-capacity sump pump; drainage improvement	6/14/2019 7:30 AM
81	Lack of money	6/14/2019 7:26 AM
82	Alerted the City drainage system in street backs up or becomes blocked	6/14/2019 7:22 AM
83	No	6/14/2019 7:13 AM
84	PurchAsed flood insurancd, sandbags, additional water pumps, etc.	6/14/2019 7:05 AM
85	NA	6/14/2019 6:53 AM

Q7 Is your home located on a floodplain?

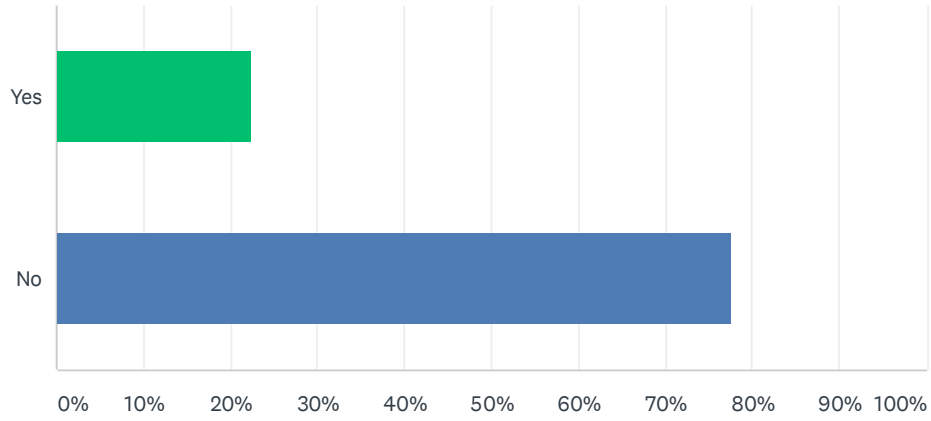
Answered: 137 Skipped: 1



ANSWER CHOICES	RESPONSES	
Yes	2.92%	4
No	72.26%	99
Don't Know	24.82%	34
TOTAL		137

Q8 Does your street or home flood regularly during significant rain events?

Answered: 138 Skipped: 0



ANSWER CHOICES	RESPONSES	
Yes	22.46%	31
No	77.54%	107
TOTAL		138

Q9 IF YES, what are the closest major cross streets to this location?

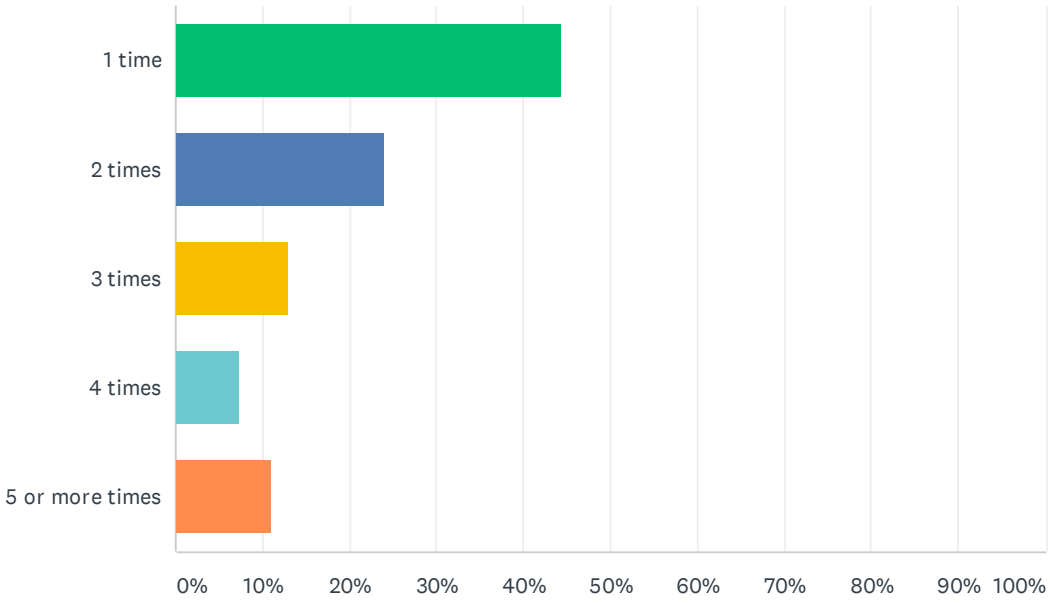
Answered: 45 Skipped: 93

#	RESPONSES	DATE
1	First Street and Willow	7/23/2019 8:18 AM
2	small amount of water in the basement.	7/19/2019 8:58 AM
3	N/A	7/19/2019 8:37 AM
4	Ours does _not_ flood, but does experience minor localized washout. Airport Pk & Forsman	7/19/2019 8:30 AM
5	Baraga and Sixth	7/19/2019 7:33 AM
6	US-41 and Massie Road	7/19/2019 7:08 AM
7	N/a	7/19/2019 6:19 AM
8	We get a small amount of moisture (typically <1") in one room of our basement about once a year. Dodge and South St.	6/26/2019 3:30 PM
9	elsie road and superior road	6/22/2019 11:32 AM
10	Elm Ave & 6th Street. Dollar Bay	6/21/2019 9:31 PM
11	5th and West Houghton, Basement floods every rain	6/20/2019 7:41 PM
12	Dodge and South	6/20/2019 4:14 PM
13	Ethel and Ingot	6/20/2019 3:28 PM
14	Waasa Road and Pontiac Road	6/17/2019 3:36 PM
15	Maple and HWY 26N	6/17/2019 10:04 AM
16	one block from my street *does* flood regularly - corner of 4th & Hancock / corner of Hamar & 5th	6/17/2019 9:54 AM
17	M-26 and Woodside Ln.	6/17/2019 8:42 AM
18	M26, Sharon Ave.	6/14/2019 4:45 PM
19	Sharon Ave. and Agate St.	6/14/2019 3:26 PM
20	us 41 and 6th street/cedar ave dollar bay mi	6/14/2019 3:09 PM
21	M-203 and Birch St	6/14/2019 2:43 PM
22	Paradise Rd, Pilgrim Rd	6/14/2019 1:00 PM
23	n/a	6/14/2019 12:44 PM
24	Main St and Green Acres (Superior Rd)	6/14/2019 12:23 PM
25	Liminga Road	6/14/2019 11:53 AM
26	n/a I answered no.	6/14/2019 11:35 AM
27	Bridge st./ 7th	6/14/2019 11:19 AM
28	Us 41 and 7th street	6/14/2019 10:52 AM
29	Ingot and Birch	6/14/2019 9:34 AM
30	about 2 inches of water in basement after a moderate to heavy rain storm.	6/14/2019 9:30 AM
31	don,t know	6/14/2019 9:15 AM
32	US41	6/14/2019 9:15 AM
33	US41 and Michigan	6/14/2019 9:07 AM
34	US HWY 41, and Broemer and Denton Roads	6/14/2019 8:51 AM
35	We are 18 miles from Houghton and several of the main roads into town regularly suffer flooding incidents from rains or melt.	6/14/2019 8:33 AM

36	I did not answer "yes"	6/14/2019 8:17 AM
37	Don't know	6/14/2019 8:01 AM
38	n/a	6/14/2019 7:48 AM
39	Canal Road	6/14/2019 7:31 AM
40	No	6/14/2019 7:30 AM
41	Mud Lake Road and South Little Traverse Road	6/14/2019 7:30 AM
42	1st street	6/14/2019 7:26 AM
43	No	6/14/2019 7:13 AM
44	Fir Ave between Main and 3rd st	6/14/2019 7:05 AM
45	NA	6/14/2019 6:53 AM

Q10 If your street or home does flood regularly during significant rain events, how many times did it flood in the past 12 months?

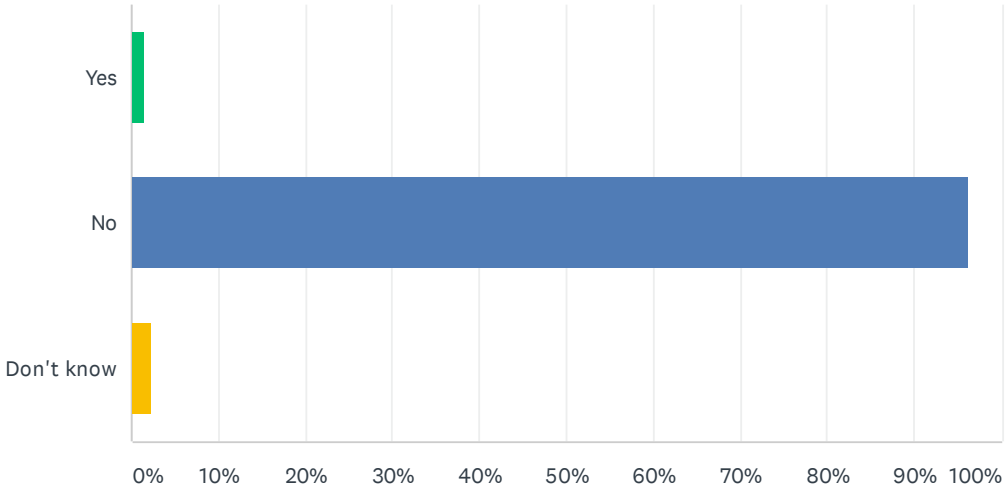
Answered: 54 Skipped: 84



ANSWER CHOICES	RESPONSES	
1 time	44.44%	24
2 times	24.07%	13
3 times	12.96%	7
4 times	7.41%	4
5 or more times	11.11%	6
TOTAL		54

Q11 Do you have flood insurance?

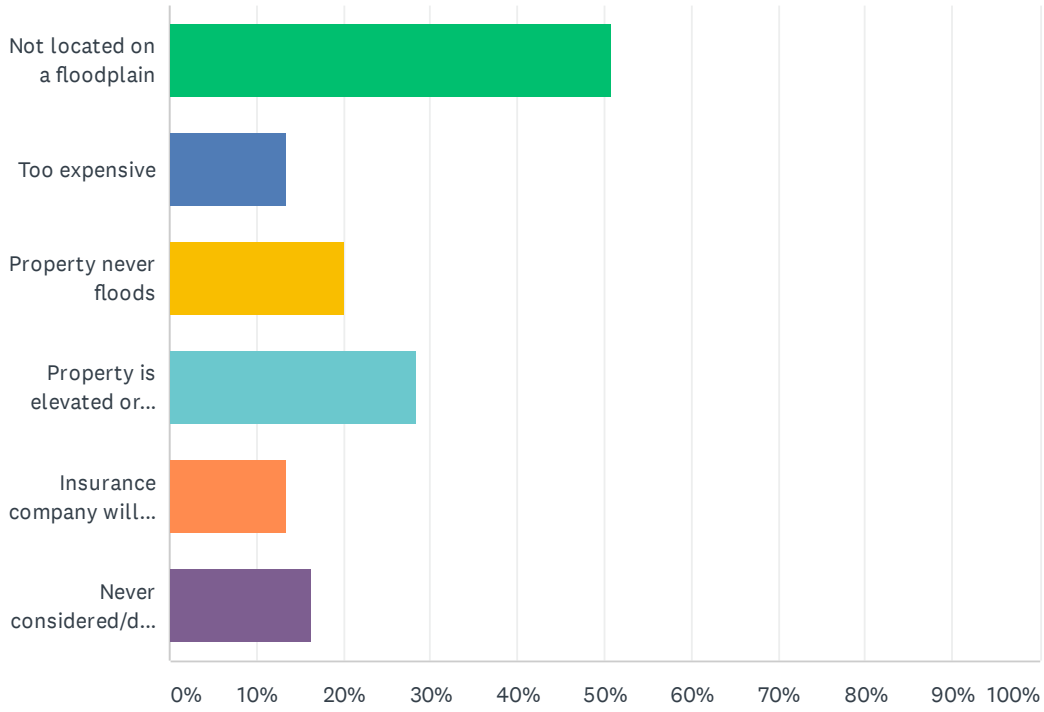
Answered: 136 Skipped: 2



ANSWER CHOICES	RESPONSES	
Yes	1.47%	2
No	96.32%	131
Don't know	2.21%	3
TOTAL		136

Q12 If you do NOT have flood insurance, please indicate reason(s) below.

Answered: 134 Skipped: 4

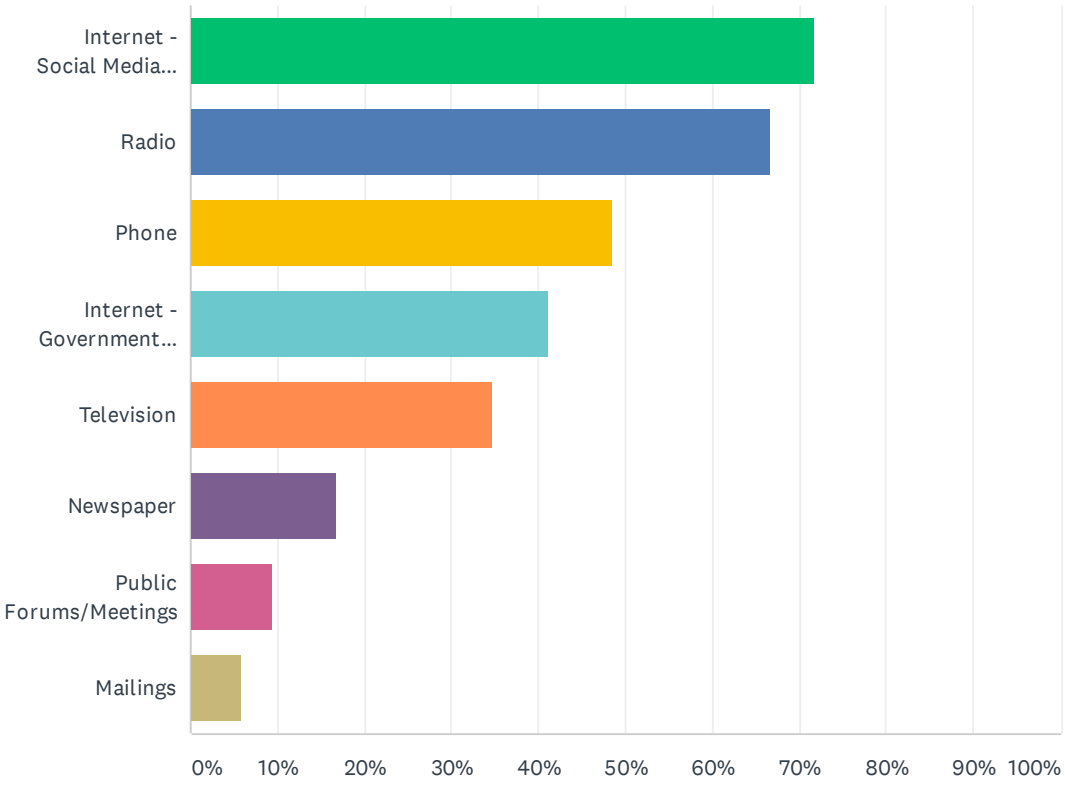


ANSWER CHOICES	RESPONSES	
Not located on a floodplain	50.75%	68
Too expensive	13.43%	18
Property never floods	20.15%	27
Property is elevated or otherwise protected	28.36%	38
Insurance company will not provide	13.43%	18
Never considered/didn't know about it	16.42%	22
Total Respondents: 134		

#	OTHER REASON (PLEASE SPECIFY)	DATE
1	During the major rain events we've had in the past five years, our basement has had a little rivulet going through it. During the flood last year our patio was damaged, but nothing more than that. However, we are concerned that if we were to purchase flood insurance (though not sure if it's available for our home, which is on West South Avenue), if we were to sell our house would potential buyers see the fact we carry flood insurance as concerning?	7/23/2019 11:03 AM
2	Sump pump and basement unfinished... No point	6/20/2019 7:41 PM
3	Floodplain mapping hasn't occurred for our area yet.	6/20/2019 4:14 PM
4	Would get it if we could.	6/17/2019 1:02 PM
5	Basement does dampen during Spring snow thaw.	6/15/2019 9:14 PM
6	Risk is not sufficient to be worth the costs	6/14/2019 7:08 PM
7	I am a renter. I have renter’s insurance. I was told flood insurance was not available in our area.	6/14/2019 3:26 PM
8	trying to obtain it now	6/14/2019 3:09 PM
9	Property stays dry for the most part. Our flooding last year was due to an extreme rain event.	6/14/2019 2:55 PM
10	I am not a home owner and do not have any kind renters insurance.	6/14/2019 2:28 PM
11	Water in the basement is only in one area. The only time our entire basement was flooded was in June 2018.	6/14/2019 12:44 PM
12	Not sure if available	6/14/2019 10:52 AM
13	City of Hancock has not yet opted in for Flood Insurance	6/14/2019 9:34 AM
14	This survey is not really segrigating a "wet michigan basement" from a flood. I have a "wet michigan basement". I hope that makes sense. So it would be hard to have some sort of insurance for this...	6/14/2019 9:30 AM
15	I don't think we can get it, but I am not positive now	6/14/2019 8:00 AM
16	I so far have not had flooding in my crawlspace so I don;t think I need flood insurance; but if in Houghton we do I would like the city to tell us.	6/14/2019 7:37 AM
17	N/a	6/14/2019 7:05 AM

Q13 What are the most effective ways for you to receive information during or immediately following a hazard emergency? (Check all that apply)

Answered: 138 Skipped: 0



ANSWER CHOICES	RESPONSES	
Internet - Social Media (Facebook or Twitter)	71.74%	99
Radio	66.67%	92
Phone	48.55%	67
Internet - Government Website Postings	41.30%	57
Television	34.78%	48
Newspaper	16.67%	23
Public Forums/Meetings	9.42%	13
Mailings	5.80%	8
Total Respondents: 138		

#	OTHER (PLEASE SPECIFY)	DATE
1	mass notification system/EAS	8/22/2019 12:15 PM
2	Text Alerts	7/19/2019 1:50 PM
3	email	7/19/2019 1:11 PM
4	Emergency Weather Radio Announcements AND Email	7/19/2019 10:04 AM
5	Text message, email, through Michigan Tech	7/19/2019 8:37 AM
6	Text message	7/19/2019 8:30 AM
7	Fire department pager and radio	6/20/2019 12:01 AM
8	text message	6/17/2019 8:04 AM
9	Text	6/14/2019 6:48 PM
10	texts	6/14/2019 4:27 PM
11	Text	6/14/2019 3:49 PM
12	I am signed up for emergency texts and emails through my employer and through local government.	6/14/2019 2:28 PM
13	email announcements	6/14/2019 11:35 AM
14	Text message is probably best.	6/14/2019 9:30 AM
15	"Phone" specifically means text alerts.	6/14/2019 8:17 AM
16	Texting	6/14/2019 8:14 AM
17	Test message	6/14/2019 8:01 AM
18	email alerts through the city.	6/14/2019 7:37 AM
19	Text	6/14/2019 7:30 AM
20	Automated call or text	6/14/2019 7:05 AM

Q14 In your opinion, what are some steps or projects your local government could take to reduce or eliminate the risk for future hazard damages to your community?

Answered: 104 Skipped: 34

#	RESPONSES	DATE
1	Assessment of potential hazards	8/22/2019 12:18 PM
2	- Long term watershed management. - Fund mitigation projects. - Public awareness of what individual homeowners/residents can do to be better prepared. - Privatize local fire departments. This would allow for more accountability for their training and collaboration with other agencies.	8/22/2019 12:15 PM
3	Rather than simply replacing culverts, etc. as they were, the community must overbuild because these rain events/flooding are going to become more common as the climate changes. We need to build like 500- to 1,000-year rain events are the new normal, because they will be. I realize this will require funding; raise taxes! It is for the good of the community. Also, the community needs to address/survey existing mining infrastructures to make sure they aren't at risk of failing or giving way now, rather than reacting when an emergency happens. Do not allow wetlands to be displaced and take care of existing wetlands. Wetlands filter water and can absorb a lot of water during major rain events. We need to protect our green spaces! Finally, there is a lot the community can do to mitigate rain events, like requiring that businesses put bioswales in their parking lots, putting bioswales/gardens in yards, putting bioswales in medians and on sidewalks throughout downtown. Creating porous places that absorb water, rather than allowing runoff as pavement does, will really help. The city of Portland, Oregon, has amazing bioswales to mitigate flooding (and prevent contaminants in water from reaching waterways). I highly recommend WUPPDR google "Portland Oregon bioswales" for the wealth of information available about them.	7/23/2019 11:03 AM
4	Not sure	7/23/2019 8:18 AM
5	Stop climate change denial, post accurate drought trends, invest in portable water barriers, do courtesy inspections of properties	7/22/2019 8:06 AM
6	Area roads are regularly repaired in a piecemeal fashion, at what I'm sure is a great expense. Many of these roads just need to be replaced. Proper site preparation, including grading/sloping (to prevent washout) and the appropriate installation of a sound sub-base under these new roads would save millions by preventing future damage and eliminating unnecessary repairs.	7/19/2019 1:50 PM
7	Educate the public about potential dangers and science of climate change.	7/19/2019 1:11 PM
8	Install roundabouts for increasing traffic near the cross streets by Burger King/Taco Bell and one by the Mobile Station that leads down to the Elementary School and one by the Michigan Tech Credit Union that leads down to the Middle/High School. All on Sharon Ave. Increase funding for local police, fire, and EMT and emergency management staff.	7/19/2019 10:04 AM
9	Maintenance of the sewer and outlets to keep them free of debris. Something no municipal entity can afford to pay for. Sadly the downpour on July 15 revealed that it isn't being kept up.	7/19/2019 9:35 AM
10	More money into infrastructure and private homeowner assistance.	7/19/2019 9:01 AM
11	No idea	7/19/2019 8:58 AM
12	Updated stormwater management that doubles as snowmelt management.	7/19/2019 8:37 AM
13	Work with industry in industrial park (by airport) to ensure compliance with hazardous materials handling, storage, disposal. Continue improving roads with better drainage, culverts. Start public education regarding urban-wildland interface, with respect to homes and proximity to forest "fuels". A large scale forest fire, driven by the Keweenaw winds is quite possible, especially given the relative unpreparedness of our local FD's and their low/slow response. No blame, but they do the best they can as complete volunteers. Generally, more preparation of the people via education. I was shocked when I read the disaster plan and realized the food stores N of Portage Lift Bridge. No long-time residents I talked to was even aware of the details [the County put together] regarding bridge-out scenario. Lack of knowledge breed unpreparedness.	7/19/2019 8:30 AM
14	In towns like Houghton and Hancock, make sure the infrastructure (storm drainage, etc.) is up-to-date and can handle floods like last year's.	7/19/2019 8:25 AM
15	Greater diversification of electrical power generation facilities. Utility scale energy storage .	7/19/2019 8:24 AM
16	Complete road repairs	7/19/2019 8:12 AM

17	Improved road infrastructure, additional training for law enforcement	7/19/2019 7:51 AM
18	better infrastructure- sewers, curbs, etc	7/19/2019 7:33 AM
19	Improve fire protection	7/19/2019 7:08 AM
20	I think making sure to keep our water drainage infrastructure working really well. For severe wind I don't think there is anything they can do . And for blizzards obviously keep our ploughing operating as they did so well last year	7/19/2019 6:35 AM
21	improved culverts	7/19/2019 6:26 AM
22	Plan for major events, larger than on the past - the climate is changing and we need to be considering the future. Engage with other communities to see what works and what doesn't. Don't reinvent the wheel!	7/19/2019 6:19 AM
23	Educate landowners about how to determine the hazards they face and best practices for addressing them. Also some sort of financial program (very low interest loans? etc.) to help pay for mitigation.	7/16/2019 11:54 AM
24	Township Board needs to be aware that climate change is real so they can be prepared to deal with its effects.	7/7/2019 9:33 PM
25	Deal with drainage and storm water issues. Maintain vulnerable areas.	7/6/2019 6:25 PM
26	Reduce vulnerability of road closures along Hwy 26 from Ripley to Lake Linden. Harden infrastructure through out the county to prevent washouts, bridge destruction. Clean culverts rgularly behind recreation trail to prevent destruction of trail and flooding of neighborhoods.	7/1/2019 9:29 PM
27	water collection/diversion	6/29/2019 12:57 PM
28	Develop a stormwater management district. Evaluate the risk of natural gas outage or fuel oil shortage and mitigate appropriately.	6/26/2019 3:30 PM
29	Redo the culverts so they don't bottleneck going down hill, invest in the infrastructure (roads especially), consider the impact of building projects on marshland up by Walmart. Publicize ways that individual community members can reinforce property/homes to prevent damage and Incentivize individual efforts to do so.	6/24/2019 12:37 PM
30	Fund sustainable preventative measures such as swales and berms.	6/23/2019 9:34 PM
31	Plan for future increases in rainfall by enlarging culverts crossing primary roads and raising the road beds in those areas.	6/22/2019 11:32 AM
32	Improve old drainage canals/systems, improve bridges	6/21/2019 10:49 PM
33	Better drainage planning	6/21/2019 10:29 PM
34	Make a second Bridge	6/20/2019 7:41 PM
35	Regular culvert cleanouts, trim back trees overhanging roadways	6/20/2019 4:21 PM
36	Having a strong plan to direct citizen response would be highly beneficial. Ability to rapidly spool up a chain of command that would establish volunteer resource centers and coordinate efforts (essentially codifying the procedures established during week 2+ of the Father's Day response). Pre-established hierarchies and roles among response personnel. Regular plan updates and execution of disaster response drills involving multiple agencies across political boundaries (village, city, township, county).	6/20/2019 4:14 PM
37	Better information shared with community on what to do about each type of challenge. How to prepare, how to cope when disaster does strike, etc.	6/20/2019 4:03 PM
38	make a strategic plan and put it into effect	6/20/2019 1:30 PM
39	Repair deteriorating infrastructure before it fails completely.	6/20/2019 12:01 AM
40	can the city purchase generators that can somehow be used in an emergency, if a local source of electricity is needed? what are our plans for a natural gas outage? Preserve our existing natural assets, don't allow thoughtless development that will cause problems downstream or later on in time....	6/18/2019 4:52 PM
41	Host a hazard preparedness fair. All gov, security, and rescue, personnel present with short	6/18/2019 7:41 AM

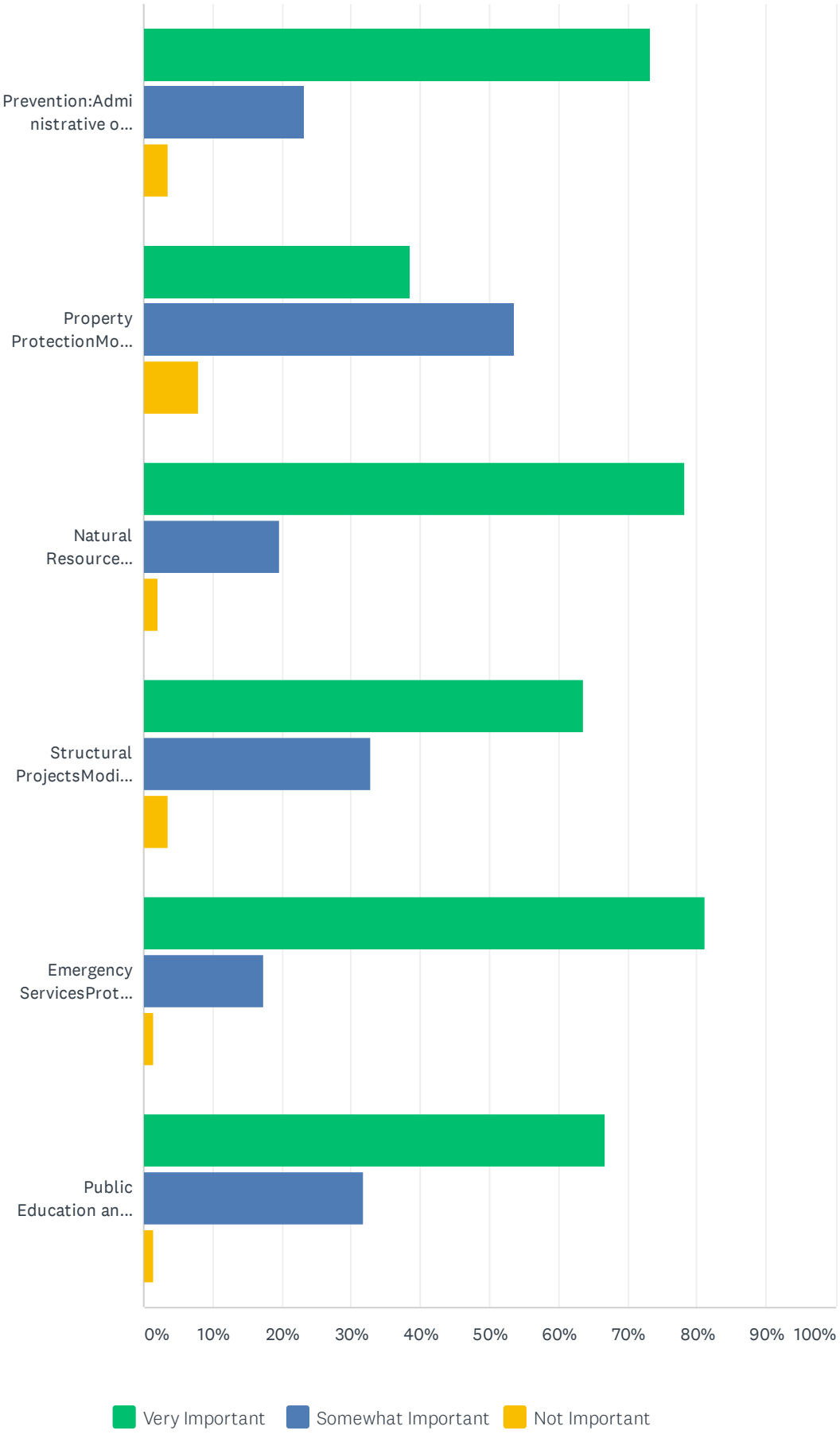
	presentations. Also, have vendors with relevant preparedness gear that is available. Teach people how to make an exit plan, and build an emergency kit for car and home. You could do this under the name of the Fathers Day Flood.	
42	Create a County Wide Fire Protection District. Consolidation of currently independent departments would improve the efficiency and effectiveness of all emergency responses by allowing for complete use of resources not utilized outside individual jurisdictions. Personnel capacity issues are reduced by removal of false barriers created at territorial jurisdiction lines, allowing responders to be automatically dispatched county wide.	6/17/2019 3:40 PM
43	Establish Drainage Districts, Establish county fire/rescue/hazmat team.	6/17/2019 3:36 PM
44	Repair the roads. Clean out the ditches on a regular basis. Cut back trees near power lines. Mow the grass on the sides of the roads like they used to. (this would help a lot with car/deer accidents!!!).	6/17/2019 1:02 PM
45	Hire a team of civil engineers to conduct studies. At Ripley Ski Hill investigate how cutting trees and lack of planning contributed to the flooding and do the necessary remediation so that future floods are prevented.	6/17/2019 10:04 AM
46	Maintain infrastructure and ditches.	6/17/2019 8:42 AM
47	Update infrastructure.	6/15/2019 6:45 AM
48	repair sewers, roads and bridges make public aware of ways to reduce carbon footprint	6/14/2019 10:20 PM
49	Deal with infrastructure to reduce concern/ hazards	6/14/2019 7:08 PM
50	After the Father’s Day flood of 2018, I’m left to believe our ground and road infrastructure is compromised. I hope qualified individuals have or are reviewing this to assure existing roads and ground work is safe.	6/14/2019 6:48 PM
51	Emergency warnings through various media sources. Better drains for run off.	6/14/2019 6:41 PM
52	Improve building codes	6/14/2019 5:53 PM
53	Keep right of ways open, keep infrastructure in best possible condition, some more ditching, Culverts, vacant property get taken down.	6/14/2019 4:45 PM
54	evaluate and strengthen roads, communication systems, and computer systems, improve healthcare, organize community wide training and exercises to respond to hazards, better coordinate volunteer and professional emergency services	6/14/2019 4:27 PM
55	better ways of channeling water from parking lots and roads	6/14/2019 3:57 PM
56	Drain clearing and regularly monitoring both municipal systems and the old mine drain systems.	6/14/2019 3:26 PM
57	dollar bay needs drainage and runoff, sewer system badly.	6/14/2019 3:09 PM
58	Monitor blight and homes with excessive junk in their yards.	6/14/2019 2:55 PM
59	Make sure roads are ditched, kept clear of debris. Make sure culverts can handle the runoff	6/14/2019 2:45 PM
60	Keep storm drains cleaned.	6/14/2019 2:43 PM
61	ensure roads and culverts are adequate for large precipitation events and that their failure will not endanger the lives and property of private citizens. ensure that utilities are repaired in a timely fashion after any emergency. ensure elected officials are keenly aware of their responsibilities to their constituents following community emergencies	6/14/2019 2:28 PM
62	The road commission should consider reported drainage concerns. In our case, we notified HCRC of the concern prior to last year's flood.	6/14/2019 1:00 PM
63	Infrastructure repairs in a timely manner.	6/14/2019 12:44 PM
64	Water run off	6/14/2019 12:23 PM
65	Have a plan ready to follow	6/14/2019 11:53 AM
66	Reconfigure stormwater runoff systems uphill.	6/14/2019 11:35 AM
67	Better communication! That was a huge problem in June 2018. The EM office should have	6/14/2019 11:35 AM

	done daily press briefings first thing in the morning and set up a Facebook page with updates in between.	
68	Plant trees, plant ground cover on slopes, retaining walls, fight erosion with building up shoreline, ensure infrastructure is capable of handling new level of flooding in our area	6/14/2019 11:19 AM
69	Maintain the ditches better. Update the sewer system.	6/14/2019 10:52 AM
70	Repair the roads properly.	6/14/2019 10:42 AM
71	We need to map, examine and catalog all streams and drainage, look for prior man-made tunnels and bridges that may not be obvious today, and fix drainage as needed to minimize flooding risk. We also need to look for steep, unstable hillsides and either stabilize them or move structures and roads out of their danger area.	6/14/2019 9:42 AM
72	Thorough review of drainage to prevent the repeat of the 2018 Fathers Day damage and loss of life. Storm drain repair. Public outreach to share info on the issues.	6/14/2019 9:39 AM
73	Stabilize slopes & eliminate areas with loose, barren soil Create runoff flow routes, teach at-risk home owners how to do this	6/14/2019 9:35 AM
74	There needs to be additional or larger storm sewers thorough-out the city or better drainage plains to better divert water to the sewers	6/14/2019 9:34 AM
75	What would be the best is for local municipalities to have nice healthy "rainy day funds" that everyone keeps there mitts off of until we have an actual rainy day like the fathers day flood in 2018...	6/14/2019 9:30 AM
76	don,t know	6/14/2019 9:15 AM
77	Put restrictions on the university's construction with out proper planning and government (DEQ) oversite and apporval	6/14/2019 9:09 AM
78	Update roads. Make flood insurance available.	6/14/2019 9:07 AM
79	clean culverts and remove debris in drainage valleys	6/14/2019 8:51 AM
80	Increased road and culvert maintenance to reduce washouts and damage. Better communication on Government outlets	6/14/2019 8:43 AM
81	Improve infrastructure	6/14/2019 8:41 AM
82	Maintain the roads, reduce the deer population, get state management of wolves so we can keep them away from our homes and livestock.	6/14/2019 8:36 AM
83	More robust road design. Raise up roads in low areas. Improve drainage to ditch on gravel side roads-some have a roadside ridge from the grader that keeps water on the road and prevents it draining into ditches. This creates standing water that permeates the roadbed turning it into a quagmire.	6/14/2019 8:33 AM
84	storm water management and reduce the level of paving required for new development. we need places for water to infiltrate the ground.	6/14/2019 8:32 AM
85	Better regulations on building and deforestation. Do something about all of the hollow mine shafts and tunnels. This contributes to thing like flooding, land slides, and sink holes.	6/14/2019 8:32 AM
86	Build reinforced channels to divert flood water away from streets and property	6/14/2019 8:23 AM
87	Restrict urban sprawl/insist on reuse of existing development rather than permitting new development. Maintain and expand storm sewers, cut trees back from power lines on a widespread basis, improve community broadband infrastructure, restrict heavy vehicles to highways/roads designed for heavy traffic	6/14/2019 8:17 AM
88	update outdated infrastructure not just patch it; prevent development and paving along waterways; ensure that the drain commissioner and DEQ are enforcing environmental regulations; have access to a temporary bridge structure (like military uses); improve power grid and bury more of the wires to prevent outages	6/14/2019 8:14 AM
89	Batter drainage systems in areas prone to flooding/washes during a rain event, to guide water to the lakes.	6/14/2019 8:11 AM
90	Better communication with media	6/14/2019 8:10 AM

91	Clean the culverts! Ditch the roads.	6/14/2019 8:04 AM
92	I think we don't have a whole lot to worry about where we are - quite frankly, we are lucky. Snow is the worst of it. The one thing I will say about that though, is I wish they would plow earlier in the morning and later at night.	6/14/2019 8:01 AM
93	Inspect the water, sewer, storm drain infrastructure, be sure it is intact. Be sure the drains are not covered with debris and leave some green areas so the water can soak into the ground naturally instead of running down pavement or cement. Inspect creeks/rivers/ditches, be sure they are not overgrown and water is able to flow.	6/14/2019 8:00 AM
94	Enforce zoning laws that would force businesses or individuals to clean up junk cars, falling down buildings, etc.	6/14/2019 7:52 AM
95	Work with state government agencies to mitigate potential hazards in the case of flooding or other severe weather events. An example are the remaining trestles on the hillsides that acted like dams during last year's rain event. They need to be removed, breached, or adequately sized culverts installed to prevent the back up of water.	6/14/2019 7:48 AM
96	One of my greatest concerns is if the water pipes freeze and/or rupture. Can the city do anything to institute regular monitoring/evaluation protocols to prevent and ensure preventive actions and maintenance?	6/14/2019 7:37 AM
97	Improve cellular coverage! Maintain ditches and culverts. Improve bridges.	6/14/2019 7:30 AM
98	Clean up old environmental hazards from the mining and industry era	6/14/2019 7:29 AM
99	Fix the sink hole that already exist. Not just push gravel in them but straight up fix the problem. A grate is not the answer either!	6/14/2019 7:26 AM
100	Provide info to residents of all the current danger/risk sites	6/14/2019 7:22 AM
101	Invest in public infrastructure. Dollar Bay has continual flooding concerns because the community has not invested in drainage ditches or storm sewers.	6/14/2019 7:05 AM
102	Infrastructure updates. Better communication.	6/14/2019 7:02 AM
103	Road infrastucture improvements.	6/14/2019 6:54 AM
104	Maintain roads and eroding hillsides	6/14/2019 6:53 AM

Q15 Several community-wide activities can reduce our risk from hazards. In general, these activities fall into one of six broad categories. Please tell us how important you think each one is for your community to consider doing:

Answered: 138 Skipped: 0


Prevention:Administrative o...
Property ProtectionMo...
Natural Resource...
Structural ProjectsModi...
Emergency ServicesProt...
Public Education an...
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Very Important
Somewhat Important
Not Important

	VERY IMPORTANT	SOMEWHAT IMPORTANT	NOT IMPORTANT	TOTAL
Prevention:Administrative or regulatory actions that influence the way land is developed and buildings are built. Examples include planning & zoning, building codes, open space preservation, and floodplain regulations.	73.19% 101	23.19% 32	3.62% 5	138
Property ProtectionModification or removal of existing buildings to protect them from a hazard. Examples include purchase, relocation, raised elevation, and structural retrofits (updates)	38.41% 53	53.62% 74	7.97% 11	138
Natural Resource ProtectionPreservation or restoration of the functions of natural systems while minimizing hazard losses. Examples include floodplain protection, forest management, and slope stabilization.	78.26% 108	19.57% 27	2.17% 3	138
Structural ProjectsModification of the natural conditions for or progression of a hazard. Examples include dams, levees, seawalls, detention/retention basins, channel modification, retaining walls, and storm sewers.	63.50% 87	32.85% 45	3.65% 5	137
Emergency ServicesProtection of people and property during and immediately after a hazard event. Examples include warning systems, evacuation planning, emergency response training, and protection of emergency facilities.	81.16% 112	17.39% 24	1.45% 2	138
Public Education and AwarenessInforming of citizens about hazards and the techniques they can use to protect themselves and their property. Examples include outreach, school education, library materials, and demonstration events.	66.67% 92	31.88% 44	1.45% 2	138

Q16 Additional comments:

Answered: 28 Skipped: 110

#	RESPONSES	DATE
1	I slept through the flood. We need an alert system that alerts people by sound during the night.	7/19/2019 1:11 PM
2	Thank you!	7/19/2019 10:04 AM
3	See above.	7/19/2019 8:30 AM
4	My preference is always setting good land use policy and strong building codes first and then enforcing vigorously. Education is key, help us understand what we can do to mitigate and give us the financial tools to do so.	7/16/2019 11:54 AM
5	educate about and mitigate toxic mold conditions	6/29/2019 12:57 PM
6	Second Bridge please	6/20/2019 7:41 PM
7	Each of the six actions is important and necessary for a holistic mitigation and response plan. Which is most effective/cost-effective for which hazard category is probably the determining factor in implementation.	6/20/2019 4:14 PM
8	I do not agree with modifying the natural world to protect us. I feel we should mitigate by education and rules against allowing structures where they do not belong. Coastlines change, river courses change, steep slopes slide. We cannot prevent this. We can choose to build on stable ground only.	6/18/2019 7:41 AM
9	At the onset of natural emergency, radio comunication between Police, Fire, EMS and public works needs to patched together so all can work as one for the common good of the people	6/17/2019 3:40 PM
10	Our community is poor. We need assistance to keep things going. Instead of putting so much money into "beautification", I believe money would best be used to improve the infrastructure. Roads need repair, drainage (this area could use a little sprucing up; the roadsides are a mess), mow the grass along the roadsides like they used to and it would help reduce car/deer accidents!!! Create a structured, scheduled maintenance program that would get local people working! Create jobs to help the area and in turn people would want to maintain their yards, thus creating more tourism.	6/17/2019 1:02 PM
11	Jerry for prez	6/14/2019 5:53 PM
12	Cyber security should be a high priority for every community, yet it isn't even mentioned here. Local governments are highly susceptible to this hazard. Unlike many small communities, we have excellent resources among our citizens to help improve cyber security, and prioritizing cyber security could help mobilize our under-utilized resources and even be a model for other communities. Greater regional cooperation on resilience and preparedness would leverage scarce resources. Cooperation between tribal and local governments is another unique opportunity for improving our communities' resilience.	6/14/2019 4:27 PM
13	Keep the public informed and get their input regularly.	6/14/2019 3:26 PM
14	We need serious grant money to improve our drainage system and revamping of the entire railroad grade from Dollar Bay to Laurium to eliminate future threats of landslides in Hubbel, Tamarack City, and Lake Linden.	6/14/2019 11:35 AM
15	I think officials and community leaders here have a good idea what we need, but money is in short supply. Due to the mining boom of the 19th Century there is disproportionately more man-made infrastructure here than the current population supports or would have built.	6/14/2019 9:42 AM
16	Thanks for all you do.	6/14/2019 9:39 AM
17	It should not be solely government and municipalities responsibility to mitigate and protect against disasters. Individuals need to have significant stake as well.	6/14/2019 9:30 AM
18	Make sure our 1st responders are trained and equipped and that they can get on the scene quickly. Enforce building codes, fix dilapidated roads, keep road right of ways mowed and free of trees, keep ditches clean and culverts open. Insist that power lines are kept free from trees and branches and the the power company makes improvements to the transmission lines so that there are no single points of failure. Finally, correct you definition of risk: risk is a measure of consequence and probability. It is not merely an “exposure to danger” as your survey defines it.	6/14/2019 8:36 AM
19	It is difficult to imagine the depth and extent of a large catastrophic event, such as The Father’s	6/14/2019 8:33 AM

	Day Flood. One such experience is very informative as to how to mitigate a future such event. Rebuilding the same structures (houses, businesses, roads and bridges) using the same place and/or design ensures that a future tragedy will occur at that location. Building permits for repair of such structures, roads, and bridges need to consider needed design changes.	
20	I am happy to hear a committee is working to host this discussion and hopefully address some issues.	6/14/2019 8:32 AM
21	Please share the survey results. Was notified survey was available via email from employer (Michigan Tech).	6/14/2019 8:17 AM
22	I know we have a lot of potential disaster/hazard areas and not enough people to staff response or the taxpayer base to fund these things to get them done. I think it's important to educate our local community on the importance of federal funding for the UP. It's so easy to say "small government" and vote accordingly, but from what I've heard, the damages incurred by the Father's Day Flood alone wiped out our local budgets for years to come.	6/14/2019 8:14 AM
23	thank you for the effort you are putting into our communities safety!	6/14/2019 8:00 AM
24	Thank you for doing this and being proactive about the safety of the community	6/14/2019 7:48 AM
25	I appreciate the city being pro-active, and solicit community input. Can you perhaps include a public announcements of key meetings (e.g. jails now but others like these issues) with 'webinars" we can link to to see these meetings if we cannot attend?	6/14/2019 7:37 AM
26	A grate is NOT the answer! Fix the culverts right. If the Village does know how to fix the problem call the township, county, etc anyone! How ridiculous that they fixed a sink hole with a grate! How can I take pride on where I live when the village doesn't. The runoff from the road doesn't even go into the grate. I'm no engineer but I know the grate was not the answer. Which moron came to work that day and said let's fix the sink hole with a grate ♀	6/14/2019 7:26 AM
27	Social media needs to be updated faster by the Cities	6/14/2019 7:22 AM
28	none	6/14/2019 6:53 AM

2019 County Hazard Mitigation Local Government/Institutions Survey

The Western Upper Peninsula Planning and Development Region is updating Hazard Mitigation Plans for all six (6) counties in the Western Upper Peninsula. Update and adoption of the plan is **required** by the Federal Emergency Management Agency (FEMA) as a pre-condition for organization and/or local government to apply for federal mitigation grant funding.

The goal of the Hazard Mitigation Plan is to recommend strategies on a pre-disaster basis for the purpose of reducing adverse effects caused by natural, man-made, and technological disasters, including flooding, dam failures, wildfires, severe weather events, public health emergencies, terrorism, and hazardous materials and gas pipeline incidents.

We need your assistance in providing input into the County Hazard Mitigation Plan update through the enclosed survey. FEMA **requires** a certain level of participation of local units of government for the plan to be approved, and this survey will help to meet that requirement. Please fill out the survey as completely as possible and return it. Feel free to attach additional pages if necessary.

Contact rpressley@wuppdr.org with any questions.

Thank you for your time and participation!

Key Definitions:

Hazard - Something that is potentially dangerous or harmful, often the root cause of an unwanted outcome.
Mitigation - The action of reducing the severity, seriousness, or painfulness of something.
Risk - A situation involving exposure to danger; the possibility that something unpleasant or unwelcome will happen.
Vulnerability - The quality or state of being exposed to the possibility of being attacked or harmed, either physically, emotionally, financially, etc.

2019 County Hazard Mitigation Local Government/Institutions Survey

Local Government/Establishment: _____

Completed by: _____

1. Please specify the degree to which you think your jurisdiction is at risk of the following hazards occurring:

Hazards	Very Concerned	Somewhat Concerned	Neutral	Not Very Concerned	Not Concerned
WEATHER HAZARDS					
Extreme Weather Temperatures (hot/cold)	☐	☐	☐	☐	☐
Fog	☐	☐	☐	☐	☐
Hail	☐	☐	☐	☐	☐
Ice and Sleet Storms	☐	☐	☐	☐	☐
Lightning	☐	☐	☐	☐	☐
Severe Winds (Windstorms)	☐	☐	☐	☐	☐
Snowstorms and Blizzards	☐	☐	☐	☐	☐
Tornados	☐	☐	☐	☐	☐
GEOLOGIC HAZARDS					
Earthquakes	☐	☐	☐	☐	☐
Landslide /Mudslide	☐	☐	☐	☐	☐
Subsidence (sink holes or ground collapse)	☐	☐	☐	☐	☐
HYDROLOGICAL HAZARDS					
Dam Failure	☐	☐	☐	☐	☐
Drought	☐	☐	☐	☐	☐
Flooding due to precipitation event or snowmelt	☐	☐	☐	☐	☐
Shoreline Flooding and Erosion	☐	☐	☐	☐	☐
ECOLOGICAL HAZARDS					
Invasive Species (Emerald Ash Borer/Asian Carp)	☐	☐	☐	☐	☐
Wildfires	☐	☐	☐	☐	☐
INDUSTIRAL HAZARDS					
Scrap Tire Fires	☐	☐	☐	☐	☐
Structural Fires	☐	☐	☐	☐	☐
Hazardous Materials, Fixed Site (e.g. buildings or industrial site)	☐	☐	☐	☐	☐
Hazardous Materials, Transportation-Related (e.g. waste spill from traffic accident)	☐	☐	☐	☐	☐
Petroleum/Natural Gas Pipeline Incident (e.g. rupture/leak resulting in outage)	☐	☐	☐	☐	☐

Hazards	Very Concerned	Somewhat Concerned	Neutral	Not Very Concerned	Not Concerned
INFRASTRUCTURE HAZARDS					
Infrastructure failure & resulting hazards (e.g. power outage)	☐	☐	☐	☐	☐
Transportation Accidents (car crashes)	☐	☐	☐	☐	☐
HUMAN RELATED					
Civil Disturbances (rioting)	☐	☐	☐	☐	☐
Public Health Emergencies (disease epidemic)	☐	☐	☐	☐	☐
Sabotage/Terrorism	☐	☐	☐	☐	☐
Other: _____	☐	☐	☐	☐	☐
Other: _____	☐	☐	☐	☐	☐
Other: _____	☐	☐	☐	☐	☐

For any of the hazards in the table for which you responded **"very"** or **"somewhat concerned,"** are there any that you feel would cause particularly severe property damage or loss of life if they occurred? Please explain.

2. Is your government agency/institution involved in any hazard mitigation projects? ☐ Yes ☐ No

   IF YES, please explain:

3. What hazard mitigation activities/projects has your government agency/institution implemented since 2013? **If any**, please describe:

4. Has your agency applied for any mitigation funding from federal, state, local, and/or private sources since 2013?

   ☐ Yes ☐ No

   IF YES, please explain:

   IF YES (on question 4), was the funding request successful? ☐ Yes ☐ No

5. What are the most important community assets to protect from damage during a hazard event?

6. How is growth and development in the community contributing to natural hazard events?

7. What activities will assist the community in reducing risk and preventing loss from future natural hazard events?

8. Do you see any gaps in the current system for reducing risk? ☐ Yes ☐ No
   Do you see new ways for agencies, organizations, or individuals to participate/coordinate to reduce risk from hazards?

9. How, if at all, does your institution educate the public concerning mitigation and preparedness projects, programs and activities?

- ☐ Newspaper
- ☐ Television
- ☐ Radio
- ☐ Internet – Social Media (Facebook or Twitter)
- ☐ Internet – Website Postings
- ☐ Mailings
- ☐ Public Workshops / Meetings
- ☐ Other (specify): _____
  _____
  _____

10. Please feel free to provide any additional comments in the space provided:

THANK YOU FOR YOUR PARTICIPATION!

The Daily Mining Gazette

Houghton County Hazard Mitigation Plan available for review

The Western Upper Peninsula Planning and Development Region (WUPPDR) has recently made updates to the Houghton County Hazard Mitigation Plan. Hazard mitigation is any action taken before, during or after a disaster to eliminate or reduce the risk to human life and property from natural, technological, or human-related hazards. The plan's purpose is to identify hazard risks throughout the county and to become better prepared for them.

The draft of the Houghton County 2020-2024 Hazard Mitigation Plan Update will be available through Jan. 2, 2020 for public review and comment prior to plan adoption by all local governments at regular meetings. A formal public hearing will also be held at a County Board meeting to be announced.

Copies of the plan draft will be available at WUPPDR (400 Quincy St.) in Hancock and at the Portage Lake District Library (58 Huron St.) in Houghton, and online at www.wuppdr.org.

Written comments will be considered by WUPPDR in cooperation with Houghton County and local governments, as appropriate. Comments must be received by Jan. 1, 2020 and may be mailed to WUPPDR, 400 Quincy St., 8th Floor, Hancock, MI 49930 or emailed to Rachael Pressley, Assistant Regional Planner, at rpressley@wuppdr.org.

Appendix F: Meeting Materials

County Hazard Mitigation Plan Update – Local Planning Team
May 2019

AGENDA

Introductions
Community Survey
Overview of the process
Timeline
Community Profile
Hazard Worksheet and Discussion
Map Review Exercise
Government/Institution Survey

Action: Submit past/present/future mitigation activities to Project Coordinator (rpressley@wuppdr.org)

Next meeting (August 2019): Survey results, review mitigation strategies, and update recommendations/implementation goals

WUPPDR Hazard Mitigation Team:
Executive Director – Jerald Wuorenmaa, jwuorenmaa@wuppdr.org
Project Coordinator – Rachael Pressley, rpressley@wuppdr.org
Planning Support – Angela Yu, ayu@wuppdr.org
GIS Support – Alanna Mingay, amingay@wuppdr.org
Hazard Mitigation Intern – Celine Carus, ccarus@wuppdr.org

2020 Houghton County Hazard Mitigation Plan
Local Planning Team Meeting #1 – May 16, 2019 (2:00pm)
Mercy EMS (23298 Airpark Blvd, Calumet)

Last Name	First Name	Representing	Email Address	Phone
Van Arsdale	Chris	Houghton County	OEM@HoughtonCounty.net	906-482-6400
Jwuorenmaa	Jerald	WUPPDR	jwuorenmaa@wuppdr.org	482-7205
Vitton	Stanley	Houghton-Hancock ~~Geo Engineering North Coast Water & Waste~~ Water Treatment	vitton@mtu.edu	906-370-5617

County Hazard Analysis Priority Checklist

Name & Email:	Representing Organization:

Worksheet Instructions:
Please circle the following hazards in concern from 1-10. If any relevant historic occurrences are known, please note in the comment box. If at the end of the checklist any information or hazards are missing please take note of it and contact: rpressley@wuppdr.org

Helpful Definitions:
Hazard - Something that is potentially dangerous or harmful, often the root cause of an unwanted outcome.
Mitigation - The action of reducing the severity, seriousness, or painfulness of something.
Risk - A situation involving exposure to danger; the possibility that something unpleasant or unwelcome will happen.
Vulnerability - The quality or state of being exposed to the possibility of being attacked or harmed, either physically, emotionally, financially, etc.
Location – The geographic areas in the county planning area that are affected by the hazard. Note whether the hazard is present on county lands; if the hazard is localized, please write the hazard's specific location
Maximum Extent – The strength or magnitude of the hazard. How is the hazard measured in your organization and list the extent of the hazard?
Impact – the consequence or effect of the hazard on the county government and its assets. List specific vulnerable agencies/populations/property that might be more susceptible to the hazard
Probability: a numerical index of risk; it is a measure of the likelihood that the undesirable event will occur.

Hazard	Overall Concern	Comments
Extreme Temperature	1 - 2 - 3 - 4 - 5 - 6 - 7 - 8 - 9 - 10	
Fog	1 - 2 - 3 - 4 - 5 - 6 - 7 - 8 - 9 - 10	
Hail	1 - 2 - 3 - 4 - 5 - 6 - 7 - 8 - 9 - 10	
Ice/Sleet Storms	1 - 2 - 3 - 4 - 5 - 6 - 7 - 8 - 9 - 10	
Lightning	1 - 2 - 3 - 4 - 5 - 6 - 7 - 8 - 9 - 10	
Severe Winds	1 - 2 - 3 - 4 - 5 - 6 - 7 - 8 - 9 - 10	
Snowstorms & Blizzards	1 - 2 - 3 - 4 - 5 - 6 - 7 - 8 - 9 - 10	
Tornadoes	1 - 2 - 3 - 4 - 5 - 6 - 7 - 8 - 9 - 10	
Dam Failures	1 - 2 - 3 - 4 - 5 - 6 - 7 - 8 - 9 - 10	
Riverine & Urban Flooding	1 - 2 - 3 - 4 - 5 - 6 - 7 - 8 - 9 - 10	
Shoreline Flooding & Erosion	1 - 2 - 3 - 4 - 5 - 6 - 7 - 8 - 9 - 10	
Drought	1 - 2 - 3 - 4 - 5 - 6 - 7 - 8 - 9 - 10	
Wildfires	1 - 2 - 3 - 4 - 5 - 6 - 7 - 8 - 9 - 10	
Invasive Species	1 - 2 - 3 - 4 - 5 - 6 - 7 - 8 - 9 - 10	

Earthquakes	1 - 2 - 3 - 4 - 5 - 6 - 7 - 8 - 9 - 10	
Subsidence/Ground Collapse/Sinkhole	1 - 2 - 3 - 4 - 5 - 6 - 7 - 8 - 9 - 10	
Scrap Tire Fires	1 - 2 - 3 - 4 - 5 - 6 - 7 - 8 - 9 - 10	
Structural Fires	1 - 2 - 3 - 4 - 5 - 6 - 7 - 8 - 9 - 10	
Hazardous Materials: Fixed Site Incidents	1 - 2 - 3 - 4 - 5 - 6 - 7 - 8 - 9 - 10	
Hazardous Materials: Transportation Incidents	1 - 2 - 3 - 4 - 5 - 6 - 7 - 8 - 9 - 10	
Petroleum & Gas Pipeline Accidents:	1 - 2 - 3 - 4 - 5 - 6 - 7 - 8 - 9 - 10	
Infrastructure Failure & Secondary Technological Hazards	1 - 2 - 3 - 4 - 5 - 6 - 7 - 8 - 9 - 10	
Transportation Accidents	1 - 2 - 3 - 4 - 5 - 6 - 7 - 8 - 9 - 10	
Civil Disturbances	1 - 2 - 3 - 4 - 5 - 6 - 7 - 8 - 9 - 10	
Public Health Emergencies	1 - 2 - 3 - 4 - 5 - 6 - 7 - 8 - 9 - 10	
Sabotage & Terrorism	1 - 2 - 3 - 4 - 5 - 6 - 7 - 8 - 9 - 10	

Write additional comments on back of page.

County Hazard Mitigation Plan Update – Local Planning Team
August 20, 2019

AGENDA

Introductions
Survey Results
Risk Assessment
Mitigation Action Plan

- Goals
- Past Mitigation Activities
- Current Projects
- Future Recommendations

Final Plan Adoption Process

Action: Review Draft when released and submit comments to Rachael Pressley (rpressley@wuppdr.org)

WUPPDR Hazard Mitigation Team:
Executive Director – Jerald Wuorenmaa, jwuorenmaa@wuppdr.org
Project Coordinator – Rachael Pressley, rpressley@wuppdr.org
Planning Support – Angela Yu, ayu@wuppdr.org
GIS Support – Alanna Mingay, amingay@wuppdr.org
Hazard Mitigation Intern – Celine Carus

2020 Houghton County Hazard Mitigation Plan
Local Planning Team Meeting #2 – August 20, 2019 (6:00pm)
Mercy EMS

Last Name	First Name	Representing	Email Address	Phone
Primeau	Gerald	Mercy EMS	gprimeau@mercyems.com	906-482-0932
BARTL	PETER	WESTERN UP HEALTH DEPT	PBARTL@WUPHD.ORG	906-482-7382
HALONEN	MARK	KOPPERS	HALONENMP@KOPPERS.COM	906-231-5728
VANARSDALE	CHRIS	OEM	OEM@HoughtonCounty.net	906-482-6400

Past Mitigation Activities

2005 Mitigation Program Action Items

2005 Item	Status
Sturgeon River Road Bank Stabilization	
Flood Mitigation—Storm Drainage Sewer Upgrades	
Drainage Improvements and Maintenance	
Mine Shaft Safety	
Secure Redridge Dam	Completed
Update Stormwater Management Plans and Flood Maps	
Development of a Multi-Hazard Mitigation Plan for Michigan Tech	Completed
Improved Emergency Response, Equipment and GIS System	
Bridge Approaches for Emergency (Temporary) Bridge	
Portable Water Treatment System	
Update Shoreline Erosion Map and Identify Future Mitigation Activities	
Public Information/Education Program	
Review Plans and Development Regulations	
Insurance	

2013 Mitigation Program Action Items

2013 Item	Status
Portage Lake Span Bridge	
Sturgeon River Road Bank Stabilization	
Flood Mitigation – Storm Drainage Sewer Upgrades	
Drainage Improvements and Maintenance	
Mine Shaft & Stope Safety	
Update Storm Water Management Plans	
Retrofit Underground Pipes	
Improved Emergency Response, Equipment and GIS System	
Bridge Approaches for Emergency (Temporary) Bridge	
Improved Firefighting Capability	
Portable Water Treatment System	
Update Shoreline Erosion Map and Identify Future Mitigation Activities	
Community Storm Shelter(s)	
Acquire and Distribute Sump Pumps for Residences	
Public Information/Education Program	
Close and remediate Pedersen/Lahti Landfill	
Review Plans and Development Regulations	
Insurance	

Appendix G: State Document Review

Appendix H: Plan Adoption

HOUGHTON COUNTY
2020 HAZARD MITIGATION PLAN UPDATE
ADOPTION RESOLUTION

WHEREAS, Houghton County, Michigan has experienced disasters that have damaged commercial, residential, and public properties; displaced citizens and businesses, closed streets and bridges, and threatened the health and safety of the general public; and

WHEREAS, Houghton County has prepared a Hazard Mitigation Plan that outlines options to reduce overall damage and impact from natural hazards; and

WHEREAS, Houghton County has reviewed and updated the Hazard Mitigation Plan on the five-year cycle as required; and

WHEREAS, opportunities to review and comment on Hazard Mitigation Plan have been provided to the public, and local, state and federal agencies; and

WHEREAS, on April 23, 2020, the Federal Emergency Management Agency approved the Hazard Mitigation Plan pending adoption by Houghton County.

NOW, THEREFORE, BE IT RESOLVED THAT:

The updated HOUGHTON COUNTY HAZARD MITIGATION PLAN dated April 2020 is hereby adopted as an official plan of Houghton County, Michigan.

The Emergency Management Coordinator shall submit a written report to the Board of Commissioners when updates, revisions, or other actions are recommended or required, at a minimum once every five years.

Albert Koskela, Chairperson
Houghton County Board of Commissioners

5-13-2020
Date