Little River Band of Ottawa Indians

Natural Hazards Mitigation Plan

2023

FEMA Letter of Approval and Tribal Plan Adoption Documentation

U.S. Department of Homeland Security
FEMA Region 5
536 S. Clark St. 6th Floor
Chicago, IL 60605

FEMA

October 31, 2024

Speaker Shannon Crampton
Little River Band of Ottawa Indians Tribal Council
Little River Band of Ottawa Indians
2609 Government Center Drive
Manistee, MI 49660

Dear Speaker Crampton:

We are pleased to inform you that the Little River Band of Ottawa Indians Natural Hazard Mitigation Plan has been approved, meeting the requirements for a Tribal Mitigation Plan as provided for under the Disaster Mitigation Act of 2000.

The expiration date of the Little River Band of Ottawa Indians Natural Hazard Mitigation Plan is five years from the date of this letter.

The approval of this plan ensures the continued availability within the tribe of non-emergency Stafford Act funding including the Pre-Disaster Mitigation Program, Hazard Mitigation Grant Program, Fire Management Assistance Grants, and Public Assistance Categories C-G. All requests for funding, however, will be evaluated individually according to the specific eligibility and other requirements of the particular program under which the application is submitted.

We encourage the Little River Band of Ottawa Indians follow the plan's schedule for monitoring and updating the plan. The plan must be reviewed, revised as appropriate, and resubmitted for approval within five years.

Congratulations to the Little River Band of Ottawa Indians on completing this significant action. If you or the community representatives have any questions, please contact Meghan Cuneo at (202) 615-5294 or Meghan.cuneo@fema.dhs.gov.

Sincerely,

John Wethington
Chief, Risk Analysis Branch
Mitigation Division

cc: Matt Schnepp
Hazard Mitigation Unit Manager
Emergency Management & Homeland Security Division
Michigan State Police

CERTIFICATION OF EXECUTION

At a 2nd Open Session of the Little River Band of Ottawa Indians Tribal Council held at the Little River Band Chamber Room on October 09, 2024, with a quorum being present for such vote, the Tribal Council adopted Resolution #24-1009-185 - Resolution adopting FEMA Approved Hazard Mitigation Plan

By my signature, I certify that an original of said Resolution was delivered to the Tribal Ogema for Execution in accordance with Article V, Section 5, (Sub.___) of the Little River Band of Ottawa Indians Tribal Consititution.

Date delivered to Ogema: October 09, 2024 Time: 2:15pm

Signature of Recorder: Teena Jackson

Acknowledgement of Receipt by Tribal Ogema: _____

Manner of Execution determined by Tribal Ogema:

☐ Copy of Resolution forwarded to Personnel/Department, with instructions for Execution (written instructions attached):

Robert Robles _____

Name Title

☐ Creation of New Regulation or Executive Order Regulation/Executive Order Number:

_____

Expected date of completion: _____

☐ Other: _____

☐ Ogema requires additional information from the Tribal Council in order to complete Execution as follows:

☐ Returned to Tribal Council for further action on: _____

Date: 10-9-2024 Larry D Romanelli

Signature of Ogema

Little River Band of Ottawa Indians
2608 Government Center Drive
Manistee, MI 49660
(231) 723-8288

Resolution # 24-1009-185

Resolution Adopting FEMA Approved Hazard Mitigation Plan

WHEREAS, the status of the *Gaá Chíng Ziibi Daáwaa Aníšhinaábek* (Little River Band of Ottawa Indians) as a sovereign and Treaty-making power is confirmed in numerous treaties, from agreements with the initial colonial powers on this land, to various treaties with the United States; and

WHEREAS, the Little River Band of Ottawa Indians (Tribe) is descended from, and is the political successor to, the Grand River Ottawa Bands, signatories of the 1836 Treaty of Washington (7 Stat. 491) with the United States, as reaffirmed by federal law in P.L. 103-324, enacted in 1994; and

WHEREAS, the Tribe adopted a new Constitution, pursuant to a vote of the membership on May 27, 1998, which Constitution became effective upon its approval by the Assistant Secretary-Indian Affairs on July 10, 1998; and

WHEREAS, the Tribe adopted amendments to the Constitution on April 26, 2004, which became effective upon approval by the Assistant Secretary-Indian Affairs on May 13, 2004; and

WHEREAS, the Tribe adopted amendments to the Constitution on July 11, 2016 which became effective upon approval by the Assistant Secretary-Indian Affairs on August 24, 2016; and

WHEREAS, the Tribal Council is authorized under Article IV, Section 7(a) to provide for the public health, peace, morals, education and general welfare of the Little River Band and its members; and

WHEREAS, the Tribe, recognizes the threat that natural hazards pose to people and property within the Little River Band of Ottawa Indians; and

WHEREAS, the Tribe, has prepared a multi-hazard mitigation plan in accordance with the Disaster Mitigation Act of 2000 and the requirements in Title 44 Code of Federal Regulations Section 201.7; and

WHEREAS the Plan specifically addresses hazard mitigation strategies and plan maintenance procedures for the Little River Band of Ottawa Indians; and

WHEREAS the Plan recommends several hazard mitigation actions and projects that will provide mitigation for specific natural hazards that impact the Little River Band of Ottawa Indians, with the effect of protecting people and property from loss associated with those hazards; and

WHEREAS the Plan was finalized and submitted to Michigan State Police and FEMA for review and approval; and

WHEREAS adoption of this plan will make the Little River Band of Ottawa Indians eligible for funding to alleviate the impacts of future hazards on the Reservation.

THEREFORE, BE IT RESOLVED,

1. The Plan is hereby adopted as an official plan of the Little River Band of Ottawa Indians.
2. The respective officials identified in the mitigation strategy of the Plan are hereby directed to pursue implementation of the recommended actions assigned to them.
3. Future revisions and plan maintenance required by 44 CFR 201.7 and FEMA are hereby adopted as a part of this resolution for a period of five (5) years from the date of this resolution.
4. An annual report on the progress of the implementation elements of the Plan shall be presented to the Tribal Ogema and Tribal Council.
5. The Little River Band of Ottawa Indians will comply with all applicable Federal statutes and regulations in effect with respect to the periods for which it receives grant funding, including 2 CFR parts 200 and 3002; and will amend our plan whenever necessary to reflect applicable changes in Tribal or federal laws or statutes.

CERTIFICATE OF ADOPTION

I do hereby certify that the foregoing resolution was duly presented and adopted by the Tribal Council with 9 FOR, 0 AGAINST, 0 ABSTAINING, and 0 ABSENT, at a Regular Session of the Little River Band of Ottawa Indians Tribal Council held on October 09, 2024, at the Little River Band of Ottawa Indians Government Center with a quorum being present for such vote.

Pam Johnson, Tribal Council Recorder

Tammy Burmeister, Tribal Council Speaker

Attest:
Distribution: Council Records
Tribal Ogema
Department of Public Safety

ACKNOWLEDGEMENTS

The Little River Band of Ottawa Indians Natural Hazard Mitigation Plan is prepared for the Gaaching Ziibi Daawaa Anishinaabe Native Sovereign Nation. The Plan is a culmination of the interdisciplinary and interagency planning effort the required the assistance and expertise of numerous organizations, departments, and individuals. Without the technical assistance and contributions of time and ideas of these organizations, departments, and individuals, this plan could not have been completed.

Tribal Councilmembers as of October 2024
Tammy Burmeister, Speaker
Pam Johnson, Recorder
Shannon Crampton
Gary DiPiazza
Al Metzger
Misty Silvis
Shirley Weaver
Ron Wittenburg
Julie Wolfe

Tribal Government Staff

Name	Title	Department
Brandy Martin	Tribal Emergency Response Team Incident Commander	Public Safety
Bill Willis	Tribal Manager	Tribal Ogema
Robert Medacco	Director	Public Safety
Robert Robles	Sergeant	Public Safety
Bradley R. Pringle	Support Staff	Tribal Council
Mary Carpenter	Enrollment Coordinator (current)	Enrollment
Jessica Wissner	Enrollment Coordinator (former)	Enrollment
Jonnie "Jay" Sam II	Director	Historic Preservation
Tara Bailey	Director	Housing
Frank Beaver	Director	Natural Resources
Allison Smart	Environmental Division Manager (former)	Natural Resources
Gary Lewis	Utility Director	Utility
Steve Parsons	Planner	Planning
Andrew-Trey Jeurnik	System Security Administrator	Information Technology
Dottie Batchelder	Be Da Bin Behavioral Health	Family Services
Andrew Hurford	Background Investigator	Gaming Commission
Lyle Dorr	Grants Administrator	Grants
James Henderson	Safety/Risk Officer	Little River Casino Resort
Lee Ivinson	Compliance	Little River Casino Resort

Non-Tribal Participation

Name	Title	Agency
Mike Machen	(Former) 911 Deputy Director/Emergency Management Coordinator	Manistee County
Alvin Rischel	(Current) 911 Deputy Director/Emergency Management Coordinator	Manistee County
Elizabeth A. Reimink	Emergency Management Coordinator	Mason County

Prepared for the Little River Band of Ottawa Indians
with assistance from:

Networks Northwest
PO Box 506
Traverse City MI 49685-0506
Telephone: 231.929.5000
www.networksnorthwest.org

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I. INTRODUCTION

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

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

A *hazard*, in the context of this plan, is an event or physical condition that has potential to cause fatalities; injuries; damage to personal property, infrastructure, or the environment; agricultural product loss; or interruption of business or civic life. The Little River Band of Ottawa Indians (LRBOI) Natural Hazard Mitigation Plan focuses primarily on *natural* hazards such as extreme heat, drought, wildfires, flooding, Lake Michigan shoreline hazards, thunderstorms, high winds, hail, tornadoes, extreme winter weather, and invasive species within the LRBOI tribal service area of Manistee, Wexford, Mason, Lake, Oceana, Newaygo, Muskegon, Ottawa and Kent Counties. The plan will also consider these technological and human-related hazards: dam failure, subsidence, and public illness outbreak.

The following natural hazards were not included in the analysis for this Hazard Mitigation Plan: earthquakes, space weather, and meteorites and other impacting objects. Based upon review of the Michigan State Police's 2019 *Michigan Hazard Analysis*, most of Michigan is not located in an area subject to major earthquake activity. Damaging space weather events were not evaluated due to the lack of significant historical impact in northern Michigan. Damaging meteorite events were not evaluated due to the lack of historical impact in northern Michigan and their low probability of occurrence.

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

This is a new Natural Hazards Mitigation Plan for the Little River Band of Ottawa Indians that meets the requirements of Title 44 of the Code of Federal Regulations, Section 201.7. A FEMA-approved hazard mitigation plan is required for receiving certain types of non-emergency disaster assistance, including funding for Hazard Mitigation Assistance projects and Public Assistance permanent work (categories C-G) for Tribal governments applying directly to FEMA for assistance. The Plan includes a description of the planning process, a description of the community, hazard identification and analysis, current mitigation capabilities, a strategy and action plan, and a process for incorporating the plan into other Tribal processes and updating the Hazard Mitigation Plan.

Through this plan, a broad perspective was taken in examining multiple natural hazard mitigation activities and opportunities for protecting the LRBOI community from future hazard events. Each hazard was analyzed from a historical perspective, evaluated for potential risk, and considered for possible mitigation. It should be noted that while LRBOI tribal members may live throughout nine-county service area, the LRBOI tribe owns property and structures within Manistee County (primarily), as well as within Muskegon County and Mason County. Additionally, only Manistee and Wexford Counties are within Networks Northwest's regional service area, which limited the production of hazard map products (Appendix A) to those two counties. Therefore, since the greatest concentration of LRBOI property and assets is within Manistee County, the primary focus of the hazard analysis pertains to Manistee County, which is complemented with a more general analysis of historic events in the other eight counties in the LRBOI tribal service area.

Section VII of this plan, "Mitigation Strategies and Priorities", provides a list of mitigation strategies for each hazard identified in the analysis. Mitigation strategies were developed based on discussions with local officials and a review of FEMA/MSP best practices for hazard mitigation. (Refer to Appendix E for a list of Alternative Mitigation Strategies that were considered.) Strategies are grouped according to their purpose: Awareness and Preparation; Shelters; Buildings & Development; Utilities & Technology; and Environment & Natural Resources. The strategies table also includes: a

description of each strategy; what hazards it addresses; where the strategy applies; who is responsible for implementing the strategy; how the strategy will be implemented (what resources are available to apply the strategy); the estimated timeframe for completion; the level of priority; and what type of strategy it is. Most strategies are intended to be action items completed during the 5-year timeframe in which the plan is active. Some long-term strategies may extend beyond the 5-year timeframe due to feasibility or level of difficulty.

Recognizing the importance of reducing community vulnerability to natural hazards, Little River Band of Ottawa Indians is actively addressing the issue through the development and implementation of this plan. This process will help ensure that Tribal community remains a vibrant, safe, enjoyable place in which to live, raise a family, continue to conduct business. The Plan serves as the foundation for natural hazard mitigation activities and actions within the nine county service area, and will be a resource for building coordination and cooperation within the community for local control of future mitigation and community preparedness around the following LRBOI Natural Hazard Mitigation Goals:

1. Ensure the health, safety, and welfare of the LRBOI members for the next seven generations
2. Protect Tribal property, members, and environmental resources from potential damage from natural hazards
3. Pursue utility resiliency and sovereignty while reducing the Tribe's carbon footprint
4. Increase awareness of natural hazard preparedness and mitigation efforts amongst Tribal members

II. PLANNING PROCESS

The Stafford Act, as amended by the Disaster Mitigation Act of 2000, shifted the Federal Emergency Management Agency's (FEMA) scope of work to promoting and supporting prevention, or what is referred to as hazard mitigation planning. FEMA requires Tribal nations to have a natural hazards mitigation plan in place and updated on a 5-year cycle as a condition for receiving grant money related to natural hazard remediation. The Little River Band of Ottawa Indians (LRBOI) is adopting a new Hazard Mitigation Plan that meets the requirements of Title 44 of the Code of Federal Regulations, Section 201.7 (44 CFR § 201.7). The adoption of the 2023 plan will affirm the Tribe's eligibility for federal funding.

The creation of the Tribe's plan was led by the Natural Hazards Task Force composed of the Tribal Emergency Response Team (TERT). Team members consist of Tribal Councilmembers, emergency response personnel, and government staff that ensure the readiness of the Tribe by recommending equipment purchases, training and exercises, and member education on preparedness issues. Networks Northwest assisted with the planning process and provided support to facilitate meetings and plan writing. The Task Force met regularly virtually and in person at the LRBOI Tribal Justice Center in Manistee Township, Manistee County. The following is an outline of events for the development of the 2023 Natural Hazard Mitigation Plan:

- On July 1, 2021, Brandy Martin, TERT Incident Commander, attended a project kick-off meeting with regional county and tribal emergency managers.
- On October 6, 2021 Networks Northwest attended a TERT meeting and provided an introduction and timeline for the project. The meeting was held virtually.
- In October 2021, the Tribe released an online community survey. More details about the survey are below. Additionally, Brandy Martin, discussed the survey availability at the monthly LRBOI employee meeting.
- On November 17, 2021 Networks Northwest presented the community profile information and provided a summary of preliminary survey results. The meeting was held in person.
- In December of 2021, Brandy Martin discussed the hazard mitigation plan creation process at a Tribal Council meeting.
- On February 18, 2022 Networks Northwest presented the final survey results and the hazard analysis including historic weather events. The meeting was held in person.
- On May 19, 2022 a joint community meeting was held between Tribal officials and representatives from Manistee County to discuss potential hazards. The meeting was held virtually.
- August 31, 2022 Networks Northwest attended a TERT meeting and facilitated a discussion about the hazard analysis, goals and objectives, and hazard mitigation strategies.
- In September of 2022, Brandy Martin discussed the current list of hazards presented in the draft plan at the monthly LRBOI employee meeting.
- On January 27, 2023 Networks Northwest participated in a TERT meeting (via Zoom) to discuss edits to the draft plan and mitigation strategies.
- On April 13, 2023 Networks Northwest hosted work session (via Zoom) with Tribal Council and TERT members to review draft maps, plan content and strategies.
- The final draft plan was released for public comment on November 8, 2023 via the following notification methods: posting on the LRBOI website and the project page on Networks Northwest's website. The Tribal Incident Commander also met with the Tribal Council on November 15 at their regular meeting to answer any questions on the final draft plan. Public comments and questions regarding the plan were requested via email to the Tribal Incident Commander through November 30, 2023.
- On February 6, 2024, the LRBOI TERT Incident Commander sent an email to all the county Emergency Managers in the 9-county tribal service area, providing an online link to view the plan and requesting their input. No comments were received within two weeks' time of the email request.

In terms of obtaining "public" input as a part of developing this plan update for the LRBOI, the term "public" can be described as persons who are LRBOI tribal members/citizens, residents on tribal land, tribal government employees, participants in any of the County Local Planning Teams (LPTs) in the 9-County LRBOI service area (Kent, Lake, Manistee, Mason, Muskegon, Newaygo, Oceana, Ottawa and Wexford), or other native sovereign nation Tribes (Grand Traverse Band Tribe and Little Traverse Bay Band Tribe) in northwest lower Michigan.

Refer to the Acknowledgments section in the beginning of this plan for a list of participants; Appendix F for a detailed table showing how and when representatives participated in the planning process; and Appendix G for meeting and participation documentation.

Community Survey Results

The primary source of feedback was gathered through the Community Survey. A link to the survey was emailed twice to tribal employees and TERT members, and posted on the project page within Networks Northwest's website. The survey asked twelve questions related to hazard mitigation and received 45 responses between October 2021 and February 2022. The majority of responses were from government employees and Tribal members. The Emergency Coordinator for Mason County also participated in the survey. The survey responses are provided in Appendix B.

Question 2 asked participants to indicate their level of concern about future natural hazard events affecting their community.

- 40% were "Very Concerned:
- 49% were "Somewhat Concerned"
- 11% were "Not Concerned"

Responses to Question 3 largely reflects the primary concern of the time, the COVID-19 Pandemic. When asked what natural hazard event is likely to have the largest impact on your community:

- 31 of the responses were related to pandemic/illness outbreak or lack of outbreak resources.
- Other responses included flood and wildfire (eighteen responses each), snowstorms/winter storms/blizzards, and major or sever weather storms.
- High winds, tornado, dam failure and power outages were mentioned less frequently.

Questions 4 and 5 asked about community concerns for infrastructure and what forms of investment might be required to mitigate natural hazards.

- Of those who responded that infrastructure is a concern, many commented on sewer system inadequacies. This goes hand-in-hand with potential power outages that would impact the operation of sanitary sewer lift stations.
- Many participants were concerned about power outages and the need for back-up power. Therefore, the Tribe's renewable energy plan was also frequently mentioned as well as internet availability, and reliable cellular service. For example, the survey received the following response, "[I] don't know about everyone else but [I] do have infrastructure concerns, stormwater management, technology, internet… we are looking at going into renewable energy so it's a start."

Question 6 asked if there have been any negative impacts on the public health and/or natural environment of their community that are attributed climate change.

- Over half (25 of the 41) participants who provided a response said "no" or were "unsure".
- Of those who responded in the affirmative, increased wildfire frequency and severity, increased precipitation, high water levels, milder winters, hot summers, and the strain on emergency services were all mentioned as impacts from climate change. Several responses identify a chain reaction between unusual or uncommon weather patterns and effects on plant and animal species.

Questions 7 and 8 asked if participants were familiar with requests for assistance for mitigation projects in the past.

- 91% were unknown as to whether or not requests have been made.

Similarly, Question 9 asked if the community has considered mitigation strategies for potential hazards.

- 75% responded, "unknown."

Question 10, the follow up question, asked "If so, please identify potential strategies you would like to explore in the future."

- Several responses identified the renewable energy studies, additional support for emergency services, and consideration for alternative locations for storing electronic information.
- A survey-taker also responded that Mason County is currently in the process of updating their hazard mitigation plan and its strategies.

Question 11 asked if there was any additional information to be considered for the Tribe's Natural Hazard Mitigation Plan.

- One participant asked to include all Reservation lands for inclusion in the plan.
- Several responses asked for the plan to reflect cultural appreciation of lands/property as well as tribal values and importance of game and non-game species to the community.
- Others mentioned the need to include winter storms including snow and ice storms and the danger they pose to employees traveling on the road.
- And another asked to have a plan that is realistic, do-able and easy to follow by the people that will implement the plan.

The final question, Question 12, asked survey-takers to respond with their contact information if they wish to be involved with the plan process. Several responses included a name, email address, and phone number to contact those who are interested. Many indicated no, they are not interested.

Draft Plan Review and Comment

The draft plan was released for public comment on November 8, 2023 via the following outreach/notification methods: posting on the LRBOI website and posting on the project page within Networks Northwest's website. Figures 1 and 2 are images of the webpage notifications. The LRBOI Tribal Council also reviewed the final draft plan at their Council Meeting held on November 15, 2023.

Additionally, the following surrounding tribal, county and regional entities to the LRBOI were provided the opportunity to formally comment on the draft plan by accessing the plan via the LRBOI website where it was posted.

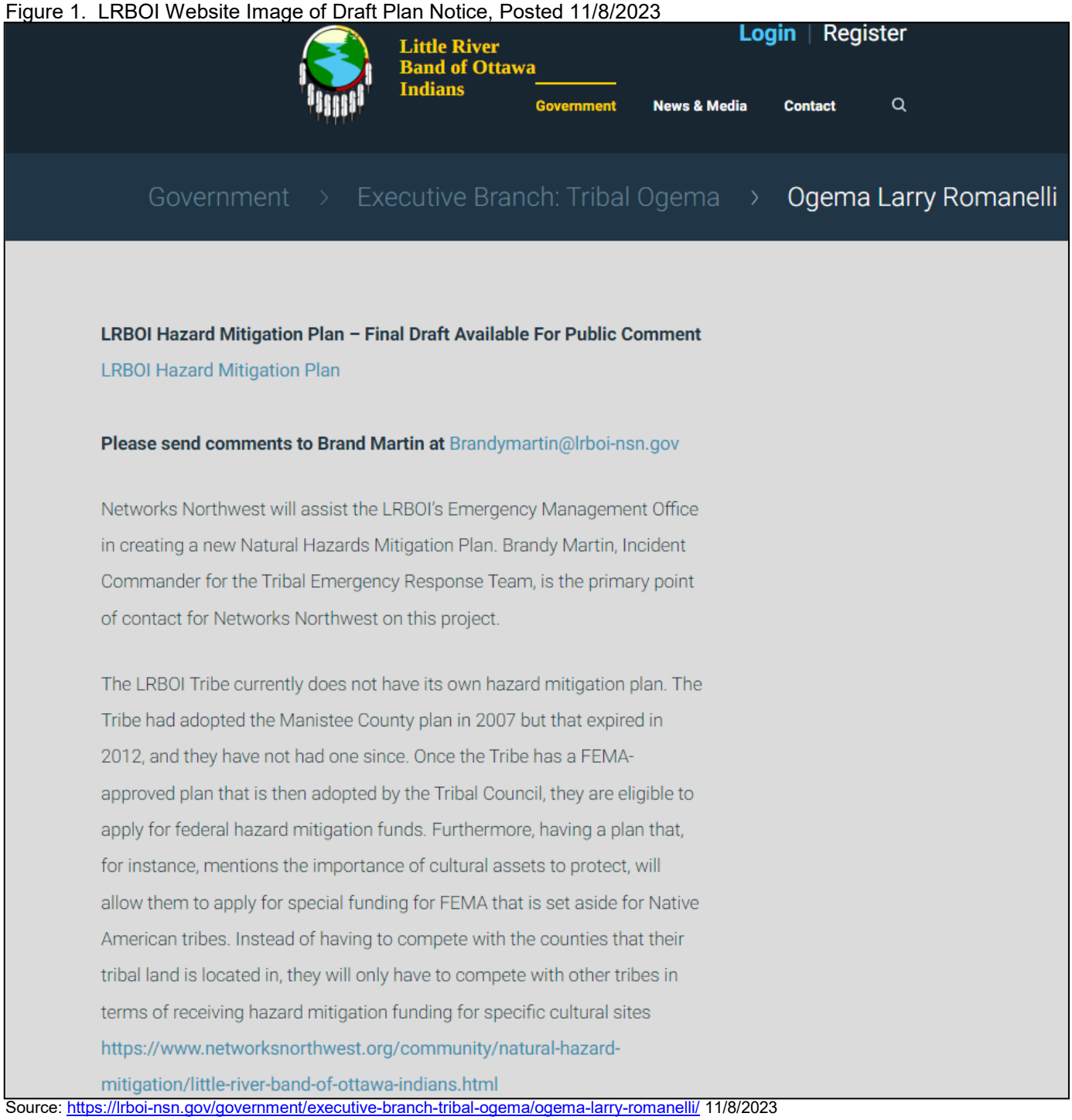
- Garrett Fairchild, Fire Chief, Grand Traverse Band of Ottawa and Chippewa Indians
- David W. Thom Jr., Safety Coordinator, Little Traverse Bay Bands of Odawa Indians
- Rebecca Hubers, Emergency Management Coordinator, Benzie County
- Alvin Rischel, Deputy Director/Emergency Management Coordinator, Manistee County
- Josh Glass, City of Manistee Police Chief

Comments were accepted until November 30, 2023. One member of the public provided an email with questions/comments during the public review period. Documentation of their questions and response from the TERT Incident Commander is included in Appendix G.

On February 6, 2024, the LRBOI TERT Incident Commander sent an email to all the county Emergency Managers in the 9-county tribal service area, as some of them were inadvertently left out of the November 2023 invitation to provide comment on the draft plan. The email provided an online link to view the plan. No comments were received within two weeks' time of the email request.

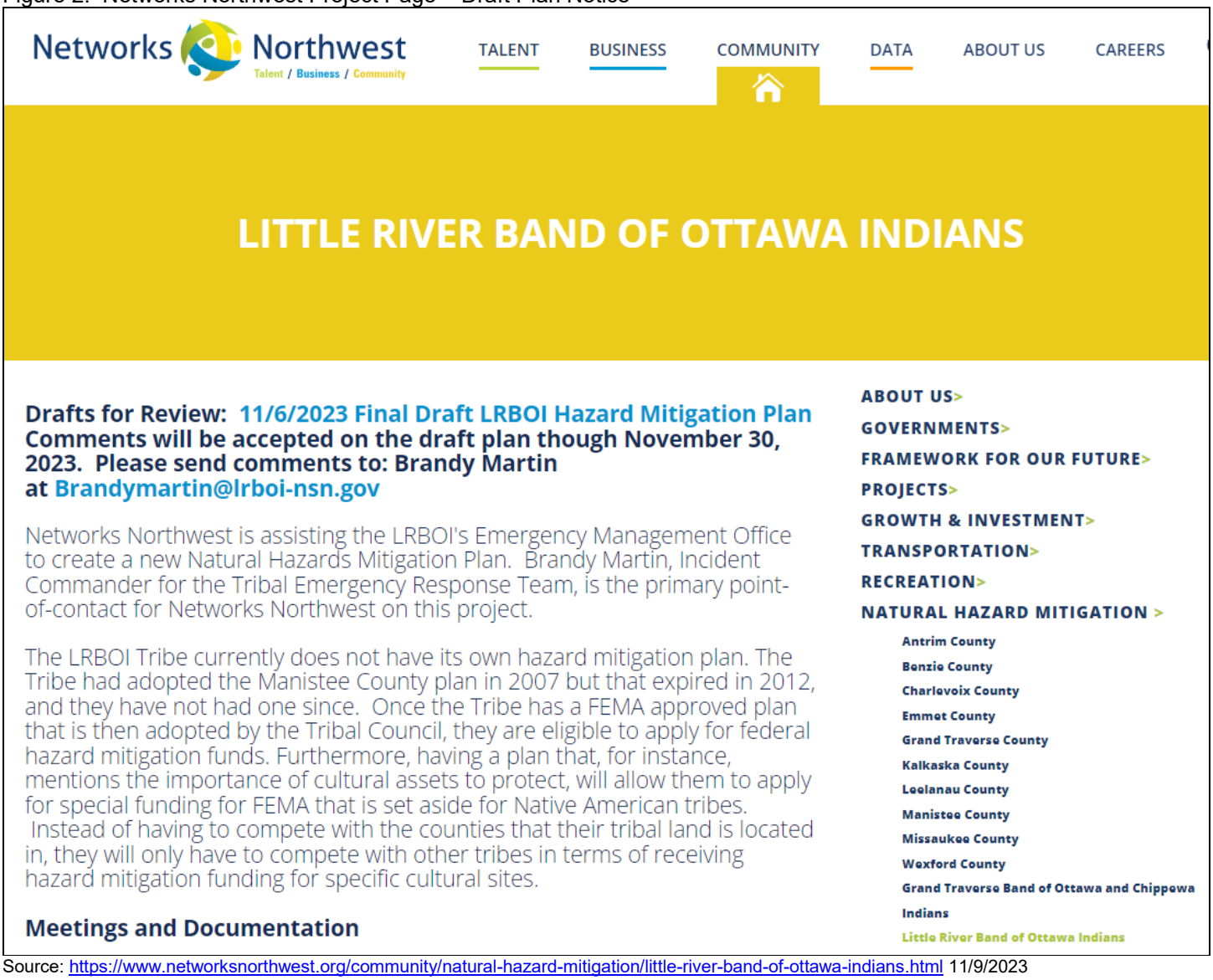
Figures 1 and 2 are screenshots of the websites where the draft plan availability notice was posted for public review.

Figure 1. LRBOI Website Image of Draft Plan Notice, Posted 11/8/2023



Source: https://lrboi-nsn.gov/government/executive-branch-tribal-ogema/ogema-larry-romanelli/ 11/8/2023

Figure 2. Networks Northwest Project Page – Draft Plan Notice



Source: https://www.networksnorthwest.org/community/natural-hazard-mitigation/little-river-band-of-ottawa-indians.html 11/9/2023

III. COMMUNITY PROFILE

The Little River Band of Ottawa Indians (LRBOI or the "Tribe") is a Federally-recognized Native Sovereign Nation descended from members of certain Grand River Ottawa Bands who lived in villages located on the Manistee River, Pere Marquette River, and at several villages on the Grand River system in Michigan. As a result of historic circumstances, only that portion of the Grand River Ottawa people now known as Little River Band of Ottawa, had its status as a federally recognized Indian tribe reaffirmed and restored by the United States in 1994. On September 21, 1994, the president of the United States signed into law Senate Bill 1357, *To Reaffirm and Clarify the Federal Relationships of the Little Traverse Bay Bands of Odawa Indians and the Little River Band of Ottawa Indians as Distinct Federally Recognized Indian Tribes*. The Tribe adopted its constitution on May 27, 1998.

Location

The Little River Band of Ottawa Indians Tribal lands are located in northwest and west-central Lower Michigan, across nine counties: Manistee and Wexford Counties are the most northern and are within the service area of Networks Northwest; south of these counties are Mason, Lake, Oceana, Newaygo, Muskegon, Kent, and Ottawa Counties (Figure 3). In 1999, the Little River Band of Ottawa Indians owned over 2,000 acres of land within the original 1836 and 1855 Reservation boundaries (Table 1, Figures 5 and 6). The original reservation areas consisted of approximately 70,000 acres in what is now known as southern Manistee County, and more than 84,000 acres in what is now known as Mason County. The LRBOI continues to purchase land within these areas for historical, spiritual, environmental, economic, and development purposes. There are 32 Tribal facilities including the Government Complex, Justice Center, member residential areas, and the Little River Casino Resort concentrated within a one-mile radius in Manistee Township, Manistee County.

The LRBOI Natural Resources Department created maps of LRBOI owned properties (combined In Trust and Fee Simple) as of September 9, 2021. The maps illustrate approximate property boundaries and should not be regarded as legal survey boundaries. The LRBOI Natural Resources Department maintains a link to these maps on their webpage: https://lrboi-nsn.gov/wp-content/uploads/2021/10/LRBOI-Property-maps.pdf

Manistee County LRBOI properties are listed below in order of their location from northwest to southeast. An overview map of Tribal and public owned lands in Manistee County is shown as Figure 4.

- Manistee Township Properties - 1,180 acres (shown as Figure 13)
    - Golf Course Property – 162 acres
    - Becker Road Property – 85 acres
    - Bialik Road Property – 19 acres
    - Becker and Bialik Road Properties – 85 and 19 acres, respectively
    - Rainbow Bend Property – 169 acres
    - Kettle Hole Property – 50 acres
    - River Road Property – 20 acres
    - Griffith Road and Bear Creek Properties – 329 acres
    - Vitaz Road Properties – 60 acres
    - Orchard Landing Property – 49 acres
    - Indian Village Road – 40 acres
    - Vitaz Road – 60 acres
    - Orchard Landing – 49 acres
    - Indian Village Road – 40 acres
    - High Bridge and Old House Road Properties – 179 and 517 acres, respectively (shown as Figure 21)
    - Tippy Dam Property – 257 acres (shown as Figure 22)
- Mason County - Custer Property - 700 acres (shown as Figure 10)

Table 1: LRBOI Land, Trust and Non-Trust

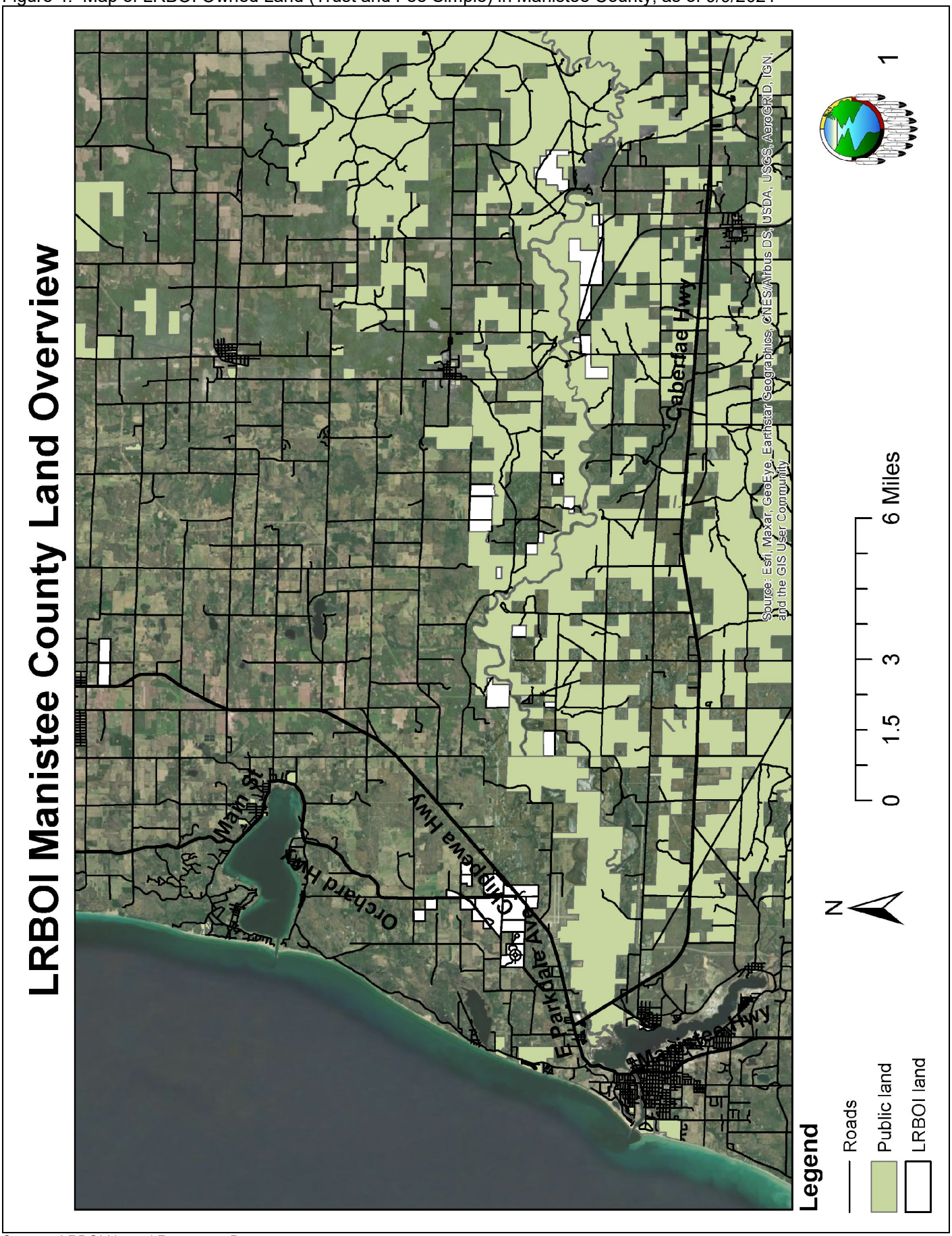
Location	In-Trust Acreage	Non-Trust Acreage
Land Within 1836 Reservation Boundary	1,002.9	1,254.2
Land Within 1855 Reservation Boundary	639.5	0
Sub-total	1,642.4	1,254.2
Land outside reservation in Manistee County	65.1	204.3
Sub-total	65.1	204.3
TOTAL	**1,707.5**	**1,458.5**

Source: Little River Band of Ottawa Indians Land Records

Figure 3: Little River Band of Ottawa Indians Service Area

Source: Little River Band of Ottawa Indians Program for Services

Figure 4. Map of LRBOI Owned Land (Trust and Fee Simple) in Manistee County, as of 9/9/2021



Source: LRBOI Natural Resources Department

Recent History of Land Use

The following historical information was based on information provided in the 2005 and 1999 Tribal Land Use Plan of Little River Band of Ottawa, and from the June 2004 Vol. I, Issue 5, Little River Currents Newspaper, pgs. 8-10.

The existing land uses on the 1836 and 1855 Reservations directly relate to the historical land uses and occurrences. The fragmentation of land and displacement of members occurred in the 1800's and altered the tribal member's way of living. This historical summary provides an explanation of why the land uses and ownership fragmentation occurred. The information in this section was derived from Jay Sam, the draft 1999 Tribal Land Use Plan, and articles in the *Little River Currents*.

Before the arrival of the European explorers, the Anishinabek (now known as the Ottawa) were located throughout the Great Lakes region, including Canada. The Little River Band of Ottawa Indians (LRBOI) is the political successor to nine of the nineteen historic bands of the Grand River Ottawa people. The Grand River Ottawa people traded, trapped, cultivated, gathered, and hunted throughout the region. They were riverine people, who used rivers for these activities as well as for traveling.

The permanent villages of the Grand River Bands, from which the Little River Ottawa people descended, were located on the Thornapple River, Grand River, White River, Pere Marquette River, and the Big and Little Manistee Rivers. The southern Grand River Bands had a close relationship with the Manistee and the Pere Marquette bands and shared winter hunting and trapping territories with the northern Grand River Bands.

During the 1820s and 1830s, a larger number of settlers originating from Europe began moving to the Michigan Territory. Eventually there were enough settlers that Michigan qualified for statehood. Territory leaders pressured the Ottawa people to convey or sell their land to allow for lumbering activities, settlement, and statehood. Although there were intense political pressures and difficult obstacles (reduced food supply and disease), the Ottawa people were protective of their native land and natural resources.

In 1821, federal officials invited the Potawatomi and Ottawa people to negotiate a Treaty to cede lands south of the Grand River. The majority of Ottawa refused to participate. An Ottawa leader, Kewaycooshkum, who did not have the authority to sell Ottawa land, attended the meeting. At this meeting, he signed the 1821 Treaty of Chicago, which sold all of the Ottawa land south of the Grand River. Although the Ottawa people did not accept this agreement and did not recognize it, federal and state officials surveyed and sold the lands to the new settlers.

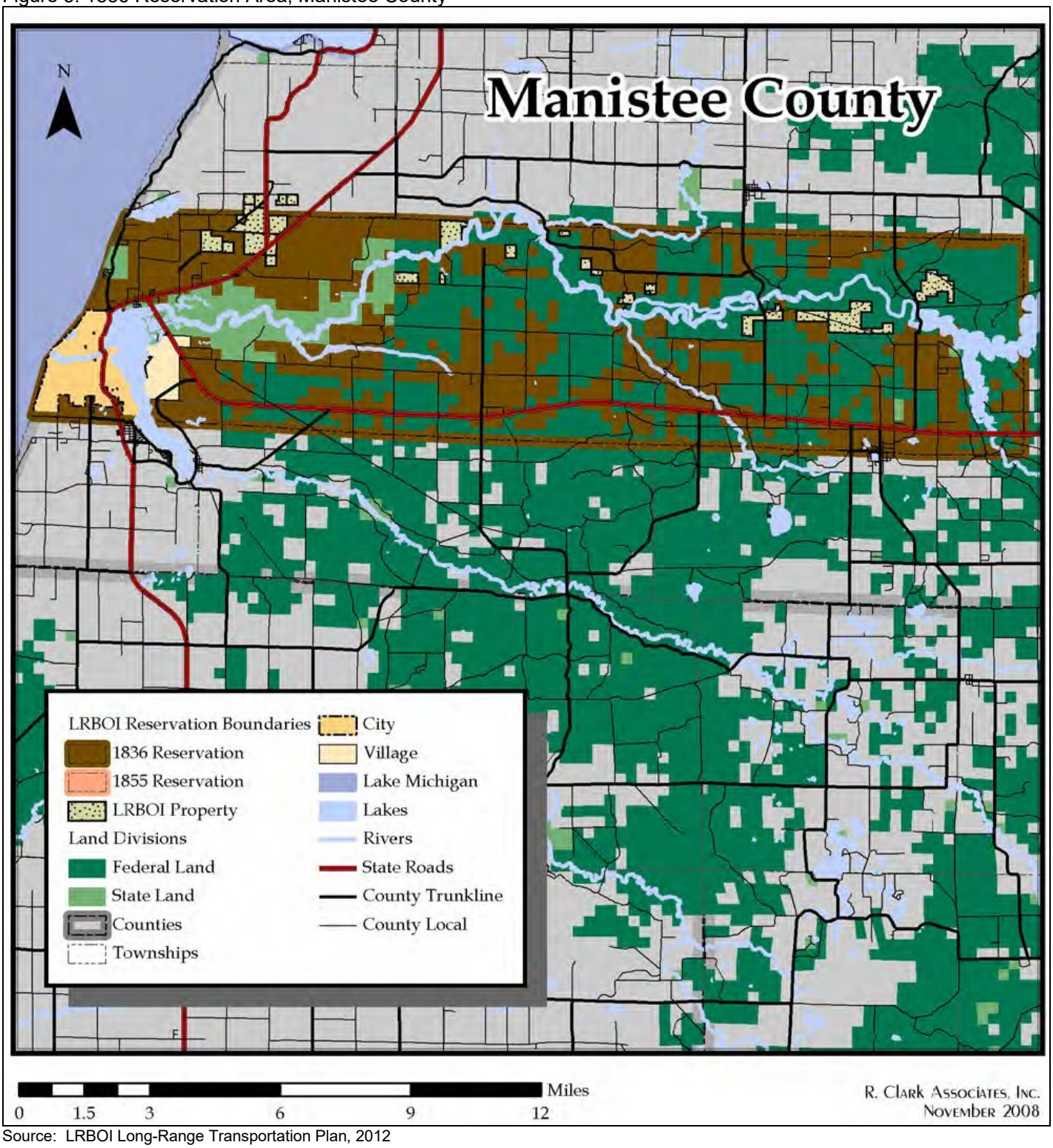
As the settlement population increase in 1830s, pressure was placed on the federal government to remove the Ottawa people from Michigan to a new reservation west of the Mississippi. The Ottawa people feared this displacement and refused to leave or sell their native Michigan land. Ottawa leaders were escorted from their home in Michigan to Washington D.C. to pressure them to sell the remaining Ottawa lands. Reluctantly, the Ottawa leaders agreed to sell most of their land to the United States in exchange for a 70,000-acre tract on the Manistee River. This area is now known as the Manistee Reservation [Figure 5]. The Ottawa leaders also reserved the right for "hunting and other usual privileges of occupancy," such as fishing, trapping, and gathering, in Article 13 of the 1836 Treaty. Unfortunately, after the Ottawa leaders returned to Michigan, they learned that members of the United States Senate had amended the 1836 Treaty to limit the length the Ottawa people could live on the Reservation to five years.

The federal government hoped to move the Grand River Ottawa people from Pere Marquette, Muskegon, and other southern river communities to the Manistee Reservation, away from the new settlers. They proposed blacksmith shops and other improvements to assist this movement.

Most of the members of the Grand River Band did not abandon their current homes along the Grand and Thornapple Rivers to move to a temporary home. Other than the Manistee Band, whose permanent villages were located on the Manistee Reservation, the southern Grand River Ottawa were only seasonal residents of the Reservation and used the area for trapping and hunting.

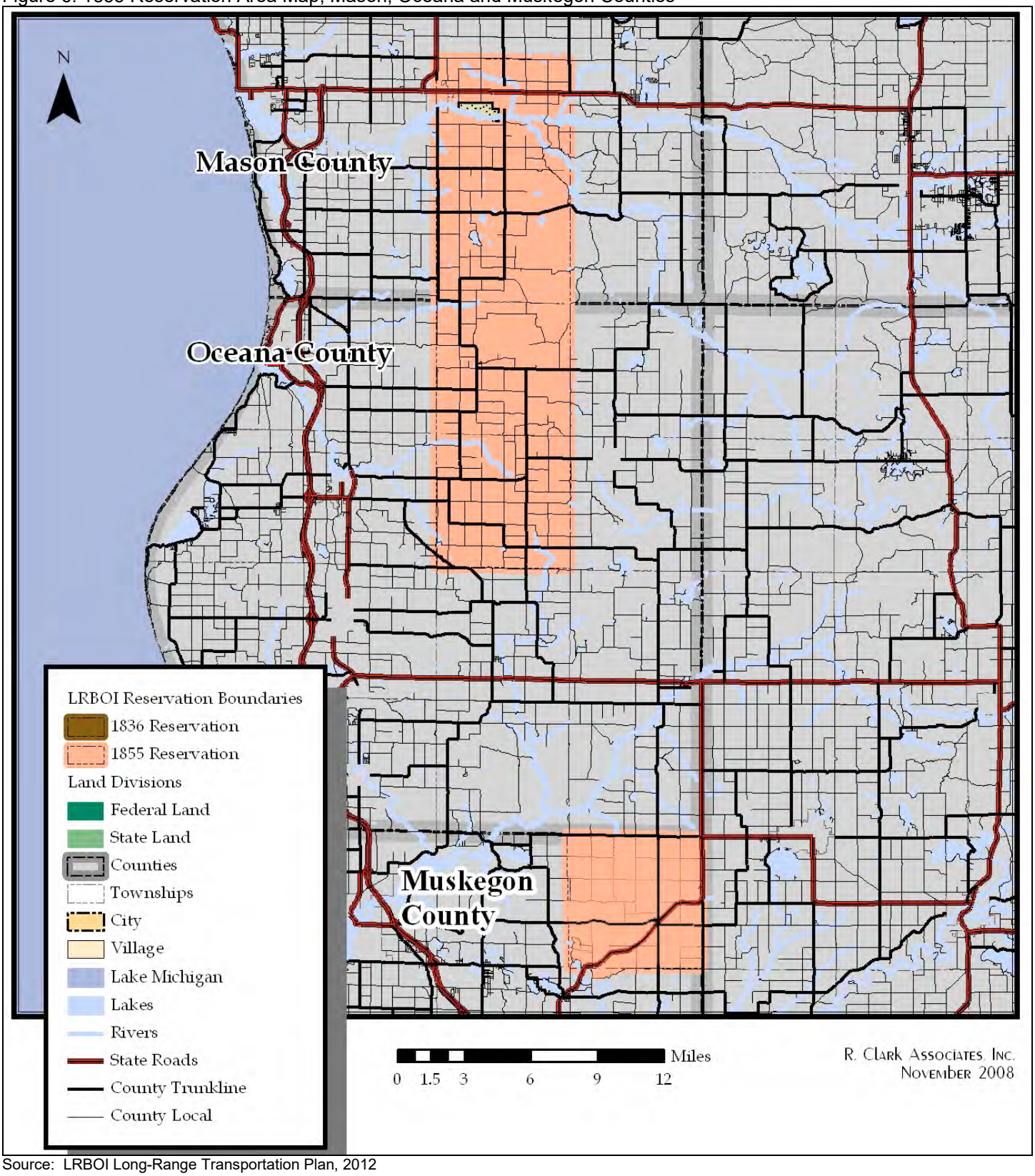
Under the 1855 Treaty of Detroit, many of the Grand River Band members were moved from their permanent villages to an 84,000-acre Reservation in Muskegon, Oceana, and Mason Counties [Figure 6]. The nine Grand River Bands, from which the Little River Ottawa are descended from, established a major settlement known as "Indian Town" on the Pere Marquette River, in Custer and Eden Townships in Mason County. The other ten Grand River Bands settled on the Pentwater River near modem-day Hart, in Oceana County.

Figure 5: 1836 Reservation Area, Manistee County



Source: LRBOI Long-Range Transportation Plan, 2012

Figure 6: 1855 Reservation Area Map, Mason, Oceana and Muskegon Counties



Source: LRBOI Long-Range Transportation Plan, 2012

Unfortunately, the Grand River Ottawa lost record title to the majority of their Reservation lands to fraud and theft. Special Homestead Laws were enacted by Congress to allow members of the Grand River Ottawa to acquire fee-restricted homestead lands. Many of the Little River Ottawa Bands from Indian Town established new settlements in Mason County at Fountain, Freesoil, and Ludington. A number of members also moved to the 1836 Reservation and established settlements along the Manistee River near Brethren and Wellston.

After a 120-year struggle, the Little River Band of Ottawa Indians was reaffirmed when President Clinton signed into law the Little Traverse Bay Band of Odawa and the Little River Band of Ottawa Indians Act, Pub. L. 103-324, 25 U.S.C. 1300k, on September 21, 1994. The Congressional findings set forth in Section 2 of the act confirm the fact the Little River Band and Little Traverse Bay Band are the political successors to signatory bands to the 1836 Treaty of Washington and the 1855 Treaty of Detroit. The Act also confirms the fact that the Little River Band "continued [its] political and social existence with [a] viable tribal government." Thus, it is clear that Congress' purpose in enacting Pub.L.103-324 was to "restore", not "recognize" the Little River Band of Ottawa Indians.

Geography and Natural Features

Northwest and west-central Michigan is blessed with abundant and high quality natural resources: the Lake Michigan coastline, extensive river systems, vast forested areas, high value wetlands, productive soils, and fresh-water lakes. Much of LRBOI's government, economic, and housing are centralized in Manistee County and therefore will be the focus of the land analysis.

Manistee County has 25 miles of Lake Michigan shoreline, including several State-regulated Critical Dune protection areas (Figure 7). It is estimated that there are 276 miles of rivers and streams in Manistee County, with an estimated 45 miles of state or federal wild/scenic/natural rivers. There are 9,600 acres of surface water in Manistee County, consisting in part of nine inland lakes each with a surface area greater than fifty acres. The importance of fresh water and water bodies for providing sustenance is immeasurable. One such resource is wild rice, or manoomin. "The word manoomin translates in Anishinaabemowin or Ojibwemowin, to 'the good berry,' a literal reflection of the cultural importance it has to Anishinaabek communities." Manoomin rice beds used to sit at the mouths of Michigan's rivers where it grows best in near-perfect shallow, slow moving waters. Some beds were thousands of acres in size. Today, only one large wild rice bed remains in Michigan.

The natural environment is one of the primary features of LRBOI culture and traditions. Its significance shows up in different aspects of daily life and Tribal celebrations and festivals. The forest lands, water features, and shorelines and all of the wildlife and vegetation within them are integral to the identity of the community. While natural resources are abundant they are vulnerable to all types of hazards. Northwest Lower Michigan is also home to many sensitive wildlife populations that require specific climates and habitats to survive. Damaged, destroyed, or changing environments may decrease the chances for certain species' survival. The LRBOI identifies the following big animals, fish, trees, and plants as critically/culturally important:

Animals

- Big game: deer, elk, bear, moose, and turkey
- Small game: squirrel (gray, black, fox, and red), rabbit (cottontail and snowshoe), ruffed grouse, ring-neck pheasant, woodchuck, porcupine, opossum, weasel, marten, skunk, ground squirrel, feral swine, feral pigeon, starling, house sparrow, raven, and crow.
- Other: beaver, muskrat, coyote, wolf, raccoon, bobcat, mink, and otter
- Migratory Birds: dove, snipes, ducks (all varieties), and geese

Fish

- Walleye, whitefish, salmon, trout, pan fish, sturgeon, bass, and pike

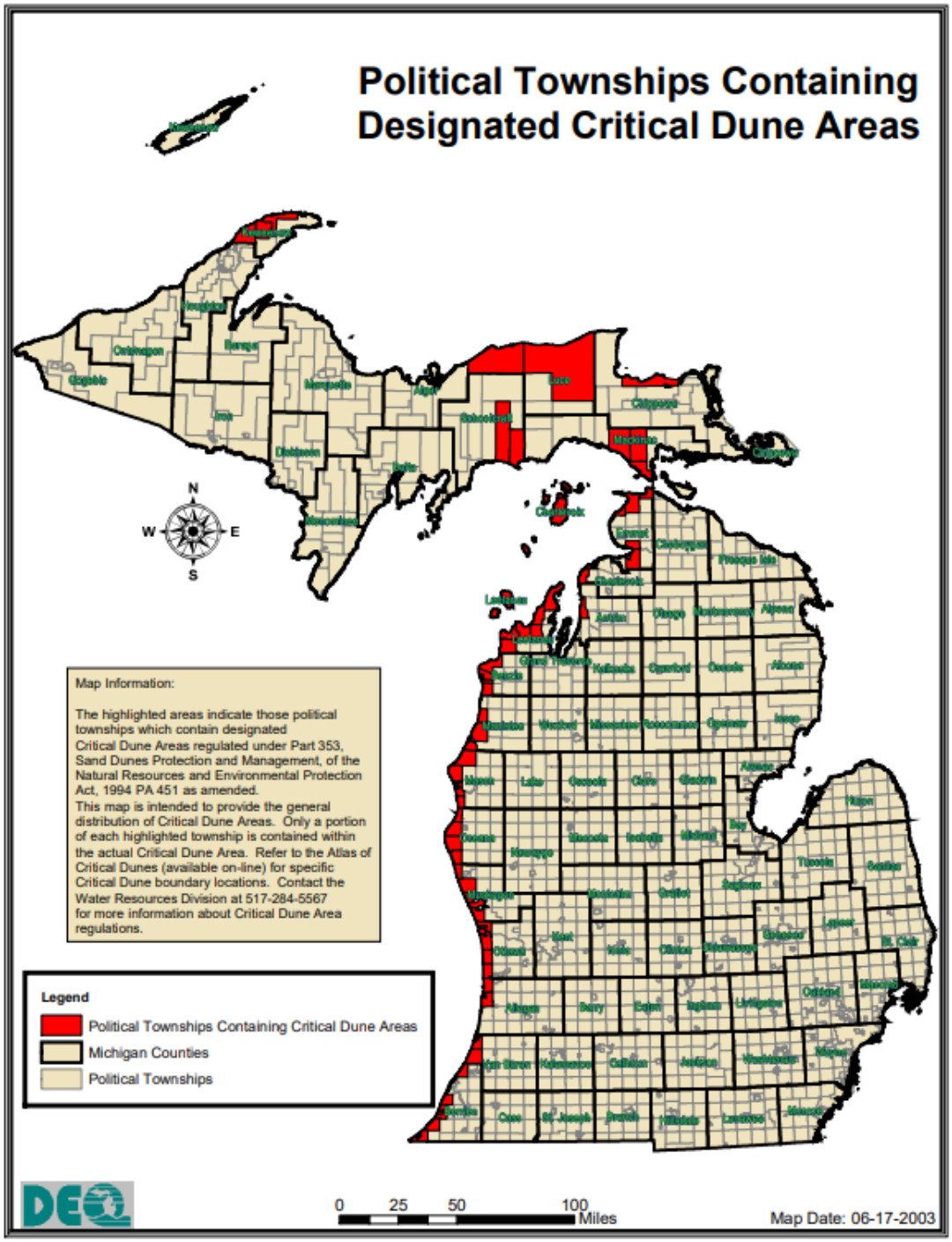
Trees

- Maple (for syrup production), birch, black ash, basswood, cedar, hemlock, and ironwood

Plants

- Manoomin (wild rice), tobacco, sweet grass, sage and cedar (found planted and/or in growing in the wild; utilized for sacred medicines)

Figure 7: Michigan Critical Dune Areas, 2003



Source: Michigan.gov/egle

The predominant land cover type in Manistee County is “Forested”, which covers over half of the county at 186,258.6 acres (Table 2). Most of the forested areas are on federally owned land in the Manistee National Forest.

The second most prevalent land cover type is “Shrub/Scrub” and “Herbaceous” at 14.29%, followed by wetlands at 13.57% (48,307.59 acres) (Table 2). These wetlands are primarily located along the Manistee River and the Manistee National Forest. Wetlands contribute significantly to water quality by acting as filters of storm water in addition to sustaining forest growth and providing habitat for wildlife. These areas generally are not suitable for development, but provide open space and recreational value as well as vital habitat for culturally significant animal and plant species.

Agriculture is the fourth largest type of land cover in the county. According to the 2017 USDA Census of Agriculture, there are 41,371 acres of farmland (274 total farms) in Manistee County. This represents a loss of 2,927 acres of farmland and 50 farms compared to what was reported in the 2012 Agriculture Census. The market value of products sold is

$10,325,000. Of the products sold, crop, especially grains, oilseeds, dry beans, and dry peas are the #1 selling product with $3,249,000 in sales. Forage (hay/hayage), corn for grain, tart cherries, corn for silage or greenchop, and apples composed the top five crops in acreage in the county. Manistee County ranks 54 out of 83 counties in the State of Michigan for the sale of agricultural crops (right behind Benzie County at 53).

Developed land cover is found predominantly in and around the villages and the City of Manistee.

Table 2: Land Cover by Type, Manistee County

Classification	Acres	Percent
Developed (High Intensity)	574.1	0.16%
Developed (Med. Intensity)	1,750.58	0.49%
Developed (Low Intensity)	6,882.43	1.93%
Developed (Open Space)	16,605.95	4.67%
Agriculture (Cultivated Crops and Hay/Pasture)	36,042.55	10.13%
Forested (Deciduous, Evergreen and Mixed)	186,258.60	52.34%
Wetlands	48,307.59	13.57%
Shrub/Scrub, Herbaceous	50,866.61	14.29%
Barren Land	1,507.12	0.42%
Open Water	7,080.00	1.99%
TOTAL	**355,875.53**	**100.00%**

Source: Networks Northwest

The 2015 Manistee County Hazard Mitigation Plan indicated that 235,300 acres, or 64.9%, of the county were forested lands, and 73,503 acres or 20.3% were wetlands. When comparing this data to current data, the amount of forested areas and wetlands have decreased. While development in the county has remained fairly steady in the past decade, it has been noted that the type of new development is changing. Office and industrial development has largely stopped, commercial development has slowed, but residential development is in high demand. This is also true for the LRBOI. Housing of all types and prices is needed, but many communities require smaller, lower maintenance units and more affordable units. This type of housing is especially important for the senior population and will likely be in demand for many years. The Environmental Features Map in Appendix A shows the intensity of development in the county as well as natural features.

Climate

Northwest Michigan experiences a four season climate with mild summers and cold, snowy winters. The LRBOI's coastal areas are set apart from inland areas. Lake Michigan keeps coastal areas warmer in the winter and cooler in the summer, with less rainfall than locations further inland. Since 1991, Manistee County has experienced the most precipitation in October with 3.91 inches on average and an average annual total precipitation of 35.54 inches. June and July share the hottest month with a mean average temperature of 92 °F, however, June has the highest temperature on record of 103 °F. February is the coldest month with a mean average temperature of -11 °F. The lowest temperature on record is -29 °F in February 2015.

On any given day, coastal areas including Manistee County, are highly susceptible to quick, sudden changes in the weather. Depending on the time of the year, the Great Lakes have a significant impact on temperatures, precipitation, and the strength of storms. In the spring when the lake water is colder than the air over them, they extract heat from the atmosphere. During the fall, the Great Lakes give off heat and moisture. In both cases, storms arrive on land stronger and more persistent than they might otherwise be. Thunderstorms, extreme winter weather events, and excessive rainfall are common natural hazards with the potential to cause loss of life and significant property damage. This plan identifies potential hazards and mitigation strategies to reduce the impact of those disasters.

Membership

Tribal membership is located throughout the nine-county region as shown in Table 3. Overall, the Tribe experienced a decrease of 100 persons, a 5.6% decrease, between 2010 and 2021. Muskegon County has the highest number of Tribal members followed by Manistee County; however membership in Muskegon County also saw the largest numeric decrease from 2010-2021. Kent County, which is the most populated county in the nine-county area and the location of the largest urban area, the City of Grand Rapids, has the third highest number of members. Mason County has the fourth highest membership population followed by Ottawa County, the southernmost county, west of Kent, has the fifth highest population. Oceana County has the sixth highest membership population and is one of only two counties with an increase in membership from 2010 to 2021. Oceana saw a 14% increase in membership; Lake County, the eighth highest in membership, saw a 13% increase in membership. Newaygo and Wexford, inland counties, have the seventh and ninth highest membership population, respectively. Wexford County also had the largest percentage decrease in membership.

Table 3: Membership Population Change by County, 2010, 2021

County	2010	2021	Numeric Change	Percentage Change
Muskegon	668	612	-56	-8.4%
Manistee	390	387	-3	-0.8%
Kent	283	250	-33	-11.7%
Mason	138	136	-2	-1.4%
Ottawa	114	104	-6	-11.8%
Oceana	71	83	-10	-8.8%
Newaygo	51	45	12	16.9%
Lake	33	38	5	15.2%
Wexford	31	24	-7	-22.6%
TOTAL	**1,779**	**1,679**	**-100**	**-5.6%**

Source: Little River Band of Ottawa Indians Membership Records

The membership's age is recorded in Table 4. The LRBOI's total 2010 and 2021 population is broken into age cohorts (analyzing which proportions of the population are in which stages of life). The membership age is broken down into cohorts of members aged 0-17, 18 to 54, and Elders, those aged 55 and over. The table identifies the number of members within each cohort for each county. Understanding the age distribution and median age can help identify social, economic, and public service needs in the community.

In the first two cohorts, ages 0-17 and 18-54, membership decreased in almost all counties. However, Lake County saw an increase in youth and went from 0 members aged 0-17 in 2010 to 5 members aged 0-17 in 2021. Ottawa County remained the same at 74 members aged 18-54 in 2010 and 2021. Oceana County saw an increase in members aged 18-54 and went from 48 members in 2010 to 53 members in 2021. There were no members aged 0-17 in Newaygo County in 2021. Every county had an increase in the Elder membership population from 2010 to 2021. About 38% of the total population is over age 55.

Table 4: LRBOI Membership by Age Cohort, County, 2010, 2021

County	Aged 0-17		Aged 18-54		Aged 55+		Total Population		% Aged 55+ in 2021
	2010	**2021**	**2010**	**2021**	**2010**	**2021**	**2010**	**2021**	
Muskegon	84	39	435	347	149	226	668	612	37%
Manistee	44	40	250	182	96	165	390	387	43%
Kent	37	16	189	157	57	77	283	250	31%
Mason	31	25	74	56	33	55	138	136	40%
Newaygo	2	0	31	15	18	30	51	45	67%
Ottawa	21	1	74	74	19	29	114	104	28%
Oceana	10	6	48	53	13	24	71	83	29%
Lake	0	5	22	17	11	16	33	38	42%
Wexford	2	1	23	11	6	12	31	24	50%
TOTAL	**231**	**133**	**1,146**	**912**	**402**	**634**	**1,779**	**1,679**	**38%**

Source: Little River Band of Ottawa Indians Membership Records

Other LRBOI demographic information can be collected from the U.S. Census Bureau, as shown in Figure 8. In 2020, population, employment, household, income, education, and health-related information was collected via the Decennial Census and the American Community Survey 5-Year Estimates for LRBOI Reservation and Off-Reservation Trust Land in Michigan. The 2020 Decennial Census indicates that the tribe contains 226 persons (Figure 8).

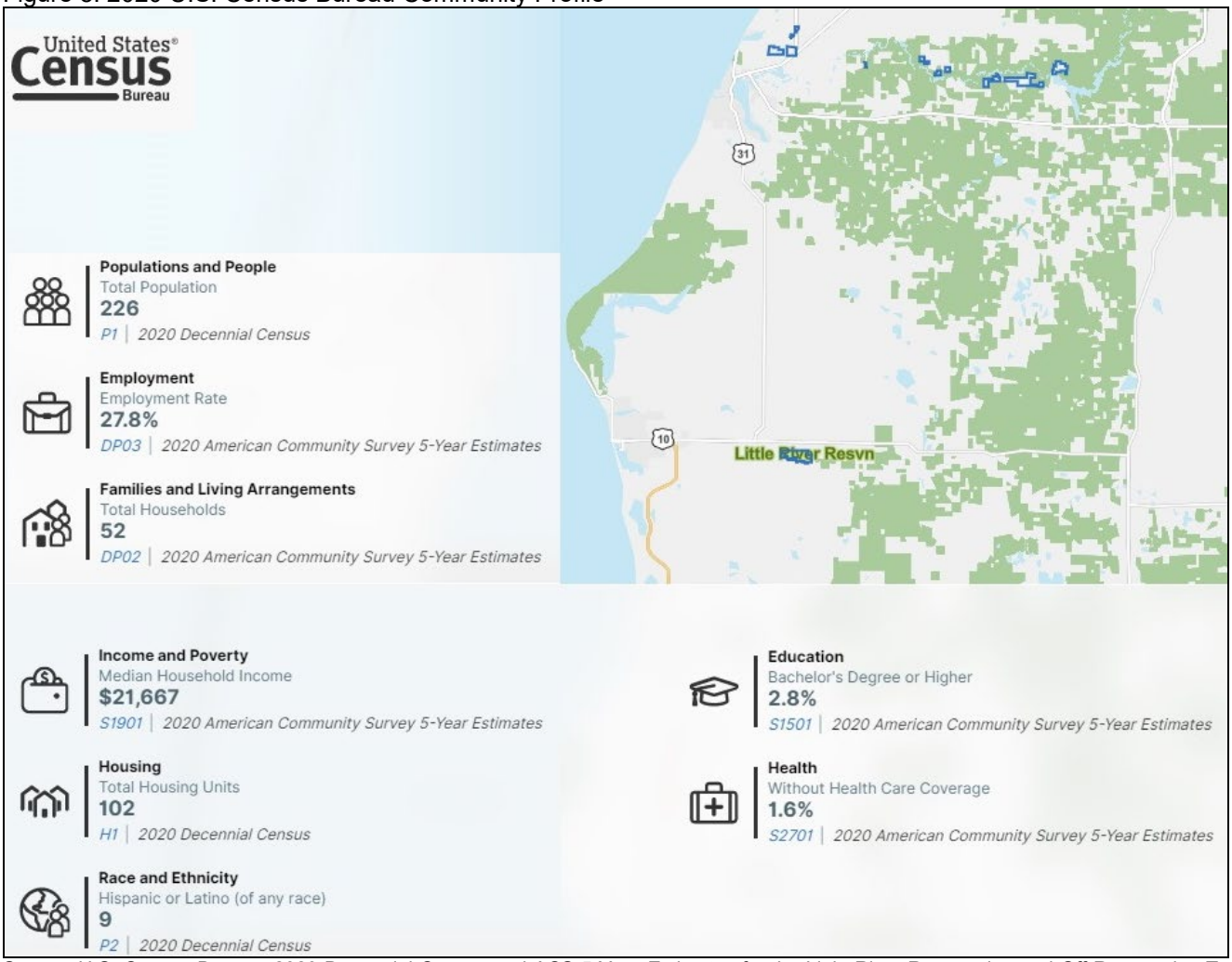
An estimated 39.2% of the LRBOI population has one or more type of disability. The majority of those persons are between 35 and 64 years of age, followed by those in the age 65+ cohort (Table 5).

Table 5. Estimated LRBOI Population with a Disability

Age Group	Total Estimated Population	Margin of Error	With a Disability	Margin of Error	% with a Disability	Margin of Error
Under 5 years	7	+/- 12	0	+/- 11	0.00%	+/- 100.00%
5 to 17 years	6	+/- 8	2	+/- 5	33.30%	+/- 58.40%
18 to 34 years	22	+/- 21	2	+/- 4	9.10%	+/- 17.00%
35 to 64 years	91	+/- 52	42	+/- 39	46.20%	+/- 25.70%
65 to 74 years	5	+/- 8	3	+/- 7	60.00%	+/- 59.60%
75 years +	17	+/- 20	9	+/- 10	52.90%	+/- 19.60%
Total	**148**	**+/- 69**	**58**	**+/- 43**	**39.20%**	**+/ -20.40%**

Source: US Census Bureau, 2021 ACS 5-year Estimates, Little Reservation and Off-Reservation Trust Land, MI

Figure 8: 2020 U.S. Census Bureau Community Profile



Source: U.S. Census Bureau, 2020 Decennial Census and ACS 5-Year Estimates for the Little River Reservation and Off-Reservation Trust Land, MI, an American Indian Area/Alaska Native Area/Hawaiian Home Land

Housing

According to the U.S. Census Bureau, in 2020 there were an estimated 102 housing units on LRBOI Reservation and Off-Reservation Trust Land in Michigan. Of these, 92 were occupied, 10 were vacant. 52 households were reported and the average household size was 2.37 persons. 71% of households reported living in a 1-unit structure while 29% reported living in a 2-or-more-unit structure. 92% of units were renter-occupied while 8% were owner-occupied. The Census defines a household as all the people who occupy a single housing unit, regardless of their relationship to one another.

For purposes of this planning process, a list of membership and residential addresses was provided. The list includes only those names and addresses who chose to make their information available. Table 6 represents a breakdown of the number of residential units by county. Similar to the membership totals, Muskegon County has the largest number of housing units (444 units) within the nine-county service area followed by Manistee County (245 units). Wexford County has the lowest number of units with 22 units.

Table 6: Membership Housing Units by County, 2019

County	2021 Member Housing Units	Percent of 2019 Total
Muskegon	444	36.9%
Manistee	245	20.4%
Kent	190	15.8%
Ottawa	89	7.4%
Mason	88	7.3%
Oceana	60	5.0%
Newaygo	41	3.4%
Lake	24	2.0%
Wexford	22	1.8%
TOTAL	**1,203**	

Source: Little River Band of Ottawa Indians Membership Records

Residential development for members continues to be a main priority for the Tribe. The LRBOI 2021 Strategic Plan includes the following objective for the Tribal Legislative Branch in "2025 and Beyond": "Work with Executive Branch and Housing Department to schedule and complete two (2) homes per year for Tribal Membership to occupy". New housing opportunities are being built at Aki Maadiziwin ("Aki") off of Dontz Road in Manistee County and at the Odeno subdivision in Fruitport Charter Township in Muskegon County. Aki contains 10 housing units for elders and 85 market rate or low-income housing units. New units will continue to be built at Aki, and the site will expand as needed for future growth. The Odeno development is taking place in two phases: Phase I has 96 single-family units, and Phase II has 68 single-family units. Table 7 indicates the number of housing permits issued from 2010-2019.

Table 7: LRBOI Housing Units by Permit, 2010-2019

Year	# of Permits
2010	6
2011	12
2012	4
2013	7
2014	0
2015	0
2016	2
2017	8
2018	2
2019	0
TOTAL	**41**

Source: Little River Band of Ottawa Indians Planning Department

The social-economic profile includes employment and income characteristics reported to the U.S. Census Bureau as shown in the following tables. Table 8 represents the occupations reported by the 32 LRBOI members who were employed at the time of the survey. The largest number of workers are employed in "Arts, entertainment, and recreation, and accommodation and food services" sector, followed by the "Transportation and warehousing, and utilities" sector.

Table 8: Occupation by Industry, 2020

Industry	Estimate	Percent
Transportation and warehousing, and utilities	11	34%
Educational services, and health care and social assistance	1	3%
Arts, entertainment, and recreation, and accommodation and food services	13	41%
Other services, except public administration	1	3%
Public administration	6	19%
TOTAL	**32**	

Source: U.S. Census 2020 ACS 5-Year Estimates

A total of 52 LRBOI households reported income and benefit information as shown in Table 9. The largest number of households reported an income of less than $10,000 (17 households or 33%) followed by those who reported an income level of $25,000 to $34,999 (14 households or 27%. According to the US Census Bureau's 2020 ACS 5-Year Estimates, 20% of *families* and 38% of *people* in the LRBOI community have income levels below the poverty line. The Census describes poverty thresholds differently based on the size of the family and the number of related children living together, as illustrated in Table 10.

Table 9: LRBOI Household Income, 2020

	Estimate	Percent
Less than $10,000	17	33%
$10,000 to $14,999	5	10%
$15,000 to $24,999	5	10%
$25,000 to $34,999	14	27%
$35,000 to $49,999	1	2%
$50,000 to $74,999	5	10%
$75,000 to $99,999	3	6%
$100,000 to $149,999	2	4%
$150,000 to $199,999	0	0%
$200,000 or more	0	0%
TOTAL	52	
Median household income	$ 21,667	

Source: U.S. Census 2020 ACS 5-Year Estimates

Table 10: 2019 Federal Poverty Level Guidelines

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

**For families/households with more than 8 persons, add $4,420 for each additional person.*

Transportation
The LRBOI service area is crossed by several national and state highways: U.S. 31 and state highways M-55, M-10, M-46, and M-37. U.S. 31 is a north-south route that follows the Lake Michigan coastline, and is a primary route for connecting the LRBOI community in Manistee to the community in Muskegon. It starts in the north near Mackinaw City and connects to Interstate 196 in Grand Rapids. M-55 is an east-west corridor which runs from Manistee in the west to Cadillac in the east. M-10 is an east-west corridor which runs from Ludington in the west and traverses the state to end in Bay City in the east. M-46, another east-west corridor, begins in the west at Muskegon and travels east across the state to Port Sanilac. M-37 is a north-south corridor which connects U.S. 31 at Traverse City to U.S. 131 at Grand Rapids in the south. Kent County is connected by many national and state highway routes including Interstate 96 and 196, U.S. 131, and M-6 and M-45. The remainder of the LRBOI service area is accessed via numerous county and forest roads. The area also contains many miles of seasonal roads with a number in Manistee County built and maintained by the U.S. Forest Service. The County Road Commissions are the primary owners of the local streets within township jurisdictions.

Rail access is available in the southern counties, Kent and Ottawa, where Amtrak operates Michigan train services from Grand Rapids and Holland to Chicago, Illinois. Major area airports include Manistee County Blacker Airport in Manistee, Muskegon County Airport in Muskegon, Gerald R. Ford International Airport in Grand Rapids, and West Michigan Regional Airport in Holland. Just to the north, in Traverse City is the Cherry Capital Airport. Ferry travel to Milwaukee, Wisconsin is also available from Muskegon via the Lake Express High-Speed Ferry.

Communications
Connected Nation Michigan (https://connectednation.org/statewide-impacts/connected-nation-michigan) provides an interactive mapping application that shows residential/business locations in Michigan Counties that are “unserved” (Less than 25 Mbps/3 Mbps) and “underserved” (>=25 Mbps/3 Mbps to less than 100 Mbps/20 Mbps). Many portions of Manistee County outside the urbanized areas are unserved/underserved for broadband access.

While the LRBOI does not have any communications towers on their properties, they utilize radio telemetry to monitor their water tower; wellhouse in Aki; seven sanitary sewer lift stations; blower garage at the wastewater treatment lagoon; and the main wastewater treatment plant. The LRBOI IT department also maintains wireless (internet-based) monitoring systems from the water tower to the main wastewater treatment plant.

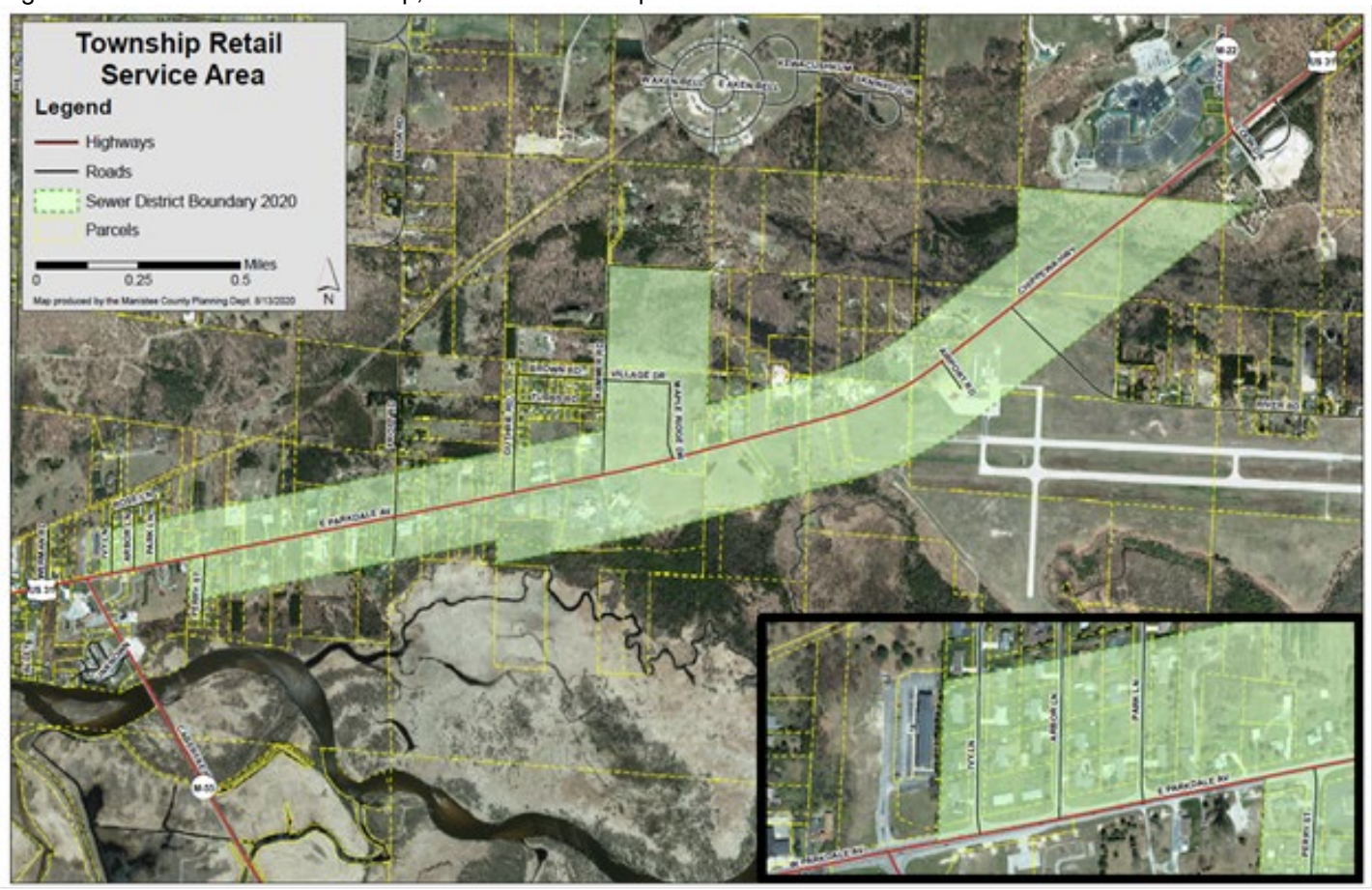
Utilities
According to the Michigan Public Service Commission, electric service in Manistee County is provided by Consumers Energy, Cherryland Electric Co-op, and Great Lakes Energy. Natural gas service is available in most of Manistee County from Superior, DTE Energy, or AmeriGas Eagle Propane. The communities of Brown, Cleon, Marilla, and Norman Townships and the Village of Copemish do not have natural gas utility service.

The LRBOI operates water and wastewater utility services in parts of Manistee Township and manages a septic sewage receiving station. The Utility Department, led by the Utility Director, was created to manage the water distribution and wastewater collection and treatment systems. LRBOI maintains a Sanitary Sewage Disposal Agreement with Manistee Township to provide wastewater services to parts of the township (Figure 9). LRBOI utilities are considered critical infrastructure, as indicated in Table 11. Recently, the Tribal Council expressed an interest in leveraging the successful self-managing wastewater system and exploring a similar expansion into renewable energy.

In 2019, by Council resolution the Utility Director and operations coordinator were appointed to the Midwest Tribal Energy Resources Association (MTERA) Board. This was done as a first step to prepare the Tribe to plan and develop Tribally-owned renewable projects. Through its MTERA membership, the project utility director started tracking the Tribe’s energy related utility bills, and launched an investment grade energy audit on the Tribe’s facilities. MTERA membership has also afforded the LRBOI the opportunity to network with other Tribal energy champions serving on the MTERA Board as well as throughout the United States.

The U.S. Department of Interior – Bureau of Indian Affairs’ Division of Energy and Mineral Development (DEMD) awarded a 2020 Solar Capacity grant to the Tribe, which builds on LRBOI’s investment grade energy audits that were conducted. These are the first major steps in developing a renewable energy (solar) microgrid that accomplishes the Tribal Council’s desire to increase sovereignty. This also enhances the Tribe’s resilience, increases economic development, and reduces the Tribe’s carbon footprint. The overarching objective of the solar capacity project is to identify the optimal renewable microgrid with battery and diesel generation back-up sources that could power LRBOI’s facilities on trust land during outages of Consumers Energy Company’s transmission and distribution system. The Solar Capacity study has been completed and site location and funding source need to be identified. The next step in electrical capacity exploration is via a Tribal Energy Development Capacity (TEDC) grant awarded by the DEMD for the completion of a Tribal Utility Feasibility Study, which will allow the LRBOI to identify what type of electrical utility best fits with their vision for the next seven generations.

Figure 9. LRBOI Sewer District Map, Manistee Township



Future Land Use

The following is an excerpt from the Vision Statement of the LRBOI 2005 Land Use Plan:

> "Lands in the 1836 and 1855 Reservations were used by our grandfather's grandfathers and will be used by our grandchildren's grandchildren. We have embraced our historical land use and environmental patterns and have applied them to the medicine wheel for land use planning. In twenty years, the Anishinabek people are viewed as successful land use custodians:
>
> We are the Ogimaniniwok and Ogimaniniikwek (leaders) in environmental stewardship, infrastructure management, service provisions, and cultural preservation. Our distinct philosophy in embracing the Medicine Wheel has been applied to these four land use components equally balanced.
>
> On the east side of the land use Medicine Wheel is the Waabinong (Environmental aspect), which is the protection of the Aki (Earth), the purity of air and water, and natural resource management. On the south side is Zhaawanong (Infrastructure), which are policies regarding how much is provided, where it is provided, what types are provided, and to whom it is provided. Epangishmok (Services) is on the west side and represent the programs that are offered directly or indirectly to our citizens. Completing the circle is the Kiiwedinong (Tribal Survival) on the north side, the items that give us our identity and existence: language, art, traditions, and culture. Every piece of land has each of these elements.
>
> Like the Medicine Wheel, all of the land uses are interconnected and complement each other. Development has been guided by the Medicine Wheel and was not solely driven by economics. Because development was planned using this approach, development costs were lower, more services were provided in an economical manner, and the natural resources were protected. Specifically, we have insured that:
>
> - Lands with fragile or sensitive natural characteristics, such as wetlands and wildlife habitat along the Manistee River and Pere Marquette River have been protected. Development was successfully integrated with

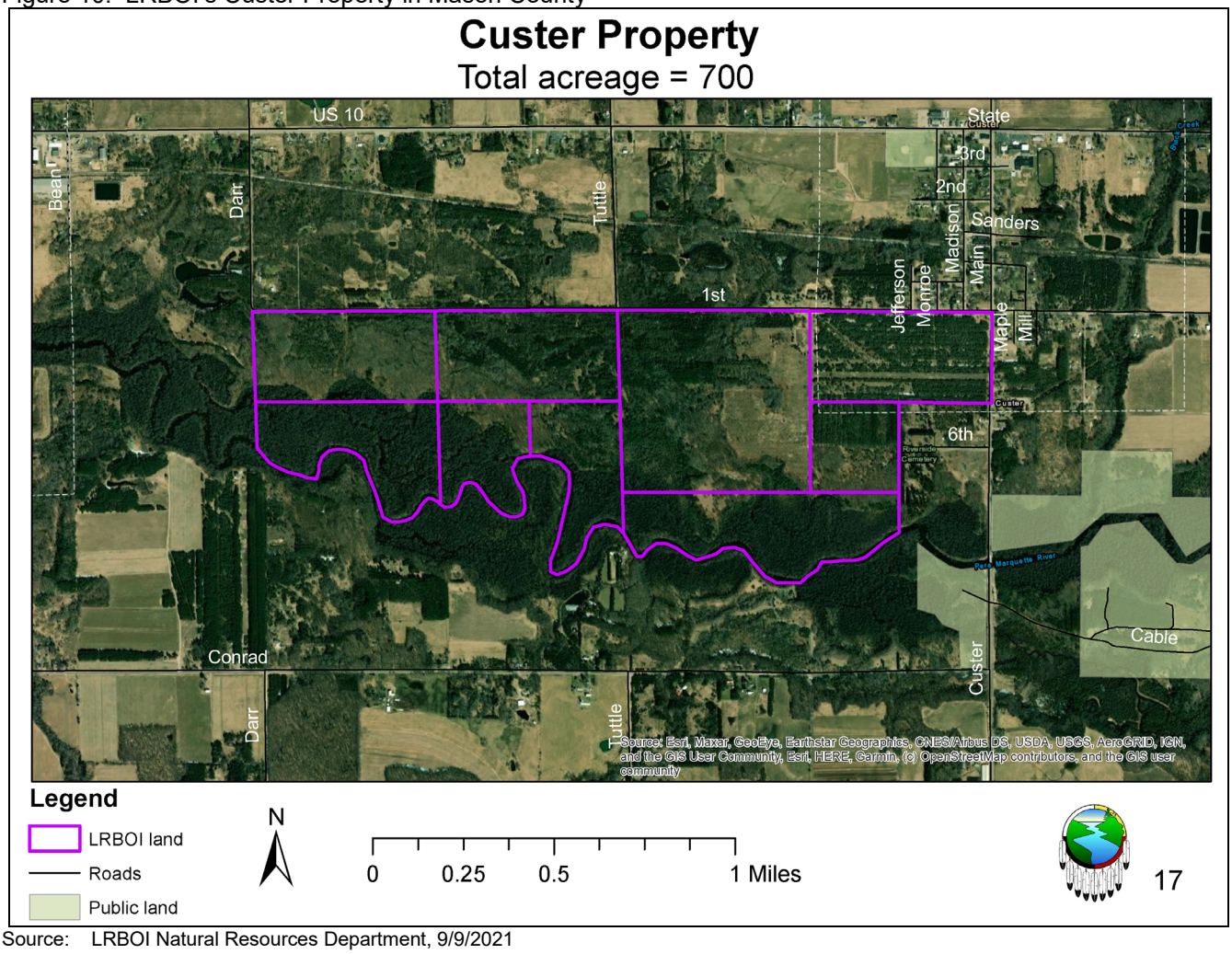
watershed and ecosystem management initiatives, animal and vegetation vitality, and Tribal member life-sustaining activities like fishing, gathering, and hunting.

- Like our ancestors, population areas were built in areas using nature as guidance. Buildings were placed where they would not be in conflict with the natural or cultural patterns. Buildings were designed to be integrated with nature, not separate. Careful infrastructure (water, sewer, and roads) planning helped guide and control where development occurred.
- These development patterns have created communities where services such as schools, hospitals, and cultural gathering areas are located near where people live. Land use planning has provided a nurturing family environment and made this a place where our membership enjoys living.
- People of all ages live here and are able to share in the culture, art, and traditions. The Anishinaabemowin, language of the Anishinabek, is spoken frequently here. Because this is a desired place, a majority of our membership lives here and keeps cultural education and preservation a priority. An important component of our cultural preservation is the use of natural resources for Tribal member life-sustaining activities. Stewardship of the natural resources has insured abundance for generations to come.

The 1836 and 1855 Reservations welcome the Seventh Generation with feelings of sustainability, community, and vitality to them and to Grandmother Earth. Our design and land use premises of our plan are based on their symbiotic relationships like the separate but touching parts of the Medicine Wheel. "…The four are interdependent, if one is ignored the others will suffer" (Jay Sam, Tribal member)."

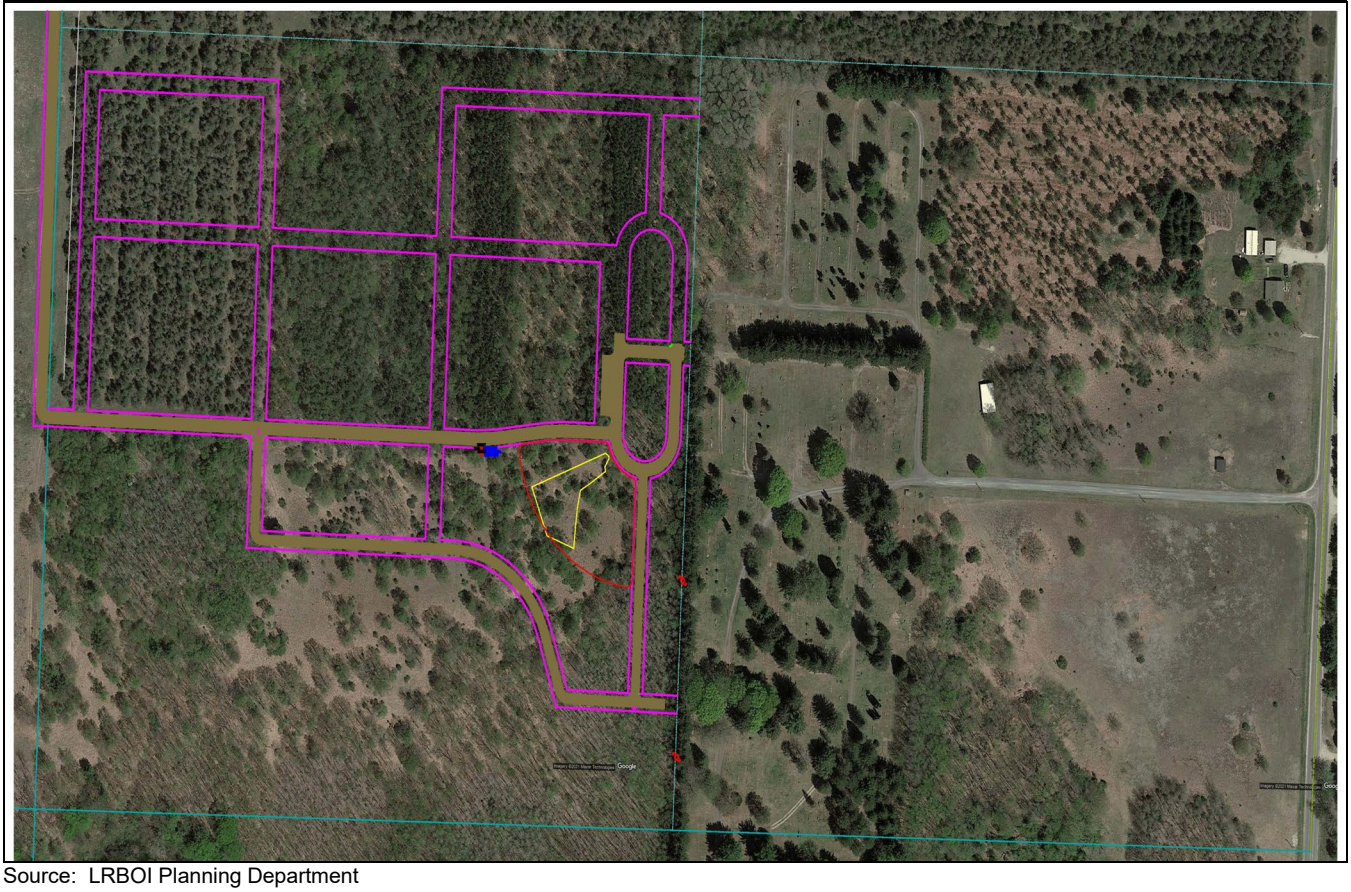
The 700 acre "Custer Property" that LRBOI owns in Mason County contains a large amount of vacant land. This is considered a culturally significant site and adjoins the Pere Marquette River to the north (Figure 10). The LRBOI plans to develop Phase 1 of a Tribal Cemetery on the property starting in 2023. Figure 11 is a conceptual phased site plan and Figure 12 is a partial road plan for the property.

Figure 10. LRBOI's Custer Property in Mason County



Source: LRBOI Natural Resources Department, 9/9/2021

Figures 11 and 12. Conceptual Site Plan and Road Plan for the Tribal Cemetery at the Custer Property



Source: LRBOI Planning Department

IV. Hazard Identification and Assessments

Vulnerability Assessment

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

Vulnerable populations include persons of racial/ethnic minority groups, the economically disadvantaged, elderly, homeless, and persons with a disability. Those that live unsheltered or in homeless encampments, assisted living facilities, mobile home parks, or isolated residences are also more susceptible to hazardous events. For the purpose of this Plan, the density of LRBOI tribal members by their residential address within Manistee County is presented in the "Vulnerable Populations" and "Vulnerable Populations and Hazard Areas" maps in Appendix A.

It is also important to note that northwest Michigan receives an influx of seasonal residents in the summer months. According to the 2022 report by Networks Northwest, *Seasonal Population Study for Northwest Lower Michigan*, the highest estimated monthly population (combined full-time, part-time and overnight visitors) within Manistee County occurs in August at 54,924 persons. This is more than double the estimated number of year-round residents (25,032 persons).

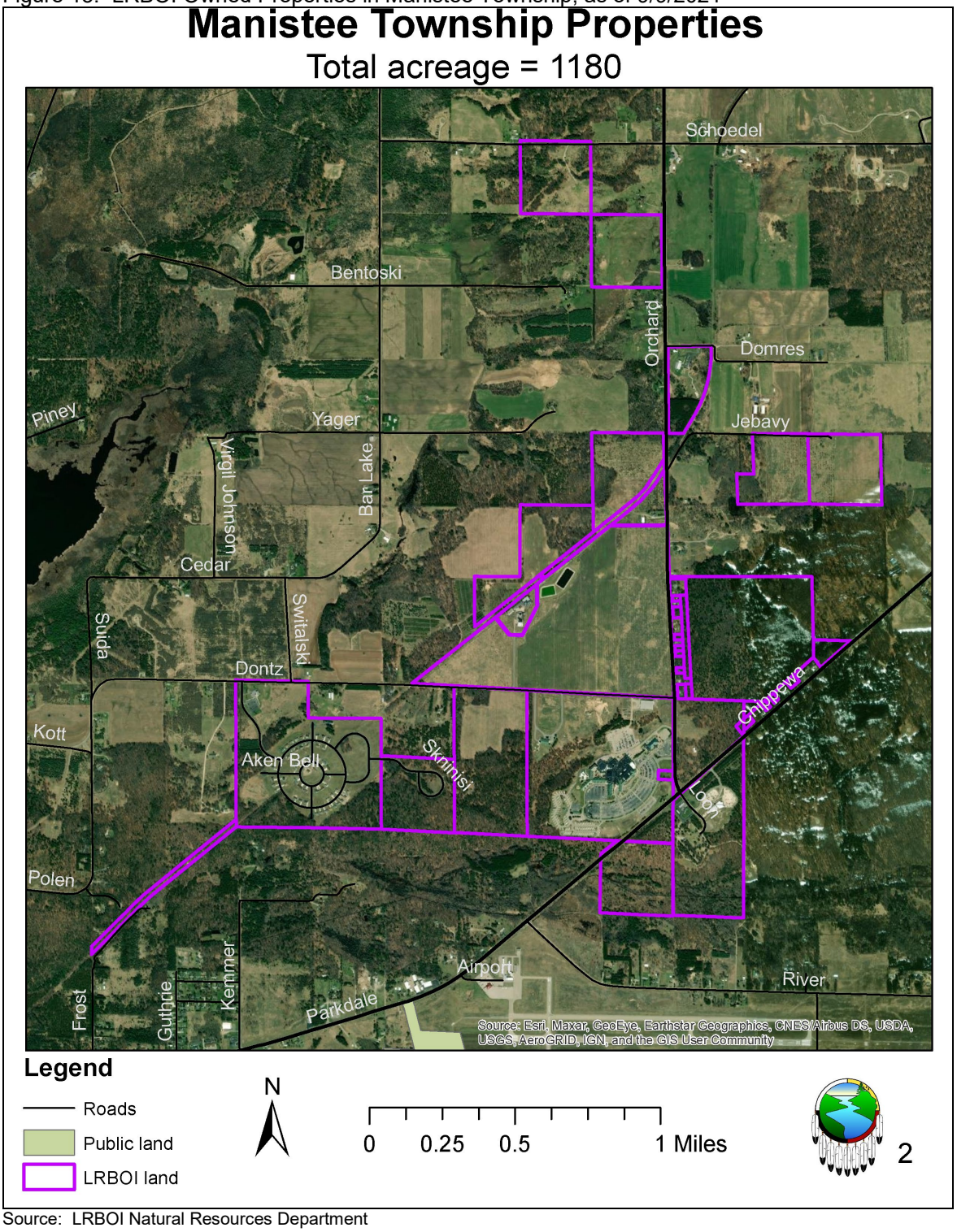
The primary economic generators for the LRBOI are Tribal government and the Little River Casino Resort. The Government Center and Casino are located within one mile of each other in addition to Tribal housing and other government facilities in Manistee County (see Figure 13). This concentration of population and resources within the built environment make this area critically important both economically and as a resource for community members. It is vulnerable to all countywide hazards which is further detailed in the hazard analysis. Infrastructure points (stream crossings, bridge conditions, and dams) and their ratings are mapped on the Infrastructure Map in Appendix A. LRBOI critical infrastructure sites are listed in Table 11. Task Force members identified the critical facilities and infrastructure and the points were mapped on the LRBOI Critical Infrastructure Map in Appendix A.

Table 11: LRBOI Critical Facilities and Infrastructure, Manistee County

LRBOI Critical Infrastructure	Facility Type	Sector	Street Address	Jurisdiction
Little River Casino Resort	Commerical	Commercial	2700 Orchard Hwy	Manistee Twp.
Little River Trading Post	Commerical	Commercial	2596 US 31	Manistee Twp.
Justice Center	Public Safety	Emergency Services	3031 Domres Rd	Manistee Twp.
Government Center	Government	Government Facility	2608 Government Center Dr	Manistee Twp.
Aki Community Center	Community Center	Government Facility	2953 Shaw Be Quo Ung	Manistee Twp.
Food Distribution Center	Government	Government Facility	2967 Dontz Rd	Manistee Twp.
"Big Blue" NR Storage	Government	Government Facility	159 Brickyard Rd	Village of Eastlake
Little River Holdings, LLC	Government	Government Facility	480 N Water St	City of Manistee
Tribal Campground	Government	Government Facility	2811 Chippewa Hwy	Manistee Twp.
Lagoon	Utility Service	Government Facility	2500 Dontz Rd	Manistee Twp.
Lift Station 1 - Meijer	Utility Service	Government Facility	550 E Parkdale	Manistee Twp.
Lift Station 2 - Sheriff	Utility Service	Government Facility	1607 E Parkdale	Manistee Twp.
Lift Station 3 - Casino	Utility Service	Government Facility	2700 Orchard Hwy	Manistee Twp.
Lift Station 4 - SBR	Utility Service	Government Facility	2539 Dontz Rd	Manistee Twp.
Lift Station 6 - Com Center	Utility Service	Government Facility	1575 Dontz Rd	Manistee Twp.
Lift Station 7 - Aki	Utility Service	Government Facility	2624 E Maw Gaw Ne Quong	Manistee Twp.
Water Tower	Utility Service	Government Facility	3031 Domres Rd	Manistee Twp.
Nme (Sturgeon) Streamside Rearing Facility	Government	Industry	7617 River Rd	Brown Twp.
Elder Apartment Complex	Residential	Residential	Ching Gawa She	Manistee Twp.
Aki Maadiziwin Housing	Residential	Residential	2593 Shaw Be Quo Ung	Manistee Twp.

Source: LRBOI Emergency Management

Figure 13. LRBOI Owned Properties in Manistee Township, as of 9/9/2021



Source: LRBOI Natural Resources Department

The available condition ratings for infrastructure points (stream crossings, bridges, and dams) in Manistee County, Wexford County, and the northern portions of Mason and Lake Counties are illustrated on the Infrastructure Map in Appendix A.

The natural environment is one of the primary features of LRBOI culture and traditions. Its significance shows up in different aspects of daily life and Tribal celebrations and festivals. The forest lands, water features, and Lake Michigan shorelines and all of the native plants and animals within them are integral to the identity of the community. While natural resources are abundant, they are vulnerable to all types of hazards. Northwest Lower Michigan is also home to many sensitive plant and animal populations that require specific climates and habitats to survive. Damaged, destroyed, or changing environments may decrease the chances for certain species' survival.

Hazard Analysis Overview

The LRBOI-owned lands and service area are vulnerable to a wide range of natural hazards. Hazard events have the potential to impact community residents and visitors, economic drivers in the community, critical infrastructure, the built environment, and the natural environment. LRBOI Emergency Management is challenged with managing these threats to protect life and property.

This plan includes a profile for each natural hazard event the LRBOI is likely to encounter. Since the greatest concentration of LRBOI property and assets is within Manistee County, the primary focus of the hazard analysis pertains to Manistee County, which is complemented with a more general analysis of historic events occurring in other counties in the LRBOI Tribe's service area. A snapshot of severe weather events for the entire Tribal service area is provided in Table 13. Descriptions of the location, extent, previous occurrences, probability of future events, and a vulnerability assessment are provided for each type of hazard, as described below:

- Location is the geographic areas within the planning area that are affected by the hazard, such as a floodplain. The entire planning area may be uniformly affected by some hazards, such as drought or a winter storm. Location may be described in narrative and/or through map illustrations.
- Extent is the strength or magnitude of the hazard. Extent can be described in a combination of ways depending on the hazard.
- Previous occurrences describe the history of previous hazard events within the county. This information helps estimate the likelihood of future events and predict potential impacts. The extent of historic events may be included when the data is available. This data is primarily collected from the National Oceanic and Atmospheric Administration's (NOAA) National Centers for Environmental Information (NCEI) Storm Events Database.
- Probability of future events is the likelihood of the hazard occurring in the future and any trends that may appear. Probability may be defined using historical frequencies or statistical probabilities.
- Vulnerability assessment accounts for the type, amount, and value of assets such as: existing and future buildings, infrastructure, critical facilities, populations, recreation areas and environmental features that may be impacted by a hazard, along with existing community assets to mitigate or respond to the hazard.

Data for natural hazard events in the LRBOI tribal service area was compiled from several different sources. Weather event data was collected primarily from the National Centers for Environmental Information through the National Oceanic and Atmospheric Administration's (NOAA) website. All sources include:

- FEMA's webpage on Disaster Declarations for States and Counties and the *Michigan Hazard Analysis*, completed by the Michigan State Police in 2019, were referenced for the most up-to-date data on Presidential-, Governor-, or Tribal-declared emergencies and disasters pertaining to Manistee County (Table 12).
- Climate: https://www.weather.gov/wrh/Climate?wfo=apx – Historical local observed weather data; Climate prediction and variability; local high impact event summaries
- Past Weather: NOAA Storm Events Database https://www.ncdc.noaa.gov/stormevents/ - Data available to search beginning in 1950 to within approximately 3 months prior to present day; however, information on record for various types of events is limited and non-contiguous. The database provides local storm reports, damage reports, and recorded event descriptions. The event types researched for the nine counties in the LRBOI tribal service area include the following (the event types in italics are as these types of events are listed in the Storm Events Database):
    - Dangerous Currents (i.e., *Rip Current*)
    - Fog (*Dense Fog*)
    - Drought (*Drought*)
    - Extreme Temperatures (*Cold/Wind Chill, Extreme Cold/Wind Chill, Heat, Excessive Heat)*
    - Severe Winter Weather (*Blizzard, Freezing Fog, Frost/Freeze, Heavy Snow, Ice Storm, Lake-Effect Snow, Sleet, Winter Storm, Winter Weather*)
    - Flooding *(Flash Flood, Flood*)
    - Hail (*Hail*)
    - Seiche (*Seiche*)
    - Shoreline Flood (*Lakeshore Flood*)
    - Thunderstorms and High Wind (*Heavy Rain, Lightning, High Wind, Strong Wind, ThunderstormWind*)
    - Tornado (*Tornado, Funnel Cloud, Waterspout*)
    - Wildfire (*Wildfire*)
- The *Michigan Hazard Analysis* was referenced to collect data on wildfires that occurred on State of Michigan owned land between 1981 and 2018 (as reported by the MDNR). Additionally, the 2021 USDA/USFS publication Spatial Wildfire Occurrence Data for the United States, 1992-2018 [FPA_FOD_20210617] was used to collect data on wildfires that occurred on state/private or federally-owned land within the county.

- The websites for the National Inventory of Dams and MI-EGLE's Michigan Dam Inventory were used to collect information on dams in the county.
- The websites Michigan Technological University's Dangerous Nearshore Current Dashboard; NOAA Storm Events Database; and NOAA Surf Zone Fatalities provide data on dangerous current-related fatalities and rescues on the Great Lakes.
- Historical drought data was obtained from the US Drought Monitor.
- The Historical Analysis of weather-related hazards in the LRBOI tribal service area uses information on impacts and losses from previous hazard events to predict potential impacts and losses during a similar future event. Based on the history and frequency of these events, communities are more likely to have experience with and data on impacts and losses. Table 12 lists emergency and disaster declarations at the federal, state and tribal governmental levels for the tribal service area. Affected areas indicated in bold, red font fall within the LRBOI tribal service area, and are included in the hazard analysis for individual event types.

Table 12: Presidential and Governor Declared Disasters or Emergencies

Declaration Date	Type of Incident	Affected Area	(P)residential Declaration* / Federal ID Number** (T) Tribal Declaration of State of Emergency (G)overnor's Declaration***
3/10/2020 3/27/2020	Pandemic	**All 83 counties / LRBOI Service area**	(P) Major Disaster, (T) Emergency, (G) Emergency
3/14/2019	Flooding	**Newaygo County**	(G) Emergency
2/7/2019	Severe Winter Weather	**City of Grand Rapids**	(G) Emergency
1/29/2019	Extreme Cold	**All 83 counties**	(G) Emergency
2/19/2018	Flooding	City of Grand Rapids and City of Lansing; Allegan, Arenac, Barry, Berrien, Cass, Clare, Eaton, Ingham, Ionia, Kalamazoo, **Kent**, **Newaygo**, Mecosta, Ogemaw, Oscoda, **Ottawa**, and St. Joseph Co.	(G) Disaster
4/12/2014	Flooding	Isabella, Mecosta, Missaukee, **Muskegon, Newaygo,** Osceola, Roscommon, and **Wexford Co.**	(G) Disaster
5/7/13 - 6/18/13	Flooding	Allegan, Baraga, Barry, Benzie, Genesee, Gogebic, Gratiot, Houghton, Ionia, Iron, **Kent**, Keweenaw, Marquette, Mecosta, Midland, **Muskegon**, **Newaygo**, Ontonagon, Osceola, **Ottawa** and Saginaw Co.; **City of Grand Rapids (Kent Co.)**; City of Ionia (Ionia Co.)	(G) Disaster
4/16/13-5/14/13	Flooding	16 counties: Allegan, Baraga, Barry, Gogebic, Houghton, Ionia, **Kent**, Keweenaw, Marquette, Midland, **Muskegon, Newaygo,** Ontonagon, Osceola, **Ottawa**, and Saginaw Co.	(P) Major Disaster (4121)
7/14/2008	Thunderstorms, flooding	12 counties: Allegan, Barry, Eaton, Ingham, **Lake, Manistee, Mason,** Missaukee, Osceola, **Ottawa**, Saginaw, and **Wexford Co.**	(P) Major Disaster (1777)
6/19/2008	Thunderstorms	**Lake, Manistee,** Osceola, **Ottawa, and Wexford Co.**	(G) Emergency
6/13/2008	Thunderstorms	City of Saginaw and City of Lansing (Ingham Co.); Allegan, Eaton, and **Mason Co.**	(G) Emergency
9/7/2005	Hurricane evacuation	**All 83 counties** (Michigan provided assistance to the states affected by Hurricane Katrina, including receiving and housing evacuees from those areas.)	(P) Emergency (3225)
9/4/2005	Hurricane evacuation		(G Disaster
5/20/04-6/8/04	Thunderstorms, flooding	23 counties: Barry, Berrien, Cass, Eaton, Genesee, Gladwin, Ingham, Ionia, Jackson, **Kent**, Livingston, Macomb, Mecosta, **Muskegon**, Oakland, **Ottawa**, Saginaw, Sanilac, Shiawassee, St. Clair, St. Joseph, Washtenaw, and Wayne Co.	(P) Major Disaster (1527)
6/3/2004	Thunderstorms, flooding	Arenac, Barry, Berrien, Cass, Genesee, Gladwin, Ingham, Ionia, Jackson, **Kent,** Livingston, Macomb, Mecosta, **Newaygo,** Oakland, **Ottawa,** Saginaw, St. Clair, St. Joseph, Sanilac, Shiawassee, Van Buren and Wayne Co.	(G) Disaster
12/11-31/00	Blizzard, snowstorm	39 counties: Allegan, Barry, Bay, Berrien, Branch, Calhoun, Cass, Clare, Clinton, Eaton, Genesee, Gladwin, Gratiot, Hillsdale, Huron, Ingham, Ionia, Isabella, Jackson, Kalamazoo, **Kent**, Lapeer, Livingston, Macomb, Mecosta, Midland, Montcalm, Muskegon, Oakland, Osceola, **Ottawa**, Saginaw, St. Clair, St. Joseph, Sanilac, Shiawassee, Tuscola, Van Buren, and Washtenaw Co.	(P) Emergency (3160)
1/2-15/99	Blizzard, snowstorm	31 counties: Alcona, Allegan, Arenac, Barry, Berrien, Cass, Crawford, Ionia, Iosco, Jackson, Kalamazoo, **Kent**, Lenawee, Macomb, Marquette, Mecosta, Monroe, Montmorency, **Muskegon, Newaygo,** Oakland, **Oceana**, Ogemaw, Osceola, Oscoda, Otsego, **Ottawa**, St. Joseph, Van Buren, Washtenaw, and Wayne Co.	(P) Emergency (3137)

6/3-5/1998	Thunderstorms, severe winds	Bay, Clinton, Gratiot, Ionia, **Kent, Mason,** Mecosta, Montcalm, **Muskegon, Newaygo, Oceana, Ottawa**, Saginaw, and Shiawassee Co.; Village of Armada (Macomb Co.)	(G) Disaster
5/31/1998	Thunderstorms, severe winds	13 counties: Bay, Clinton, Gratiot, Ionia, **Kent, Mason,** Montcalm, **Muskegon, Newaygo, Oceana, Ottawa**, Saginaw, and Shiawassee Co.	(P) Major Disaster (1226)
6/27/1997	Rainstorms, flooding	Allegan and **Ottawa Co.**	(G) Disaster
10/28/1986 **9/15/1986** **9/12/1986**	Flooding, heavy rain	Allegan, Arenac, Bay, Clare, Clinton, Genesee, Gladwin, Gratiot, Huron, Ionia, Isabella, **Kent, Lake,** Lapeer, Macomb, **Manistee, Mason,** Mecosta, Midland, Montcalm, **Muskegon, Newaygo, Oceana,** Osceola, **Ottawa,** Saginaw, Shiawassee, Tuscola, and Van Buren Co.	(G) Disaster
9/10-19/86	Flooding	30 counties: Allegan, Arenac, Bay, Clare, Clinton, Genesee, Gladwin, Gratiot, Huron, Ionia, Isabella, **Kent, Lake,** Lapeer, Macomb, **Manistee, Mason,** Mecosta, Midland, Montcalm, **Muskegon, Newaygo, Oceana,** Osceola, **Ottawa,** Saginaw, Sanilac, Shiawassee, Tuscola, and Van Buren Co.	(P) Major Disaster (774)
2/21/1986	Great Lakes flooding, wave action	Allegan, Arenac, Bay, Berrien, Grand Traverse, Iosco, Macomb, Marquette, Menominee, Monroe, **Muskegon, Ottawa**, Saginaw, St. Clair, Tuscola, Van Buren, and Wayne Co.	(G) Disaster
7/21/1980	Thunderstorms, severe winds	Allegan, Berrien, Calhoun, Cass, Jackson, St. Joseph, Van Buren, Washtenaw, and Wayne Co.; **City of Grand Haven and Village of Spring Lake (Ottawa Co.)**	(G) Disaster
7/15-20/80	Severe winds	10 counties: Allegan, Berrien, Calhoun, Cass, Jackson, **Ottawa**, St. Joseph, Van Buren, Washtenaw, and Wayne Co.	(P) Major Disaster (631)
1/26-27/78	Blizzard, snowstorm	**Statewide**	(P) Emergency (3057)
1/26/1978	Blizzard, snowstorm	**Statewide**	(G) Disaster
3/2/1977	Drought	44 counties: Alcona, Alger, Alpena, Antrim, Arenac, Baraga, Benzie, Charlevoix, Cheboygan, Chippewa, Clare, Crawford, Delta, Dickinson, Emmet, Gladwin, Gogebic, Grand Traverse, Houghton, Iosco, Iron, Isabella, Kalkaska, **Lake**, Leelanau, Luce, Mackinac, **Manistee,** Marquette, **Mason**, Mecosta, Menominee, Missaukee, Montmorency, **Oceana**, Ogemaw, Ontonagon, Osceola, Oscoda, Otsego, Presque Isle, Roscommon, Schoolcraft, and **Wexford Co**.	(P) Emergency (3035)
1/26-31/77	Blizzard, snowstorm	15 counties: Allegan, Barry, Berrien, Cass, Chippewa, Hillsdale, Kalamazoo, **Kent**, Monroe, **Muskegon, Newaygo, Oceana, Ottawa**, St. Joseph, and Van Buren Co.	(P) Emergency (3030)
1/28/1977	Blizzard	Allegan, Barry, Berrien, Cass, Chippewa, Eaton, Hillsdale, Ionia, **Muskegon, Newaygo, Oceana, Ottawa**, Sanilac, Shiawassee, and Van Buren Co.	(G) Disaster
3/20/76, 3/2-7/76	Ice storm, tornadoes	29 counties: Allegan, Bay, Clare, Clinton, Genesee, Gladwin, Gratiot, Ionia, Isabella, Jackson, **Kent**, Lapeer, Macomb, Mecosta, Midland, Montcalm, **Muskegon, Newaygo,** Oakland, **Oceana,** Osceola, **Ottawa,** Roscommon, Saginaw, St. Clair, Sanilac, Shiawassee, Tuscola, and Wayne Co.	(P) Major Disaster (495)
8/20/75-9/6/75	Rainstorms, severe winds, flooding	16 counties: Allegan, Clare, Genesee, Gratiot, Ingham, Isabella, Mecosta, Midland, Montcalm, **Muskegon, Newaygo, Oceana**, Osceola, **Ottawa**, Saginaw, and Shiawassee Co.	(P) Major Disaster (486)
4/18-30/75	Flooding, rain, tornadoes	21 counties: Allegan, Barry, Berrien, Calhoun, Clinton, Crawford, Eaton, Genesee, Ingham, Ionia, Kalamazoo, **Kent,** Lapeer, Livingston, Macomb, Oakland, **Ottawa**, Saginaw, St. Clair, Shiawassee, and Van Buren Co.	(P) Major Disaster (465)
4/11/1965	Tornadoes, severe storms	16 counties: Allegan, Barry, Bay, Branch, Clinton, Eaton, Gratiot, Hillsdale, Kalamazoo, **Kent,** Lenawee, Monroe, Montcalm, **Ottawa,** Shiawassee, and Washtenaw Co.	(P) Major Disaster (190)
4/5/1956	Tornado	4 counties: Benzie, Leelanau, **Manistee, and Ottawa Co.**	(P) Major Disaster (53)

Notes

***Does not include separate Secretary of Agriculture or Small Business Administration (SBA) disaster declarations, which are issued under other authorities. Declarations after 1974 were issued under PL 93-288 (Disaster Relief Act), as amended by the Robert T. Stafford Disaster Relief and Emergency Assistance Act (1988) and the Disaster Mitigation Act (2000).**

****Indicates federal declaration number assigned by FEMA or its predecessor agencies**

*****Declarations since 1977 were issued under 1976 PA 390, as amended (Michigan Emergency Management Act).**

Sources: FEMA https://www.fema.gov/data-visualization/disaster-declarations-states-and-counties and Michigan State Police 2019 Michigan Hazard Analysis (MHA) pub. 103; LRBOI Department of Emergency Management

The NOAA-NCEI Storm Events Database is updated on a rolling basis, and thus the database is always being added to. The database indicates that 226 events were reported for Manistee County between 01/01/1950 and 12/31/2022 (26,663 days). There were a total of 187 days with an event, 3 days with an event and death or injury, 34 days with an event and property damage, and 2 days with an event and crop damage. Those events, as well as the emergency/disaster declaration events, are included in the hazard analysis. It is important to note when viewing the data that many of the events were recorded after the mid-1990's, even though the available search range dates back to 1950. Table 13 provides a summary of all hazard events in Manistee County.

Table 13: Summary of Hazard Events for Manistee County

Type of Event	# of Events	Event Location	Time Interval/ Year Event Recorded
Wildfire	54 / 75	MDNR Lands / Federal Lands	1981-2018 / 1994-2017
Severe Winter Weather (i.e. Ice storm, Heavy Snow, Blizzard)	104	Countywide	*1978, 1997-2016, 2018-2022
Thunderstorms and High Winds	65	Countywide	1964, 1966, 1973, 1975, 1980, 1985, 1987, 1989, 1991, 1997-2003, 2005-2013, 2015, 2017-2019, 2021
Hail	35	Countywide	1973, 1985, 1998-2000, 2003-2005, 2006, 2008, 2011, 2012, 2017, 2019, 2020-2022
Riverine and Urban Flooding	11	Arcadia Township, Onekama Township, Manistee Township, Filer Township, City of Manistee, Marilla Township, Dickson Township, Brown Township, and Stronach Township	*1986, 2000, 2001, 2005, *2008, 2011, 2019
Shoreline Hazard (Lakeshore Flood)	4	Arcadia Township, Onekama Township, Manistee Township, Filer Township, City of Manistee	2019 (2), 2020 (2)
Extreme Temperatures (Heat / Cold)	2 / 3	Countywide	2001, 2018 / 2007, 2014, *2019
Shoreline Hazards (Dangerous Currents)	2	City of Manistee	2007, 2009
Lightning	2	Countywide	2000, 2016
Tornado	2	Onekama Township, Bear Lake Township, Pleasanton Township; Stronach Township	*1956; 2008
Dense Fog	1	Countywide	2010
Drought	1	Countywide	*1977
Public Health Emergency	1	Tribal, State, and National Declarations	*2020
Invasive Species		Countywide	Ongoing
Shoreline Hazards (Waterspout, Seiche)	0	City of Manistee, Village of Eastlake, Filer Charter Township, Manistee Township, Onekama Township, Village of Onekema, Arcadia Township	-
Subsidence	0	Countywide	-

Sources: NOAA NCEI Storm Events Database; MDNR; USFS/USDA; Michigan State Police-Dept. of Homeland Security; FEMA; NWS Great Lakes Current Incident database. Note: * indicates a state or federal declaration of an emergency or disaster

Table 14 provides a summary of all natural hazard events in the nine county LRBOI service area. Thunderstorm/wind and high winds are the most commonly occurring natural hazard type event, followed by severe winter weather, hail, inland flooding, and tornados. Based on frequency of events, some areas of the region are more susceptible to certain hazards. For example, Kent County and Ottawa County have had the most tornadoes (38 and 23, respectively) of all of the counties, and therefore, it can be expected that a tornado is more likely to occur in those counties. Also, dangerous current incidents have occurred most often along the Lake Michigan shoreline in Ottawa County.

Table 14: Natural Hazard Events, 1950-2022, LRBOI Service Area

	Kent	Lake	Manistee	Mason	Muskegon	Newaygo	Oceana	Ottawa	Wexford	Total Events
High Wind/T-Storm Wind	270	81	65	88	161	103	71	194	70	**1,103**
Severe Winter Weather	113	89	104	120	128	91	125	153	77	**1,000**
Hail	132	18	35	22	63	50	39	93	33	**485**
Inland Flooding	29	10	11	15	18	17	11	25	11	**147**
Tornado	38	4	2	5	8	13	5	23	8	**106**
Dangerous Current			2	11	13		3	44		**73**
Extreme Cold	2	1	3	1	1	2	1	1	3	**15**
Lightning	3		2		1	1		3	1	**11**
Extreme Heat	1		2			1			2	**6**
Lake MI Coastal Flooding/Erosion			4		1			1		**6**
Drought		1	1				1		2	**5**
Waterspout					1					**1**
Seiche					1					**1**
Dense Fog			1							**1**
Wildfire*										**0**
Subsidence										**0**
Total Events	**588**	**204**	**232**	**262**	**396**	**278**	**256**	**537**	**207**	**2,960**

Sources: NOAA NCEI Storm Events Database; Michigan State Police-Dept. of Homeland Security; FEMA; Great Lakes Current Incident Database. *Note: only wildfires reported as events in the NOAA Storm Events database; not those reported by the MDNR or USFS.

Table 15 presents the *reported* deaths, injuries, property damages, and crop damages from hazard events in Manistee County from 1950-2022. There have been 94 deaths, 2 rescues and 3,531 illnesses, which were mostly related to the COVID-19 pandemic. The economic impact of NOAA-recorded hazard events for Manistee County is $6,779,000 in property damages and $10,035,000 in crop damages. It should be noted that many events likely cause numerous small amounts of property damage, but these often go unreported.

Table 15: Extent of Damage by Event Type, Manistee County

Event	Deaths	Rescue, Injury, Illness	Property Damages	Crop Damages
Severe Winter Weather	0		$350,000	$10,000,000
Thunderstorm and High Wind	2		$645,500	$0
Riverine and Urban Flooding	0		$5,020,000	$0
Lakeshore Flooding	0		$499,000	$0
Tornado	0		$265,000	$0
Hail	0		$0	$35,000
Extreme Temperatures (Heat or Cold)	0		$0	$0
Lightning	1		$0	$0
Wildfire	0		$	$
Rip Current or Structural Current	1	2	$0	$0
Dense Fog	1 (indirect)		$0	$0
Public Health Emergency (COVID-19 Pandemic)	89*	3,529*	N/A	N/A
Invasive Species	N/A		N/A	N/A
Subsidence	0	0	$0	$0
TOTAL	**94**	**3,531**	**$6,779,000**	**$10,035,000**

Sources: NOAA's National Centers for Environmental Information; NWS Great Lakes Beach Hazards Incident Statistics; *State of Michigan https://www.michigan.gov/coronavirus/stats, reported confirmed deaths and cases in Manistee County as of December 31, 2022.

Severe Winter Weather

The National Weather Service defines a winter weather event as: *a winter weather phenomenon (such as snow, sleet, ice, wind chill) that impacts public safety, transportation, and/or commerce. It typically occurs during the climatological winter season between October 15 and April 15.* The Extreme Winter Weather category in this Plan's hazard analysis includes the following subcategories: winter weather, winter storm, ice storm, heavy snow, blizzard, frost/freeze, and lake effect snow. Blizzards are the most perilous snowstorms and are characterized by low temperatures, strong winds, and enormous amounts of fine, powdery snow. Snowstorms have the potential to reduce visibility, cause property damage, and loss of life.

According to the 2019 Michigan Hazard Analysis, the 29 counties of the Northern Lower Peninsula of Michigan have an annual average of 79 snowstorm events, with 0 average annual deaths or injuries, $6.53 million in average annual property damage and $20 million in crop damage. Michigan experiences large differences in snowfall over short distances due to the Great Lakes. The average annual snowfall accumulation ranges from 30 to 200 inches with the highest accumulations in the northern and western parts of the Upper Peninsula. In Lower Michigan, the highest snowfall accumulations occur near Lake Michigan and in the higher elevations of northern Lower Michigan. For example, the average snowfall ranges from 141 inches in the Gaylord area to 101 inches in Traverse City.

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

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

Location

Severe winter weather events are regional events that are not confined to geographic boundaries and can affect several areas at one time with varying severity depending on factors such as elevation and wind patterns. All LRBOI lands are at risk from extreme winter weather hazards. The counties of Manistee, Mason, Muskegon, Oceana, and Ottawa adjoin Lake Michigan, and are therefore more susceptible to lake-effect snow events than other inland counties (see Table 19 for number of recorded lake effect snow events by county).

Extent

Snowstorms can be measured based on snowfall accumulations or damages. Severe winter weather events in the LRBOI service area have resulted in a total of $16.633 million in property damages and $10,000,000 in crop damages between 1996 and 2022 (Table 16). Kent County has the greatest amount of property damages ($6.15 million), followed by Ottawa County ($3.85 million), Muskegon County ($2.3 million), Newaygo County (1.325 million), Oceana County ($1.3 million), and Lake County ($725,000). Manistee, Mason and Wexford have the lowest amount of property damages associated with severe winter weather events, ranging from $283,000 to $350,000 each. All reported crop damages are associated with a frost/freeze event in April 2012 that affected fruit trees in Manistee County. There are no reported deaths or injuries associated with these events.

Previous Occurrences

Table 16. Severe Winter Weather Events in LRBOI Service Area, by County

	Kent	Lake	Manistee	Mason	Muskegon	Newaygo	Oceana	Ottawa	Wexford	Total
Winter Storm	43	37	51	46	41	36	41	52	41	388
Heavy Snow	27	21	30	29	35	22	31	38	23	256
Lake-Effect Snow	15	12	9	25	25	11	27	36	2	162
Winter Weather	13	12	1	12	12	12	13	11	1	87
Blizzard	8	5	7	6	10	5	8	9	5	63
Ice Storm	6	1	5	1	4	4	4	6	5	36
Sleet	1	1	0	1	1	1	1	1	0	7
Frost/Freeze	0	0	1	0	0	0	0	0	0	1
Total Events	**113**	**89**	**104**	**120**	**128**	**91**	**125**	**153**	**77**	**1,000**
Property Damages	$6.15 M	$725K	$350K	$350K	$2.3 M	$1.325 M	$1.3 M	$3.85 M	$283K	**$16.633M**
Crop Damages	$0	$0	$10M	$0	$0	$0	$0	$0	$0	**$10M**
Deaths	0	0	0	0	0	0	0	0	0	**0**
Injuries	0	0	0	0	0	0	0	0	0	**0**

Sources: NOAA NCEI Storm Events Database; MSP's *2019 Michigan Hazard Analysis*

Total number of events include: March 1976 ice storm, Presidential Major Disaster for Kent, Muskegon, Newaygo, Oceana, and Ottawa; January 1977 blizzard Governor Disaster for Muskegon, Newaygo, Oceana, and Ottawa counties and Presidential Emergency Blizzard/Snowstorm Kent, Muskegon, Newaygo, Oceana and Ottawa counties; and the January 1978 blizzard/snowstorm resulting in a Governor-declared Disaster and Presidential-declared Emergency for the entire state of Michigan.

There have been 1,000 severe winter weather events reported within the LRBOI tribal service area, including heavy snow, ice storms, frost/freeze, sleet, blizzards, winter weather, and winter storms (Table 16). These include four blizzard and/or snowstorm events that have resulted in Presidential or Governor declared emergencies or disasters (January 1977, January 1978, January 1999, and December 2000. In recent years, the more common events are winter storms with moderate snowfall of 5-10 inches. Heavy snow, blizzards, and lake-effect snows have been less common. Nonetheless, extreme winter weather events are the most frequent recorded event with the potential to impact the entire county and cause widespread damage. With combined property and crop damages, winter weather events are also the most costly events to occur in the LRBOI tribal service area.

One of the highest-impact snowstorms in recent memory pounded Northern Michigan on the night of March 2, 2012. Low pressure tracked from Missouri, to southern Lower Michigan, and on to eastern Canada, while rapidly strengthening. Precipitation surged northward into the region on the evening of the 2nd. This was primarily snow, except in parts of east central Lower Michigan (especially near Lake Huron), where temperatures were mild enough for rain. Snow wound down on the morning of the 3rd, and though somewhat blustery winds occurred behind the system on the 3rd, blowing snow was limited because the snowfall was so wet. Snow totals ranged from 6 to 14 inches across most of Northern Michigan. Higher amounts fell near and west of Grand Traverse Bay, with a maximum amount of 20 inches near Lake Ann. With relatively warm temperatures, the snow was very wet; Traverse City saw around a foot of snow during the night, with a low temperature of 33 degrees. The snow stuck to everything, with the weight of the snow downing many, many trees and power lines. Power outages were widespread, with an outright majority of Northern Michigan residents losing power at some time during or after the storm. In Benzie County, 95 percent of residents lost power. Outages lasted up to a week in some spots. Great Lakes Energy described it as the worst snowstorm (in regards to power outages) in 30 years. A number of counties and communities opened shelters to aid those without power or heat. Also included in the tree damage was substantial damage to fruit trees in the Grand Traverse Bay region, particularly cherry trees. Reported property damages in Manistee County associated with this event were $350,000.

The frost/freeze event listed in Table 19 took place on April 27, 2012 across Northwest Lower Michigan. A killing freeze caused extreme damage to agriculture, particularly in the fruit belt of Northwest Lower Michigan. Traverse City saw low temperatures of 25 degrees on the 27th, 31 degrees on the 28th, and 26 degrees on the 29th. These values were not exceptionally colder than normal lows, which are in the middle 30s. Ultimately, the main culprit was a stretch of unprecedented warmth in mid-March, which included five consecutive 80-degree days (17th-21st). This caused fruit trees to bud out far, far ahead of schedule, and left them vulnerable to even relatively normal weather as the spring progressed.

The tart cherry crop was a total loss, while other orchard fruits such as sweet cherries, apples, pears, and peaches saw losses in excess of 90% of the expected crop. This event resulted in $10 million of crop damages in Manistee County.

Probability of Future Events and Vulnerability Assessment

There have been 1,000 severe winter weather events reported within the LRBOI tribal service area, including heavy snow, ice storms, frost/freeze, sleet, blizzards, winter weather, and winter storms (Table 16). Table 17 lists the number of severe winter weather events recorded in the NOAA Storm Events Database, by county, in order from most to least, the timeframe in which they occurred, and the resulting average annual number of events per county. Ottawa County is expected to have the most number of annual events (5.6), while Wexford is expected to have the least (2.9). Manistee County, where the majority of LRBOI tribal-owned land and infrastructure is located, is expected to have an annual average of 3.9 events. Additionally, the variability in temperatures within the different latitudes across the service area can be reflected in some of the weather event data: sleet events have occurred in all counties except the northern two counties in the service area – Manistee and Wexford, while a damaging frost/freeze event has impacted only Manistee County. The LRBOI grows some of its own crops and a frost/freeze event similar to the magnitude of the event in 2012 would decimate an essential food source.

Heavy snow events have the potential of shutting down towns and businesses for a significant period of time. Blowing and drifting snow with blizzard conditions cause driving hazards. Ice damage may occur when high winds push lake water and ice past the shoreline, causing damage to public infrastructure and residential property.

Table 17. Number and Probability of Severe Winter Weather Events in LRBOI Tribal Service Area

County	# of Severe Winter Weather Events	Timeframe	Average Annual # of Events
Ottawa	150	1996-2022 (27 years)	5.6
Muskegon	125	1996-2022 (27 years)	4.6
Oceana	122	1996-2022 (27 years)	4.5
Mason	119	1996-2022 (27 years)	4.4
Kent	110	1996-2022 (27 years)	4.1
Manistee	102	1997-2022 (26 years)	3.9
Lake	88	1996-2022 (27 years)	3.3
Newaygo	88	1996-2022 (27 years)	3.3
Wexford	76	1997-2022 (26 years)	2.9

Many LRBOI members can be considered vulnerable to impacts from severe winter weather-related events. The reasons for member vulnerability include: the high percentage of Elder members, the high percentage of members within the poverty level, members who live in remote areas, limited access to technology including cellular phone service and broadband internet, and minimal access to backup power sources. The Community Survey results specifically mentioned that internet and cell access was an issue and there were concerns about access to power in the event of a natural hazard. One response said, “Cell towers in our region are spotty and are regularly taken out by violent storms.” Ice, heavy snow, and wind storms have the capability to take out power, and cold temperatures can be fatal for members without a backup power source. Providing help and assistance to members in remote locations can be treacherous when combined with icy or snowy roads.

Thunderstorms and Severe Winds

The National Weather Service defines a severe thunderstorm as: *a thunderstorm that produces a tornado, winds of at least 58 mph (50 knots or ~93 km/h), and/or hail at least 1" in diameter.* These storms can also produce lightning or heavy rain (that could cause flash flooding). Severe thunderstorms can occur at any time in Michigan, although they are most frequent during the warm spring and summer months from May through September.

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

Location
Thunderstorms and severe wind are regional events that are not confined to geographic boundaries and can affect several areas at one time with varying severity depending on factors such as elevation and wind patterns. The entire LRBOI tribal service area is at risk from thunderstorms and severe wind hazards.

Extent
Thunderstorms can be measured based on wind speed or damages. Maximum recorded wind speeds for thunderstorm/wind, high wind and strong wind events NOAA Storm Events Database are as follows: Kent, Mason and Ottawa counties: 87 knots; Manistee County: 75 knots; Muskegon and Newaygo counties: 74 knots; Oceana County: 70 knots; Wexford County: 69 knots; Lake County: 61 knots. There have been $237,846,550 in property damages and $35,715,000 in crop damages, 14 deaths and 129 injuries associated with these events.

Previous Occurrences
Between the years 1956 and 2022, there have been a total of 1,103 thunderstorm/wind, high wind, or strong wind events reported for the LRBOI service area (Tables 18 and 19). These types of events are the most frequently occurring weather hazards in the LRBOI service area. Episode/event narratives obtained from the NOAA Storm Events Database are provided below for some of the particularly impactful events:

<u>Manistee County</u>

- 7/20/1987: Two swimmers were drowned when winds came up suddenly as the result of a severe weather outbreak across Michigan.

<u>Manistee, Lake, Ottawa, Mason and Wexford Counties</u>

- 6/12/2008: A large area of thunderstorms developed over Lake Michigan late in the evening on the 12th, as very moist air surged into the region. These storms were severe as they moved onshore, producing damaging winds, large hail, and a brief tornado. However, the biggest impact was from excessive rainfall, which produced unusually severe flooding in West Central Lower Michigan. The Governor of Michigan declared a state of emergency that included Manistee, Lake, Ottawa, Mason and Wexford counties. This episode featured widespread straight-line wind damage in parts of northwest Lower Michigan, and the largest hail on record in northern Michigan in Ogemaw County.

<u>Kent County</u>

- 5/17/1999: “Gusty thunderstorm winds flattened a house under construction in Wyoming in Kent County, causing one fatality and injuring another person.”

- 7/28/2000: One person was killed in Cascade Township when a tree limb fell on an automobile, killing the driver at the intersection of Cascade Road and 45th Street.

- 7/11/2011: “A 38 year old man was killed inside his garage along 68th street SE in Cutlerville when wind gusts of up to 80 mph ripped a large tree and its roots out of the ground and toppling it onto the garage, splitting it in half.”

- 7/23/2022: “Severe thunderstorms bringing wind gusts in the 60 to 72 mph range brought down several trees, tree limbs and power lines across portions of southern and south central lower Michigan. One fatality occurred just north of downtown Grand Rapids when a large hinged steel door on a shipping container was blown onto a man.”

Newaygo County

- 7/31/2012: A large tree fell on a house, killing two people.

Ottawa County

- 5/31/1998: In the aftermath of a derecho event, a utility worker was killed while attempting to repair storm-damaged electrical lines. The derecho event produced widespread 60 to 90 mph wind gusts, which caused extensive tree and structural damage and left over 861,000 homes and businesses without electricity across Michigan's Lower Peninsula.

  "Michigan State Police EMD's Damage and Injury Assessment Report indicated $4,195,604 in public damage costs, 17 homes destroyed, 827 homes damaged, 8 businesses destroyed, and 129 businesses damaged. Total private damage costs were estimated at $25.0 Million in the city of Grand Haven and Grand Haven Township, $5.1 Million in the Village of Spring Lake, $130,000 in Park Township, $182,900 in the city of Zeeland, and approximately $20,000 in Holland. Damage and losses were concentrated in the city of Grand Haven, the Village of Spring Lake, and the townships of Grand Haven (northern portion), Spring Lake, Crockery, Polkton, Wright, Park, Holland Charter, Zeeland, and Jamestown. Private damage costs were not available from other cities and townships within the county. The Mill Point Condominiums along the Grand River in Spring Lake sustained major damage and approximately 50% of the units were destroyed. Numerous campers, trailers, and RV's were overturned at Grand Haven State Park along the Lake Michigan shoreline. One fatality was reported. Crop damage was estimated at around $10.0 Million in the fruit belt (to apple, cherry, and peach trees) in the northern part of the county. Severe tree damage occurred in Grand Haven State Park. Ottawa County declared a local state of emergency and was granted a Governor's disaster declaration to activate state assistance for the county. A Michigan National Guard team was deployed to the Village of Spring Lake to assist the local jurisdiction with debris removal and cleanup operations. On June 24th, President Clinton granted a Major Disaster Declaration for Ottawa County, making federal disaster assistance available."

- 6/8/2008: Law enforcement near Ravenna reported that a woman was killed when a tree fell on her as she was walking in Chester Township. A two foot diameter tree fell on a car in motion in Spring Lake, killing the driver and injuring the passenger.

- 8/9/2009: In Grand Haven, a 35-year old male died in a vehicle with a towed trailer.

Muskegon County

- 11/10/1998: A person was killed when a wind-blown tree fell on them.

Kent, Mason, Muskegon, Newaygo, Oceana, and Ottawa Counties

- 5/31/1998: "The widespread and severe damage which occurred with the fast-moving line of thunderstorms during the early morning hours of Sunday, May 31st, was caused primarily by strong straight-line winds and isolated wet microburst winds. The derecho event produced widespread 60 to 90 mph wind gusts, which caused extensive tree and structural damage and left over 861,000 homes and businesses without electricity across Michigan's Lower Peninsula. Consumers Energy reported the derecho event was the most destructive weather event in its history, leaving over 600,000 of its customers without power (Consumers Energy is the largest utility company in western and mid Lower Michigan). There were 4 storm-related fatalities reported in the state and 146 injuries (mostly minor). Statewide, approximately 250 homes were destroyed, 12,250 homes damaged, 34 businesses destroyed, and 829 businesses damaged. Damage estimates across the above listed counties totaled over $166 Million.

  NWS Storm Damage Field Studies suggested highest wind gusts in wet microbursts reached 120 to 130 mph in Spring Lake (Ottawa County) and Walker (Kent County), 100 mph in portions of Montcalm County (including Cody Lake and Stanton), 90 mph in Rockford (Kent County) and Zeeland (Ottawa County), and 80 mph in Big Rapids (Mecosta County), Ludington (Mason County), Sparta (Kent County), and northern Osceola County. On June 24th, President Clinton declared 13 Michigan counties federal disaster areas, including the following 10 from the NWSO Grand Rapids County Warning Area: Clinton, Gratiot, Ionia, Kent, Mason, Montcalm, Muskegon, Newaygo, Oceana, and Ottawa. It took up to 10 days to fully restore power to certain areas including the City of Walker and portions of Montcalm and Gratiot Counties."

Table 18: Thunderstorm/Wind Events, LRBOI Tribal Service Area

County	Thunderstorm / Wind Events	Event Years	Part of a Federal or State Disaster or Emergency Declaration	Property Damage	Crop Damage	Deaths	Injuries
Kent	251	1956, 1958-60, 1962, 1964-72, 1974-76, 1978-2022	4/11/1965, 5/31/1998, 6/3/1998-6/5/1998, 5/20/2004-6/8/2004,	$61,581,000	$20,090,000	4	60
Lake	72	1976, 1978, 1985, 1988, 1990, 1992, 1995, 1998-2002, 2004, 2005, 2007, 2008, 2011-14, 2016-21	6/19/2008, 7/14/2008	$1,963,000	0	0	0
Manistee	56	1964, 1966, 1973, 1975, 1980, 1985, 1987, 1989, 1991, 1997-2003, 2005-09, 2011-13, 2015, 2017-19, 2021	6/19/2008, 7/14/2008	$510,500	0	2	0
Mason	77	1976, 1983-85, 1988, 1989, 1992, 1994, 1995, 1997-2008, 2012-15, 2017-21	5/31/1998, 6/3/1998-6/5/1998, 6/13/2008, 7/14/2008,	$2,903,000	$35,000	0	5
Muskegon	142	1956, 1960, 1961, 1963, 1964, 1967-71, 1973, 1975, 1980, 1982-84, 1986-92, 1994, 1995, 1997-2022	5/31/1998, 6/3/1998-6/5/1998, 5/20/2004-6/8/2004,	$29,763,000	$5,030,000	0	5
Newaygo	92	1958, 1963, 1965, 1975, 1978, 1980-88, 1992, 1994, 1995, 1997-2009, 2011, 2012, 2014-16, 2018-22	5/31/1998, 6/3/1998-6/5/1998, 6/3/2004	$2,689,000	$50,000	2	0
Oceana	59	1960, 1965-67, 1978-79, 1981-83, 1989, 1991, 1992, 1994, 1995, 1998-2006, 2008, 2011-13, 2015, 2017-21	5/31/1998, 6/3/1998-6/5/1998,	$4,715,000	$450,000	0	37
Ottawa	173	1962, 1963, 1965, 1968, 1971, 1973, 1975-77, 1979-2022	4/11/1965, 7/21/1980, 5/20/2004-6/8/2004, 6/19/2008, 7/14/2008,	$38,646,000	$10,060,000	5	22
Wexford	61	1956, 1960, 1964, 1965, 1976, 1985, 1990-93, 1995, 1996, 1998, 1999, 2001-03, 2005-09, 2011-13, 2015-19, 2021, 2022	5/31/1998, 6/3/1998-6/5/1998, 6/19/2008, 7/14/2008,	$281,050	$0	0	0
Total	**983**			**$143,051,550**	**$35,715,000**	**13**	**129**

Source: NOAA: National Centers for Environmental Information Storm Events Database

Table 19: High Wind and Strong Wind Events, LRBOI Tribal Service Area

County	High Wind / Strong Wind Events	Event Years	Part of a Federal or State Disaster or Emergency Declaration	Property Damage	Crop Damage	Deaths	Injuries
Kent	19	1997, 1998, 2002, 2004, 2007, 2008, 2012, 2013, 2017, 2019, 2020, 2021		$26,110,000	0	0	0
Lake	9	1997, 1998, 2001, 2002, 2004, 2008, 2012, 2013, 2017		$5,670,000	0	0	0
Manistee	9	1998, 2001, 2003, 2005, 2010, 2015, 2021		$135,000	0	0	0
Mason	11	1997, 1998, 2002, 2004, 2008-10, 2012, 2013, 2017, 2021		$5,135,000	0	0	0
Muskegon	19	1997, 1998, 2002, 2004, 2008-10, 2012, 2013, 2017, 2019, 2021	8/20/1975-9/6/1975	$16,150,000	$0	1	0
Newaygo	11	1997, 1998, 2002, 2004, 2007, 2008, 2011, 2013, 2017, 2021	8/20/1975-9/6/1975	$10,170,000	$0	0	0
Oceana	12	1997, 1998, 2002, 2004, 2007, 2008, 2012, 2013, 2017, 2019, 2021	8/20/1975-9/6/1975	$11,145,000	$0	0	0
Ottawa	21	1997, 1998, 2002, 2004, 2007-10, 2012, 2013, 2017, 2019-21	8/20/1975-9/6/1975, 7/15/1980-7/20/1980	$20,200,000	$0	0	0
Wexford	9	1998, 2003, 2005, 2008, 2010, 2011, 2015, 2021		$125,000	$0	0	0
Total	**120**			**$94,840,000**	**$0**	**1**	**0**

Source: NOAA National Centers for Environmental Information Storm Events Database; MSP 2019 *Michigan Hazards Analysis*

Probability of Future Events and Vulnerability Assessment

There have been 1,103 thunderstorm/wind, high wind, or strong wind events reported for the entire LRBOI service area between 1956 and 2002. This is the most frequently occurring natural hazard in the service area. Table 20 provides an estimate of a future thunderstorm/wind or severe wind event occurring in each of the counties within the LRBOI Service area. The data indicates that Kent County can expect the greatest number of events per year (4.1), while Wexford can expect the fewest (1.0). Manistee County, which contains the majority of the LRBOI tribal-owned lands and built infrastructure, can expect 1.1 events per year.

Table 20. Annual Average Number of Thunderstorm/Wind and Severe Wind Events, LRBOI Service Area

County	# of T-Storm & Wind Events	Timeframe	Average Annual # of Events
Kent	270	1956-2022 (67 years)	4.1
Ottawa	194	1962-2022 (61 years)	3.2
Muskegon	161	1956-2022 (67 years)	2.4
Newaygo	103	1958-2022 (65 years)	1.6
Mason	88	1976-2022 (47 years)	1.9
Lake	81	1972-2022 (51 years)	1.6
Wexford	70	1956-2022 (67 years)	1.0
Oceana	71	1960-2022 (63 years)	1.1
Manistee	65	1964-2022 (59 years)	1.1

Source: NOAA National Centers for Environmental Information Storm Events Database; MSP 2019 *Michigan Hazards Analysis*

Damage from straight line winds usually affects multiple counties with the loss of electricity from trees/tree limbs downing power lines; widespread property damage; and potentially exposing people to severe injury or fatality due to windblown objects, falling trees or collapsing roofs. The magnitude of the impact of a thunderstorm/wind, high wind, or strong wind event also depends on the seasonal population, seasonal activities, and the spread of development at the location of the storm.

During the warm or summer months, the area's population expands to include both the permanent population and visitors. The seasonal population is attracted to both rural, sparsely populated rural areas and urban activity centers. Impoverished persons living in substandard housing and elderly and/or disabled persons are also vulnerable to impacts from high wind events, such as experiencing structural damage to their residence or having to endure long-term power outages. Additionally, the Tribe holds festivals and events such as the annual Jiingtamok and Anishinaabe Family Language Camp, usually held in mid- to late-July. Both events are held at the LRBOI Pow Wow Grounds in Manistee Township, where rustic camping accommodations are available. In general, those without permanent shelter or are caught outside in a quickly moving storm are vulnerable to hazardous conditions.

During community meetings, Tribal government employees indicated thunderstorms, lightning and resulting potential power outages were the #1 concern for the members. Thunderstorms can appear quickly and cause significant damage. Members are geographically spread out and notifying them of inclement weather is difficult. The Tribe currently uses "Fast Command", TV and radio announcements, and weather notifications to alert members. Fast Command is limited due to the sign up process: tribal members and employees must request to be added to the alert system. The Tribe seeks better ways to forewarn people about severe storms.

Additionally, power outages caused by downed trees or lightning strikes have caused service issues for the Tribe's wastewater utility system. Lightning has struck the utility system's electrical components, and Tribe had to repair the components and put surge protectors in place. The Tribe has installed generators in some areas of the wastewater utility system in order to minimize disruptions from power loss. However, the Hazard Areas Map in Appendix A indicates that LRBOI's sanitary sewer collection system along E. Parkdale Avenue does not have backup generator power for any of the system's lift stations.

The American marten (a charismatic mammal in the weasel family) is both ecologically and culturally significant to the Little River Band of Ottawa Indians (Little River) community and are a species of concern to Little River. Clan members associated with marten are members of the Wabizhashi Dodem (Marten Clan), and are known as warriors, hunters, and gatherers. To be better stewards of this native species, Little River's Wildlife Division partnered with Grand Valley State University (GVSU) to evaluate the impact of timber harvest and severe weather-induced habitat modification on marten habitat use and selection.

In 2019, the LRBOI Wildlife Division and GVSU began live trapping marten in areas where a large storm in 2018 caused widespread fallen trees and areas planned for timber harvesting/management. Areas are being targeted where they have previously collected data on marten habitat use so they can compare habitat use before and after the area changed by natural disaster or timber management. Data on how marten utilize areas before and after timber management will be valuable in determining how to mitigate negative impacts that logging may have on marten habitat. This project will provide valuable information on how large habitat changes, particularly timber harvest, impact marten habitat use. LRBOI can use this information to provide management recommendations to the Forest Service to help conserve marten and be better stewards of this native species.

Hail

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

According to the 2019 *Michigan Hazard Analysis*, Michigan has an annual average of 191 hail storms incurring over $17 million in property damages, nearly $600,000 in crop damages, and 0.2 deaths. Despite damaging hail occurring in every part of Michigan, the areas of the state most prone to severe thunderstorms (e.g. the southern half of Michigan's Lower Peninsula) are also most prone to large and damaging hail. The majority of the hailstorms occur during the growing season from May through August when crops have the greatest potential to be damaged by hail.

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

Location
Hailstorms are regional events that frequently accompany thunderstorms, and are not confined to geographic boundaries. The severity of hailstorms may range across the affected areas. All counties in the LRBOI tribal service area are at risk from hailstorm damage. Most Michigan counties see an average of two hail events per year.

Extent
According to the NOAA National Centers for Environmental Information, the approximate size of hail is described as follows in Table 21. If a thunderstorm produces hail that is 1 inch in diameter (quarter size) or larger, it is considered to be a severe thunderstorm.

Table 21: NOAA Hail Size Description

Appearance	Approximate Size in Inches
Pea	0.25-0.5 inch
Penny	0.75 inch
Nickel	0.88 inch
Quarter	1.00 inch
Walnut/Ping Pong	1.50 inch
Golf Ball	1.75 inch
Hen Egg	2.00 inch
Tennis Ball	2.50 inch
Baseball	2.75 inch
Tea Cup	3.00 inch
Grapefruit	4.00 inch
Softball	4.50 inch

The greatest extent hail reported in Manistee County was 2 inches on September 26, 1998, near Bear Lake. The storm severely damaged two apple orchards. Around 15,000 bushels of apples were destroyed with an estimated monetary loss of $35,000. Hail can damage aircraft, homes and cars, and can be deadly to livestock and people. Hailstorms have caused no deaths or injuries, no recorded property damages, and $35,000 in crop damages in Manistee County.

Previous Occurrences
Between 1973 and 2022, Manistee County had 35 hailstorms reported to NOAA (Table 22). Hail events in occurring in the entire LRBOI service area are provided in Table 23.

Table 22: Hail Events, Manistee County

Place	Date	Magnitude
MANISTEE	7/12/1973	1.75
MANISTEE	6/8/1985	0.75
ONEKAMA	8/23/1998	1.75
BEAR LAKE	9/26/1998	2
WELLSTON	9/26/1998	1.25
BEAR LAKE	10/13/1999	0.75
WELLSTON	10/13/1999	0.75
MANISTEE	8/9/2000	0.88
WELLSTON	4/15/2003	1
BEAR LAKE	7/20/2003	0.88
MANISTEE	7/24/2005	0.88
COPEMISH	9/7/2005	0.75
MANISTEE	10/3/2006	0.75
SPRINGDALE	6/14/2008	1
KALEVA	6/14/2008	0.75
WELLSTON	6/14/2008	0.75
NORWALK	5/11/2011	0.75
WELLSTON	5/11/2011	1.25
MANISTEE	5/11/2011	1.5
MANISTEE	5/15/2012	0.88
MANISTEE	5/15/2012	1
WELLSTON	5/27/2012	0.75
STRONACH	8/3/2017	0.75
ARCADIA	5/31/2019	0.75
COPEMISH	5/31/2019	0.88
ARCADIA	4/7/2020	1
BEAR LAKE	4/7/2020	0.75
BEAR LAKE	4/7/2020	1
PARKDALE	9/7/2021	1
HIGH BRIDGE	9/7/2021	1.5
WELLSTON	9/7/2021	1.75
MANISTEE	9/7/2021	0.88
MANISTEE	5/11/2022	0.88
BEAR LAKE	9/21/2022	1
KALEVA	9/21/2022	1.5

Source: NOAA: National Centers for Environmental Information

Table 23. History of Hail Events in the LRBOI Service Area

County	# of Events	Years Recorded	Avg. # Events Per Year	Damages	Hail Diameter
Kent	132	1956, 1960-62, 1963, 1965, 1966, 1968, 1969, 1971, 1972, 1975, 1981, 1983-88, 1991, 1993, 1994, 1997-2008, 2010-14, 2016, 2019-22 (45 years)	2.9	$15,112,000 in property damages; $1,395,000 in crop damages	0.5" to 4"
Lake	18	1961, 1978, 1996-98, 2000, 2001, 2003, 2008, 2011, 2021 (11 years)	1.6	$135,000 in property damages; $65,000 in crop damages	0.75" to 2.5"
Manistee	35	1973, 1985, 1998-2000, 2003, 2005-06, 2008, 2011-12, 2017, 2019, 2020-22 (16 years)	2.2	$35,000 in crop damages	0.75" to 2"
Mason	22	1960, 1975, 1991, 1996, 1998, 2000-02, 2005, 2006, 2008, 2010-12, 2021 (15 years)	1.5	$195,000 in property damages; $40,000 in crop damages	0.75" to 2.5"
Muskegon	63	1956, 1957, 1960, 1963, 1972, 1978-82, 1986, 1990, 1991, 1994, 1996, 2000-08, 2011, 2012, 2014, 2015, 2019-21 (31 years)	2.0	$965,000 in property damages; $260,000 in crop damages	0.75" to 4"
Newaygo	50	1958, 1963, 1973, 1975, 1985, 1986, 1993-95, 1997, 1999, 2000, 2003-08, 2011, 2013, 2018, 2019, 2021, 2022 (24 years)	2.1	$325,000 in property damages; $235,000 in crop damages	0.75" to 2.5"
Oceana	39	1968, 1979, 1983, 1986, 1988, 1991, 1996, 2000, 2002-04, 2006, 2008, 2011, 2012, 2014, 2017, 2021, 2022 (19 years)	2.1	$260,000 in property damages; $175,000 in crop damages	0.75" to 1.75"
Ottawa	93	1961, 1963, 1965, 1967, 1971, 1972, 1974-76, 1978, 1980, 1983-86, 1988, 1991, 1994, 1996-2008, 2010, 2011, 2014, 2016, 2017, 2021 (37 years)	2.5	$497,000 in property damages; $302,000 in crop damages	0.75" to 3"
Wexford	33	1984, 1988, 1991, 1993, 1996-98, 2000, 2003, 2004, 2006-08, 2010-12, 2020-22 (19 years)	1.7	$0	0.75" to 2"

Source: NOAA National Centers for Environmental Information

Probability of Future Events and Vulnerability Assessment

Kent County has had the greatest number of recorded hail events (132), followed by Ottawa County (93), Muskegon County (63), Newaygo County (50), Oceana County (39), Manistee County (35), Wexford County (33), Mason County (22) and Lake County (18). The average number of hail events per year in each county ranges between 1.5 (Mason) and 2.9 (Kent).

The LRBOI Tribe owns developed, agricultural and vacant property in Manistee, Mason and Muskegon counties.

All existing and future buildings, exposed infrastructure, and populations are at risk from hailstorms since hail causes damage to roofs, brick walls, glass, landscaping, crops, and cars. Manufactured homes and campground populations located throughout the county and are more susceptible to impacts from hail. Hail can also damage roads, sidewalks, bridges, and above ground utilities. Although no there are no reported deaths or injuries associated with hail in the NOAA Storm Events Database for the LRBOI tribal service area, hail has the potential to cause injury and death, and populations are advised to take shelter when an event occurs.

Riverine and Urban Flooding

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

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

Dam failure is also a potential source of flooding. Infrastructure in the state is aging and costly to maintain. FEMA provides Federal Guidelines for Dam Safety. These guidelines encourage strict safety standards in the practices and procedures employed by federal agencies or required of dam owners regulated by the federal agencies (2004). The National Inventory of Dams provides a catalogue of dams in the nation with a profile of each. Each profile lists the Hazard Potential Classification. This is a system that categorizes dams according to the degree of adverse incremental consequences of a failure or mis-operation of a dam. The hazard potential classification does not reflect in any way on the current condition of the dam. Three classification levels are adopted as follows: Low, Significant, and High, listed in order of increasing adverse incremental consequences.

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

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

Location

The City of Manistee is the urbanized center of Manistee County and the most likely location to experience both riverine and urban flooding with a large contiguous amount of impervious surfaces. Five of the seven flooding events on record with NOAA for Manistee County occurred in the City of Manistee. Additionally, the county's major river system, the Manistee River, travels west through the city to reach the Lake Michigan. The Manistee River starts in Antrim County to the northeast, travels through Otsego County, Crawford County, Kalkaska County, Missaukee County, Wexford County, and enters Manistee County. The Manistee River then runs through in Dickson, Norman, Stronach, and Manistee Townships and ends in the City of Manistee at Lake Michigan. These places are likely to experience riverine flooding from the Manistee River tributaries.

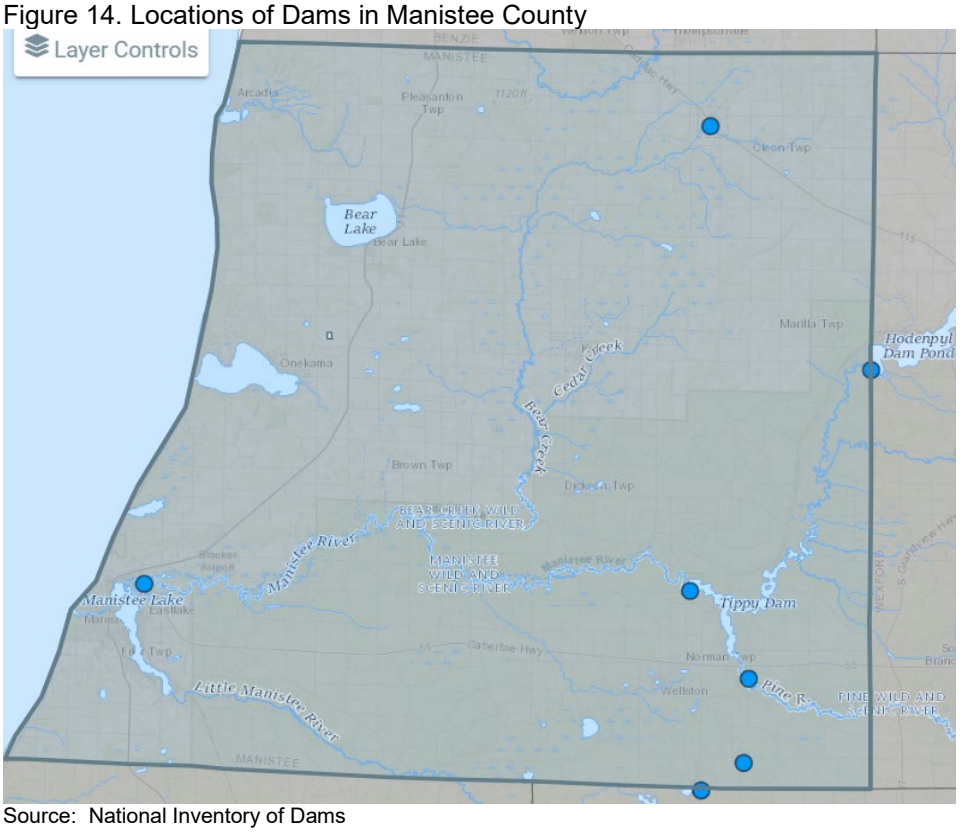
Additionally, the Townships of Onekama, Pleasanton, and Bear Lake may experience flooding from inland lakes and surrounding tributaries. Other flooding may involve low-lying areas that collect runoff waters; flaws or shortcomings in existing sewer infrastructure; undersized or poorly designed storm water control practices; collective effects of land use and development trends; illegal diversion of water, or actions that interfere with system function.

Other major river systems are located in the LRBOI service area and have experienced flooding-related disasters and emergencies: The Grand River in Ottawa and Kent counties; the Muskegon River in Muskegon and Newaygo counties; the Manistee River in Wexford (and Manistee) counties; and the Pere Marquette River in Lake, Mason, Newaygo and Oceana counties.

Manistee County has five (5) dams listed on the National Inventory of Dams: Tippy, Stronach, Peters Bayou, Copemish, and Sunny Brook. The Hodenpyl Dam is located near the county boundary in Wexford County, adjacent to Manistee County. Both the Hodenpyl and Tippy Dams are located on the Manistee River and are high hazard potential dams located upstream of the City of Manistee and Manistee Township, where there is a high concentration of residents and

businesses (Figure 14). The other four dams in the county are considered low hazard potential dams and do not require Emergency Action Plans (Table 24).

Figure 14. Locations of Dams in Manistee County



Source: National Inventory of Dams

Table 24. Dams in Manistee County

Name	Hodenpyl Dam	Tippy Dam	Stronach Dam	Sunny Brook Dam	Peters Bayou/ Manistee Game Area Dam	Copemish Dam
Downstream Hazard Potential	High	High	Low	Low	Low	Low
Location	Wexford County (Springville Township)	Dickson Township	Norman Township	Norman Township	Manistee Township	Village of Copemish (Cleon Twp.)
Height (Ft)	90	82	20	8	12	10
Storage (Acre Ft)	39,684	27,620	850	60	595	180
Water Body	Manistee River	Manistee River	Pine River	Pine Creek	Manistee River	First Creek
Owner	Consumers Energy Company	Consumers Energy Company	Consumers Energy Company	Patrick F. Kelley (Private)	MDNR Wildlife	Village of Copemish
Year Completed	1925	1918	1912	1890	1969	1950
Purpose	Hydroelectric	Recreation	Recreation	Other	Other	Recreation
Regulatory Agency	FERC	FERC	None	MI DEGLE	MI DEGLE	None
Condition Assessment	Not Available	Not Available	Not Rated	Satisfactory (4/3/2000)	Unsatisfactory (9/17/2020)	Not Rated
Inspection Frequency	Annually	Annually	5 Years	5 Years	5 Years	5 years
Emergency Action Plan (EAP) Prepared?	Yes	Yes	Not Required	Not Required	Not Required	Not Required
Last EAP Revision	10/11/2019	10/11/2019				

Sources: National Inventory of Dams; EGLE Michigan Dam Inventory

Appendix D provides a list of other dams listed with the National Inventory of Dams for the other eight counties within the LRBOI tribal service area. There are no dams with a "high" or "significant" downstream hazard potential located upstream of LRBOI tribal property located in Mason or Muskegon counties.

Extent

The extent of impact from flooding can be measured by the amount of property damage, crop damage, injuries, deaths and accumulation of rainfall. Flooding events account for about 74% of all property damages recorded with NOAA for severe weather events in Manistee County ($5.02 million), 45% in Newaygo County, 43.9% in Ottawa County, and 41.5% in Mason County (Table 25). In Mason County, flooding events contributed to 91.9% of all recorded total crop damages; in Lake County, 85.9%, and in Newaygo, 54.3% (Table 25).

Table 25. Comparison of Property and Crop Damages due to Flooding Events, LRBOI Service Area, 1950-2022

County	Property Damages (all NOAA storm events)	Flooding Property Damages	Flooding % of Total	Crop Damages (all NOAA storm events)	Flooding Crop Damages	Flooding % of Total
Kent	$149,291,000	$4,068,000	2.7%	$22,025,000	$510,000	2.3%
Lake	$15,833,000	$6,099,000	38.5%	$815,000	$700,000	85.9%
Manistee	$6,779,000	$5,020,000	74.1%	$10,035,000	$0	0.0%
Mason	$18,938,000	$7,855,000	41.5%	$925,000	$850,000	91.9%
Muskegon	$62,110,000	$12,795,000	20.6%	$5,825,000	$535,000	9.2%
Newaygo	$26,909,000	$12,110,000	45.0%	$645,000	$350,000	54.3%
Oceana	$22,655,000	$4,666,000	20.6%	$2,675,000	$45,000	1.7%
Ottawa	$120,976,000	$53,165,000	43.9%	$12,770,000	$1,905,000	14.9%
Wexford	$2,492,000	$982,000	39.4%	$0	$0	0.0%

Ottawa County has the greatest extent of recorded impacts associated with inland flooding events within the LRBOI service area: $53,165,000 in property damages, $1,905,000 in crop damages, two deaths and three injuries. About 64% ($34 million) of those total recorded property damages are associated with a June 19, 2009 flash flood event; the NOAA episode/event narratives are as follows:

> "Thunderstorms developed and moved across Lake Michigan during the evening hours on June 19th. Several hours of intense rainfall occurred starting around 7:00 PM EST. The ground was already saturated from early morning thunderstorms that produced very heavy rainfall. In addition to the heavy rain, severe thunderstorms and tornadoes accompanied the thunderstorms. Numerous reports of damage to homes and streets across the warned area occurred. Over 2,000 homes sustained some type of damage during the flooding. In terms of roads impacted by water, there were four road closures, twenty five road washouts and forty roads were covered by water. A Local State of Emergency was declared."

Previous Occurrences

Table 26: Manistee County Fluvial and Pluvial Flood Events

LOCATION	DATE	EVENT TYPE	DEATHS / INJURIES	PROERTY DAMAGE	CROP DAMAGE	FLOOD CAUSE
Manistee County and several other counties	Sept. 1986*	Presidential Major Disaster (774); Governor Disaster				Heavy Rain
Manistee / Cadillac	5/12/2000	Flash Flood	0 / 0	$ -	$ -	Heavy Rain
Manistee River Communities	4/12/2001	Flash Flood	0 / 0	$ -	$ -	Snowmelt / Rain
Manistee River Communities	5/19/2001	Flash Flood	0 / 0	$ -	$ -	Heavy Rain
Manistee River Communities	7/24/2005	Flash Flood	0 / 0	$ 500,000	$ -	Heavy Rain
Manistee River Communities	6/12/2008	Flash Flood**	0 / 0	$ 970,000	$ -	Excessive Rain
Manistee River Communities	6/13/2008	Flood**	0 / 0	$ -	$ -	Excessive Rain
City of Manistee	5/11/2011	Flash Flood	0 / 0	$ 40,000	$ -	Heavy Rain
Manistee River Communities	5/11/2011	Flash Flood	0 / 0	$ 10,000	$ -	Heavy Rain
Manistee River Communities	7/20/2019	Flash Flood	0 / 0	$ 3.5 M	$ -	Excessive Rain
Manistee River Communities	7/20/2019	Flood	0 / 0	$ -	$ -	Excessive Rain
TOTAL				**$5.020 M**	**$ -**	

Sources: NOAA National Centers for Environmental Information Storm Events Database; Michigan State Police's 2019 *Michigan Hazard Analysis*
Notes: Manistee River Communities include the City of Manistee, Village of Eastlake, and the Townships of Filer, Manistee, Stronach, Brown, Norman, Dickson and Marilla. * Event not listed in the NOAA Storm Events Database. **Events associated with 7/14/2008 Presidential Declared Disaster (1777) for Manistee County and 11 other counties as the result of thunderstorms and flooding, and a Governor Declared Emergency for Manistee County and four other nearby counties for thunderstorms.

The most damaging flood event in Manistee County occurred on July 20, 2019, when a large area of regenerating thunderstorms produced excessive rainfall and some severe weather in northern Lower Michigan. Thunderstorms moved repeatedly over Manistee County in the morning and afternoon of the 20th. Excessive rainfall produced substantial flooding across central and southern Manistee County. By late on the 20th, rainfall totals reached 8.90 inches at Parkdale (near Manistee), and 5.95 inches at Wellston. Water entered numerous homes and stores in the greater Manistee area, and in Dublin, resulting in property damage. The campground at Orchard Beach State Park was at one point under four feet of water. Many roads were flooded and closed to travel for several hours. 12th Street in the city of Manistee was washed out. Places near the Manistee River were most susceptible to flooding. This event is associated with $3.5 million dollars in property damage.

The threat of damage to communities along the Manistee River, especially the City of Manistee, is significant. With many of the flooding events the extent of the damage was multiplied by soil erosion, sewer backups, and road washouts. The NOAA event narrative for the flash flood event on July 24, 2005 further describes the damages a heavy rainfall can cause. A slow moving thunderstorm dumped over three inches of rain (and hail) on the southwest corner of Manistee County. A spotter in the City of Manistee reported 4.35 inches of rain in two and a half hours. Widespread urban flooding resulted in the city and its environs, with the worst damage along the River Street corridor. Erosion was severe in spots, due to the sandy soils prevalent in the area. Some gravel roads and driveways were washed out; city streets had one to two feet of flowing water in them. Numerous vehicles stalled out in the high water. Basement flooding was also widespread. A hotel had flood waters enter its ground floor, prompting the evacuation of twenty five guests. Sewage system backups contributed to flood damage in the city. This event caused $500,000 in damages.

In June 2008, the Governor declared a state of emergency related to flooding caused by thunderstorms for counties that included Lake, Manistee, Mason, Ottawa, and Wexford counties. A large area of thunderstorms developed over Lake Michigan late in the evening on the 12th, as very moist air surged into the region. These storms were severe as they moved onshore, producing damaging winds, large hail, and a brief tornado. However, the biggest impact was from excessive rainfall, which produced unusually severe flooding in West Central Lower Michigan. Spotters in Manistee and Wellston measured around 6 inches of rain in a few hours very late on the 12th into the pre-dawn hours of the 13th. Radar estimated up to 10 inches of rainfall along the southern border of Manistee County. Substantial flash flooding resulted, with considerable soil erosion, thanks in part to the sandy soils of the area. At one point the majority of roads in the south half of Manistee County were under water. High water entered some homes. In the city of Manistee, asphalt, stop signs, and light posts were flushed into Lake Michigan by the raging waters. The county road commission estimated $500,000 in damages to the county road system. This flash flood event reportedly caused a total of $970,000 in damages. These events are associated with the Presidential Declared disaster (#1777) for Manistee County and 11 other counties in the Northern Lower Peninsula.

In September 1986, a Federal Disaster (#774) was declared for 30 counties in Central Lower Michigan, which included Kent, Lake, Manistee, Mason, Muskegon, Newaygo, Oceana and Ottawa counties. A Governor's Disaster Declaration is also associated with this event. This event is not included in the NOAA Storm Events database. The following is a description of the event according to the Michigan State Police's 2019 *Michigan Hazard Analysis*: "A slow moving low-pressure system produced 8-17" of rainfall over a 60 mile wide/180 mile long area during a 24-hour period. In Big Rapids, 19" of rain fell from September 9-12. The storm resulted in thousands of persons being evacuated due to flooding. Five persons were killed and 89 injured (up to ten were killed if indirect effects are included). Roughly 30,000 homes suffered basement and structural damage and 3,600 miles of roadways were made impassable due to the failure of four primary bridges and hundreds of secondary road bridges and culverts. Eleven dams failed with 19 others threatened. The flood resulted in over $300 million in damages."

Other Presidential- or Governor-Declared Emergencies or Disasters have been enacted for counties in the LRBOI service area regarding flooding (look for the asterisk by the date in the flooding events tables) in the years 1975, 1997, 2004, 2013, 2014, 2018, and 2019.

Table 27 lists the inland flooding events for the eight other counties in the LRBOI service area. Kent County has the greatest number of events (29), followed by Ottawa County (25), Muskegon County (18), Newaygo County (17), Mason County (15), Manistee, Lake and Wexford counties (11 events each) and Lake County (10).

Table 27. Fluvial and Pluvial Flood Events in the LRBOI Tribal Service Area, Excluding Manistee County

COUNTY	LOCATION	DATE	EVENT TYPE	PROPERTY DAMAGES	CROP DAMAGES	DEATHS / INJURIES
Kent		4/18-30/1975*	Flooding, rain			
		10/28/1986*, 9/10-19/1986*	Flooding, Heavy Rain			
	GRAND RAPIDS	5/20/1996	Flash Flood	$10,000	$0	
	ADA	6/12/1996	Flash Flood	$0	$0	
	NORTHWEST	6/17/1996	Flash Flood	$0	$0	
	GRAND RAPIDS	2/21/1997	Flash Flood	$0	$0	
		2/22/1997	Flood	$0	$0	
		3/1/1997	Flood	$0	$0	
	GRAND RAPIDS	9/17/1997	Flash Flood	$0	$0	
		3/22/1998	Flood	$0	$0	
	GRAND RAPIDS	10/6/1998	Flood	$0	$0	
		1/30/1999	Flood	$0	$0	
	COUNTYWIDE	5/18/2000	Flash Flood	$300,000	$100,000	
		2/9/2001	Flood	$50,000	$0	
		2/24/2001	Flood	$10,000	$0	
	KENTWOOD	5/15/2001	Flash Flood	$500,000	$200,000	
	GRANDVILLE	10/24/2001	Flash Flood	$20,000	$0	
		5/21/2004*	Flood	$3,000,000	$200,000	
	GRAND RAPIDS	6/19/2009	Flash Flood	$25,000	$0	
	PLAINFIELD HGTS	5/31/2010	Flash Flood	$200,000	$10,000	
	KENTWOOD	6/15/2010	Flood	$350,000	$0	
	GODWIN HGTS	6/21/2011	Flash Flood	$0	$0	
	WESTGATE	6/21/2011	Flood	$0	$0	
	CHESTERFIELD HGTS	6/21/2011	Flash Flood	$5,000	$0	
	GRAND RAPIDS	7/27/2011	Flash Flood	$0	$0	
	BYRON CENTER	4/17/2013*	Flood	$0	$0	
	EASTMONT	10/2/2019	Flood	$10,000	$0	
		2/19/2018*	Flood			
	ALPINE	5/18/2020	Flood	$200,000	$0	
	Total	**29 Events**		**$4,068,000**	**$510,000**	**None**
Lake		10/28/1986*, 9/10-19/1986*	Flooding, Heavy Rain			
		5/23/2004	Flood	$1,000,000	$200,000	
	BALDWIN	2/21/1997	Flash Flood	$0	$0	
	NORTHWEST PORTION	8/6/1998	Flash Flood	$10,000	$0	
	COUNTYWIDE	2/9/2001	Flash Flood	$100,000	$0	
	PEACOCK	6/13/2008*	Flash Flood	$2,000,000	$500,000	
	NIRVANA	8/2/2011	Flash Flood	$10,000	$0	
	BRANCH	5/3/2012	Flash Flood	$70,000	$0	
	IRONS	4/17/2013	Flood	$3,000,000	$0	
	IRONS	7/20/2019	Flood	$800,000	$0	
	Total	**10 Events**		**$6,099,000**	**$700,000**	**None**

COUNTY	LOCATION	DATE	EVENT TYPE	PROPERTY DAMAGES	CROP DAMAGES	DEATHS / INJURIES
Mason		10/28/1986*, 9/10-19/1986*	Flooding, Heavy Rain			
		2/21/1997	Flood	$0	$0	
		5/23/2004	Flood	$1,000,000	$200,000	
		6/9/2004	Flood	$20,000	$0	
	SCOTTVILLE	2/21/1997	Flash Flood	$0	$0	
	WALHALLA	8/6/1998	Flash Flood	$10,000	$0	
	COUNTYWIDE	2/9/2001	Flash Flood	$100,000	$0	
	COUNTYWIDE	5/15/2001	Flash Flood	$50,000	$50,000	
	COUNTYWIDE	5/15/2001	Flash Flood	$25,000	$25,000	
	COUNTYWIDE	5/16/2001	Flash Flood	$50,000	$50,000	
	COUNTYWIDE	5/16/2001	Flash Flood	$25,000	$25,000	
	HAMLIN LAKE	6/13/2008*	Flash Flood	$3,000,000	$500,000	
	FREESOIL	5/3/2012	Flash Flood	$75,000	$0	
	FREESOIL	4/17/2013	Flood	$3,000,000	$0	
	FREESOIL	7/20/2019	Flood	$500,000	$0	
	Total	**15 Events**		**$7,855,000**	**$850,000**	**None**
Muskegon		8/20/1975 to 9/9/1975*	Rainstorms, severe winds, flooding			
		10/28/1986*, 9/10-19/1986*	Flooding, Heavy Rain			
	MONTAGUE	2/21/1997	Flash Flood	$0	$0	
		2/22/1997	Flood	$0	$0	
	MUSKEGON	8/4/1998	Flash Flood	$0	$0	
	COUNTYWIDE	5/18/2000	Flash Flood	$100,000	$50,000	
	COUNTYWIDE	2/9/2001	Flash Flood	$100,000	$0	
		2/24/2001	Flood	$10,000	$0	
	TWIN LAKE	4/11/2001	Flash Flood	$10,000	$10,000	
	MUSKEGON	5/15/2001	Flash Flood	$500,000	$200,000	
	COUNTYWIDE	5/15/2001	Flash Flood	$25,000	$25,000	
	COUNTYWIDE	5/16/2001	Flash Flood	$25,000	$25,000	
	COUNTYWIDE	5/16/2001	Flash Flood	$25,000	$25,000	
		5/21/2004*	Flood	$1,000,000	$200,000	
	MUSKEGON LAKE	1/7/2008	Heavy Rain	$0	$0	
	WHITEHALL	4/17/2013*	Flood	$5,000,000	$0	
		4/12/2014*	Flood			
	MONTAGUE ARPT	5/18/2020	Flood	$6,000,000	$0	
	Total	**18 Events**		**$12,795,000**	**$535,000**	**None**

COUNTY	LOCATION	DATE	EVENT TYPE	PROPERTY DAMAGES	CROP DAMAGES	DEATHS / INJURIES
Newaygo		8/20/1975 to 9/9/1975*	Rainstorms, severe winds, flooding			
		10/28/1986*, 9/10-19/1986*	Flooding, Heavy Rain			
	FREMONT	2/21/1997	Flash Flood	$0	$0	
	COUNTYWIDE	2/9/2001	Flash Flood	$100,000	$0	
		2/24/2001	Flood	$10,000	$0	
	COUNTYWIDE	5/15/2001	Flash Flood	$50,000	$50,000	
	COUNTYWIDE	5/15/2001	Flash Flood	$25,000	$25,000	
	COUNTYWIDE	5/16/2001	Flash Flood	$50,000	$50,000	
	COUNTYWIDE	5/16/2001	Flash Flood	$25,000	$25,000	
		5/23/2004*	Flood	$1,000,000	$200,000	
	HESPERIA	8/13/2011	Flash Flood	$100,000	$0	
	VOLNEY	4/17/2013*	Flood	$5,000,000	$0	
	CROTON	4/12/2014*	Flood	$4,000,000	$0	
		2/19/2018*	Flood			
	NEWAYGO	3/14/2019*	Flood	$1,700,000	$0	
	SITKA	10/2/2019	Flood	$25,000	$0	
	SITKA	5/18/2020	Flood	$25,000	$0	
	Total	**17 Events**		**$12,110,000**	**$350,000**	**None**
Oceana		8/20/1975 to 9/9/1975*	Rainstorms, severe winds, flooding			
		10/28/1986*, 9/10-19/1986*	Flooding, Heavy Rain			
		2/24/2001	Flood	$10,000	$0	
	ROTHBURY	2/21/1997	Flash Flood	$0	$0	
	HART	8/4/1998	Flash Flood	$0	$0	
	COUNTYWIDE	2/9/2001	Flash Flood	$100,000	$0	
		5/23/2004	Flood	$1,000,000	$200,000	
	COUNTYWIDE	5/15/2001	Flash Flood	$500,000	$200,000	
	COUNTYWIDE	5/15/2001	Flash Flood	$25,000	$25,000	
	COUNTYWIDE	5/16/2001	Flash Flood	$25,000	$25,000	
	PENTWATER	4/17/2013	Flood	$3,000,000	$0	
	Total	**11 events**		**$4,660,000**	**$450,000**	**None**
Ottawa		4/18/1975 to 4/30/1975*	Flooding, rain			
		8/20/1975 to 9/9/1975*	Rainstorms, severe winds, flooding			
		10/28/1986*, 9/10-19/1986*	Flooding, Heavy Rain			
	SOUTHERN	5/20/1996	Flash Flood	$100,000	$0	1 injury
	HOLLAND	6/18/1996	Flash Flood	$100,000	$0	
	GRAND HAVEN	2/21/1997	Flash Flood	$0	$0	
	COUNTY-WIDE	6/20/1997*	Flash Flood	$1,350,000	$0	2 injuries
		3/22/1998	Flood	$0	$0	
	COUNTYWIDE	5/18/2000	Flash Flood	$300,000	$100,000	
		2/9/2001	Flood	$50,000	$0	
		2/24/2001	Flood	$10,000	$0	
	COUNTYWIDE	5/15/2001	Flash Flood	$50,000	$50,000	
	COUNTYWIDE	5/15/2001	Flash Flood	$25,000	$25,000	
	HOLLAND	7/23/2001	Flash Flood	$50,000	$25,000	

	LOCATION	DATE	EVENT TYPE	PROPERTY DAMAGES	CROP DAMAGES	DEATHS / INJURIES
Ottawa	HOLLAND	10/24/2001	Flash Flood	$25,000	$0	
		5/21/2004*	Flood	$1,000,000	$200,000	
	HOLLAND	6/7/2008*	Flash Flood	$1,000,000	$1,500,000	1 Death
	ROBINSON	6/8/2008	Flood	$5,000	$5,000	1 Death
	CRISP	12/27/2008	Flood	$3,600,000	$0	
	VRIESLAND	6/19/2009	Flash Flood	$34,000,000	$0	
	HUDSONVILLE	6/21/2011	Flash Flood	$0	$0	
	VRIESLAND	6/21/2011	Flash Flood	$1,500,000	$0	
	FERRYSBURG	4/17/2013*	Flood	$5,000,000	$0	
		2/19/2018*	Flood			
	GRAND HAVEN ARPT	5/18/2020	Flood	$5,000,000	$0	
	Total	**25 Events**		**$53,165,000**	**$1,905,000**	**2 Deaths, 3 Injuries**
Wexford	CADILLAC	5/12/2000	Flash Flood	$0	$0	
	COUNTYWIDE	4/12/2001	Flash Flood	$0	$0	
	COUNTYWIDE	5/15/2001	Flash Flood	$0	$0	
	WEST PORTION	5/19/2001	Flash Flood	$0	$0	
	CADILLAC	5/9/2004	Flash Flood	$20,000	$0	
	HOXEYVILLE	6/12/2008*	Flash Flood	$750,000	$0	
	HARRIETTA BUNCH ARPT	6/13/2008*	Flood	$40,000	$0	
	HARING	7/25/2012	Flash Flood	$40,000	$0	
	CADILLAC WEXFORD ARP	7/27/2012	Flash Flood	$12,000	$0	
	LAKE MITCHELL	11/17/2013	Flash Flood	$10,000	$0	
	LAKE CADILLAC	4/14/2014*	Flood	$110,000	$0	
	Total	**11 Events**		**$982,000**	**$0**	**None**

Sources: NOAA National Centers for Environmental Information Storm Events Database, search history 01/01/1950 to 12/31/2022; MSP's 2019 *Michigan Hazard Analysis*
Notes: * indicates event associated with Disaster or Emergency Declaration(s) from the Governor and/or President

Probability of Future Events and Vulnerability Assessment

Between 1986 and 2022, Manistee County has had 11 inland flooding events, indicating there is a 29.7% annual chance of a riverine or urban flood event occurring in that county. The LRBOI Tribe holds festivals and events such as the annual Pow Wow, which takes place in mid-July, and the annual Language Camp, held the last weekend in July, at the LRBOI Governmental Center in Manistee County. This area is not located in close proximity to the Manistee River.

Table 28 provides estimates for annual future inland flooding in the remaining counties of the LRBOI Service area, based on historic flood event data.

Table 28. Annual Percent Chance of an Inland Flooding Event

County	# of Inland Flood Events	Timeframe	Annual % Chance of a Flood
Kent	29	1975-2022 (48 years)	60.4%
Ottawa	25	1975-2022 (48 years)	52.0%
Muskegon	18	1975-2022 (48 years)	37.5%
Newaygo	17	1975-2022 (48 years)	35.4%
Mason	15	1986-2022 (37 years)	40.5%
Wexford	11	2000-2022 (23 years)	47.8%
Oceana	11	1975-2022 (48 years)	22.9%
Lake	10	1986-2022 (37 years)	27.0%

The magnitude and severity of a flooding event depends on the population, seasonal activity, and the intensity of development at the areas of impact. During the warm or summer months, the population expands to include both the permanent population and visitors to the area. The seasonal population is attracted to both rural, sparsely populated and

urban centers, such as the cities of Manistee, Muskegon, Grand Rapids, Holland, Grand Haven, and Ludington. These cities are located along major river systems that have experienced flooding disasters and emergencies: The Grand River in Ottawa and Kent counties; the Muskegon River in Muskegon and Newaygo counties; the Manistee River in Wexford and Manistee counties; and the Pere Marquette River in Lake, Mason, Newaygo and Oceana counties. The cities' dense, urban development, including historical resources, impoverished neighborhoods, and assisted living facilities, are vulnerable to flooding from rivers that pass through.

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

Inland flooding events will continue to occur at times in Manistee County. Years with exceptional snowfall levels will likely result in flooding events from snowmelt. Increasing Lake Michigan water temperatures will create more active storm systems and heavier rainfalls. Fluctuating Lake Michigan water levels will also increase inland flooding events as groundwater tables rise. Furthermore, increased development, reduction in green space, and subsequent soil erosion can cause sedimentation to accumulate in river and lake beds reduce the amount of water flow. Rivers and lakes with sedimentation buildup will experience water backups and flooding events unless mitigated.

Specific flood hazard areas were identified during public meetings and are identified on the Hazard Areas Map provided in Appendix A. It should be noted that the Hazard Areas Map identifies parts of the City of Manistee as having combined sewer overflows; however as of spring of 2023 the City completed all of its multi-phase storm sewer and sanitary sewer separation projects to eliminate combined sewer overflows that historically impacted the water quality of Manistee Lake and Lake Michigan.

The Manistee River corridor is an identified flood hazard area with the added flooding risk of a potential dam failure at Tippy or Hodenpyl Dams. Both dams are classified as "High Hazard" potential dams, meaning that failure or dam misoperation will probably result in loss of human life. Consumers Energy (CE), as the owner/operator, is required to maintain Emergency Action Plans for the dams on file with the Federal Energy Regulation Commission (FERC).

CE held community input sessions regarding their long-term hydro strategy options for these dams in 2022. The hydro operating licenses issued by FERC to CE for the dams will expire in 2034. Future potential options for the dams include: 1) Relicense the dam, meeting all the new regulatory requirements, and continue to generate power; 2) Surrender the license and sell the dam to a third-party owner, who could maintain the dam structure and impoundment; 3) Remove the dam and return the river to its natural state; or 4) Replace the dam with an alternative structure. In 2023, CE intends to provide their long-term hydro strategy, and between 2023 and 2034, the relicensing and/or retiring process will be underway, which will continue to include community engagement efforts. Refer to CE's website for updated information: https://www.consumersenergy.com/company/electric-generation/renewables/hydroelectric/hydro-future

While dams can provide flood protection, energy supply, and water security, they also pose a significant threat to freshwater species. Dams block fish from moving along their natural pathways between feeding and spawning grounds, causing interruptions in their life cycles that limit their abilities to reproduce. The Manistee River is a Blue Ribbon Trout Stream, a top-quality stream able to support excellent stocks of wild resident trout and have excellent water quality, while being able to support trout habitat and food sources. In addition to trout, the Manistee River also supports the lake sturgeon population. The LRBOI Lake Sturgeon Rehabilitation Program identifies the river area below the Tippy Dam as a larval drifting area. The Manistee River's native aquatic species are vulnerable to potential flooding and dam failure.

Whitefish and lake trout would populations would bear the largest impact from removal of dams along the Manistee River or a major flood event in Manistee County. Arctic Grayling, a species of freshwater fish in the salmon family that is found further upstream in the watershed, is another species that may also be adversely impacted by these events. Little River is a founding partner to the Michigan Arctic Grayling Initiative (MAGI). This organization has grown to include more than 50 partners to develop ideas and move Grayling reintroductions forward. Through research conducted by Little River and the help of various graduate students, the best candidate streams in the Upper Manistee are becoming more apparent. Habitat work will continue on this region to provide a recommendation as to where Grayling eggs should be first be placed in the Upper Manistee. Little River has plans to continue to develop Remote Site Incubators (RSI) so they are more efficient in Michigan's low gradient streams and we also are evaluating other devices that may be easier to deploy when Arctic Grayling eggs are first put into the streams again. Little River is also working with various partners to improve the Upper Manistee prior to Grayling reintroductions by exploring culvert replacement projects which will help Grayling freely migrate throughout the system, which will enhance their ability to self-sustain.

Additionally, the 700 acre Custer Property that LRBOI owns in Mason County contains a cemetery (a culturally significant site; See Figure 10) and adjoins the Pere Marquette River to the north. While no impacts from flooding/erosion of the cemetery land have been observed by LRBOI staff to-date, the site does have the potential to experience impacts from future flooding and erosion along the steep banks leading down to the riverbed.

Flood zone hazard information may be obtained from the Flood Rate Insurance Maps (FIRM) available for jurisdictions through FEMA's online Flood Map Service Center. Flood hazard zones are also labeled on the Environmental Features Maps in Appendix A.

The Infrastructure Map included in Appendix A illustrates the locations of road/stream crossings, bridges and Michigan-regulated dams with their currently available condition rating. It should be noted that data is not available for every infrastructure location. The Townships of Bear Lake, Brown, Cleon, Dickson, Manistee, Maple Grove, Marilla, Norman, Pleasanton, Springdale and Stronach have road/stream crossings that are rated as having a "moderate" or "severe" condition. The US-31 Bridge over the Manistee River in the City of Manistee has a "poor" condition rating. The Kurick Road Bridge over the Betsie River in Springdale Township is in "poor" condition, and the Leffew Road Bridge over Bear Creek in that township is indicated as "closed".

NFIP Participation Status

The Little River Band of Ottawa and Chippewa Indians is not a participant in the National Flood Insurance Program. Table 29 lists available FIRMs for the communities within the LRBOI tribal service area. The highlighted/bolded entries in are communities with printed FIRMs that include lands under LRBOI ownership. Note that the LRBOI tribe owns properties only in Manistee, Mason and Muskegon counties.

Table 29. NFIP FIRM Information for Communities in the LRBOI Service Area

CID	County	NFIP-Participating Community Name	Init FHBM	Init FIRM	Curr Eff Map Date	Reg-Emer Date	Tribal
260248A	KENT	ADA, TOWNSHIP OF	11/22/74	10/15/80	02/23/23	10/15/80	No
260738A		ALGOMA, TOWNSHIP OF		01/03/85	02/23/23	01/03/85	No
260961A		ALPINE, TOWNSHIP OF		02/23/23	02/23/23	02/23/23	No
260963A		BYRON, TOWNSHIP OF		02/23/23	02/23/23	07/14/23	No
260693A		CALEDONIA, CHARTER TOWNSHIP OF	03/24/78	07/02/81	02/23/23	07/02/81	No
260734A		CANNON, TOWNSHIP OF		09/16/88	02/23/23	09/16/88	No
260814A		CASCADE, CHARTER TOWNSHIP OF		11/06/91	02/23/23	11/06/91	No
260105A		EAST GRAND RAPIDS, CITY OF	05/17/74	09/03/80	02/23/23	09/03/80	No
260106A		GRAND RAPIDS, CITY OF	11/09/73	01/17/79	02/23/23	01/17/79	No
260271A		GRANDVILLE, CITY OF	07/13/73	09/16/82	02/23/23	09/16/82	No
260107A		KENTWOOD, CITY OF	11/02/73	11/18/81	02/23/23	11/18/81	No
260108A		LOWELL, CITY OF	05/10/74	05/16/83	02/23/23	05/16/83	No
260974A		OAKFIELD, TOWNSHIP OF		02/23/23	(NSFHA)	02/23/23	No
260109A		PLAINFIELD, CHARTER TOWNSHIP OF	11/09/73	01/02/81	02/23/23	01/02/81	No
260976A		SAND LAKE, VILLAGE OF			(NSFHA)	05/05/23	No
260741A		SPARTA, TOWNSHIP OF		01/03/85	02/23/23	01/03/85	No
260336A		SPARTA, VILLAGE OF	10/15/76	02/16/83	02/23/23	02/16/83	No
260110A		WALKER, CITY OF	10/12/73	06/01/82	02/23/23	06/01/82	No
260111A		WYOMING, CITY OF	11/09/73	09/02/82	02/23/23	09/02/82	No
260798	LAKE	CHERRY VALLEY, TOWNSHIP OF			(NSFHA)	09/30/87	No
260691		LAKE, TOWNSHIP OF			(NSFHA)	03/16/88	No
260431		PLEASANT PLAINS, TOWNSHIP OF	08/01/75	09/01/86	09/01/86(L)	09/01/86	No
260754		WEBBER, TOWNSHIP OF			(NSFHA)	09/18/87	No
260432		YATES, TOWNSHIP OF	08/15/75	09/01/86	09/01/86(L)	09/01/86	No
260306A	MANISTEE	ARCADIA, TOWNSHIP OF	01/31/75	09/01/86	06/02/21	09/01/86	No
260130A		FILER, CHARTER TOWNSHIP OF	11/26/76	07/01/91	06/02/21	07/01/91	No
260131A		**MANISTEE, CITY OF**	**05/24/74**	**03/18/87**	**06/02/21**	**03/18/87**	**No**
260132A		**MANISTEE, TOWNSHIP OF**	**05/14/76**	**11/15/89**	**06/02/21**	**11/15/89**	**No**
260276A		ONEKAMA, TOWNSHIP OF	06/28/74	05/01/78	06/02/21	05/01/78	No
261935A		ONEKAMA, VILLAGE OF		06/02/21	06/02/21	05/25/21	No
260801A		STRONACH, TOWNSHIP OF		09/30/88	06/02/21	09/30/88	No

CID	County	NFIP-Participating Community Name	Init FHBM	Init FIRM	Curr Eff Map Date	Reg-Emer Date	Tribal
261271B	MASON	AMBER, TOWNSHIP OF		07/16/14	08/24/21(M)	08/15/14	No
261272#		BRANCH , TOWNSHIP OF		07/16/14	07/16/14(M)	08/01/14	No
261274#		EDEN, TOWNSHIP OF		07/16/14	07/16/14(M)	07/16/14	No
260134B		HAMLIN, TOWNSHIP OF	08/23/74	12/17/87	08/24/21	12/17/87	No
260811#		LOGAN, TOWNSHIP OF		09/07/98	07/16/14(M)	09/07/98	No
260581B		LUDINGTON, CITY OF	10/03/75	07/16/14	08/24/21	07/16/14	No
261026#		MEADE, TOWNSHIP OF		07/16/14	(NSFHA)	07/16/14	No
260582B		PERE MARQUETTE, CHARTER TOWNSHIP OF	01/30/78	07/03/85	08/24/21	07/03/85	No
261282#		SHERIDAN, TOWNSHIP OF		07/16/14	(NSFHA)	07/16/14	No
261281#		SHERMAN, TOWNSHIP OF		07/16/14	(NSFHA)	07/16/14	No
260307B		SUMMIT, TOWNSHIP OF	01/31/75	12/17/87	08/24/21	12/17/87	No
261283B		VICTORY, TOWNSHIP OF		07/16/14	(NSFHA)	04/13/18	No
261198B	MUSKEGON	CEDAR CREEK, TOWNSHIP OF		07/06/15	07/06/15(M)	09/26/16	No
261199B		DALTON, TOWNSHIP OF		07/06/15	(NSFHA)	10/11/19	No
260680B		EGELSTON, TOWNSHIP OF	08/19/77	08/01/86	07/06/15(M)	08/01/86	No
260265B		FRUITLAND, TOWNSHIP OF	06/28/74	09/01/86	10/07/21	09/01/86	No
261200B		FRUITPORT, CHARTER TOWNSHIP OF		07/06/15	10/07/21	07/06/15	No
260159B		LAKETON, TOWNSHIP OF	08/02/74	04/03/78	10/07/21	04/03/78	No
260160B		MONTAGUE, CITY OF	06/14/74	05/01/78	10/07/21	05/01/78	No
260162B		MUSKEGON HEIGHTS, CITY OF	06/28/74	02/18/81	10/07/21	02/18/81	No
260163B		MUSKEGON, CHARTER TOWNSHIP OF	09/06/74	08/01/77	10/07/21	08/01/77	No
260161B		MUSKEGON, CITY OF	06/07/74	06/01/77	10/07/21	06/01/77	No
260164B		NORTH MUSKEGON, CITY OF	05/31/74	05/02/77	10/07/21	05/02/77	No
260165B		NORTON SHORES, CITY OF		09/15/77	10/07/21	09/15/77	No
260731B		RAVENNA, TOWNSHIP OF		05/17/89	07/06/15(M)	05/17/89	No
260299B		WHITE RIVER, TOWNSHIP OF	10/08/76	01/16/81	10/07/21	01/16/81	No
260166B		WHITEHALL, CITY OF	08/23/74	10/15/80	10/07/21	10/15/80	No
260694A	NEWAYGO	ASHLAND, TOWNSHIP OF	05/19/78	09/01/86	02/18/15	09/01/86	No
260466A		BRIDGETON, TOWNSHIP OF	10/22/76	09/04/86	02/18/15	09/04/86	No
260467A		BROOKS, TOWNSHIP OF	07/18/75	07/03/86	02/18/15	07/03/86	No
260468A		CROTON, TOWNSHIP OF	03/10/78	09/30/78	02/18/15(M)	09/30/88	No
261402A		DAYTON, TOWNSHIP OF		02/18/15	02/18/15(M)	12/15/15	No
261042A		ENSLEY, TOWNSHIP OF		02/18/15	(NSFHA)	02/18/15	No
260167A		FREMONT, CITY OF	05/31/74	08/10/79	02/18/15(M)	08/10/79	No
260469A		GARFIELD, TOWNSHIP OF	08/08/75	09/29/86	02/18/15	09/29/86	No
260828A		LINCOLN, TOWNSHIP OF		09/27/91	02/18/15	02/21/96	No
260340A		NEWAYGO, CITY OF	09/12/75	02/18/15	02/18/15	05/25/84	No
261899A		SHERIDAN, CHARTER TOWNSHIP OF		02/18/15	02/18/15(M)	12/07/15	No
261384A		SHERMAN, TOWNSHIP OF		02/18/15	02/18/15(M)	02/18/15	No
260470A		WHITE CLOUD, CITY OF	04/11/75	09/01/86	02/18/15(M)	09/01/86	No
261013A		WILCOX, TOWNSHIP OF		02/18/15	02/18/15(M)	02/18/15	No
260485B	NEWAYGO /OCEANA	HESPERIA, VILLAGE OF	07/11/75	08/01/86	08/04/14(M)	08/01/86	No
260481B	OCEANA	BENONA, TOWNSHIP OF	10/15/76	08/01/86	08/24/21	08/01/86	No
260482B		CLAYBANKS, TOWNSHIP OF	11/26/76	08/04/14	08/24/21	03/18/87	No
261799#		FERRY, TOWNSHIP OF		08/04/14	08/04/14(M)	11/20/17	No
260301B		GOLDEN, TOWNSHIP OF	01/17/75	09/01/86	08/24/21	09/01/86	No
260484B		HART, CITY OF	04/11/75	09/01/86	08/24/21(M)	09/01/86	No
260697#		NEWFIELD, TOWNSHIP OF	12/23/77	09/01/86	08/04/14(M)	09/01/86	No
260183B		PENTWATER, TOWNSHIP OF	06/21/74	03/01/78	08/24/21	03/01/78	No
260277B		PENTWATER, VILLAGE OF	09/13/74	05/15/78	08/24/21	05/15/78	No

CID	County	NFIP-Participating Community Name	Init FHBM	Init FIRM	Curr Eff Map Date	Reg-Emer Date	Tribal
260490#	OTTAWA	ALLENDALE, CHARTER TOWNSHIP OF	03/25/77	07/05/82	05/16/13	07/05/82	No
261005#		BLENDON, TOWNSHIP OF		12/16/11	(NSFHA)	05/16/13	No
260829#		CHESTER, TOWNSHIP OF		11/20/91	12/16/11(M)	11/20/91	No
260491#		COOPERSVILLE, CITY OF	09/26/75	03/02/83	12/16/11	03/02/83	No
260981#		CROCKERY, TOWNSHIP OF		12/16/11	12/16/11	06/24/14	No
260184C		FERRYSBURG, CITY OF	06/28/74	03/01/78	10/21/21	03/01/78	No
260589#		GEORGETOWN, CHARTER TOWNSHIP OF	09/26/75	07/18/85	05/16/13	07/18/85	No
260269C		GRAND HAVEN, CITY OF	06/28/74	02/15/78	10/21/21	02/15/78	No
260270C		GRAND HAVEN, TOWNSHIP OF	08/02/74	01/16/81	10/21/21	01/16/81	No
260492C		HOLLAND, CHARTER TOWNSHIP OF	08/12/77	12/01/83	10/21/21	12/01/83	No
260493#		HUDSONVILLE, CITY OF	09/05/75	12/04/84	12/16/11	12/04/84	No
261001#		JAMESTOWN, TOWNSHIP OF		12/16/11	12/16/11	06/24/14	No
261006C		OLIVE, TOWNSHIP OF		12/16/11	10/21/21	12/16/11	No
260185C		PARK, TOWNSHIP OF	08/16/74	05/15/78	10/21/21	05/15/78	No
260923#		POLKTON, CHARTER TOWNSHIP OF		12/16/11	12/16/11	12/16/11	No
260278C		PORT SHELDON, TOWNSHIP OF	08/16/74	05/15/78	10/21/21	05/15/78	No
260913#		ROBINSON, TOWNSHIP OF		12/16/11	12/16/11	12/16/11	No
260281C		SPRING LAKE, TOWNSHIP OF	06/28/74	02/15/78	10/21/21	02/15/78	No
260282C		SPRING LAKE, VILLAGE OF	06/28/74	06/01/78	10/21/21	06/01/78	No
260494#		TALLMADGE, CHARTER TOWNSHIP OF	06/10/77	03/02/83	05/16/13	03/02/83	No
260495#		WRIGHT, TOWNSHIP OF	05/27/77	12/16/11	12/16/11(M)	11/12/97	No
260983#		ZEELAND, CITY OF		12/16/11	12/16/11	06/24/14	No
260932#		ZEELAND, TOWNSHIP (CHARTER)		12/16/11	12/16/11	12/16/11	No
260247#	WEXFORD	CADILLAC, CITY OF	06/14/74	03/18/96	08/03/98	03/18/96	No
260935#		CEDAR CREEK, TOWNSHIP OF		08/03/98	(NSFHA)	09/26/16	No
260938#		CHERRY GROVE, TOWNSHIP OF		08/03/98	08/03/98	07/28/99	No
260947#		GREENWOOD, TOWNSHIP OF		08/03/98	(NSFHA)	06/30/97	No
260757#		SELMA, TOWNSHIP OF		09/30/88	08/03/98	09/30/88	No

CID	County	Non-NFIP Participating Community Name	Init FHBM	Init FIRM	Curr Eff Map Date	Sanction Date	Tribal
260966A	KENT	CEDAR SPRINGS, CITY OF		02/23/23	02/23/23	02/23/24	No
260990A		GAINES, CHARTER TOWNSHIP OF		02/23/23	02/23/23	02/23/24	No
260968A		GRAND RAPIDS, CHARTER TOWNSHIP OF		02/23/23	02/23/23	02/23/24	No
260971A		KENT CITY, VILLAGE OF		02/23/23	02/23/23	02/23/24	No
260972A		LOWELL, CHARTER TOWNSHIP OF		02/23/23	02/23/23	02/23/24	No
260975A		ROCKFORD, CITY OF		02/23/23	02/23/23	02/23/24	No
261409A		SOLON, TOWNSHIP		02/23/23	02/23/23	02/23/24	No
260979A		TYRONE, TOWNSHIP OF		02/23/23	02/23/23	02/23/24	No
260980A		VERGENNES, TOWNSHIP OF		02/23/23	02/23/23	02/23/24	No
261934A	MANISTEE	EASTLAKE, VILLAGE OF		06/02/21	06/02/21	06/02/22	No
261273#	MASON	CUSTER, TOWNSHIP OF		07/16/14	07/16/14	07/16/15	No
261277B		GRANT, TOWNSHIP OF		07/16/14	08/24/21	07/16/15	No
261279B		RIVERTON, TOWNSHIP OF		07/16/14	08/24/21	07/16/15	No
261201B	MUSKEGON	FRUITPORT, VILLAGE OF		10/07/21	10/07/21	10/07/22	No
261240B		MONTAGUE, TOWNSHIP OF		07/06/15	10/07/21	07/06/16	No
261205B		MOORLAND, TOWNSHIP OF		07/06/15	07/06/15	07/06/16	No
260464B		RAVENNA, VILLAGE OF	09/26/75	05/17/89	07/06/15	09/26/76	No
261207B		SULLIVAN, TOWNSHIP OF		07/06/15	07/06/15	07/06/16	No
261208B		WHITEHALL, TOWNSHIP OF		07/06/15	10/07/21	07/06/16	No
260965A	MUSKEGON, KENT	CASNOVIA, VILLAGE OF		02/23/23	02/23/23	02/23/24	No
261404A	NEWAYGO	EVERETT, TOWNSHIP OF		02/18/15	02/18/15	02/18/16	No
261379A		LILLEY, TOWNSHIP OF		02/18/15	02/18/15	02/18/16	No

CID	County	Non-NFIP Participating Community Name	Init FHBM	Init FIRM	Curr Eff Map Date	Sanction Date	Tribal
260483B	OCEANA	GREENWOOD, TOWNSHIP OF	10/22/76	08/01/86	08/04/14	08/05/14(S)	No
260777B		HART, TOWNSHIP OF		08/04/14	08/24/21	08/05/14(S)	No
261873#		OTTO, TOWNSHIP OF		08/04/14	08/04/14	08/04/15	No
261868B		WEARE, TOWNSHIP OF		08/04/14	08/24/21	08/04/15	No
260939#	WEXFORD	CLAM LAKE, TOWNSHIP OF		08/03/98	08/03/98	08/03/99	No
260928#		HARING, CHARTER TOWNSHIP OF		08/03/98	08/03/98	08/03/99	No
260944#		SOUTH BRANCH, TOWNSHIP OF		08/03/98	08/03/98	08/03/99	No
Legend:							
NSFHA	No Special Flood Hazard Area - All Zone C						
(M)	No Elevation Determined - All Zone A, C and X						
(L)	Original FIRM by Letter - All Zone A, C and X						
(S)	Suspended Community						

Sources: FEMA Community Status Book Report; FEMA Flood Map Service Center https://msc.fema.gov/portal/home
Note: Communities shown in BOLD font contain LRBOI Tribal-owned property

Networks Northwest staff requested information on any NFIP "repetitive loss" properties in the nine county LRBOI service area from the Regional Flood Insurance Liaison within FEMA's Region 5 Mitigation Division. At the time this plan was completed, a response had not been received. Refer to Appendix G for documentation of this request.

None of the LRBOI critical infrastructure properties (shown in Appendix A) are located within the flood hazard areas indicated on available Flood Insurance Rate Map (FIRM) panels[1] for Manistee Township, the City of Manistee, or the Village of Eastlake. However, the LRBOI-owned property at 480 N. Water Street in the City of Manistee adjoins the Zone AE Flood Hazard Area (the Manistee River). Also, part of a vacant tribe-owned parcel of land off of Schoedel Road in Manistee Township is located in part of a "Zone A" Special Flood Hazard Area (SFHA) (part of Bar Lake Swamp). Refer to Table 30 for a list of tribal owned parcels that are included in printed FIRMs. The LRBOI has not identified any properties or structures that have suffered repetitive loss from flooding. The Tribe will continue to monitor properties and structures located in flood-prone areas.

Table 30. Printed FIRM Panels Containing LRBOI Tribal-Owned Lands

County	Community	Flood Map #	Effective Date	Description of Tribal Property
Manistee	City of Manistee	26101C0377D	6/2/2021	Office building and lawn at 480 N. Water Street. The property is not within a SFHA, but the lawn portions of the property adjoin SFHA "Zone AE" (Manistee River).
Manistee	Village of Eastlake	26101C0400D	6/2/2021	The LRBOI's "Big Blue" NRD storage building at 159 Brickyard Rd. is located near Zone AE (Manistee Lake), but not in it; a railroad separates the tribal-owned parcel from the SFHA.
Manistee	Manistee Township	26101C0234D*, 26101C0275D, 26101C0245D	6/2/2021	A portion of a LRBOI parcel* (vacant land, no buildings) is located south of Schoedel Road. Part of Bar Lake Swamp runs through the parcel and is a "Zone A" SFHA. Other LRBOI-owned properties in Manistee Township are in areas designated as "minimal flood hazard" (Zone X).
Mason	Custer Township	26105C0300C	7/16/2014	Parcels (undeveloped land) owned by LRBOI adjoin the Pere Marquette River. This area is outside the limits of FEMA Flood Study for this part of Custer Township.
Muskegon	Fruitport Charter Township	26121C0287E, 26121C0289E, 26121C0293E	10/7/2021	Parcels of vacant land and a farmstead, in designated areas of minimal flood hazard ("Zone X").
Muskegon	City of Norton Shores	26121C0287E	10/7/2021	Commercial building at 4905 S. Harvey Street in designated area of minimal flood hazard ("Zone X").
Muskegon	City of Muskegon	26121C0259E	10/7/2021	Commercial building at 1101 W. Hackley Ave. in designated area of minimal flood hazard ("Zone X").
Other LRBOI-owned properties are located in communities that do not have completed FEMA flood insurance studies.				

[1] Source: FEMA Flood Map Service Center https://msc.fema.gov/portal/home

Lightning

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

Location
Lightning is not confined to geographic boundaries and is a regional event. Since lightning occurs randomly, it is impossible to predict where lightning will occur and how severe it will be. The entire LRBOI service area is at risk from lightning hazards.

Extent
Lightning can be measured by damages-caused including deaths, injuries, property damages, and/or crop damages. Between 1950 and 2022, ten lightning events have been reported to NOAA for the LRBOI tribal service area. These events resulted in one fatality (a hiker on the North Country Trail), one injury (a park employee), and a total of $1.2 million in property damage (incurred from lightning strikes causing structural fires and a gas well fire). No crop damages were reported.

Previous Occurrences
Table 31 provides a description of lightning events in the LRBOI service area.

Table 31: Lightning Events in the LRBOI Service Area

County	Community	Date	Deaths	Injuries	Property Damage	Event Details
Ottawa	Nunica	4/21/1998	0	0	$60,000	The Muskegon Chronicle reported that lightning struck the roof of a brick house at 10048 State St. in Nunica at 4:45 pm EDT. No one was injured in the blaze that ensued. Damage to the home was estimated at $45,000 and the fire destroyed about $15,000 worth of the family's belongings.
Ottawa	Jamestown	5/6/1998	0	1		The Muskegon Chronicle reported a 34 year-old male was critically injured when he was struck by lightning at Spring Grove Park near Jamestown, in southeastern Ottawa County. The Ottawa County Parks and Recreation Department employee suffered severe leg and chest injuries.
Kent	Alto	6/16/1998	0	0		A fire sparked by a lightning strike destroyed the new education building of the Whitneyville Bible Church at 8546 Whitneyville Ave SE in Alto, located in southeast Kent County. Lightning struck the southwest corner of the building around 6:30 pm EDT, according to the church's senior pastor. The fire destroyed the 80-foot by 120-foot brick building and charred classrooms, musical instruments, furniture, books, and computers. An estimate of the damage was not available.
Ottawa	Hudsonville	7/21/1998	0	0		Lightning struck the roof of a three-bedroom home at 7836 Mooring Court in the Hidden Ridge Estate Complex in Georgetown Township at 6:10 am EDT. Most of the house was destroyed in the blaze touched off by the strike. No injuries were reported. A damage estimate was not available.

Kent	Kentwood	7/21/1998	0	0	$500,000	The Grand Rapids Press reported that a lightning strike at a Kentwood apartment building caused a fire that heavily damaged the building. Fire Chief Jim Carr said that the blaze was started by a lightning strike and caused more than $500,000 in structural damage to the complex. Six apartments, on the top floor of a building at Wingate Apartments on Schafer Avenue SE, were destroyed when the roof caved in and at least 10 more apartments were damaged. No injuries were reported. The thunderstorm knocked out electricity to about 15,000 homes in the Grand Rapids metropolitan area, mostly caused by lightning strikes.
Muskegon	Muskegon County	7/21/1998	0	0	$40,000	The Muskegon Chronicle reported lightning strikes caused 2 separate fires in the area and resulted in power outages affecting 7,500 people in the Muskegon service area. A house fire at 2862 Evanston Avenue in Muskegon Township was caused by a lightning strike. The fire burned the attic and damage was estimated at $40,000. Lightning was also the cause of a fire at an 18-unit storage building at Boxer Store and Lock in Egelston Township. The sheet metal and wood frame building and all of its contents were completely destroyed. A damage estimate for this fire was not available.
Manistee and Wexford	Countywide/ Region	9/1/2000	0	0	0	Lightning associated with several thunderstorms moving over the region that night was nearly continuous. Lightning that Friday night also disrupted numerous high school football games. Many games were cancelled or postponed until the following Saturday morning. Many of the schools which began play had lengthy delays and many waited an hour or more before fans and players could return to the field. This was widely covered by area newspapers and television stations. The cost of postponed games is not known.
Newaygo	Ensley Center	6/5/2008	0	0	$100,000	An isolated severe thunderstorm resulted in a report of one inch diameter hail. A lightning strike resulted in a gas well fire in Ensley Center in Newaygo County, resulting in significant damage.
Kent	Eastmont	9/21/2010	0	0	$500,000	Local fire departments reported that around a dozen house fires were produced by lightning from Ada south to Caledonia.
Manistee	High Bridge	9/6/2016	1	0	0	A line of strong to severe thunderstorms crossed northern lower Michigan during the afternoon. A 71-year old Texas man was struck and killed by lightning while on the North Country Trail in Dickson Township.
		Total	**1**	**1**	**$1,200,000**	

Source: NOAA: National Centers for Environmental Information Storm Events Database, search dates 1/1/1950 to 12/31/2022

Probability of Future Events and Vulnerability Assessment

There have been eleven impactful lightning events reported for the LRBOI service area in the past 25 years (between 1998 and 2022). This indicates there is a 44% chance of an impactful lightning strike occurring in a future year. However, it is assumed that not all lightning events have been reported since events with injuries, deaths, and extensive damages tend to be the only ones reported. Therefore, the number of lightning events and damages may be higher.

As conveyed in the event details from lightning events in the LRBOI tribal service area (Table 31), lightning strikes can cause structural, gas well, or wildland fires (especially in drought/dry soil conditions); disruption of outdoor events; inoperability of electrical, telecommunications, and utility systems; destruction of personal property; and injury or death to people. Persons that work outside or participate in outdoor recreation activities have a higher risk of being struck by

lightning. During the hazard mitigation planning process, LRBOI Tribal government staff expressed concern for members who may be caught unaware by a severe storm incident.

Additionally, power outages caused by downed trees or lightning strikes have caused service issues for the Tribe's wastewater utility system. Lightning has struck the utility system's electrical components, and Tribe had to repair the components and put surge protectors in place. The Tribe has installed generators in some areas of the wastewater utility system in order to minimize disruptions from power loss. However, the Hazard Areas Map in Appendix A indicates that LRBOI's sanitary sewer collection system along East Parkdale Avenue does not have backup generator power for any of the system's lift stations.

Tornado

Tornadoes are rapidly rotating columns of air that impact the ground after forming from some of the severe thunderstorms that occur during Michigan's warm months. Tornadoes can cause catastrophic damage to either a limited or an extensive area. A tornado can have winds exceeding 200 miles per hour and can have widths over one mile. These storms are the most violent of the atmospheric storms since they have the potential to destroy buildings, uproot trees, hurl objects, and cause loss of life.

According to the National Oceanic and Atmospheric Administration/National Weather Service's Storm Prediction Center, tornadoes cause approximately 60 deaths and hundreds of millions of dollars in property damage each year. The Michigan State Police's *2019 Michigan Hazard Analysis*, Michigan is located on the northern fringe of the nation's tornado belt, and since 1996 has averaged about 18 tornadoes per year. The longer term annual average (since 1950) is 8 injuries and one death per year, and over $17 million in property damages statewide.

Between 1999 and 2019, Michigan has had 314 reported tornado events with 52.9% as EF0 (weak) or EF1 (moderate), 38.9% reported as F0 or F1 (weak), 6.7% as EF2 (significant) or EF3 (severe), and 1.6% as F2 (strong). In Northern Michigan, tornados are most likely in the summer months, although some have occurred in the spring and fall.

Location
Tornadoes are a regional event that are not confined to geographic boundaries and can affect several areas at one time. Also, the magnitude of tornadoes may range across the affected areas. The entire LRBOI service is at risk from tornados. It is impossible to predict where and with what magnitude a tornado will touch down. Approximate trajectories of recorded tornadoes with NOAA are illustrated on the Hazard Areas Map in Appendix A.

Extent
The Fujita Scale (Table 32) categorizes tornado severity based on observed damage. The six-step scale ranges from F0 (light damage) to F5 (incredible damage). As of February 2007, the National Weather Service uses the Enhanced Fujita Scale (EF Scale). This new scale ranges from EF0 to EF5.

The greatest tornado to occur in the LRBOI tribal service area was an F5 on April 3, 1956 in Kent County. It caused four deaths, 130 injuries, and $25,000 in property damages.

An F4 magnitude tornado was recorded in Manistee County on April 3, 1956, resulting in $250,000 in property damage.

An F4 magnitude tornado occurred on April 11, 1965 in Ottawa County, resulting in $25,000 in property damage.

An F4 magnitude tornado occurred on April 11, 1965 in Kent County, resulting in five deaths, 142 injuries, and $2.5 million in property damage.

An F3 magnitude tornado occurred on April 21, 1967 in Kent County, resulting in 32 injuries and $25 million in property damage.

The remaining recorded tornadoes in the LRBOI service area range from F0 to F2 in magnitude. It should be noted that the magnitude of the tornado does not always correspond with damages incurred. For example, an EF1 magnitude tornado that occurred on July 6, 2014 in Kent County caused 6 injuries and $4.5 million in property damage.

Table 32: Fujita and Enhanced Fujita Scale Comparison

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

Source: FEMA

Previous Occurrences

Table 33 lists the tornadoes on record with the NOAA NCEI Storm Events Database for the 9-county LRBOI tribal service area. Kent County has had the most tornados on record (38), along with the highest numbers of associated deaths, injuries, property damage and crop damage.

Table 33: Tornado Events in the LRBOI Service Area

County	Date	Magnitude	Deaths	Injuries	Property Damage	Crop Damage	Location
Kent **38 events**	4/3/1956	F5	4	130	$25,000	$0	
	7/1/1956	F1	0	0	$2,500	$0	
	4/16/1960		0	0	$25,000	$0	
	9/22/1961	F2	0	0	$25,000	$0	
	4/11/1965*	F4	5	142	$2,500,000	$0	
	4/11/1965*	F4	0	0	$0	$0	
	4/20/1966	F1	0	0	$25,000	$0	
	4/21/1967	F3	0	32	$25,000,000	$0	
	4/21/1967	F2	0	0	$25,000	$0	
	8/5/1968	F2	0	0	$250,000	$0	
	9/9/1968	F2	0	1	$25,000	$0	
	6/25/1969	F1	0	0	$25,000	$0	
	5/20/1975	F2	0	1	$250,000	$0	
	6/15/1976	F1	0	0	$25,000	$0	
	7/28/1976	F1	0	1	$250,000	$0	
	7/24/1979	F0	0	0	$25,000	$0	
	7/9/1987	F1	0	2	$2,500	$0	
	9/6/1989	F1	0	0	$2,500	$0	
	9/6/1989	F1	0	1	$25,000	$0	
	9/14/1990	F1	0	0	$25,000	$0	
	9/14/1990	F1	0	0	$2,500	$0	
	7/7/1991	F0	0	0	$2,500	$0	
	6/17/1992	F1	0	0	$0	$0	
	8/19/1996	F1	0	0	$5,000	$0	ROCKFORD
	5/21/2001	F0	0	0	$100,000	$0	GRANDVILLE
	5/21/2001	F1	0	0	$200,000	$0	COMSTOCK PARK
	5/21/2001	F0	0	0	$50,000	$0	PLAINFIELD HGTS
	5/21/2001	F0	0	0	$75,000	$0	ALPINE
	8/13/2002	F0	0	0	$40,000	$10,000	ROCKFORD
	9/23/2006	F0	0	0	$100,000	$20,000	CALEDONIA
	7/6/2014	EF1	0	6	$4,500,000	$0	GRAND RAPIDS SOUTH K; EAST GRAND RAPIDS
	7/14/2015	EF0	0	0	$50,000	$0	BROWNE CENTER
	8/20/2016	EF0	0	0	$500,000	$0	GRANDVILLE ARPT; IVANREST
	8/20/2016	EF0	0	0	$25,000	$0	GRAND RAPIDS; PLAINFIELD HGTS
	4/10/2017	EF1	0	0	$200,000	$0	BROWNE CENTER; ELMDALE
	9/11/2019	EF0	0	0	$0	$0	GRAND RAPIDS
	4/10/2021	EF0	0	0	$75,000	$0	CORINTH
	6/26/2021	EF0	0	0	$50,000	$0	LOWELL
			9	**316**	**$34,507,500**	**$30,000**	

County	Date	Magnitude	Deaths	Injuries	Property Damage	Crop Damage	Location
Lake 4 events	6/8/1985	F1	0	0	$0	$0	
	7/26/2005	F1	0	0	$150,000	$50,000	BALDWIN
	8/28/2018	EF0	0	0	$100,000	$0	BALDWIN
	8/28/2018	EF1	0	0	$100,000	$0	BALDWIN MUNI ARPT
			0	0	**$350,000**	**$50,000**	
Manistee 2 events	4/3/1956*	F4	0	0	$250,000	$0	Onekama Township, Bear Lake Township, Pleasanton Township
	6/12/2008	EF0	0	0	$15,000	$0	Stronach Township; High Bridge
			0	**0**	**$265,000**	**$0**	
Mason 5 events	8/15/1966	F0	0	0	$0	$0	
	4/12/1972	F1	0	0	$0	$0	
	4/12/1972	F2	0	8	$2,500,000	$0	
	4/12/1972	F1	0	0	$0	$0	
	6/12/2008	EF1	0	0	$0	$0	HAMLIN LAKE
			0	**8**	**$2,500,000**	**$0**	
Muskegon 8 events	5/13/1956		0	0	$0	$0	
	5/13/1956		0	0	$0	$0	
	9/4/1965	F2	0	0	$25,000	$0	
	4/16/1967	F1	0	0	$2,500	$0	
	4/21/1967	F0	0	0	$0	$0	
	11/10/1998	F0	0	0	$0	$0	ROOSEVELT PARK
	4/11/2001	F0	0	0	$0	$0	CLOVERVILLE
	11/17/2013	EF0	0	0	$50,000	$0	TRENT; BAILEY
			0	**0**	**$77,500**	**$0**	
Newaygo 13 events	9/26/1951	F2	1	3	$0	$0	
	4/28/1964	F1	0	0	$25,000	$0	
	8/10/1971	F1	0	0	$2,500	$0	
	6/17/1975	F2	1	0	$0	$0	
	4/12/1979	F1	0	0	$25,000	$0	
	5/25/1989	F1	0	0	$25,000	$0	
	6/2/1990	F1	0	0	$25,000	$0	
	9/14/1990	F1	0	0	$25,000	$0	
	3/27/1991	F0	0	0	$0	$0	
	7/1/1999	F0	0	0	$10,000	$0	NEWAYGO
	8/1/2002	F0	0	0	$2,000	$0	GRANT
	6/29/2005	F0	0	0	$0	$10,000	NEWAYGO
	11/17/2013	EF0	0	0	$50,000	$0	GRANT; BIG PRAIRIE
			2	**3**	**$189,500**	**$10,000**	
Oceana 5 events	7/11/1967	F1	0	0	$25,000	$0	
	3/30/1977	F1	0	3	$25,000	$0	
	8/15/1978	F2	0	1	$250,000	$0	
	9/14/1990	F1	0	0	$25,000	$0	
	5/28/1991	F2	0	0	$250,000	$0	
			0	**4**	**$575,000**	**$0**	

County	Date	Magnitude	Deaths	Injuries	Property Damage	Crop Damage	Location
	3/6/1956	F2	0	0	$25,000	$0	
	4/3/1956*	F3	0	0	$2,500,000	$0	
	4/3/1956	F5	14	200	$250,000	$0	
	6/22/1957	F2	0	0	$25,000	$0	
	9/22/1961	F2	0	1	$25,000	$0	
	4/11/1965*	F4	0	0	$25,000	$0	
	9/4/1965	F2	0	0	$25,000	$0	
	7/12/1966	F2	0	0	$25,000	$0	
	6/17/1975	F0	0	0	$25,000	$0	
	3/12/1976	F1	0	1	$250,000	$0	
	6/15/1976	F1	0	0	$250,000	$0	
Ottawa 23 events	5/13/1978	F0	0	0	$30	$0	
	8/9/1979	F1	0	0	$250,000	$0	
	8/9/1979	F1	0	0	$25,000	$0	
	8/9/1979	F0	0	0	$2,500	$0	
	7/9/1987	F0	0	0	$2,500	$0	
	5/30/1991	F1	0	0	$2,500	$0	
	6/17/1992	F0	0	0	$0	$0	
	4/11/2001	F0	0	0	$0	$0	COOPERSVILLE
	5/21/2001	F0	0	0	$50,000	$0	MARNE
	6/21/2010	EF0	0	0	$200,000	$10,000	VRIESLAND
	8/20/2016	EF1	0	0	$500,000	$0	GITCHEL; FOREST GROVE
	6/26/2021	EF0	0	0	$100,000	$0	OLIVE CENTER; RUSK
			14	**202**	**$4,557,530**	**$10,000**	
	7/31/1963	F2	0	0	$250,000	$0	
	8/4/1968	F1	0	0	$2,500	$0	
	6/7/1974	F2	0	1	$25,000	$0	
	6/15/1976	F1	0	0	$25,000	$0	
Wexford 8 events	7/7/1980	F0	0	0	$0	$0	
	10/15/1989	F1	0	0	$250,000	$0	
	10/4/2006	F0	0	0	$260,000	$0	BENSON
	7/18/2010	EF0	0	0	$8,000	$0	LAKE CADILLAC
			0	**1**	**$820,500**	**0**	

Sources: NOAA National Centers for Environmental Information Storm Events Database, search history 01/01/1950 to 12/31/2022; MSP's 2019 *Michigan Hazard Analysis*
Notes: * indicates event associated with Disaster or Emergency Declaration(s) from the Governor and/or President

Probability of Future Events and Vulnerability Assessment

Within the LRBOI tribal service area, Kent County has had a total of 38 tornado events on record between 1950 and 2022 (73 years). This equates to a 52% future annual chance of a tornado event occurring in that county. Kent County has also experienced the greatest number of deaths, injuries, property damages and crop damages associated with tornados out of all other counties in the LRBOI tribal service area, and the greatest magnitude tornado (F5). It should be noted that Kent County contains the metropolitan area of the City of Grand Rapids, and therefore a large amount of developed areas and population compared to other counties in the LRBOI service area. There are 250 out of the 1,679 registered LRBOI tribal members (14.9%) residing in Kent County.

Ottawa County has had a total of 23 tornado events on record, equating to a 31.5% future annual chance of a tornado occurring in that county. There are 104 out of the 1,679 registered LRBOI tribal members (6.2%) residing in Ottawa County.

Newaygo County has had a total of 13 tornado events on record, equating to a 17.8% future annual chance of a tornado occurring in that county. There are 45 out of the 1,679 registered LRBOI tribal members (2.7%) residing in Newaygo County.

The remaining counties in the LRBOI service area (Manistee, Mason, Muskegon, Lake, Oceana, and Wexford) have each had 8 or fewer tornado events in the past 73 years, indicating an 11% or lower annual chance of an annual tornado event.

Most historic events have resulted in property damage and occasional crop damage, with few recent deaths or injuries. Due to increased urbanization that has occurred around city centers over the past 50 years, the chances of a tornado touching down and causing residential damage is very high, especially in the City of Manistee and adjoining communities where LRBOI tribal residential concentrations are highest within Manistee County (refer to the Vulnerable Populations Map in Appendix A).

LRBOI's Aki Maadiziwin Subdivision Building Restrictions Ordinance does not allow the construction of manufactured homes or any other kind of home that is built on a non-removable steel chassis, which segments are not always placed on a permanent foundation. The ordinance also states that any modular homes are to be built in conformance with all applicable state, local or regional building codes. Additionally, most of the homes in the Aki Maadiziwin Subdivision have basements, except for the ADA-accessible units, Elders Complex and duplexes.

The Little River Casino is the designated emergency shelter location for all of Manistee County, and meets the need for a tornado shelter to serve the adjoining RV Campground on the casino grounds. However, LRBOI has identified the need for additional LRBOI tornado/severe storm shelter sites:

- The Gathering Grounds (campground) near the Tribal Government Center. There is an existing concrete block bathhouse building at the campground that could be retrofitted and expanded to serve as a "safe room", and would also need a generator installed.

- The Aki Residential area. The Community Center building at the entrance to Aki is not a suitable tornado shelter, as it has a large wall of glass windows on one side of the building. Potential options include creating a safe room in the Elder's housing building, and installing prefabricated underground shelters for the other Aki residents (similar to what the Grand Traverse Band Tribe of Ottawa and Chippewa Indians installed on their tribal lands in 2008 with the assistance of a FEMA hazard mitigation project grant).

The LRBOI Tribal service area in Manistee County relies on the tornado siren operated out of the Manistee Township Fire Department. Other communities in the LRBOI service area are responsible for providing their own tornado sirens and shelter sites.

The LRBOI utilizes the "Fast Command" mass notification system for tribal residents to receive phone notifications in the event of a NWS-issued tornado watch or warning. Also, each County Emergency Management department in the LRBOI service area may offer their own emergency mass notification system that Tribal members can sign up for.

Other emergency public notification methods available include:

- Integrated Public Alert & Warning System (IPAWS): FEMA's national system for local alerting that provides authenticated emergency and life-saving information to the public through mobile phones using Wireless Emergency Alerts, to radio and television via the Emergency Alert System, and on the National Oceanic and Atmospheric Administration's Weather Radio.
- The FEMA Mobile App: provides real-time weather alerts, locations of emergency shelters, and allows for notifications to be sent to loved ones.
- NOAA Weather Radio All Hazards: a nationwide network of radio stations broadcasting continuous weather information directly from the nearest National Weather Service office. NWR broadcasts official Weather Service warnings, watches, forecasts and other hazard information 24 hours a day, 7 days a week.

Extreme Temperatures

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

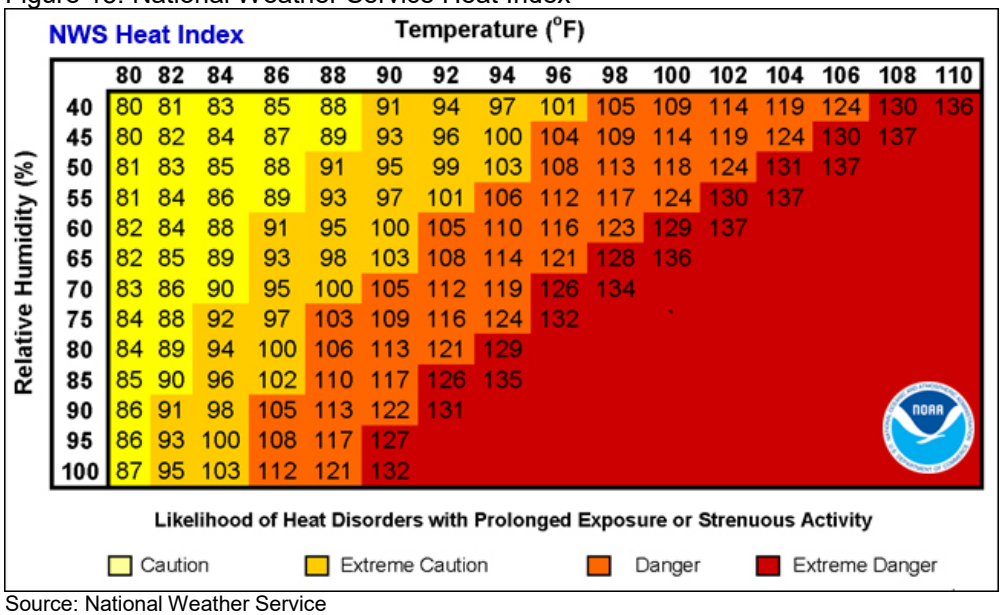
Nationwide, there have been approximately 175 deaths per year that are attributable to extreme heat according to the 2019 Michigan Hazard Analysis. The threats from extreme heat are heatstroke, sunstroke, muscle cramps, heat exhaustion, and fatigue. It is hazardous to livestock and agricultural crops,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

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

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

Measuring Extreme Temperatures (Extreme Heat and Extreme Cold)
Extreme heat is measured with the National Weather Service's Heat Index Chart (Figure 15). The chart uses relative humidity and air temperature to determine the likelihood of heat disorders with prolonged exposure or strenuous activity. Individuals are unable to shed excess heat from their bodies when they experience prolonged exposure to hot temperatures, which results in heat disorders.

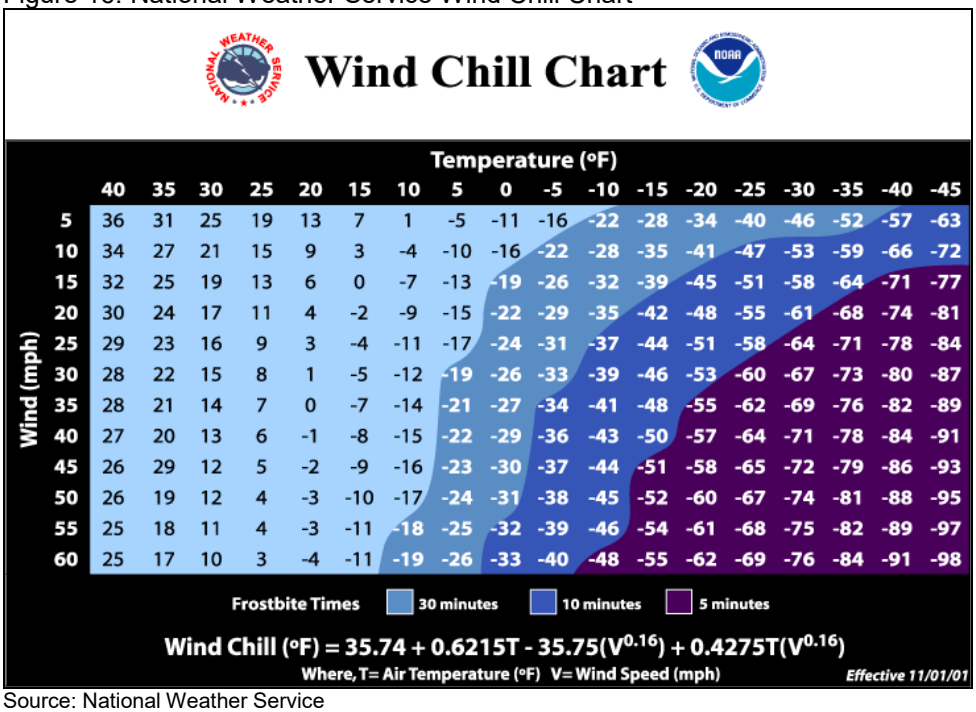
Figure 15: National Weather Service Heat Index



Source: National Weather Service

Extreme cold is measured with the wind chill index, which is a measure of the rate of heat loss from exposed skin caused by the combined effects of wind and cold. As the wind increases, heat is carried away from the body and reduces the external and internal body temperatures. Figure 16 shows the NOAA Wind Chill Chart as it corresponds to various temperatures and wind speeds.

Figure 16: National Weather Service Wind Chill Chart



Wind Chill Chart

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

Frostbite Times: 30 minutes; 10 minutes; 5 minutes

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

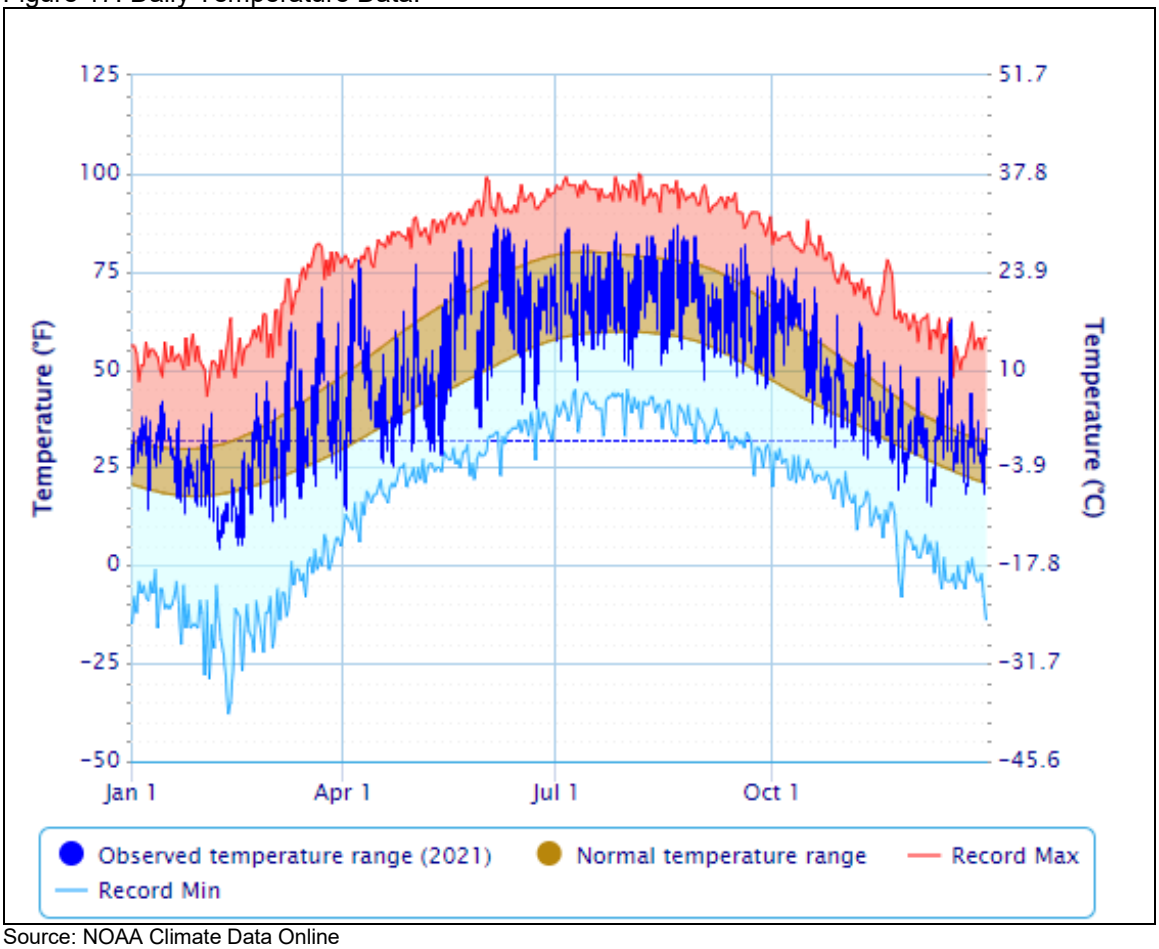
Where, T= Air Temperature (°F) V= Wind Speed (mph)

Effective 11/01/01

Source: National Weather Service

Figure 17 shows the observed temperatures at Manistee 3SE for 2021. The dark blue line shows temperatures recorded between January 1, 2021 and December 21, 2021. The red line above shows record high temperatures for that day, and the light blue line below indicates record low temperatures for that day.

Figure 17: Daily Temperature Data:



Source: NOAA Climate Data Online

Location and Extent
Extreme temperatures are a regional event that are not confined to geographic boundaries and range in severity across the affected areas. The entire LRBOI service area is at risk from extreme temperature hazards.

Previous Occurrences
Manistee County and Wexford County have had heat-related events in on August 1, 2001 and June 30, 2018 (Table 34). Kent County and Newaygo County also had an excessive heat event in on June 30, 2018. The events were not associated with any reported deaths, injuries, or property/crop damages. The heat events consisted of hot and humid conditions that caused outdoor events to be modified; attendance at outdoor events to be lower than normal; hospital admittance due heat-related illness; and livestock losses at county fairs.

Table 34: Hot Temperature Hazard Events, LRBOI Service Area

LOCATION	DATE	EVENT TYPE	INJURIES, DEATHS, DAMAGES	EPISODE/EVENT NARRATIVES
MANISTEE (ZONE); WEXFORD (ZONE)	8/1/2001	Heat	0	Excessive Heat was a problem the first two weeks in August across all of northern Michigan. Temperatures reach the mid to upper 90s, on average, a few days each year; however, for a 5 day (8/5 - 8/9) stretch overnight low temperatures failed to fall below the lower 70s in most areas. This very humid air mass was unusual for northern Michigan, an area which typically sees cool nighttime temperatures and for this reason has very few homes with air conditioners. No heat related deaths or injuries were reported; however, most outdoor events were modified due to the forecasts of hot and humid conditions. County fairs sent animals home, yet still there were livestock losses at fairs in Otsego and Alcona counties. Attendance at county fairs was well below normal and this was attributed to the heat.
MANISTEE (ZONE); WEXFORD ZONE	6/30/2018	Excessive Heat	0	The month of June closed with one of the hottest days in recent memory. Highs were well into the 90s, including 99 at Alpena, and 98 at Traverse City and Gaylord. The National Weather Service office near Gaylord also hit 98; that was (by several degrees) the warmest reading recorded at that location since observations began there in the late 1990s. Heat indices exceeded 105 degrees across most of northern lower Michigan, and some locations exceed 110. The warmest reported heat index on the day was 114 near Indian River. There were estimated to be between 25 and 30 individuals who visited local hospitals due to heat-related illnesses.
KENT (ZONE); NEWAYGO (ZONE)	6/30/2018	Excessive Heat	0	Very hot and humid weather occurred on June 30th in southwest lower Michigan. High temperatures reached the lower to middle 90's which in conjunction with dew point values reaching the middle 70's resulted in heat indices that reached or exceeded 105 degrees at several locations. The high temperature at Grand Rapids reached 94 degrees with a dew point of 76 degrees. This resulted in a heat index reading of 107 degrees. Fremont municipal airport in Newaygo reached 92 degrees with a dew point of 76 degrees and a heat index reading of 105 degrees.

Source: NOAA - National Centers for Environmental Information, Storm Events Database

Table 35 lists the events related to cold temperature hazards for the LRBOI Service area: Kent County (February 1996 – extreme cold shattered roof membranes on school buildings, causing $150,000 in damage); Newaygo County (May 1997 – record cold temperatures resulted in frost that destroyed 20 percent of the county's annual asparagus crop, causing $2 million in crop damages); Manistee and Wexford Counties (February 2007 and January 2014 – extreme cold/wind chill resulting in school closings), Wexford County (February 2015 for extreme cold/wind chill).

In January 2019, a statewide Governor Declared Emergency was issued for extreme cold.

Table 35: Cold Temperature Hazard Events, LRBOI Service Area

LOCATION	DATE	EVENT TYPE	INJURIES, DEATHS, DAMAGES	EVENT DESCRIPTION
KENT (ZONE)	2/1/1996 to 2/5/1996	Cold/Wind Chill	$150,000 Property Damages	A cold wave limited daytime temperatures to the single digits on 2/2 and 2/3 followed by overnight lows in the range of -15 to -30 on 2/3 and 2/4. The extreme cold shattered rubberized roof membranes on several school buildings. The weather warmed during the following two days, and one school in Grand Rapids was forced to close when rain leaked through the damaged roof on 2/7 and 2/8 before repairs were complete.
NEWAYGO (ZONE)	5/16/1997	Cold/Wind Chill	$2,000,000 Crop Damages	Record-cold temperatures in the upper 20s across the southwest quarter of Lower Michigan on May 16, 1997, caused financial losses for many West Michigan farmers. A hard frost wiped out approximately 20 percent of Oceana County's annual asparagus crop, causing an estimated $2 million in damages.
MANISTEE (ZONE); WEXFORD (ZONE)	2/4/2007	Extreme Cold/wind chill	0	High temperatures on the 4th (Super Bowl Sunday) were around zero, with low temperatures that night from five to ten below zero. Gusty northwest winds produced hazardous wind chills of 20 to 30 below zero, along with blowing and drifting snow. Many area schools closed on the 5th, due to the extreme cold and poor road conditions.
MANISTEE (ZONE); WEXFORD (ZONE)	1/6/2014	Extreme Cold/wind chill	0	One of the most brutal cold air outbreaks in recent memory - the coldest since at least January 1994 - plunged into the Great Lakes region. Near- to below-zero temperatures were accompanied by blustery northwest winds. Away from the warming influence of Lake Michigan, wind chills sunk to 30 below zero or colder. The coldest wind chills observed were -44 near Cedarville, -39 near Engadine, -36 at Sault Ste Marie, and -33 at West Branch and Houghton Lake. All of these were reached in the morning hours of the 7th. As a result, school closings were widespread across northern Michigan on the 7th.
WEXFORD (ZONE)	2/9/2015	Extreme Cold/Wind Chill	0	The second blast of extremely cold air into northern Michigan in about a week. This event featured colder air (including the coldest high temperature ever recorded in Gaylord), but not quite as much wind, as the event a week previous. As a result, wind chills were not quite as drastically cold. Still, wind chills reached 30 to 40 below zero across part of northern Michigan, bottoming out at -43 near Cadillac early in the morning on the 19th.
STATEWIDE	1/29/2019	Extreme Cold/wind chill	0	Governor Declared Emergency – Wind chills of 15 to 30 below zero were common in northern lower Michigan. Wind chills were much colder in eastern upper Michigan, including -51 at Kinross, and -42 at Sault Ste Marie and Mackinac Island.

Source: NOAA - National Centers for Environmental Information, Storm Events Database; MSP 2019 *Michigan Hazard Analysis*

Probability of Future Events and Vulnerability Assessment

Since 2001, there have been three hot temperature hazard events in the LRBOI service area. This indicates there is a 13.6% chance than an event would occur in a future year.

Since 1996, there have been five cold temperature hazard events in the LRBOI service area. This indicates there is an 18.5% chance an event would occur in a future year. Since extreme cold events tend to occur during the winter months and are coupled with blustery winds and snowstorms, these events may have been reported as other hazards or not at all, which means these events may occur more frequently.

The homes in the Aki Maadiziwin Subdivision in Manistee Township do have air conditioning, but they do not have generators on site in case of power outages. The community center is near the entrance to the Aki subdivision. With the installation of a generator for that building, it could serve as a temporary heating/cooling shelter for the tribal residents in

case a power outage occurred. A generator could also be installed in the Elder's apartment complex so they don't have to travel to the larger shelter building in the event of a power outage.

Extreme heat and cold events are more likely to impact unsheltered populations, such as the urban homeless population and people working or recreating outside. The Little River Casino in Manistee Township can be utilized as an overnight or temporary emergency shelter location for all of Manistee County in the event of an extreme heat/cold emergency. Also, the Wagoner Community Center (utilized by the Manistee County Council on Aging) in Manistee is utilized as a temporary emergency warming/cooling center. In addition, the Manistee County Emergency Management Department maintains agreements with public schools, local fire departments/government offices and some churches for use of their buildings as secondary shelter sites.

Anecdotally, emergency personnel see more fatalities during extreme temperature events. Vulnerable populations may not be able to find or access heating or cooling stations or are able to communicate their needs. In addition to human vulnerability to extreme temperatures, because heat is an additive, there are also environmental concerns when heat increases the risk of wildfire and drought.

The *Northwest Lower Michigan Coastal Resilience Atlas,* written by the Land Information Access Association, includes a Heat Vulnerability Assessment[2] of Lake Michigan coastal communities. A community's vulnerability is defined as their exposure to the hazard (determined by tree canopy and impervious surface coverage) + their sensitivity. Sensitivity is determined by the folowing factors:

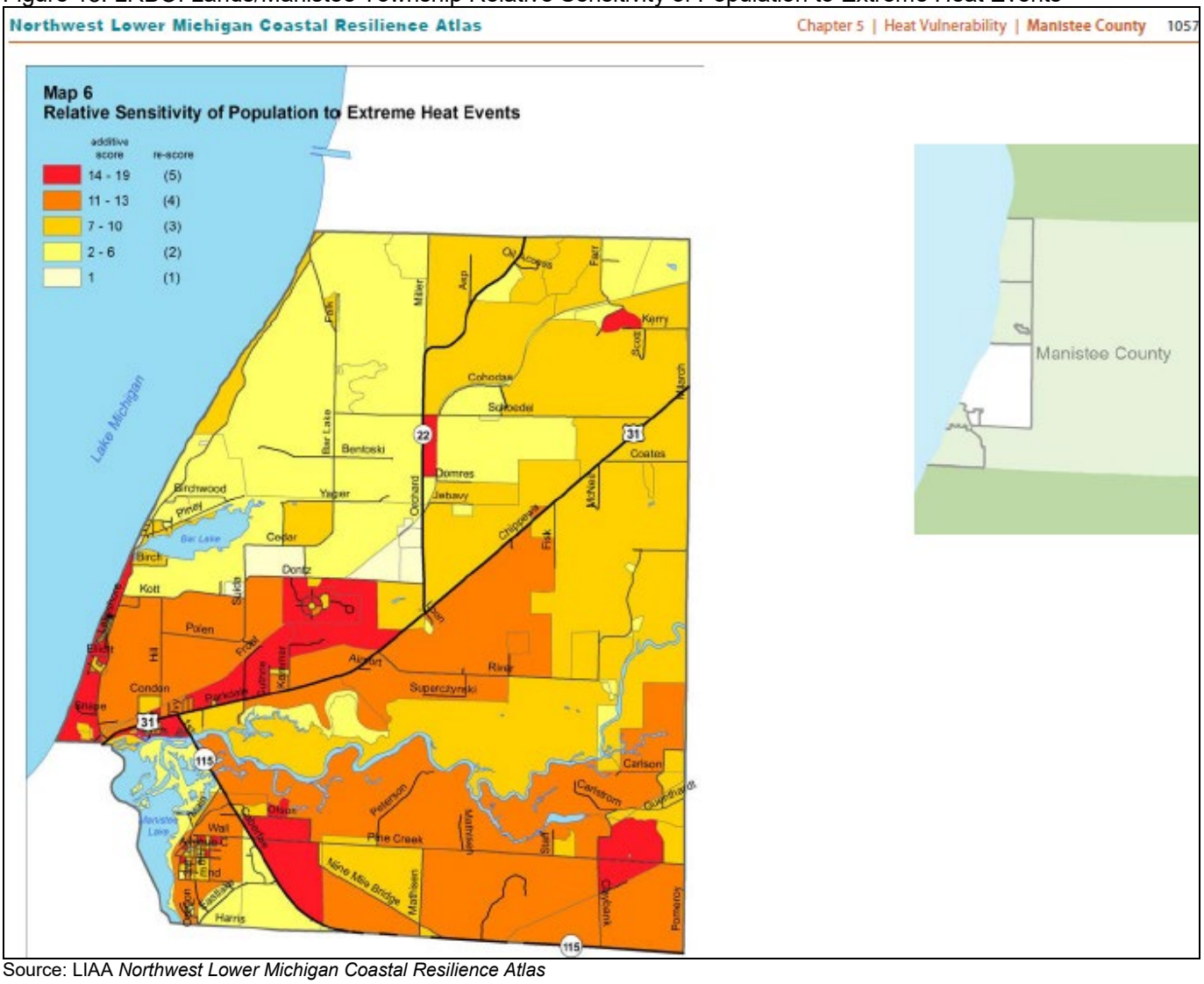
- Persons > 65 years
- Persons living alone
- Minority (non-white) persons
- Persons living below the poverty threshold
- People > age 25 with less than a high school education
- Disability status (i.e., ambulatory difficulty, mental disability)

Figure 18 indicates the Relative Sensitivity of the Population to Extreme Heat Events in Manistee Township. Note that the area covering the Aki residential community for the LRBOI tribal members (including elders), off of Dontz Road, scores in the highest rating for relative sensitivity to extreme heat events.

The LRBOI Elder population ranges anywhere from 28% to as high as 67% in county membership counts. Newaygo County has the highest percentage of Elder members and Muskegon County has the highest number of Elders. Manistee County has the second highest number of Elder members. Census data also indicates high levels of poverty for many Tribal members. These factors should be considered when mitigating potential impacts of extreme temperature events on LRBOI members.

[2] Land Information Access Association. (2019). *Northwest Lower Michigan Coastal Resilience Atlas.* http://www.resilientmichigan.org/nw_atlas.asp

Figure 18: LRBOI Lands/Manistee Township Relative Sensitivity of Population to Extreme Heat Events



Source: LIAA *Northwest Lower Michigan Coastal Resilience Atlas*

Drought

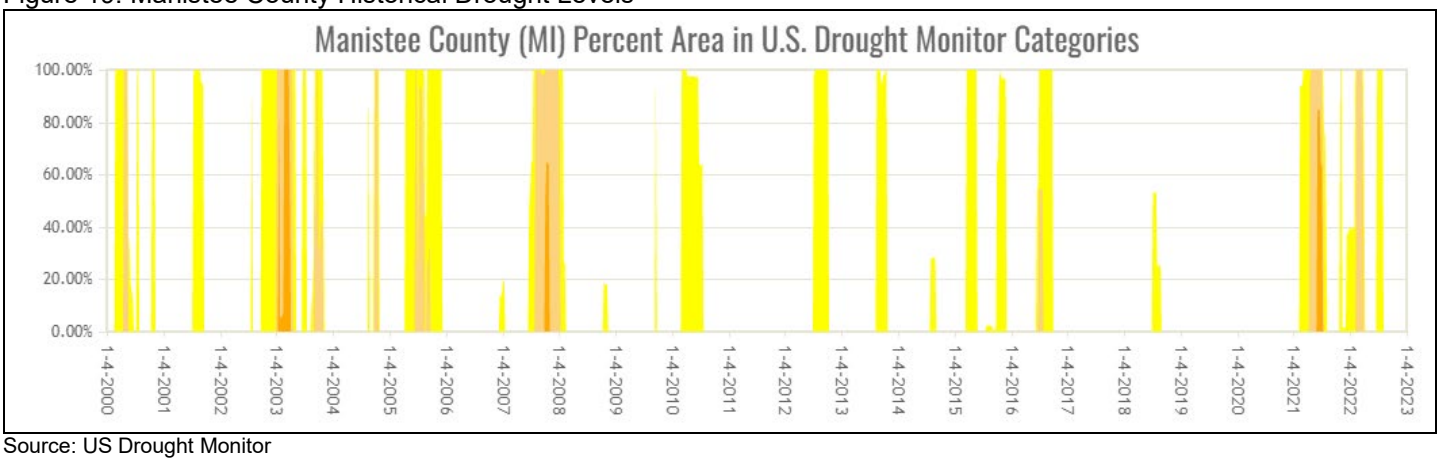
Drought is a normal part of the climate cycle. It is a slow-moving hazard, which causes people to underestimate the damage it can do, but losses from drought are as substantial as those from hurricanes, tornadoes and other faster-moving disasters. Drought can cause agricultural loss; affects domestic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

Location
Drought is a regional event that is not confined to geographic boundaries and ranges in severity across the affected areas. The entire LRBOI service area is at risk from drought.

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

The U.S. Drought Monitor (Figure 19) combines several input sources including the PDSI and the Standardized Precipitation Index to prepare a weekly map showing parts of the U.S. that are in drought. The map uses five classifications: abnormally dry (D0), showing areas that may be going into or are coming out of drought, and four levels of drought: moderate (D1), severe (D2), extreme (D3) and exceptional (D4) (Figure 20).

Figure 19: Manistee County Historical Drought Levels



Source: US Drought Monitor

Figure 20: U.S. Drought Categories and Historically Observed Impacts

Michigan

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

Source: US Drought Monitor

Previous Occurrences
On March 2, 1977, a Presidential Emergency was declared for drought problems affecting 44 counties in Michigan, including Lake, Manistee, Mason, Oceana, and Wexford counties in the LRBOI service area.

Additionally, the NOAA NCEI Storm Events Database contains a drought incident for Wexford County between August 1 and 9, 2001. The episode narrative is as follows: "After a cool beginning, the last half of July 2001 was characterized by warmer than normal and drier than normal weather. Less than an inch of rainfall was recorded in some areas for the month of July. This lack of rain and warm conditions became serious during the first two weeks of August when little if any rain fell and temperatures jumped into the 90s. The stress on the crops was most noted in northern Michigan corn, but also hit hay crops to a lesser extent. As a result of the drought, the U.S.D.A. declared several counties disaster areas and granted farmers in counties where the crop losses were 30% or greater, special low interest loans."

Probability of Future Events and Vulnerability Assessment
There have been two incidents of a drought incident affecting the LRBOI tribal service area in the past 46 years. This indicates a 4.3% chance of a drought occurring in a future year. In Northern Michigan's forested regions, drought can adversely impact timber and agricultural production and some tourism and recreational enterprises. This can also cause a drop in income, which impacts other economic sectors.

The biggest problem drought presents, however, is the increased threat of wildfire. The southern portions of Manistee County and much of Wexford County are heavily forested, especially with pine trees, and are therefore highly vulnerable to wildfire in drought conditions.

Additionally, the threat to water sources should also be considered. Many tribal residents rely on ground water wells for drinking water, such as the well servicing the LRBOI water tower on Domres Road. Even drought events in category D1 experience water well level decline. Drought events combined with excessive heat can also have severe impacts on elderly and low income people.

Wildfire

A wildfire is an unplanned, uncontrolled fire in grassland, brushland, or forested areas. Wildfires can occur in any forest or grassland type under dry conditions; however, some forest types are more susceptible to wildland fires. For example, jack and red pine forest stands have a high risk for wildfires, as they dependent on fire to provide all the right conditions for regeneration, while aspen and white pine forest stands have a moderate risk.

The primary cause of wildfire is from human activities, specifically burning outdoor debris. Recently, only about 4% of all wildfires in Michigan were caused by lightning strikes, and most other causes have been attributed to human activity. Most Michigan wildfires occur close to where people live and/or recreate, which puts both people and property at risk. The immediate danger from wildfires is the destruction of property, timber, wildlife, and injury or loss of life of persons who live in the affected area or who are using recreational facilities in the area. Long-term effects include scorched and barren land, soil erosion, landslides/mudflows, water sedimentation, and loss of recreational opportunities.

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

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

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

Location

LRBOI-owned lands in Manistee County are vulnerable to wildfires. Many developed areas of the county interface with the high risk forest types (e.g. Red Pine, Eastern White Pine, and Jack Pine). In terms of tree type and coverage, there are 54,514.33 acres of Red Pine, 102.01 acres of Eastern White Pine, and 959.13 acres of Jack Pine in Manistee County. As shown in the Environmental Features map in Appendix A, Red Pine and Eastern White Pine forest types are located throughout the county. Jack Pine forest types are located more sporadically: in the eastern townships of Cleon, Dickson, and Norman, as well as small pockets in Manistee, Onekama, Maple Grove, and Stronach Townships, and the City of Manistee. Much of the pine forest areas overlap with designated public lands (USFS/MDNR).

Additionally, eastern adjoining Wexford County contains large amounts of pine forest and greater amounts of Jack Pine forest in comparison to Manistee County (see Environmental Features Map in Appendix A). LRBOI does not own property in Wexford County, but it is part of the Tribe's Service Area.

Extent and Previous Occurrences

Extent can be measured by the number of acres burned and the cost of property damage. According to the Michigan State Police's *2019 Michigan Hazard Analysis*, between 1981 and 2018 there were 54 reported fires on land in Manistee County under MDNR jurisdiction. This resulted in 1,070.7 acres burned and 28.2 acres burned per year. No property damages were recorded.

According to the 2021 USDA/USFS publication *Spatial Wildfire Occurrence Data for the United States, 1992-2018 [FPA_FOD_20210617*], there were 75 fires that occurred on federal lands in Manistee County between 1994 and 2017, comprising about 238.74 acres of land burned. Additionally, there were 22 wildfires on private land between 2014-2018 in the county, and 180 fires on State, private, or other types of owned land from 1992-2018 (altogether a total of 1,151.61 acres burned). Property damage estimates were not provided. Most of these fires were human-caused and under 5 acres

in size. The largest size fire in this records database was the “Warfield Road” fire on April 14, 2003, which burned 764 acres on state or private land. The fire was caused by debris and open burning.

More recently, the community of Dublin (100-150 people) in Norman Township experienced a wildfire event in 2021 that burned around 1,000 acres of land. This area is surrounded by forest that tends to be very dry in certain weather conditions. Additionally, the community consists of an older population and has a neighborhood that is accessible by one street (James Street), with no other access point in or out. The Norman Twp. Fire Chief, in coordination with the County EM and USFS, held a community meeting in Dublin in the spring of 2022 to provide information to residents about fire prevention and preparedness practices, such as utilizing CodeRED, conducting neighborhood cleanups to get rid of brush, etc. Discussions have also occurred amongst the Norman Township Fire Chief and local partners to determine an alternate fire access route to the neighborhood. Norman Township is also a participant in the “FireWise USA” program.

“Wildfire” was identified as the in the community survey as the second most likely type of hazard event that would have the largest impact on the community.

Probability of Future Events and Vulnerability Assessment

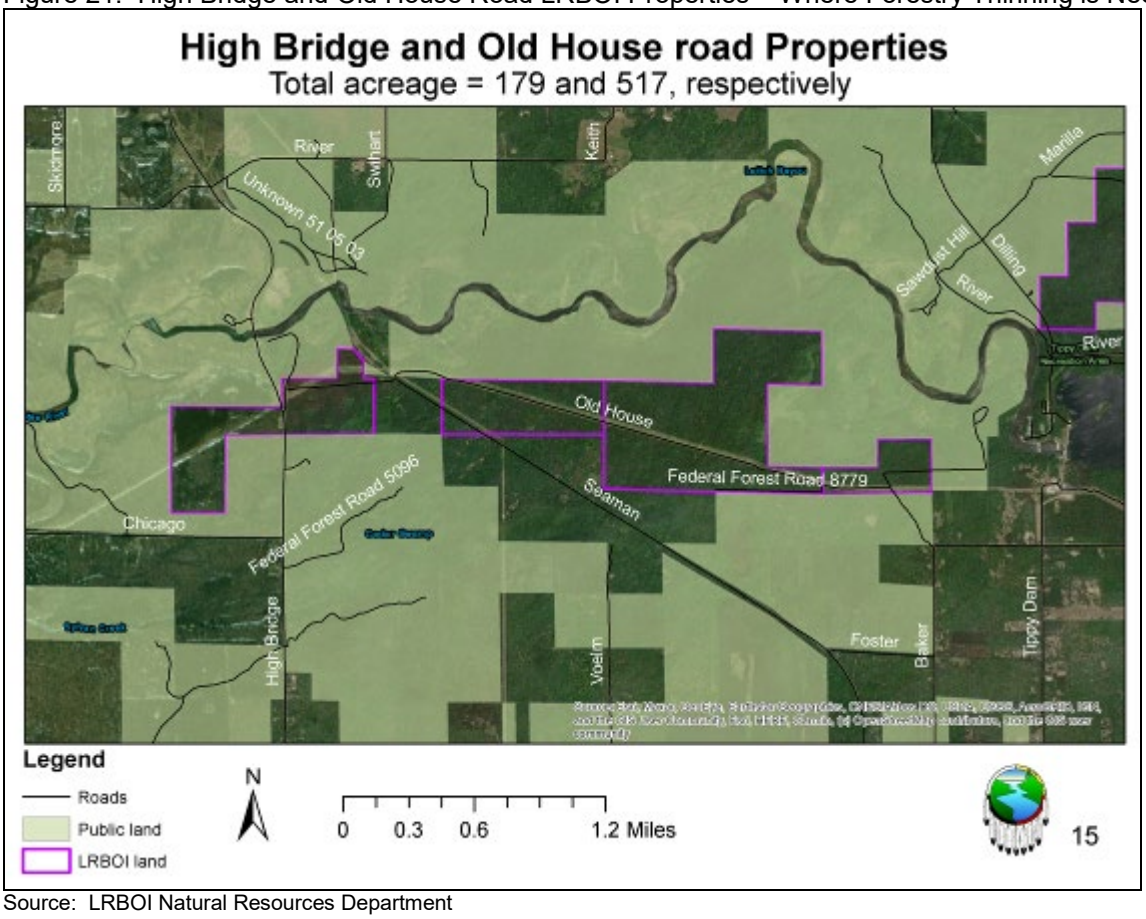
There is a 100% annual chance there will be a wildfire on MDNR or USFS lands, and a small chance there will be a wildfire on lands outside of these areas. Forest types (Red Pine, Eastern White Pine, and Jack Pine) within Manistee County are susceptible to wildfires; these are scattered throughout every community in the county. However, areas of Manistee County located south of the Manistee River (Filer Township, Stronach Township, Manistee Township, Norman Township, Brown Township, and Dickson Township) are heavily forested with pine and are therefore highly vulnerable to wildfire threats. There are concentrations of LRBOI tribal residents in these areas, according to the Hazard Areas and Vulnerable Population Map in Appendix A.

Additionally, eastern adjoining Wexford County contains large amounts of pine forest and greater amounts of Jack Pine forest in comparison to Manistee County (see Environmental Features Map in Appendix A). LRBOI does not own property in Wexford County, but it is part of the Tribe’s Service Area.

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

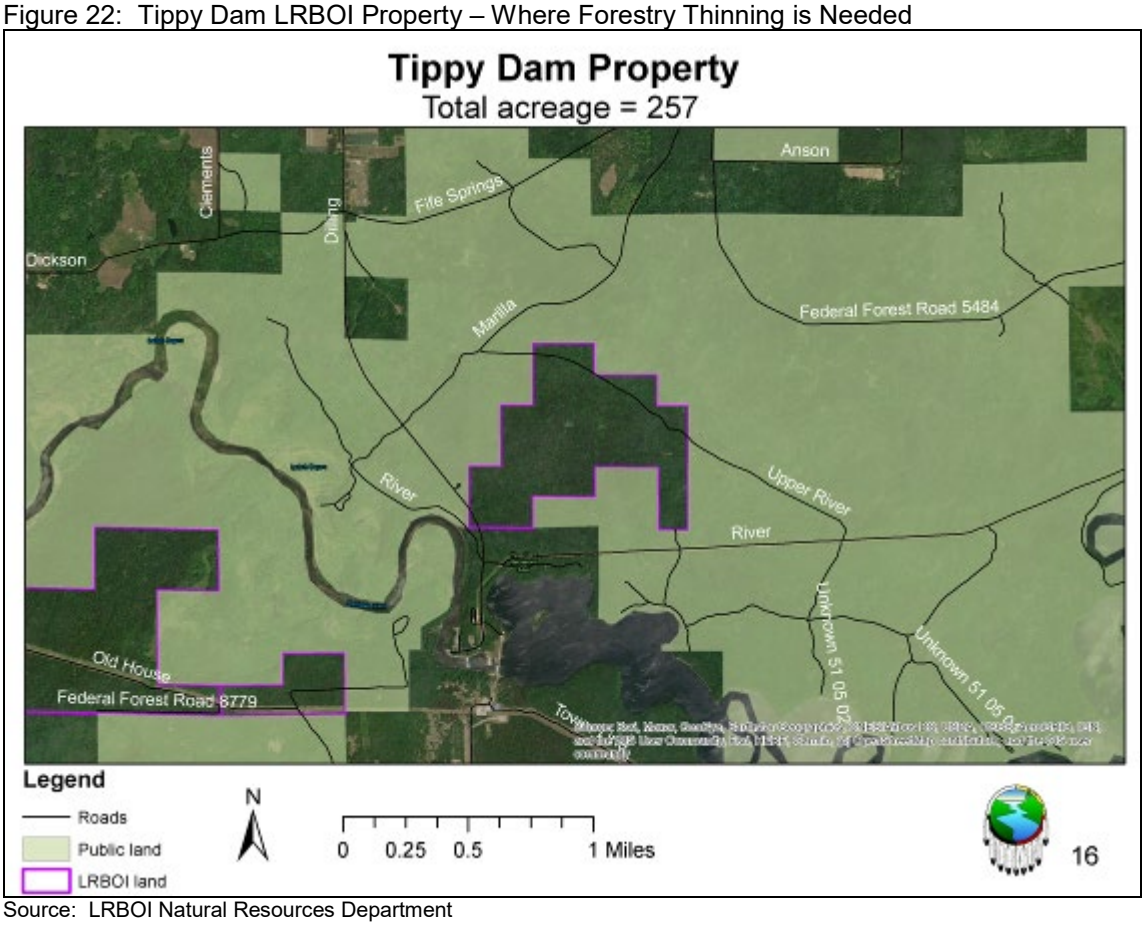
Figures 21 and 22 are maps of LRBOI owned, undeveloped properties in southeastern Manistee County – the High Bridge & Old House Road and Tippy Dam properties located in Dickson Township. These areas have a high fire danger potential due to the concentration of pine forest. The Mitigation Strategies Table (in Section VII of this plan) for includes forestry thinning for these areas to improve the health of tree species and reduce wildfire risk.

Figure 21: High Bridge and Old House Road LRBOI Properties – Where Forestry Thinning is Needed



Source: LRBOI Natural Resources Department

Figure 22: Tippy Dam LRBOI Property – Where Forestry Thinning is Needed



Source: LRBOI Natural Resources Department

Dense Fog

Fog forms when water vapor condenses into tiny liquid water droplets that remain suspended in the air just above the Earth's surface, reducing visibility to values equal to or below locally/regionally established values for dense fog (usually 1/4 mile or less) and impacting transportation or commerce.

Two ways that air can become saturated with water are by cooling it to its dew point temperature, or by evaporating moisture into it to increase its water vapor content. Although most fog, by itself, is not generally a hazard because it does not actually apply damaging forces, the interaction between humans and fog can be a dangerous situation, sometimes resulting in disastrous consequences. It must be noted, however, that freezing fog (a hazard for which the National Weather Service issues special statements) can cause direct harm by causing slickness on roadways, walkways, bridges, and highway ramps, and therefore leading to serious transportation accidents.

Fog is not so easy to classify as a severe and high-impact hazard, although it has caused costs and casualties in the transportation sector, especially—sometimes with deadly consequences. Fog has played a contributing role in several multi-vehicle interstate highway pileups during recent years. While statistics suggest that highway accidents and fatalities, in general, have fallen, that trend is not evident with respect to accidents and fatalities caused by fog. The vast majority of automotive accidents are caused by unsafe driving habits and risk-taking behaviors, such as following too closely behind another vehicle, driving too fast for weather and visibility conditions, and distracted driving. Airplanes have their own inherent vulnerabilities when foggy conditions develop and make a safe landing more difficult.

Fog can be very dangerous when it reduces visibility. Although some forms of transport can penetrate fog using radar, road vehicles have to travel slowly and use their lights to become visible to each other. Localized fog is dangerous if drivers are surprised by it. At airports, some efforts have been made to develop methods (such as using heating or spraying salt particles) to aid fog dispersal, especially at temperatures near or below freezing.

One severe fog event is estimated to occur in Michigan approximately every two years. Property damage can be significant for vehicles, although real property and structures are usually unaffected. Fog has not yet been identified as one of the most significant hazards in any of Michigan's local hazard mitigation plans.

Location
Dense fog can be a local, regional, or state-wide event that is not confined to geographic boundaries and ranges in severity across the affected areas. The entire LRBOI service area is at risk from a dense fog hazard.

Extent
Dense fog can be measured by damages-caused including deaths, injuries, property damages, and/or crop damages. There has been one significant dense fog event in Manistee County, which impacted seven persons (one of which was reported as an indirect fatality).

Previous Occurrences
On May 22, 2010, a dense fog event was recorded in Manistee County. A charter fishing boat struck a pier at the entrance to Manistee Harbor, took on water, and sank. The seven people on board were pulled from the water by the Coast Guard and a local Good Samaritan. The first mate of the boat, a 55 year old male, was given CPR and later pronounced dead (considered an indirect fatality). Two others were treated at a Manistee hospital, while the other four were treated at the scene. Visibility at the accident site was described as being very poor by local media.

In addition, on January 20, 1999, a dense fog event was recorded for Ottawa and Kent counties. Dense fog developed across southern lower Michigan as a result of snow on the ground, winds that went calm overnight, and considerable low level moisture that was in place. Visibilities across the area were reduced to a quarter of a mile or less during the early morning hours. The fog quickly burned off during the mid-morning hours. This event is not associated with any deaths, injuries or property damage.

Probability of Future Events and Vulnerability Assessment
One dense fog event has occurred in Manistee County in the past 13 years, representing a 7.7% future annual chance of an event occurring in that county. Ottawa and Kent counties have experienced one dense fog event in the past 24 years, representing a 4.2% annual chance of an event occurring in those counties. Dense fog events are likely to occur more frequently, but go unreported as injuries, deaths and damages do not occur. The entire LRBOI service area is at risk from a dense fog hazard. The continued and increased use of NOAA Weather Radio and mobile alert systems can inform people of hazardous conditions and the appropriate precautions to take (such as limiting travel) during a dense fog event.

Coastal Hazards - Dangerous Currents

Dangerous currents and breaking waves are common in the Great Lakes region. Rip currents and other currents found near piers are extremely dangerous for swimmers and can lead to drownings. Currents in the Great Lakes can form from any combination of wind, waves, bottom formation, beach slope, water temperature, man-made structures, and natural outlets. In the Great Lakes, swimmers are most likely to encounter one of five common currents: rip, longshore, structural, outlet, and channel.

During rip currents, the water "piles up" between a sandbar and the beach. It has to find a way back out to sea. After the pressure builds up, the water creates a pathway and gushes from the shore back out to open water. That's a rip current: a narrow but powerful stream of water and sand moving (ripping) swiftly away from shore. Rip currents vary in size and speed and can be found on many beaches every day. They typically extend from the shoreline through the surf zone, and past the line of breaking waves. Typically, they form at breaks in sandbars, and also near structures, such as jetties and piers, as well as cliffs that jut into the water.

Rip currents carry swimmers into deeper water, where they may not be able to get their footing. These currents rarely extend far out, and will not pull a swimmer underwater. Rip currents vary in size from very narrow to more than 50 yards wide. Speeds can also vary. The average speed is 1-2 feet per second, but they have been measured as fast as 8 feet per second.

Longshore currents move parallel to or the "long" way along the shoreline. These currents will exert a force to move along shore, making it difficult to remain in front of a spot on the beach. They often happen between the first and second sandbars near the shore. Longshore currents become more dangerous when they combine with rip currents or structural currents since they can move a swimmer swiftly down a beach and into the path of another current or into a structure (pier or breakwall), making it more difficult to swim to shore.

Structural currents - the currents found alongside or as a result of structures like piers and breakwalls - are usually always present. Structural currents are dangerous on their own, but when paired with others like longshore or rip currents, the combination can create a washing machine effect, moving the swimmer from one dangerous current area to another with no clear path to safety.

Outlet currents can be found where rivers and streams empty into the Great Lakes. The flow of water from the river or stream can move quickly. As it enters the open water of a lake, it may take a while for that current to dissipate. Pair that with currents that are present in the lake and the situation can become dangerous.

Channel currents are like a river running parallel to shore. With a channel current, typically there is an island or structure such as a large group of rocks not far from shore. A channel current forms when the flow of water speeds up as it goes between the island and shore, like a bottleneck. This is made worse by the presence of a submerged or partially submerged sandbar connecting the beach to the island, which allows pressure to build behind the water and waves until it breaks through. When the wind speed increases, the waves also increase in intensity, and this causes the current to become stronger and faster.

According to the Great Lakes Current Incident Database, between 2002 and 2020, there have been 75 deaths and 274 persons rescued from dangerous current incidents along the Lake Michigan coastline of Michigan's Lower Peninsula.

It is important to note that there are no "rip tides" or "undertows" in the Great Lakes. Since there are no tides in the Great Lakes, and rip currents don't pull a person down under the water (it will carry them out to the open water, away from shore), "rip tides" or "undertows" are inaccurate coastal hazard terms.

Dangerous current-related incidents in the Great Lakes most often occur when:

- Winds are blowing towards the shore
- Wave heights reach 3 to 6 feet
- A cold weather front is passing through

Location

Dangerous currents are coastal events that are not confined to geographic boundaries and may occur anywhere in Lake Michigan waters. All coastal areas in the LRBOI service area are at risk from dangerous current hazards.

Extent

The National Weather Service provides a Surf Zone Forecast to measure the risk level associated with rip current hazards. Surf Zone Forecasts contain three levels of Rip Current Outlooks:

- Low Risk: The risk for rip currents is low, however, life threatening rip currents often occur in the vicinity of groins, jetties, reefs, and piers.
- Moderate Risk: Life threatening rip currents are possible in the surf zone.
- High Risk: Life threatening rip currents are likely in the surf zone.

Dangerous currents can result in rescues of, or fatalities / injuries to persons swimming in the current.

Previous Occurrences

The number of dangerous current incidents are as follows: Manistee County (2), Oceana County (3), Mason County (11), Muskegon County (13), and Ottawa County (44). Manistee County has had the least number of dangerous current-related fatalities (1), while Ottawa County has had the greatest (20).

Table 36. Dangerous Current Incidents, LRBOI Tribal Service Area

County	Date	Location	Fatalities	Rescues	Type Of Current
Manistee	7/10/2007	5th Ave. Beach	1		Classic Rip
	8/24/2009	Douglas Park		2	Structural
	Total	**2 events**	**1**	**2**	
Mason	8/14/2010	Ludington State Park	1		Classic Rip
	9/5/2010	Stearns Park	1		Structural
	8/1/2012	Ludington State Park		7	Outlet
	7/18/2013	Stearns Park		6	Classic Rip
	7/6/2017	Stearns Park		4	Structural
	7/20/2019	Ludington State Park		1	Outlet
	7/21/2019	Ludington State Park	1	7	Outlet
	7/22/2019	Ludington State Park	1		Outlet
	7/24/2019	Ludington State Park	1	3	Outlet
	7/25/2019	Ludington State Park	1		Other
	9/3/2023	Near Summit County Park	1		Rip Current
	Total	**11 events**	**7**	**28**	
Muskegon	7/20/2002	Pere Marquette Park	1		Structural
	8/11/2002	Pere Marquette Park	1		Structural
	7/17/2005	PJ Hoffmaster State Park	1		Classic Rip
	7/23/2005	Pere Marquette Park	1		Classic Rip/Structural
	7/16/2006	Duck Lake State Park		1	Classic Rip
	8/21/2009	Pere Marquette Park		1	Structural
	7/24/2010	Pere Marquette Park	1	1	Classic Rip/Structural
	8/14/2010	Pere Marquette Park	1		Classic Rip/Structural
	8/16/2010	Muskegon State Park		1	Classic Rip/Structural
	9/1/2011	Norman Kruse Park	1		Classic Rip
	7/18/2013	Pere Marquette Park	1	1	Structural
	7/16/2016	Medbery Park		1	Structural
	7/24/2022	Pere Marquette Park	1		Unknown
	Total	**13 events**	**9**	**6**	
Oceana	8/1/2005	Charles Mears State Park		2	Structural
	7/3/2010	Silver Lake State Park	1		Classic Rip
	8/2/2011	Charles Mears State Park	1		Structural
	Total	**3 events**	**2**	**2**	

County	Date	Location	Fatalities	Rescues	Type Of Current
	6/7/2002	Grand Haven State Park		1	Structural
	6/10/2002	Grand Haven State Park		1	Structural
	8/19/2003	Grand Haven State Park	1	1	Structural
	9/2/2003	Grand Haven State Park	1		Structural
	11/28/2003	Grand Haven State Park	1		Structural
	8/9/2005	Holland State Park	1		Classic Rip/Structural
	7/3/2006	Grand Haven State Park		2	Structural
	7/8/2006	North Beach Park	1	1	Classic Rip/Structural
	7/16/2008	Pierce St. Beach	1		Classic Rip/Outlet
	7/20/2008	Holland State Park		5	Classic Rip/Structural
	7/31/2009	Grand Haven State Park		3	Structural
	8/2/2009	Grand Haven State Park		1	Structural
	8/2/2009	Holland State Park		4	Structural
	8/10/2009	Holland State Park		23	Structural
	7/4/2010	Grand Haven State Park		2	Structural
	7/22/2010	Grand Haven State Park	1	1	Classic Rip/Structural
	8/18/2010	Grand Haven State Park	1		Classic Rip/Structural
	8/30/2010	Grand Haven State Park		2	Structural
	6/25/2011	Holland State Park		3	Structural
	7/19/2011	Grand Haven State Park		2	Structural
	8/2/2011	Holland State Park		16	Structural
	8/2/2011	Holland State Park		2	Structural
Ottawa	8/2/2011	Holland State Park		2	Structural
	8/2/2011	Holland State Park		4	Structural
	8/2/2011	Holland State Park		4	Structural
	7/6/2012	Holland State Park		19	Structural
	9/9/2014	Grand Haven State Park		2	Structural
	8/10/2015	Holland State Park		2	Structural
	8/19/2015	Grand Haven State Park		2	Classic Rip
	8/5/2016	Holland State Park		2	Structural
	8/12/2016	Grand Haven State Park		2	Classic Rip
	8/20/2016	Port Sheldon	1	1	Structural
	8/30/2016	Holland State Park	2	2	Structural
	7/26/2017	Holland State Park		4	Structural
	8/4/2018	Grand Haven State Park	1	1	Classic Rip
	8/4/2018	Grand Haven State Park	1		Structural
	8/4/2018	Grand Haven State Park		2	Classic Rip
	8/5/2018	Grand Haven State Park	1		Structural
	6/6/2020	Holland State Park	1		Structural
	7/21/2020	Grand Haven State Park	1		Structural
	8/22/2021	Holland State Park	1		Unknown
	9/4/2021	Holland State Park	1		Unknown
	7/13/2022	North Park Beach, Ferrysburg	1		Rip Current
	8/8/2022	South Haven State Park	1		Rip Current
	Total	**44 events**	**20**	**119**	

Sources: Michigan Technological University's Dangerous Nearshore Current Dashboard; NOAA Storm Events Database; NOAA Surf Zone Fatalities

Probability of Future Events and Vulnerability Assessment
Ottawa County has had 44 dangerous current events, as well as the greatest amounts of deaths and rescues, between 2002 and 2022. This equates to an average of 1.9 events per year.

Muskegon County has had 13 dangerous current events between 2002 and 2022, indicating there is about a 62% chance of an event occurring in a future year.

Mason County has had 11 dangerous current events between 2010 and 2023, indicating there is about a 79% chance of an event occurring in a future year.

Manistee County and Oceana County have had less than five incidents each since on record, indicating a very low probability of a future annual event.

Dangerous current events likely to occur more frequently, but often go unreported as injuries, deaths or rescues do not occur. Strong currents are dangerous to all swimmers, especially those who are unprepared to be swept up in them. Many Lake Michigan beaches do not have a lifeguard on duty who may identify potential hazardous swimming conditions. Swimmers who are caught unaware may panic when caught up in the fast-moving water, tire as they try to swim against the current, and drown.

Public beaches with Lake Michigan access in Manistee County are located in the City of Manistee, Manistee Township, Filer Charter Township, Onekama Township and Arcadia Township.

The LRBOI does not own any Lake Michigan shoreline property.

Coastal Hazards - Seiche

According to the National Weather Service, a seiche is a standing-wave oscillation in any enclosed lake that continues after a forcing mechanism has ceased and results in shoreline flooding and/or damage. In the Great Lakes and large inland lakes, large pressure differences, high winds, or fast-moving squall lines may act as the forcing mechanism. In addition, earthquakes or debris flows can initiate a seiche. When the forcing mechanism ends, the water sloshes back and forth from one end of the lake to the other, causing water level fluctuations of up to several feet before damping out.

A seiche is usually limited to partially or fully enclosed basins, such as Lake Erie. Lake Erie is known for seiches, especially when strong winds blow from southwest to northeast. In 1844, a 22-foot seiche breached a 14-foot-high sea wall killing 78 people and damming the ice to the extent that Niagara Falls temporarily stopped flowing. As recently as 2008, strong winds created waves 12 to 16 feet high in Lake Erie, leading to flooding near Buffalo, New York.

In some of the Great Lakes and other large bodies of water, the time period between the "high" and "low" of a seiche can be as much as four to seven hours. This is very similar to the time period between a high and low tide in the oceans, and is often mistaken as a tide.

According to the NOAA-NCEI Storm Events Database, there have been 15 seiche events in Michigan since 1998. There are no deaths, no injuries, and $31,000 in property damages due to seiche events.

Location
A seiche is a coastal event that is not confined to geographic boundaries and may occur anywhere in Lake Michigan waters or on large inland lakes. All Lake Michigan coastal areas are at risk from a seiche hazard.

Extent and Previous Occurrences
Seiche events can be measured by damages-caused including deaths, injuries, and property damages. The NOAA Storm Events Database contains one record of a seiche event occurring within the LRBOI service area. On May 31, 1998 a seiche occurred at Wabaningo in Muskegon County, causing $20,000 of property damage. The event narrative is as follows: “The tug boat Stephen M. Asher sunk in White Lake Channel, just north of Wabaningo between Lake Michigan and White Lake, at approximately 5:15 am EDT due to a seiche created by the derecho moving across Lake Michigan. The crew reported a storm surge swept through the channel into White Lake as the derecho moved onshore. As the storm passed, the water rushed back out of White Lake through the channel, reaching the top of the channel walls. The tug boat, floating against a barge, rolled on its side and sank. No crew members were injured. The company which owns the tug boat estimated repairs would cost $20,000.”

Probability of Future Events and Vulnerability Assessment
Seiche events have likely occurred along the Lake Michigan coastline elsewhere in the LRBOI service area, but may have been unreported if injuries, deaths, or significant property damages did not occur. However, persons and property along the lake shore, particularly at marinas (such as those in the City of Manistee, Onekama Township/Village and Arcadia Township), are vulnerable to high waves caused by a seiche. Seiche events are also dangerous to all swimmers, especially those who are unprepared to be swept up in the current. Many Lake Michigan beaches do not have a lifeguard on duty who may identify potential hazardous swimming conditions. Public beaches with Lake Michigan access in Manistee County are located in the City of Manistee, Manistee Township, Filer Charter Township, Onekama Township and Arcadia Township.

Coastal Hazards - Waterspout

NOAA defines a waterspout as a "funnel which contains an intense vortex, sometimes destructive, of small horizontal extent and which occurs over a body of water." Tornadic waterspouts generally begin as true tornadoes over land in association with a thunderstorm, and then move out over the water. They can be large and are capable of considerable destruction, and are often accompanied by high winds and seas, large hail, and frequent dangerous lightning.

Fair weather waterspouts, on the other hand, form only over open water. They develop at the surface of the water and climb skyward in association with warm water temperatures and high humidity in the lowest several thousand feet of the atmosphere. They are usually small, relatively brief, and less dangerous. The fair weather variety of waterspout is much more common than the tornadic.

Waterspouts occur most frequently in northern Michigan during the months of August, September, and October, when the waters of the Great Lakes are near their warmest levels of the year. Waterspout formation typically occurs when cold air moves across the Great Lakes and results in large temperature differences between the warm water and the overriding cold air. They tend to last from about two to twenty minutes, and move along at speeds of 10 to 15 knots.

There are five stages of waterspout formation:

1. Dark spot. A prominent circular, light-colored disk appears on the surface of the water, surrounded by a larger dark area of indeterminate shape and with diffused edges.
2. Spiral pattern. A pattern of light and dark-colored surface bands spiraling out from the dark spot which develops on the water surface.
3. Spray ring. A dense swirling annulus (ring) of sea spray, called a cascade, appears around the dark spot with what appears to be an eye similar to that seen in hurricanes.
4. Mature vortex. The waterspout, now visible from water surface to the overhead cloud mass, achieves maximum organization and intensity. Its funnel often appears hollow, with a surrounding shell of turbulent condensate. The spray vortex can rise to a height of several hundred feet or more and often creates a visible wake and an associated wave train as it moves.
5. Decay. The funnel and spray vortex begin to dissipate as the inflow of warm air into the vortex weakens.

According to NOAA's National Weather Service, the best way to avoid a waterspout is to move at a 90-degree angle to its apparent movement.

Location

Waterspouts are a common occurrence posing a great threat to marine traffic. According to the MSP's 2019 *Michigan Hazard Analysis*, Michigan waterspouts have been noted by National Climatic Data Center between 1993 and 2001. Many additional events have occurred since, which NCDC has classified according to the corresponding lake location rather than as part of Michigan itself. Waterspouts are less frequent on Lake Superior (8 events since 2001) than on Lakes Huron (23 events) or Michigan (51 events).

Extent

Waterspouts typically last from about two to twenty minutes, and move along at speeds of 10 to 15 knots. They can overturn watercraft and cause damage to structures built over the water. According to the MSP's 2019 *Michigan Hazard Analysis*, a waterspout caused $200,000 in damage to a boat house and storage building at Drummond Island (Lake Huron) on July 3, 1999.

Previous Occurrences

There is one waterspout event on record with NOAA's NCEI Storm Event Database for the LRBOI service area. On November 10, 1998, a waterspout was reported as one-half mile wide off the Lake Michigan shoreline of Roosevelt Park neighborhood in Muskegon County. Radar indicated a rotation of 8,000 feet. This waterspout is associated with a high wind event where winds exceeded 50 mph and gusts exceeding 60 mph over the warning area.

Probability of Future Events and Vulnerability Assessment

Although there is only one recorded Lake Michigan waterspout event with the NOAA NCEI Storm Event Database within the LRBOI service area, it is likely that waterspouts have occurred in the past, but have not been officially documented.

The National Weather Service (NWS) meteorologists consider forecasting waterspouts during the late summer and fall whenever large, cool air masses overspread the waters of the Great Lakes. Once the NWS has determined that waterspouts are possible, the threat is outlined in the Nearshore Marine Forecast and Hazardous Weather Outlook. The NWS strives to provide this information to the public 12 to 24 hours prior to waterspout occurrence.

When waterspouts have been detected by Doppler radar or reported by local law enforcement or spotters, the NWS issues a Special Marine Warning. Since it is not uncommon for numerous waterspouts to occur simultaneously over a large area, these warnings tend to cover larger geographic areas than land-based tornado warnings which generally cover a single county.

In most cases, waterspouts which make landfall are much weaker than tornadoes, produce little or no damage, and dissipate quickly. Once on land, they tend not to be a great threat to life and property. In these instances, the NWS issues a Tornado Warning.

A mitigation strategy for marine vessel operators on the Great Lakes includes education and awareness about the prevailing weather conditions, appearance and destructive potential related to waterspouts. When warnings are issued for waterspouts, boaters should prepared to quickly seek safe harbor, or to find shelter out of the path of the waterspout. The best source for waterspout forecast information is NOAA Weather Radio (NWR). These continuous broadcasts from transmitters scattered around the Great Lakes provide forecasts and warnings 24 hours a day. Mobile emergency alert systems can also be utilized as an informational source for waterspout forecasts and warnings.

Coastal Hazards - Coastal Recession and Shoreline Flooding

Coastal recession (erosion) is the wearing away of land, such as loss of riverbank, beach, shoreline, or dune material. It is measured as the rate of change in the position or displacement of a riverbank or shoreline over a period of time. Short-term erosion typically results from periodic natural events, such as flooding, hurricanes, storm surge, and windstorms, but may be intensified by human activities. Long-term erosion is a result of multi-year impacts such as repetitive flooding, wave action, sea level rise, sediment loss, subsidence, and climate change. Death and injury are not typically associated with erosion; however, it can destroy buildings and infrastructure. Waters of the Great Lakes may cause shoreline hazards to occur making the entire northwest Michigan coastline is susceptible to shoreline hazards. As indicated in Figure 23, large portions of the Lake Michigan shoreline throughout west Michigan are identified as “High Risk Erosion Areas in 2019.”

Coastal (shoreline) flooding results when Great Lakes water levels rise and push inland, or when rainfall or snowmelt accumulates along the shoreline and is not able to drain properly. Shoreline flooding may also be caused during storms and wind events with high-energy waves.

Most of the northwest Michigan coastline is susceptible to coastal recession and shoreline flooding.

Figure 23: Great Lakes Shorelines with High Risk Erosion Areas, 2019

Location
To reference the 2019 *Northwest Lower Michigan Coastal Resilience Atlas*, "Climate scientists predict that northwest Lower Michigan can expect more frequent storms of increasing severity in the decades ahead. The total amount of rainfall per year in also likely to increase. The potential for substantially larger rain events and severe storms raises concerns of harm to human health and damage to buildings and infrastructure, especially for areas along the Lake Michigan coastline."

Manistee County jurisdictions that may be impacted by shoreline hazards are those along the Lake Michigan coast and direct tributaries to Lake Michigan: the City of Manistee, Manistee Township, Filer Charter Township, the Village of Eastlake, Onekama Township, the Village of Onekama, and Arcadia Township (Figure 24). The Land Information Access Association documented potential shoreline hazards for these communities in the *Northwest Lower Michigan Coastal Resilience Atlas*. Specific areas of shoreline hazards were also identified during the development of this plan. These are marked as a "shoreline erosion" type of hazard area on the Hazard Area Maps in Appendix A.

Figure 24: Manistee County Shoreline Communities in the Northwest Lower MI Coastal Resilience Atlas

In developing the *Northwest Lower Michigan Coastal Resilience Atlas,* scenario planning was used to determine the potential impact of three differing levels of storms combined with high waters:

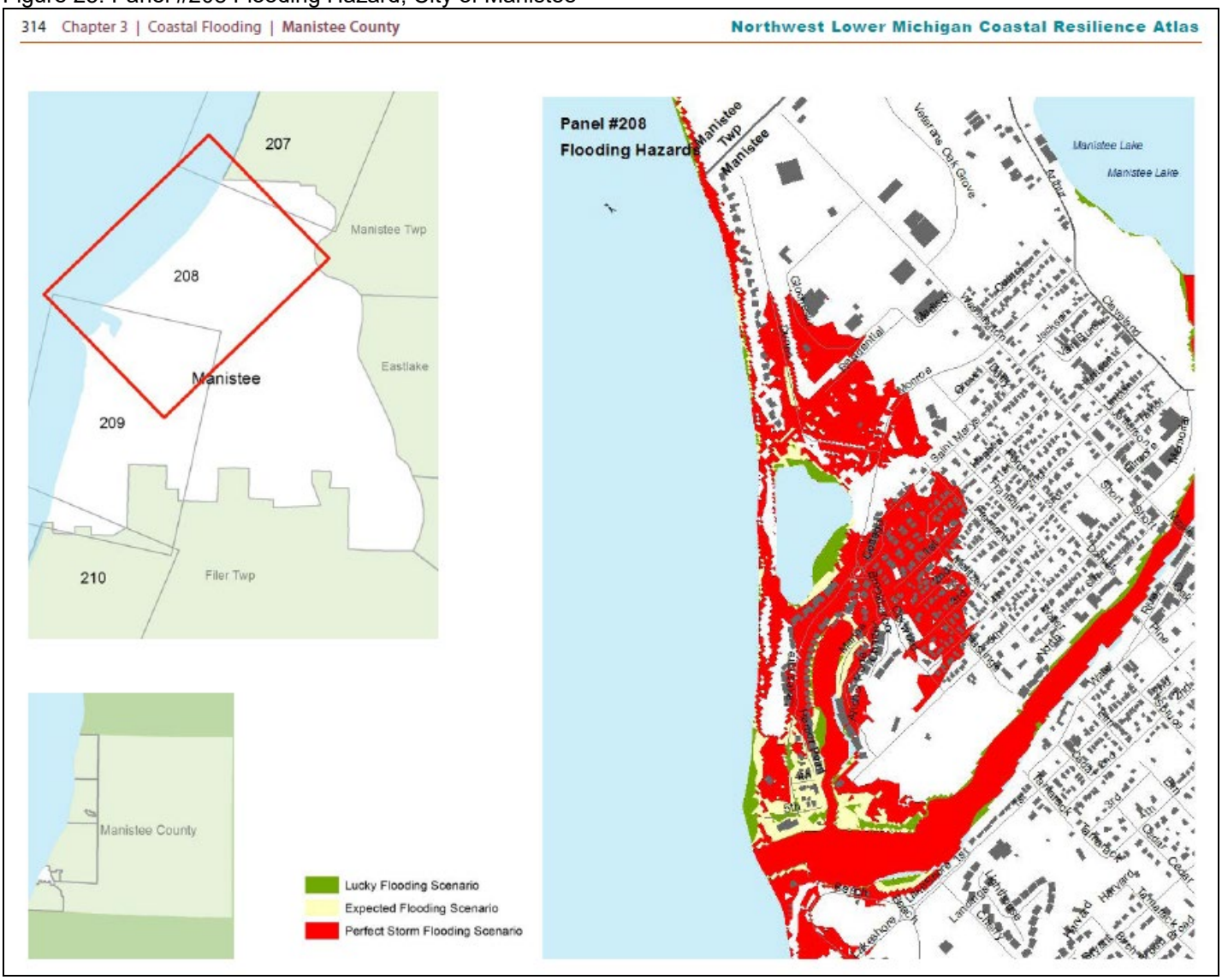
"Lucky" Future: Great Lakes water levels will continue to stay relatively low. Although there will be wave and wind action, major storm events and wave impacts will not encroach on properties landward of current beaches. A Lucky Future projection, indicating the land areas that would be affected by high-energy waves along the shorefront and/or adjacent riverine flooding under these conditions, is shown in green on the maps.

"Expected" Future: Great Lakes water levels will continue to fluctuate according to long-term decadal patterns, including recent extreme storm events incorporated into the ongoing Great Lakes Coast Flood Study being conducted by the Federal Emergency Management Agency (FEMA). Given those ongoing fluctuations, this Climate Future accounts for periods when Great Lakes still-water elevations are closer to the long-term average. In addition, this Climate Future anticipates the so-called "100-year storm event" (or 1% storm) becoming more like a 20- or 50-year storm event (i.e., an expected storm within the normal community planning time horizon) because of increased storminess. The Expected Future projection is shown in yellow on the maps.

"Perfect Storm" Future: Great Lakes water levels will continue to fluctuate according to decadal patterns, consistent with assumptions made for the Expected Future. However, for this Perfect Storm Climate Future, the estimated still-water elevation is set higher than the long-term average and closer to the long-term high (583 feet). In addition, this Climate Future anticipates the occurrence of a so-called "500-year storm event" (or 0.2% storm) occurring within the planning time horizon while lake levels are high. The Perfect Storm Future projection is shown in red on the maps.

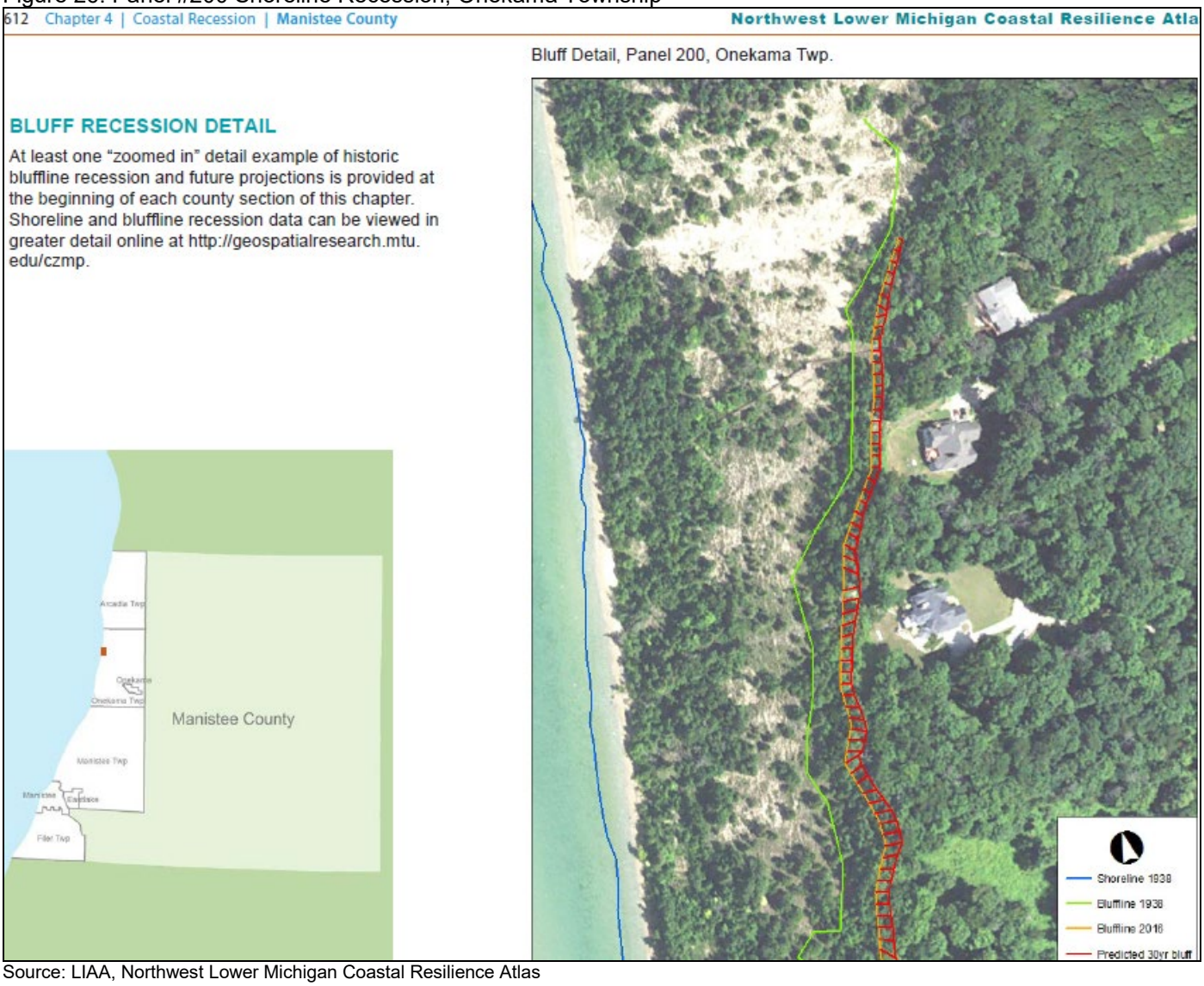
Figure 25 illustrates the three potential flooding scenarios in part of the City of Manistee. “Lucky” scenario flooding is shown in green, “Expected” flooding scenario is shown in yellow, and “Perfect Storm” future scenario is shown in red.

Figure 25: Panel #208 Flooding Hazard, City of Manistee



Coastal recession, or erosion, to Lake Michigan communities is a constant, but small wearing away of the shoreline. The Great Lakes are estimated to lose one foot of shoreline per year to normal wave and wind activity. However, storms and increased wave activity have caused increased coastal recession to varying degrees in Lake Michigan coastal communities. Chapter 4 of the *Northwest Lower Michigan Coastal Resilience Atlas* describes bluffline recession since the 1938 recorded shoreline location. The varying lines are shown in Figure 26 depicting the recession of the bluffline in Onekama Township. The blue line indicates the shoreline in 1938, the green line indicates the bluffline in 1938, the yellow line is the bluffline in 2016, and the red line is the predicted 30 year bluffline.

Figure 26: Panel #200 Shoreline Recession, Onekama Township



Source: LIAA, Northwest Lower Michigan Coastal Resilience Atlas

Additionally, the Manistee County communities of Filer Charter Township, the City of Manistee, Manistee Township, Onekama Township and Arcadia Township contain "High Risk Erosion Areas" (HREAs) along various locations adjoining Lake Michigan. Designated and regulated by the State of Michigan's Department of EGLE, HREAs are shorelines of the Great Lakes where the land is receding at a rate of one foot or more per year for a minimum of 15 years. Recession rates change over time as water levels fluctuate and coastal conditions change. Along these shorelines, new structures are required to meet setbacks for their protection from a changing shoreline. When structures are not in danger, the shoreline does not need to be altered to protect the structure.

A permit is required by EGLE for construction, movement, or enlargement of a structure on any portion of a designated HREA parcel regardless of how far the project is from the lakeshore. Common activities requiring a permit include construction of a new house, commercial building, garage, covered porch or addition; substantial reconstruction of a home; and the installation of a septic system. HREAs are regulated by the Administrative Rules of Part 323, Shorelands Protection and Management, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended. Currently EGLE administers Part 323 for all HREAs in the county.

The Manistee County communities of Filer Charter Township, Manistee Township and Onekama Township contain State-designated "Critical Dune Areas" (CDAs), which are a combination of coastal barrier dunes, land that has dune-like features, and unique plant communities along a Great Lakes shoreline. Regulatory authority goes to the water's edge. The CDAs include public lands and private properties where developmental, silvicultural, and recreational activities are regulated and a permit is required under Part 353, Sand Dunes Protection and Management, of the Natural Resources and Environmental Protection Act for activities that significantly alter the CDA, such as the construction of a house or garage, building a road or driveway, installing a septic system, installing retaining walls, and sand removal. The law balances the benefits of protecting, preserving, restoring and enhancing the diversity, quality, functions, and value of the critical dunes with the benefits of economic development, multiple uses, and public access. Currently EGLE administers Part 353 for all CDAs in the county.

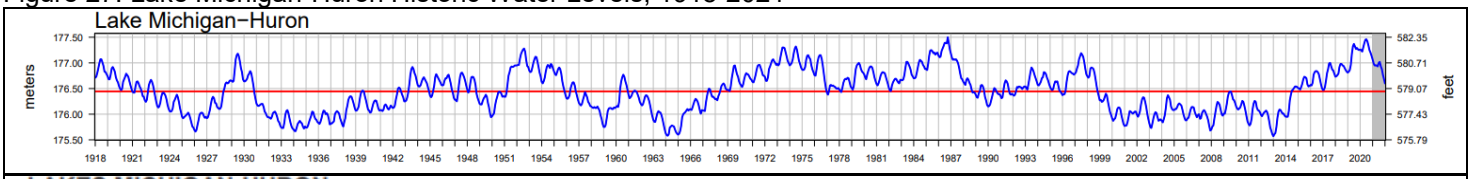
The HREAs and CDAs in Manistee County are shown on the Environmental Features Map are included in Appendix A. Detailed maps of HREAs and CDAs provided by EGLE can be viewed at: https://www.michigan.gov/egle/about/organization/water-resources/shoreland-management/high-risk-erosion-areas/maps and https://www.michigan.gov/egle/about/organization/water-resources/sand-dunes/critical-dunes/maps. There are no HREAs or CDAs on LRBOI-owned property.

Extent

Shoreline recession can be measured by feet of bluffline retreat and property damages. Bluffline retreat distances vary across the county, and there are no reported damages from bluffline recession. Shoreline flooding can be measured by flood water levels, inches of rainfall, lake water levels (shown in Figure 27), and damages. The four Lakeshore Flooding events in 2019 and 2020 caused $499,000 in property damages in Manistee County (Table 27). As a result, the City of Manistee recently completed a $2 million project to elevate their Riverwalk system, including strategic shoreline protection and concrete walkway reconstruction. A wave analysis and FEMA FIRMs were also utilized to inform the project.

In recent years, the swings in water levels have been unprecedented. In January 2013, Lake Michigan-Huron set an all-time record low of 576.02 feet, and seven years later in July of 2020 Lake Michigan-Huron reached a monthly record high of 582.22, only second to the October 1986 monthly record high of 582.35.

Figure 27: Lake Michigan-Huron Historic Water Levels, 1918-2021



LAKES MICHIGAN-HURON

2021	*580.94*	*580.68*	*580.54*	*580.54*	*580.54*	*580.48*	*580.71*	*580.77*	*580.48*	*580.41*	*579.95*	*579.69*	*580.48*
Mean	**578.48**	**578.44**	**578.48**	**578.77**	**579.07**	**579.30**	**579.40**	**579.33**	**579.17**	**578.94**	**578.77**	**578.61**	**578.90**
Max	581.56	581.53	581.43	581.69	581.96	582.19	582.22	582.09	581.96	582.35	581.96	581.56	
	2020	2020	2020	2020	2020	2020	2020	2020	1986	1986	1986	1986	
Min	576.02	576.08	576.05	576.15	576.57	576.64	576.71	576.67	576.64	576.44	576.28	576.15	
	2013	1964	1964	1964	1964	1964	1964	1964	1964	1964	1964	2012	

Source: US Army Corps of Engineers

Previous Occurrences

In the approximately the past four decades, the Great Lakes experienced record high lake levels in 1985-86, 1997-98, and most recently in 2019-20. Four lakeshore flood incidents have been reported in Manistee County, as described below.

Table 37: Shoreline Flooding Events in the LRBOI Tribal Service Area

LOCATION	DATE	EVENT TYPE	DEATHS / INJURIES	PROERTY DAMAGE	CROP DAMAGE
Manistee County	10/16/2019	Lakeshore Flood	0 / 0	$ 350,000	$ -
Manistee County	10/22/2019	Lakeshore Flood	0 / 0	$ 142,000	$ -
Manistee County	4/13/2020	Lakeshore Flood	0 / 0	$ -	$ -
Manistee County	11/1/2020	Lakeshore Flood	0 / 0	$ 7,000	$ -
TOTAL				$ 499,000	$ -

Source: NOAA NCEI Storm Events Database

The narrative of the October 16, 2019 lakeshore flood event:

Northwest to north winds produced high waves and elevated water levels along the northwest Lower Michigan coastline. With Great Lakes water levels at near-record levels, significant coastal flooding and beach erosion resulted. Flooding covered a portion of Lakeshore Drive at 5th Avenue Beach in Manistee. In Parkdale, the beach eroded up to the foundation of several homes, and several trees washed into the lake.

The narrative of the October 22, 2019 lakeshore flood event:

Strong northerly to easterly winds resulted in another round of substantial coastal flooding and beach erosion, this time on both Lake Michigan and Lake Huron, for the 21st into the 22nd. A dock, boardwalk, and beach signage were destroyed in Parkdale.

The narrative for the two lakeshore flooding events in 2020:

April 13, 2020: *A strong low pressure passed just north of eastern upper Michigan on the morning of the 13th. Gusty west to northwest winds developed during the day, in the wake of the low. Gusts of 40 to 50 mph were common across northern Michigan, especially during the afternoon. The highest measured wind gust was 58 mph at the airport in Gaylord. Some localized power outages resulted. Lakeshore flooding also occurred along portions of the Lake Michigan coastline of northwest Lower Michigan. The city boat launch in Frankfort experienced flooding of docks and the parking lot. And severe coastal erosion destroyed a portion of the Little Traverse Wheelway between Petoskey and Charlevoix.*

November 1, 2020: *A strong low pressure crossing northern Ontario would drag a cold front across northern Michigan early on the 1st. Gusty southwest winds ahead of the front became even gustier out of the northwest behind the front. Peak measured wind gusts included 58 mph at Leland and Traverse City, 57 mph at Bay Mills, and 54 mph at Pellston. North Lakeshore Drive was flooded near the US Coast Guard Station in Manistee. Streets were covered in water, and the water extended to near the base of some homes.*

The lakeshore flood events in 2020 resulted in wave-run up from Lake Michigan into parts of the City of Manistee, with flood levels at 2 to 2.5 feet. Sand and water flooded through the 5th Avenue beach area, impacting the local wastewater treatment plant, the Coast Guard station, and local residences; streets were difficult or impossible to access. The City of Manistee has obtained preliminary engineering estimates for two projects to mitigate future shoreline flooding in this area of the City. One project is the 5th Avenue Flood Mitigation project: construct a wave barrier add a secondary gravity storm sewer and pump station that outlets into the Harbor Village channel. The other project is to construct shoreline protection (~1,023') around the City of Manistee's clean water recovery facility. Details about these proposed projects are included in Appendix C.

Additionally, on February 21, 1986, a Governor-Declared Disaster was issued for Muskegon County, Ottawa County and other Great Lakes shoreline counties outside of the LRBOI service area for Great Lakes flooding and wave action.

Probability of Future Events and Vulnerability Assessment

There have been four lakeshore flooding events in Manistee County in the past four years. These events occurred at the same time as near-record high Great Lakes water levels. Additionally, Muskegon and Ottawa counties were included in a 1986 Governor's disaster declaration due to the high Lake Michigan levels/wave action causing shoreline flooding.

As lake water levels fluctuate and increased storminess occurs, shoreline recession and flooding will continue. In 2021 the level of Lake Michigan began to decline, however, as historic data indicates, the water will begin to rise again. Historic lake level fluctuations have ranged between 3 to 16 year intervals (Figure 27).

Those communities that have already faced shoreline hazards are likely to experience issues in the future. Changes in land use practices and improvements to the shoreline such as natural vegetation plantings or shoreline armoring may reinforce the shoreline for a period of time, but is likely not a permanent solution. The LRBOI service area includes the Lake Michigan shoreline counties of Manistee, Mason, Oceana, Muskegon, and Ottawa.

Shoreline flooding can also result in soil erosion, which carries a risk of loss to shoreline properties. It may necessitate the relocation of homes or other structures as sand or soil is removed by flowing water (lake, river, etc.) and carried away over time. The foundation of a structure, or underground utility pipes in the area, may become fully exposed and vulnerable to weather, extreme temperatures, water damage, or other sources of risk. Shoreline banks that support roadways may erode and cause the road surface to crack, become unstable, or more prone to deposits of sand, snow, water, and ice. Shoreline flooding and erosion is relevant to those municipalities that contain residential and commercial development along Lake Michigan that experience seasonal shifts in water levels and possible ice erosion hazards.

The LRBOI does not own any property along the Lake Michigan shoreline in Manistee County. However, two properties identified as LRBOI critical infrastructure sites - the “Big Blue” NR storage building on Brickyard Road in the Village of Eastlake and the building LRBOI leases for Little River Holdings, LLC on N. Water Street in the City of Manistee - adjoin Manistee Lake and the Manistee River, respectively. These locations are at risk from rising Lake Michigan shoreline flooding events.

Public Health Emergency (Infectious Disease)

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

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

Extent
The extent of a public health emergency can be determined by the number of cases and deaths, and the amount of money spent to prepare for and respond to public health threats. In Manistee County, the District Health Department #10 works with local, state, and federal agencies to prepare for and respond to public health threats. State of Michigan (https://www.michigan.gov/coronavirus/stats) reports, as of December 31, 2022, there were 3,529 cases and 89 deaths confirmed to be attributed to COVID-19 in Manistee County. Of the confirmed deaths, those aged 60 years and older have the most deaths of any age range at 75 deaths. All of the deaths reported were persons 50 years and above. The State of Michigan began collecting data on COVID-19 cases and deaths on March 1, 2020.

Previous Occurrences
Throughout the years, there have been many pandemics. For example, there was an outbreak of severe acute respiratory syndrome (SARS) in 2003. This virus was a new coronavirus that resulted in over 8,000 illnesses worldwide. Of these, 774 died. Since 2012, Middle East respiratory syndrome (MERS), a coronavirus, has been reported in 27 countries where there have been approximately 2,494 people infected and 858 deaths. In 2017, the World Health Organization (WHO) put SARS and MERS on its priority pathogen list to spur further research into coronaviruses. More recently in 2020, a Presidential and Governor Emergency was declared for COVID-19 Pandemic in Michigan, as well as by the LRBOI Tribe. Variants of the corona virus are still being found after the initial spread; vaccinations are available to limit the reaction from exposure and limit the spread of the disease.

Probability of Future Events and Vulnerability Assessment
Naturally occurring pandemics may result in widespread precautions around the world. The Michigan Department of Health and Human Services created a Pandemic Response Plan (Annex 12 of the MDHHS Emergency Operations Plan, June 2023) respond to a large-scale outbreak of influenza and other highly infectious respiratory diseases. The elderly, immune-compromised, and low income populations are most vulnerable to public health emergencies.

LRBOI provides health services, such as immunizations, to Tribal members through a Health Clinic in the Tribal Governmental Center in Manistee Township; Community Health Representatives that perform home visits and transport clients to medical appointments; and contract health services for those Tribal members throughout the nine county service area.

Subsidence
Note: much of the information presented in this section was obtained from MSP's 2019 Michigan Hazard Analysis.

Subsidence is defined as the lowering or collapse of a land surface, caused by natural or human-induced activities that erode or remove subsurface support. Natural subsidence occurs when the ground collapses into underground cavities produced by the dissolution of limestone or other soluble materials by groundwater. Human-induced subsidence is caused principally by groundwater withdrawal, drainage of organic soils, and underground mining.

More than 80% of the identified subsidence in the United States is a consequence of human impact on subsurface water. Three distinct processes account for most of the water-related subsidence: compaction of aquifer systems, drainage and subsequent oxidation of organic soils, and dissolution and collapse of susceptible rocks. Compaction of soils in some aquifer systems can accompany excessive ground-water pumping and cause subsidence.

Approximately 18% of the United States land surface is underlain by cavernous limestone, gypsum, salt, or marble, making the surface of these areas susceptible to collapse into sinkholes. The term *karst*, first applied to a plateau region of the Dinaric Alps in Yugoslavia, is now used to describe regions throughout the world that have features formed largely by underground drainage. Karst terrains are characterized by caves, steep valleys, sinkholes, and a general lack of surface streams. Within Michigan, sinkholes are found predominantly in the northeastern Lower Peninsula and eastern Upper Peninsula.

Additionally, an increasing number of urban subsidence events have resulted from infrastructure failures, such as water main breaks, which cause road surfaces to collapse. Construction-related incidents have also occurred in Michigan.

Location
Within the LRBOI tribal service area, the potential for mine-related subsidence threats are as follows (refer to Figure 28).

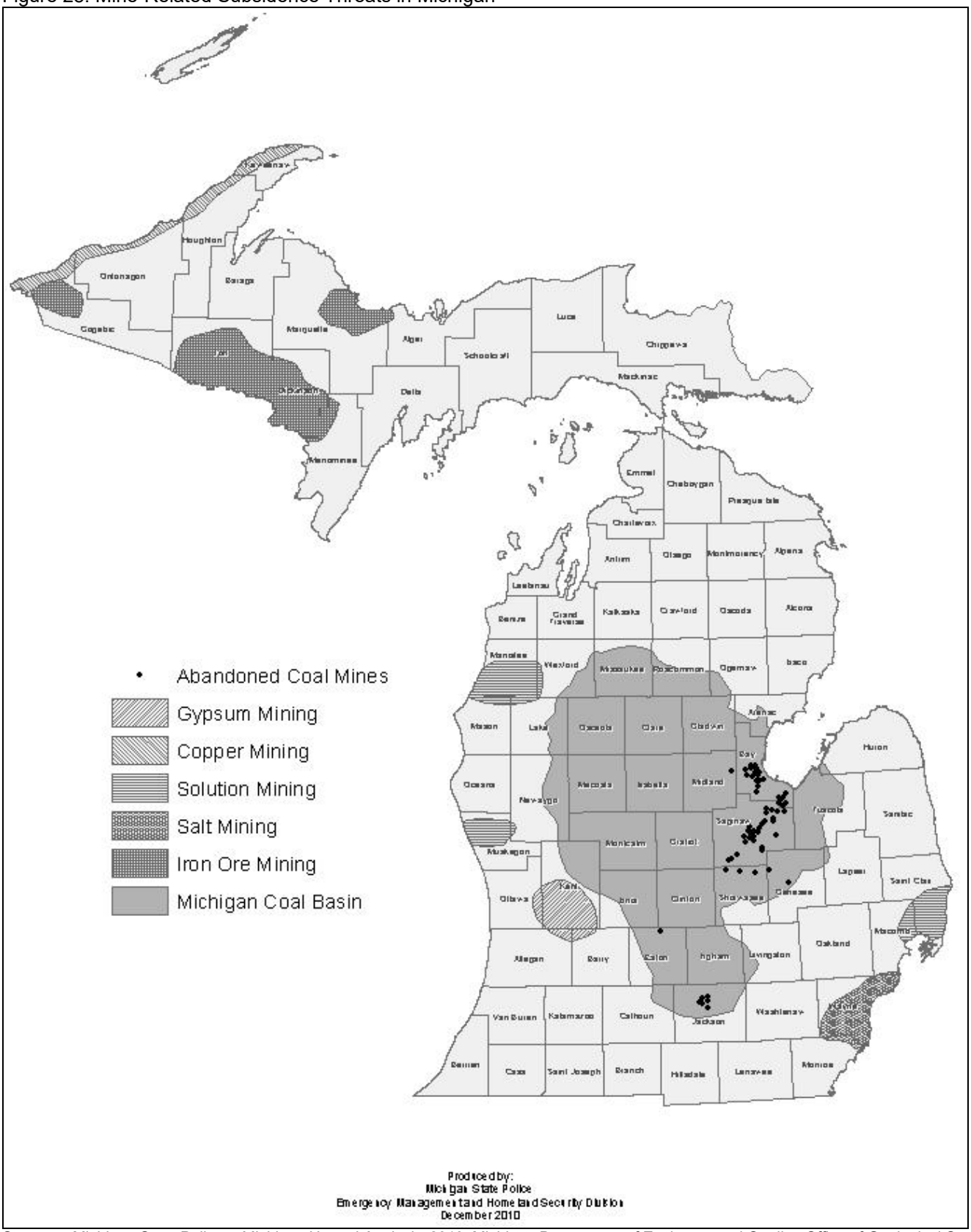
- Solution mining (injecting freshwater into salt formations and retrieving the resulting brines) in parts of Manistee, Wexford, Mason, Lake, Newaygo and Muskegon counties;
- Gypsum mining in parts of Kent and Ottawa counties. There are two known gypsum mines in Kent County: The Kentwood mine in the City of Kentwood, southeast of the City of Grand Rapids; and the Georgia-Pacific mine near the western limits of the City of Grand Rapids.
  https://www.dnr.state.mi.us/spatialdatalibrary/pdf_maps/Geology/Mines/Kent.pdf
- Presence of the "Michigan Coal Basin" (but no known abandoned coal mines) in parts of Kent, Newaygo, Lake and Wexford counties.

The sinkhole risk categories within the LRBOI tribal service area are "infrequent or likely infrequent" within portions of Manistee, Mason, Oceana, Muskegon, Kent, Newaygo and Ottawa counties (Figure 29).

Extent
Although some subsidence incidents may cause private property damage and casualties within Michigan, others may affect roadways or other public infrastructure, and thus cause a more general impact on the population of an area. Most past incidents have had limited effect upon the general public, but in time, some exception may arise. Roadways have now been identified that are in proximity to, if not completely overlaying, abandoned mine lands that therefore may be vulnerable to collapse, potentially injuring or killing persons traveling in vehicles or trapped within a collapse area. A recent rain event revealed that mudslides and structural collapse can occur as a result of rapid hydrological runoff within hilly areas of the state, and can cause fatal impacts. The number of houses and other buildings that may be at substantial risk has not yet been pinned down, but probably numbers over 100 on the basis of the identified mine locations mapped by MDNR. Infrastructure is likely to be affected just as surface roads are. It is not yet clear what facilities may be at risk, but they probably include some that will impact the quality of life in some of Michigan's oldest communities (both small and large). Likely forms of infrastructure vulnerability include transportation, water supply, urban sewage, and underground pipelines for oil and gas. One of the most serious such events could have resulted from the 2016 incident in Fraser, which involved a major component of the water infrastructure within one of the most heavily and densely populated counties in Michigan, but fortunately was handled promptly and carefully in a way that limited its impacts to the broader metropolitan area.

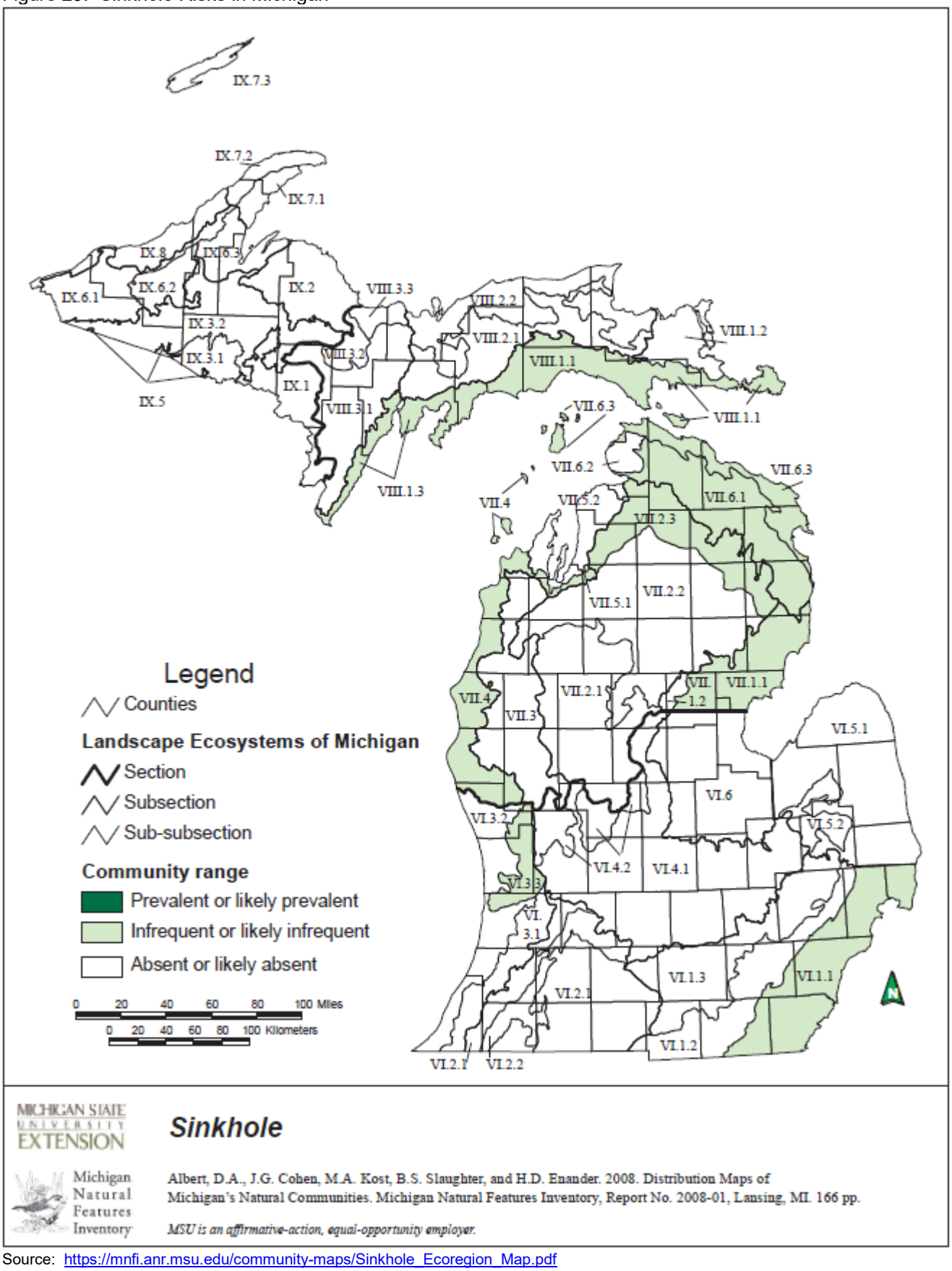
Previous Occurrences
The *2019 Michigan Hazard Analysis*, completed by the Michigan State Police, does not indicate that any significant subsidence incidents, such as mine cave-ins or sinkholes, have occurred within the LRBOI tribal service area.

Figure 28. Mine-Related Subsidence Threats in Michigan



Sources: Michigan State Police – *Michigan Hazard Analysis*, 2019; Michigan Department of Environmental Quality, Office of Geological Survey

Figure 29. Sinkhole Risks in Michigan



Source: https://mnfi.anr.msu.edu/community-maps/Sinkhole_Ecoregion_Map.pdf

Probability of Future Events and Vulnerability Assessment

The probability of a subsidence event occurring within the LRBOI service area is low, but not impossible. An event is more likely to occur within areas of underground utility infrastructure in urbanized areas (such as the cities of Manistee and Muskegon), or in areas of solution mining and gypsum mining activity (various parts of Kent, Lake, Manistee, Mason, Muskegon, Newaygo, Ottawa and Wexford counties, per Figure 28).

LRBOI owns property and/or structures within Manistee, Mason and Muskegon counties, and LRBOI tribal members live throughout the tribal service area, on and off of tribal-owned land.

Options to mitigate the risk from subsidence hazards affecting LRBOI property and tribal members include the following:

- Limiting or preventing new LRBOI development in high-risk areas, such as old mining areas and geologically unstable terrain.
- Regularly maintain water and sewer infrastructure operations to ensure the availability of clean potable water and collection and treatment of sanitary sewer.

Invasive Species

The National Invasive Species Council defines an invasive species as, "A species that is not native and whose introduction causes, or is likely to cause, economic or environmental harm or harm to human health." The Council was formed under Presidential Executive Orders 13112 and 13751 to prevent the introduction and spread of invasive species, and to support efforts to eradicate and control invasive species that are established throughout the United States. NOAA's National Ocean Service identifies invasive species as "capable of causing extinctions of native plants and animals, reducing biodiversity, competing with native organisms for limited resources, and altering habitats." Invasive species harmful to Michigan and LRBOI Tribal lands may be either terrestrial invasive species (TIS) or aquatic invasive species (AIS).

Terrestrial invasive include non-native, land-based plants, insects, animals and diseases that harm Michigan's environment, economy, and human health. Aquatic invasive (water-dwelling) species include non-native plants, animals, and other organisms that have evolved to live primarily in water (aquatic habitats) rather than on land. Aquatic habitats are habitats that are covered with water all or part of every year.

Location
Combined, terrestrial and aquatic invasive species may be present in the entire nine county service area including forest, wetland, farmland, grassland, aquatic, shoreline, and urban environments. "A Field Guide to Invasive Plants of Aquatic and Wetland Habitats for Michigan" (Campbell, Higman, Slaughter, Schools) identifies the Lake Michigan coastline as particularly vulnerable. "Lake-moderated climates along the Lake Michigan shoreline, Saginaw Bay, the Thumb, Lake St. Clair, and western Lake Erie are much milder than those in the state's interior… These areas have the potential to harbor species typically found far south of Michigan."

Extent
According to the State of Michigan 2013 Aquatic Invasive Species State Management Plan, "Since the 1800s, at least 182 nonindigenous aquatic organisms have colonized habitats of the Great Lakes ecosystem. These species include: algae (27), vascular plants (55), invertebrates (66), fish (28), and bacteria and viruses (6) (National Oceanic and Atmospheric Administration 2011). Roughly 55% of these species are native to Eurasia; 13% are native to the Atlantic Coast." The Great Lakes Regional Collaboration estimates that a new aquatic invasive species arrives in the Great Lakes at a rate of one every eight months.

The LRBOI Wildlife Division strives to preserve, protect, and enhance native plant communities and wildlife populations important to the Tribe and its membership. To promote native plant species and protect the ecosystems they rely on, Wildlife Division staff manage Tribal properties by removing terrestrial invasive plant species, such as autumn olive, Russian olive, spotted knapweed, and honeysuckle, among others. Invasive plants may outcompete native vegetation for space and nutrients so removing them reduces their risk of establishing monocultures and frees up resources for native species. Invasive plants are very persistent and often require multiple treatments to eradicate them. Therefore, this has been an ongoing multi-year project for the Wildlife Division, but Table 38 highlights work done over the past year. Wildlife Division staff also plant native species to help restore natural ecosystems and promote biodiversity. LRBOI has allocated $30,000 of the 2023 budget for all expenses of staff to treat and manage affected areas. Note, this amount is scaled to the limits of current staff and is conservative. 88.41 acres were treated from 2020-2021.

Table 38: Invasive Species Removal

Property	Treatment	Species	Year	Acres
Aki Maadiziwn	Mechanical removal	Scotch pine	2020	1.01
		Autumn olive	2020	3.04
Bull Homestead	Mechanical removal	Autumn olive	2020	5.82
			2021	5.33
Custer	Mowed		2020	9.61
			2021	8.21
Dontz	Chemical	Autumn olive	2020	2.64
	Mechanical removal		2021	37.26
Griffith	Mowed		2020	12.94
Justice Center	Chemical	Autumn olive	2020	1.67
Orchard warehouse	Chemical and mechanical removal	Autumn olive	2020	.34
	Mechanical removal		2021	.54
TOTAL			**2020-2021**	**88.41**

Previous Occurrences
Non-native terrestrial and aquatic species are introduced to Michigan and the Great Lakes both intentionally and unintentionally. Aquatic invasive species are the result of unwanted fish and aquatic plants released from home aquariums, travelled across the ocean in ballast water carried by freighters, or entered from the ocean through human-built channels such as the Welland Canal. There are 32 AIS specifically listed in the State Management Plan. The State TIS Management Plan lists fourteen species including insects, mollusks, plants, mammals, a shrub, and a bird. In addition to the Tribe's priority plants (autumn olive, Russian olive, spotted knapweed, and honeysuckle, among others), top priority plants in the region include garlic mustard, Japanese knotweed, invasive phragmites, and Oriental bittersweet.

Probability of Future Events and Vulnerability Assessment
The Great Lakes and connecting channels and rivers form the largest surface freshwater system in the world. This freshwater system, along with Michigan's inland lakes, streams, rivers, and wetlands represent an invaluable resource and are therefore justifiably a top natural resource management priority. The State of Michigan estimates 42% of threatened or endangered species are considered at risk due to non-native species. The Michigan Department of Environment, Great Lakes, and Energy produced the "Michigan Watch List Aquatic Invasive Plants: A Guide for Identification" for those species that have been identified as posing an immediate or potential threat to Michigan's economy, environment, or human health. Included in the watch list are ten species that have been found in limited parts of Michigan and surrounding states. The State TIS Management Plan provides a list of eleven terrestrial species on the watch list. The Wildlife Division may coordinate with the Northwest Michigan Invasive Species Network and Manistee Conservation District and other partners "protect, enhance, and promote Northwest Michigan's natural communities through terrestrial invasive plant management and outreach."

While the Tribe and other conservation agencies work to remove and control invasive species, some species are pervasive and spread more quickly than can be managed. There is a maintenance cost for invasive species management, and there is also a cost to the native wildlife species. Much of northern Michigan's native terrestrial and aquatic species have adapted to specific set of environmental conditions. Where invasive species out compete natural flora there may be a reduction in food sources for fauna.

Specific hazard concerns regarding invasive species that were expressed by LRBOI members/stakeholders during the development of this plan include the following:

- Many trees were impacted by Fuzzy Moth (Gypsy Moth) in 2022; caused lots of defoliation
- Autumn olive and Japanese knotweed are two prevalent terrestrial invasive plants that are overtaking local plants; very difficult to eradicate.
- "Winters have become milder in terms of lower snowfall and higher minimum temperatures, which increases the spread of invasive pests and diseases in the environment. For example, the lack of killing frosts has facilitated hemlock woolly adelgid spread." (Survey response.)
- Protection of native animal and plant species (mentioned many times in survey responses).

Impacts of Climate Change

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

According to a new comprehensive report from the World Meteorological Organization (WMO), "A disaster related to a weather, climate or water hazard occurred every day on average over the past 50 years – killing 115 people and causing $202 million (US $) in losses daily The number of disasters has increased by a factor of five over the 50-year period, driven by climate change, more extreme weather and improved reporting. But, thanks to improved early warnings and disaster management, the number of deaths decreased almost three-fold[3]" (World Meteorological Organization, 2021).

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

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

The Great Lakes Integrated Sciences and Assessments (GLISA) is one of 11 NOAA Regional Integrated Sciences and Assessments teams that focus on helping the nation prepare for and adapt to climate variability and change. A summary of findings from NCA and the GLISA report, *Climate Change in the Great Lakes Region*[4], are provided to show the impacts of climate change throughout the state of Michigan.

Temperature
Warm-season temperatures are projected to increase more in the Midwest than any other region of the United States.[5] Since 1951, annual average air temperatures have increased by 2.3°F (1.3°C) in the U.S., Great Lakes region. By mid-century (2050), average air temperatures are projected to increase by 3°F to 6°F (1.7°C to 3.3°C). By end of century (2100), average air temperatures are projected to increase by 6°F to 11°F (3.3°C to 6.1°C).

The frost-free season is projected to increase 10 days by early this century (2016–2045), 20 days by mid-century (2036–2065), and possibly a month by late century (2070–2099) compared to the period 1976–2005 according to the higher scenario (RCP8.5).[6]

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

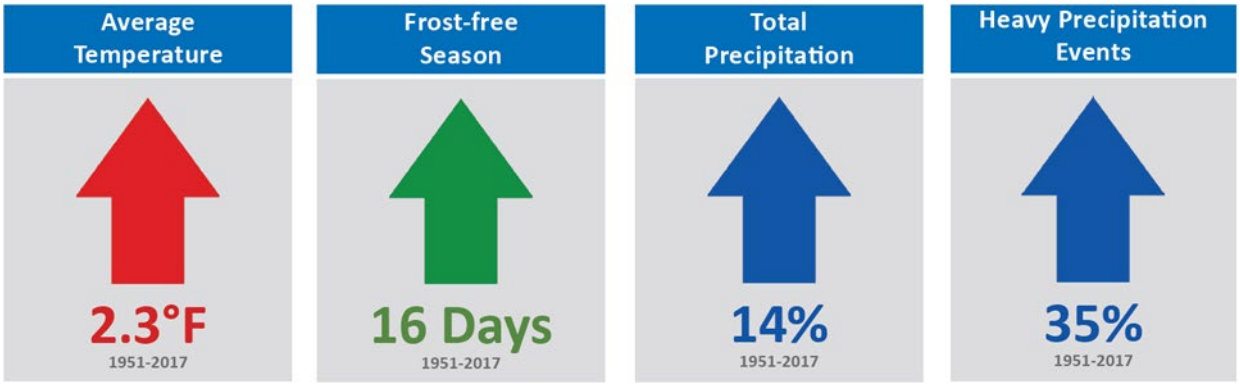
[3] *World Meteorological Organization*. (2021, August 31). Retrieved from Weather-related disasters increase over past 50 years, causing more damage but fewer deaths: https://public.wmo.int/en/media/press-release/weather-related-disasters-increase-over-past-50-years-causing-more-damage-fewer

[4] (2019, February 14). Retrieved from Climate Change in the Great Lakes Region: https://glisa.umich.edu/wp-content/uploads/2021/04/GLISA-2-Pager.pdf

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

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

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



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

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

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

Climate Change Vulnerability Assessment
A vulnerability assessment in the report *Climate Change in the Great Lakes Region* by GLISA at https://glisa.umich.edu/wp-content/uploads/2021/04/GLISA-2-Pager.pdf lists key challenges from climate change:

- **Public Health**
  - Increased risk of heat waves and increased humidity may amplify the number of heat-related deaths and illnesses.
  - More storm activity and flooding, resulting in increased point- and non-point source pollution, will likely increase watershed contamination and water-borne illnesses, while warmer surface waters amplify the risk of toxic algal blooms and fish contamination.

- **Tourism and Recreation**
  - *Winter recreation/tourism are likely to suffer* due to reduced snow cover and shorter winters. Reduced lake ice cover and enhanced evaporation may lead to increased lake-effect snowfall in the near-term, but rising temperatures will cause more winter precipitation to fall as rain as opposed to snow across the region by late century.
  - Increasing temperatures and a longer summer season may *increase the demand for lake and beach use*.
  - Overall, *summer tourism may grow before temperature rise becomes unfavorable* for outdoor recreation.
  - *The fishing industry* (commercial and recreation) is likely to be impacted by the *decline of coldwater species of fish, such as lake trout and whitefish*.

- **Natural Environment**
    - Despite increasing precipitation, land surfaces in the region are expected to become drier overall due to increasing temperatures and evaporation rates.
    - More frequent summer droughts could affect soil moisture, surface water, and groundwater supply.
    - Increased evaporation rates and sustained levels of high or low water levels may change wetland areas in the region.
    - The rate of warming may *outpace the rate at which ecosystems are able to migrate and adapt*.
    - *Wildlife populations better adapted to cold temperatures will continue to decline* as competing species migrate into the region with rising air and surface water temperatures.
    - *Forest productivity will likely increase in the short term*, until other impacts of climate change such as increased drought, fire and invasive species present additional stressors to forests.

In addition to concerns that impact all of northwest Lower Michigan, the LRBOI have identified additional natural resources that are directly impacted by climate change and have reached a critical population size. The following paragraphs describe the Tribe's work with native turtles, and observations of climate change impacts on other aspects of the natural environment.

Turtles are culturally and ecologically important to the Little River Band of Ottawa Indians (Little River) community. Clan members that are associated with turtles are part of the Miishiki Dodem (Turtle Clan). Eastern box, Blanding's, spotted, and wood turtles are experiencing widespread population declines and are designated as Species of Greatest Conservation Need (SGCN) in Michigan. Blanding's, spotted, and wood turtles are also candidates for federal listing under the Endangered Species Act. These vulnerable turtles are very susceptible to habitat loss through climatic changes. Therefore, species distribution modeling to map suitable habitat and assess the potential impacts of climate change on their habitat is critical to provide sound scientific, data-driven management directives.

Little River's Wildlife Division partnered with Grand Valley State University (GVSU) and the United States Forest Service (USFS) to create distribution models for eastern box, Blanding's, spotted, and wood turtles in northwest Michigan. Northwest Michigan provides a unique opportunity to study these turtle species, as it is one of the only places in North America where all four species co-occur. Once the regional models are created, state-wide species distribution models will also be created to validate the regional model and help assess potential habitat changes at a broader scale. These models will use the predicted changes in factors like temperature and precipitation over decades to assess what areas may become more or less suitable for each turtle species. The models will also incorporate connectivity between areas of suitable turtle habitat to emphasis important corridors of travel to maintain or possibly create.

As a result of the warming climate, LRBOI has observed a decrease in the snowshoe hare populations, an increase in tick populations, changes in the general breed of wild rice, and the new designation of a "threatened" status to a particular breed of wild rice. With additional future staffing, Little River's Natural Resources department intends to create a comprehensive list of species that are experiencing or at risk from climate change impacts.

Question 6 of the community survey, which was issued at the beginning of the hazard mitigation planning process, asked if there have been any negative impacts on the public health and/or natural environment of their community that are attributed climate change.

- Over half (25 of the 41) participants who provided a response said "no" or were "unsure".
- Of those who responded in the affirmative, increased wildfire frequency and severity, increased precipitation, high water levels, milder winters, hot summers, and the strain on emergency services were all mentioned as impacts from climate change. Several responses identified a possible link between unusual or uncommon weather patterns and effects on plant and animal species.

V. Tribal Vulnerability Summary

LRBOI Population Characteristics for Future Planning Considerations

Based on membership statistics for 2010 and 2021, the Tribe has experienced a decrease in overall membership, but an increase in the percentage of elders (those aged 55+). The elder population accounts for 38% of the total membership. The greatest number of Tribal members live in Muskegon County (612 members), followed by Manistee (387), Kent (250) and Mason Counties (136). Wexford County has the fewest number of members (24). When planning for new tribal housing development, there can be an expected increased demand for Elder-specific housing units. The occupants of these residences would benefit from the provision of accessible safe rooms and back-up power generators to increase safety and resiliency during severe storm events.

Furthermore, based on the available demographic data from the US Census Bureau and LRBOI Administration, a significant amount of LRBOI members have limited financial resources, and/or may be physically unable to prepare or evacuate for a hazard event. These households likely would have more of a need for social/public services - such as assistance with transportation, food, water, medical care, or shelter - before, during or after a hazard event.

The following is a list of key issues related to hazard mitigation planning for the LRBOI's tribal service area. These issues are addressed in the mitigation strategies table provided in Section VII of this plan; note that each strategy in the table can apply to more than one type of hazard.

Severe Winter Weather, Thunderstorms, and High Wind – the most common events; can cause a large impact

- Ice, heavy snow, thunderstorms and wind storms have the capability to cause power outages, particularly when tree limbs fall on overhead power lines. This can affect the operability of: cellular and internet service; gas stations; structural heating systems; the ability to pump water from wells; and sanitary sewer pump failures (which have occurred in the past, requiring portable generators for power). These events can also cause downed power lines, which present a safety hazard.
- The Lake Michigan adjoining counties of Manistee, Mason, Muskegon, Oceana and Ottawa can expect to encounter more lake effect snow events than other counties in the tribal service area.
- Many LRBOI members can be considered vulnerable to impacts from these events, due to the high percentage of Elder members; the high percentage of members within the poverty level; members who live in remote areas; limited access to technology including cellular phone service and broadband internet; and minimal access to backup power sources.
- The Community Survey results specifically mentioned that internet availability and reliable cellular service was an issue; there were many concerns about access to power in the event of a natural hazard. One respondent said, "Cell towers in our region are spotty and are regularly taken out by violent storms."
- Many survey respondents mentioned potential power outages that would impact the operation of sanitary sewer lift stations.
- There are no generators installed at the Aki Elder's housing complex, or at the Community Center at the entrance to Aki.
- The LRBOI grows some of its own crops and a frost/freeze event of the magnitude in 2012 affecting Manistee County would decimate an essential food source for the tribe.
- Providing assistance to members in remote locations can be treacherous when combined with icy or snowy roads.
- Tribal employees whose jobs permit remote work can avoid the risk of commuting on dangerous road conditions during severe winter weather events.
- The Tribe is striving towards achieving energy sovereignty by investing in renewable energy projects, such as solar. This can assist with provision of electricity to tribal homes and businesses when an outside power company's electric service fails during a severe weather event.

Hail and Lightning

- Lightning strikes can cause structural or woodland/grassland fires
- Power outages caused by downed trees or lightning strikes have caused service issues for the Tribe's wastewater utility system. Lightning has struck the utility system's electrical components, and Tribe had to repair the components and put surge protectors in place. The Tribe has installed generators in some areas of the wastewater utility system in order to minimize disruptions from power loss. However, the Hazard Areas Map in Appendix A indicates that LRBOI's sanitary sewer collection system along E. Parkdale Avenue does not have backup generator power for any of the system's lift stations.

- Outdoor recreation/special event areas, such as the Tribal Gathering Grounds, are where people are most at risk from injury due to a lightning strike or hail
- The LRBOI grows some of its own crops and a significant hail storm could cause crop loss.

Inland Flooding

- Intense rainstorms can result in riverine flooding (particularly in Manistee River communities) and flash flooding on roads, particularly in urbanized areas, such as the City of Manistee. Many tribal members live in the City of Manistee (see Vulnerable Populations Map in Appendix A).
- Some survey respondents mentioned concerns of potential failure of the two dams owned by Consumers Energy (Tippy and Hodenpyl) located upstream on the Manistee River. Developed areas in the floodplain of the river, as well as native aquatic species, would be impacted by flooding and sedimentation caused by a potential dam failure. Also, there are three LRBOI critical infrastructure sites located along the river or Manistee Lake (see LRBOI Critical Infrastructure Map in Appendix A).
- Some survey responses indicated the concern for two major drawbridges and railroad bridges in the City of Manistee that are aging. If they failed (perhaps due to the impact flood waters) then transportation would be significantly disrupted in the City, where many tribal members live.
- Part of an undeveloped, LRBOI-owned parcel of land off of Schoedel Road in Manistee Township is located in a "Zone A" Special Flood Hazard Area (SFHA) that is part of Bar Lake Swamp.
- Two properties identified as LRBOI critical infrastructure sites in Manistee County - the "Big Blue" NR storage building on Brickyard Road in the Village of Eastlake and the building LRBOI leases for Little River Holdings, LLC on N. Water Street in the City of Manistee - adjoin Manistee Lake and the Manistee River, respectively. These water bodies are FEMA-designated SFHA's.

Tornado

- The Little River Casino is the designated emergency shelter location for all of Manistee County, and meets the need for a tornado shelter to serve the adjoining RV Campground on the casino grounds. However, LRBOI has identified the need for additional LRBOI tornado/severe storm shelter sites:

    - The Gathering Grounds (campground) near the Tribal Government Center. There is an existing concrete block bathhouse building at the campground that could be retrofitted and expanded to serve as a "safe room", and would also need a generator installed.
    - The Aki Residential area. The Community Center building at the entrance to Aki is not a suitable tornado shelter, as it has a large wall of glass windows on one side of the building. Potential options include creating a safe room in the Elder's housing building, and installing prefabricated underground shelters for the other Aki residents (similar to what the Grand Traverse Band Tribe of Ottawa and Chippewa Indians installed on their tribal lands in 2008 with the assistance of a FEMA hazard mitigation project grant).

- Emergency alert systems in place for tornado warnings include a tornado siren operated by Manistee Township and the "Fast Command" mobile alert system utilized by the LRBOI.

Extreme Temperatures

- Can cause damage to crops/forests and affect the health of livestock and wildlife
- The homes in the Aki Maadiziwin Subdivision in Manistee Township do have air conditioning, but they do not have generators on site in case of power outages. With the installation of a generator at the Community Center at the entrance to the Aki subdivision, the building could serve as a temporary heating/cooling shelter for the tribal residents in case a power outage occurred. A generator could also be installed in the Elder's apartment complex so Elders don't have to travel to the larger shelter building in the event of a power outage.
- Extreme heat and cold events are more likely to impact unsheltered populations, such as the urban homeless population and people working or recreating outside. The Little River Casino in Manistee Township can be utilized as an overnight or temporary emergency shelter location for all of Manistee County in the event of an extreme heat/cold emergency. Also, the Wagoner Community Center (utilized by the Manistee County Council on Aging) in Manistee is utilized as a temporary emergency warming/cooling center. In addition, the Manistee County Emergency Management Department maintains agreements with public schools, local fire departments/government offices and some churches for use of their buildings as secondary shelter sites.
- Extreme heat events can exacerbate the risk for drought or wildfire.

Wildfire

- Forests containing Red Pine, Eastern White Pine, and Jack Pine trees within Manistee County are more susceptible to wildfire, especially in drought conditions. These areas are scattered throughout every community in Manistee County, as well as in much of westerly adjoining Wexford County. However, areas of Manistee County located south of the Manistee River (Filer Township, Stronach Township, Manistee Township, Norman Township, Brown Township, and Dickson Township) are heavily forested with pine and are therefore highly vulnerable to wildfire threats. There are concentrations of LRBOI tribal residents in these areas, according to the Hazard Areas and Vulnerable Population Map in Appendix A, as well as tribal-owned lands, including the Nme (Sturgeon) streamside rearing facility.

Drought

- Can cause damage to crops/forests and affect the health of livestock and wildlife
- LRBOI's groundwater well for the water tower on Domres Road could be affected by excessive water usage during extreme heat or a drought
- Drought conditions increase the risk for wildfire

Dense Fog

- Can result in transportation accidents.

Coastal Hazards: Coastal Recession and Shoreline Flooding

- The majority of the northwest Michigan coastline is susceptible to coastal recession and shoreline flooding. In particular, the Manistee County communities of Filer Charter Township, the City of Manistee, Manistee Township, Onekama Township and Arcadia Township contain state-designated High Risk Erosion Areas.
- The Natural Hazards Task Force also indicated there are four parcels of interest near the cities of Grand Haven, Muskegon, and Manistee that may be at risk from shoreline erosion.

Coastal Hazards: Dangerous Currents, Seiche, Waterspout

The LRBOI does not own or operate any beaches or marinas on Lake Michigan. However, LRBOI tribal members may visit local beaches or marinas on Lake Michigan. A mitigation strategy for marine operators and beach visitors on the Great Lakes includes education and awareness about the prevailing weather and surf conditions. The best source this information is NOAA Weather Radio (NWR). These continuous broadcasts from transmitters scattered around the Great Lakes provide forecasts and warnings 24 hours a day. Also, the mobile emergency alert system service offered by LRBOI, "*Fast Command*", can be utilized as an informational source for coastal hazard forecasts and warnings.

Subsidence

The probability of a subsidence event occurring within the LRBOI service area is low, but not impossible. An event is more likely to occur within areas of underground utility infrastructure in urbanized areas (such as the cities of Manistee and Muskegon), or in areas of solution mining and gypsum mining activity (various parts of Kent, Lake, Manistee, Mason, Muskegon, Newaygo, Ottawa and Wexford counties, per Figure 28).

LRBOI owns property and/or structures within Manistee, Mason and Muskegon counties, and LRBOI tribal members live throughout the tribal service area, on and off of tribal-owned land.

Options to mitigate the risk from subsidence hazards affecting LRBOI property and tribal members include the following:
• Limiting or preventing new LRBOI development in high-risk areas, such as old mining areas and geologically unstable terrain.
• Regularly maintaining LRBOI's water and sewer infrastructure in Manistee Township to ensure the availability of clean potable water and proper collection and treatment of sanitary sewer.

Public Health Emergency

- The Elder population of the LRBOI is increasing in numbers. Based on data provided by the State of Michigan regarding COVID-19 cases and deaths, elderly persons are more at risk for serious illness / death in the event of a future corona virus outbreak.

Invasive Species

Specific hazard concerns regarding invasive species that were expressed by LRBOI members/stakeholders during the development of this plan include the following:

- Many trees were impacted by Fuzzy Moth (Gypsy Moth) in 2022; caused lots of defoliation
- Autumn olive and Japanese knotweed are two prevalent terrestrial invasive plants that are overtaking local plants; very difficult to eradicate.
- “Winters have become milder in terms of lower snowfall and higher minimum temperatures, which increases the spread of invasive pests and diseases in the environment. For example, the lack of killing frosts has facilitated hemlock woolly adelgid spread.” (Survey response.)
- Protection of native animal and plant species (mentioned many times in survey responses).

VI. Goals and Objectives

The purpose of the LRBOI Natural Hazards Mitigation Plan is to protect the health and safety of tribal members and general public on tribal lands, and maintain or improve the quality of the natural environment and built environments within LRBOI owned and managed lands. This is done by taking actions to permanently eliminate or reduce the long-term risks from hazards in order to prevent injury, loss of life, property damage, and loss of vital services such as transportation and infrastructure.

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

Goal 1. Ensure the health, safety, and welfare of the LRBOI members for the next seven generations

a. Continue to provide and improve health services and senior services to Tribal members
b. Strengthen partnerships with other agencies (i.e., MSUE, Counties, Health Departments, hospitals, non-profits) to coordinate and improve services

Goal 2: Protect Tribal property, members, and environmental resources from potential damage from natural hazards

a. Protect power sources and provide backup power to critical facilities
b. Identify tribal residents with special needs (i.e., rely on powered medical equipment) that may need a community loaned generator during a power outage
c. Strengthen partnerships with other agencies (i.e., MSUE, MDNR, USFS, Counties, Health Departments, hospitals, non-profits) to coordinate and improve services
d. Investigate opportunities to improve existing tribal facilities for use as temporary shelters.
e. Investigate opportunities to incorporate "green" technology and design in new construction.
f. Identify potential hazards (dead trees or limbs) close to houses and buildings and remove them

Goal 3: Pursue utility resiliency and sovereignty while reducing the Tribe's carbon footprint

a. Pursue solar energy and other renewable energy strategies

Goal 4: Increase awareness of natural hazard preparedness and mitigation efforts amongst Tribal members.

a. Educate Tribal members, hold a "Preparedness Day" open to all members to learn how to prepare for natural hazards
b. Prepare emergency kits and share with Tribal members; explain how to use them; and have kits available on stand-by to share
c. Participate in bi-annual membership event to meet with Tribal members
d. Continue to utilize Fast Command notifications and increase participation rate
e. Educate Tribal members about all emergency notification resources available within the Tribal service area
f. Investigate the ability to post information on hazard/emergency preparedness on the Tribes' website
g. Streamline communication efforts to provide timely notices of events
h. Promote public awareness of the locations of emergency shelters.
i. Hold a Storm Spotter Training class with tribal members via partnership with the NWS.
j. Develop and maintain an emergency plans for outdoor gatherings and special events, such as those held at the LRBOI campground, so that people will be efficiently directed to evacuation routes and designated areas of refuge.

VII. Mitigation Strategies and Priorities

Types of Mitigation Actions

Mitigation strategies are agency-specific actions intended to reduce the risk from natural hazards and disasters. FEMA's standard tribal mitigation plan requirements include identifying and analyzing a comprehensive range of specific mitigation actions and projects to reduce the impacts of the hazards identified in the risk assessment. The emphasis is on the impacts or vulnerabilities identified in the risk assessment, not on the hazards themselves. The types of mitigation actions can be classified into the following types:

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

Furthermore, a set of evaluation criteria was developed to determine which mitigation strategies were best suited to address the identified problems for the LRBOI Tribe.

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

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

Existing Tribal Pre- and Post-Disaster Hazard Management Capabilities

Emergency Warning System Coverage

- Mobile warning systems: The LRBOI uses the "Fast Command" Emergency Communications Network, which is an electronic high-speed outbound notification service available to Tribal members and employees.

  The FEMA Mobile App is also a publicly available mobile warning system providing real-time weather alerts, locations of emergency shelters, and allows for notifications to be sent to loved ones.

  Each county Emergency Management Department in the LRBOI service area is responsible for implementing their own emergency mass notification system that the public can sign up for. Manistee County uses the CodeRED Emergency Communications Network.

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

- Website and Social Media Platforms: The LRBOI make regular updates to the Tribal website and Facebook pages.

- Tornado Sirens: The LRBOI Tribal service area in Manistee County relies on the tornado siren operated by Manistee Township Fire Department. Other counties in the LRBOI service area are responsible for providing their own tornado sirens.

- Flood Warning Systems: For dam failures/flooding downstream an active warning system is pre-determined utilizing geographic boundary information and the Fast Command and CodeRED emergency communications networks.

  Additionally, the Federal Energy Regulatory Commission requires hydroelectric facilities to be able to quickly notify residents and visitors of any developing emergency at the plants. Consumers Energy maintains four (4) emergency warning sirens on the Manistee River to alert the public of impending danger from rapidly rising waters due to an emergency at the Hodenpyl or Tippy Dams. The sirens are activated, accompanied with instructions,

during an actual dam emergency. The sirens are located near the Tippy Dam, the High Bridge U.S. Forest Service boat launch, the Hodenpyl Dam, and the Red Bridge U.S. Forest Service boat launch. In an emergency, the sirens would only be used if the threat of a dam failure is imminent at one of the facilities. At that time, anyone on or near the river should evacuate at once to high ground. The sirens can be controlled physically on-site or remotely from Manistee County Central Dispatch. The siren systems are tested each August and December. Information related to a dam breach would be provided on local radio and television stations.

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

Shelters

- The Little River Casino can be utilized as an overnight or temporary shelter location for all of Manistee County.

- Potential future shelter sites for the LRBOI Tribe in Manistee County have been identified as the Gathering Grounds (campground) and Aki Community Center. However, both of these facilities would need backup generators installed. The existing campground structure would also need retrofitting and expansion to accommodate more persons to serve as a severe weather shelter.

- The Manistee County Office of Emergency Management maintains an agreement with the Wagoner Community Center (utilized by the Manistee County Council on Aging) in the City of Manistee for use as a temporary emergency warming/cooling center. In addition, the Manistee County Emergency Management Department maintains agreements with public schools, local fire departments/government offices and some churches for use of their buildings as secondary shelter sites. Other counties in the LRBOI service area are responsible for providing their own shelter sites.

Tribal Law and Planning Mechanisms

- The LRBOI Public Safety Department has a Conservation Enforcement branch pertaining to fishing, hunting, trapping and gathering on the Great Lakes and inland tribal ceded territory.

- The LRBOI Natural Resources Department operates the following programs, many of which rely on funding and/or partnerships with the US EPA, Conservation Resource Alliance of Northwest Michigan, US Forest Service, US Fish and Wildlife Service, local watershed councils, Grand Valley State University, counties and townships, and the Manistee County Road Commission.
    - Air Quality Monitoring. LRBOI's Air Monitoring Station (AMS) is located at the tribe's Justice Center and has been in operation since 2005. LRBOI monitors ambient (outdoor) air for: Ground level ozone (O3), Particulate matter (dust) 2.5 microns in diameter and smaller (PM2.5), and Meteorological conditions.
    - Inland Fisheries Program to preserve, protect and enhance the Tribal Fishery while providing subsistence fishing opportunities to LRBOI Membership.
    - Lake Sturgeon Research and Rehabilitation Program
    - Tribal Brownfield and Response Program to enable the Tribe to monitor and manage Brownfield site assessment, cleanup, and reuse.
    - Water Quality Program to monitor Reservation surface water quality, leading to the development of designated uses for water bodies and Tribal water quality standards.
        - Wetlands Program –LRBOI NRD initiated a Wetland Program in 2021 to map and monitor wetlands on Tribal properties. Wetlands are key to mitigating floodwater surges, and their protection and restoration is vital to flood hazard mitigation. Wetlands also provide critical habitat for Manoomin beds.
    - Watershed Initiative Program – A road/stream crossing evaluation of the effects from five improved road crossings on water quality; a stream bank stabilization studying the effects from at least four improved stream banks; a study of the effects of improved water access sites on water quality.
    - Wildlife Program – Goal is to preserve, protect and enhance Tribal Wildlife resources while providing subsistence harvest opportunities to LRBOI citizen. This is done through ongoing wildlife and habitat assessments, outreach activities, inter-agency cooperation, habitat restoration, invasive species control, and sound scientific management.

- The LRBOI has several Environmental Ordinances in place, including a Utility Ordinance that allows for LRBOI to operate a Utility Department to provide for a sanitary community water and sewerage system.

- The LRBOI has a Building Ordinance, which designates the Tribe's Planning Department with the responsibility to determine if building permits are required, to issue permits or licenses and to approve design plans. The ordinance indicates that such actions shall be carried out by the Building Official who shall be an employee located within the Planning Department. A building permit is required is required for any applicant to construct, enlarge, alter, repair, move, demolish or change the occupancy of a building or structure on Tribal land.

  Commercial and non-residential construction on Tribal land is governed by the most current versions of the Michigan Building Codes. The Michigan Building Codes shall apply to the construction, alteration, movement, enlargement, replacement, repair, equipment, use and occupancy, location, maintenance, removal and demolition of every building or structure or any appurtenances connected or attached to such buildings or structures. LRBOI has adopted the Michigan Building Codes as Tribal law with the exception that all questions of jurisdiction and agency authority are replaced by the Little River Band of Ottawa Indians and the bodies described in this Ordinance. This includes but is not limited to references to: a. Michigan Department of Building Safety-referred to as "building official" in Michigan's Building Codes; and b. Board of Appeals for Department of Building Safety.

  Residential building construction and remodeling on Tribal land is governed by the latest published version of the Michigan Residential Code (MRC). The MRC applies to the design, construction, quality of materials, erection, installation, alteration, repair, location, relocation, replacement, addition to, use or maintenance of single-family houses, two-family houses (duplexes) and townhouses not more than three stories above grade plane in height.

- LRBOI maintains a Planning Department, which is responsible for the following:

  Land Use Planning
  - Develop, maintain and update the Tribe's Land Use Plan (originally created in 2005) as directed by Tribal Council
  - Assist (as needed or requested) in the Tribe's land acquisition efforts, including the process of placing Tribal lands into Federal Trust Status
  - Develop Tribal land-use zoning/planning ordinances or regulations as needed
  - Serve as Tribal Building Office. Responsibilities include:
    - Enforcement of Tribal Building Ordinance
    - Issuing building permits and certificates of occupancy
    - Arranging site/building plan reviews and building inspections

  Transportation Planning
  - Serve as Tribal contact/liaison with the Bureau of Indian Affairs Roads Program
  - Develop, maintain and update the Tribe's Long Range Transportation Plan (created March 2012) as directed by the Bureau of Indian Affairs Roads Program
  - Develop, maintain and update the Tribe's Transportation Safety Plan in accordance with Bureau of Indian Affairs Roads Program policies
  - Maintain and update the Tribe's BIA Roads Inventory as needed
  - Develop the annual Tribal Transportation Improvement Plan (TTIP)—list of road construction & maintenance projects that are funded with BIA federal highway monies
  - Serve as Tribal contact/liaison with other transportation-related entities: Michigan Department of Transportation, Manistee County Road Commission, and Federal Highway Association

  Other
  - Serve as Tribal contact/liaison with area non-profit and governmental agencies
  - Serve as Tribal contact/liaison with the U.S. Census Bureau

Other Hazard Prevention/Response Mechanisms

- The Manistee County Planning Department administers the Soil Erosion and Sedimentation Control program pertaining to construction activities within Manistee County. An application is required for any soil disturbance that: is within 500 feet of a surface water body or a county drain; results in earth changes over one acre of land, no matter what distance to a waterbody or drain; is on a site that has greater than a 20% slope.

- District Health Department #10 issues well and septic permits and inspections for residential and commercial well and septic systems in Manistee County.

- The LRBOI utilizes the fire and rescue services provided by local governments in the LRBOI service area.

Mitigation Strategies
Strategies were developed based on discussions with the Task Force and the LRBOI Tribal Council, and a review of FEMA best practices for hazard mitigation. A list of alternative strategies considered is included as Appendix E. The strategies table is grouped according to purpose. Purpose types include: Awareness & Preparation, Shelters, Buildings & Development, Utilities & Technology, and Environment & Natural Resources. The table also includes: a description of each strategy; what natural hazards they address; where the strategy applies; who is responsible for implementing the strategy; how the strategy will be implemented (what resources are available to help execute the strategy); when the strategy could feasibly begin; the level of priority; and what type of strategy it is. Strategies are intended to be action items completed during the 5-year timeframe in which the plan is active. Some strategies may extend beyond the 5-year timeframe due to feasibility or level of difficulty.

Rationale for Prioritization of Mitigation Strategies
The LRBOI Tribal Incident Commander and Natural Hazards Task Force considered factors like level of need, economic impact, ease of execution/level of effort, cost, and range of benefit (i.e., short term, long term, small group/area, large group/area) when determining the level of priority for each strategy.

Strategies that provide essential comprehensive benefits for the community, such as human health, community safety, and protecting property and critical infrastructure, were prioritized as high priority strategies. High priority strategies are considered critical to preserve life and property, and will have the largest impact on the LRBOI community. High priority strategies often focus on education efforts and infrastructure improvements with potentially high costs associated with them, but the cost of those effort can be adequately addressed through sources such as available funds in the LRBOI budget and eligible grant or partnership opportunities. High priority strategies have an estimated benefit/cost ratio that is greater than one (1), assuring that the value of the action's benefits are estimated to be greater than the costs incurred.

Important, but ongoing efforts that provide a direct benefit to the Tribe and natural resources were also categorized as either high or medium priority strategies. Medium priority strategies can have a lower cost-benefit ratio than high priority strategies, with higher up-front costs and time needed to implement and a delayed future return on investment (i.e., pursuing renewable energy projects on tribal land.) Medium priority strategies are considered to be ongoing efforts to maintain a safer environment for the Tribal community.

Strategies with minimal direct benefit to the Tribe or natural resources were marked as low priority. The resources needed to implement the strategy and the cost of the strategy was taken into account, but not above the need demonstrated. Low priority strategies are considered to be long-term mitigation efforts that will be worked on as resources (such as staff or financing) become available.

The keys for the priority level and strategy types as shown in the Strategies Table are illustrated below:

PRIORITY LEVEL

HIGH
MEDIUM
LOW

STRATEGY TYPES

1	**Planning & Regulations**
2	**Building & Infrastructure Projects**
3	**Natural Systems Protection**
4	**Education & Awareness Efforts**

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			Severe Winter Weather	T-Storm, High Winds, Hail, Tornado, Lightning	Inland Flooding and Erosion	Shoreline Hazards: Flooding, Erosion, Dangerous Currents, Seiche, Waterspout	Extreme Temperatures	Drought	Wildfire	Dense Fog	Subsidence	Invasive Species	Public Health Emergency						Planning & Regulations	Building & Infrastructure Projects	Natural Systems Protection	Education & Awareness Efforts
Awareness and Preparation	1	**Develop and maintain an emergency plans for outdoor gatherings and special events, such as those held at the LRBOI campground, so that people will be efficiently directed to evacuation routes and areas of refuge.**	X	X			X		X				X	Campground near Gathering Grounds; RV park by Little River Casino	**TERT**	A	0-1 years	**H**	**X**			**X**
	2	**Identify tribal residents with access and functional needs (i.e., rely on powered medical equipment) that may need a community loaned generator during a power outage**	X	X			X		X				X	Tribal Service Area	**TERT**	A, Y, Z	0-1 years	**H**	**X**			
	3	**Continue the provision of/partnerships with programs and services offered by the LRBOI Health Services Department, Local Health Depts., and non-profits**, such as: home health visits to tribal members; immunizations; community clinics; school health services; wastewater and drinking water safety.											X	Tribal Service Area	**Tribal Clinic**	R, T3 - W3	0-1 years	**H**	**X**		**X**	**X**
	4	**Continue to pursue intradepartmental and intergovernmental cooperation and coordination of police, fire, rescue and EMS services to achieve community-wide coverage availability.**	X	X	X	X	X	X	X	X	X	X	X	Tribal Service Area	**Public Safety**	A - J	0-1 years	**H**	**X**			
	5	**Increase participation in "Fast Command"**, the Tribe's emergency mass notification system.	X	X	X	X	X	X	X	X	X		X	Tribal Service Area	**TERT**	A, L	2-4 years	**M**				**X**
	6	**Coordinate with other county Emergency Managers regarding public awareness of available emergency mass notification systems.**	X	X	X	X	X	X	X	X	X		X	Tribal Service Area	**TERT**	A - L	0-1 years	**M**	**X**			**X**
	7	**Continue to provide the annual Tribal Safety Day**	X	X	X	X	X	X	X	X			X	Tribal Service Area	**TERT**	A	0-1 years	**M**				**X**
	8	**Continue to provide information on emergency preparedness through the Tribe's website and social media accounts.**	X	X	X	X	X	X	X	X			X	Tribal Service Area	**TERT**	A	0-1 years	**M**				**X**
	9	**Provide classes on 72-hr emergency kit preparation**	X	X	X	X	X		X	X			X	Tribal Service Area	**TERT**	A, W2	2-4 years	**M**				**X**
	10	**In the warmer weather months, consider posting online information on Great Lakes Current safety and the NWS Beach Hazards Forecast, indicating swim and rip current risk levels.**				X								Manistee, Mason, Oceana, Muskegon and Ottawa Counties	**TERT**	A, W2, Y2, Z2	2-4 years	**M**				**X**
	11	**Educate Tribal members about the statewide annual tornado drill;** what to do in the event of a drill and encourage participation in the drill		X										Tribal Service Area	**TERT**	A	2-4 years	**M**				**X**

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Awareness and Preparation	12	**Hold a Storm Spotter Training class with tribal members** via partnership with the NWS.		X										Tribal Service Area	**TERT**	A, W2	2-4 years	**M**				**X**
	13	**Investigate online posting of MDNR/NFS Fire Danger Status/Maps**							X					Tribal Service Area	**TERT**, NRD	A, L	0-1 years	**M**			**X**	**X**
	14	**Continue to promote availability of the Elder Chore Assistance Programs that include snow removal and other home maintenance tasks**	X	X			X		X				X	Tribal Service Area	**Members Assistance**	A, T, U	0-1 years	**M**	**X**	**X**		
	15	**Continue to provide and promote food assistance, elder meal programs, and healthy eating education to help tribal members prepare for unanticipated pandemics and also increase regular access to healthy foods.**											X	Tribal Service Area	**Members Assistance**	A, R - V, S3, C4 - G4	0-1 years	**M**	**X**			**X**
	16	**Continue to rely on Local Health Departments and MDHHS for information about new or emerging disease threats; refer to the State's Pandemic Response Plan as needed.**											X	Tribal Service Area	**Tribal Clinic**/TERT	A, R, T3 - W3	0-1 years	**M**	**X**			**X**
	17	**Promote awareness of vegetation/fuel management for fire prevention around homes and other structures.**		X				X	X					Tribal Service Area	**TERT**	A, L, A2 - D2	2-4 years	**M**			**X**	**X**
	18	**Continue to provide information on campfire regulations and fire prevention measures at campgrounds**						X	X					LRCR; Gathering Grounds	**TERT**	A, B2, D2	0-1 years	**M**			**X**	**X**
	19	**Assess tribal fire suppression access points and equipment and pursue improvements as needed.**						X	X					Tribal Service Area	**Maintenance**	A, Y - A2	0-1 years	**M**	**X**	**X**		
	20	**Consider developing a drought communication plan in coordination with Manistee County and early warning system** to facilitate timely communication of local drought conditions/outlook to officials, decision makers, emergency responders, and the general public.						X	X					Manistee County	**NRD**	A, B, L, U2, V2	5+ years	**L**	**X**		**X**	**X**
	21	**Consider the application of mandatory water conservation measures during drought emergencies, such as:** ▪▪ Developing an ordinance to restrict the use of public water resources for non-essential usage, such as landscaping, washing cars, filling swimming pools, etc. ▪▪ Adopting ordinances to prioritize or control water use, particularly for emergency situations like fire fighting.						X	X						Tribal Service Area	LRBOI Utility Dept., **local governments**	A, L, U2, V2	5+ years	**L**	**X**		**X**	**X**

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Shelters	22	**Promote public awareness of the locations of emergency shelters.**	X	X	X		X		X		X			Tribal Service Area	**TERT**	A, B, L	0-1 years	**M**				**X**
	23	**Maintain an accurate inventory of emergency shelter sites (overnight vs. daily use types) within the service area; review annually and update as needed.**	X	X	X	X	X		X		X		X	Tribal Service Area	**TERT**	A - J, L	0-1 years	**M**	**X**			
	24	**Develop and maintain procedures to create quarantine areas in emergency shelters.**											X	All tribal shelter sites	**TERT**	A, R, T3 - W3	2-4 years	**L**	**X**			
	25	**Investigate funding opportunities to install a generator at the Aki Maadiziwin Community Center to enable its use as a heating/cooling shelter.**	X	X			X							Aki Maadiziwin Community Center	**Housing**	A, Y, Z	2-4 years	**M**		**X**		
	26	**Investigate the ability to construct safe rooms or in-ground temporary shelters at the Aki elder's complex** (possibly retrofit the maintenance room)		X										Aki Elders Complex	**Housing**	A, K, Y, Z	2-4 years	**M**	**X**	**X**		
	27	**Investigate renovating the concrete block bath-house building at the Gathering Grounds campground area to serve as a severe weather "safe room" with a generator.**		X										Gathering Grounds near the Tribal Government Center	**TERT**	A, K, Y, Z	2-4 years	**M**	**X**	**X**		
	28	**Investigate utilizing the Next Generation building** (next to the casino; currently a vacant, former daycare) **into a large shelter with overnight accommodations** (It has a full kitchen, small generator, and large restrooms but no showers).	X	X	X		X		X				X	Little River Casino and Resort	**TERT**	A, Y, Z	5+ years	**L**	**X**	**X**		
	29	**When installing new backup generators for shelter sites, ensure there are appropriate electrical outlets to accommodate their use.**	X	X	X		X		X				X	Tribal Service Area	**Maintenance,** Utilities	A	2-4 years	**M**	**X**	**X**		

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Buildings and Development	30	**Identify potential hazards (dead trees or limbs) close to houses and buildings and remove them**	X	X					X					Tribal Service Area	**Maintenance,** TERT	A	0-1 years	**M**	**X**			**X**
	31	**Continue enforcement of current building codes for new construction through the permitting process**	X	X	X		X		X		X			Tribal Service Area	**Planning**	A	0-1 years	**M**	**X**	**X**		
	32	**Continue to enforce Section 4.05 of the Aki Maadiziwin Subdivision Building Restrictions Ordinance that requires all homes to be built on a permanent foundation.**		X	X									Aki subdivision	**Planning**	A	0-1 years	**M**	**X**	**X**		
	33	**Continue compliance with the State soil erosion regulations** (applicable if a construction project involves earth change that disturbs one or more acre, or is within 500 feet of a lake, stream or wetland.)			X	X								Tribal Service Area	**Planning**	A - J	0-1 years	**M**	**X**		**X**	
	34	**Protect Tribal cultural sites from potential impacts of encroaching development.**			X							X		Tribal Service Area	**Historic Preservation**	A, F3, O3 - Q3	0-1 years	**M**	**X**			
	35	**Promote the availability of residential weatherization, energy assistance/efficiency, and home improvement programs**	X	X	X		X		X				X	Tribal Service Area	**Members Assistance**	A, M - Q, X3 - B4	2-4 years	**M**	**X**	**X**		**X**
	36	**Upgrade to larger replacement culverts or new bridges to better accommodate road crossings over high volume stream flows.**			X	X		X				X		Tribal Service Area	**County Road Commissions;** LRBOI Utilities	A - J, L, X - Z, J3 - N3	2-4 years	**M**	**X**	**X**	**X**	
	37	**Consider establishing a tree planting plan/program for the Aki subdivision.**		X	X		X					X	X	Aki subdivision	**NRD**	A, X2, E3, F3, O3, R3	5+ years	**L**	**X**	**X**	**X**	
	38	**Investigate opportunities to install the following in the Aki commons area(s): native plant gardens with a rain garden system, and benches with solar panel shades.**			X		X	X				X	X	Aki subdivision	**Housing,** NRD	A, V, X2, F3, O3, R3	2-4 years	**L**	**X**	**X**	**X**	**X**
	39	**Consider incorporating "green" finishes/construction materials to reduce heat absorption, such as green or "living roofs", "cool roofs", or "cool pavement".**					X		X				X	Aki subdivision	**Housing**	A, X2, F3, O3, R3	5+ years	**L**	**X**	**X**	**X**	
	40	**Consider the development of a reduced-cost program to install air conditioning in the homes of elders.**					X						X	Tribal Service Area	**Members Assistance**	A, X - Z	2-4 years	**L**	**X**	**X**		
	41	**Monitor and report any areas of persistent flooding and property loss.**			X	X					X			Tribal Service Area	**LRBOI Planning**	A, W	0-1 years	**L**	**X**	**X**		
	42	**Avoid new LRBOI development in areas at risk for subsidence hazards**, such as old mining areas and geologically unstable terrain.									X			Tribal Service Area	**LRBOI Planning**	G5	As needed	**L**	**X**	**X**		

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Buildings and Development	43	**Complete infrastructure improvements in hazard areas in the City of Manistee and Manistee County**				X	X									B, X-Z	As needed	**H**	**X**	**X**		
	43a	**Pursue funding for conceptual 5th Avenue Flood Mitigation project in the City of Manistee:** construct a wave barrier and add a secondary gravity storm sewer and pump station that outlets into the Harbor Village channel					X						X	City of Manistee	**City of Manistee**	B, X, Z	0-3 years	**H**	**X**	**X**		
	43b	**Pursue funding for shoreline protection (~1,023') around the City of Manistee's clean water recovery facility**					X						X	City of Manistee	**City of Manistee**	B, X, Z	0-3 years	**H**	**X**	**X**		
	43c	**Continue to investigate funding opportunities to relocate or replace aging and/or underutilized railroad bridges in or near the City of Manistee**	X	X		X								City of Manistee, Manistee Township, Stronach Township	**City of Manistee, Manistee Township, Stronach Township, CSX Railroad**	B, X, Z	0-3 Years	**H**	**X**	**X**		
	43d	**Inventory and prioritize improvements for flood prone locations in Manistee County's transportation network.** (I.e., upgrading aging stormwater abatement structures, or replacing undersized/aging culverts and bridges.)				X	X							Countywide	**MCRC, MDOT, Villages, Townships, Railroad Companies**, County Drain Commissioner, land management agencies	B, W-Z, R2, K3	Annually	**H**	**X**	**X**		

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Utilities and Technology	44	**Improve wireless cellular service near the Gathering Grounds.**	X	X	X		X		X	X			X	Manistee Tribal Governmental Center Area	**IT**	A	2-4 years	**H**		**X**		
	44a	**Consider partnering with Manistee County HAM radio group or RACES to assist with upgrading the repeaters/towers by the Gathering Grounds to improve cellular service.**	X	X	X		X		X				X	Manistee Tribal Governmental Center Area	**IT**	A	2-4 years	**M**		**X**		
	45	Continue to i**mprove the Tribe's energy sovereignty and expand the use of renewable energy sources** by implementing findings from the LRBOI Renewables Microgrid Study and referencing other resources, such as the Energy Zones Mapping Tool.	X	X	X		X		X				X	Tribal Service Area	**LRBOI Utilities**	A, E2 - G2	2-4 years	**H**	**X**	**X**	**X**	
	46	**Regularly maintain water and sewer infrastructure** to ensure the availability of clean potable water and collection and treatment of sanitary sewer.	X	X	X		X				X		X	LRBOI in Manistee Twp.	**LRBOI Utilities**	A	0-1 years	**M**	**X**	**X**	**X**	
	46a	**Install backup power sources to water/sewer infrastructure to maintain continuous service in the Aki housing area.**	X	X	X		X		X				X	LRBOI - Manistee - Aki Maadiziwin sanitary sewer lift station	**LRBOI Utilities**	A, Y	2-4 years	**H**		**X**		
	46b	**Install backup power sources where needed to the LRBOI Sewer District along US-31 (E. Parkdale Ave.) to maintain continuous service in the event of a power outage.**	X	X	X		X		X				X	LRBOI Sanitary Sewer Authority Area along US-31 in Manistee Township	**LRBOI Utilities**	A, Y	2-4 years	**H**		**X**		
	47	**Continue to reduce risks to cybersecurity threats with IT programs and services that ensure security in remote work and in the use of the online medical database (IHS).**	X	X						X			X	Tribal Service Area	**IT**	A	2-4 years	**H**	**X**	**X**		
	48	**Continue to develop Continuity of Operations (COOP) plans and alternative "remote work" schedules and affiliated computer software.**	X	X						X			X	Tribal Government Employees	**IT**	A	2-4 years	**H**	**X**			
	49	**Continue collaboration amongst the utility companies and the County Road Commission to clear vegetation (particularly diseased or dead trees, i.e., from Emerald Ash Borer infestations) along various road and utility right-of-ways to minimize power outages and road blockages during heavy ice/snow storms.**	X	X					X			X		Tribal Service Area	**Planning**	A - J, I2 - K2	0-1 years	**M**	**X**		**X**	
	50	**Continue to maintain effective communications practices between electric utility companies (Consumers E., Cherryland Electric, or Great Lakes Energy) and the County/Tribal E.M.S and Emergency Dispatch regarding power restoration after outages.**	X	X			X		X					Manistee County	**Utilities**, TERT	A, I2 - K2	0-1 years	**M**	**X**			**X**

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Utilities and Technology	51	**Investigate opportunities to bury overhead utilities, such as during new construction or in areas regularly prone to power outages.**	X	X			X		X					Tribal Service Area	**LRBOI Utilities**	A - J, Y, I2 - K2	5+ years	**M**	**X**	**X**		
	52	**Evaluate the feasibility of creating a program where the Tribe can purchase small portable generators to loan out to members as needed, or perhaps offer a partial rebate to households who purchase a generator.**	X	X			X							Tribal Service Area	**Members Assistance**	A, Y, Z, R3	2-4 years	**M**	**X**			
	53	**Collaborate with local government partners and utility providers to increase the availability of high-speed internet service to allow for increased remote work/learning.**	X										X	Tribal Service Area	**IT**	L2 - O2	2-4 years	**M**	**X**	**X**		
	54	**Stay informed about future plans for the Tippy Dam and Hodenpyl Dams; participate in public input sessions provided by Consumers Energy.**			X			X				X		Manistee County; Federal and State agencies	**NRD**	H2	0-1 years	**M**			**X**	**X**
Environment & Natural Resources	55	**Continue and expand programs provided by the Tribe's Natural Resources Department that protect and preserve plant and wildlife species important to the Tribe and environmental monitoring** (air quality, water quality, fish populations, etc.)		X	X							X		Tribal Service Area	**NRD**	A,	2-4 years	**M**	**X**	**X**	**X**	**X**
	55a	**Pursue forestry thinning practices at the High Bridge, Old House Road, and Tippy Dam LRBOI properties to improve the health of tree species and reduce wildfire risk.**							X			X		High Bridge, Old House Road and Tippy Dam properties in Dickson Township	**NRD**	A, D2	0-2 years	**M**	**X**		**X**	
	56	**Continue to identify and prioritize sites for open space protection/preservation, green infrastructure and/or stormwater management in collaboration with local land protection organizations.**			X	X						X		Tribal Service Area	NRD and **Planning**	A, F3, G3, O3 - Q3	0-1 years	**M**	**X**		**X**	
	57	**Continue to clean out plugged culverts** (due to sediment deposits, invasive species, etc.)			X							X		Tribal Service Area	**County Road Commissions;** LRBOI Utilities	A - J, F3, G3, L3 - N3	0-1 years	**M**	**X**	**X**	**X**	
	58	**Create and maintain a comprehensive list of species that are experiencing/at risk to impacts from climate change.**										X		Tribal Service Area	**NRD**	A, V	2-4 years	**M**	**X**		**X**	

THEME		LITTLE RIVER BAND OF OTTAWA INDIANS 2023 HAZARD MITIGATION STRATEGIES	HAZARD TYPE											WHERE - Affected Locations or Groups	WHO - Responsible Party (Lead entity is in **Bold** font)	HOW - Resources and/or Partnerships	WHEN - Timeframe (Years)	PRIORITY TYPE (High, Medium, or Low)	STRATEGY TYPE			
			Severe Winter Weather	T-Storm, High Winds, Hail, Tornado, Lightning	Inland Flooding and Erosion	Shoreline Hazards: Flooding, Erosion, Dangerous Currents, Seiche, Waterspout	Extreme Temperatures	Drought	Wildfire	Dense Fog	Subsidence	Invasive Species	Public Health Emergency						Planning & Regulations	Building & Infrastructure Projects	Natural Systems Protection	Education & Awareness Efforts
Environment & Natural Resources	59	**Continue and expand management/treatment capabilities for invasive species.**										X		Tribal Service Area; Autumn olive is a particular problem at Aki	**NRD**	A, A3 - E3	0-1 years	**M**	**X**		**X**	
	59a	**Continue to conduct annual routine invasive species surveying and monitoring to identify new emergent invasive species before they get established and spread.**										X		Tribal Service Area	**NRD**	A, A3 - E3	0-1 years	**M**	**X**		**X**	
	59b	**Continue to utilize and promote the assistance of other natural resource management agencies to provide technical assistance, outreach and education pertaining to invasive species management.**										X		Tribal Service Area	**NRD**	A, A3 - E3, H3, I3	0-1 years	**M**			**X**	**X**
	59c	**Utilize and promote EGLE's "NotMISpecies" webinars and resources to help educate tribal members about invasives control and management**										X		Tribal Service Area	**NRD**	C3	0-1 years	**M**			**X**	**X**
	59d	**Support efforts to manage aquatic invasive species,** such as the installation of boat washing facilities, annual Great Lakes Aquatic Invasive Species "Landing Blitz" events, and local Lake Improvement Board efforts.										X		Tribal Service Area	**NRD**	B3	0-1 years	**M**			**X**	**X**
	59e	**Support the installation of equipment cleaning facilities at trailheads for boots, ORVs, and construction/logging equipment as voluntary measures to reduce the spread of invasives.**										X		Tribal Service Area	**LBROI NRD,** USFS, MDNR, Land Conservancies	A, A3, H3, I3, R3	0-1 years	**M**			**X**	**X**
	59f	**Consider adoption of a Tribal ordinance that regulates activities to prevent the introduction of or the contribution to the spread of invasive species, such as prohibiting the use of invasive species in landscaping and/or vegetative riparian buffers.**			X	X						X		Tribal Service Area	**LRBOI Natural Resource Commission,** NRD and Planning	A, A3, H3, I3	5+ years	**M**	**X**		**X**	**X**
	60	**Continue to coordinate with MDNR/USFS on wildfire management such as prescribed burns and surface fuels management projects** on open space/public land (this also encourages regeneration of native plant species).							X			X		MDNR/USFS land in Manistee County; LRBOI parcels in Manistee County, near Tippy Dam and Old House Road	**LRBOI NRD,** USFS, MDNR	A, L, C2, D2	0-1 years	**M**	**X**		**X**	**X**
	61	**Monitor the risk of coastal erosion that may impact four sites of land near Grand Haven, Muskegon and Manistee.**			X	X								Manistee, Muskegon, and Ottawa Counties	**LRBOI Planning**	P2 - T2	0-1 years	**L**	**X**			**X**
	62	**Incorporate green infrastructure-related goals and objectives in the Tribe's Land Use Plan.**			X		X					X		Tribal Service Area	LRBOI Planning & **NRD**	A	2-4 years	**L**	**X**		**X**	

VIII. Implementation

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

This Plan is intended to be a resource for building coordination and cooperation within a community for local control of future mitigation and community preparedness. The LRBOI Tribal Council will lead the implementation of the Natural Hazards Mitigation Plan with assistance from the Tribal Incident Commander and the Tribal Manager. The Tribal Emergency Response Team (TERT) is an inter-agency partnership and will collaborate to accomplish the goals and objectives of the Plan. The TERT meets on a regular basis to carry out its duties and has expanded its role to function as the Natural Hazards Task Force. The Natural Hazards Task Force will be responsible for implementing, monitoring, evaluating and updating the Plan. Staff support will be provided by the LRBOI Tribal Incident Commander and will coordinate with Tribal Management and Tribal Council.

Implementation of the Strategies

To assist with the funding and/or enacting of the proposed natural hazards mitigation strategies, the following pages contain a table of potential resources that can help fund, staff or support the implementation of hazard mitigation strategies. Each potential entity or program is assigned a letter code, listed in the “Resources” column of the strategies table.

Resources List for LRBOI Tribe 2023 Hazard Mitigation Strategies

Key	Resource	Description	Website	Hazard Type
A	**Little River Band of Ottawa Indians**	Human resources include Tribal staff and members, including the Tribal Incident Commander. Monetary funding resources for tribal government operations discretionary programs include, but are not limited to: the U.S Bureau of Indian Affairs (provides services directly or through contracts, grants, or compacts to 574 Federally recognized tribes); BIA Indian Health Service self-governance funding; federal ARPA funds; reimbursements from the LRBOI's Economic Development Corporation; and internal tribal resources.	https://lrboi-nsn.gov/	All hazards
B	**Manistee County**	County staff including Emergency Management; Road Commissions	https://www.manisteecountymi.gov	All hazards
C	**Mason County**		https://www.masoncounty.net/	
D	**Wexford County**		https://wexfordcounty.org/	
E	**Oceana County**		https://oceana.mi.us/	
F	**Lake County**		http://www.lakecounty-michigan.com/	
G	**Muskegon County**		https://co.muskegon.mi.us/	
H	**Ottawa County**		https://www.miottawa.org/	
I	**Kent County**		https://www.accesskent.com/	
J	**Newaygo County**		https://www.newaygocountymi.gov/	
K	**Grand Traverse Band of Ottawa and Chippewa Indians**	Tribal staff including Emergency Manager	https://www.gtbindians.org/	All hazards
L	**Emergency Services and Fire Departments in Manistee County**	Fire Departments: Arcadia Township, Bear Lake Township, City of Manistee, Cleon Township, Dickson Township, East Lake Village, Filer Township, Manistee Township, Maple Grove Township, Norman Township, Onekama Township, and Stronach Township. USDA Forest Service - Huron-Manistee National Forests - Cadillac/Manistee Ranger Station in Wellston (Norman Twp.) EMS Services: Mobile Medical Rescue EMS; City of Manistee EMS		Severe winter weather; Thunderstorm, High Winds, Hail, Tornado, Lightning; Flooding; Shoreline Hazards; Extreme Temperatures; Dense Fog; Public Health Emergency
M	**LRBOI Emergency Home Repair Program**	This is an ARPA-BIA funded program with limited funds available. Applications will be accepted on a first come, first serve basis up to $15,000 per home. The emergency fund shall be used only for EMERGENCY repairs of LRBOI members who own their own home, anywhere within the United States. EMERGENCY shall be defined as: No heat, No hot water, Electrical hazards, Plumbing, Mold, Roof, Windows, Entry Doors, Imminent structural collapse (foundation, floor, wall, roof that is determined by LRBOI Housing Department as ready to collapse.) Minimum State Building Standards will be met.	https://lrboi-nsn.gov/membership-services/housing/	Severe winter weather; Thunderstorm, High Winds, Hail, Tornado, Lightning; Flooding; Extreme Temperatures; Public Health Emergency
N	**LRBOI Homeowner Assistance Fund Program**	The LRBOI Homeowner Assistance Fund program was created to prevent homeowner mortgage delinquencies, defaults, foreclosures, loss of utilities or home energy services, and displacements of homeowners experiencing COVID-19 related financial hardship after January 21, 2020, for eligible household applicants who are enrolled LRBOI tribal members.	https://lrboi-nsn.gov/membership-services/housing/	Severe winter weather; Extreme Temperatures; Public Health Emergency
O	**Low Income Home Energy Assistance Program (LIHEAP)**	This is a D.H.H.S. grant-funded program available to assist Tribal members in the nine-county service area who are experiencing heating and energy crises and meet the program eligibility guidelines.	https://lrboi-nsn.gov/membership-services/members-assistance/	Severe winter weather; Extreme Temperatures; Public Health Emergency

P	**Michigan Public Service Commission's Low Income Winter Protection Plan**	The state has adopted a Winter Protection Plan that protects seniors and low income families that receive services from MPSC-regulated natural gas and electric companies from having their electric or heat shut off during winter months.	https://www.michigan.gov/mpsc/consumer/get-help/utility-customers	Extreme Cold; Severe Winter Weather; Public Health Emergency
Q	**"MI HOPE" Grants (Michigan Housing Opportunities Promoting Energy Efficiency)**	Program for up to $25K to repair or replace roofs, doors, windows, insulation, heating/cooling systems, water heaters, security lighting, Energy Star appliances and electrical systems for eligible low-income residents.	www.michigan.gov/mi-hope	Severe winter weather; Thunderstorm, High Winds, Hail, Tornado, Lightning; Flooding; Extreme Temperatures; Public Health Emergency
R	**LRBOI Health Services**	Community Health Representatives (CHR), such as a Community Health Nurse/Diabetic Educator, are out in the nine county service area performing home visits to Tribal Members and transporting clients for medical purposes only.	https://lrboi-nsn.gov/membership-services/health-services/#	Public Health Emergency
		Contract Health Services (CHS) for the nine county service area; Extended Health Assistance Program (EHAP) outside the nine county service area; and Individualized Support services		Public Health Emergency
S	**LRBOI Food Distribution Program**	The Food Distribution Program on Indian Reservations (FDPIR) provides a variety of Commodity Foods to low-income households living on or near Indian reservations. These foods include fresh and canned vegetables, frozen meats, breakfast cereals, cheese, and butter. Many households participate in the FDPIR as an alternative to the Food Stamp Program, because they do not have easy access to Food Stamp offices or authorized food stores.	https://lrboi-nsn.gov/membership-services/food-distribution-program/	Public Health Emergency
T	**LRBOI Elder Services**	Elder Meal Program (Title VI): This program provides nutrition, social interaction, and supportive services to Tribal Elder Members at the Aki Community Center. A nutritious meal will be served and activities and informational presentations will be provided. The Elder Chore Assistance Program is designed to provide limited assistance for elder chore services: Snow Removal from driveway and sidewalks; Weather stripping around doors and windows; Grass cutting, leaf raking and removal, and general clearing of debris around the home; Gutter cleaning; General household cleaning	https://lrboi-nsn.gov/membership-services/members-assistance/	Severe winter weather, High Winds, Thunderstorms, Extreme temperatures, Public Health Emergency
U	**Manistee County Council on Aging**	Provides programs and services to assist seniors with health and well-being: Senior Project FRESH; Senior Center Food Pantry, Senior Nutrition Program, Senior Dining Out Program, Senior Services Reimbursement Program (for transportation, lawn care, snow removal and light housekeeping). Senior Center (The Wagoner Community Center) is also utilized as a community emergency warming/cooling center.	https://www.manisteecountycoa.com/	Severe winter weather; Thunderstorm, High Winds, Hail, Tornado, Lightning; Flooding; Extreme Temperatures; Public Health Emergency
V	**Michigan State University Extension**	Various programming and education available regarding nutrition, agriculture, and natural resources protections.	https://www.canr.msu.edu/outreach/	Inland and shoreline flooding and erosion; Invasive Species; Public Health Emergency
W	**FEMA Floodplain Management Resources for Local Government Officials**	How to participate with the NFIP and tools and resources to provide higher standards for floodplain management.	https://www.fema.gov/floodplain-management/manage-risk/local	Inland and coastal flooding
X	**FEMA Flood Mitigation Assistance (FMA) Grant Program**	FMA is a non-disaster, competitive grant program that provides funding to states, local communities, federally recognized tribes. Funds can be used for projects that reduce or eliminate the risk of repetitive flood damage to buildings insured by the National Flood Insurance Program. ▪ $800 million available in funding for FY22 ▪ Application Period: September 30, 2022, to January 27, 2023 ▪ Period of Performance: 3 Years ▪ Cost-share: 25% non-federal ▪ Severe Repetitive Loss (up to 100% federal) ▪ Repetitive Loss (up to 90% federal) ▪ Priorities are set each fiscal year	https://www.fema.gov/grants/mitigation/floods	Flooding

Y	**FEMA Building Resilient Infrastructure and Communities (BRIC) Grant Program**	BRIC is a non-disaster grant program, which provides funds on an annual basis for hazard mitigation planning and the implementation of mitigation projects prior to a disaster. The BRIC program guiding principles are supporting communities through capability- and capacity-building; encouraging and enabling innovation; promoting partnerships; enabling large projects; maintaining flexibility; and providing consistency. Funding has doubled for BRIC to $2.295 billion for FY21.▪ Caps: Tribal set-aside: $2 million;National Competition: $2.133 billion▪ Application Period: September 30, 2022 to January 27, 2023▪ Period of Performance: 3 year from start date on Recipient's federal award▪ Cost-share: 25% non-federal▪ Economically disadvantaged rural communities are eligible for 10% non-federal▪ Priorities are set each fiscal year	https://www.fema.gov/grants/mitigation/building-resilient-infrastructure-communities	Severe Winter Weather, Thunderstorm, High Winds, Hail, Tornado, Lightning, Inland Flooding & Erosion, Shoreline Flooding & Erosion, Extreme Temperatures, Drought, Wildfire, Invasive Species
Z	**FEMA Hazard Mitigation Grant Program (HGMP)**	HMGP is a post-disaster grant program, where funding is only made available under a Presidential major disaster declaration, in the areas of the State requested by the Governor. Federally-recognized tribes may also submit a request for a Presidential major disaster declaration within their impacted areas.	https://www.fema.gov/grants/mitigation/hazard-mitigation	All hazards
A2	**HMGP Post-Fire Assistance (PFA) grant program**	This grant funds projects that make a community more resilient after a designated wildfire disaster. States and federally-recognized tribes affected by fires resulting in a Fire Management Assistance Grant (FMAG) declaration on or after October 5, 2018, are eligible to apply.	https://www.fema.gov/grants/mitigation/post-fire	Wildfire, Drought
B2	**National Fire Protection Association Firewise USA Program**	Firewise USA Program: Each applicant must create a board/committee, complete a community wildfire risk assessment with a 3-year action plan to reduce home ignition risk, and complete annual educational and risk reduction actions identified in the plan. Also training on "Assessing Structure Ignition Potential from Wildfire".	https://www.nfpa.org/Public-Education/Fire-causes-and-risks/Wildfire/Firewise-USA	Wildfire, Drought
C2	**NFPA Community Wildfire Defense Grants**	Communities can use these grants from the USFS in a variety of ways to reduce the wildfire risk to people and property. One key use is capacity building for wildfire mitigation. For example, communities can use the grants to support the implementation and enforcement of wildfire-related codes and standards; to train people to assess wildfire risk and implement effective mitigation measures; and to perform outreach to community members through programs like Firewise USA®. Communities that build these fundamentals—sound land use and building practices, a skilled workforce, and an educated public—will be better prepared for sustained and effective risk reduction and better equipped to take advantage of future federal grants that prioritize communities with codes in place.	https://www.nfpa.org/Public-Education/Fire-causes-and-risks/Wildfire	Wildfire, Drought
D2	**US Department of the Interior (US DOI) Bureau of Indian Affairs (BIA) Division of Wildfire Management Programs**	The Fuels Management Program works with the Bureau of Indian Affair's (BIA) 12 regional offices, local BIA agencies and Tribes to reduce wildfire risk through management of natural and invasive fuels. Hazardous fuels reduction treatments include prescribed fire, mechanical treatments (such as thinning, regeneration cuts, pruning, mastication, and chipping) and the careful use of natural fire. Traditional Ecological Knowledge (TEK) is a body of observations, oral and written knowledge, practices, and beliefs that promote environmental sustainability and the responsible stewardship of natural resources through relationships between humans and environmental systems, applied across biological, physical, and cultural systems. BIA staff work alongside Tribes to blend traditional ecological knowledge with a scientific approach in their fuels management efforts. The Reserved Treaty Rights Lands (RTRL) program facilitates collaborative projects between Tribal trust and non-Tribal land managers. The program's intent is to provide Tribes the opportunities to conduct Tribally-determined project work on ancestral lands regardless of ownership to enhance the health and resiliency of priority Tribal natural resources with high risks of wildland fire.	https://www.bia.gov/service/fuels-management	Wildfire, Drought

E2	**US DOI BIA Tribal Energy Development Capacity Grant**	Every year, the BIA's Division of Energy and Mineral Development provides the opportunity for Tribes to receive financial assistance to establish the legal framework for developing and regulating their energy resources. Development Activities Eligible for Funding: Developing the legal infrastructure to create any type of Tribal energy business Establishing an energy-focused corporation under Tribal or state incorporation codes Establishing an energy-related Tribal business charter under federal law (IRA Section 17 corp.) Regulatory Activities Eligible for Funding: Developing or enhancing tribal policies, codes, regulations, or ordinances related to energy resource, including land-lease regulations in accordance with the Helping Expedite and Advance Responsible Tribal Homeownership (HEARTH) Act for energy development purposes or for business purposes connected to an energy project Establishing a Tribal utility authority (TUA) Adopting secured transaction codes and a subsequent joint power agreement with a state government	https://www.bia.gov/service/grants/tedc	Severe winter weather; Thunderstorm, High Winds, Hail, Tornado, Lightning; Flooding; Extreme Temperatures
F2	**Energy Zones Mapping Tool**	The Energy Zones Mapping Tool is a free online mapping tool to identify potential energy resource areas and energy corridors in the US. The website provides background on the energy resources: Biomass, Coal, Geothermal, Natural Gas, Nuclear, Solar, Storage, Water, and Wind; flexible modeling of power plant and corridor siting factors such as slope and land protections; and tools to generate and analyze potential corridor routes.	https://ezmt.anl.gov/	Severe winter weather; Thunderstorm, High Winds, Hail, Tornado, Lightning; Flooding; Extreme Temperatures
G2	**CBS Solar**	Various solar information/funding resources	https://www.cbssolar.com/resources	Extreme Temps, Severe Winter Weather, Thunderstorms/High Wind
H2	**Consumer's Energy Hydro Planning**	Information on planning processes and documents related to the future of hydropower dams in Michigan.	www.consumersenergy.com/hydrofuture	Flooding, Erosion, Invasive Species
I2	**Consumer's Energy Utility Service**	Consumers Energy electrical and natural gas utility service. Energy through renewable energy sources is available. A power outage map is available to track outage locations.	https://www.consumersenergy.com/outagemap	Severe winter weather; Thunderstorm, High Winds, Hail, Tornado, Lightning; Flooding; Extreme Temperatures, Wildfire
J2	**Cherryland Electric Cooperative Outage Center**	Report an outage, check outage status, power outage preparation & safety tips	https://cherrylandelectric.coop/outage/	Severe winter weather; Thunderstorm, High Winds, Hail, Tornado, Lightning; Flooding; Extreme Temperatures, Wildfire
K2	**Great Lakes Energy Cooperative Outage Center**	Report an outage, check outage status, power outage preparation & safety tips	https://www.gtlakes.com/power-outages/	Severe winter weather; Thunderstorm, High Winds, Hail, Tornado, Lightning; Flooding; Extreme Temperatures, Wildfire
L2	**Michigan High Speed Internet Office**	Information on plans and funding opportunities to increase high speed internet service in Michigan.	https://www.michigan.gov/leo/bureaus-agencies/mihi	All hazards.
M2	**Connected Nation Michigan**	Connected Nation develops and provides the tools, resources, and methods that help states and communities create and implement solutions to their broadband and digital technology gaps. They assess and plan for the expansion of broadband access, adoption, and use. They empower people with technology skills and resources to improve their quality of life, and we develop public-private partnerships to bring technology access to targeted geographies and population.	https://connectednation.org/michigan/	All hazards.

N2	**The Federal Communication Commission's Affordable Connectivity Program**	An FCC program to help families and households struggling to afford internet service during the COVID-19 pandemic. This new benefit will connect eligible households to jobs, critical healthcare services, virtual classrooms, and so much more.The Emergency Broadband Benefit will provide a discount of up to $50 per month towards broadband service for eligible households and up to $75 per month for households on qualifying Tribal lands. Eligible households can also receive a one-time discount of up to $100 to purchase a laptop, desktop computer, or tablet from participating providers if they contribute more than $10 and less than $50 toward the purchase price. The Emergency Broadband Benefit is limited to one monthly service discount and one device discount per household. A household is eligible if a member of the household meets certain low-income criteria.	https://www.fcc.gov/broadbandbenefit	All hazards.
O2	**"Lifeline" program provided by the Universal Service Administrative Co.**	Lifeline is a federal program that offers a monthly benefit of up to $9.25 towards phone or internet services for eligible subscribers (up to $34.25 for those living on Tribal lands). A consumer can qualify for the Lifeline benefit if their income is 135% or less than the federal poverty guidelines, or if they participate in SNAP, Medicaid, or other federal programs.	https://www.usac.org/lifeline/	All hazards.
P2	**LIAA's Northwest Lower MI Coastal Resilience Atlas**	LIAA supports community resiliency and natural resource preservation, and provides community assistance. Their Coastal Resilience Atlas provides maps of coastal flooding and coastal erosion based on three future climate scenarios for communities adjoining Lake MI; and areas of the shoreline population, by census tract, that are most vulnerable to extreme heat events.	http://www.resilientmichigan.org/nw_atlas.asp	Lake Michigan shoreline flooding and erosion; Extreme Heat
Q2	**State-designated High-Risk Erosion Areas: programs and maps**	High risk erosion areas are those shorelands of the Great Lakes where recession of the landward edge of active erosion has been occurring at a long-term average rate of one foot or more per year, over a minimum period of 15 years.	https://www.michigan.gov/egle/about/organization/water-resources/shoreland-management/high-risk-erosion-areas	Lake Michigan shoreline erosion
R2	**EGLE's Wetlands Map Viewer**	The WMV application was created for the Department of Environment, Great Lakes, and Energy to provide the public with quick and easy access to wetland spatial data.	https://www.mcgi.state.mi.us/wetlands/mcgiMap.html	Flooding, drought, extreme temperatures
S2	**Michigan EGLE's Coastal Zone Management Program**	A plethora of resources to improve coastal and climate resiliency through both planning and best management projects.	https://www.michigan.gov/egle/about/organization/water-resources/coastal-management	Lake Michigan shoreline erosion
T2	**Great Lakes Shoreviewer Tool**	View aerial imagery of Lake MI shoreline and associated risk levels for coastline, infrastructure/roads, and buildings.	http://www.greatlakesshoreviewer.org/	Lake Michigan shoreline erosion
U2	**Midwest Agriculture Climate Team**	MAC-T members are Extension specialists and state climatologists from many of the states represented in the Midwest Climate Hub, and NOAA NWS climate and weather specialists. The goal of this team is to share expertise regionally, discuss impacts and opportunities as it relates to agriculture and outlooks, and maintain an open line of communication so when weather/climate events do occur, the Midwest agriculture community is set to respond. The team meets monthly during the growing season regularly, and as needed during the winter season.	https://www.climatehubs.usda.gov/hubs/midwest/topic/midwest-agriculture-climate-team-mac-t	Drought, Extreme Temperatures, Flooding, Severe Winter Weather, High Winds, Hail
V2	**NWS Climate Prediction Center**	The U.S. Drought Monitor is a map released every Thursday, showing parts of the U.S. that are in drought. The map uses five classifications: abnormally dry (D0), showing areas that may be going into or are coming out of drought, and four levels of drought: moderate (D1), severe (D2), extreme (D3) and exceptional (D4).	https://www.cpc.ncep.noaa.gov/products/Drought/	Drought
W2	**National Weather Service Education**	Outreach and education materials for school children and adults. Includes the SKYWARN® storm spotter program that trains local volunteers to provide timely and accurate reports of severe weather to the National Weather Service.	https://www.weather.gov/education/outreach	Severe winter weather, thunderstorm, lightning, hail, high winds, tornado, flooding, extreme heat/cold, drought, dense fog

X2	**FEMA Fact Sheet: Mitigating the Risk of Extreme Temperatures with Hazard Mitigation Assistance Funds**	FEMA's Hazard Mitigation Assistance (HMA) grant programs provide funding for eligible mitigation measures that build climate resilience. These funds can be used to plan for and mitigate risks posed by natural hazards, including extreme temperatures. This fact sheet identifies opportunities for hazard mitigation assistance, provides an overview of considerations and identifies other available FEMA resources.	https://www.fema.gov/sites/default/files/documents/fema_extreme-heat-fact-sheet_102022.pdf	Extreme Temps, Severe Winter Weather, Thunderstorms/High Wind
Y2	**Great Lakes Water Safety Consortium**	A nonprofit community of best practices, connecting and serving safety experts & water enthusiasts, educating the public on safer ways to enjoy the water, and encouraging leaders to take bold action to make their shoreline safer for residents and visitors.	https://www.greatlakeswatersafety.org/	Dangerous Coastal Currents
Z2	**Great Lakes Beach Hazards and Forecast**	Know before you go! Great Lakes Beach Forecasts & Statements are issued seasonally for the U.S. side of Lake Erie, Lake Huron, Lake Michigan, Lake Ontario, and Lake Superior from roughly Memorial Day weekend through Labor Day weekend (weather dependent). Beach forecasts contain a daily swim risk, which is based on that day's threat of high waves and dangerous currents. Beach hazard statements provide additional details on high swim risk days	https://www.weather.gov/greatlakes/beachhazards	Dangerous Coastal Currents
A3	**Michigan Invasive Species Grant Program**	This program is designed to address strategic issues of prevention, detection, eradication and control for both terrestrial invasive species (TIS) and aquatic invasive species (AIS) in Michigan. Tribal units of government are eligible to apply. Projects must support the overalls goals of the MISGP: Prevent new invasive species introductions. Strengthen statewide invasive species early detection and response network. Limit the dispersal of recently confirmed invasive species. Manage and control widespread, long-established invasive species.	www.michigan.gov/invasives/grants/misgp	Invasive Species
B3	**Clean Boats, Clean Waters Program**	Funding from the Michigan Department of Environment, Great Lakes, and Energy and the Great Lakes Restoration Initiative has enabled Clean Boats, Clean Waters to grow into a comprehensive aquatic invasive species boater outreach program. The program's mission is to prevent new aquatic invasive species introductions and limit their dispersal from water recreation activities through outreach and engagement. The program promotes understanding of boat cleaning practices and regulations through the distribution of educational materials, an online resource library, boat washing demonstrations, grants and partnerships.	www.canr.msu.edu/clean_boats_clean_waters/index	Invasive Species
C3	**EGLE's "NotMISpecies" webinar series**	This webinar series explores how agencies, universities and locally led organizations are working together to protect Michigan's natural resources through the Michigan Invasive Species Program. If you are concerned about the impacts of invasive species or interested in the techniques used to control them, join us as we examine species-specific actions, innovations in research and technology, and programs designed to help communities prevent and manage harmful invasive species.	https://www.michigan.gov/invasives/take-action	Invasive Species
D3	**MSU Michigan Inland Lakes Partnership**	The purpose of the Michigan Inland Lakes Partnership (Partnership) is to engage state and local agencies, Native American Nations, outreach institutions (universities and other educational institutions), non-governmental organizations (NGOs), businesses, industries and citizens in a collaborative effort to ensure the quality, sustainability and ecological diversity of lakes, while considering society's needs. The Partnership will promote communication and cooperation between partners, communities and citizens interested in the management of Michigan's inland lakes, educating leaders, and strengthening stewardship efforts.	https://www.canr.msu.edu/michiganlakes/convention/	Inland flooding, shoreline erosion; Invasive Species
E3	**USDA Natural Resources Conservation Service (NRCS)**	The NRCS helps America's farmers, ranchers, and landowners conserve our nation's resources through voluntary programs and science-based solutions.	https://www.nrcs.usda.gov/	Drought; Extreme Temperatures; Invasive Species; Public Health Emergency
F3	**Manistee Conservation District**	MCD connects private landowners to numerous services and information for natural resource concerns, including access to government programs and technical land-management assistance. Our services assist Manistee County residents and landowners in the protection, enhancement and restoration of natural resources.	https://www.manisteecd2.org/	Flooding, Coastal Hazards, Invasive Species, Public Health Emergency

G3	**Wexford Conservation District (WCD)**	The mission of the WCD is to enable the citizens of Wexford County to be stewards of their natural resources. By providing services such as tree sales, plant sales, workshops, and the Michigan Forestry Assistance Program (FAP). We also partner and work with USDA-NRCS, Missaukee Conservation District, and the North Country Cooperative Invasive Species Management Area (NCCISMA).	https://www.wexfordconservationdistrict.org/	Flooding & Erosion; Invasive Species; Wildfire; Drought; Extreme Temperatures; Public Health Emergency
H3	**Northwest Michigan Invasive Species Network (NMISN)**	A Cooperative Invasive Species Management Area (CISMA) serving Benzie, Grand Traverse, Leelanau & Manistee counties to manage populations of invasive species that threaten northwest Michigan's high-quality natural areas through terrestrial invasive plant management and outreach.	https://www.habitatmatters.org/	Invasive Species
I3	**North Country Cooperative Invasive Species Management (NCCISMA) (Lake, Mason, Mecosta, Missaukee, Osceola & Wexford Counties)**	NCCISMA acts as an umbrella organization, bringing together a diverse group of partners to collaborate on programs and projects designed to combat invasive species. NCCISMA empowers people to address invasive species on their own property through: Assistance in identifying invasive species Guidance on treating invasive species and buying herbicides Invasive species treatment demonstrations Strike Team for hire to control high priority invasive species on private property Outreach and educational events	https://www.northcountryinvasives.org/	Flooding, Coastal Hazards, Invasive Species, Public Health Emergency
J3	**Conservation Resource Alliance (CRA) (10-county northwest MI region, along with the southerly adjoining counties of Mason, Lake, Osceola, Oceana and Newaygo.)**	Current projects include: Wild Roots, a cost-share program offering native plants to property owners at a greatly reduced rate; and The River Care Program, which ensures that natural resource professionals maintain a consistent and prioritized action plan for each river in the organization's region. River Care professionals not only find and repair physical problems before they become worse, they also team with local agencies, residents, and interest group representatives for fact-based conversations. These cross-functional teams can speak openly and affect change in an agile, efficient and transparent way.	https://www.rivercare.org/	Flooding & Erosion; Invasive Species; Drought; Extreme Heat; Public Health Emergency
K3	**Great Lakes Stream Crossing Inventory**	Previously, individual inventories were conducted by partnership agencies, watershed organizations, and road agencies but were not readily accessible to stakeholders and did not contain comparable information. The newly developed protocol and datasheet are intended to promote consistent data collection, selection criteria for improvement projects, and selection of appropriate Best Management Practices for each project to benefit all stakeholders. Information gathered on the datasheet can and has been used to prioritize structure replacement and successfully seek funding.	https://great-lakes-stream-crossing-inventory-michigan.hub.arcgis.com/	Flooding & Erosion
L3	**Little Manistee Watershed Conservation Council**	They monitor the health of the watershed with implementing annual and periodic water quality and wildlife surveys, including assessment of bank erosion, sedimentation from road crossings, and fish habitat degradation. They identify, recommend to appropriate state and local authorities, secure permits for, fund, and staff various remediation projects or contract for the completion of those projects when necessary, and identify potential funding sources. Partners include the MDNR, CRA, USFS, USF&WS, the Little Manistee River Watershed Restoration/Partnership Committee, and the Little River Band of Ottawa Indians	http://www.lmwcc.org/	Flooding & Erosion; Invasive Species; Drought; Extreme Heat; Public Health Emergency
M3	**Upper Manistee River Association**	The purpose of this Association is to preserve and protect for future generations the Upper Manistee River system and its drainage as a world class natural resource. MRA consists largely, but not exclusively, of riparian property owners who share river related interests on that part of the Manistee River system.	http://www.umrasite.org/	Flooding & Erosion; Invasive Species; Drought; Extreme Heat; Public Health Emergency
N3	**Muskegon River Watershed Assembly**	The Muskegon River Watershed Assembly is dedicated to the preservation, protection, restoration, and sustainable use of the Muskegon River, the land it drains, and the life it supports, through educational, scientific and conservation initiatives. Projects have included watershed clean-up events; lake and river evaluation, monitoring and restoration; rain gardens; shorescaping workshops; and habitat improvement.	https://mrwa.org/	Flooding & Erosion; Invasive Species; Drought; Extreme Heat; Public Health Emergency

O3	**Grand Traverse Regional Land Conservancy (includes Manistee Co.)**	GTRLC focuses land conservation efforts on protecting crucial wildlife habitat and corridors, critical watersheds, unique high-quality farm lands, valuable forestland and ecologically significant dunes along Lake Michigan. They protect land in several ways: Working with landowners to permanently protect private land through voluntary conservation easements; Acquiring high quality natural lands by purchase or donation to create Conservancy owned nature preserves; Assisting local units of government in creating or expanding public parks and natural areas that result in enhanced public access to nature and improved recreational opportunities; and Providing technical assistance to local units of government with the administration of farmland protection programs.	https://www.gtrlc.org/	Flooding & Erosion; Invasive Species; Drought; Extreme Heat; Public Health Emergency
P3	**Cadillac Area Land Conservancy (Missaukee, Osceola, Wexford, and northern Lake and Mason counties)**	The Cadillac Area Land Conservancy protects significant natural, scenic, and farm lands for current and future generations and fosters an appreciation for the environment. Efforts include: - Working with property owners to protect natural, scenic and farm lands through conservation easements so they remain undeveloped forever. - Conducting annual monitoring and stewardship of easement properties. - Building coalitions with state and federal agencies to identify priority "wildlife corridors" for establishing future easements. - Conducting community outreach for education and advancing land stewardship now and for future generations.	https://calc-landtrust.org/	Flooding & Erosion; Invasive Species; Drought; Extreme Heat; Public Health Emergency
Q3	**Land Conservancy of West Michigan (Includes Kent, Ottawa, Newaygo, Muskegon, Oceana, Mason, and Lake counties)**	As a non-profit land conservancy, we work with private landowners and governmental bodies to permanently protect and care for the land. Our protected land reflects the diversity and beauty of West Michigan and includes lush forests, grassy fields, flowering meadows, marshy wetlands, and rolling sand dunes. These significant habitats and ecosystems are home to a rich variety of plants and wildlife, some of which are now threatened or endangered species.	https://naturenearby.org/	Flooding & Erosion; Invasive Species; Drought; Extreme Heat; Public Health Emergency
R3	**Manistee County Community Foundation**	The mission of the Manistee County Community Foundation is to build community endowment, effect positive change through grantmaking and provide leadership on key community issues, all to enhance the quality of life for Manistee County. The Foundation is the only entity serving Manistee County that impacts all aspects of life: youth, education, human services, the arts, environment, community development and more.	http://manisteefoundation.org	Flooding & Erosion; Invasive Species; Drought; Extreme Heat; Public Health Emergency
S3	**Groundwork Center for Resilient Communities**	With roots firmly embedded in the pro-health, pro-environment, and pro-economy principles of a local food system, the Groundwork Food and Farming team creates markets for local farmers, and helps connect locally grown food to school children, food pantry clients and families across the state.	https://www.groundworkcenter.org/food-farming/	Public Health Emergency
T3	**District Health Department #10 (Lake, Manistee, Mason, Newaygo, Oceana and Wexford counties)**	Provide programs and services such as: immunizations; infectious disease education and prevention; community clinics; school health services; permitting processes for proper location and installation of water wells and septic systems; education about cleaning, monitoring and maintaining septic systems; septic or well repair financial assistance, and the inspection and licensing of food service establishments.	https://www.dhd10.org/	Severe winter weather; Thunderstorm, High Winds, Hail, Tornado, Lightning; Flooding; Extreme Temperatures; Public Health Emergency
U3	**Public Health - Muskegon County (PHMC)**		https://www.co.muskegon.mi.us/1712/Public-Health	
V3	**Kent County Health Department (KCHD)**		https://www.accesskent.com/Health/	
W3	**Ottawa County Department of Public Health**		https://www.miottawa.org/Health/OCHD/	
X3	**Five CAP, Inc. (Community Action Agency) - Weatherization Program (For Mason, Lake and Newaygo counties)**	The weatherization of homes benefits income eligible households by conserving energy. Improvements include, but are not limited to: air sealing, caulking, insulation of side walls, attics, and foundations, water heater jackets, and a variety of additional energy and/or health and safety measures. Weatherization is generally a "one time" service for a given home. Funding by the U.S. Department of Energy (DOE).	https://www.fivecap.org/weatherization-and-housing.html	Severe winter weather; Thunderstorm, High Winds, Hail, Tornado, Lightning; Flooding; Extreme Temperatures; Public Health Emergency

Y3	**Northern Michigan Community Action Agency Home Improvement (For Manistee and Wexford counties)**	Weatherization Assistance Program (Manistee and Wexford counties) and Emergency Home Repair Program (Wexford County) for low- to moderate- income households.	https://www.nmcaa.net/home_improvement.asp	Severe winter weather; Thunderstorm, High Winds, Hail, Tornado, Lightning; Flooding; Extreme Temperatures; Public Health Emergency
Z3	**Mid-Michigan CAA Weatherization Programs (for Oceana and Muskegon counties)**	For households struggling with high energy costs, weatherization provides cost-effective energy solutions like insulation and weather stripping to reduce energy costs, increase safety in the home, and improve the health of the residents.	https://www.mmcaa.org/weatherization.html	
A4	**Ottawa County CAA Home Weatherization Assistance**	This is a free program for individuals and homes that qualify. The program includes an inspection that will determine what eligible Weatherization activities will be performed. A licensed contractor will complete these measures and a post inspection will be done for quality assurance. Weatherization tasks may include things like attic insulation, wall insulation, floor insulation, weather stripping, window caulking, and other minor home repairs.	https://www.miottawa.org/Community/CAA/weatherization.htm	
B4	**Kent County CAA Weatherization Assistance**	The Weatherization Assistance Program (WAP) and Senior Home WAP enable households with low-income to reduce their heating costs by making homes more energy efficient. Services may include: Attic & Wall Insulation, Health & Safety Checks, Air Sealing Measures, and Other Energy Efficiency Measures.	https://www.accesskent.com/Departments/CommunityAction/weatherization.htm	
C4	**Five CAP, Inc. (Community Action Agency) - Nutrition Programs (for Manistee, Mason, Lake and Newaygo counties)**	COMMODITY SUPPLEMENTAL FOOD PROGRAM (CSFP) - a USDA funded program providing nutritionally balanced food supplements to senior citizens 60 & over. Must meet income guidelines. THE EMERGENCY FOOD ASSISTANCE PROGRAM (TEFAP) - A USDA funded program providing federally purchased surplus food to low-income families. No age requirement but must meet the income guidelines. EMERGENCY FOOD PANTRY - Funded by the Emergency Food & Shelter Program (EFSP), to provide up to 30 days of food to families and individuals on an emergency needs basis. GARDENING AND FOOD PREPARATION - Funded by the Community Services Block Grant, this program provides plants to families each year with training to encourage gardening and food preservation. The program offers canning, drying and freezing food workshops, as well as loans rototillers to participants.	https://www.fivecap.org/nutrition-programs.html	Public Health Emergency
D4	**Northern Michigan Community Action Agency Food Assistance (Wexford County)**	CSFP and TEFAP offered (food assistance programs)	https://www.nmcaa.net/food.asp	
E4	**Mid-Michigan CAA Food Programs (for Oceana and Muskegon counties)**	Low income seniors age 60+ can receive a distribution of two food boxes every other month	https://www.mmcaa.org/seniors.html#food	
F4	**Ottawa County CAA Food Assistance Programs**	CSFP and TEFAP offered. OTTAWA FOOD works to connect people who are food insecure with food resources in the community. They have two subcommittees (Healthy Eating and Hunger) that both focus on local food.	https://www.miottawa.org/Community/CAA/commodity_food.htm	
G4	**Kent County CAA Food Assistance**	CSFP and TEFAP offered	https://www.accesskent.com/Departments/CommunityAction/CSFP.htm	
G5	**MDNR Maps of Michigan's Underground Mines**	The MDNR has completed a maps of mines for some counties in Michigan, which includes gypsum mines in Kent County. Note that subsidence incidents have occurred in counties not yet mapped, and therefore this map set should not be considered comprehensive. There may also be unmapped mines existing within the 10 counties whose maps have been made available.	http://www.dnr.state.mi.us/spatialdatalibrary/pdf_maps/Geology/Mines/	Subsidence

Monitoring and Evaluating the Plan
The LRBOI 2023 Natural Hazard Mitigation Plan is a living document that will provide guidance for reducing the impacts of natural hazards for future generations. To make sure this plan is accurate and current, it will be monitored, evaluated, and updated over its life.

The plan will be reviewed annually on the anniversary of plan adoption and after any major disaster or emergency declaration that applies to the LRBOI service area. Annual plan maintenance tasks, to be completed by the Natural Hazards Task Force, include the following:

- Determine if the hazard identification and assessments, tribal vulnerability summary, and mitigation strategies continue to be accurate, current and relevant.
- Document progress made on mitigation strategies, including a description of any successes and challenges.
- Monitor the progress of all hazard mitigation projects, including FEMA-funded projects in accordance with applicable grant management standards, including progress reports and regular financial reviews from the accounting department to be completed throughout the lifecycle of the project.
- Any significant revisions to the plan within the 5-year period will be forwarded as a plan addendum to the MSP EMHSD.

Natural Hazards Task Force (the LRBOI TERT) members will coordinate with their respective departments in the above maintenance tasks. When a department or entity assigned responsibility for a mitigation action is not represented by a Task Force member, the Task Force will select a member to work with that department/entity. Each tribal department responsible for an action will provide updates in a timely manner to the Natural Hazards Task Force and will provide documentation of progress for incorporation into the plan.

Updating the Plan
The Stafford Act, as amended by the Disaster Mitigation Act of 2000, requires governmental entities to have a Natural Hazard Mitigation Plan be updated, adopted, and re-submitted for Federal Emergency Management Agency (FEMA) approval every five years.

Approximately 18 months prior to the plan's expiration date, the Natural Hazards Task Force will convene to review the plan in compliance with all applicable Federal statutes and regulations in effect with respect to the periods for which it receives grant funding, including 2 CFR Parts 200 and 3002, and will amend its plan to reflect changes in tribal or Federal laws and statutes. The Task Force will also determine if the LRBOI will need to seek grant funding to assist with the plan update.

Future plan updates will include determining changes in the Tribal service area (such as changes in development, an increase in exposure to hazards, an increase or decrease in the Tribe's capability to address hazards); addition and/or removal of mitigation actions and strategies; reviewing goals and objectives; and any change in federal or state legislation. Upon completion of an updated draft plan and public review period, the LRBOI Tribal Council can review, approve and adopt the plan. The plan will then be sent to the State Hazard Mitigation Officer at the Michigan State Police for final review and approval in coordination with FEMA.

Continued Public Involvement
The LRBOI Natural Hazards Task Force is committed to keeping tribal members and stakeholders involved in the implementation and update of the Hazard Mitigation Plan. As stated in Section II of this plan, the Tribal Emergency Response Team (TERT) members consist of Tribal Councilmembers, emergency response personnel, and government staff that ensure the readiness of the Tribe by recommending equipment purchases, training and exercises, and member education on preparedness issues. TERT and Tribal Council meetings are always open to tribal members.

Public comment on plan revisions and updates will be solicited through public outreach efforts that may include open houses, public meetings, press releases, websites or displays at community events. Task Force and Tribal members may review the status of mitigation projects by evaluating implementation actions and processes, identifying those that have worked well, difficulties encountered, and making suggestions for revisions to the mitigation strategies as necessary.

A copy of the current Natural Hazard Mitigation Plans for the LRBOI, as well as Manistee County and Wexford County, will be available on Networks Northwest's website. Additionally, the Tribal Incident Commander will be responsible for maintaining a copy of the plan and keeping a record of public comments and future plan changes.

Plan Integration

Part of ensuring that the plan is current and useful to a community is integrating it into existing and future planning efforts. Once a year, the Tribal Incident Commander will gather information on all planning mechanisms expected to be updated in the next year. Then, the TERT will determine which plans and projects that are appropriate to incorporate the mitigation plan's goals and actions. These could include natural resources management, housing, infrastructure, economic development, and transportation plans or projects. Additionally, pertinent mitigation goals and objectives may be integrated into future updates of tribal planning documents.

The LRBOI will also continue to be a participant in future Natural Hazard Mitigation Plan updates for the counties within its 9 county service area. As such, the counties will work with the Tribal Incident Commander to maintain and update their information when it is warranted. LRBOI will continue to have an open seat on Manistee County's Local Planning Team/ Emergency Planning Team.

APPENDIX A: MAPS

Due to their large file size, each map can be viewed by clicking on the following links:

1. LRBOI Service Area Map
   https://drive.google.com/file/d/1hjT22gysBrkzi9KXP15rahGTYMH8JSXL/view?usp=sharing

2. Environmental Features Map (Manistee and Wexford Counties)
   https://drive.google.com/file/d/1hhclfJArfLFtRRZQKMNbbC1tN5Pkb39A/view?usp=sharing

3. Infrastructure Map
   https://drive.google.com/file/d/1hk8ilKasL7f_4iMM73vLc-fH8TT7YWbt/view?usp=sharing

4. LRBOI Critical Infrastructure Map
   https://drive.google.com/file/d/1de-pKK2bEPA86nZmSS-_GyYf6rkIAAFI/view?usp=sharing

5. Hazard Areas Map
   https://drive.google.com/file/d/1tclrKCWQ4Vnp1j4YPyOAED7z2wLqGWvr/view?usp=sharing

6. Vulnerable Population Map
   https://drive.google.com/file/d/1hmS6fbkmBJXZ38ztxX83DGXQdq8gjbWe/view?usp=sharing

7. Vulnerable Population and Hazard Areas Map
   https://drive.google.com/file/d/1hnonaIm_H9XG9IG0wkYDnIfQi_BjMDaU/view?usp=sharing

APPENDIX B: COMMUNITY SURVEY RESULTS

Q1 What is your role in the LRBOI community? (i.e., police officer, government employee, citizen, etc.)

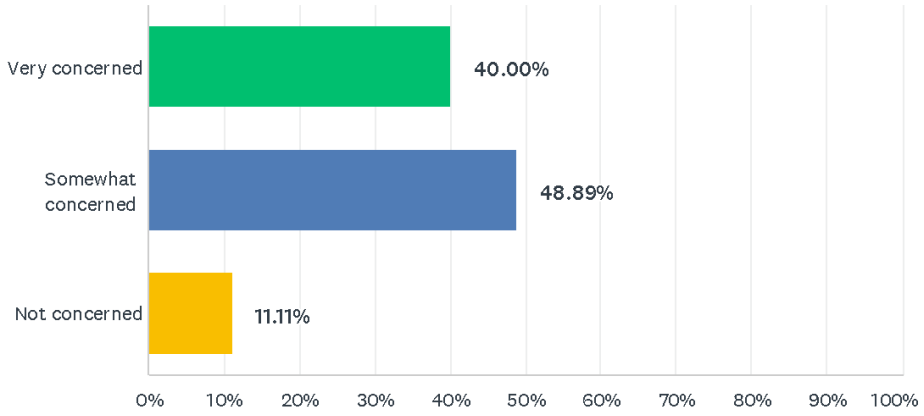
Answered: 44 Skipped: 1

#	RESPONSES	DATE
1	Member	12/9/2021 11:07 PM
2	PHYSICIAN	11/22/2021 8:15 AM
3	government employee	11/19/2021 11:05 AM
4	Victim Advocate	11/19/2021 8:50 AM
5	citizen	11/18/2021 11:59 AM
6	Government employee and tribal citizen	11/18/2021 10:40 AM
7	employee	11/18/2021 10:30 AM
8	government employee	11/18/2021 10:20 AM
9	Government employee	10/28/2021 8:35 AM
10	government employee and citizen	10/14/2021 2:35 PM
11	government employee	10/14/2021 1:21 PM
12	Government Employee	10/14/2021 1:15 PM
13	Utlity Operator WWTP	10/14/2021 12:51 PM
14	government employee	10/14/2021 12:45 PM
15	pharmacy technician	10/14/2021 12:40 PM
16	Government employee	10/14/2021 12:39 PM
17	government employee	10/14/2021 12:17 PM
18	Goverbment employee	10/14/2021 12:17 PM
19	government employee	10/13/2021 11:39 AM
20	citizen and government employee	10/13/2021 9:59 AM
21	government employee	10/12/2021 1:55 AM
22	Government employee	10/11/2021 2:11 PM
23	government employee	10/8/2021 5:05 PM
24	Government employee	10/8/2021 3:35 PM
25	Police Chief/Citizen	10/8/2021 12:43 PM
26	Government Employee-Legislative Assistant	10/8/2021 7:22 AM
27	Surveillance Operator	10/7/2021 12:43 PM
28	Government Employee	10/7/2021 12:03 PM
29	Tribal Probation officer, and Tribal citizen	10/7/2021 11:35 AM
30	Government employee	10/7/2021 11:29 AM
31	Utility Director	10/7/2021 11:27 AM

32	Tribal Councilor	10/7/2021 11:24 AM
33	Government Employee	10/7/2021 10:55 AM
34	Government Employee	10/7/2021 10:46 AM
35	Government Employee	10/7/2021 10:41 AM
36	Government employee and spouse	10/7/2021 10:27 AM
37	Government Employee	10/7/2021 9:59 AM
38	Program Specialist	10/7/2021 9:48 AM
39	government employee	10/7/2021 9:45 AM
40	police detective	10/7/2021 9:44 AM
41	Government, Citizen	10/7/2021 9:44 AM
42	Tribal Government Employee and Tribal Member	10/7/2021 9:40 AM
43	Neighboring County Emergency Management Coordinator	10/6/2021 3:06 PM
44	Government Employee	10/6/2021 11:16 AM

Q2 How concerned are you about future natural hazard events impacting your community?

Answered: 45 Skipped: 0



ANSWER CHOICES	RESPONSES	
Very concerned	40.00%	18
Somewhat concerned	48.89%	22
Not concerned	11.11%	5
TOTAL		45

Q3 What type of natural hazard events are likely to have the largest impact on your community (for example fire, flood, drought, illness outbreak, etc.)?

Answered: 45 Skipped: 0

#	RESPONSES	DATE
1	Snow storm , power outages, pandemic	12/9/2021 11:07 PM
2	TORNADO	11/22/2021 8:15 AM
3	illness outbreak	11/19/2021 11:05 AM
4	flood, illness outbreak	11/19/2021 8:50 AM
5	illness outbreak, fire	11/18/2021 11:59 AM
6	Forest fire, intentional and unintentional destruction of natural medicines and/or endangered plants/trees	11/18/2021 10:40 AM
7	illness outbreak, flooding	11/18/2021 10:30 AM
8	illness pandemic, flood	11/18/2021 10:20 AM
9	fire, illness	10/28/2021 8:35 AM
10	flood, chemical spills	10/18/2021 8:40 AM
11	flooding, snow storms, wind, illness	10/14/2021 2:35 PM
12	fire	10/14/2021 1:21 PM
13	Fire, Floods, Illness outbreak	10/14/2021 1:15 PM
14	illness, loss of power to unprotected lift stations	10/14/2021 12:51 PM
15	Illness and outbreak, possible threat attacks.	10/14/2021 12:45 PM
16	illness outbreak, weather (snow)	10/14/2021 12:40 PM
17	Large storm, possible flood, apparently illness outbreak most recently	10/14/2021 12:39 PM
18	Illness outbreak, flood.	10/14/2021 12:17 PM
19	Illness Outbreak	10/14/2021 12:17 PM
20	flood, with corresponding dam failure(s)	10/13/2021 11:39 AM
21	water contamination, air pollution, lack of outbreak resources	10/13/2021 9:59 AM
22	fire	10/12/2021 1:55 AM
23	Thunder storms, high winds, snow storms, illness outbreaks	10/11/2021 2:11 PM
24	illness outbreak, fire, drought	10/8/2021 5:05 PM
25	Not sure. Probably disease	10/8/2021 3:35 PM
26	Illness outbreak and wildfire	10/8/2021 12:43 PM
27	Illness Outbreak	10/8/2021 7:22 AM
28	Severe Weather Storms	10/7/2021 12:43 PM
29	Fire, tornado, bad snow storms, and illness outbreak	10/7/2021 12:03 PM
30	Major storms and damage caused by the storm.	10/7/2021 11:35 AM

31	Flood, Illness, possible fires, Damaging winds, Blizzards	10/7/2021 11:29 AM
32	Electrical Outage, fire, illness outbreak,	10/7/2021 11:27 AM
33	Fire, illness outbreaks, flooding, wind damage not necessarily tornadoes but those can be included	10/7/2021 11:24 AM
34	Illness outbreak, Fire,	10/7/2021 10:55 AM
35	Flood and/or drought	10/7/2021 10:46 AM
36	Primarily flooding due to old infrastructure (dams) failing. Also, severe weather such as straight-line winds & tornadoes.	10/7/2021 10:41 AM
37	Flood, fire (wildfire if conditions are dry), and illness outbreak (people are gross!)	10/7/2021 10:27 AM
38	Tornado or Fire	10/7/2021 9:59 AM
39	Illness, flooding, Winter Storms.	10/7/2021 9:48 AM
40	illness outbreak	10/7/2021 9:45 AM
41	flood or fire	10/7/2021 9:44 AM
42	fire, illness outbreak	10/7/2021 9:44 AM
43	There are two things I am concerned about. The first would be some type of natural disaster or severe weather occurrence. The second would be a serious illness outbreak like the current Covid-19 pandemic.	10/7/2021 9:40 AM
44	Severe Storms, Flooding, Winter Weather	10/6/2021 3:06 PM
45	Flood, Fire, Drought, PFAS, oil or oil product spill, dam failure, extreme seiche event, train derailment,	10/6/2021 11:16 AM

Q4 Does your community have concerns about infrastructure (dams, bridges, utilities, etc.) and the potential for a hazardous event in the future? Please describe.

Answered: 42 Skipped: 3

#	RESPONSES	DATE
1	Unsure	12/9/2021 11:07 PM
2	NO	11/22/2021 8:15 AM
3	not really	11/19/2021 11:05 AM
4	unsure	11/19/2021 8:50 AM
5	I'm not for sure but they should	11/18/2021 11:59 AM
6	It doesn't appear there is concern because the county does not appear to prioritize these items accordingly. The county doesn't work with the Tribe to address critical issues such as sewage dumpage in the lake, deforestation, and erosion in addition to road, dam, and bridge repairs.	11/18/2021 10:40 AM
7	city sewer system is inadequate	11/18/2021 10:30 AM
8	concerns over roadways flooding, and recent scares with covid 19	11/18/2021 10:20 AM
9	i am unsure	10/28/2021 8:35 AM
10	bridges, manufacturing spills - water contamination	10/18/2021 8:40 AM
11	Only one dam (Tippy) but bridges are being repaired	10/14/2021 1:15 PM
12	loss of power at some of our sewage lift stations that do not have generator backup, would cause sewage to overflow into peoples homes and from the wet wells out onto the ground. this would create the perfect environment for vectors to carry diseases to the population	10/14/2021 12:51 PM
13	The intersection of US 31 at the casino needs a traffic light. Not a round-a-bout!	10/14/2021 12:45 PM
14	no	10/14/2021 12:40 PM
15	Yes. infrastructure in some areas are getting old. While maintenance is occurring on some, it is an ongoing process.	10/14/2021 12:39 PM
16	Yes all the above	10/14/2021 12:17 PM
17	LRBOI is downstream of Hodenpyl and Tippy dams. failure of these dams would cause widespread flooding in the community.	10/13/2021 11:39 AM
18	roads need to be repaired. Infrastructure needs to be expanded to allow for future building.	10/13/2021 9:59 AM
19	bridges are in need of repair	10/12/2021 1:55 AM
20	Not that I am aware of.	10/11/2021 2:11 PM
21	Tippy Dam	10/8/2021 5:05 PM
22	not really	10/8/2021 3:35 PM
23	Yes. We work with Consumers Energy on dam failure or flood as most of the community would be flooded should this event take place.	10/8/2021 12:43 PM
24	Manistee has two draw bridges that may be damaged like during a severe storm. Traffic needs to flow through those two areas to get from one side to the other in Manistee.	10/8/2021 7:22 AM
25	Utilities	10/7/2021 12:43 PM
26	There are no annual infrastructure assessments or inspections done on our roofs, windows,	10/7/2021 12:03 PM

	etc.	
27	power outages, caused by snow storms.	10/7/2021 11:35 AM
28	I believe so, we have lots of Bridges, and a few dams that is a great concern for most.	10/7/2021 11:29 AM
29	We have processes in pace for Utility disasters, Vulnerability assessment, water and sewer issues.	10/7/2021 11:27 AM
30	i do. our infrastructure isnt as strong as it should be. nor it is updated. with our utilities dept. concern is keeping it updated and functioning properly and do we have enough going into the future to handle what we need	10/7/2021 11:24 AM
31	Utilities are a concern. Back up generators would be Great Idea	10/7/2021 10:55 AM
32	I would hope they do	10/7/2021 10:46 AM
33	Yes, as described Dams are old and may be prone to failure in a hard rain event.	10/7/2021 10:41 AM
34	Tippy dam - if this were to break it would not be good!	10/7/2021 10:27 AM
35	Not that I am aware of	10/7/2021 9:59 AM
36	Bridges (vehicle and railcars), Utility Lines, City water and sewage infrastructure	10/7/2021 9:48 AM
37	several of the bridges in the area are quite old and need of repair	10/7/2021 9:45 AM
38	yes	10/7/2021 9:44 AM
39	no	10/7/2021 9:44 AM
40	The only infrastructure we have at this time is our water and wastewater systems. I am not aware of any major concerns regarding those systems.	10/7/2021 9:40 AM
41	Yes. Infrastructure is aging while certain severe storms are increasing in intensity and frequency. Many of the County's drainage systems have been impacted in recent years with flash flooding.	10/6/2021 3:06 PM
42	dams are old, train bridges are old, major bridges and culverts in the community are undersized. infrastructure in general is not designed for climate chaos.	10/6/2021 11:16 AM

Q5 Does your community have concerns that a natural hazard event in the future would require investment in new and/or upgraded infrastructure and technology? (I.e., renewable energy, improved stormwater management, internet/cellular, etc.)

Answered: 43 Skipped: 2

#	RESPONSES	DATE
1	Yes	12/9/2021 11:07 PM
2	NO	11/22/2021 8:15 AM
3	yes	11/19/2021 11:05 AM
4	unsure	11/19/2021 8:50 AM
5	Don't know but should have a energy plan in place	11/18/2021 11:59 AM
6	I'm sure they are aware, but if there's a plan in place, that is not known. I hope there's a plan and monies being put aside along with steps to be ahead of the game rather than it being an emergency if and when something should happen.	11/18/2021 10:40 AM
7	improved sewer/storm water system	11/18/2021 10:30 AM
8	road improvements are needed as well as internet access	11/18/2021 10:20 AM
9	I do not know	10/28/2021 8:35 AM
10	yes	10/18/2021 8:40 AM
11	rural internet	10/14/2021 1:21 PM
12	renewable energy, improved cellular and internet access.	10/14/2021 1:15 PM
13	yes backup generators need to be installed at all waste water liftstations, and improved software to allow control of systems remotely	10/14/2021 12:51 PM
14	Possibly internet/cellular. The government center needs wireless internet and a cell booster. My department does much communication with clients via cell phone. The reception is horrible. Calls are often dropped and sometimes messages won't send.	10/14/2021 12:45 PM
15	no	10/14/2021 12:40 PM
16	Internet, especially in rural areas.	10/14/2021 12:39 PM
17	All the above	10/14/2021 12:17 PM
18	wastewater treatment and roads infrastructure could be severely impacted by natural hazards.	10/13/2021 11:39 AM
19	Internet, renewable energy	10/13/2021 9:59 AM
20	unknown	10/12/2021 1:55 AM
21	Not that I am aware of.	10/11/2021 2:11 PM
22	Improved stormwater management will be important to handle increased extreme rainwater events.	10/8/2021 5:05 PM
23	not sure	10/8/2021 3:35 PM
24	Yes. Cell towers in our region are spotty and are regularly taken out by violent storms.	10/8/2021 12:43 PM
25	The loss of Electrical Services would be the most damaging due to Elders needing these services.	10/8/2021 7:22 AM

26	yes all of the above	10/7/2021 12:43 PM
27	Upgraded infrastructure is needed with our technology.	10/7/2021 12:03 PM
28	in an event of a natural hazard, access to emergency support and relief would be helpful.	10/7/2021 11:35 AM
29	Not sure about this.	10/7/2021 11:29 AM
30	currently working on renewable energy	10/7/2021 11:27 AM
31	i dont know about everyone else but i do have infrastructure concerns, stormwater management, technology, internet... we are looking at going into renewable energy so its a start	10/7/2021 11:24 AM
32	Upgraded Electrical Generators and or Solar power would be good Ideas	10/7/2021 10:55 AM
33	I would hope so	10/7/2021 10:46 AM
34	The Tribe has interest in renewable energy investment to build resilience against down time due to natural hazard events.	10/7/2021 10:41 AM
35	Internet/cellular, renewable energy is always a plus when done right! There are houses in the tribal housing that have solar panels that were never set up completely.	10/7/2021 10:27 AM
36	I think these are certainly concerns, that good planning can help mitigate.	10/7/2021 9:59 AM
37	Internet/cellular, water run off, Power lines	10/7/2021 9:48 AM
38	not sure	10/7/2021 9:45 AM
39	yes	10/7/2021 9:44 AM
40	internet/cellular, renewable energy	10/7/2021 9:44 AM
41	I don't think there is a specific concern regarding a natural hazard event. However, we are taking a serious look at renewable energy and internet broadband resources, and would like to make them available as soon as possible.	10/7/2021 9:40 AM
42	Stormwater management will be an on-going need especially during development. Fluctuations in Lake Michigan levels have prompted the need for upgrade infrastructure for water treatment and shoreline erosion prevention	10/6/2021 3:06 PM
43	yes	10/6/2021 11:16 AM

Q6 Have there been any negative impacts on the public health and/or natural environment of your community that you attribute to climate change?

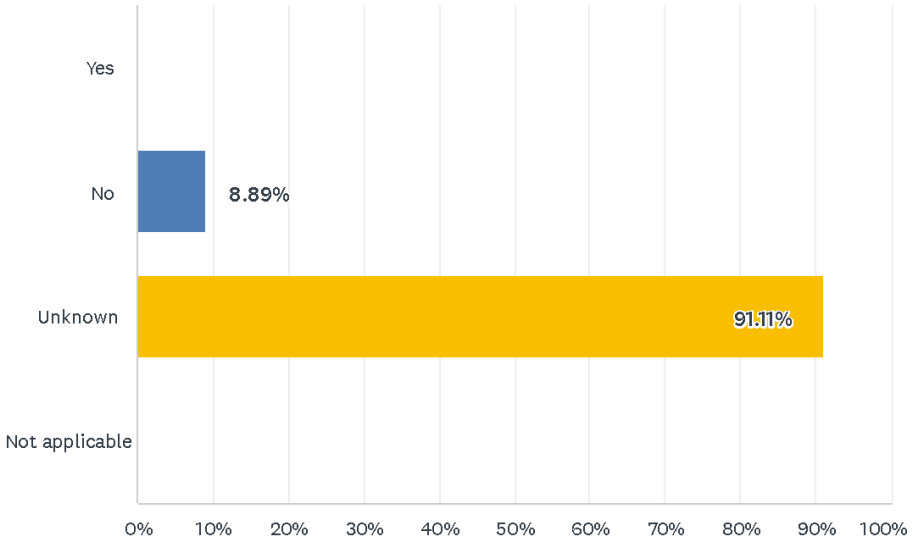
Answered: 41 Skipped: 4

#	RESPONSES	DATE
1	Yes shut down line 5	12/9/2021 11:07 PM
2	NO	11/22/2021 8:15 AM
3	no	11/19/2021 11:05 AM
4	high water levels have impacted the shoreline	11/19/2021 8:50 AM
5	illness	11/18/2021 11:59 AM
6	Yes. I think that climate change has had an effect on the weather causing extra precipitation at times which has caused seiche events and sewage backups and overflows. These issues have resulted in pollution into our lakes and streams and created erosion problems. I believe these issues have resulted in more fish kills and contaminated fish, which are essential to the native diet. The contaminated water is also utilized by people and animals, which is unhealthy and although people have the filtration from utility plants, animals do not. These animals either get sick or die or in cases of deer, people eat them and can get sick as well.	11/18/2021 10:40 AM
7	no	11/18/2021 10:30 AM
8	unsure if the weather patterns are normal fluctuations or climate change	11/18/2021 10:20 AM
9	Not that I am aware of	10/28/2021 8:35 AM
10	unknown	10/18/2021 8:40 AM
11	natural environment with decline in wetlands, increased fire damage	10/14/2021 1:15 PM
12	Don't know	10/14/2021 12:45 PM
13	no	10/14/2021 12:40 PM
14	In environmental community yes. Many animal species, including some culturally significant species, have been seen negative impacts.	10/14/2021 12:39 PM
15	NO!	10/14/2021 12:17 PM
16	None that I am aware of. But it is only a matter of time before these impacts become impossible to miss.	10/13/2021 11:39 AM
17	yes	10/13/2021 9:59 AM
18	not that I'm aware of	10/12/2021 1:55 AM
19	Not that I am aware of.	10/11/2021 2:11 PM
20	Climate change has led to increased wildfire frequency and severity. Particulates from western wildfires reached us here and was detectable in air quality monitoring data. Winters have become milder in terms of lower snowfall and higher minimum temperatures, which increases the spread of invasive pests and diseases in the environment. For example, the lack of killing frosts has facilitated hemlock woolly adelgid spread. Erratic precipitation patterns have resulted in periods of drought which impact native plant and animal species. For example, the drought in Spring 2021 was followed by an unusually wet summer, which negatively impacted wild rice populations.	10/8/2021 5:05 PM
21	Yes the climate is changing. Hopefully the flora and fauna will be able to adapt.	10/8/2021 3:35 PM
22	Not to my knowledge	10/8/2021 12:43 PM

23	Weather related impacts causes more than just physical or structural damage.	10/8/2021 7:22 AM
24	yes	10/7/2021 12:43 PM
25	No, not that I'm aware of.	10/7/2021 12:03 PM
26	not yet, however evasive insects have harmed the black ash trees.	10/7/2021 11:35 AM
27	Well there is Public Health issues all over, not sure if it has to do with climate change.	10/7/2021 11:29 AM
28	not as of yet	10/7/2021 11:27 AM
29	climate change??? i dont think so.	10/7/2021 11:24 AM
30	Water tables rise and falling	10/7/2021 10:55 AM
31	Not sure	10/7/2021 10:46 AM
32	No	10/7/2021 10:41 AM
33	Possibly - not my area of study but it would not be surprising that there are.	10/7/2021 10:27 AM
34	No, the climate has not changed, weather changes in the short term. Our climate has remained pretty much the same for generations.	10/7/2021 9:59 AM
35	Shoreline erosion	10/7/2021 9:48 AM
36	not so much in this area	10/7/2021 9:45 AM
37	I would say yes, high water levels heavy rains, hot summers	10/7/2021 9:44 AM
38	no	10/7/2021 9:44 AM
39	It's really hard to say. Since I don't interact directly in the public health or environmental areas, I have no direct knowledge of any negative impacts.	10/7/2021 9:40 AM
40	County has responded to several severe storms that have impacted the community. Overall public impacted are limited but the strain this places on the community and the emergency response network is starting to have an effect.	10/6/2021 3:06 PM
41	yes	10/6/2021 11:16 AM

Q7 Has your community requested assistance for mitigation projects in the past?

Answered: 45 Skipped: 0



ANSWER CHOICES	RESPONSES	
Yes	0.00%	0
No	8.89%	4
Unknown	91.11%	41
Not applicable	0.00%	0
TOTAL		45

Q8 If so, was your request granted and what type of project did the request include?

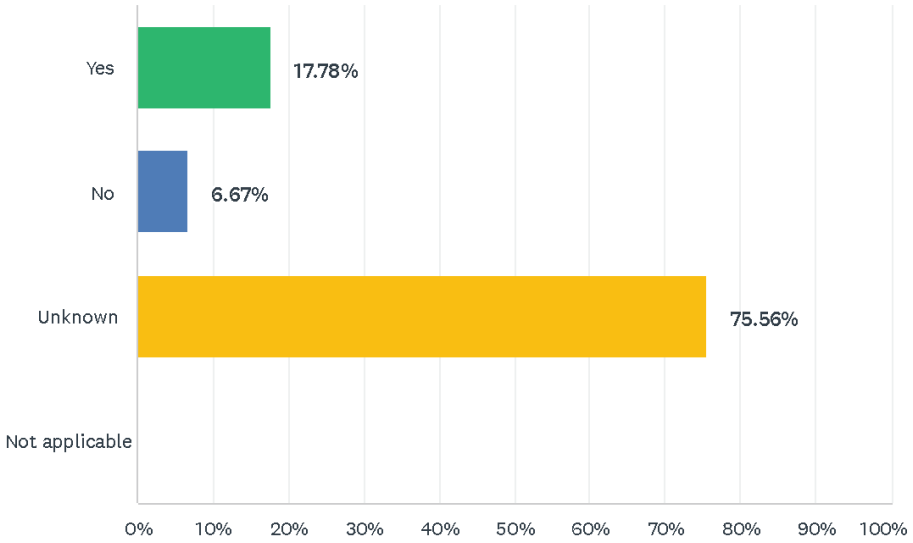
Answered: 38 Skipped: 7

#	RESPONSES	DATE
1	NA	12/9/2021 11:07 PM
2	UNKNOWN	11/22/2021 8:15 AM
3	n/a	11/19/2021 11:05 AM
4	unknown	11/19/2021 8:50 AM
5	did not have one	11/18/2021 11:59 AM
6	Unknown	11/18/2021 10:40 AM
7	unkown	11/18/2021 10:30 AM
8	unknown	11/18/2021 10:20 AM
9	N/A	10/28/2021 8:35 AM
10	unknown	10/14/2021 1:15 PM
11	NA	10/14/2021 12:45 PM
12	n/a	10/14/2021 12:40 PM
13	Possibly for infrastructure work	10/14/2021 12:39 PM
14	N/A	10/14/2021 12:17 PM
15	Unknown	10/13/2021 11:39 AM
16	unknown	10/13/2021 9:59 AM
17	unknown	10/12/2021 1:55 AM
18	Unknown	10/11/2021 2:11 PM
19	N/A	10/8/2021 5:05 PM
20	n/a	10/8/2021 3:35 PM
21	n/a	10/8/2021 12:43 PM
22	N/A	10/8/2021 7:22 AM
23	Unknown	10/7/2021 12:43 PM
24	n/a	10/7/2021 12:03 PM
25	N/A	10/7/2021 11:35 AM
26	?	10/7/2021 11:29 AM
27	N/A	10/7/2021 11:24 AM
28	unknown	10/7/2021 10:55 AM
29	N/A	10/7/2021 10:41 AM
30	Don't know.	10/7/2021 10:27 AM
31	Unknown	10/7/2021 9:59 AM

32	unknown	10/7/2021 9:48 AM
33	not sure	10/7/2021 9:45 AM
34	n/a	10/7/2021 9:44 AM
35	Unknown	10/7/2021 9:44 AM
36	I have no knowledge of this.	10/7/2021 9:40 AM
37	Have only requested Hazard Mitigation Grants to update Mason County's plan during my tenure	10/6/2021 3:06 PM
38	unknown	10/6/2021 11:16 AM

Q9 Has your community considered mitigation strategies for potential or current hazards?

Answered: 45 Skipped: 0



ANSWER CHOICES	RESPONSES	
Yes	17.78%	8
No	6.67%	3
Unknown	75.56%	34
Not applicable	0.00%	0
TOTAL		45

Q10 If so, please identify potential strategies you would like to explore in the near future.

Answered: 36 Skipped: 9

#	RESPONSES	DATE
1	Na	12/9/2021 11:07 PM
2	NOT APPLICABLE	11/22/2021 8:15 AM
3	n/a	11/19/2021 11:05 AM
4	unknown	11/19/2021 8:50 AM
5	solar energy,	11/18/2021 11:59 AM
6	Unknown	11/18/2021 10:40 AM
7	unkown	11/18/2021 10:30 AM
8	unknown	11/18/2021 10:20 AM
9	N/A	10/28/2021 8:35 AM
10	I don't have that information	10/14/2021 1:15 PM
11	NA	10/14/2021 12:45 PM
12	n/a	10/14/2021 12:40 PM
13	Infrastructure	10/14/2021 12:39 PM
14	N/A	10/14/2021 12:17 PM
15	Unknown	10/13/2021 11:39 AM
16	n/a	10/13/2021 9:59 AM
17	unknown	10/12/2021 1:55 AM
18	Unknown	10/11/2021 2:11 PM
19	N/A	10/8/2021 5:05 PM
20	na	10/8/2021 3:35 PM
21	n/a	10/8/2021 12:43 PM
22	N/A	10/8/2021 7:22 AM
23	None	10/7/2021 12:43 PM
24	n/a	10/7/2021 12:03 PM
25	as our population ages, help and emergencies services for the elderly in a hazard event.	10/7/2021 11:35 AM
26	previous plan in place updating this plan is needed	10/7/2021 11:27 AM
27	We are in the process of completing renewable energy studies and strategic planning to begin investing in renewable energy projects to make our community more resilient.	10/7/2021 10:41 AM
28	Again, don't know.	10/7/2021 10:27 AM
29	One consideration is to have our duplicate electronic information and data stored at an alternative site at least 50 miles from our "home" site. Reducing the risk of having a singular event wipe out all electronic information and its back-up.	10/7/2021 9:59 AM
30	unknown	10/7/2021 9:48 AM

31	not sure	10/7/2021 9:45 AM
32	n/a	10/7/2021 9:44 AM
33	Unknown	10/7/2021 9:44 AM
34	I have no recommendations in this area.	10/7/2021 9:40 AM
35	Mason County is currently in the process of updating our hazard mitigation plan and it's strategies	10/6/2021 3:06 PM
36	we haven't identified strategies	10/6/2021 11:16 AM

Q11 Is there any additional information you would like us to consider as we write the tribe's Natural Hazard Mitigation Plan?

Answered: 35 Skipped: 10

#	RESPONSES	DATE
1	No	12/9/2021 11:07 PM
2	NO	11/22/2021 8:15 AM
3	no	11/19/2021 11:05 AM
4	no	11/19/2021 8:50 AM
5	not at this time	11/18/2021 11:59 AM
6	I would like to see it include all of our Reservation lands and not just here locally. We need to ensure all of our land is protected.	11/18/2021 10:40 AM
7	no	11/18/2021 10:30 AM
8	no	11/18/2021 10:20 AM
9	Unknown	10/28/2021 8:35 AM
10	cultural properties and impacts	10/14/2021 1:15 PM
11	Safety over profits, please!	10/14/2021 12:45 PM
12	no	10/14/2021 12:40 PM
13	Native plant and animal species. Infrastructure	10/14/2021 12:39 PM
14	N/A	10/14/2021 12:17 PM
15	Unknown	10/13/2021 11:39 AM
16	Cultural appreciation of lands/ property.	10/13/2021 9:59 AM
17	no	10/12/2021 1:55 AM
18	No	10/11/2021 2:11 PM
19	LRBOI NRD initiated a Wetland Program in 2021 that is working to map and monitor wetlands on Tribal properties. Wetlands are key to mitigating floodwater surges, and their protection and restoration is vital to flood hazard mitigation.	10/8/2021 5:05 PM
20	no	10/8/2021 3:35 PM
21	n/a	10/8/2021 12:43 PM
22	No	10/8/2021 7:22 AM
23	Winter storm or Severe weather impact on employees who must come to work during dangerous event.	10/7/2021 12:43 PM
24	I would consider adding snow storms and ice storms to the plan.	10/7/2021 12:03 PM
25	Have a "Natural Hazard Mitigation Plan" that is realistic, do-able and easy to follow by the people the will implement the plan.	10/7/2021 11:35 AM
26	nothing comes to mind	10/7/2021 11:27 AM
27	No	10/7/2021 10:41 AM
28	If this includes drugs (meth, cocaine, etc.) this would be a great thing to include as this seems to be a rising problem in the community - not sure if it falls under this umbrella or not.	10/7/2021 10:27 AM

29	No	10/7/2021 9:59 AM
30	unknown	10/7/2021 9:48 AM
31	no	10/7/2021 9:45 AM
32	no	10/7/2021 9:44 AM
33	Unknown	10/7/2021 9:44 AM
34	Not at this time. Thank you.	10/7/2021 9:40 AM
35	Considering the Tribal values and importance of game and non-game species to the community.	10/6/2021 11:16 AM

APPENDIX C: CITY OF MANISTEE PROPOSED SHORELINE HAZARD MITIGATION PROJECT INFORMATION

Networks Northwest
Talent / Business / Community

Jennifer Neal <jennifer.neal@networksnorthwest.org>

City of Manistee projects

Stephanie Marchbanks <stephanie.marchbanks@networksnorthwest.org> Tue, Dec 20, 2022 at 11:09 AM

To: Jennifer Neal <jennifer.neal@networksnorthwest.org>

OK122022

---------- Forwarded message ---------
From: **Mike Machen** <mmachen@manistee911.org>
Date: Fri, Dec 16, 2022 at 12:10 PM
Subject: Fwd: Follow up on Cities Initiative coastal resilience program
To: Stephanie Marchbanks <stephanie.marchbanks@networksnorthwest.org>, Jennifer Neal <jennifer.neal@networksnorthwest.org>

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From: Bill Gambill <bgambill@manisteemi.gov>
Sent: Friday, December 16, 2022 11:06:17 AM
To: Mike Machen <mmachen@manistee911.org>
Cc: Jeff Mikula <JMikula@manisteemi.gov>
Subject: Fw: Follow up on Cities Initiative coastal resilience program

[WARNING: External Message - Use extreme caution opening links or attachments]

Mike,

Here's some information about the City projects that should be included in the Manistee County Hazard Mitigation Plan. Please let us know what other information you need. Thank you.

Bill Gambill
City Manager
City of Manistee
Ph: 231.398.2801

From: Richardson, Lucas M. <lucas.richardson@spicergroup.com>
Sent: Thursday, December 15, 2022 11:50 PM
To: Bill Gambill <bgambill@manisteemi.gov>; Middleton, Shawn P. <shawnm@spicergroup.com>
Cc: Jeff Mikula <JMikula@manisteemi.gov>; Bentley, Anne M. <anne.bentley@spicergroup.com>
Subject: RE: Follow up on Cities Initiative coastal resilience program

Hi Bill,

Sorry for the late response. Please see attached for information that can be used as a starting point for discussion on a bioengineered “green” approach for the shoreline protection around the Clean Water Recovery Facility. Also,

attached is a conceptual design for 5th Avenue Flooding that we have went back and forth on in previous meetings with City Staff.

For the 5th Avenue project, our recommendation would be to start with the concrete wall with stop logs on the pier ramp to help prevent the high water/ waves from flooding the streets. The wall would also help reduce the amount of sand blown onto the streets which currently causes a lot of drainage issues. The catch basins get filled with sand frequently and I am sure DPW has to clean them all the time. A second route of protection would be to add a secondary gravity storm sewer that outlets in the Harbor Village channel. This outlet would be utilized if and when the streets are flooded and would help reduce the amount of time the residents in that area are inconvenienced with the flooded streets. A third option of protection could be to add a storm pump station with discharge out to the channel. This would again, help with reducing the time that the streets are flooded. However, the most important piece of the flood protection would be to construct the barrier to prevent the waves from flooding the streets. An additional drain or pump can only keep up with Lake Michigan for so long.

I will send follow up emails with additional photos that Rick Mohr sent me.

Please let us know if you have any questions.

Thank you,

Lucas Richardson, P.E. | Design Engineer III
SPICER GROUP, INC.
Office: 231-794-5620 | Cell: 231-668-1107
www.spicergroup.com
Stronger. Safer. Smarter. *Spicer*

From: Bill Gambill <bgambill@manisteemi.gov>
Sent: Tuesday, December 13, 2022 1:59 PM
To: Middleton, Shawn P. <shawnm@spicergroup.com>
Cc: Jeff Mikula <JMikula@manisteemi.gov>; Richardson, Lucas M. <lucas.richardson@spicergroup.com>
Subject: RE: Follow up on Cities Initiative coastal resilience program

> **Caution:** This email originated from a source outside Spicer Group. Do not click on links or open attachments unless you recognize the sender and you know the content is safe.

Hi Shawn,

Do we have any more information we can share on this with the call on Friday? Rough costs, recommended pump size for 5th ave.?

Bill Gambill
City Manager
City of Manistee
Ph: 231.398.2801

From: Middleton, Shawn P. <shawnm@spicergroup.com>
Sent: Tuesday, November 29, 2022 7:01 AM
To: Bill Gambill <bgambill@manisteemi.gov>
Cc: Jeff Mikula <JMikula@manisteemi.gov>; lucas.richardson@spicergroup.com
Subject: RE: Follow up on Cities Initiative coastal resilience program

Bill,

I misunderstood, I thought you were pursuing FEMA PDM or HMGP money. That is why I was asking about the Cost Benefit Ratio information. I am not familiar with this program.

Here is what we have for these two sites. We can prepare the supplemental information pretty quickly.

1. **CWRF shoreline erosion**. We have some preliminary plans for the WWTP that Brian and Shane had quickly put together. I think we would design it a little different than what is shown, especially if this grant has any required green or soft engineering components.. I need to confirm the cost. Brian had $1.4M. It should be significantly less than this. I don't know what we have for pictures of flooding and erosion, but we can check. Rick may have some as well.
2. **5th Avenue flooding**. – I think I have some photos of highwater. I am guessing Jeff and Brandon have some as well. Our last direction was a gravity storm sewer outlet to minimize costs. If we can get funding a wall and pump station would provide greater protection. We do not have any concept drawings or cost estimates for a PS and wall, but could prepare some pretty quickly. The pump station size cost will depend on the how fast we want to dewater and what recurrence interval we design for. Lucas and I can work through some scenarios and provide the City with some options.

Thanks,

Shawn
Shawn P. Middleton, PE CFM | Sr Project Manager
SPICER GROUP, INC.
Cell/Text: 989-928-8027

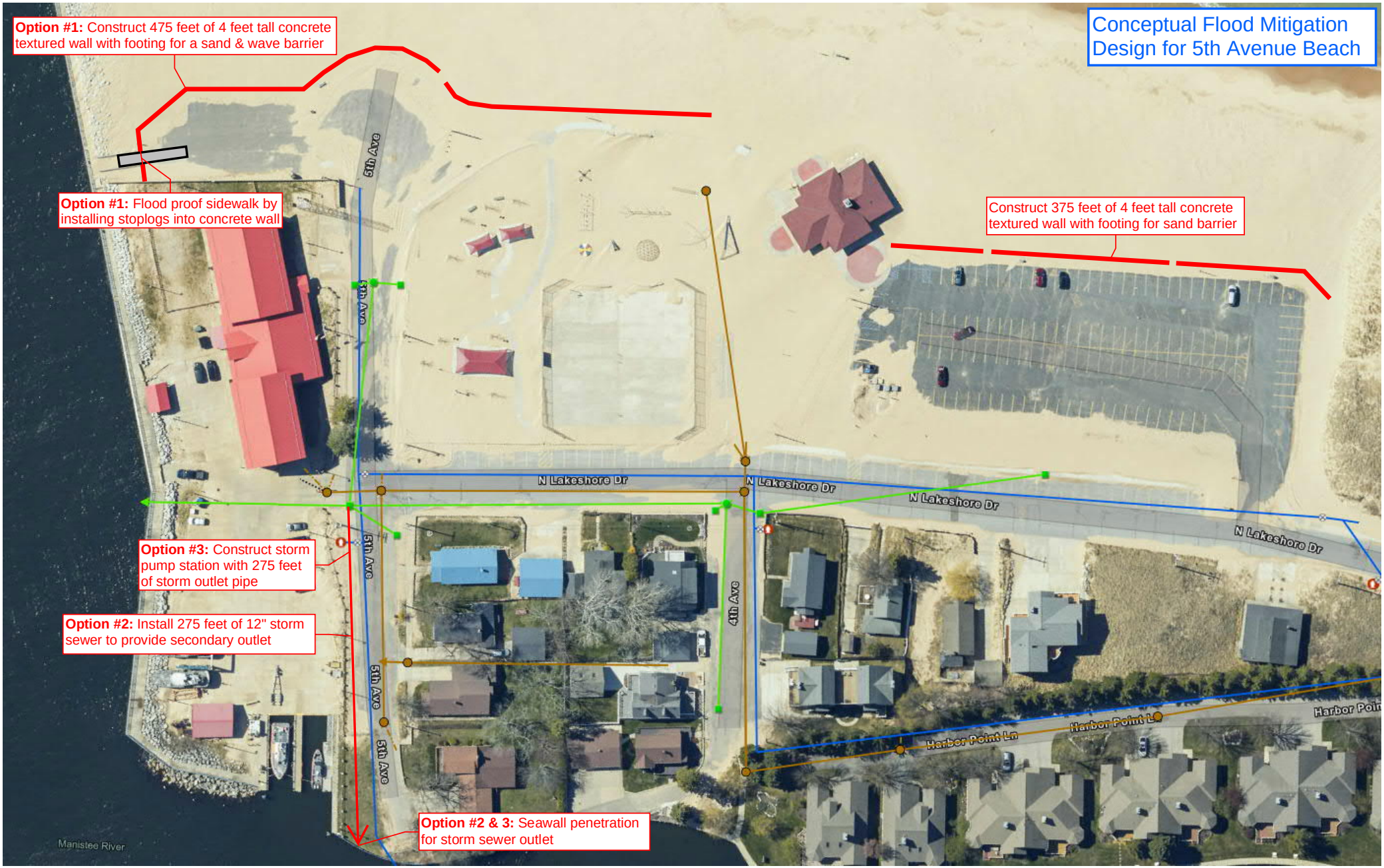
3 attachments

20221215_5th Ave Flood Mitigation.pdf
662K

5th Ave_Combined Flooding Photos.pdf
8948K

CWRF_Conceptual Design_.pdf
155K


Existing 5th Avenue Beach
5th Ave
5th Ave
5th Ave
5th Ave
5th Ave
N Lakeshore Dr
N Lakeshore Dr
N Lakeshore Dr
N Lakeshore Dr
Harbor Point Ln
Harbor Point Ln
Harbor Point
Manistee River


Conceptual Flood Mitigation Design for 5th Avenue Beach
Option #1: Construct 475 feet of 4 feet tall concrete textured wall with footing for a sand & wave barrier
Option #1: Flood proof sidewalk by installing stoplogs into concrete wall
Construct 375 feet of 4 feet tall concrete textured wall with footing for sand barrier
Option #3: Construct storm pump station with 275 feet of storm outlet pipe
Option #2: Install 275 feet of 12" storm sewer to provide secondary outlet
Option #2 & 3: Seawall penetration for storm sewer outlet
5th Ave
N Lakeshore Dr
4th Ave
Harbor Point Ln
Manistee River

ENGINEER'S ESTIMATE OF COST
5TH AVENUE FLOOD MITIGATION
CITY OF MANISTEE
MANISTEE COUNTY

Item No.	Estimated Quantity	Unit	Description	Unit Price	Amount
Option #1 (Only wall)					
1.	1	Lsum	Mobilization, Option #1	$8,000.00	$8,000.00
2.	850	Ft	2-foot wide, 6-inch thick, concrete footing	$20.00	$17,000.00
3.	850	Ft	4-foot tall, 6-inch thick, textured concrete wall	$80.00	$68,000.00
4.	200	Cyd	Excavation and handling for wall	$15.00	$3,000.00
5.	450	Sft	Sidewalk, Conc, 6-inch & Floodproofing wall with stop logs	$12.00	$5,400.00
6.	50	Syd	Sidewalk Removal	$12.00	$600.00
				Sub-Total Construction Cost:	$102,000.00
				Contingency (10%+/-):	$10,600.00
				Sub-Total Engineering:	$20,400.00
				Option #1 Total Project Cost:	**$133,000.00**
Option #2 (Wall & Secondary Outlet)					
7.	1	Lsum	Mobilization, Option #2	$1,800.00	$1,800.00
8.	275	Ft	12-inch Storm Sewer	$60.00	$16,500.00
9.	50	Syd	HMA surface, removal	$10.00	$500.00
10.	10	Ton	HMA	$180.00	$1,800.00
11.	1	Ea	Dr Structure Tap	$750.00	$750.00
12.	1	Ea	12-inch water-tight seawall penetration	$750.00	$750.00
				Sub-Total Construction Cost:	$22,100.00
				Contingency (10%+/-):	$2,500.00
				Sub-Total Engineering:	$4,400.00
				Option #2 Sub-Total Cost:	$29,000.00
				Option #2 Total Project Cost:	**$162,000.00**
Option #3 (Wall & Storm pump station)					
13.	1	Lsum	Mobilization, Option #3	$9,000.00	$9,000.00
14.	250	Ft	Storm Sewer Pressure Main Discharge Pipe	$80.00	$20,000.00
15.	25	Ft	12-inch Storm Sewer	$60.00	$1,500.00
16.	50	Syd	HMA surface, removal	$10.00	$500.00
17.	10	Ton	HMA	$180.00	$1,800.00
18.	1	Lsum	Electrical	$7,500.00	$7,500.00
19.	1	Ea	Storm Pump Station, Floats, Pump	$50,000.00	$50,000.00
20.	1	Ea	Dr Structure Tap	$750.00	$750.00
21.	1	Ea	12-inch water-tight seawall penetration	$750.00	$750.00
				Sub-Total Construction Cost:	$91,800.00
				Contingency (10%+/-):	$9,800.00
				Sub-Total Engineering:	$18,400.00
				Option #3 Sub-Total Cost:	$120,000.00
				Option #3 Total Project Cost:	**$253,000.00**

December 15, 2022

(*PRICES REFLECT CURRENT PRICING IN DEC 2022)


UNITED STATES
COAST GUARD


ST GUARD


Clean Water Recovery Facility
(Roughly 1,023 feet of shoreline)
9th St
1,023.01 ft
9th St
Conceptual Green Engineering Design
(Typical Cross-Section)
Plantings on bank and on
Coir Logs above Toe-Stone
and Minor Rock Reventment
High Water Level
Mean Water Level

ENGINEER'S ESTIMATE OF COST

CLEAN WATER RECOVERY FACILITY SHORELINE PROTECTION

CITY OF MANISTEE

MANISTEE COUNTY

Item No.	Estimated Quantity	Unit	Description	Unit Price	Amount
1.	1	Lsum	Mobilization	$35,000.00	$35,000.00
2.	1023	Lft	Toe Stone (2-3 Ton)	$150.00	$153,450.00
3.	1023	Lft	Heavy RipRap (18-36 Inch Diameter Stone)	$100.00	$102,300.00
4.	1023	Lft	Bioengineering/ Coir Logs	$50.00	$51,150.00
5.	0.3	Acres	Native vegetation plantings	$50,000.00	$15,000.00
6.	100	Cyd	Sand Backfill	$20.00	$2,000.00
				Sub-Total Construction Cost:	$358,900.00
				Contingency (10%+/-):	$36,000.00
				Sub-Total Engineering:	$65,100.00
				Total Project Cost:	**$460,000.00**

December 15, 2022

(*PRICES REFLECT CURRENT PRICING IN DEC 2022)

APPENDIX D: INFORMATION ON OTHER DAMS IN THE LRBOI SERVICE AREA

National Inventory of Dams Information for Kent, Lake, Mason, Muskegon, Newaygo, Oceana, Ottawa and Wexford Counties

KENT COUNTY

Dam Name	ID #	Nearest City	Owner Names	Primary Owner Type	Primary Purpose	River or Stream Name	Regulatory Agency	Year Completed	Data Last Updated	Last Inspection Date	Hazard Potential Classification	Condition Assessment	EAP Prepared	EAP Last Revision Date	Operational Status
Eastbrook Lake Level Control Structure	MI00429	Grand Rapids	Kent County Drain Commissioner	Private	Recreation	Whiskey Creek	MI DEGLE	1965	4/7/2021	3/17/2020	Low	Satisfactory	Not Required		
Wabasis Lake Level Control Structure	MI00571	Morgan Lake	Oakfield Township	Private	Recreation	Wabasis Creek	MI DEGLE	1864	4/7/2021	3/25/2020	Low	Satisfactory	Not Required		
Beckwith Dam	MI00960	Grand Rapids	Precision Properties	Private	Flood Risk Reduction	Tributary to Lamberton Creek	MI DEGLE	1999	4/7/2021	8/17/2018	Low	Satisfactory	Not Required		
Myers Lake Level Control Structure	MI00938	Rockford	Kent County Drain Commissioner	Private	Recreation	Trib to Rum Creek	None	1975	4/7/2021	12/18/2018	Low	Satisfactory	Not Required		
Westdale Family Dam	MI00665	Ada	Leonard Westdale, Jr.	Private	Recreation	Tributary to Honey Creek	None	1974	4/7/2021	8/14/1974	Low	Not Rated	Not Required		
Ada	MI00501	Ada	Thornapple Association Inc	Private	Hydroelectric	Thornapple River	FERC	1926	4/12/2023	9/11/2018	Low	Satisfactory	Yes	9/16/2022	Normal Operations
Grass Lake Level Control Structure	MI00453	Belmont	Kent County Drain Commissioner	Private	Recreation	Barkley Creek	MI DEGLE	1973	4/7/2021	8/18/2020	Significant	Satisfactory	Yes	12/31/2016	
Secluded Lake Dam	MI00792	Grand Rapids	Moseley & Willey	Private	Recreation	Tributary to Grand River	MI DEGLE	1967	4/7/2021	6/9/2017	Significant	Fair	Yes	7/15/2020	
King Milling Company Dam	MI00570	Lowell	King Milling Company	Private	Recreation	Flat River	MI DEGLE	1942	4/7/2021	7/11/2019	Significant	Satisfactory	Yes	11/27/2018	
Rockford Dam	MI00572	Rockford	City of Rockford	Local Government	Recreation	Rogue River	MI DEGLE	1888	4/7/2021	10/28/2020	Significant	Satisfactory	Yes	2/10/2016	
Grand Rapids West Side Dam	MI00508	Grand Rapids	City of Grand Rapids	Local Government	Recreation	Grand River	None	1917	4/7/2021	1/1/1901	High	Not Rated	Not Required		
Cascade	MI00502	Ada	Cascade Charter Township	Local Government	Hydroelectric	Thornapple River	FERC	1927	4/12/2023	6/29/2022	High	Satisfactory	Yes	9/16/2022	Normal Operations
Flat River Diversion Dam	MI00506S001		STS HydroPower LLC	Private	Hydroelectric	Flat River	FERC	1903	4/12/2023	6/29/2022	High	Satisfactory	Yes	1/15/2020	Normal Operations
Fallasburg Dam	MI00506	Lowell	STS HydroPower LLC	Private	Hydroelectric	Flat River	FERC	1903	4/12/2023	6/29/2022	High	Satisfactory	Yes	11/30/2022	Normal Operations
La Barge	MI00503	Alaska		Not Listed	Hydroelectric	Thornapple River	FERC	1901	4/12/2023	8/9/2022	High	Fair	Yes	1/3/2023	Under Remediation

LAKE COUNTY

Dam Name	ID #	Nearest City	Owner Names	Primary Owner Type	Primary Purpose	River or Stream Name	Regulatory Agency	Year Completed	Data Last Updated	Last Inspection Date	Hazard Potential Classification	Condition Assessment	EAP Prepared	EAP Last Revision Date	Operational Status
Olga Lake Dam	MI00190	Skookum	Huron-Manistee National Forests	Federal	Recreation	Coe Creek	MI DEGLE	1937	4/7/2021	10/7/2019	Low	Fair	Not Required		
Clear Lake Dam	MI02677	Ludington	Roger Jones	Private	Recreation	Carr Creek	MI DEGLE		4/7/2021		Low	Not Rated	Not Required		
Lake Connamara Dam	MI00445	Scottville	Alyce Roodvoets	Private	Recreation	Baker Creek	MI DEGLE	1970	4/7/2021	11/24/2020	Low	Poor	Not Required		
Danaher Lake Dam	MI00573	Scottville	P M Rod & Gun Club	Private	Recreation	Danaher Creek	MI DEGLE	1931	4/7/2021	7/11/2013	Low	Satisfactory	Not Required		
Midget Lake Dam	MI00888		Twin Lakes Property Owners Assoc.	Private	Recreation	Tributary to Stronach Creek	MI DEGLE		4/7/2021	9/25/2019	Low	Satisfactory	Not Required		
Little Widewaters Flooding Dam	MI01414	Old Grd Trail Campgr. USFS	MDNR Wildlife	State	Other	Trib to Little Manistee River	MI DEGLE	1962	4/7/2021	7/19/2019	Low	Satisfactory	Not Required		
Big Star Lake Level Control Structure	MI00957	Ludington	Lake County Road Commission	Private	Recreation	Trib to Jenks Creek		1987	4/7/2021	10/27/2020	Low	Not Rated	Not Required		
Olga Lake Dam	MI82401	BRISTOL,MI	USDA FS	Federal	Fish and Wildlife Pond	COE CREEK	US Forest Service	1937	5/17/2021	12/31/2019	Low	Not Rated	Not Required		
Baldwin Fish Hatchery Dam	MI02673		David Stevenson	Private	Recreation	Baldwin River	MI DEGLE		4/7/2021	12/23/2011	Significant	Unsatisfactory	Yes	2/25/2009	
Luther Pond Dam	MI00574	Luther	Village of Luther	Local Government	Recreation	Little Manistee River	MI DEGLE	1910	4/7/2021	3/28/2018	Significant	Satisfactory	Yes	7/13/2001	

MASON COUNTY

Dam Name	ID #	Nearest City	Owner Names	Primary Owner Type	Primary Purpose	River or Stream Name	Regulatory Agency	Year Completed	Data Last Updated	Last Inspection Date	Hazard Potential Classification	Condition Assessment	EAP Prepared	EAP Last Revision Date	Operational Status
West Shore Community College Dam	MI00473	Sugar Grove	West Shore Community College	Private	Recreation	Tr South Branch Lincoln River	MI DEGLE	1972	4/7/2021	12/15/2015	Low	Satisfactory	Not Required		
Whiskey Creek Dam #2	MI00771	Pentwater	Mark E. Todd	Private	Recreation	Whiskey Creek	MI DEGLE	1972	4/7/2021	9/20/1994	Low	Not Rated	Not Required		
Hamlin Lake Dam	MI00236	Ludington State Park	MDNR Parks & Recreation	State	Recreation	Big Sable River	MI DEGLE	1913	4/7/2021	7/19/2019	High	Satisfactory	Yes	7/9/2015	
Ludington	MI00180	Ludington	Consumers Energy Company	Public Utility	Hydroelectric	Lake Michigan	FERC	1973	4/12/2023	5/23/2022	High	Fair	Yes	12/19/2022	Under Remediation

MUSKEGON COUNTY

Dam Name	ID #	Nearest City	Owner Names	Primary Owner Type	Primary Purpose	River or Stream Name	Regulatory Agency	Year Completed	Data Last Updated	Last Inspection Date	Hazard Potential Classification	Condition Assessment	EAP Prepared	EAP Last Revision Date	Operational Status
Silver Creek Pond Dam	MI00232	Montague	Randall Scott Webster	Private	Recreation	Silver Creek	MI DEGLE	1950	4/7/2021	11/13/2002	Low	Satisfactory	Not Required		
Little Black Lake Dam	MI01687	Hoffmaster Sta	Muskegon County Drain Commissi	Local Government	Recreation	Little Black Creek	MI DEGLE	1927	4/7/2021	7/25/2017	Low	Satisfactory	Not Required		
Whitehall Millpond Dam	MI00669	None	William J. Bartholomew	Private	Recreation	Mill Pond Creek	MI DEGLE	1940	4/7/2021	9/20/2016	Low	Satisfactory	Not Required		
Cleveland Lake Dam	MI00741	Whitehall	Owasippe Scout Reservation	Private	Recreation	Cleveland Creek	MI DEGLE	1960	4/7/2021	12/7/2016	Significant	Satisfactory	Yes	1/3/2017	
Browns Pond Dam	MI00228	Montague	Blue Lake Township	Local Government	Recreation	Sand Creek	MI DEGLE	1844	4/7/2021	5/8/2015	Significant	Satisfactory	Yes	6/28/2019	
Muskegon Waste Water Lagoons	MI00613	Cloverville	Muskegon County	Local Government	Other	Black and Mosquito Creeks	MI DEGLE	1973	4/7/2021	11/8/2019	High	Satisfactory	Yes	2/8/2016	

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National Inventory of Dams Information for Kent, Lake, Mason, Muskegon, Newaygo, Oceana, Ottawa and Wexford Counties

NEWAYGO COUNTY

Dam Name	ID #	Nearest City	Owner Names	Primary Owner Type	Primary Purpose	River or Stream Name	Regulatory Agency	Year Completed	Data Last Updated	Last Inspection Date	Hazard Potential Classification	Condition Assessment	EAP Prepared	EAP Last Revision Date	Operational Status
Rowe Dam No 1	MI00234	Newaygo	Mark Coe	Private	Recreation	Penoyer Creek	MI DEGLE	1888	4/7/2021	10/26/1993	Low	Not Rated	Not Required		
Rowe Dam No 2	MI00235	Newaygo	Mark Coe	Private	Recreation	Penoyer Creek	MI DEGLE	1915	4/7/2021	7/2/1994	Low	Not Rated	Not Required		
Clayton Dam	MI00312	Woodland Park	Leonard Kurello	Private	Recreation	Michigan Creek	MI DEGLE	1955	4/7/2021	6/9/2017	Low	Fair	Not Required		
Pease Creek Dam	MI00406	Baldwin	Grass Lake Hunting Club	Private	Recreation	Pease Creek	MI DEGLE	1965	5/24/2021	8/29/2020	Low	Satisfactory	Not Required		
Peterson Dam	MI02119	Brookside	Mr. Thomas Merritt	Private	Recreation	Brooks Creek	MI DEGLE		4/7/2021	11/14/2011	Low	Fair	Not Required		
Minnie Lake Dam	MI00185	HESPERIA,MI	USDA FS	Federal	Recreation	MENA CREEK	MI DEGLE / USFS	1939	5/17/2021	11/4/2013	Low	Not Rated	Not Required		
Henkin Pond Dam	MI01759	Custer	Steve F Pagura	Private	Recreation	Tributary to Freeman Creek		1966	5/24/2021	6/5/1989	Low	Not Rated	Not Required		
Croton	MI00162	Newaygo	Consumers Energy Company	Public Utility	Hydroelectric	Muskegon River	FERC	1907	4/12/2023	6/14/2022	High	Satisfactory	Yes	12/19/2022	Normal Operations
Hardy	MI00171	Newaygo	Consumers Energy Company	Public Utility	Hydroelectric	Muskegon River	FERC	1931	4/12/2023	7/12/2022	High	Fair	Yes	12/19/2022	Under Remediation
White Cloud Dam	MI00526	White Cloud	City of White Cloud	Local Government	Recreation	White River	MI DEGLE	1872	10/4/2023	5/25/2022	High	Poor	Yes	1/24/2007	

OCEANA COUNTY

Dam Name	ID #	Nearest City	Owner Names	Primary Owner Type	Primary Purpose	River or Stream Name	Regulatory Agency	Year Completed	Data Last Updated	Last Inspection Date	Hazard Potential Classification	Condition Assessment	EAP Prepared	EAP Last Revision Date	Operational Status
Hart Lake	MI00281	Pentwater	Hart, City of	Local Government	Hydroelectric	South Branch Pentwater	FERC	1927	4/12/2023	8/16/2018	Low	Satisfactory	Yes	1/22/2020	Normal Operations
Crystal Valley Dam	MI00279	Pentwater	Oceana County	Local Government	Recreation	Crystal Creek	MI DEGLE	1937	4/7/2021	8/15/2016	Low	Fair	Not Required		
Gales Pond Dam	MI00280	Hart	Oceana County	Local Government	Recreation	Huftile Creek	MI DEGLE	1941	4/7/2021	7/25/2018	Low	Satisfactory	Not Required		
Silver Lake Level Control Structure	MI00817	None-Lake Michigan	Oceana County Drain Commissioner	Private	Recreation	Silver Creek	MI DEGLE	1995	4/7/2021	7/24/2019	Low	Not Rated	Not Required		
Hesperia Dam	MI00678	Hesperia	Village of Hesperia	Local Government	Recreation	White River	MI DEGLE	1977	4/7/2021	7/1/2017	Significant	Fair	Yes	7/15/1998	
Foster Lake Dam	MI00668	Scottville	Foster Lake, LLC	Private	Recreation	Tr-Big S Br Pere Marquette	MI DEGLE	1973	4/7/2021	5/15/2014	Significant	Satisfactory	Dam Name	5/17/2010	
Upper Silver Lake Dam	MI00016	Silver Lake Village	Upper Silver Lake Improvement Assoc	Private	Recreation	Au Sable Creek	MI DEGLE	1964	4/7/2021	11/23/2019	High	Satisfactory	Yes	8/1/2009	
Holiday Lake Dam	MI00436	Silver Lake	Multiple	Private	Recreation	Golden Creek	MI DEGLE	1971	4/7/2021	9/20/2019	High	Satisfactory	Yes	3/1/2010	

OTTAWA COUNTY

Dam Name	ID #	Nearest City	Owner Names	Primary Owner Type	Primary Purpose	River or Stream Name	Regulatory Agency	Year Completed	Data Last Updated	Last Inspection Date	Hazard Potential Classification	Condition Assessment	EAP Prepared	EAP Last Revision Date	Operational Status
Timmer Dam	MI02577	Zeeland	Ottawa Co DC/Clifford J. VanPutten	Private	Flood Risk Reduction	Tributary to Macatawa River	MI DEGLE	1988	4/7/2021	6/20/2015	Low	Not Rated	Not Required	1/14/2005	
Rush Creek Detention Basin Dam #2	MI00812	Hudsonville	Ottawa County Drain Commissioner	Local Government	Flood Risk Reduction	Deweerd Drain	MI DEGLE	1983	4/7/2021	11/25/2019	Low	Satisfactory	Yes	10/9/2014	
North Branch Rush Creek Retention Basin Dam	MI00704	Hudsonville	Ottawa County Drain Commissioner	Private	Flood Risk Reduction	North Branch Rush Creek	MI DEGLE	1978	4/7/2021	7/26/2016	Low	Satisfactory	Yes	1/18/2005	
Steenwyk Dam	MI01354	Holland	Ottawa County Drain Commissioner	Local Government	Flood Risk Reduction	Tributary to Macatawa River	MI DEGLE	1990	5/24/2021	11/25/2019	Low	Satisfactory	Yes	10/9/2014	
Kenowa Lake Level Control Structure	MI00727	Jenison	J. Hoogewind	Private	Recreation	Huizeinga Dr trib to Rush Cr	MI DEGLE	1975	4/7/2021	4/23/2018	Low	Satisfactory	Not Required		
Rushmore Lake Level Control Structure	MI00945	Hudsonville	Ottawa County Drain Commissioner	Private	Recreation	Rushmore Creek	None	1975	4/7/2021	12/11/2018	Low	Satisfactory	Not Required		
Beren's Dam	MI01353	Holland	Ottawa County Drain Commissioner	Private	Flood Risk Reduction	Black Creek	MI DEGLE	1993	5/24/2021	11/25/2019	Significant	Satisfactory	Yes	6/11/2002	
Buttermilk Creek Detention Dam	MI04010		Ottawa County WRC	Private	Flood Risk Reduction	Buttermilk Creek	MI DEGLE	2000	10/4/2023	4/27/2023	High	Satisfactory	Yes	7/17/2018	

WEXFORD COUNTY

Dam Name	ID #	Nearest City	Owner Names	Primary Owner Type	Primary Purpose	River or Stream Name	Regulatory Agency	Year Completed	Data Last Updated	Last Inspection Date	Hazard Potential Classification	Condition Assessment	EAP Prepared	EAP Last Revision Date	Operational Status
Norman Smith Dam	MI00742	Skokum	SAKK Investments LLC	Private	Recreation	Tributary to Spaulding Creek	MI DEGLE	1974	4/7/2021	10/21/2011	Low	Satisfactory	Not Required		
White Lake Dam	MI00479	Mesick	Ronald White	Private	Recreation	Tributary to Adams Creek	MI DEGLE	1973	4/7/2021	8/29/2016	Low	Satisfactory	Not Required		
Brandy Brook Dam	MI00154	Cadillac	USDA FS	Federal	Fish and Wildlife Pond	BRANDY CREEK	MI DEGLE / USFS	1964	5/17/2021	10/7/2019	Low	Not Rated	Not Required		
Kerr Upper Dam	MI01907	Sherman	Marlin Kerr	Private		Tributary to Manistee River			4/7/2021	8/24/1977	Low	Not Rated	Not Required		
Archie Castle's Dam	MI02492	Cadillac	Mark Platz	Private	Recreation	Tributary to Brandy Creek		1963	5/24/2021	1/1/1901	Low	Not Rated	Not Required		
Manton Millpond Dam	MI00596	Sherman	City of Manton	Local Government	Recreation	Manton Creek		1919	4/7/2021	9/16/2011	Low	Not Rated	Not Required		
Wheeler Creek Dam	MI00419	Sherman	Lake Gitchegumee Property Own Assn	Private	Recreation	Wheeler Creek	MI DEGLE	1965	4/7/2021	5/30/2018	Significant	Satisfactory	Yes	8/8/2018	
Lake Billings Dam	MI00400	Manton	City of Manton	Local Government	Recreation	Manton Creek	MI DEGLE	1919	4/7/2021	6/21/2017	Significant	Satisfactory	Yes	2/24/2009	
Hodenpyl	MI00174	Manistee	Consumers Energy Company	Public Utility	Hydroelectric	Manistee River	FERC	1925	4/12/2023	7/13/2022	High	Fair	Yes	12/19/2022	Under Remediation

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APPENDIX E: CONSIDERATION OF ALTERNATIVE MITIGATION STRATEGIES

Hazard Mitigation Alternatives Considered for the LRBOI Tribe

A check mark indicates it was included in the list of mitigation strategies.

Sources of alternatives: Michigan State Police's *2019 Michigan Hazard Analysis* and *Hazard Analysis Supplement*

Hazard Mitigation Alternatives for General Thunderstorm Hazards, Hail, and/or Lightning	
✓	Increased coverage and use of NOAA Weather Radio, and public early warning systems and networks.
✓	Buried/protected power and utility lines. (NOTE: Where appropriate: Burial may sometimes cause additional problems and costs in cases where eventual cable breakages are harder to locate and more expensive to repair.)
✓	Tree trimming and maintenance to prevent limb breakage and safeguard nearby utility lines. (Ideal: Establishment of a community forestry program with a main goal of creating and maintaining a disaster-resistant landscape in public rights-of-way.)
	Using structural bracing, window shutters, laminated glass in window panes, and impact-resistant roof shingles to minimize damage to public and private structures.
	Moving vehicles into garages or other covered areas.
	Installing lightning protection devices on the community's communications infrastructure and critical structures. More widespread use of lightning protection devices might also occur.
	Purchase of insurance that includes coverage for hail damage.
	Using surge protectors on critical electronic equipment.

Hazard Mitigation Alternatives for Tornadoes and Severe Winds	
✓	Increased coverage and use of NOAA Weather Radio, or comparable device-based notifications.
✓	Public early warning systems and networks.
✓	Tree trimming and maintenance to prevent limb breakage and safeguard nearby utility lines. (Ideal: Establishment of a community forestry program with a main goal of creating and maintaining a disaster-resistant landscape in public rights-of-way.)
✓	Buried/protected power and utility lines. (NOTE: Where appropriate. Burial may cause additional problems and costs when breakage or malfunction occurs, due to the increased difficulty in locating and repairing the problem.)
	Using appropriate wind engineering measures and construction techniques (e.g. structural bracing, straps and clips, anchor bolts, laminated or impact-resistant glass, reinforced entry and garage doors, window shutters, waterproof adhesive sealing strips, and interlocking roof shingles) to strengthen public and private structures against severe wind damage.
✓	Proper anchoring of manufactured homes and exterior structures such as carports and porches.
✓	Securing loose materials, yard, and patio items indoors, or where winds cannot blow them about. *(Advice to be provided in public outreach/education efforts).*
✓	Construction of concrete safe rooms in homes and shelter areas in mobile home parks, fairgrounds, shopping malls, or other vulnerable public areas or event locations.

Hazard Mitigation Alternatives for the Extreme Temperatures Hazard	
✓	Organizing outreach to vulnerable populations during periods of extreme temperatures, including establishing and building awareness of accessible heating and/or cooling centers in the community, and other public information campaigns about this hazard.
✓	Increased coverage and use of NOAA Weather Radio.
✓	Provide and publicize designated heating and cooling centers within the community, where persons in need may go to obtain relief from outdoor temperatures.

Hazard Mitigation Alternatives Considered for the LRBOI Tribe

A check mark indicates it was included in the list of mitigation strategies.

Sources of alternatives: Michigan State Police's *2019 Michigan Hazard Analysis* and *Hazard Analysis Supplement*

	Hazard Mitigation Alternatives for Winter Weather Hazards (Includes snowstorms, ice & sleet storms)
✓	Increased coverage and use of NOAA Weather Radio.
✓	Tree trimming and maintenance to prevent limb breakage and safeguard nearby utility lines. (Ideal: Establishment of a community forestry program with a main goal of creating and maintaining a disaster-resistant landscape in public rights-of-way.)
✓	Buried/protected power and utility lines. (NOTE: Where appropriate. Burial may cause additional problems and costs in case of breakage, due to the increased difficulty in locating and repairing the problem.)
✓	Establishing heating centers/shelters for vulnerable populations.
✓	Home and public building design and maintenance to prevent roof and wall damage from "ice dams" *(Advice to be provided in public outreach/education efforts).*
✓	Proper building/site design and code enforcement relating to snow loads, roof slope, snow removal and storage, etc.
	Agricultural activities to reduce impacts on crops and livestock.
	Pre-arranging for shelters for stranded motorists/travelers, and others.
	Using snow fences or "living snow fences" (rows of trees or vegetation) to limit blowing and drifting of snow over critical roadway segments.

	Hazard Mitigation Alternatives for Fluvial (Riverine) Flooding
✓	Floodplain management–planning acceptable uses for areas prone to flooding (through comprehensive planning, code enforcement, zoning, open space requirements, subdivision regulations, land use and capital improvements planning) and involving drain commissioners, hydrologic studies, etc. in these analyses and decisions.
	Acceptable land use densities, coverage and planning for particular soil types and topography (decreasing amount of impermeable ground coverage in upland and drainage areas, zoning and open space requirements suited to the capacity of soils and drainage systems to absorb rainwater runoff, appropriate land use and capital improvements planning) and involving drain commissioners, hydrologic studies, etc. in these analyses and decisions.
	Dry floodproofing of structures within known flood areas (strengthening walls, sealing openings, use of waterproof compounds or plastic sheeting on walls).
	Wet floodproofing of structures (controlled flooding of structures to balance water forces and discourage structural collapse during floods).
	Elevation of flood-prone structures above the 100-year flood level.
	Purchase or transfer of development rights - to discourage development in floodplain areas.
	"Floating" architectural designs for structures in flood-prone areas.
✓	Construction of elevated or alternative roads that are unaffected by flooding, or making roads more flood-resistant through better drainage and/or stabilization/armoring of vulnerable shoulders and embankments.
	Government acquisition, relocation, or condemnation of structures within floodplain or floodway areas.
✓	Employing techniques of erosion control within the watershed area (proper bank stabilization, techniques such as planting of vegetation on slopes, creation of terraces on hillsides, use of riprap boulders and geotextile fabric, etc.).
✓	Protection (or restoration) of wetlands and natural water retention areas.
✓	Higher engineering standards for drain and sewer capacity, or the expansion of infrastructure to higher capacity.
✓	Joining the National Flood Insurance Program (NFIP).
	Obtaining flood insurance. (Requires community participation in the NFIP.)
	Participation in the Community Rating System (CRS).

Hazard Mitigation Alternatives Considered for the LRBOI Tribe

A check mark indicates it was included in the list of mitigation strategies.

Sources of alternatives: Michigan State Police's *2019 Michigan Hazard Analysis* and *Hazard Analysis Supplement*

Hazard Mitigation Alternatives for Urban Flooding	
✓	Stormwater management–Adequate design, installation, maintenance, and monitoring of municipal storm sewer systems. Ordinances or amendments to assist in stormwater management (e.g. forbidding illicit discharges). Planning for and regulating areas prone to flooding (acceptable uses and development restrictions through comprehensive planning, code enforcement, zoning, open space requirements, subdivision regulations, purchased or transferred development rights, land use and capital improvements planning) and involving drain commissioners, hydrologic studies, etc. in these analyses and decisions.
	Homeowner's and rental insurance that includes coverage of damages and cleanup of sewer backflow impacts.
	Structural projects to channel water away from people and property (dikes, levees, floodwalls) or to increase drainage or absorption capacities (spillways, water detention and retention basins, relief drains, drain widening/dredging or rerouting, debris detention basins, logjam and debris removal, extra culverts, bridge modification, flood gates and pumps, wetlands protection and restoration).
✓	Higher engineering standards for drain and sewer capacity, or the expansion of infrastructure to higher capacity.
	Drainage easements (allowing the planned and regulated public use of privately owned land for temporary water retention and drainage).
	Installing (or re-routing or increasing the capacity of) storm drainage systems, including the separation of storm and sanitary sewage systems.
✓	Farmland and open space preservation.
	Elevating mechanical and utility devices above expected flood levels.
	Flood warning systems and the monitoring of water levels with stream gauges and trained monitors.
✓	Increased coverage and use of NOAA Weather Radio.
	Anchoring of manufactured homes to a permanent foundation in flood areas, but preferably these structures would be readily movable if necessary or else permanently relocated outside of flood-prone areas and erosion areas.
	Control and securing of debris, yard items, or stored objects (including oil, gasoline, and propane tanks, and paint and chemical barrels) in floodplains that may be swept away, damaged, or pose a hazard when flooding occurs.
✓	Back-up generators for pumping and lift stations in sanitary sewer systems, and other measures (alarms, meters, remote controls, switchgear upgrades) to ensure clear drainage infrastructure.
	Detection and prevention/discouragement of illegal discharges into storm-water sewer systems, from home footing drains, downspouts and sump pumps.
✓	Increasing the function and capacity of sewage lift stations and treatment plants (installation, expansion, and maintenance), including possible separation of combined storm/sanitary sewer systems, if appropriate.
✓	Wetlands protection regulations and policies.
	Use of check valves, sump pumps and backflow preventers in homes and buildings.
	Acceptable land use densities, coverage and planning for particular soil types and topography (decreasing amount of impermeable ground coverage in upland and drainage areas, zoning and open space requirements suited to the capacity of soils and drainage systems to absorb rainwater runoff, appropriate land use and capital improvements planning) and involving drain commissioners, hydrologic studies, etc. in these analyses and decisions.
✓	Employing techniques of erosion control within the watershed area (proper bank stabilization, techniques such as planting of vegetation on slopes, creation of terraces on hillsides, use of riprap boulders and geotextile fabric, etc.).
✓	Protection (or restoration) of wetlands and natural water retention areas.
	Landslide mitigation ideas: Do not build houses, buildings, parks, or playgrounds close to steep slopes; install flexible pipe fittings to avoid gas and water line breakage.

Hazard Mitigation Alternatives Considered for the LRBOI Tribe

A check mark indicates it was included in the list of mitigation strategies.

Sources of alternatives: Michigan State Police's *2019 Michigan Hazard Analysis* and *Hazard Analysis Supplement*

Hazard Mitigation Alternatives for Dam Failures	
✓	Regular inspection and maintenance of dams.
	Garnering community support for a funding mechanism to assist dam owners in the removal or repair of dams in disrepair.
	Regulate development in the dam's hydraulic shadow (where flooding would occur if a severe dam failure occurred).
	Ensuring that dams meet or exceed the design criteria required by law.
✓	Public warning systems.
	Obtaining insurance.
✓	Increased coverage and use of NOAA Weather Radio
	Increased funding for dam inspections and enforcement of the Dam Safety Program (Part 315 of the Natural Resources and Environmental Protection Act) requirements and goals.
	Constructing emergency access roads to dams, where needed.
	Pump and flood gate installation/automation.

Mitigation Alternatives for Drought Hazard	
✓	Storage of water for use in drought events (especially for human needs during periods of extreme temperatures, and for responding to structural fire and wildfire events).
✓	Legislative acts, local ordinances, and other measures to prioritize or control water use.
✓	Encouragement of water-saving measures by consumers (including landscaping, irrigation, farming, lower priority lawn maintenance, and non-essential auto washing).
✓	Anticipation of potential drought conditions, and the preparation of drought contingency plans.
	Designs, for recreational and other water-related structures and land uses, that take into account the full range of water levels (of lakes, streams, and groundwater).
	Designs and plans for water delivery systems that include a consideration of drought events.
	Obtaining agricultural insurance.

Hazard Mitigation Alternatives for Subsidence	
✓	Identifying and mapping old mining areas and geologically unstable terrain, and limiting or preventing development in high-risk areas.
	Filling or buttressing subterranean open spaces (such as abandoned mines) to discourage their collapse.
	Hydrological monitoring of groundwater levels in subsidence-prone areas.
	Insurance coverage for subsidence hazards.
	Real estate disclosure laws.

Hazard Mitigation Alternatives Considered for the LRBOI Tribe

A check mark indicates it was included in the list of mitigation strategies.
Sources of alternatives: Michigan State Police's *2019 Michigan Hazard Analysis* and *Hazard Analysis Supplement*

Hazard Mitigation Alternatives for Wildfire Hazard *(Note: Many of these actions are included in the Firewise USA public education program on wildfire preparedness)*	
✓	Proper maintenance of property in or near wildland areas (including short grass; thinned trees and removal of low-hanging branches; selection of fire-resistant vegetation; use of fire resistant roofing and building materials; use of functional shutters on windows; keeping flammables such as curtains securely away from windows or using heavy fire-resistant drapes; creating and maintaining a buffer zone (defensible space) between structures and adjacent wild lands; use of the fire department's home safety inspections; sweeping/cleaning dead or dry leaves, needles, twigs, and combustibles from roofs, decks, eaves, porches, and yards; keeping woodpiles and other combustibles away from structures; use of boxed or enclosed eaves on houses; thorough cleaning-up of spilled flammable fluids; and keeping garage areas protected from blowing embers).
✓	Safe disposal of yard and house waste rather than through open burning. *(Advice to be provided in public outreach efforts).*
	Use of fire spotters, towers, planes.
✓	Use of structural fire mitigation systems such as interior and exterior sprinklers, smoke detectors, and fire extinguishers. *(Advice to be provided in public outreach efforts).*
	Arson prevention activities, including reduction of blight (cleaning up areas of abandoned or collapsed structures, accumulated junk or debris, and lands with a history of flammable substances stored, spilled, or dumped on them).
✓	Public notification of fire weather and fire warnings.
✓	Prescribed burns and fuel management (thinning of flammable vegetation, possibly including selective logging to thin out some areas. Fuels cleared can be given away as firewood or made into wood chips for distribution.)
✓	Have adequate water supplies for emergency fire-fighting (in accordance with NFPA standards).
✓	The creation of fuel breaks (areas where the spread of wildfires will be slowed or stopped due to removal of fuels, or the use of fire-retardant materials/vegetation) in high-risk forest or other areas.
✓	Keeping roads and driveways accessible to vehicles and fire equipment–driveways should be relatively straight and flat, with at least some open spaces to turn, bridges that can support emergency vehicles, and clearance wide and high enough for two-way traffic and emergency vehicle access (spare keys to gates for properties should be provided to the local fire department, and an address should be visible from the road so homes can be located quickly). *(Advice to be provided in public outreach efforts).*
✓	Enclosing the foundations of homes and buildings rather than leaving them open with their underside exposed to blown embers or materials. *(Advice to be provided in public outreach efforts).*
✓	Safe use and maintenance/cleaning of fireplaces and chimneys (with the use of spark arresters and emphasis on proper storage of flammable items). Residents should be encouraged to inspect chimneys at least twice a year and clean them at least once a year. *(Advice to be provided in public outreach efforts).*
✓	Proper maintenance and storage of motorized equipment that could catch on fire (from blown embers, etc.) *(Advice to be provided in public outreach efforts).*
✓	Proper storage and use of flammables, including the use of flammable substances (such as when fueling machinery). Store gasoline, oily rags and other flammable materials in approved safety cans. Stack firewood at least 100 feet away and uphill from homes. *(Advice to be provided in public outreach efforts).*
	Avoid building structures on hilltop locations, where they will be at greater risk from wildfires (also, hillsides facing south or west are more vulnerable to increased dryness and heat from sun exposure).
	Use of proper setbacks from slopes (outside of the "convection cone" of intense heat which would be projected up the slope of the hill as a wildfire "climbs" it).
	Obtaining insurance.

Hazard Mitigation Alternatives Considered for the LRBOI Tribe

A check mark indicates it was included in the list of mitigation strategies.
Sources of alternatives: Michigan State Police's *2019 Michigan Hazard Analysis* and *Hazard Analysis Supplement*

Hazard Mitigation Alternatives for Invasive Species	
	Restrictions on the import and transport of species carriers.
✓	Adjustments to hunting, fishing, and other policies and regulations related to wildlife populations.
✓	Use of barriers to prevent invasive species travel.
✓	Use of competing species or other population control techniques.

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

Hazard Mitigation Alternatives for Shoreline Flooding and Erosion	
✓	Floodplain/coastal zone management – planning acceptable uses for areas prone to flooding (comprehensive planning, zoning, open space requirements, subdivision regulations, land use and capital improvements planning).
	Dry floodproofing of structures within known flood areas (strengthening walls, sealing openings, use of waterproof compounds or plastic sheeting on walls).
	Wet floodproofing of structures (controlled flooding of structures to balance water forces and discourage structural collapse during floods).
	Elevation of flood-prone structures above the 100-year flood level.
✓	Construction of elevated or alternative roads that are unaffected by flooding, or making roads more flood-resistant through better drainage and/or stabilization/armoring of vulnerable shoulders and embankments.
	Government acquisition, relocation, or condemnation of structures within floodplain or floodway areas.
✓	Employing techniques of erosion control in the area (bank stabilization, planting of vegetation on slopes, creation of terraces on hillsides).
✓	Enforcement of basic building code requirements related to flood mitigation.
✓	Joining the National Flood Insurance Program.
	Obtaining private flood insurance.
	Participate in the Community Rating System (CRS) for NFIP.
✓	Structural projects to channel water away from people and property (dikes, levees, floodwalls) or to increase drainage or absorption capacities (spillways, water detention and retention basins, relief drains, drain widening/dredging or rerouting, debris detention basins, logjam and debris removal, extra culverts, bridge modification, dike setbacks, flood gates and pumps, wetlands protection and restoration).

Hazard Mitigation Alternatives Considered for the LRBOI Tribe

A check mark indicates it was included in the list of mitigation strategies.

Sources of alternatives: Michigan State Police's *2019 Michigan Hazard Analysis* and *Hazard Analysis Supplement*

	Elevating mechanical and utility devices above expected flood levels.
✓	Flood warning systems.
	Monitoring of water levels with stream gauges and trained monitors.
	Anchoring of manufactured homes to a permanent foundation in flood areas, but preferably these structures would be permanently relocated outside of flood-prone areas and erosion areas.
✓	Control and securing of debris, yard items, or stored objects in floodplains that may be swept away, damaged, or pose a hazard when flooding occurs. *(Advice to be provided in public outreach efforts).*
✓	Increased coverage and use of NOAA Weather Radio.
✓	Locating structures and infrastructure landward of the established setbacks.

APPENDIX F: PARTICIPATION TABLE

Little River Band of Ottawa and Chippewa Indians - Hazard Mitigation Advisory Committee Participation Table

Participating Agency or Jurisdiction	Completed Survey	Meeting Attended/In Kind Labor										
		HM Project Kick-off Meeting 7/1/2021 (in-person and via Zoom)	Tribal Emergency Response Team 10/06/2021	LRBOI Enrollment Data (Emails) 10/14/2021	Tribal Emergency Response Team 11/17/2021	Tribal Emergency Response Team 02/18/22	Public Input Meeting via Zoom 5/19/22 Hazard ID (joint meeting with Manistee County)	Tribal Emergency Response Team 08/31/22	LRBOI Housing and Enrollment Data (Emails) 2/28/2022, 9/15/22	TERT meeting (via Zoom) 1/23/2023	Draft Plan Strategies Review 1/31 - 2/2/2023	Tribal Council work session (via Zoom) 4/13/2023
LRBOI Tribal Members and/or Employees	Various											
Brandy Martin, Tribal Emergency Response Team Incident Commander		X	X	X	X	X	X	X	X	X	X	X
Steve Parsons, Planning Coordinator			X		X		X	X		X		X
Bill Willis - Tribal Manager			X		X					X		
Gary DiPiazza - Tribal Council						X	X	X		X		
Julie Wolfe - Tribal Council												X
Pam Johnson - Tribal Council										X		X
Bradley R. Pringle - Tribal Council												X
Ron Wittenburg - Tribal Council Recorder												X
Lyle Dorr - Grants			X		X							
James Henderson - LRCR Safety/Risk Officer					X			X				
Robert Medacco - Public Safety					X							
Robert Robles - Public Safety					X		X					X
Gary Lewis - Utilities					X	X	X	X			X	
Jay Sam - Historic Preservation					X			X				
Allison Smart - Natural Resources Division					X							
Frank Beaver - Natural Resources Division					X					X		
Andrew-Trey Jeurnik - IT			X					X			X	
Dottie Batchelder - Family Services			X							X		
Mary Carpenter - Enrollment Coordinator (current)									X			
Jessica Wisner - Enrollment Coordinator (former)				X								
Tara Bailey - Housing			X					X				
Andrew Hurford - Gaming; Background Investigator			X					X				
Lee Ivinson - Compliance Director for Little River Casino Resort								X				
Manistee County												
Mike Machen, (Former) Emergency Mgr/911 Coordinator		X					X					
Lisa Sagala, Manistee County Administrator		X										
Mike Szokola, (former) Manistee County Planner		X										
Jeff Dontz, Manistee County BOC							X					
Pat Bak, National Weather Service							X					
Andy Bradford, TES Filer City Station Maintenance							X					
Samantha VanAelst, Reith-Riley/Interstate Asphalt							X					
Lt. Michael deCastro, Michigan State Police							X					
Brad Lasko, Manistee County Road Commission							X					
Megan Powers, American Red Cross							X					
Benzie County												
Rebecca Hubers, Emergency Manager		X										
Wexford County												
Travis Baker, Emergency Manager		X										
Mason County												
Emergency Management Coordinator	X											

APPENDIX G: MEETING AND PUBLIC INPUT DOCUMENTATION

Hazard Mitigation Plan Update Kick Off Meeting

July 1, 2021, 9:30 a.m.

Networks Northwest
600 East Front Street, Suite 205
Traverse City, MI 49686
Conference Room #2

Agenda

I. Welcome

II. Introductions

III. Roles and Responsibilities
   a. Federal Emergency Management Agency
   b. Michigan State Police
   c. Networks Northwest
   d. County and Tribal Staff
   e. Local Government Staff
   f. Local Stakeholders
   g. General Public

IV. Communication

V. The Process
   a. Phase I – Obtain Public Input
   b. Phase II – Complete Hazard Analysis
   c. Phase III – Create Action Plan
   d. Phases IV – Update Plans and Maps
   e. Phase V – Facilitate Local Adoptions

VI. Project Timeline
   a. Period of Performance Expires: December 16, 2023

VII. Next Steps

Hazard Mitigation Plan Update Kick Off Meeting

July 1, 2021, 9:30 a.m.

Networks Northwest
600 East Front Street, Suite 205
Traverse City, MI 49686
Conference Room #2

I. In-person meeting location information

The Networks Northwest main office has an attached parking garage with entrances from Front Street and Railroad Avenue. Enter the building on the second floor and access Conference Room #2 through the door on the right. The conference room is down the hall on the left, past the bathrooms.

II. Remote meeting attendance

Community Planning is inviting you to a scheduled Zoom meeting.

Topic: Hazard Mitigation Kick Off
Time: Jul 1, 2021 09:30 AM Eastern Time (US and Canada)

Join Zoom Meeting
https://us02web.zoom.us/j/2319295012

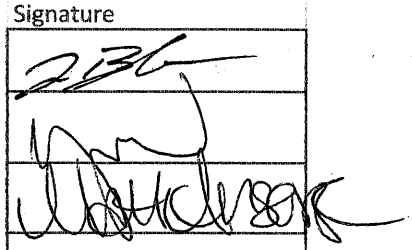
Meeting ID: 231 929 5012
One tap mobile
+16468769923,,2319295012# US (New York)
+13017158592,,2319295012# US (Washington DC)

Dial by your location
+1 646 876 9923 US (New York)
+1 301 715 8592 US (Washington DC)
+1 312 626 6799 US (Chicago)
+1 669 900 6833 US (San Jose)
+1 253 215 8782 US (Tacoma)
+1 346 248 7799 US (Houston)
Meeting ID: 231 929 5012
Find your local number: https://us02web.zoom.us/u/kbKc4W10Ib

Date: Meeting Title:

	Name	Title/ Organization	Email	Phone #	Salary Fed Funded	Miles to Mtg	Miles from Mtg
1	Travis Baker	EM Director Wexford County	tbaker@wexfordcounty.org	231-306-2130	Yes	37 47	37 47
2	Brandy Martin	Incident Commander Little River Band	brandymartin@lrboi-nsn.gov	231-398-6818	no	60	60
3	Matt Anserge	EM/911 Leelanau	manserge@leelanau.gov	231 256-8715	Yes	25	25
4	Zach Vega	comm. planner NWNW	zach.vega@networknorthwest.org	231.			
5	Rob Carson	Networks Northwest	rob.carson@networknorthwest.org	2	Yes.	45	45
6	Frank Post		Frank.Post@live.com	231-383-0558		64	64
7							
8							
9							
10							
11							
12							
13							
14							
15							

Signature



09:34:30 From Mike Sobocinski to Community Planning(Direct Message) : Mike Sobocinski, MSP/EMHSD - Position is federally funded and therefore not eligible for matching federal planning grant.
09:34:51 From Rebecca Hubers to Everyone : Rebecca Hubers - Benzie County Emergency Management / rhubers@benzieco.net / 231-882-0567
09:36:01 From PLANNING EMD to Everyone : Linda Hartshorne-Shafer, Missaukee County Planning/Emergency Management Director, planningemd@missaukee.org, 231-839-7264 Ext 3
09:36:08 From Manistee County to Community Planning(Direct Message) : Michael Machen/Deputy 911 Director/Emergency Manager/ $59,000 mmachen@manistee911.org/231-723-9970/ Yes Federally Funded
09:37:43 From Mike Thompson to Everyone : Mike Thompson, Kalkaska County Emergency Management Coordinator, mthompson@kalso.org, 231.258.3319 ext. 2229
09:37:49 From Garrett Fairchild GTB Fire Dept to Everyone : Garrett Fairchild / GTB Fire Chief / garrett.fairchild@gtbindians.com / 231-534-7161
09:40:07 From Mike Sobocinski to Community Planning(Direct Message) : Is this introduction separate from my agenda item?
09:40:40 From JAMurphy to Everyone : Jolanda Murphy, Grand Traverse Band Emergency Manager, Jolanda.murphy@gtbindians.com, 231-534-7111
09:42:22 From Becky Oien to Everyone : Rebecca Oien, Grand Traverse Band, Tribal Manager, becky.oien@gtbindians.com 231-534-7136
09:44:12 From Rebecca Hubers to Everyone : my mic must not be working
10:01:22 From Manistee County to Community Planning(Direct Message) : Lisa Sagala, Manistee County Administrator $84,,200 231-398-3501, lsagala@manisteecountymi.gov
10:02:49 From Manistee County to Community Planning(Direct Message) : Mike Szokola, Manistee County Planner, $68,500 mszokola@manisteecountymi.gov, 231-398-3527
10:10:24 From Mike Sobocinski to Everyone : FEMA Map Service Center (access to NFIP flood map information): https://msc.fema.gov/portal/home
10:11:46 From Mike Sobocinski to Everyone : FEMA has an impressive new mapping resource called the National Risk Index, providing information by county or even census tract. Risks from natural hazards, social vulnerability, etc. https://www.fema.gov/flood-maps/products-tools/national-risk-index
10:14:31 From Mike Sobocinski to Everyone : The Michigan Hazard Analysis (2019) provides an overview of natural hazards throughout Michigan. You can search the document for your county's name to find local information more quickly (Ctrl F search function)
https://www.michigan.gov/documents/msp/MHA_2019__full_update_natural_hazards_653708_7.pdf
10:38:03 From Rebecca Hubers to Everyone : I'm sorry I have to walk away now to attend another meeting - thank you

Little River Band of Ottawa Indians

Emergency Response Team

October 6, 2021

Updates

- TERT Trailer
- CERT Shed

Upcoming Projects

- Hazard Mitigation Planning
  - Networks Northwest providing an overview
  - IS 350 Mitigation Planning for Tribal Communities
  - Region 5 Mitigation for Tribal Nations Summit – Nov 16th

Training

- FEMA Resource Typing for CERT
- CPR/AED training – Nov 15th

COVID-19

Updates, Questions, Concerns – Round Table

Next Meeting – following results from Hazard Mitigation survey in November

Little River Band of Ottawa Indians

Emergency Response Team

October 6, 2021 Minutes

Meeting started – 2pm

Those in attendance – Frank Post, Jennifer Neal and Stephanie Loria from Networks Northwest, Steve Parson – Planning, Drew Jeurnik – IT, Dottie Batchelder – Family Services, Tara Bailey – Housing, Andrew Hurford – Gaming, Bill Willis – Finance, Lyle Dorr – Grants, Brandy Martin - TERT

Upcoming Projects

- Hazard Mitigation Planning
    - Networks Northwest providing an overview
        First phase – Identify hazards
        Collect information via survey monkey through October 29th
        Second Phase – Ranking hazards
        Benefits of Plan – Identifying hazards, creating a strategy to address them and being able to apply for hazard mitigation grants to address hazards.
        In Kind match requirements
        Timeline – Grant runs through December 2023

Training

- IS 350 Mitigation Planning for Tribal Communities available on EMI website
- Region 5 holding a Mitigation Tribal Nations Summit virtually on Nov 16th – Contact Nick Bruscato or Troy Christensen at FEMA to register
- FEMA Resource Typing for CERT – Classes requirements for 3 different position and by Type 1 or Type 2
- CPR/AED training – Nov 15th Class will be virtual prior to date and will be tested individually during a 2 hour window by Kyle Gunderson. I will send out the link once the requisition is completed.

Updates

- CERT shed and TERT trailer – Have located both shed and trailer to be used. Asked for funds to purchase 2 portable generators. Education may have items to outfit them with from items purchased years ago for youth camp at Indian Village.

Next Meeting – following results from Hazard Mitigation survey in November

Meeting concluded – 3pm

Little River Band of Ottawa Indians

Emergency Response Team

November 17, 2021

Updates

- Hazard Mitigation Survey Results

Upcoming Projects

Training

COVID-19

Updates, Questions, Concerns – Round Table

Next Meeting – January 2022

Little River Band of Ottawa Indians

Emergency Response Team

November 17, 2021 Minutes

Meeting started – 2pm

Those in attendance – Jennifer Neal and Stephanie Loria from Networks Northwest, Steve Parson – Planning, Bill Willis – Finance, Lyle Dorr – Grants, Brandy Martin – TERT, James Henderson – LRCR, Robert Medacco and Robert Robles – Public Safety, Gary Lewis – Utilities, Jay Sam – Historic Preservation, Allison Smart and Frank Beaver - NRD

Updates – Networks Northwest presentation of Hazard Mitigation Survey Results

Items of Discussion –

-Resend survey link

-Tribal Citizens First Policy

-Strategic Plan Outline approved in January

-Renewable Energy

-Disabilities

-Integrate Language into plan

-EDC economic drives

-137 historical sites in Manistee and Mason Co.

-Housing

-Food distribution – 14 county coverage – 60 households

-LIHEAP

-CEDED Territory – 38 Counties – 3 Great Lakes

-Public Safety – Manistee County

-No formal Zoning Ordinance – Ad hoc – Trust land only

-Look at those turning 55 in the next 2 years and following 5 years

-Invite maintenance, Manistee Co EM, Ogema and Tribal Council reps to next meeting

Next Meeting – January

Meeting concluded – 4:15 pm

Hazard Mitigation

Event - Survey findings

Date - November 17th

Name	Time in	Time Out	Mileage
✓ Brandy Martin	1:30	4:15	
✓ James Hader	1352	4 pm	
✓ Robert R Mesarco	1400	4 pm	
✓ LYLE DORR	2pm	4:15	
✓ Steve Parsons	2pm	4:15	
✓ Gary Lewis	2pm	4:15	
[illegible]	2pm	4:15	
Fedfed ✓ Allison Smart	2pm	4:15	
✓ Robert Robbs	2pm	4:15	
Bill Willis	2pm	4 pm	
Fedfed FRANK BENNER	203PM	4:15	
Jennifer Neal	1:10 pm	4:00 pm	

Little River Band of Ottawa Indians

Emergency Response Team

February ~~January~~ **18, 2022**

Updates

- Hazard Mitigation Survey Results

Upcoming Projects

Training

COVID-19

Updates, Questions, Concerns – Round Table

Next Meeting – April 2022

Little River Band of Ottawa Indians

Emergency Response Team

February ~~January~~ **18, 2022 Minutes**

Meeting started – 11:30

Those in attendance – Jennifer Neal and Stephanie Loria from Networks Northwest, Brandy Martin – TERT, Gary Lewis – Utilities, Gary DiPiazza - Council

Updates – Networks Northwest presentation of Hazard Mitigation Survey Results, Historic Weather Events, Hazard Identification

Items of Discussion –

- MTERA – 15 Tribes in Michigan/Wisconsin/Minnesota focus on Renewable Energy
- Have Lyle share renewable energy info/studies and background information
- Number of 55+ in Jan 2024 will be 1,629 and in Jan 2029 2,046
- Focus on 9 county area
- Provide Emergency Declaration for COVID
- Have Linda provide info on wells and septic application locations
- Discuss Bus tour for April meeting with Manistee Co for Dams, Forests and Wetlands
- Talk to Allison about shape files for GIS Mapping

Next Meeting – April

Meeting concluded – 2:00 pm

LRBOI ERT

Event - Hazard Mitigation Planning

Date - February 18, 2022

Name	Time in	Time Out	Mileage
Randy Martin	11 Am	2pm	
[illegible]	11:10am	noon	
Stephanie Loria	11:30AM	2pm	
Jennifer Neal	11:30AM	2pm	
Gary Lewis	12:50	2pm	

LEPC/LPT Meeting

External HazMitigation/Manistee

Mike Machen <mmachen@manistee911.org> May 3, 2022, 1:25 PM
to angelawang@packagingcorp.com, Breanna, Bret, Sheriff, cbrandt@packagingcorp.com, Frank, Fred, hdarling@manisteemi.gov

May
19
Thu

Manistee & LRB LEPC/LPT Meeting

View on Google Calendar

When Thu May 19, 2022 11am – 12pm (EDT)
Where https://us02web.zoom.us/j/86099490485
Who Michael Decastro, houset@michigan.gov, jadams@interstateasphalt.com, jcoleman, Jeff Dontz...

Yes Maybe No

More options

Agenda

Thu May 19, 2022

No earlier events

11am Manistee & LRB LEPC/LPT Meeting

No later events

This meeting will focus on our Hazard Mitigation Plan in the areas of Hazard Identification and Mapping.

Mike Machen is inviting you to a scheduled Zoom meeting.

Join Zoom Meeting
https://us02web.zoom.us/j/86099490485

Meeting ID: 860 9949 0485
One tap mobile
+13126266799,,86099490485# US (Chicago)
+19292056099,,86099490485# US (New York)

Dial by your location
- +1 312 626 6799 US (Chicago)
- +1 929 205 6099 US (New York)
- +1 301 715 8592 US (Washington DC)
- +1 346 248 7799 US (Houston)
- +1 669 900 6833 US (San Jose)
- +1 253 215 8782 US (Tacoma)

Meeting ID: 860 9949 0485
Find your local number: https://us02web.zoom.us/u/kcDWfnHB0Q

5/19/22 ZOOM Joint Meeting with Manistee County LEPC/LPT and LRBOI Tribe

Participants:

- Mike Machen, Manistee County EM /911-Director
- Jeff Dontz, Manistee County Board of Commissioners
- Joe Coleman, Administrator for Manistee County Medical Care Facility
- Pat Bak, National Weather Service – Gaylord, Warning Coordination Meteorologist
- Andy Bradford, TES Filer City Station Maintenance Supervisor
- Samantha VanAelst, Reith-Riley, Interstate Asphalt
- Megan Powers, American Red Cross
- Lt. Michael deCastro, Michigan State Police
- Brad Lasko, Manistee County Road Commission Maintenance Supervisor
- Brandy Martin, LRBOI Tribal Emergency Response Team
- Robert Robles, LRBOI Tribal Police
- Gary Lewis, LRBOI Utility Department
- Steve Parsons, LRBOI Planning Coordinator
- Gary Paul DiPiazza, LRBOI Tribal Councilor

Presenters:

- Jennifer Neal, AICP, Networks Northwest Community Planner
- Stephanie Loria, Networks Northwest Community Planner

Participants were asked to indicate their top natural hazard concerns in the chat box:

Top Natural Hazard Event	# of Responses
Winter Storms	4
Dam Failure	3
Excessive Rainfall/Flooding	2
Severe Thunderstorms	2
Coastal Erosion	1
Invasive Species/Wildlife Diseases	1

Severe Thunderstorm/Wind Storm Group Discussion

- Steve Parsons, LRBOI: Severe thunderstorms appear quickly and people are unaware of what is coming. They usually results in no severe damage or injury to people; mostly result in downed trees; damaged homes, yards and buildings. They need a better system to warn people other than relying on TV/Radio announcements. There is the potential for people to become severely injured and they need a better way to forewarn people of severe storms. Also, once the storm comes through, their tribal community needs a better mechanism to access resources for recovery and cleanup. They have the sense that there is no “fallback” mechanism to rely on for this.
- Brandy Martin, LRBOI: the LRBOI sends severe weather notifications out only to their employees, but not to tribal members because they are so geographically spread out. So tribal members have to rely on news sources for weather alerts.
- Gary Lewis, LRBOI: his concern from the utility management side is power outages from thunderstorms. They have some backup generators at certain utility locations. But they have had to deal with lightning strikes on some of their utility system’s electrical components; have had repair and put surge protectors on certain ones.

Severe Winter Weather Group Discussion

- Joe Coleman, Manistee Medical Care Facility: anything like a once-in-a-decade major winter storm would affect the ability of staff to drive to their jobs at the facility. Results in staffing issues if roads are not cleared.
- Brandy Martin, LRBOI: They have a heat/cooling center available for residents downhill from the Aqi housing complex, but they would need protocols/facilities/equipment to also deal with power outages for residents.
- Jeff Dontz – power outages often occur in areas where the lines are aging and/or tree trimming along the lines has been neglected. There are several areas in Manistee Twp. like this.
- The definition of winter storm events seems to have changed over the years. For example, the blizzards of the late 1970's/early 1980's seem to be a rarity nowadays. It appears that the media, particularly social media, report most weather events as severe even if they are not. Social media has diluted the definitions provided by the NWS. But, perhaps this is a result of the news media wanting to make sure people are well prepared for any scenario.
- Megan Powers – the American Red Cross (ARC) receives residential calls for assistance in severe weather events. They do provide assistance for anyone who needs power to run medical devices in their home. She has noticed that many people are buying perishable goods instead of canned goods in grocery stores, and when the power goes out, they lose most of their food supply. The ARC does provide informational brochures, etc. on how to prepare emergency kits with the appropriate supplies. However, during an ice storm, they cannot respond/travel to help people until the roads are cleared.
- Pat Bak – The NWS has specific criteria for defining each type of severe weather event. For example, a blizzard is defined by winds over 35 mph, and blowing and drifting snow lasting for at least 3 hours. A blizzard is not the same as a heavy snowstorm. The NWS emails out to county/local agencies, EMS/1st responders, etc. alerts for severe weather. Also, even though it is considered a low tech option, the NOAA Weather Radios can be quite effective as a warning system. They are loud and can wake people up at night with a warning.

Extreme Heat and Drought – no discussion

Vulnerable Populations Group Discussion

- Some local residential renters have to move out of rental homes in the summer, due to the demand for short-term rental properties in the summer. Those year-round renters are often living out of campers, on campsites, etc. during that time and therefore are more exposed to severe weather events.
- Those living, vacationing or recreating in the wilderness areas often have no nearby emergency services in a severe weather event.

Invasive Species Group Discussion

- Gary Paul DiPiazza, LRBOI – he serves on the tribe's Natural Resource Commission. They have concerns about diseases with the deer population, zebra/quagga mussels, round gobi, Asian carp (when they arrive) and the Autumn olive shrub (they have tried pulling some of it). Their tribe values hunting & gathering activities and many invasive species would negatively impact this.

Pandemic Group Discussion

- The County's 911 Center received fewer calls during the pandemic and their workload actually went down because of this. People did not want to go to the hospital due to fears of COVID exposure. The calls they did get were often of true emergency situations where someone was very sick or injured and needed immediate medical care.
- The 911 Dispatch crew had to change the questions they asked when taking a call in order to obtain and relay information about COVID symptoms/exposure before lending in the first responder team.
- The EMS staff was down due to COVID exposures, quarantine timing guidelines and less interest in the workforce for this sector.
- It was difficult/frustrating to relay the constantly changing COVID procedures and guidelines provided by the State of Michigan. The guidelines seemed to be more politically driven than science-based. Also, the procedures did not account for the different types of impact on rural areas vs. urban areas.
- Some of the rules/guidelines seemed to be extreme and not based on scientific evidence. For example, having to fire health care workers who did not get vaccinated. Then they found out that workers who did get vaccinated still got COVID and could spread it. The effects on fewer staff available in the health industry and just about every other industry have not lessened and we are still not at recovered employment levels.
- The overall message of what to do to be safe (quarantine guidelines) could have been changed based on new scientific evidence.
- Vaccination clinics provided by the local Health Department were very efficient and went well. They efficiently completed vaccinations for the County Medical Care Facility after their original arrangement for vaccinations with commercial pharmacies fell through.

Mapping Exercise/Discussion: Coastal Hazards, Inland Flooding, and Wildfire

Coastal Hazards

- In 2019, before the pandemic, coastal erosion/flooding issues was the primary concern in Manistee County. On a positive note, EGLE has streamlined the process for shoreline permits in high risk erosion areas.
- FEMA Flood Zone Map changes – an issue to get the flood zone designation changed or removed on a property title when transferring ownership.
- The entire Lake MI coastline has erosion/flooding issues, particularly around Portage Lake/Portage Point/Manistee Lake.
- Sheriff's Dept. took photos of the entire coastline during high lake levels.
- When heavy rainfall events occur, there is often a sewage overflow in the City of Manistee. There is a corrective action being completed now.
- The Manistee River channel experiences a lot of damage to boat docks, launches, and the Riverwalk during high lake levels combined with a seiche event (2018 or 2019?)
- Some people with flood insurance were not covered during coastal erosion events because the event was categorized as erosion, not flooding.

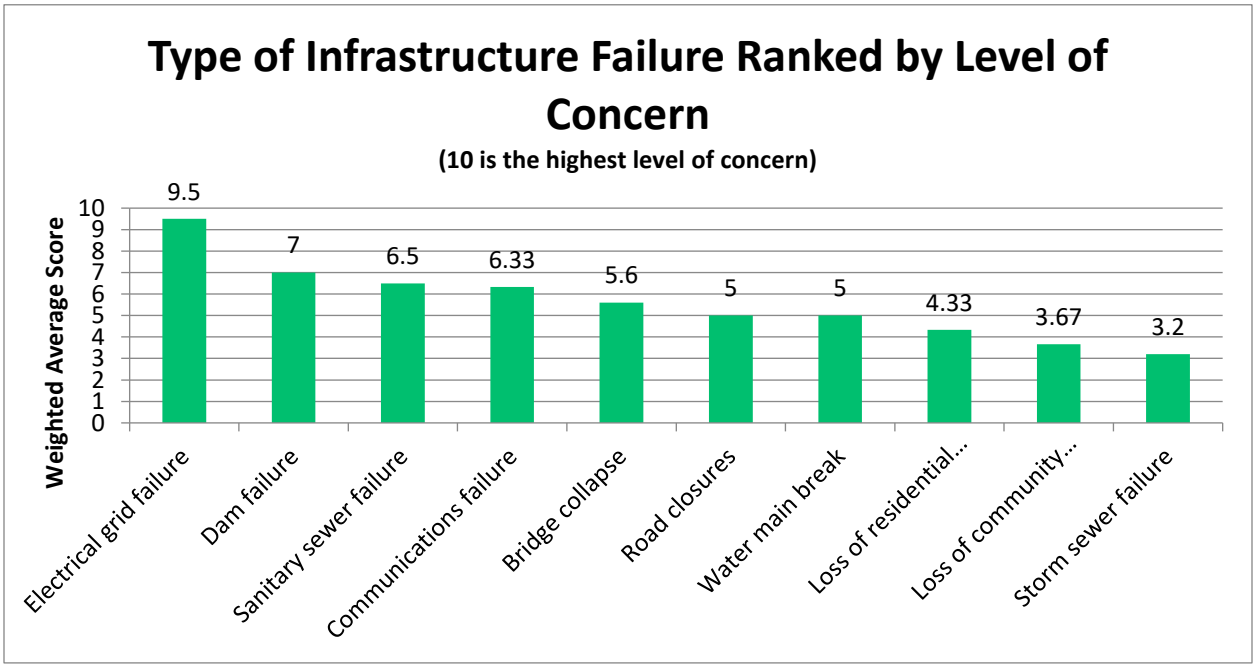
Inland Flooding – no discussion.

Wildfire

- The area in the community of Dublin (100-150 people) in the southeast area of the county (Norman Twp.) experienced a wildfire in 2021 that burned about 1,000 acres. There is a concern with one neighborhood in particular where James Street is the only access in and out. The area is surrounded by forest which tends to be very dry. The Norman Fire Chief held a community meeting in Dublin

sometime in March or April of 2022 to provide information on fire prevention in the neighborhood. They distributed information on CODE RED; will start to do neighborhood cleanups to get rid of brush… The Fire Chief said it was a good turnout.

- This year the USFS has been active in working on fire mitigation plans in the county; Mike Machen has heard from Ben Wagner, Manistee Zone Fire Officer.



Survey respondents (5 out of 6) respondents:

- Manistee County Emergency Mgmt.
- Manistee and Onekama Twp.
- Manistee County
- Manistee Township
- LRBOI

Zoom Meeting Chat Box 05/19/22

11:06:31 From Andy Bradford to Everyone:
Andy Bradford
11:06:39 From Brandy Martin to Everyone: Brandy Martin LRBOI

11:07:02 From Lt. deCadtro to Everyone:
Lt. Michael deCastro. Yes I'm federally funded.
11:07:09 From Gary Lewis to Everyone:
Gary Leiws, LBOI, Utility Dept. not Federally funded
11:07:10 From Andy Bradford to Everyone:
Andy Bradford TES Filer City Station Maintenance Supervisor, not Federally funded
11:07:12 From Manistee County Road Commission - Brad Lakso to Everyone:
brad
11:07:13 From Gary Paul DiPiazza to Everyone:
Gary Paul DiPiazza LRBOI Tribal Councilor
11:07:15 From Joe Coleman to Everyone:
Joe Coleman, Administrator, Manistee County Medical Care Facility My position is not federally funded.
11:07:16 From Robert Robles to Everyone:
Sgt Robert Robles LRBOI Public Safety
11:07:18 From Jeffrey Dontz to Everyone:
Jeffrey Dontz
Not Federally funded
Manistee County Board of Commissioner's
11:07:29 From Pat Bak - NWS Gaylord to Everyone:
Pat Bak, Warning Coordination Meteorologist, National Weather Service, Gaylord. Federal employee
11:07:40 From Steve Parsons to Everyone:
Steve Parsons, Planning Coordinator, Little River Band of Ottawa Indians. My position is funded by tribal revenues and is not federally funded.
11:08:22 From Andy Bradford to Everyone:
Excessive Rainfall / flooding
11:08:25 From Brandy Martin to Everyone:
winter weather
11:08:27 From Mike Machen to Everyone:
Dam Failure
11:08:35 From Joe Coleman to Everyone:
Winter storm (staffing)
11:08:40 From Jeffrey Dontz to Everyone:
Coastal Erosion
11:08:50 From Manistee County Road Commission - Brad Lakso to Everyone:
Brad Lakso, Manistee County Road Commission
11:08:55 From Steve Parsons to Everyone:
Steve Parsons:: Severe Thunderstorms and Winter storms.
11:08:59 From Robert Robles to Everyone:
Dam failure
11:09:18 From Gary Lewis to Everyone:
Storm Damages, Dam Failure, Energy Resiliency
11:10:56 From Manistee County Road Commission - Brad Lakso to Everyone:
Winter weather, flooding affecting structures - roads and bridges
11:11:03 From Gary Paul DiPiazza to Everyone:
Invasive Species, Wildlife Diseases
11:36:33 From Samantha VanAelst to Everyone:
Samantha VanAelst Rieth-Riley, Interstate Asphalt
11:39:49 From Joe Coleman to Everyone:
It seems every storm has a name now.
11:42:04 From Pat Bak - NWS Gaylord to Everyone:
pat.bak@noaa.gov
11:43:57 From Pat Bak - NWS Gaylord to Everyone:
The National Weather Service does not name winter storms. That is the Weather Channel doing that and others have picked up on it. Tropical Storms/Hurricanes are named when a tropical weather system reaches a specified strength.
12:29:34 From Meghan Powers to Everyone: Meghan powers Red Cross
12:30:29 From Stephanie Loria_Networks NW to Everyone: https://www.surveymonkey.com/r/MVKQ38M

Little River Band of Ottawa Indians

Emergency Response Team

August 31, 2022

Updates

- Draft Hazard Mitigation Plan

Upcoming Projects

Training

COVID-19

Updates, Questions, Concerns – Round Table

Next Meeting –

Little River Band of Ottawa Indians

Emergency Response Team

January 27, 2023

Updates

- Draft Hazard Mitigation Plan
- Strategies
- Goals and objectives

Upcoming Projects

Training

COVID-19

Updates, Questions, Concerns – Round Table

Next Meeting –

Little River Band of Ottawa Indians

Emergency Response Team

April 13, 2023

Updates

- **Work session with council to review-**
- Draft Hazard Mitigation Plan
- Strategies
- Goals and objectives

Upcoming Projects

Training

COVID-19

Updates, Questions, Concerns – Round Table

Next Meeting –

Little River Band of Ottawa Indians

TRIBAL COUNCIL
WORK SESSION REQUEST

A. Work Session Topic/Title: Hazard Mitigation Plan

Requested by: Brandy Martin Lead: Brandy Martin Dept Director

Who Should Attend? 1. Bill Willis 4. Frank Beaver
(Apart from Council) 2. Gary Lewis 5. Bobby Robles
3. Robert Medacco 6. Networks Northwest-Community Planners

When would you like to meet? Alternative: April 13th 3-5pm

How much time is needed? 2 hrs

B. Reason for Work Session (be as specific as possible): This portion must be completed.
1. Review the Hazard Mitigation plan for any input before it goes out for community engagement. These steps are required before submitting it to FEMA.

C. Recommendation/Proposal and justification/intent: (Must have at least one, will not be accepted if this is blank – attach additional documentation if necessary.)
1. Review and make necessary changes before community engagement.

Tribal Ogema Signature — Date: 2-22-2023
*required if request is being made by executive employee

Tribal Council Recorder Signature — Date

Tribal Council Executive Assistant Signature — Date

Disclaimer: If you fail to appear at the scheduled work session it will be cancelled.

D. **Date & time meeting scheduled:** _____
Note: It is the responsibility of the individual requesting the Work Session to notify and work out any potential scheduling conflicts with any participants, apart from Council, being requested to attend.

If not attached, all supporting documents and materials are due to Tribal Council 48 hours prior to the Work Session. Due on: _____

Networks Northwest
Talent / Business / Community

Stephanie Marchbanks <stephanie.marchbanks@networksnorthwest.org>

FEMA Hazard Mitigation Plan

1 message

Brandy Martin <brandymartin@lrboi-nsn.gov> Thu, Nov 9, 2023 at 1:29 PM
To: ALL LRBOI <ALLLRBOI@lrboi-nsn.gov>
Cc: Alvin Rischel <arischel@manistee911.org>, Rebecca Hubers <rhubers@benzieco.net>, "Fairchild, Garrett" <Garrett.Fairchild@gtb-nsn.gov>, "David W. Thom Jr." <DWThom@ltbbodawa-nsn.gov>, Stephanie Marchbanks <stephanie.marchbanks@networksnorthwest.org>, Josh Glass <jglass@manisteemi.gov>

Good afternoon,

The link to the FEMA Hazard Mitigation Plan for Little River Band of Ottawa Indians is available on the Tribes website and attached below. I am seeking public comment through November 30th before the plan goes to FEMA for review. Please send your comments to me at brandymartin@lrboi-nsn.gov.

https://lrboi-nsn.gov/government/executive-branch-tribal-ogema/ogema-larry-romanelli/

Respectfully,

Brandy Martin

Little River Band of Ottawa Indians

Tribal Emergency Response Team

Incident Commander

231-398-6818

LITTLE RIVER BAND OF OTTAWA INDIANS
TRIBAL COUNCIL
REGULAR MEETING
WEDNESDAY, NOVEMBER 15, 2023 at 10:00 a.m.
Little River Band Government Center
VIA ZOOM & LODGE
AGENDA

This agenda is subject to adoption or amendment by vote of the Tribal Council

Join Zoom Meeting
https://zoom.us/j/99705796129?pwd=OWY5SVVnUis4Y0d1aGdqMXBjRjdxZz09

Meeting ID: 997 0579 6129
Passcode: 1836

Call in numbers
1 929 436 2866 Meeting ID 99705796129 # CODE 1836 #
1 301 715 8592 Meeting ID 99705796129 # CODE 1836 #

I. Opening Prayer

II. General Business
- **A. Call to Order** — **T. Burmeister**
- **B. Roll Call** — **P. Johnson**
- **C. Approval of Agenda**
- **D. Tribal Council Minutes** ☐ **None Submitted**

III. Continuing Business
- **A. Grants & Contracts** — **Tribal Ogema**
- **B. Budget Modifications**
  - **1. Approval of Budget Modification MB-2023-__; Authorizing a modification to the Information Technology Budget in the amount of $73,668** — **Tribal Ogema**, **A. Jeurink**

    Budget modifications to a line item within a department, fund or Program Budget and modifications in excess of 10% of the total original Program Budget require Tribal Council approval.

- **C. Approval of Budgeted Expenditure**

IV. Acceptance of Reports
- **A. Report of the Tribal Ogema** — **Tribal Ogema**
  - **1. Operations Report** ☐ **None Submitted**
  - **2. Financial Report** ☐ **None Submitted**

V. Acceptance of Commission Reports
- **A. Binojeeuk Commission** ☐ **None Submitted**
- **B. Enrollment Commission** ☐ **None Submitted**

NOTE: Resolution number for the first resolution adopted for this meeting is 23-1115-191
1st supplemental appropriation 2023-09 – 4th QTR
1st budget modification MB-2023-68

C. Gaming Commission ☐ **October 2023**
D. Health Commission ☐ **None Submitted**
E. Housing Department Reports 1. ☐ **September 2023**
2. ☐ **October 2023**
F. Natural Resource Commission ☐ **None Submitted**

VI. Acceptance of Committee Minutes and Other Entities

A. Little River Casino Resort Preference Report ☐ **October 2023**
B. Biskaabiiyang Committee ☐ **None Submitted**
C. Elders Committee ☐ **None Submitted**

VII. Old Business

A. Approval of Re-appointment of Krystyne Kiogima to the Enrollment Commission — **Tribal Ogema**
Appointment to the Enrollment Commission. This item was postponed at the 11/8/23 Tribal Council Meeting.

B. Approving Withholding 6% Payment to the State of Michigan — **P. Johnson**
Payments to the State of Michigan commonly known as Payment In Lieu of Taxes. This item was postponed at the 11/8/23 Tribal Council Meeting.

VIII. New Business

A. FEMA Hazard Mitigation Seeking Public Comment — **Tribal Ogema**, **B. Martin**
Seeking Public Comment for the FEMA Hazard Mitigation Plan before sending to FEMA. The plan is on the Tribe's website for review and have asked for it to be in the newsletter. FEMA wants to see that effort was made to collect Public Comment to ensure the plan is thorough.

IX. Concluding Business

A. Next Meeting Date(s) - Wednesday, November 22, 2023
B. Legislative Affairs Update
C. Public Comment Period

The purpose of closed session is to discuss business matters considered privileged or confidential involving consideration of bids/contracts, pending legal issues, and/or personnel matters.

X. Closed Session

A. Tribal Council Closed Session Minutes ☐ None Submitted

B. Submissions for business matters that are Confidential
1. Enterprise and/or Reservation Development matters
a) 2020 Consent Decree Negotiations (Treaty Rights)

NOTE: Resolution number for the first resolution adopted for this meeting is 23-1115-191
1st supplemental appropriation 2023-09 – 4th QTR
1st budget modification MB-2023-68

2. Legal Updates

a) Delisting of the Gray Wolf
b) Line 5 Update
c) Line 5 Tunnel Update
d) Opioid Litigation Settlement
e) Maverick Gaming LLC v United States
f) Ludington Property

C. Bids & Contracts

D. Acceptance of Submission from Tribal Entities requiring action in Closed Session

1. Binojeeuk Commission Closed Session Minutes ☐ None Submitted
2. Gaming Commission Closed Session Report ☐ October 2023
3. Little River Holdings, LLC Minutes ☐ None Submitted
4. Housing Department Closed Session Reports ☐ October 2023

E. Litigation

1. Sedelmaier v LRBOI & Romanelli (Employment Matter)
2. Stone et al (Burmeister, Walter, Waitner, Ivinson, Saunders) Ogema vs Tribal Council
3. Tribal Council v Ogema, Prosecutor
4. Chapman et al (Puflett) v LRBOI Housing Department and LRBOI Housing Commission
5. Romanelli v LRBOI Tribal Council, Bordeaux, Pringle

F. Personnel

XI. Open Session

A. Items Moved from Closed to Open-Minutes and Materials shall remain Confidential

1. Binojeeuk Commission Closed Session Minutes ☐ None Submitted
2. Gaming Commission Closed Session Report ☐ October 2023
3. Little River Holdings, LLC Minutes ☐ None Submitted
4. Housing Department Closed Session Reports ☐ October 2023

XII. Adjourn

NOTE: Resolution number for the first resolution adopted for this meeting is 23-1115-191
1st supplemental appropriation 2023-09 – 4th QTR
1st budget modification MB-2023-68

Networks Northwest
Talent / Business / Community

Stephanie Marchbanks <stephanie.marchbanks@networksnorthwest.org>

FW: Hazard Mitigation Plan - Public Comment

2 messages

Brandy Martin <brandymartin@lrboi-nsn.gov> Fri, Dec 1, 2023 at 4:57 PM
To: Stephanie Marchbanks <stephanie.marchbanks@networksnorthwest.org>

Happy Friday!

This is the only public comment I got from posting the hazard mitigation plan. None of her comments really pertain to the plan, more to the process of planning.

Have a great weekend.

Brandy Martin

Staff Accountant

Little River Band of Ottawa Indians

2608 Government Center Drive

Manistee, MI 49660

Brandymartin@lrboi-nsn.gov

From: Brandy Martin
Sent: Thursday, November 30, 2023 11:40 AM
To: Sara Agosa
Subject: RE: Hazard Mitigation Plan - Public Comment

Sara,

Thank you for your comments. I appreciate you taking the time to read the plan and provided feedback. The Hazard Mitigation plans main purpose is to eliminate or reduce long term effects of natural hazards. Through the planning process we have set goals, objectives, identified strategies and priorities. Once the plan is accepted by FEMA, the Tribe will be eligible to apply for grant funding to carry out those strategies. I will do my best to answer your questions below.

1. As with any other jurisdiction, we are at the mercy of the utilities to restore service. The Tribe does have priority for power restoration with Consumers but I am not aware of any other utilities offering that service. Once services are restored, we will restore services to members.
2. Most hazard mitigation plans are developed for counties. The planning committee identified that we could reasonably be able to plan for the 9 county area. It is impossible to plan for every natural hazard for every member in every corner of the world as there is a lot of time and data put into each plan. Emergency response starts locally and escalates upward as resources are exhausted. Each member should be aware of their counties natural hazards and how they should prepare for them. If an entire community is impacted, it may take awhile for first responders to reach you. The rule of thumb is you should be able to care for you and your family for 72 hours. The Tribe has the extra advantage to care for their members during a natural disaster.
3. The poverty data was obtained from Tribal members that agreed to having their information shared. It is a small percentage of the overall membership. We did not want to violate anyone's privacy.
4. The Tribe will only fund projects that directly relate to the Tribe. The county has it's own plan and strategies. I also worked on the Manistee County plan and there is was no plans to collaborate on financing each other's strategies.
5. The acknowledgements page has the list of participants in the plan. We worked with a community planner (along with 8 other counties and GTB) to create the plan. They had a list of stakeholders that should participate. Those include local officials, utilities, public safety, NRD, historic preservation and other departments that could provide expert input on the impacts of the natural hazards identified.
6. The community survey was sent to employees because a lot of them are Tribal members and live in the area. It was the best cost saving option to get the information we needed for the plan.
7. I am unaware of and definitive plan to purchase properties. That was added to make sure that any properties we do acquire can be included in any future grant funding for mitigation projects.

Our planning process was not that different from the counties. Those who participated were the county equivalents to the Tribe. The public county commission meeting in which their plan was accepted had only community members there that had business on the agenda. Unfortunately, this is typical for most counties. Hazard mitigation is not something that people think about unless they have been impacted by an event. We are fortunate to live in an area that has minimal natural hazards. Another interesting fact is that in our area, most people are resilient and chose to care for themselves during these events. Counties are less likely to open shelters immediately because the need is just not there. They typically open one after 24 hours and they are basically used to charge cell phones. If you are at all curious about the hazard mitigation plan in your own county, I would encourage you to reach out to your county emergency manager. They are typically happy to talk about their strategies.

Once again, thank you for taking the time to read the plan and email me your questions. I appreciate your feedback.

Brandy Martin

Little River Band of Ottawa Indians

Tribal Emergency Response Team

Incident Commander

From: Sara Agosa **Sent:** Wednesday, November 29, 2023 8:27 AM **To:** Brandy Martin <brandymartin@lrboi-nsn.gov> **Subject:** Hazard Mitigation Plan - Public Comment

Brandy,

A few questions:

1) Outlying members rely on telecommunications (phone, internet) to contact the tribe for services. What is the emergency plan to maintain these services in the event of a disaster/emergency?

2) Given that Outlying members would be impacted by an emergency (such as internet went down), why demographic data is not included for Outlying members (outside of 9 County)?

3) In the plan, poverty data is included. Where has this data been obtained?

4) At the end of this plan, there are cost estimates from City of Manistee/Manistee County. How is it determined what projects the tribe finances and what is the responsibility of other local governments that have a tax base? Is there collaboration with financing these projects? In terms of the City of Manistee, what assets do we have near the lakeshore to justify financing these projects? The Budget and Appropriations Act - Purchasing and Procurement Regulations states "To promote cost-effective use of shared services, program directors may choose to enter into state and local intergovernmental agreements."

5) Who comprises the Natural Hazards Task Force and how are candidates selected (qualifications)?

6) Community Survey Results: Why the survey was distributed to employees and not tribal members? For instance, tribal members visit from all over during the Pow Wow. What happens if a tornado occurred while everyone is camping?

7) Community Profile: It states "The LRBOI continues to purchase land within these areas for historical, spiritual, environmental, economic and development purposes." Can you please provide more information of what properties fall under each category? From what I understand, the tribe has purchased quite a bit of property that is toxic (downtown Gateway Project which has procured Brownfield grants, Big Blue which is toxic, and our reservation sits on polluted land.) Also, we purchased the Racetrack, invested 30+ million dollars, and it is sitting vacant.

I would also like to provide feedback that many members feel it is pointless to submit comments when they have been given the impression the plan is already completed, and comments will be selectively incorporated. This is why it was so important to utilize all available platforms and to distribute the survey to all tribal members, at the very least, to all those who reside in Michigan and travel to the reservation when hazardous weather could occur.

-Sara Agosa

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Networks Northwest
Talent / Business / Community

Stephanie Marchbanks <stephanie.marchbanks@networksnorthwest.org>

Hazard Mitigation Plan Review

Brandy Martin <brandymartin@lrboi-nsn.gov> Tue, Feb 6, 2024 at 4:10 PM
To: "matt.groesser@kentcountymi.gov" <matt.groesser@kentcountymi.gov>, "OCEM@miottawa.org" <OCEM@miottawa.org>, "abbym@newaygocountymi.gov" <abbym@newaygocountymi.gov>, "emergencymanagement@oceana.mi.us" <emergencymanagement@oceana.mi.us>, "911director@co.lake.mi.us" <911director@co.lake.mi.us>, Randy Boike <EMD@wexfordcounty.org>, Elizabeth Reimink <emergencymanagement@masoncounty.net>
Cc: Stephanie Marchbanks <stephanie.marchbanks@networksnorthwest.org>

Good afternoon-

Little River Band of Ottawa Indians is submitting a hazard mitigation plan to FEMA. The plan is available for you to review and comments will be accepted through February 20th. The plan can be downloaded from Networks NW project webpage: https://www.networksnorthwest.org/community/natural-hazard-mitigation/little-river-band-of-ottawa-indians.html and here is a direct link: https://www.networksnorthwest.org/userfiles/filemanager/wxyf0tvj7eijjwsonwli/. Please send your comments to brandymartin@lrboi-nsn.gov.

Respectfully,

Brandy Martin

Little River Band of Ottawa Indians

Tribal Emergency Response Team

Incident Commander

231-398-6818

Networks Northwest
Talent / Business / Community

Stephanie Marchbanks <stephanie.marchbanks@networksnorthwest.org>

NFIP Data Request

Sink, James <james.sink@fema.dhs.gov> Thu, Feb 22, 2024 at 2:51 PM
To: Stephanie Marchbanks <stephanie.marchbanks@networksnorthwest.org>
Cc: "Radics, Minh-Huy (EGLE)" <RadicsM@michigan.gov>, "Killen, Brian" <brian.killen@fema.dhs.gov>, FEMA-R5-NFIP-DataRequest <fema-r5-nfip-datarequest@fema.dhs.gov>

Ok! I will work on pulling the aggregate information and get it to you by tomorrow morning!

From: Stephanie Marchbanks <stephanie.marchbanks@networksnorthwest.org>
Sent: Thursday, February 22, 2024 1:48 PM
To: Sink, James <james.sink@fema.dhs.gov>
Cc: Radics, Minh-Huy (EGLE) <RadicsM@michigan.gov>; Killen, Brian <brian.killen@fema.dhs.gov>; FEMA-R5-NFIP-DataRequest <fema-r5-nfip-datarequest@fema.dhs.gov>
Subject: Re: NFIP Data Request

Hi James,

I am only looking for aggregate data that would not include names and specific property addresses that would provide this information:

- Estimated numbers and types (residential, commercial, institution, etc.) and County; Community Name/City; Community Number; Mitigated? (y/n); and NFIP Insured? (y/n).

I am also copying Susan Conradson, Floodplain Engineer with MI EGLE for the northern counties in the lower Michigan peninsula, on this email; I emailed her earlier this week requesting the same information for other counties in the NW Lower Peninsula within her region of work, and she is out of the office until next week.

So, in sum, I am looking for information on NFIP Repetitive Loss Properties for all NFIP-participating jurisdictions within these counties:

Antrim
Benzie
Charlevoix
Emmet
Grand Traverse
Kent
Lake
Leelanau
Manistee
Mason
Muskegon
Newaygo
Oceana
Ottawa
Wexford

Do you need me to provide you with a list of each NFIP-participating community within these counties, or can you search for the information I requested based on county name?

Stephanie Marchbanks

Community Planner

Networks Northwest

Desk: 231.439.5247

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On Thu, Feb 22, 2024 at 12:18 PM Sink, James <james.sink@fema.dhs.gov> wrote:

> Good afternoon, Stephanie. Your request for NFIP data (repetitive loss properties) was forwarded to me. I am able to provide aggregate data without an Information Sharing and Access Agreement (ISAA); however, information that can be tied to a specific person or property is restricted by the Privacy Act of 1974 (as amended).
>
> If you require only aggregate data, please let me know the communities for which you are seeking information. If you require more detailed information, please complete the attached template letter, sign it, and send it to fema-r5-nfip-datarequest@fema.dhs.gov. From there, the request will be routed to FEMA headquarters for further action.
>
> Please be aware that if you are a contractor supporting the hazard mitigation planning process, contract information will be required to complete the ISAA. There is a space in the template letter to provide the required information.
>
> Should you have questions or need any assistance, please let me know.
>
> James G. Sink
>
> Regional Flood Insurance Liaison | Mitigation Division | FEMA Region 5
>
> (C) 202-285-8519
>
> james.sink@fema.dhs.gov
>
> Federal Emergency Management Agency
>
> **fema.gov**

FEMA NATIONAL FLOOD INSURANCE PROGRAM