Leelanau County Michigan

Natural Hazards Mitigation Plan

2016

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TABLE OF CONTENTS

I.	Acknowledgements	Page 4
II.	FEMA Letter of Approval	Page 5
III.	Preface	Page 7
IV.	Executive Summary Table 1: Planning Goals Table 2: Priority Areas Table 3: Mitigation Strategies	Page 8 Page 8 Page 9 Page 10
V.	Purpose of the Plan	Page 11
	Figure 1: Disaster Declarations for the State of Michigan	Page 12
VI.	Community Profile Table 4: Geographic features Table 5: Leelanau County Population by Municipality Table 6: Poverty Statistics Table 7: Economic Census	Page 13 Page 13 Page 13 Page 14 Page 14
VII.	The Development of the Plan Table 8: Critical Facilities and Infrastructure • Natural Flood Insurance Program (NFIP) Table 9: NFIP Participation Figure 2: 2012 Economic Damages for Disasters in the US • Natural Hazards Information Table 10: Flood Events Table 11: Hail Events Table 12: Extreme Winter Weather Events Table 13: Severe Thunderstorm Events Table 14: Tornado Events • Leelanau County Natural Hazards Task Force and Public Input • Natural Hazards Priority Areas • Emergency Warning System Coverage • Economic Impact Analysis Table 15: Damage Cost by Natural Hazard Table 16: Geographic Economic Value	Page 15 Page 15 Page 16 Page 16 Page 17 Page 17 Page 18 Page 18 Page 19 Page 20 Page 22 Page 23 Page 24 Page 25 Page 25 Page 25 Page 25
VIII.	Natural Hazards Mitigation Goals and Objectives	Page 26
IX.	Identification and Selection of Mitigation Strategies	Page 27
X.	Participation in the Development of the Natural Hazards Mitigation Plan Table 17: Plan Participation	Page 29 Page 30
XI.	Implementation of the Natural Hazards Mitigation Plan • Natural Hazards Mitigation Plan Managers and Technical Assistance • Funding the Implementation of the Plan • Action Agenda Table 18: Action Strategies • Monitoring and Evaluation	Page 31 Page 31 Page 32 Page 32 Page 32 Page 34
XII.	Natural Hazards Mitigation Plan Adoption Resolution	Page 35
XIII.	Appendices A. Glossary B. Detailed Maps C. Population Density Map D. Critical Infrastructure List E. Risk Assessment Work Sheet F. Examples of Past Mitigation Projects G. Resources	Page 36 Page 36 Page 39 Page 44 Page 45 Page 51 Page 52 Page 53

I. ACKNOWLEDGEMENTS

The Plan is the culmination of the interdisciplinary and interagency planning effort that required the assistance and expertise of numerous agencies, organizations, and individuals. Without the technical assistance and contributions of time and ideas of these agencies, organizations, and individuals, this plan could not have been completed.

Each jurisdiction within Leelanau County is a continuing participant in the update of the Plan. The following is a list of key contributors who were instrumental in the development of the Leelanau County Natural Hazards Mitigation Plan:

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Jim Johnson

Grand Traverse Band of Ottawa and Chippewa Indians
Jolanda Murphy

Others

- Northflight EMS
- Grand Traverse Band Environmental Response
- Senior Services
- Leland Schools
- Suttons Bay Fire
- Benzie/Leelanau County Health Department
- Elmwood Fire
- Cedar Fire
- Northport Fire
- Michigan State Police
- Traverse City Fire
- Leelanau Township Council
- Brownfield Redevelopment Authority
- Leelanau Conservation District
- Solon Township Council
- Michigan Department of Transportation

II. FEMA Letter of Approval

U.S. Department of Homeland Security
Region V
536 S. Clark St., 6th Floor
Chicago, IL 60605-1509

FEMA

JUN 09 2015

RECEIVED
Michigan State Police
JUN 15 2015
Emergency Management and
Homeland Security Division

Mr. Matt Schnepp
State Hazard Mitigation Officer
Michigan State Police
Emergency Management and Homeland Security Division
4000 Collins Rd
Lansing, MI 48910

Dear Mr. Schnepp:

Thank you for submitting the Leelanau County Hazard Mitigation Plan update for our review. The plan was reviewed based on the local plan criteria contained in 44 CFR Part 201, as authorized by the Disaster Mitigation Act of 2000. Leelanau County met the required criteria for a multi-jurisdiction hazard mitigation plan. Formal approval of this plan is contingent upon the adoption of the current version of the plan by the county. Once FEMA Region V receives documentation of adoption we will send a letter of official approval to your office.

We look forward to receiving the adoption documentation and completing the approval process for the Leelanau County plan.

If you or the community has any questions, please contact Kirstin Kuenzi at (312) 408-4460 or Kirstin.Kuenzi@fema.dhs.gov.

Sincerely,

Christine Stack

Christine Stack, Director
Mitigation Division

Attachments: Local Plan Review Sheets

www.fema.gov

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III. PREFACE

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

The mission of the Leelanau County Natural Hazard Mitigation Plan is to permanently eliminate or reduce long-term risks to people and property from natural hazards so that county assets such as transportation, infrastructure, commerce, and tourism can be sustained and strengthened. This can be accomplished through collaborative efforts/activities amongst agencies within Leelanau County.

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. This process is needed to ensure 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.

Recognizing the importance of reducing community vulnerability to natural hazards, Leelanau County is actively addressing the issue through the development and implementation of this plan. The many benefits to be realized from this effort are:

Community Benefits of a Natural Hazard Mitigation Plan
Protection of the public health and safety
Preservation of essential services
Prevention of property damage
Preservation of the local economic base

This process will help ensure that Leelanau County remains a vibrant, safe, enjoyable place in which to live, raise a family, preserve the local agricultural and economic base and maintain a vibrant tourist base.

IV. EXECUTIVE SUMMARY

In 2000, the Disaster Mitigation Act shifted the Federal Emergency Management Agency's (FEMA) scope of work to promoting and supporting prevention, or what is called hazard mitigation planning. FEMA now requires government entities to have natural hazards mitigation plans in place as a condition for receiving grant money, such as hazard mitigation grant program funds, in the future.

To meet this requirement, the Michigan State Police provided funding to encourage regional cooperation in the development of individual county Natural Hazards Mitigation Plans. The ***Northwest Michigan Hazard Mitigation Planning Project* update** was coordinated by the Northwest Michigan Council of Governments (NWMCOG) with Leelanau County being the Fiduciary. The update included Antrim, Kalkaska, Missaukee, Wexford, Grand Traverse, Leelanau, Benzie, and Manistee counties. NWMCOG worked with the Task Forces to update plans for these counties, which includes a general community profile, a comprehensive inventory of existing hazards, a hazard analysis, goals and objectives, and feasible mitigation strategies to address the prioritized hazards.

The Leelanau County Natural Hazards Mitigation Plan focuses on natural hazards such as drought, flooding, shoreline erosion, thunderstorms and high winds, and extreme winter weather, and was created to protect the health, safety, and economic interests of the residents and businesses by reducing the impacts of natural hazards through planning, awareness, and implementation. Through this Plan, a broad perspective was taken in examining multiple natural hazards mitigation activities and opportunities in Leelanau County. Each natural hazard was analyzed from a historical perspective, evaluated for potential risk, and considered for possible mitigative action.

The Plan serves as the foundation for natural hazard mitigation activities and actions within Leelanau County, 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:

Table 1: Planning Goals for Leelanau County

Natural Hazards Mitigation Planning Goals for Leelanau County
Goal 1: Increase local participation, strategies, and initiatives in natural hazards mitigation
Goal 2: Integrate natural hazards mitigation considerations into the County's comprehensive planning process
Goal 3: Utilize available resources and apply for others for natural hazards mitigation projects
Goal 4: Develop and complete natural hazards mitigation projects in a timely manner

Table 2: Priority Areas for Leelanau County

Natural Hazards Mitigation Priority Areas
Priority Area 1: Extreme Winter Weather – Countywide heavy snow, extreme temperatures, and concerns about major power, energy and agriculture loss Mitigation Strategies: ***Extreme Winter Weather***
Priority Area 2: Severe Weather (High Winds, Tornadoes) - Countywide highlighting the seasonal population influx and festivals held in various towns and villages throughout Leelanau Mitigation Strategies: ***High Winds and Tornadoes***
Priority Area 3: Erosion of slopes and bluffs in Lake Michigan communities; and Countywide concerns of Wetlands loss Mitigation Strategies: ***Erosion***
Priority Area 4: Dam and Bridge failure and localized flooding (further affected by elevated water levels in Lake Michigan and inland lakes) - Countywide Mitigation Strategies: ***Flood***
Priority Area 5: Countywide potential wildfire/urban interface Mitigation Strategies: ***Wildfire***

Table 3: Mitigation Strategies for Leelanau County

Frequent Natural Hazard	Mitigation Strategies
High Winds and Tornadoes	
	• Develop and implement mutual support and aid practices with surrounding communities
	• Tree management by power companies on power line easements
	• Public education and awareness
	• Suggest that events, campgrounds, and others have an evacuation plan
	• Building Code enforcement for new construction
Extreme Winter Weather	
	• Snow load design standards – develop planning grant for a study of snowfall patterns and occurrence of damage
	• Public education and awareness
	• Building Code enforcement for new construction
Slope Erosion	
	• Inventory shoreline erosion sites
	• More detailed soil erosion permits: slide areas, drainage control, grading, debris flow measures, vegetation (native species) placement
	• Zoning administration and enforcement of ordinances
	• Open space designations: acquisition or conservation easements by land conservancies, county, townships
	• Public education and awareness
	• Building code enforcement through permits
Flood	
	• Assessment of flood threat and dam inspections results
	• Research a flood warning system
	• Public education and awareness
	• Building code enforcement
	• Mapping of flood prone areas.
	• Identify structures in those flood prone areas
Wildfire	
	• Public education and awareness activities such as programs and brochures regarding fuel management, proper vegetation, fire breaks
	• Continue enforcement of state fire codes regarding setback requirements
	• Public education utilizing the Michigan Department of Natural Resources flyers and the Federal Emergency Management Administration information at parks and campgrounds
	• Real estate and insurance agents to distribute information
	• Assess fire suppression access and make improvements
	• Research the Department of Natural Resources' State Forest wildfire/urban interface rules or plan

V. PURPOSE OF THE PLAN

In 2000, the Disaster Mitigation Act shifted the Federal Emergency Management Agency's (FEMA) scope of work to promoting and supporting prevention, or what is referred to as hazard mitigation planning. FEMA requires government entities to have natural hazards mitigation plans in place and updated on a 5-year cycle as a condition for receiving grant money related to natural hazard remediation.

The **purpose of the Leelanau County Natural Hazards Mitigation Plan** is to find solutions to existing problems, anticipate future problems, prevent wasteful public and private expenditures, protect property values, and allocate land resources. The implementation of the Plan is to prevent injury, loss of life, property damage, breakdown in vital services like transportation and infrastructure, economic slumps, diminished tourist activity, liability issues, and damage to a community's reputation. For Leelanau County in the northwest region of the lower peninsula of Michigan, the **planning process** utilized the following steps in the development of the Plan. Emphasis was placed on natural hazards that have had significant impact on the community in the past.

Steps in the Planning Process
Identification of natural hazards and risks
Preparation of draft plan
Identification of natural hazards mitigation goals and objectives for emergency management programs
Selection of evaluation criteria
Selection of mitigation strategies using locally chosen criteria
Public Comment
Completion of the final plan

What is a Hazard?

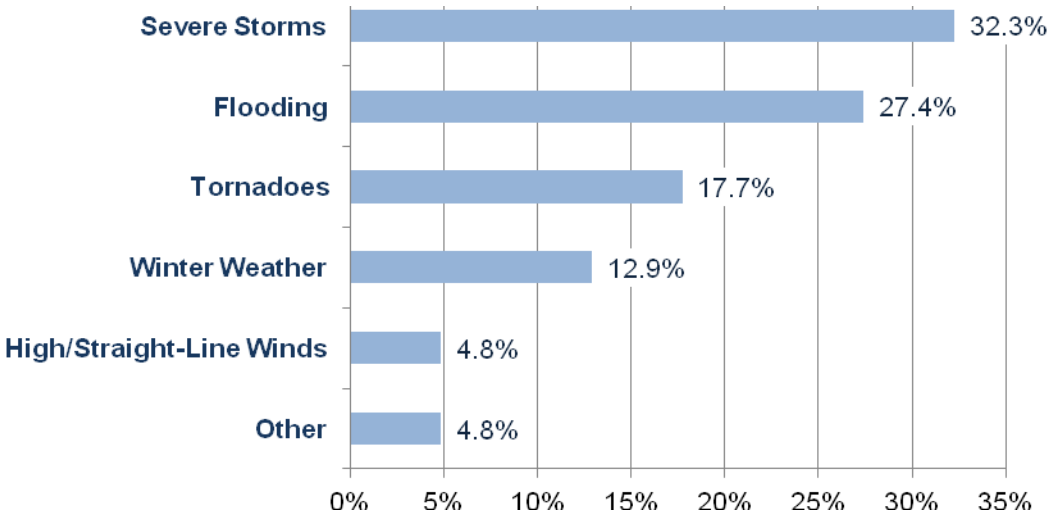
A **hazard** is an event or physical condition that has potential to cause fatalities, injuries, property damage, infrastructure damage, agricultural loss, damage to the environment, interruption of business, or other types of harm or loss. This plan focuses on principle natural hazards that occur in the northern lower region (see page 12). 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.

Principle Natural Hazards in Northern Lower Michigan
Severe Storms (Thunderstorms, Winter storms)
High Winds
Tornadoes
Extreme Temperatures
Flooding
Shoreline Hazards
Dam Failures
Drought
Wildfires
Invasive Species
Subsidence

Source: FEMA

Percent of natural hazard events for all formal disaster declarations in the State of Michigan (1953 – 2014)

Figure 1: Disaster Declarations for the State of Michigan



Source: FEMA

What is Mitigation?

Mitigation is the sustained action taken to lessen the impact from natural hazards and to work to reduce the long-term risk to human life and property, and their effects. This long-term planning distinguishes mitigation from actions geared primarily to emergency preparedness and short-term recovery. This Plan can be used to lessen the impact, to support and be compatible with community goals, to lay out considerations in choosing and evaluating methods, and to look at the feasibility of mitigation strategies.

VI. COMMUNITY PROFILE

Leelanau County offers its residents and visitors access to some magnificent natural features including excellent access to Great Lakes shoreline and inland lakes such as Lake Leelanau, Glen Lake, Lime Lake, and many more.

The following community data located below is provided to describe Leelanau County for planning and implementing the mitigation strategies.

There has not been any major infrastructure development, nor major hazard mitigation efforts, in the county since the last adoption of the Plan in 2007.

Table 4: Geographic features for Leelanau County

Feature	Measure	Percent
Area in Water	16,000 acres	5.6%
Forest Lands	126,900 acres	44.4%
Wetlands	27,412 acres	9.6%
Farmland	62,406 acres	21.8%
Operating Farms	494	NA
Miles of Great Lakes shoreline	151 miles	NA

Source: US Agricultural Census, 2012; County Data

The total County population is **21,708**. The projected growth for 2020 is 24,165. The population numbers are from the 2010 Census for the **11 Townships, 3 Villages, and part of 1 City** covered by this plan are:

Table 5: Breakdown of Leelanau County Population

Township/City/Village	Population	Township/City/Village	Population
Bingham Township	2,497	Leland Township	2,043
Centerville Township	1,274	Solon Township	1,509
Cleveland Township	1,031	Suttons Bay Township	2,982
Elmwood Township	4,503	City of Traverse City (part)	192
Empire Township	1,182	Village of Empire	375
Glen Arbor Township	859	Village of Northport	526
Kasson Township	1,609	Village of Suttons Bay	618
Leelanau Township	2,027		

Source: U.S. Census Bureau, 2008-2012 American Community Survey

- There are 14,960 *Housing Units* in Leelanau County with an average household size of 2.31 people per household.
- The number of residents 65 years and over is 23.9% of the population.
- The number of residents 19 years and under is 21.4% of the population.
- The number of residents over 65 with a disability is 28.4% of the population.
- The total Number of residents with disability is 12.0% of the population.
- The number of residents that have a language barrier or are linguistically isolated is 1.1% of the population.
- February 2014 Income poverty level:
    - $19,790 Family of 3
    - $11,670 Family of 1

Table 6: Poverty Statistics for Leelanau County

Poverty	Statistics
Families in poverty	6.9%
Income less than $15,000	5.0%
Population in poverty	11.1%

Source: U.S. Census Bureau, 2008-2012 American Community Survey

Table 7: Economic Census for Leelanau County

Industry Description	Number of Establishments	Number of Employees
Manufacturing	36	257
Wholesale trade	17	80
Retail trade	125	553
Information	8	NA
Real estate, rental, leasing	30	NA
Professional, scientific, technical services	73	236
Administrative, support, waste management, remediation services	44	166
Educational services	5	NA
Health care, social assistance	56	635
Arts, entertainment, recreation	31	247
Accommodation and food services	71	663

Source: US Census Bureau: County Business Patterns 2008-2012

VII. THE DEVELOPMENT OF THE PLAN

Data Methodology and Map Development

Leelanau County staff identified the critical facilities and infrastructure on the base map and provided updated GIS shp files for mapping purposes. Natural hazards points, polygons, and population centers data was then added to the base maps utilizing the following:

Table 8: Critical Facilities and Infrastructure in Leelanau County

5	Airports and Airstrips
16	Banks
8	Bridges
34	Places of Worship
19	Communications Facilities
5	Dams
6	Emergency Management Services Facilities
3	Emergency Operations Centers
1	Ferry Dock
10	Fire Stations
18	Government Buildings
6	Historic Sites
1	Hospital Facilities (closing)
49	Industrial Facilities
8	Medical Facilities
2	Nursing Home/Assisted Living Facilities
6	Police Stations
11	Resort/Recreational Facilities
8	Schools
10	Water and Sewage Treatment Facilities • Water: 12.6% public system or private company; 85.6% individual wells; • Sewer: 12.6% public sewer; 84.7% individual septic/cesspool; 2.7% other
2	Water Tower

Source: Leelanau County Data

Flood Data

Flood hazard information may be obtained from the Flood Insurance Rate Maps (FIRM) available for jurisdictions. In order to delineate potential flood plain areas (seasonal floodplains) for each county, NWMCOG overlaid wetland, soils, and elevation data to determine the most likely flood prone areas. Once overlaid; isolated polygons (areas) were deleted in order to show a more accurate representation of potential flood prone areas along lakes, rivers, and streams. Sources: Temporary/Seasonally Flooded Areas data are from the National Wetland Inventory of the US Fish and Wildlife Service; Hydric soils data are from the county digital soil surveys (were available); and Digital Elevation Model data are from the Center for Geographic Information, Michigan Department of Information Technology.

NFIP Participation Status:

Table 9: NFIP Participation

Municipality	NFIP status	Flood Maps	Year Joined
Centerville Township	P	Y	1986
Cleveland Township	P	Y	1986
Elmwood Township	P	Y	1983
Glen Arbor Township	P	Y	1986
Leelanau Township	P	Y	1986
Northport Village	P	Y	1989
Suttons Bay Village	P	Y	1977
Bingham Township	P	N	1987
Empire Township	P	N	1986
Empire Village	P	N	1985
Leland Township	P	N	1987
Suttons Bay Township	P	N	1987

Source: Department of Environmental Quality

P = Participates
NP = Non Participating
Y = Yes
N = No

According to an official database associated with the National Flood Insurance Program, Leelanau County has no properties currently designated as suffering from repetitive losses in insured flood events

Fire Data
Modern forest fire data was obtained from the USDA forest service and the Departments of Natural Resources in Minnesota, Wisconsin, and Michigan. Fire regimes data (fire prone areas) where provided by the USDA Forest Service, North Central Research Station in Wisconsin. Land type associations, and historical and modern fire rotations were used to identify the fire prone areas.

Tornadoes - National Weather Service

Damaging Winds - National Weather Service

Large Hail - National Weather Service

Winter Weather - National Weather Service

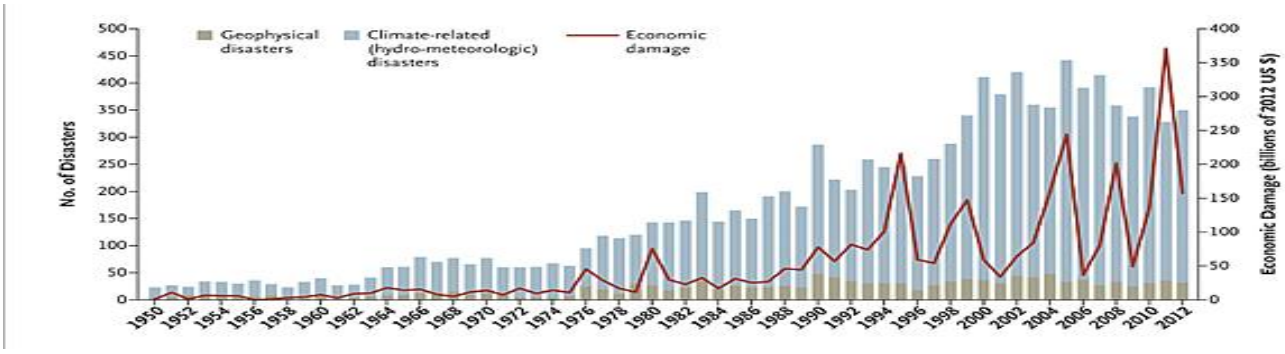
Landslide/Erosion
Shoreline erosion and landslide incident zones are delineated by the US Geological Service. Digital Elevation Model data is from the Center for Geographic Information, Michigan Department of Information Technology.

Other hazards such as earthquakes and subsidence were considered but are not substantial risks in Leelanau County.

Potential Impacts from Climate Change

According to the New England Journal of Medicine, around 217 million people are affected by natural disasters each year since 1990. The study separates natural disasters into two categories: geophysical; which include earthquakes, volcanoes, landslides, and avalanches, and climate-related; which include meteorological storms, flooding, heat/cold waves, drought, and wildfires. The number of geophysical disasters has remained constant since the 1970's, while climate-related disasters greatly increased. There were three times as many natural disasters between 2000-2009 as there were between 1980-1989, and the report goes on to state that natural disasters, primarily flooding and storms, will become more frequent and severe due to climate change.

Figure 2: 2012 Economic Damages for Disasters in the US



Northwest Lower Michigan depends heavily on groundwater, on freshwater from Lake Michigan, and on rainfall for agriculture, drinking, and industrial uses. As the population in this region continues to grow, the demand for water for all needs increases. The projected changes in rainfall, evaporation, and groundwater recharge rates from climate changes will affect ecosystems and all freshwater users. *Please note that these are predictions from the most recent data available regarding climate change and that many feel that any natural hazard events cannot be predicted on a yearly basis.*

- Impacts of extreme water levels on Domestic, Municipal, and Industrial Water uses can include compromised or unusable water intakes, sedimentation problems, increased operation and maintenance requirements, and reduction in water quality.
- Historically, the most serious impact to coastal property occurred when water levels were extremely high, as a result of flooding or erosion from severe storms.
- If water levels raise above historic thresholds coastal wetland habitats could be threatened because land beyond a coastline may not be available to transition into new wetland habitats.
- Development and climate change will degrade the flood-absorbing capacities of wetlands and floodplains, resulting in increased erosion, flooding, and runoff polluted with nutrients, pesticides, and other toxins.

Natural Hazards Recorded Events

Data for weather events was compiled from the National Oceanic and Atmospheric Administration's (NOAA) website utilizing the following sections:

- Weather/Climate Events, Information, Assessments
- Climatology and Extreme Events
- NOAA Storm Event Database; 1950 to present, local storm reports, damage reports, events checked for MLeelanau County included: Flood (Flash Flood, Flood, Lakeshore Flood), Hail (Hail), Snow and Ice (Blizzard, Extreme Cold/Wind Chill, Freezing Fog, Frost/Freeze, Heavy Snow, Ice Storm, Lake-effect Snow, Sleet, Winter Storm, Winter Weather), Tornado (Tornado, Funnel Cloud), Thunderstorm and High Wind (Heavy Rain, High Wind, Lightning, Strong Wind, Thunderstorm Wind), Wildfire (Wildfire)

The following list includes the frequency, dates, and descriptions of the most severe natural hazard events that have occurred within Leelanau County, according to the NOAA Storm Event Database; January 1950 – August 2014. *Extreme Winter Weather* includes events with ice covering, property damage, and/or up to/over 12 in. of snow. *Severe Thunderstorm* include 50 knot winds + and property damage figures.

Flooding: 6 events

Table 10: Flood Events for Leelanau County

Month	Year	Location	Effect	Damage
April	1993	County/Region	NA	$5,000,000
July	1999	Countywide	Secondary roads washed out	NA
September	2000	Countywide	Roads and basements flooded	$50,000
April	2004	Countywide	Secondary roads washed out	NA
Spring	2014	Countywide	High water tables cause localized flooding	NA
Fall	2014	South Lake Leelanau	Flooding caused by heavy rains	NA

Hail: 19 events

Table 11: Hail Events for Leelanau County

Month	Year	Location	Effect	Damage
June	1998	Suttons bay	0.75 in.	NA
May	2000	Leland	1.00 in.	NA
May	2000	Suttons bay	1.00 in.	NA
May	2000	Maple City	1.00 in.	NA
June	2000	Northport	0.88 in.	NA
May	2001	Suttons Bay	1.75 in.	NA
May	2001	Leland	1.00 in.	NA
May	2002	Leland	0.75 in.	
August	2003	Greilickville	0.88 in.	NA
June	2004	Leland	0.75 in.	$5,000
August	2004	Glen Haven	0.75 in.	NA
September	2005	Cedar	0.88 in.	NA
July	2006	Leland	1.00 in.	$50,000
October	2007	Empire Airport	1.00 in.	NA
June	2008	Empire	0.88 in.	NA
June	2008	Hatchs	1.0 in.	NA
July	2008	Cedar	0.88 in.	NA
July	2008	Suttons Bay	0.75 in.	NA
September	2008	Leland	0.88 in.	NA
April	2009	Suttons Bat	0.75 in.	NA
April	2011	Maple City	0.88 in.	NA

Hail (continued)

Month	Year	Location	Effect	Damage
April	2011	Empire	1.00 in.	NA
April	2011	Maple City	1.00 in.	NA
June	2011	Countywide	0.88-1.00 in.	NA
May	2013	Greilickville	1.00 in.	NA
May	2013	Northport	1.00 in.	NA
August	2013	Northport	1.50 in.	NA

Extreme Winter Weather: 112 Events

Table 12: Extreme Winter Weather Events for Leelanau County

Month	Year	Location	Effect	Damage	Other Event
Winter	1978	County/Region	NA	NA	Blizzard
April	1993	County/Region	NA	$50,000	
December	1993	Countywide	13 in. snow/ 54 mph winds	NA	
January	1994	Countywide	NA	$5,000,000 (statewide)	Heavy Snow/Freezing Rain
November	1996	Countywide	6 - 14 in. snow	NA	
January	1997	Countywide	10 - 12 in. snow	NA	
January	1997	Countywide	8 - 12 in. snow/ wind gusts 50 mph	NA	
March	1998	County/Region	8 - 12 in. snow/ wind gusts 45 mph	NA	Blizzard
December	1998	County/Region	12 - 18 in. snow	NA	
December	1998	County/Region	8 - 18 in. snow	NA	
January	1999	Countywide	6 - 12 in. snow	NA	
February	2001	County/Region	1/4 in. ice/ trees and power lines down/ power outages	NA	Ice Storm
March	2002	County/Region	10 -16 in/ snow	NA	
March	2002	County/Region	Major highways closed	NA	Blizzard
December	2002	Countywide	6-12 in. snow	NA	
December	2002	County/Region	1/4 in. ice	NA	Ice Storm
January	2003	County/Region	6 - 12 in. snow	NA	
January	2004	County/Region	20 in. snow/ 5 -6 ft. drifts on M-72	NA	
January	2004	County/Region	4 - 12 in. snow	NA	
January	2004	County/Region	10 - 20 in. snow	NA	
January	2005	County/Region	1/2 - 1/3 in. ice	NA	Ice Storm
January	2005	County/Region	6 - 10 In. snow/ wind gusts 40 mph	NA	Blizzard
November	2005	County/Region	10 - 17 in. snow	NA	
December	2005	Region/ Suttons Bay	16.5 in. snow	NA	

Extreme Winter Weather (continued)

Month	Year	Location	Effect	Damage	Other Event
December	2006	County/Region	5 - 17 in. snow	NA	
January	2007	Region/ Maple City	11 - 13 in. snow	NA	
February	2007	County/Region	-20 to -30 wind chills	NA	Extreme Temp
April	2007	County/Region	6 - 18 in. snow	NA	
November	2007	County/Region	Wind gusts 60 Mph/ trees and power lines down	$3,000	
December	2007	County/Region	Wind gusts 40 - 50 mph/ power outages	NA	
January	2008	County/Region	Wind gusts 40 - 50 mph/ near blizzard conditions	NA	
February	2008	County/Region	Wind gusts 45 mph/ hazardous wind chill/ blizzard conditions/ 1 fatality	NA	Extreme Temp
February	2008	County/Region	1/2 - 1/3 in. ice	NA	Ice Storm
February	2008	Region/Empire	7 - 14 in. snow	NA	
December	2008	County/Region	12 - 17 in. snow	NA	
December	2008	County/Region	8 - 23 in. snow	NA	
March	2009	Region/ Leland	15 in. snow	NA	
December	2009	County/Region	6 - 21.8 in. snow	NA	
December	2010	County/Region	6 - 15 in. snow	NA	
March	2011	County/Region	6 - 15 in. snow	NA	
March	2012	County/Region	6 - 14 in. snow	NA	
April	2012	County/Region	Crop killing frost	$37, 500	Frost/Freeze
January	2014	Region/ Suttons Bay	12 - 16 in. snow	NA	
January	2014	County/Region	12 - 16 in. snow/ wind gusts 45 mph	NA	
February	2014	County/Region	-15 to -25 wind chills	NA	Extreme Temp

Thunderstorm and High Wind: 33 Events

Table 13: Storm Events for Leelanau County

Month	Year	Location	Effect	Damage	Other Event
July	1995	Northport	52 knot winds/ trees and power lines down	$10,000	
July	1995	Suttons Bay	52 knot winds/ trees and power lines down	$10,000	
July	1995	Empire	50 knot winds/ trees and power lines down	$2,000	
July	1995	Glen Arbor	50 knot winds/ trees and power lines down	$2,000	
November	1998	Countywide	61 knot winds/ 50 - 90 mph wind gusts/ trees and power lines down/ power outages	NA	
June	1999	Cedar	50 knots/trees down	NA	

Thunderstorm and High Wind (continued)

Month	Year	Location	Effect	Damage	Other Event
June	1999	Leland	50 knot winds	NA	
August	2001	Northport	50 knot winds	NA	
October	2001	County/Region	50 knot winds/ trees and power lines down/ power outages	NA	
December	2001	Empire	50 knot winds/ property damage/ power outages	$1,000	
April	2002	Suttons Bay	50 knot winds/ trees and power lines down	NA	
July	2002	Suttons Bay	50 knot winds/ trees and power lines down	NA	
August	2003	Northport	52 knot winds/ trees and power lines down	NA	
November	2003	County/Region	68 knot winds/ trees and power lines down/ power outages	NA	
September	2004	Leland	55 knot winds/ trees and power lines down	$6,000	
September	2005	Empire	55 knot winds/ trees down	$5,000	
September	2005	Cedar	55 knot winds/ trees down/ property damage	$2,000	
November	2005	Countywide	50 knot winds/ trees down	$10,000	
November	2005	Countywide	57 knot winds/ wind gusts 66 mph/ trees, power lines, and utility poles down	$25,000	
August	2007	Greilickville	54 knot winds/ trees down/ property destroyed	$10,000	
August	2007	Greilickville	Lightning ignited fire damaging property	$40,000	Lightning
August	2007	Lake Leelanau	50 knot winds/ trees down	$1,000	
October	2007	Countywide	43 knot winds/ trees and power lines down	$18,000	
October	2007	Northport	54 knot winds/ trees and power lines down	$6,000	
October	2007	Glen Arbor	52 knot winds/ trees down	$4,000	
November	2007	Countywide	41 knot winds/ trees down	$4,000	
June	2008	Greilickville	52 knot winds/ 60 mph wind gusts	NA	
March	2009	Countywide	50 knot winds/ 60 mph wind gusts	NA	
August	2010	Leland	50 knot winds/ trees down	$4,000	
October	2010	Countywide	64 knot winds/ trees and power lines down/ roof damage	$2,000	
May	2011	Maple City	52 knot winds/ trees down/ roads blocked	$6,000	
June	2011	Countywide	52 knot winds/ trees down	$4,000	
June	2011	Countywide	55 knot winds/ crop damage/ cherry trees destroyed	$8,000 (crop)	
June	2011	Countywide	52 knot winds/ 60 mph wind gusts/ trees and power lines down	$5,000	
August	2013	Glen Lake	52 knot winds/ trees and power lines down	$10,000	

Tornado: 4 events

Table 14: Tornado Events for Leelanau County

Month	Year	Location	Effect	Damage
July	1956	Suttons Bay	NA	NA
July	1977	Countywide	F1/ 8 miles long, 167 yards wide	$25,000
August	1978	Countywide	F1/ 2 miles long, 160 yards wide	$250,000
June	2011	Countywide	EF0/ 0.35 miles long, 75 yards wide	$20,000

Wildfires:
The Michigan Hazard Analysis of 2012 identified around 35 wildfires occurred in Leelanau County from 1981 to 2010.

Other Possible Natural Hazards

Shoreline Erosion:
The Michigan Hazard Analysis of 2012 identifies Leelanau County as a High Risk Erosion Area with the Lake Michigan shoreline at risk. The National Climatic Data Center indicates that there has been no lake surf erosion events reported in Leelanau County since 1950. While there were Governor's Disaster Declarations for shoreline problems in the state in 1985 and 1986, these declarations did not include Leelanau County.

Storm Surges (Seiches) and Rip Currents
Weather-related events can also cause lake fluctuations that can last from several hours to several days. For example, windstorms combined with differences in barometric pressure can temporarily tilt the surface of a lake up at one end by as much as eight feet. This phenomenon is called a storm surge or seiche and can drive lake waters inland over large areas, cause weakening and erosion of shoreline areas, make water travel hazardous, and cause flood damages, deaths, and injuries to occur.

A rip current is a strong flow of water returning seaward from the shore. When wind and waves push water towards the shore, the previous backwash is often pushed sideways. This water streams along the shoreline until it finds an exit back to the sea. The resulting rip current is usually narrow and located between sandbars, under piers or along jetties. The current is strongest at the surface, and can dampen incoming waves, leading to the illusion of a particularly calm area. Rip current speeds are typically 1-2 feet per second. However, speeds as high as 8 feet per second have been measured. Rip currents cause approximately 100 deaths annually in the United States, more than all other natural hazards except excessive heat. In the Great Lakes alone, the average over the last six years is 10 drownings per year caused by rip currents. About 80% of rescues by surf beach lifeguards are due to rip currents. According to the National Climatic Data Center, Michigan has experienced at least 17 deaths and 9 injuries caused by rip currents in just the past 10 years.

Drought
In Northern Michigan's forested regions, drought can adversely impact timber 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. Many Northern Michigan counties are heavily forested and are therefore highly vulnerable to drought-related wildfire threats. The most extreme drought was in January 1931, when the Palmer index hit a record low of -8.07. Lengthy drought incidents took place in 1895-1896 (17 months), 1898-1899 (8 months), 1899-1901 (21 months), 1901-1902 (15 months), 1908-1911 (37 months), 1913-1914 (11 months), 1914-1915 (10 months), 1919-1920 (8 months), 1920-1922 (17months), 1925-1926 (17 months), 1929-1931 (28 months), 1935-1936 (20 months), 1955-1956 (13 months), and 1976-1977 (13 months).

Pandemics or other Public Health Emergencies

Naturally occurring pandemics may cause widespread precautions around the world. The Benzie - Leelanau County Health Department created a pandemic influenza plan that serves as a template for responding to a large-scale outbreak of influenza and other highly communicable diseases.

Probability of Hazards

There is a possibility that a natural hazard such as hail, thunderstorm and high wind, tornadoes, and snow and ice will affect this area of Michigan on an annual basis. The magnitude and severity depends on the season, which determines temperature, moisture in the air, ice cover on the lakes, etc. Also, the severity of harm and damage from natural hazard events can be connected with tourist activity, the increased pace of second home development, and a general increase in the base population in northwest, Lower Michigan. The geographic impact of the natural hazards' impact has remained the same in Leelanau County.

The areas where natural hazards overlap in Leelanau County can include heavy snow that causes trees and power lines down, and then melting, rain and flooding. Rising water levels with high winds can cause coastal landslides/debris flow/erosion.

Leelanau County Natural Hazards Task Force and Public Input

The Natural Hazards Task Force comprised of the County's Local Planning Team (LPT) which is a collection of first responders and local, regional, and state public entities that ensure the readiness of County entities by recommending equipment purchases, training and exercises, and public education on preparedness issues. The Task Force meetings were scheduled monthly in 2014, held in various locations throughout the county, and open to the public. Participants analyzed and updated the hazard priority maps, goals & objectives, hazard priority areas, mitigation measures, and the action agenda items.

The general list of hazard priorities and locations of concern was also reviewed and updated by the Task Force:

- Extreme winter weather – energy loss (power)
- Slopes and bluffs along Lake Michigan – homes lost near Leland
- Festivals/events and seasonal population – Northport, Cedar, Leland, Glen Arbor, Dune Fest, Suttons Bay, Peshawbestown, Empire, Maple City, Lake Leelanau
- Tornadoes and high winds
- Greilickville – population
- Cedar area – wetlands, not a lot of people, buildings; can release water at Leland dam for Lake Leelanau
- Sugarloaf Resort - Aging electric transformers contain large amounts of hazardous material
- Stormwater and soil erosion
- Dams/Bridges
- Degradation of wetlands
- Infrastructure/cell tower locations
- Wineries/golf courses
- Sleeping Bear Dunes National Shoreline - wildfire management.
- Leelanau Fruit and Cherry Growers – Anhydrous Ammonia
- Electrical transformers at Sugarloaf Resort – Polychlorinated Biphenyls (PCB)

The following priority areas remain unchanged since the previous plan had been completed.

Top Five Natural Hazards Priority Areas

1. **Extreme Winter Weather – Countywide heavy snow, extreme temperatures, and concerns regarding power and agriculture loss**

   Leelanau County experiences frequent heavy snow events due to its location in a "snow-belt" area. 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. Extreme winter weather may also adversely affect agricultural production, such as vineyards, which are vital to the County's base economy. Ice damage may occur when high winds push lake water and ice past the shoreline, affecting public infrastructure and residential areas.

2. **Severe Weather (High Winds and Tornadoes) - Countywide highlighting seasonal population influx and local festivals**

   There is a historical record of high wind events and tornadoes in Leelanau County. Damage from straight line winds usually affects multiple counties through the loss of electricity from trees/tree limbs downing power lines; causing widespread property damage; and potentially exposing the public to severe injury or fatality due to flying debris. This is especially relevant as many towns within the County host various seasonal festivals that are critical in contributing to the overall tourist industry economy.

3. **Erosion affecting Slopes and Bluffs near Lake Michigan communities; and Wetland loss Countywide**

   Shoreline or soil erosion hazards involve the loss of property or necessitate the relocation of homes 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. Roadways along the shoreline may experience bank erosion which contributes to cracking and overall structural instability

4. **Dam and Bridge failure and Localized Flooding (further affected by elevated water levels in Lake Michigan and inland lakes) - Countywide**

   A dam failure can result in loss of life, and in extensive property or natural resource damage for miles downstream from the dam. Dam failures occur not only during flood events, which may cause overtopping of a dam, but also as a result of poor operation, lack of maintenance and repair, and vandalism. Such failures can be catastrophic because they occur unexpectedly, with no time for evacuation. The Michigan Hazard Analysis of 2012 identifies the Leland and Meeuwenber Dams as a "high hazard", (there is development downstream in the dam's "hydraulic shadow"); and the Cedar Lake Dam as a "significant hazard" (development should be discouraged in areas that would increase the risks from potential dam failures).

   Major bridges include the Narrows Bridge between Big and Little Glen Lakes, and bridges in Leland, Lake Leelanau, and Cedar. Damages will be greater from flash flood types of events than they would from gradual floodplain inundation.

   In addition to natural flooding in a riverine floodplain, other flooding may involve low-lying areas that collect runoff waters; flaws or shortcomings in existing sewer infrastructure; undersized or poorly designed stormwater control practices; collective effects of land use and development trends; illegal diversion of water, or actions that interfere with system function.

5. Potential wildfire/urban interface - Countywide

Wildfires can cause widespread concerns and disruptions even in cases where physical damages have been prevented. Smoke, closed roadways, and infrastructure impacts may interfere with ordinary life, as well as an area's economy and planned events (including tourism). Additional factors that increase fire risk include dead or dying Ash trees as a result of disease/invasive species and human factors such as the number of persons residing, camping, or traveling through the County.

The Sleeping Bear Dunes National Lakeshore, which attracts more than 1.5 million visitors annually, is located in a wildfire and development interface area. The SBDNL has a fire suppression policy and is presently developing a Wildfire Management Plan.

Emergency Warning System Coverage

There are warning sirens located at each Fire Station (Suttons Bay, Leland, Elmwood, Northport, Cedar, and Glen Lake) and one warning siren located in Peshawbestown at the Pow Wow Grounds on Stallman Road for the Grand Traverse Band of Ottawa and Chippewa Indians.

Economic Impact Analysis

The total Damaging Events' Costs recorded since 1950 with the National Oceanic and Atmospheric Administration for Leelanau County, the region, and the state are as follows:

Table 15: Natural Hazard Cost Breakdown for Leelanau County

Leelanau County	Property Damage Cost	Crop Damage Cost
Flood	$5,050,000	NA
Hail	NA	$55,000
Extreme Winter Weather	$5,053,000	$37,500,000
Tornado	$295,000	NA
Thunderstorm and High Wind	$187,000	$8,000
Wildfire	NA	NA

The Leelanau County Equalization Department calculated each Priority Area's economic value through the State Equalized Values (SEV) for real and personal property (residential and commercial). The following includes 2010 Census data and 2014 SEV dollar amount times two (estimated fair market values) for each priority area. According to the 2014 Northwest Michigan Season Population Analysis, assume a 19% increase to account for the annual average seasonal population within the county.

Table 16: Geographic Economic Value for Leelanau County

Priority Area(s)	Geography	Population	State Equalized Value
	Leelanau	21,708	$6,794,260,658
3	Lake Michigan shoreline communities	8,180	$1,686,682,438
4	Dam and Bridge areas	7,285	$695,124,040

VIII. NATURAL HAZARDS MITIGATION GOALS AND OBJECTIVES

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

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

Goal 1: Increase whole community participation, strategies, and initiatives in natural hazards mitigation

- Encourage cooperation and communication between planning and emergency management officials
- Encourage additional local governmental agencies to participate in the hazard mitigation process
- Encourage public and private organizations to participate, including organizations who advocate for individuals with functional or access needs
- Encourage use of the "Firewise Communities Program" (www.firewise.org) which offers both workshops and web-based interactive training geared toward homeowners, forestry professionals, firefighters and others on a variety of wildfire safety topics.

Goal 2: Integrate hazard mitigation considerations into the community's comprehensive planning process:

- Enforce and/or incorporate hazard mitigation provisions in building code standards, ordinances, and procedures; and into the county's comprehensive master plan
- Create or update zoning ordinances to reflect any new regulations
- Incorporate hazard mitigation into basic land use regulation mechanisms
- Incorporate hazard area classifications into standard zoning classifications
- Develop community education and warning systems
- Integrate hazard mitigation into the capital improvement planning process so that public infrastructure does not lead to development in hazard areas
- Encourage county agencies to review local roads, bridges, dams, and related transportation infrastructure for hazard vulnerability

Goal 3: Utilize available resources and apply for additional funding for hazard Mitigation:

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

Goal 4: Develop and complete hazard mitigation projects in a timely manner

- Encourage public and business involvement in hazard mitigation projects

IX. IDENTIFICATION AND SELECTION OF MITIGATION STRATEGIES

Selection of Feasible Mitigation Strategies

A set of evaluation criteria was developed to determine which mitigation strategies were best suited to address the identified problems in Leelanau County.

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

By anticipating future problems, the County can reduce potential injury, structure losses, loss of power, such as electric and gas, and prevent wasteful public and private expenditures.

Priority Area 1: Extreme Winter Weather – Countywide heavy snow, extreme temperatures, and concerns regarding power and agriculture loss

Snow load Mitigation Strategies

- Snow load design standards – develop planning grant for a study of snowfall patterns and occurrence of damage
- Public education and awareness (National weather Service Weather Spotter classes offered free of charge at the Emergency Operations Center)
- Building Code enforcement for new construction

Priority Area 2: Severe Weather (High Winds and Tornadoes) - Countywide highlighting seasonal population influx and local festivals

High Winds and Tornado Mitigation Strategies

- Develop and implement mutual support and aid practices with surrounding communities
- Tree management by power companies on power line easements
- Public education
- Completion of Pre-event Plans for all festivals and events in the County (39 completed in 2014)
- Suggest that events have an evacuation plan
- Building Code enforcement for new construction

Priority Area 3: Erosion affecting Slopes and Bluffs near Lake Michigan communities; and Wetland loss Countywide

Erosion and Debris Flow Mitigation Strategies

- Inventory shoreline erosion sites
- More detailed soil erosion permits: slide areas, drainage control, grading, debris flow measures, vegetation (native species) placement
- Zoning administration and enforcement of ordinances: development setbacks, lot sizes, driveways, relocation of structures, Lake Michigan coastal zoning ordinances – U.S. Army Corps of Engineers and Michigan Department of Environmental Quality
- Open space designations: acquisition or conservation easements by land conservancies, county, townships (Herman Park was acquired in March 2008, 126 acres. Veronica Valley Park was acquired December 2008, 92.3 acres)
- Public education
- Building code enforcement through permits

Priority 4: Dam and Bridge failure and Localized Flooding (further affected by elevated water levels in Lake Michigan and inland lakes) - Countywide

NFIP list of participating communities –Bingham, Centerville, Cleveland, Elmwood, Empire, Glen Arbor, Leelanau, Leland, Suttons Bay Townships, Villages of Suttons Bay, Northport, Empire

Flood Mitigation Strategies

- Assessment of flood threat and dam inspections results
- Research a flood warning system
- Public education and awareness
- Building code enforcement

Priority 5: Potential wildfire/urban interface - Countywide

Wildfire Mitigation Strategies

- Public education and awareness activities such as programs and brochures regarding fuel management, proper vegetation, fire breaks
- Continue enforcement of state fire codes regarding setback requirements
- Public education utilizing the Michigan Department of Natural Resources flyers and the Federal Emergency Management Administration information at parks and campgrounds
- Real estate and insurance agents to distribute information
- Assess fire suppression access and make improvements
- Research the Department of Natural Resources' State Forest wildfire/urban interface rules or plan

Additional Mitigation Strategies

- Collaborate with governmental entities such as townships, villages, and the Grand Traverse Band of Ottawa and Chippewa Indians; organizations, businesses, and the public
- Develop a multi-hazard warning plan and strategies for festivals/events
- Develop mutual support and aid from surrounding communities
- Incorporate the Plan's hazard mitigation concepts, strategies, and policies into existing elements of Leelanau General Plan

X. Participation in the Development of the Leelanau County Natural Hazards Mitigation Plan

The opportunities for review by other governmental entities and the public included the following:

- Public Notices were published in the Leelanau Enterprise.

Public Notice

LEELANAU COUNTY

OFFICE OF EMERGENCY MANAGEMENT/ 9-1-1

8525 E. Government Center Drive Suttons Bay, MI 49682 Phone (231) 256-8775 Fax (231) 256-8701

PUBLIC NOTICE:

The Leelanau County Office of Emergency Management is seeking public comment on the Natural Hazard Mitigation Plan draft update. A public hearing has been set for Tuesday February 10th, 2015 from 1-3pm in the Community Meeting Room, lower level of the Government Center.

Draft copies are also available for review at the Leelanau County Administrator's Office and Planning and Community Development Department. Written comments will be accepted until Friday February 20th, 2015 submitted to:

Natural Hazard Mitigation Plan
Office of Emergency Management
8525 E Government Center Dr.
Suttons Bay, MI 49682

- The Natural Hazards Mitigation Plan was presented to the Leelanau County Planning Commission where the meetings are posted in the newspaper and are open to the public. Commission members gave their input.

- The Natural Hazards Mitigation Plan was presented to the Leelanau County Board of Commissioners where the meetings are posted in the newspaper and are open to the public. Commissioners gave their input.

- During development of the plan, all townships and villages were provided the opportunity to formally comment on plan drafts and other related materials. They were given the opportunity via mailings of both meeting notices and draft copies of the plan for comment. Notification was also provided to them that the plans were posted on the NWMCOG website and could be reviewed there. While no jurisdictions (other than the county) provided formal written comments, they did provide county staff (particularly the county emergency manager) with feedback via other informal means. This feedback took the form of phone calls, emails and conversations that occurred at various non-mitigation related meetings throughout the county. This information was provided back to NWMCOG staff by the county staff and used in development of the plan, including the risk assessment and community profile sections.

In addition, the townships and villages (whether or not they have their own zoning) have indicated to NWMCOG and the county emergency manager that they will follow the county's lead in identifying mitigation projects and developing grant applications to fund those projects. Land use issues associated with those projects (where applicable) will be handled by each jurisdiction that controls zoning in the project area.

Community planning services are provided by the professional staff of the Leelanau County Planning & Development Department. The Department assists communities in developing plans and zoning ordinances, provides resource information and technical assistance, and convenes communities to address land use issues of common interest. The Leelanau County Planning Commission coordinates and reviews local zoning and master plans to ensure consistency across jurisdictional boundaries. Building permits are issued by the Leelanau County Inspections Department.

The Townships/Villages in the priority areas include:

Bingham Township – Zoning
Centerville Township – Zoning
Cleveland Township – Zoning
Elmwood Township – Zoning
Empire Township – Zoning
Village of Empire – Zoning
Glen Arbor Township – Zoning
Kasson Township – Zoning
Leelanau Township – Zoning
Village of Northport – Zoning
Leland Township – Zoning
Solon Township – Zoning
Suttons Bay Township – Zoning
Village of Suttons Bay – Zoning
City of Traverse City – Zoning
Village of Empire – Zoning

Table 17: Plan Participation

County/Township/Others	Zoning	Participation
Leelanau County	No	Task Force meetings, review of draft plans, approval to submit plan: County Commissioners County Administrator Drain Commissioner Emergency Management Coordinator Equalization Department Planning Commission Planning Department Sheriff's Office County LEPC/LPT
Bingham	Yes	See last bullet point paragraph, above
Centerville	Yes	See last bullet point paragraph, above
Cleveland	Yes	See last bullet point paragraph, above
Elmwood	Yes	See last bullet point paragraph, above
Empire	Yes	See last bullet point paragraph, above
Village of Empire	Yes	See last bullet point paragraph, above
Glen Arbor	Yes	See last bullet point paragraph, above
Kasson	Yes	See last bullet point paragraph, above
Leelanau	Yes	See last bullet point paragraph, above
Village of Northport	Yes	See last bullet point paragraph, above
Leland	Yes	See last bullet point paragraph, above
Solon	Yes	See last bullet point paragraph, above
Suttons Bay	Yes	See last bullet point paragraph, above
Village of Suttons Bay	Yes	See last bullet point paragraph, above
Traverse City	Yes	See last bullet point paragraph, above
Grand Traverse Band of Ottawa and Chippewa Indians	N/A	See last bullet point paragraph, above

***The* Traverse Band *of Ottawa Indians has their own planning authority over lands they own that have been put in trust with the Federal Government. The County Natural Hazards Mitigation Plan would not cover the Tribe/lands, but the Tribes may adopt the approved County plan as their own.*

N/A = Not applicable; these are non-governmental authority entities

XI. IMPLEMENTATION OF THE LEELANAU COUNTY NATURAL HAZARDS MITIGATION PLAN

Natural Hazards Mitigation Plan Managers and Technical Assistance

The leader for implementing the Natural Hazards Mitigation Plan is the Leelanau County Board of Commissioners, with the staff leaders being the Emergency Management Coordinator and the Planning Department. Working partnerships can be established with the following to provide technical assistance to accomplish the goals and objectives of the Plan.

- Leelanau County Government
- Townships, cities, and villages
- Leelanau County Conservation District
- Leelanau County Drain Commissioner
- Leelanau County Road Commission
- Grand Traverse Band of Ottawa and Chippewa Indians
- Conservation Resource Alliance
- Watershed Center Grand Traverse Bay
- Michigan State University Extension
- Michigan Department of Environmental Quality
- Michigan Department of Natural Resources
- U.S. Environmental Protection Agency
- U.S. Army Corps of Engineers
- U.S. Department of Agriculture Natural Resources Conservation Service
- U.S. National Park Service
- Insurance Companies
- Real Estate Companies
- Architects
- Engineers

All natural hazards mitigation planning could be pursued with the new tool available to the local governments which is the Michigan Public Act 134 of 2010, the Enrolled House Bill Number 6152; and Michigan Public Act 226 of 2003, the Joint Municipal Planning Act. These Acts provides for joint land use planning by cities, villages, and townships and allows two or more municipalities' legislative bodies to create a single joint planning commission to address planning issues. This tool helps with planning for the "big picture" issues such as natural hazards that cross jurisdictional boundaries.

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

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

Funding the Implementation of the Plan

To assist with the funding of the proposed natural hazards mitigation strategies, here is a list of potential financial assistance entities to help fund the implementation projects of the Plan.

- Federal Emergency Management Administration – Hazard Mitigation Grant Program
- U.S. Environmental Protection Agency
- U.S. Department of Agriculture Natural Resources Conservation Service
- U.S. Department of Agriculture Rural Development: Rural broadband opportunity – high speed telecommunication funding from the Public Telecommunications Facilities Planning and Construction grants
- U.S. Department of Housing and Urban Development
- Michigan Department of Environmental Quality
- Michigan Department of Natural Resources
- National Oceanic and Atmospheric Administration
- Community, Regional Foundations
- Businesses: Home Depot (local store and Foundation) The Home Depot Foundation assists with educational initiatives that provide developers and the general public with the information they need to make homes more disaster resistant.

Action Agenda

The following is a summary for accomplishing the **recommended natural hazards mitigation actions** for Leelanau County.

Table 18: Recommended Mitigation Actions for Leelanau County

Priority and Action Strategies	Responsible Parties	Timeframe
Priority Area 1: Snow Load Mitigation		
a. Snow load design standards – develop planning grant for a study of snowfall patterns and occurrence of damage	County Planning Department Emergency Management Coordinator County Building Official	1-3 years from adoption of the plan
b. Public education and awareness	County Building Official County Planning Department Emergency Management Coordinator Townships, Villages, City	1-3 years from adoption of the plan
c. Enforcement of building codes for new construction	County Building Official	Ongoing
Priority Area 2: High Winds and Tornado Mitigation		
a. Develop and implement mutual support and aid practices with surrounding communities	County Planning Emergency Management Coordinator County Building Official Townships, Villages, City	1-3 years from adoption of the plan
b. Tree management by power companies on power line easements	Emergency Management Coordinator County Building Official	Ongoing
c. Public education	County Building Official County Planning Emergency Management Coordinator Townships, Villages	1-3 years from adoption of the plan
d. Suggest that events have an evacuation/response plan	County Planning Emergency Management Coordinator	1-3 years from adoption of the plan
e. Building Code enforcement for new construction	County Building Official	Ongoing

Priority and Action Strategies	Responsible Parties	Timeframe
Priority Area 3: Erosion and Debris Flow Mitigation		
a. Inventory of shoreline erosion sites	County Planning Emergency Management Coordinator Drain Commissioner County Soil Conservation District	1-3 years from adoption of the plan
b. More detailed soil erosion permits – slide areas, drainage control, grading, debris flow measures, vegetation (native species) placement	County Soil Conservation District Emergency Management Coordinator MI Department of Environmental Quality	Ongoing
c. Zoning administration and enforcement of ordinances/permits	County Planning County Building Official Emergency Management Coordinator Drain Commissioner County Soil Conservation District MI Department of Environmental Quality U.S. Army Corps of Engineers	Ongoing
d. Open space designations: acquisition or conservation easements by land conservancies, county, townships	County Planning Townships, Villages Land Conservancies	1-5 years from adoption of the plan
e. Public education	County Planning Emergency Management Coordinator County Soil Conservation District Drain Commissioner Townships, Villages	1-3 year from adoption of the plan
f. Building code enforcement through permits	County Building Official	Ongoing
Priority Area 4: Flood Mitigation		
a. Assessment of flood threat and dam inspections results	Emergency Management Coordinator County Planning Drain Commissioner	1-3 years from adoption of the plan
b. Research a flood warning system	Emergency Management Coordinator	1-3 years from adoption of the plan
c. Public education	Emergency Management Coordinator County Planning Drain Commissioner County Soil Conservation District Townships, Villages	
d. Building code enforcement		Ongoing
Priority Area 5: Wildfire Mitigation Strategies		
a. Public education and awareness activities such as programs and brochures regarding fuel management, proper vegetation, fire breaks	County Planning Townships, City, Villages MSU Extension	1-3 years after adoption of the plan
b. Continue enforcement of state fire codes regarding setback requirements	County Planning Building Department MSU Extension Emergency Management Coordinator	Ongoing
c. Public education utilizing the Michigan Department of Natural Resources flyers and the Federal Emergency Management Administration information at parks and campgrounds	County Planning County Parks & Recreation MSU Extension Emergency Management Coordinator	1-3 years from adoption of the plan

Priority and Action Strategies	Responsible Parties	Timeframe
Priority Area 5: Wildfire Mitigation Strategies (continued)		
d. Real estate and insurance agents to distribute information	Insurance Agencies Real Estate Agencies Emergency Management Coordinator	Ongoing
e. Assess fire suppression access and make improvements	Emergency Management Coordinator	Ongoing
f. Research the Department of Natural Resources' State Forest wildfire/urban interface rules or plan	MSU Extension MDNR Emergency Management Coordinator	

Leelanau County can also utilize watershed management plans and data that have been developed within the county boundaries. Proposed mitigation strategies that have been laid out in the Grand Traverse Bay Watershed Management Plans include:

- Inventory shoreline erosion sites
- Reduce the magnitude of overland stormwater runoff to streams
- Minimize the change of terrestrial vegetation types from forest/shrub species to turf species
- Utilize maps for potential flood area and wetland identification
- Work to stop wetland and other types of lowland filling
- Protect critical riparian areas
- Limit habitat fragmentation by maintaining compact communities
- Adequate setbacks for buildings
- Minimize development clearings by landowners
- Establish riparian buffers along waterway
- Establish and support stormwater best management practices
- Reduce the amount of impervious surfaces in the watershed, especially in areas of high groundwater recharge
- Regularly inform public about the watershed, activities, study findings, success/example projects, and opportunities for contribution (organization to public)
- Provide focused information to residents, visitors, local governments, and other target groups on priority topics (organization to individual)
- Involve the citizens, public agencies, user groups and landowners in implementation of the watershed plan through meetings and workshops with individuals or groups.

Monitoring and Evaluation

The Leelanau County Natural Hazards Mitigation Plan will be monitored on a regular basis by the Emergency Management Coordinator and the Planning Department. Because Leelanau County is a dynamic, changing county with population growth, it is expected that the plan should be reviewed on an annual basis.

To assess the effectiveness of the Plan, some questions to ask in the review include: 1) How many and which mitigation strategies were developed? Implemented? 2) Did any new natural hazards events take place the past year to report? This review will be administered by the Emergency Management Coordinator with the Local Emergency Planning Committee, the County Planning Commission and Department, and the public. If changes are needed, the plan will be presented to the Task Force participants for revisions.

Although review of the plan will occur annually, and a formal revision may not be needed each year, a new edition of the plan will be expected within every five year period. New additions of the plan will be based on annual reviews, monitoring, evaluation, and an accumulation of official feedback and public input. When it is appropriate to publish a revised version of the plan, the Task Force participants shall again be involved in the revision process. Each new edition of the plan will again be officially adopted by the Leelanau County Board of Commissioners.

XII. NATURAL HAZARDS MITIGATION ADOPTION RESOLUTION (PLACEHOLDER LANGUAGE)

To be inserted after adoption by the Leelanau County Board of Commissioners

XIII. APPENDICES

Appendix A

Glossary of Mitigation Planning Terms

Alluvial fan: A gently sloping fan-shaped landform created over time by the deposition of eroded sediment and debris.

Base Flood: A flood having a one percent chance of being equaled or exceeded in any given year.

Coastal high hazard area: An area of special flood hazard extending from offshore to the inland limit of a primary frontal dune along an open coast and any other area subject to high velocity wave action from storms.

Disaster: A major detrimental impact of a hazard upon the population and economic, social, and built environment of an affected area.

Exposure: The number, types, qualities, and monetary values of various types of property or infrastructure and life that may be subject to an undesirable or injurious hazard event.

Flood Insurance Rate Map: As defined under the National Flood Insurance Program, an official map of the community on which the administrator of the Flood Insurance Administration has delineated both the special flood hazard areas and the risk premium zones applicable to the community.

Floodplain or flood prone area: Any land area susceptible to being inundated by water from any source.

Floodplain management: The operation of an overall program of corrective and preventive measures for reducing flood damage, including but not limited to emergency preparedness plans, flood control works, and floodplain management regulations.

Fuel: Combustible plant material, both living and dead, that is capable of burning in a wildland situation; any other flammable material in the built environment that feeds a wildfire.

Hazard: An event or physical condition that has the potential to cause fatalities, injuries, property damage, infrastructure damage, agricultural loss, damage to the environment, interruption of business, or other types of harm or loss.

Hazard identification: The process of defining and describing a hazard, including its physical characteristics, magnitude and severity, probability and frequency, causative factors, and locations or areas affected.

Lifeline systems: Public works and utilities such as electrical power, gas and liquid fuels, telecommunications, transportation, and water and sewer systems.

Major disaster: As defined in the Stafford Act, “any natural catastrophe or, regardless of cause, any fire, flood, or explosion in any part of the United States, which in the determination of the President causes damage of sufficient severity and magnitude to warrant major disaster assistance under this Act to supplement the efforts and available resources of states, local governments, and disaster relief organizations in alleviating the damage, loss, hardship, or suffering caused thereby.”

Mitigation: Sustained action taken to reduce or eliminate the long-term risk to human life and property from natural hazards and their effects. Note that this emphasis on long-term risk distinguishes mitigation from actions geared primarily to emergency preparedness and short-term recovery.

Multiple-objective management: A holistic approach to floodplain management (or the management of other hazards) that emphasizes the involvement of multiple distinct interests in solving land use problems related to the hazardous area.

Natural hazard: Hurricanes, tornadoes, storms, floods, tidal wave, tsunamis, high or wind-driven waters, volcanic eruptions, earthquakes, snowstorms, wildfires, droughts, landslides, and mudslides.

One hundred year flood: The flooding event that has a one percent chance of occurring in a particular location in any given year. While this is the most common reference point statistically because it is used for regulatory purposes in the National Flood Insurance Program, the same language applies in referring to other actual or hypothetical events in terms of their statistical probabilities.

Risk: The potential losses associated with a hazard, defined in terms of expected probability and frequency, exposure, and consequences.

Risk assessment: A process or method for evaluating risk associated with a specific hazard and defined in terms of probability and frequency of occurrence, magnitude and severity, exposure, and consequences.

Special flood hazard area: Land in the floodplain within a community subject to one percent or greater chance of flooding in any given year.

Stafford Act: The Robert T. Stafford Disaster Relief and Emergency Assistance Act (P.L. 93-288, as amended by P.L. 100-707), which provides the greatest single source of federal disaster assistance.

Structure: A walled and roofed building, including a storage tank for gas or liquid that is mostly above ground, as well as a manufactured home.

Tornado Classifications:

F-Scale Number	Intensity Phrase	Wind Speed	Type of Damage Done
F0	Gale tornado	40-72 mph	Some damage to chimneys, breaks branches off trees, pushes over shallow-rooted trees, damages sign boards.
F1	Moderate tornado	73-112 mph	The lower limit is the beginning of hurricane wind speed, peels surface off roofs, mobile homes pushed off foundations or overturned, moving autos pushed off the roads, attached garages may be destroyed.
F2	Significant tornado	113-157 mph	Considerable damage. Roofs torn off frame houses, mobile homes demolished, boxcars pushed over, large trees snapped or uprooted, light object missiles generated.
F3	Severe tornado	158-206 mph	Roof and some walls torn off well constructed houses, trains overturned, most trees in forest uprooted
F4	Devastating tornado	207-260 mph	Well-constructed houses leveled, structures with weak foundations blown off some distance, cars thrown and large missiles generated.
F5	Incredible tornado	261-318 mph	Strong frame houses lifted off foundations and carried considerable distances to disintegrate, automobile sized missiles fly through the air in excess of 100 meters, trees debarked, steel reinforced concrete

			structures badly damaged.
F6	**Inconceivable tornado**	**319-379 mph**	**These winds are very unlikely. The small area of damage they might produce would probably not be recognizable along with the mess produced by F4 and F5 wind that would surround the F6 winds. Missiles, such as cars and refrigerators would do serious secondary damage that could not be directly identified as F6 damage. If this level is ever achieved, evidence for it might only be found in some manner of ground swirl pattern, for it may never be identifiable through engineering studies**

Urban Wildfire: A fire moving from a wildland environment, consuming vegetation as fuel, to an environment where the fuel consists primarily of buildings and other structures.

Urban/wildland interface: A developed area, also known as the “I-zone,” occupying the boundary between an urban or settled area and a wildland characterized by vegetation that can serve as fuel for a forest fire.

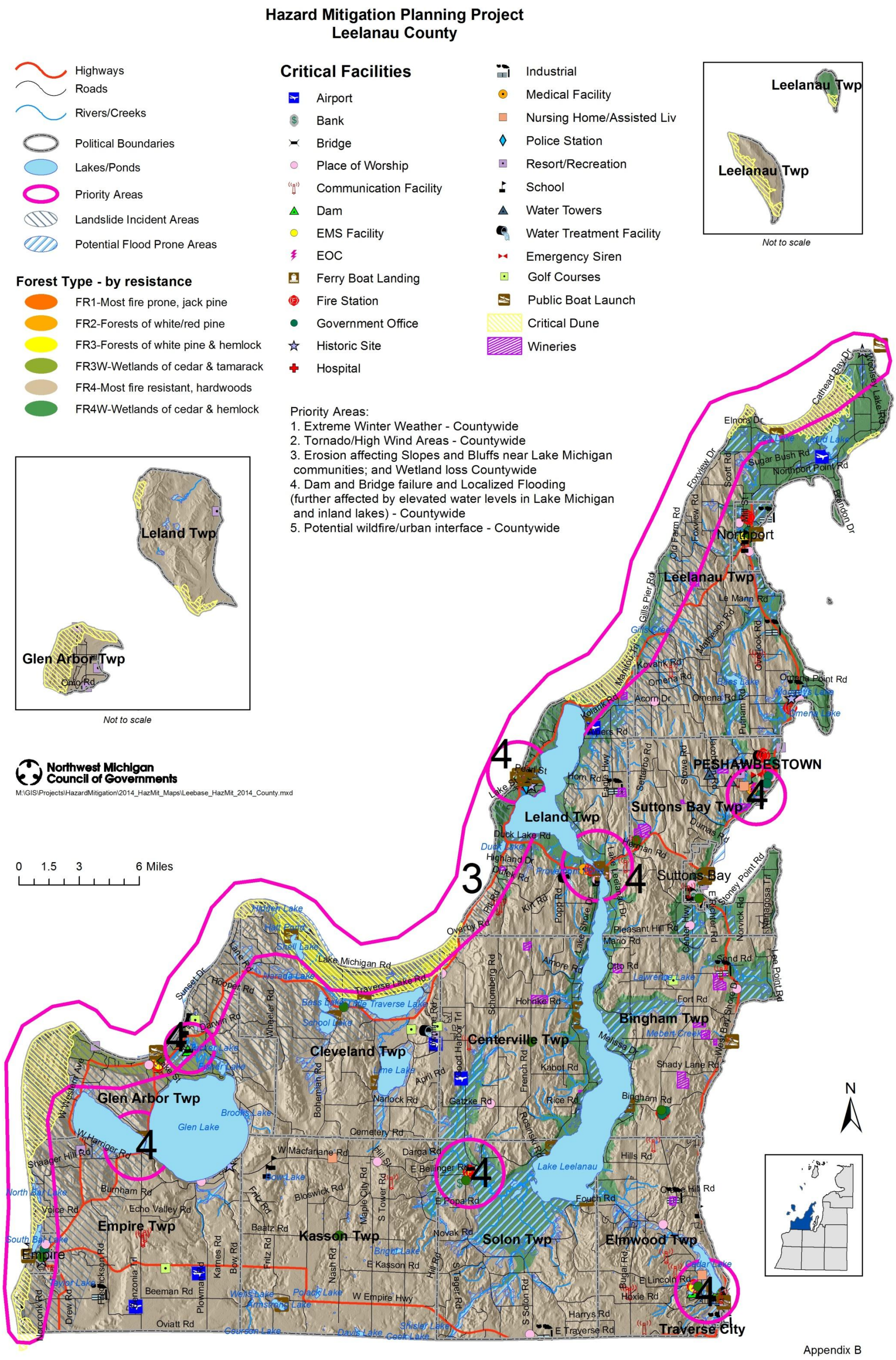
Vulnerability: The level of exposure of human life and property to damage from natural hazards.

Watershed management: The implementation of a plan or plans for managing the quality of flow of water within a watershed, the naturally defined area within which water flows into a particular lake or river or its tributary. The aims of watershed management are holistic and concern the maintenance of water quality, the minimization of stormwater runoff, the preservation of natural flood controls such as wetlands and pervious surface, and the preservation of natural drainage patterns. Watershed management is, in many ways, an enlargement of most of the concerns that underlie floodplain management.

Wildland: An area in which development has not occurred with the exception of some minimal transportation infrastructure such as highways and railroads, and any structures that are widely spaced and serve largely recreational purposes.

Appendix B

Detailed Maps



Hazard Mitigation Planning Project
Leelanau County - Peshawbestown

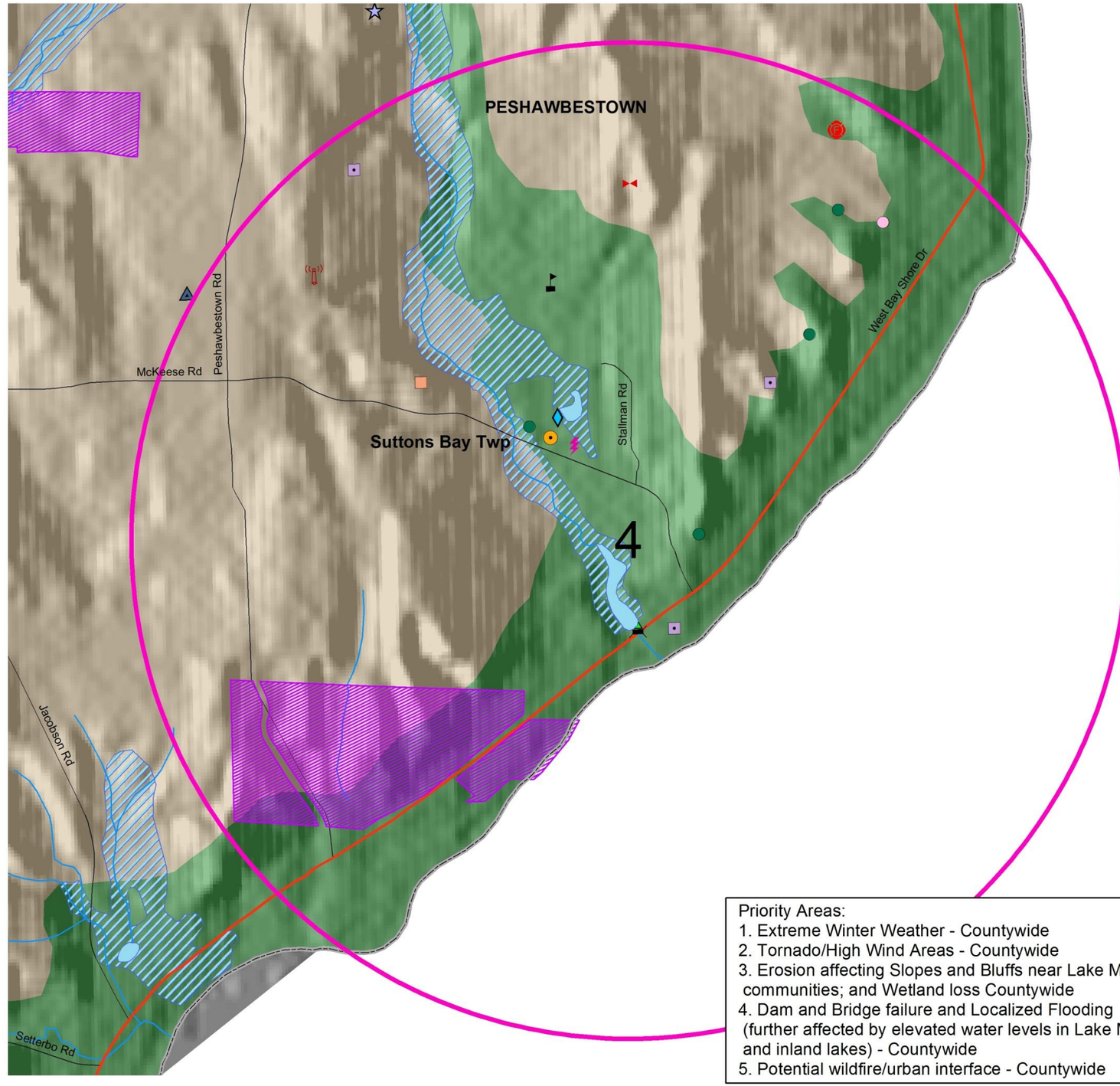
Forest Type - by resistance

- FR1-Most fire prone, jack pine
- FR2-Forests of white/red pine
- FR3-Forests of white pine & hemlock
- FR3W-Wetlands of cedar & tamarack
- FR4-Most fire resistant, hardwoods
- FR4W-Wetlands of cedar & hemlock

Critical Facilities

- Airport
- Bank
- Bridge
- Place of Worship
- Communication Facility
- Dam
- EMS Facility
- EOC
- Ferry Boat Landing
- Fire Station
- Government Office
- Historic Site
- Hospital
- Industrial
- Medical Facility
- Nursing Home/Assisted Liv
- Police Station
- Resort/Recreation
- School
- Water Towers
- Water Treatment Facility
- Emergency Siren
- Golf Courses
- Public Boat Launch
- Critical Dune
- Wineries

- Highways
- Roads
- Rivers/Creeks
- Political Boundaries
- Lakes/Ponds
- Priority Areas
- Landslide Incident Areas
- Potential Flood Prone Areas



Priority Areas:
1. Extreme Winter Weather - Countywide
2. Tornado/High Wind Areas - Countywide
3. Erosion affecting Slopes and Bluffs near Lake Michigan communities; and Wetland loss Countywide
4. Dam and Bridge failure and Localized Flooding (further affected by elevated water levels in Lake Michigan and inland lakes) - Countywide
5. Potential wildfire/urban interface - Countywide

Northwest Michigan Council of Governments

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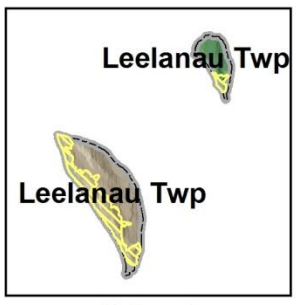
Hazard Mitigation Planning Project
Leelanau County - North Section

- Highways
- Roads
- Rivers/Creeks
- Political Boundaries
- Lakes/Ponds
- Priority Areas
- Landslide Incident Areas
- Potential Flood Prone Areas

Priority Areas:
1. Extreme Winter Weather - Countywide
2. Tornado/High Wind Areas - Countywide
3. Erosion affecting Slopes and Bluffs near Lake Michigan communities; and Wetland loss Countywide
4. Dam and Bridge failure and Localized Flooding (further affected by elevated water levels in Lake Michigan and inland lakes) - Countywide
5. Potential wildfire/urban interface - Countywide



Critical Facilities

- Airport
- Bank
- Bridge
- Place of Worship
- Communication Facility
- Dam
- EMS Facility
- EOC
- Ferry Boat Landing
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- Government Office
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- Police Station
- Resort/Recreation
- School
- Water Towers
- Water Treatment Facility
- Emergency Siren
- Golf Courses
- Public Boat Launch
- Critical Dune
- Wineries

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- FR2-Forests of white/red pine
- FR3-Forests of white pine & hemlock
- FR3W-Wetlands of cedar & tamarack
- FR4-Most fire resistant, hardwoods
- FR4W-Wetlands of cedar & hemlock

0 2.5 5 10 Miles

N

Northwest Michigan Council of Governments

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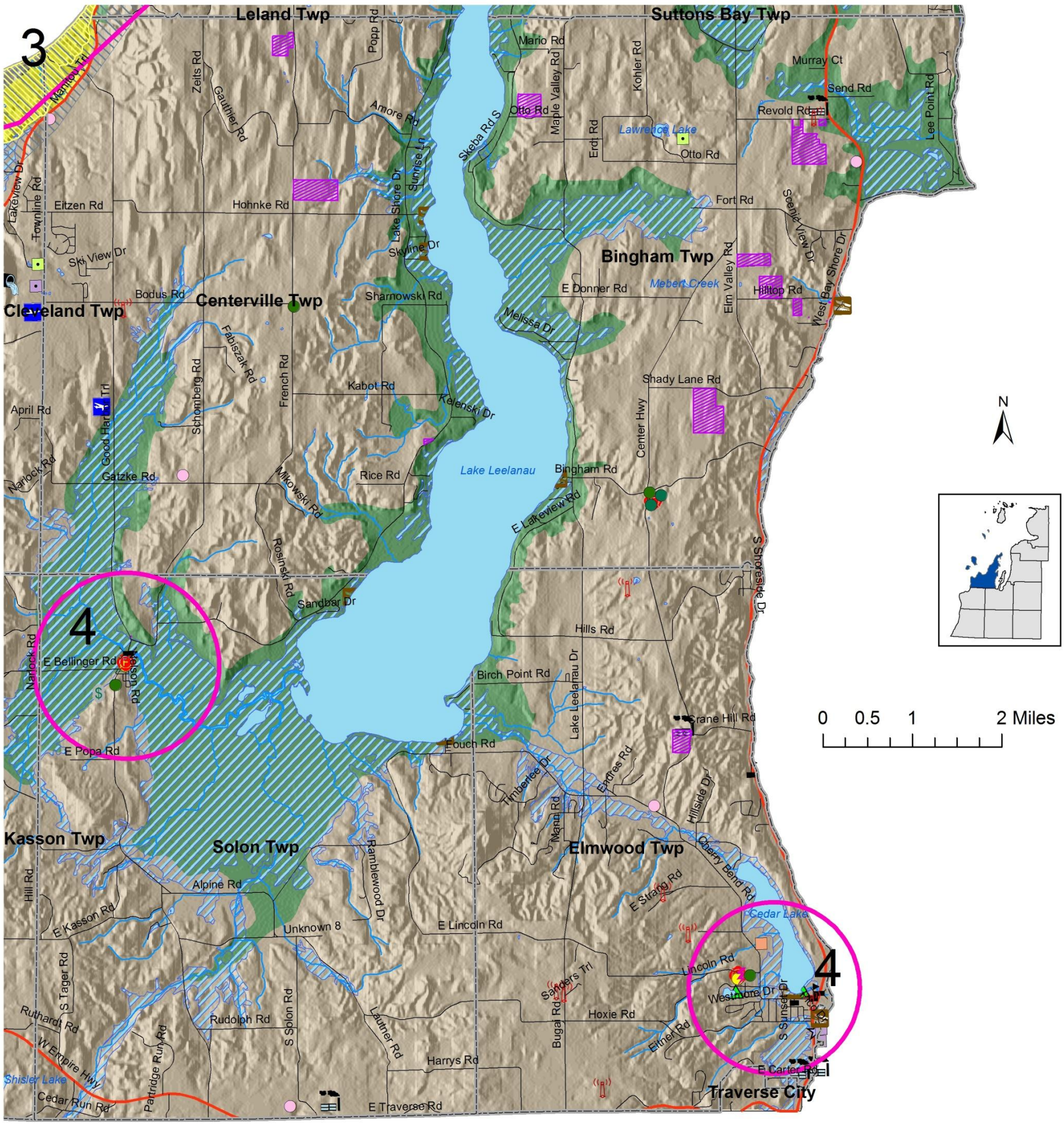
Hazard Mitigation Planning Project
Leelanau County - Southeast Section



Critical Facilities

- Airport
- Bank
- Bridge
- Place of Worship
- Communication Facility
- Dam
- EMS Facility
- EOC
- Ferry Boat Landing
- Fire Station
- Government Office
- Historic Site
- Hospital
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- Nursing Home/Assisted Liv
- Police Station
- Resort/Recreation
- School
- Water Towers
- Water Treatment Facility
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- Golf Courses
- Public Boat Launch
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2. Tornado/High Wind Areas - Countywide
3. Erosion affecting Slopes and Bluffs near Lake Michigan communities; and Wetland loss Countywide
4. Dam and Bridge failure and Localized Flooding (further affected by elevated water levels in Lake Michigan and inland lakes) - Countywide
5. Potential wildfire/urban interface - Countywide

Northwest Michigan Council of Governments

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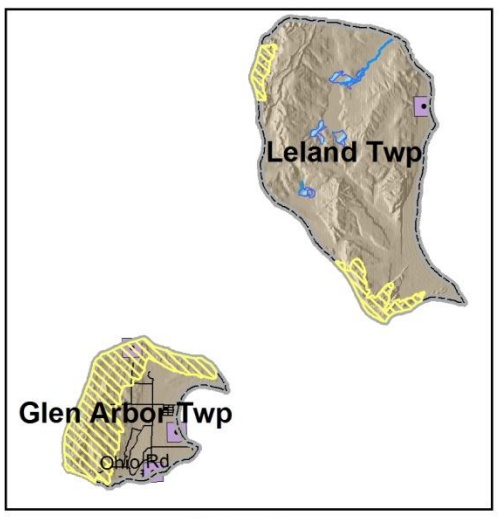
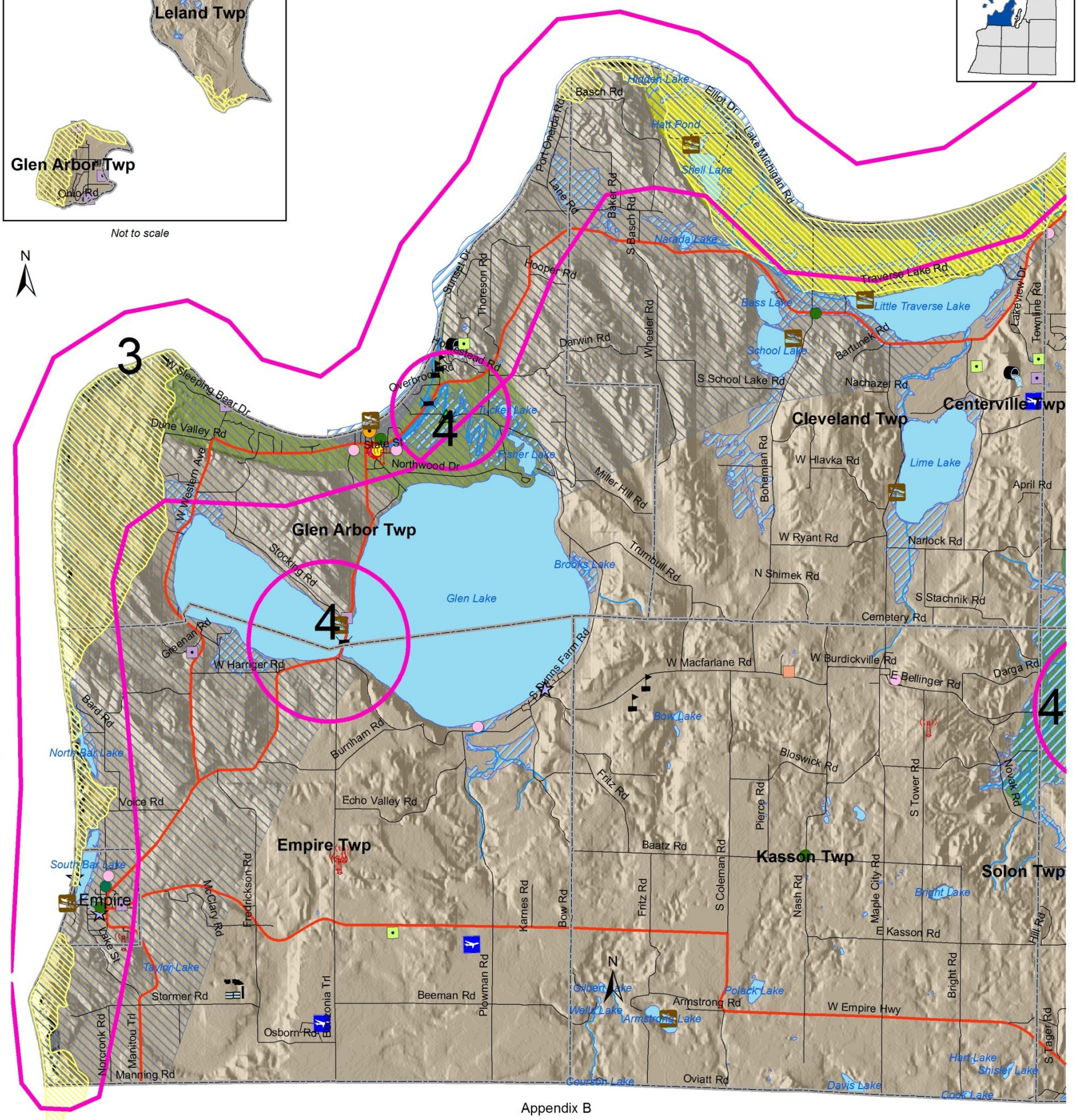
Hazard Mitigation Planning Project
Leelanau County - Southwest



Not to scale



Appendix B

Critical Facilities

- Airport
- Bank
- Bridge
- Place of Worship
- Communication Facility
- Dam
- EMS Facility
- EOC
- Ferry Boat Landing
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0 1.5 3 6 Miles

Priority Areas:
1. Extreme Winter Weather - Countywide
2. Tornado/High Wind Areas - Countywide
3. Erosion affecting Slopes and Bluffs near Lake Michigan communities; and Wetland loss Countywide
4. Dam and Bridge failure and Localized Flooding (further affected by elevated water levels in Lake Michigan and inland lakes) - Countywide
5. Potential wildfire/urban interface - Countywide

Northwest Michigan Council of Governments
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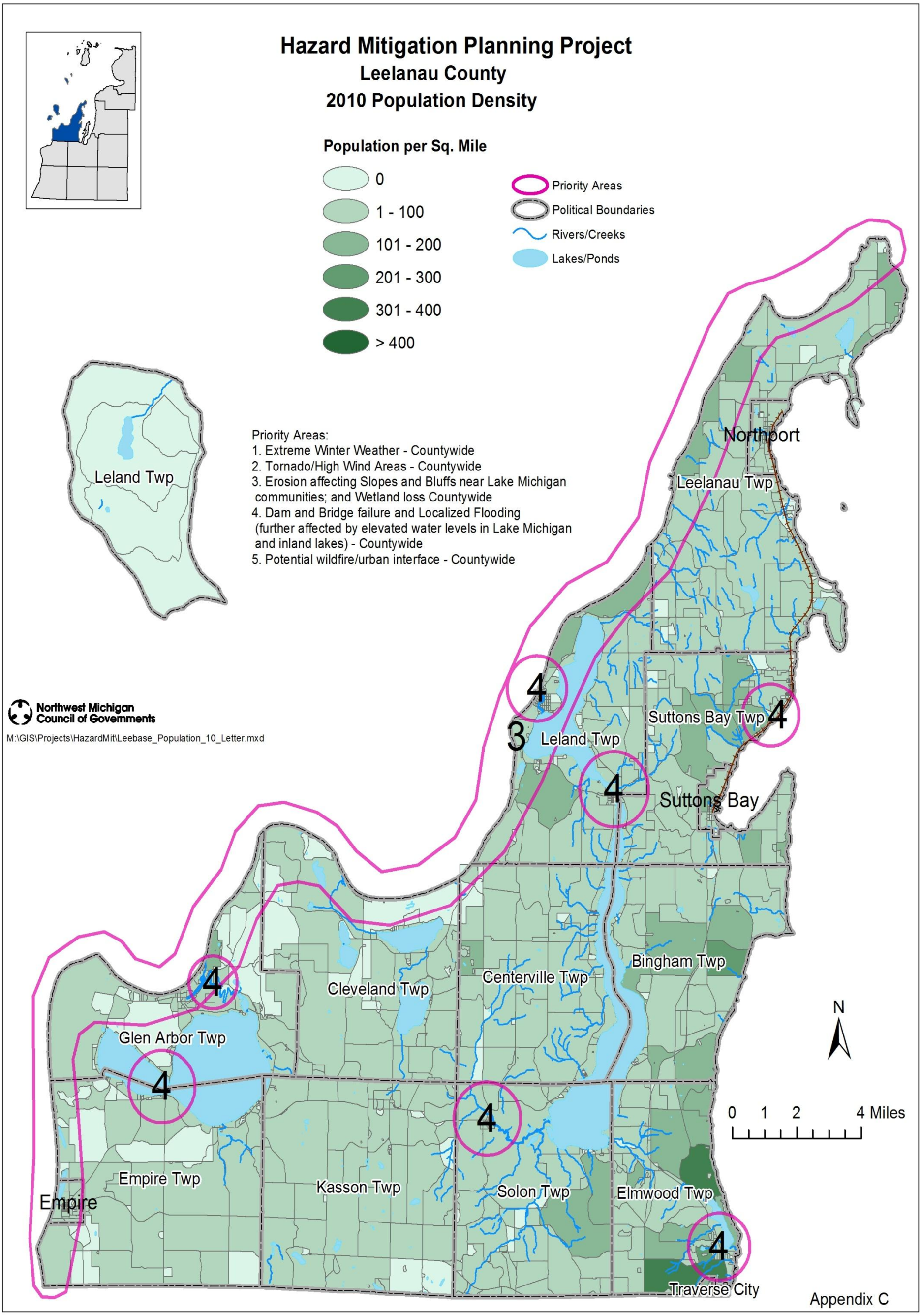
Appendix C

Population Density Map



Appendix D: **Critical Infrastructure**

Type	Name	Address	City	Latitude	Longitude	Parcel ID	Additional Information	Notes
Adult Foster Care Facility	Effie's	300 S. Grand Ave	Leland					
Adult Foster Care Facility	Fort Road Residence	4470 S. Forthill Dr	Suttons Bay					
Adult Foster Care Facility	Lakeview Estates	421 W. Harbor Hwy	Maple City					
Adult Foster Care Facility	Lincoln	8122 E. Lincoln Rd	Cedar					
Adult Foster Care Facility	Northport Highlands	215 S. High St	Northport					
Adult Foster Care Facility	Orchard Creek Supportive Care	9739 E. Cherry Bend Rd	Traverse City					
Adult Foster Care Facility	The Toy House Retirement Home	1990 N. Setterbo Rd	Suttons Bay					
Adult Foster Care Facility	The Wurm Residence	5419 S. French Rd	Cedar					
Airport	Sugarloaf			44.910688	-85.813631	003-024-001-00		
Airport	Woolsey			45.162575	-85.570724	008-224-003-00		
Airport	Empire			44.789416	-86.002391	005-033-002-00		
Airstrip	N. Fox Island			45.480784	-85.78536	008-590-001-00		
Airstrip	Miller			44.877365	-85.791202	002-032-004-01		
Bank	Chase Bank	9104 S Kasson St	Cedar					
Bank	Huntington Bank	10210 W Front St	Empire					
Bank	State Savings Bank	11470 S Leelanau Hwy	Empire					
Bank	Fifth Third Bank	6545 W Western Ave	Glen Arbor					
Bank	Northwestern Bank	13936 S West Bay Shore Dr	Greilickville					
Bank	Northpointe Bank	13818 S West Bay Shore Dr	Greilickville					
Bank	Chemical Bank	10691 E Carter Rd	Greilickville					
Bank	East Traverse Catholic Federal Credit Union	209 S St Marys St	Lake Leelanau					
Bank	TBA Credit Union	209 S St Marys St	Lake Leelanau					
Bank	Huntington Bank	111 N Main St	Leland					
Bank	Northwestern Bank	115 N Main St	Leland					
Bank	Huntington Bank	122 E Nagonaba St	Northport					
Bank	Northwestern Bank	212 S St Joseph St	Suttons Bay					
Bank	Northwestern Bank	105 W Fourth St	Suttons Bay					
Bank	Fifth Third Bank	120 S St Joseph St	Suttons Bay					
Bank	Traverse City State Bank	93 W Fourth St Suite D	Suttons Bay					
Bridge	M-22	SW Bay Shore D near Cherrybend Road		44.794357	-85.63624			
Bridge	M-22	NW Bay Shore Dr near Stallman Rd.		45.01214	-85.61339			
Bridge	M-22	S. Main St. near E. River St., Leland		45.02247	-85.760298			
Bridge	M-204	E. Duck Lake Rd. near S. Mary's St., Lake Leelanau		44.981404	-85.711624			
Bridge	M-201	Mill St. NP near Second St		45.130275	-85.615625			
Bridge	M-22	S. Glen Lake Rd., near Day Forest Rd		44.860758	-85.99605			
Bridge	M-22	W. Harbor Hwy. near Crystal View Rd		44.905014	-85.9739			
Bridge	Cedar River	S. Kasson St near E. Sullivan St., Cedar		44.849994	-85.793173			
Child Care Facility	Benodjenh Center	2600 N. Strongheart Way	Suttons Bay					
Child Care Facility	Bolger, Shana	1230 S. Pine View Rd	Suttons Bay					
Child Care Facility	Clarke, Nancy Mae	7050 S. Anscer Rd	Traverse City					
Child Care Facility	Drow-Harfst, Barbara Ann	9318 S. Nash Rd	Maple City					
Child Care Facility	Elliot, Sally	5485 E. Lincoln Rd	Cedar					
Child Care Facility	Glen Lake Elementary Child Care	3375 W. Burdickville Rd	Maple City					
Child Care Facility	Glen Lake Kids Club	3245 W. Burdickville Rd	Maple City					
Child Care Facility	Leelanau Children's Center	111 N. Fifth St	Leland					
Child Care Facility	Leelanau Children's Center - Northport	164 S. High St	Northport					
Child Care Facility	Leelanau Children's Center - School Age	200 N. Grand Ave	Leland					
Child Care Facility	Leelanau Montessori Public School Academy	310 S. Elm St	Suttons Bay					
Child Care Facility	Leland Kids Club	200 N. Grand Ave	Leland					
Child Care Facility	Martin, Gwendolyn	5675 N. Manitou Trl	Leland					
Child Care Facility	Maslowski-Neumann, Jan	4468 E. Rudolph Rd	Cedar					
Child Care Facility	McDonough, Julie	6619 S. Lime Lake Rd	Cedar					

Child Care Facility	Morio, Kathryn Marie	2301 S. Lake Leelanau Dr	Lake Leelanau					
Child Care Facility	Mudget, Gail Yvonne	12630 S. Cedar Ln	Traverse City					
Child Care Facility	Northport Public School Age	104 S. Wing St	Northport					
Child Care Facility	Pathfinder School	11930 S. West-Bay Shore Dr	Traverse City					
Child Care Facility	Precious Times Christian Daycare	4755 E. Gauthier Rd	Cedar					
Child Care Facility	Reece, Susan Marie	8292 S. West-Bay Shore Dr	Traverse City					
Child Care Facility	Roush, Jessica	10800 S. Maple City Rd	Maple City					
Child Care Facility	SEEDS: Suttons Bay	310 S. Elm St	Suttons Bay					
Child Care Facility	Schaub, Andrea	110 S. St Joseph St	Lake Leelanau					
Child Care Facility	Skowronski, Judith	2620 S. Kohler Rd	Suttons Bay					
Child Care Facility	Slagal, Jan Marie	9300 E. Cherry Bend Rd	Traverse City					
Child Care Facility	Smith, Shelly	7988 S. Center Hwy	Traverse City					
Child Care Facility	St. Mary Preschool	209 S. St Mary St	Lake Leelanau					
Child Care Facility	Suttons Bay Early Childhood Education Programs	310 S. Elm St	Suttons Bay					
Child Care Facility	Suttons Bay Kids Club	310 S. Elm St	Suttons Bay					
Child Care Facility	Suttons Bay Migrant Head Start	1878 S. West-Bay Shore Dr	Suttons Bay					
Child Care Facility	TBA-ISD Migrant Child Care	310 S. Elm St	Suttons Bay					
Child Care Facility	Trudeau, Jennifer Lynn	412 S. St Mary St	Lake Leelanau					
Child Care Facility	VanderZon, Latisha	4972 S. Lime Lake Rd	Cedar					
Dam	Leland Dam			45.02247	-85.760298	009-009-009-00		
Dam	Cedar Lake Dam			44.794357	-85.63624			
Dam	Meeuwenberg Dam			44.794648	-85.655364	004-380-901-00		
Dam	Belanger Dam			45.01214	-85.61339	011-140-003-00		
Dam	Fisher Lake Dam			44.90021	-85.955			
Farm Plans 302 Sites	Alpers Farm	7373 E Pertner Rd		45.024411	-85.70571			
Farm Plans 302 Sites	Bardenhagen Berries	7990 E Horn Rd		45.008279	-85.695203			
Farm Plans 302 Sites	Black Star Farm	10844 E Revold Rd		44.933061	-85.635151			
Farm Plans 302 Sites	Carlson Farms	6715 N Swede Rd		45.080016	-85.643887			
Farm Plans 302 Sites	Cherry Bay Orchards	2801 N Jacobson Rd		45.023097	-85.647525			
Farm Plans 302 Sites	Cherry Growers	9440 S Center Hwy		44.841176	-85.667464			
Farm Plans 302 Sites	Cherry Home Orchard	7271 N West Bay Shore Dr		45.088238	-85.603848			
Farm Plans 302 Sites	Cherry Lane Farms	2866 S Lee Point Rd		44.937604	-85.611026			
Farm Plans 302 Sites	Cherry View Farms	9610 E Bingham Rd		44.879673	-85.661567			
Farm Plans 302 Sites	Eagle View Farms	9051 E Duck Lake Rd		44.997249	-85.674033			
Farm Plans 302 Sites	Eitzen Farms	4023 S Good Harbor Trl		44.919701	-85.79529			
Farm Plans 302 Sites	Flaska Farm	573 W Ryant Rd		44.874269	-85.865428			
Farm Plans 302 Sites	Frammi Enterprises	6997 E Horn Rd		45.016895	-85.712138			
Farm Plans 302 Sites	Fredrickson Farm	10201 N Foxview Dr		45.132674	-85.647507			
Farm Plans 302 Sites	Grant Farms	3883 S Lake Leelanau Dr		44.924119	-85.713237			
Farm Plans 302 Sites	Harbor Hills Fruit Farm	1742 S Schomberg Rd		44.955573	-85.772786			
Farm Plans 302 Sites	Hohnke & Sons	3383 E Hohnke Rd		44.922545	-85.788395			
Farm Plans 302 Sites	James Bardenhagen Farm	7881 E Pertner Rd		45.02621	-85.695885			
Farm Plans 302 Sites	John Gallagher Farms	8641 E Lincoln Rd		44.798529	-85.680083			
Farm Plans 302 Sites	John Schlueter Farm	3291 S French Rd		44.932391	-85.753709			
Farm Plans 302 Sites	Edward and Anne Kalchik	6352 N Jelinek Rd		45.074693	-85.672915			
Farm Plans 302 Sites	Keith Parker Farm	12675 S Solon Rd		44.794497	-85.753752			
Farm Plans 302 Sites	Kiessel Farms	10477 E Fort Rd		44.921963	-85.643986			
Farm Plans 302 Sites	L. Mawby Vineyards	4519 S Elm Valley Rd		44.913752	-85.652152			
Farm Plans 302 Sites	Glenn LaCross Farms	5536 S Sharnowski Rd		44.894144	-85.736164			
Farm Plans 302 Sites	Leelanau Fruit Company	2900 S West Bay Shore Dr		44.937732	-85.63412			
Farm Plans 302 Sites	Legacy Orchards	7666 E Hoxie Rd		44.789283	-85.704041			
Farm Plans 302 Sites	Mike McManus Farm	3550 N Eagle Hwy		45.035314	-85.700226			
Farm Plans 302 Sites	NW MI Horticultural Research Station (MSU)	6686 S Center Hwy		44.881813	-85.67533			
Farm Plans 302 Sites	Overlook Farms	6961 N Overlook Rd		45.082099	-85.608813			

Farm Plans 302 Sites	Redpath Orchards	7373 E Pertner Rd		44.024411	-85.70571			
Farm Plans 302 Sites	Runge Industries	7661 E Horn Rd		45.018743	-85.700239			
Farm Plans 302 Sites	Stallman Chemical	113 W Fourth St		44.970282	-85.652267			
Farm Plans 302 Sites	Stoney Point Orchards	475 S Donnybrook Rd		44.974182	-85.607986			
Farm Plans 302 Sites	Stuart Whittaker Farm	4745 S Center Hwy		44.910512	-85.65855			
Farm Plans 302 Sites	Sunblossom Orchards	10266 E Revold Rd		44.935404	-85.646908			
Farm Plans 302 Sites	Suttons Point Farms	180 N Nanagosa Trl		44.983079	-85.601793			
Farm Plans 302 Sites	Suttons Point Farms	Sylt Rd		44.993777	-85.694363			
Farm Plans 302 Sites	Tom Korson Farms	8580 E Pertner Rd		45.024298	-85.684252			
Farm Plans 302 Sites	Victor Chimoski Farm	4044 N Jacobson Rd		45.040662	-85.644297			
Farm Plans 302 Sites	Victor Chimoski Farm	620 S Donnybrook Rd		44.973274	-85.612355			
Farm Plans 302 Sites	WFLP dba SFF and Omena Organics	7250 N Overlook Rd		45.087231	-85.606326			
Fresh Water Supply	Suttons Bay Village			44.980584	-85.655802			
Fresh Water Supply	GTB Putnam Rd #1 tank			45.020175	-85.63353			
Fresh Water Supply	Tank #2 (larger)			45.020659	-85.633639			
Fresh Water Supply	Empire Village			45.126	-85.63			
Fresh Water Supply	Northport Village			45.129591	-85.631877			
Fresh Water Supply	Homestead Resort			44.917	-85.967			
Government Building	Benzie/Leelanau District Health Department	7401 E. Duck Lake Rd	Lake Leelanau					
Government Building	Bingham Township Hall	7171 S. Center Hwy	Traverse City					
Government Building	Centerville Township Hall	5001 S. French Rd	Cedar					
Government Building	Cleveland Township Hall	995 W. Harbor Hwy	Maple City					
Government Building	Elmwood Township Hall	10090 E. Lincoln Rd	Traverse City					
Government Building	Empire Township Hall	10088 W. Front St	Empire					
Government Building	Empire Village Hall	11518 S. LaCore St	Empire					
Government Building	Glen Arbor Township Hall	6394 W. Western Ave	Glen Arbor					
Government Building	GTB Strongheart Center	2600 N. Strongheart Way	Peshawbestown					
Government Building	Kasson Township Hall	10988 S. Newman Rd	Maple City					
Government Building	Leelanau Township Hall	119 E. Nagonaba St	Northport					
Government Building	Leland Township Hall	123 N. St Josephs St	Lake Leelanau					
Government Building	Northport Village Hall	116 W. Nagonaba St	Northport					
Government Building	NPS Leelanau Ranger Station	5291 S. Glen Haven Rd	Glen Arbor					
Government Building	Sleeping Bear National Lakeshore Headquarters	9922 W. Front St	Empire					
Government Building	Solon Township Hall	8907 S. Railroad Ave	Cedar					
Government Building	Suttons Bay Township Hall	95 W. Fourth St	Suttons Bay					
Government Building	Suttons Bay Village Hall	420 N. Front St	Suttons Bay					
Industrial	CONSUMERS ENERGY CO	W BROADWAY				011-029-001-00	ELECTRICAL SUBSTATION	
Industrial	CONSUMERS ENERGY CO	S ELM ST				043-829-019-00	ELECTRICAL SUBSTATION	
Industrial	CONSUMERS ENERGY CO	10580 E ECKERLE RD				043-833-001-20	ELECTRICAL SUBSTATION	
Industrial	WOLVERINE POWER SUPPLY CO-OP INC	496 N EAGLE HWY				009-024-004-00	ELECTRICAL SUBSTATION	
Industrial	CONSUMERS ENERGY CO	E DUCK LAKE RD				009-898-005-00	ELECTRICAL SUBSTATION	
Industrial	CONSUMERS ENERGY CO	N JACOBSON RD				008-133-003-01	ELECTRICAL SUBSTATION	
Industrial	CONSUMERS ENERGY CO	225 S WING ST				042-500-075-00	ELECTRICAL SUBSTATION	
Industrial	CONSUMERS ENERGY CO	5615 S DUNNS FARM RD				006-124-036-00	ELECTRICAL SUBSTATION	
Industrial	WOLVERINE POWER SUPPLY CO-OP INC	10995 S MANN RD				004-018-014-10	ELECTRICAL SUBSTATION	
Industrial	WOLVERINE POWER SUPPLY CO-OP INC	13807 S BUGAI RD				004-031-034-10	ELECTRICAL SUBSTATION	
Industrial	CONSUMERS ENERGY CO	7100 E LINCOLN RD				004-125-001-20	ELECTRICAL SUBSTATION	
Industrial	CONSUMERS ENERGY CO	500 E SULLIVAN WOODS RD				003-035-017-00	ELECTRICAL SUBSTATION	
Industrial	WOLVERINE POWER SUPPLY CO-OP INC	2802 S WEST-BAY SHORE DR				001-004-019-00	ELECTRICAL SUBSTATION	
Industrial	MARATHON PETROLEUM COMPANY LP	13510 S WEST-BAY SHORE DR				004-033-096-00	FUEL STORAGE	MARATHON PETROLEUM COMPANY STORAGE & DOCK
Industrial	D & K PROPERTIES OF LELAND LLC	946 S SAWMILL RD				009-033-006-30	INDUSTRIAL SITE	LITTLE FISH WOODWORKS
Industrial	PLAMONDON FAMILY LLC	226 W MAIN ST				009-770-204-00	INDUSTRIAL SITE	LAKE LEELANAU EXCAVATING

Industrial	PETERSON CHARLES R & PATRICIA	13600 E WOOLSEY LAKE RD				008-224-006-10	INDUSTRIAL SITE	
Industrial	SHERWOOD REALTY LLC	922 N MILL ST				042-234-004-10	INDUSTRIAL SITE	SHERWOOD MANUFACTURING CORPORATION
Industrial	MILL STREET PARTNERS	931 N MILL ST				042-234-016-10	INDUSTRIAL SITE	THOMAS & MILLIKEN MILLWORKS
Industrial	ALLINGTON FAMILY TRT	771 N MILL ST				042-301-001-00	INDUSTRIAL SITE	MASTER CRAFT EXTRUSION TOOLS INC
Industrial	TRIPLE D ORCHARDS	8310 W STORMER RD				005-029-007-00	INDUSTRIAL SITE	TRIPLE D ORCHARDS FRUIT PROCESSOR
Industrial	CHERRY GROWERS INC	9440 S CENTER HWY				004-008-009-00	INDUSTRIAL SITE	CHERRY GROWERS INC FRUIT PROCESSOR
Industrial	LEELANAU FRUIT COMPANY	2900 S WEST-BAY SHORE DR				001-004-018-00	INDUSTRIAL SITE	LEELANAU FRUIT COMPANY FRUIT PROCESSOR
Industrial	BINGHAM PARTNERS INC	8595 E BINGHAM RD				001-030-021-00	INDUSTRIAL SITE	PDM LUMBER CO
Industrial	D & K PROPERTIES OF LELAND LLC	946 S SAWMILL RD				009-033-006-00	RESIDENTIAL	LITTLE FISH WOODWORKS
Industrial	LAKE LEELANAU EXCAVATING	N MANITOU TRL				009-125-001-50	SAND-GRAVEL PIT	
Industrial	RIETH RILEY CONSTRUCTION CO INC	9848 S COLEMAN RD				007-008-005-10	SAND-GRAVEL PIT	
Industrial	LAKE LEELANAU EXCAVATING	S NASH RD				007-009-002-00	SAND-GRAVEL PIT	
Industrial	LAKE LEELANAU EXCAVATING	9310 S NASH RD				007-010-010-00	SAND-GRAVEL PIT	
Industrial	NOONAN FAMILY LLP	10285 S PIERCE RD				007-016-001-00	SAND-GRAVEL PIT	
Industrial	NOONAN FAMILY LLP	10282 S PIERCE RD				007-016-003-10	SAND-GRAVEL PIT	
Industrial	NOONAN GLEN M & ELLA M	W KASSON CENTER RD				007-016-003-20	SAND-GRAVEL PIT	
Industrial	NOONAN FAMILY LLP	10015 S COLEMAN RD				007-016-004-00	SAND-GRAVEL PIT	
Industrial	NOONAN GLEN M & ELLA M	W KASSON CENTER RD				007-016-006-10	SAND-GRAVEL PIT	
Industrial	ELMERS REAL ESTATE COMPANY LLC	10212 S COLEMAN RD				007-017-001-20	SAND-GRAVEL PIT	
Industrial	ELMERS CRANE & DOZER INC	2272 W EMPIRE HWY				007-020-001-00	SAND-GRAVEL PIT	
Industrial	ELMERS REAL ESTATE COMPANY LLC	W KASSON CENTER RD				007-021-013-05	SAND-GRAVEL PIT	
Industrial	CONCRETE SERVICE INC	S NEWMAN RD				007-027-006-00	SAND-GRAVEL PIT	
Industrial	PEPLINSKI DONALD & MARIAN	S NEWMAN RD				007-027-007-00	SAND-GRAVEL PIT	
Industrial	FLASKA CHARLES J & MARILYN M	12488 S NEWMAN RD				007-028-003-00	SAND-GRAVEL PIT	
Medical Care Facility	Crystal Lake Clinic	9975 W. Ottawa Ave	Empire					
Medical Care Facility	Munson Health Care Paul Oliver Offsite	9973 W. Ottawa Ave	Empire					
Medical Care Facility	Cherry Bend Family Care	10223 E. Cherry Bend Rd	Traverse City					
Medical Care Facility	Creekside Clinic	49 N. Eagle Hwy	Lake Leelanau					
Medical Care Facility	Dr. Michael J. Ziter MD	301 N. Mill St	Northport					
Medical Care Facility	GTB Family Health Clinic	2300 N. Stallman Rd	Peshawbestown					
Medical Care Facility	Leelanau Urgent Care	650 S. West-Bay Shore Dr	Suttons Bay					
Medical Care Facility	Suttons Bay Medical Clinic	93-B W. Fourth St	Suttons Bay					
Place of Worship	LEELANAU COMMUNITY CHURCH	245 S LAKE LEELANAU DR				011-025-009-20		
Place of Worship	IMMACULATE CONCEPTION CHURCH	N WEST-BAY SHORE DR				011-643-020-00		
Place of Worship	IMMANUEL LUTHERAN CHURCH	203 N LINCOLN ST				043-762-013-00		
Place of Worship	FIRST EVANGELICAL LUTHERAN CHURCH	321 N ST MARYS ST				043-801-422-00		
Place of Worship	ST MICHAELS CHURCH	118 S ELM ST				043-829-010-00		
Place of Worship	WEST SIDE COMMUNITY CHURCH INC	4975 E TRAVERSE HWY				010-033-016-10		
Place of Worship	ZION BAPTIST MINISTRIES	6563 E HARRYS RD				010-035-003-21		
Place of Worship	CHURCH M E (LELAND METHODIST)	106 N FOURTH ST				009-580-702-00		
Place of Worship	IMMANUEL EVANGELICAL LUTHERAN	315 E PEARL ST				009-750-251-00		
Place of Worship	IMMANUEL EVANGELICAL LUTHERAN	303 E PEARL ST				009-750-252-00		
Place of Worship	ST MARYS CHURCH AUDITORIUM	310 S ST MARYS ST				009-770-401-00		
Place of Worship	UNITED METHODIST INDIAN	8626 N MANITOU TRL				008-109-013-00		
Place of Worship	OMENA PRESBYTERIAN CHURCH	5066 N WEST-BAY SHORE DR				008-125-016-00		
Place of Worship	ST WENCESLAUS CHURCH	8500 E KOLARIK RD				008-130-007-00		

Place of Worship	SWEDISH EVANGELICAL COVENANT	409 S SHABWASUNG ST				042-100-052-00		
Place of Worship	ST GERTRUDE CATHOLIC CHURCH	701 N WARREN ST				042-234-022-00		
Place of Worship	TRINITY CHURCH OF UNITED	103 N WARREN ST				042-450-021-00		
Place of Worship	ST RITA ST JOSEPH CHURCH	8707 S HILL ST				007-002-028-00		
Place of Worship	MAPLE CITY COMMUNITY CHURCH	89 W CHURCH ST				007-003-051-00		
Place of Worship	ST RITA CATHOLIC CHURCH	9243 S MAPLE CITY RD				007-010-006-00		
Place of Worship	BETHLEHEM LUTHERAN CHURCH	6012 S LAKE ST				006-122-070-00		
Place of Worship	FIRST CHURCH OF CHRIST SCIENTIST	6753 W HARBOR HWY				006-740-072-00		
Place of Worship	GLEN LAKE COMMUNITY CHURCH	4884 W MACFARLANE RD				005-012-054-00		
Place of Worship	EMPIRE BAPTIST CHURCH	7474 W EMPIRE HWY				005-028-003-00		
Place of Worship	EMPIRE METHODIST CHURCH	10050 W MICHIGAN ST				041-300-075-00		
Place of Worship	ST PHILIP NERI CHURCH	11411 S LACORE RD				041-719-011-00		
Place of Worship	NORTHLAND CHURCH OF THE UNITED	9105 E FOUCH RD				004-017-015-10		
Place of Worship	WEST BAY COVENANT CHURCH	12720 S WEST-BAY SHORE DR				004-028-100-00		
Place of Worship	FAITH MISSIONARY BAPTIST CHURCH	8075 E HOXIE RD				004-030-011-10		
Place of Worship	ST JOSEPH CATHOLIC CHURCH	5899 S BOHEMIAN RD				003-021-017-00		
Place of Worship	ST PAULS LUTHERAN CHURCH	2943 S MANITOU TRL				002-006-020-00		
Place of Worship	KILWY CHURCH & CEMETERY	S GOOD HARBOR TRL				002-007-003-00		
Place of Worship	HOLY ROSARY CATHOLIC CHURCH	3919 E GATZKE RD				002-029-009-00		
Place of Worship	KESWICK UNITED METH CHURCH	3376 S CENTER HWY				001-008-009-15		
Police Station	Grand Traverse Band Tribal Police	2300 N. Stallman Rd	Suttons Bay					
Police Station	Leelanau County Sheriff's Office	8525 E. Government Center Dr	Suttons Bay					
Police Station	Elmwood Township Deputy Office	10090 E. Lincoln Rd	Traverse City					
Police Station	Leelanau Township Deputy Office	100 W. Eighth St	Northport					
Police Station	National Park Service Ranger Station	9922 W. Front St	Empire					
Police Station	Suttons Bay Township Deputy Office	201 S. St Marys St	Suttons Bay					
School	PHOENIX SCHOOL INC	11930 S WEST-BAY SHORE DR				004-021-020-00		
School	PHOENIX SCHOOL INC	S WEST-BAY SHORE DR				004-021-020-50		
School	GTRAC LLC	10781 E CHERRY BEND RD				004-028-059-00		
School	PHOENIX SCHOOL INC	11930 S WEST-BAY SHORE DR				004-028-151-00		
School	PHOENIX SCHOOL INC	11930 S WEST-BAY SHORE DR				004-028-154-00		
School	EMPIRE RURAL AG SCHOOL	S BENZONIA TRL				005-022-004-00		
School	EMPIRE RURAL AG SCHOOL	S BENZONIA TRL				005-022-005-00		
School	EMPIRE RURAL AG SCHOOL	S BENZONIA TRL				005-022-008-00		
School	GLEN LAKE COMMUNITY SCHOOL	W CHENEY RD				006-030-002-00		
School	GLEN LAKE COMMUNITY SCHOOL	S PORT ONEIDA RD				006-101-013-00		
School	LEELANAU CENTER FOR EDUCATION	S HOMESTEAD RD				006-114-012-00		
School	LEELANAU CENTER FOR EDUCATION	S HOMESTEAD RD				006-114-013-00		
School	LEELANAU CENTER FOR EDUCATION	W HARBOR HWY				006-122-104-10		
School	LEELANAU CENTER FOR EDUCATION	5233 S OLD HOMESTEAD RD				006-123-009-00		
School	LEELANAU CENTER FOR EDUCATION	5233 S OLD HOMESTEAD RD				006-123-009-10		
School	GLEN LAKE COMMUNITY SCHOOL	3245 W BURDICKVILLE RD				007-006-025-00		
School	GLEN LAKE COMMUNITY SCHOOL	W BURDICKVILLE RD				007-006-026-00		
School	GLEN LAKE COMMUNITY SCHOOL	W BURDICKVILLE RD				007-007-001-00		
School	GLEN LAKE COMMUNITY SCHOOL	3375 W BURDICKVILLE RD				007-007-003-00		
School	NORTHPORT PUBLIC SCHOOLS	N PURKISS RD				008-018-002-00		
School	LELAND PUBLIC SCHOOLS	200 N GRAND AVE				009-009-002-00		
School	ST MARYS CHURCH & SCHOOL	303 S ST MARYS ST				009-025-002-00		
School	TOWNSHIP SCHOOL UNIT	N MANITOU ISLAND				009-203-004-00		
School	LELAND PUBLIC SCHOOLS	200 N GRAND AVE				009-580-401-00		
School	NORTHPORT PUBLIC SCHOOLS	104 S WING ST				042-200-001-00		
School	NORTHPORT PUBLIC SCHOOLS	104 S WING ST				042-200-057-00		
School	NORTHPORT PUBLIC SCHOOLS	W THIRD ST				042-234-030-10		
School	NORTHPORT PUBLIC SCHOOLS	S SHABWASUNG ST				042-500-052-00		

School	NORTHPORT PUBLIC SCHOOLS	S SHABWASUNG ST				042-500-054-00		
School	SUTTONS BAY PUBLIC SCHOOL	310 S ELM ST				043-829-018-00		
Tower Site	Old Elmwood FD			44.793022	-85.638197	004-028-101-00		
Tower Site	Breithaupt Rd.			44.804186	-85.666314	004-029-004-00		
Tower Site	Strang Rd.			44.810839	-85.671968	004-020-030-00		
Tower Site	Bugai Rd.			44.794667	-85.694667	004-125-007-25		
Tower Site	S. Center Hwy/Bing.			44.860235	-85.679604	004-006-001-00		
Tower Site	Revold Dr.			44.936246	-85.636476	001-004-018-00		
Tower Site	Suttons Bay School			44.972562	-85.6566944	043-829-018-00		
Tower Site	LEC			44.99383	-85.68916667	011-019-004-00		
Tower Site	Putnam Rd. GTB			45.030072	-85.609417	011-658-001-00		
Tower Site	Omena Davis Rd.			45.074643	-85.611911	008-122-008-10		
Tower Site	Northport Fire			45.137673	-85.616338	042-234-017-07		
Tower Site	Kovarik Rd.			45.070197	-85.666773	008-120-010-00		
Tower Site	Pit Rd			44.96639	-85.77425	009-033-006-10		
Tower Site	Bodus Rd.			44.90581	-85.794177	002-020-007-00		
Tower Site	Maple City Tower Rd			44.844389	-85.842906	007-011-001-00		
Tower Site	Glen Lake Fire			44.895393	-85.9861	006-127-027-30		
Tower Site	Benzonia Trl			44.819673	-85.997962	005-022-003-00		
Tower Site	Northern Star Benzon			44.821214	-85.996334	005-022-002-00		
Tower Site	AT&T off 641			44.983956	-85.695829	009-024-029-00		
Wastewater Treatment	Suttons Bay			44.958589	-85.647767			
Wastewater Treatment	Sugarloaf			44.912	-85.816			
Wastewater Treatment	GTB			45.030662	-85.608819			
Wastewater Treatment	Empire Village			44.811	-86.06			
Wastewater Treatment	Northport Village			45.125519	-85.625693			
Wastewater Treatment	Homestead Resort			44.913	-85.964			

APPENDIX E

Risk Assessment Summary Table: LEELANAU COUNTY

HAZARD (Years of Record)	Number of Events	Probability**	Geographic Size Affected	Population Impacted	Specific Priority	Estimated Damage Known Costs
Lake Surf Erosion and Severe Erosion	Lost homes near Leland	Cyclical water level change	Lake Michigan shoreline Countywide	8,180 21,708	**3**	NA
Flooding 1993 – 2014)	6 events	Occasional	Wetland loss - county Dams/Bridges Low areas – secondary roads	21,708 7,285	**4**	$50,000 ($5,000,000 regionwide)
Hail (1998 – 2014)	19 events	Frequent	Countywide	21,708	**1/2**	$55,000
Extreme Winter Weather (1978 – 2014)	112 events	Frequent	Countywide	21,708	**2**	$90,500 ($37,500 crop; 5,000,000 statewide)
Thunderstorms/Winds (1995 – 2014)	23 events	Frequent	Countywide	21,708	**1**	$195,000 ($8,000 crop)
Tornadoes (1956 – 2014)	4 events	Rare	Countywide	21,708	**1**	$295,000
Wildfire (1981 – 2010)	56 events	Occasional	Countywide	21,708	**5**	NA

**Rare - Hazard event is likely to occur less than once every 30 years.
Occasional - Hazard event is likely to occur less than once every 5 years, but more often than once every 30 years.
Frequent - Hazard event is likely to occur more than once every 5 years.

Appendix F

Examples of Past Mitigation Projects

Flood Projects	**Tornado/Wind Projects**	**Extreme Cold/Winter/Infrastructure Failure Projects**
Replace culvert with bridge	Modify roof ballast system on airport	Insulate municipal water tower
Install stormwater relief drain	Construct storm shelters in public buildings	Insulate city infrastructure
Upgrade road culvert	Construct storm shelters for homes, facilities	Insulate sanitary/storm sewer mains
Elevate floors of homes	Wind bracing for microwave/radio towers	Insulate water mains
Acquire of floodway properties	Construct mobile home park storm shelter	Bury utility lines
Create retention basin	Wind retrofitting for municipal buildings	Relocate sewer mains
Construct new dike	Wind bracing for school facilities	Reroute power lines under a river
Upgrade bridge over a creek (for greater stream flow)	Upgrade warning sirens**	Install plumbing devices to prevent sewer backup
Install sea wall	Install warning sirens**	Elevate and build casing for generator for EOC
Install rip rap to protect roadway	Purchase/Distribute NOAA radios**	Living snow fences for highways and roadways
Re-route various county drains	Severe weather monitoring systems**	
Purchase back-flow prevention valves	Implement long-term community outreach**	
Construct new drains for flood relief		
Flood study for home acquisition		
Flood study of community's flood risk	**T-storm/Lightning Projects**	**Wildfire Projects**
Flood study for stream, roadways		
Elevate electrical equipment in basements	Lightning protection (grounding/phasing)	Vegetation management for roadways
Flood proof wastewater treatment plant	Purchase/Distribute NOAA radios**	Vegetation mgmt. for urban interface areas of city
Warning sensor for creek/river	Install weather alert monitors**	Vegetation mgmt. for homes in fire prone areas
Warning sensor for dam		Urban Interface Education Program**
Raise manholes above 100-Yr floodplain		
Expand storm sewer network for subdivision		
Excavate floodway channel bypass		
Establish permanent flood elevation benchmarks**		
Increase pump capacity for pump stations		
Remove abandoned dam		
Construct emergency floodway		
Install plumbing devices to prevent sewer backup		

******Denotes Hazard Mitigation Grant Program State Discretionary projects (only 5-10% set aside of HMGP funding)

Appendix G

Resources

Benchmarks 2014, Northwest Michigan Council of Governments

Confronting Climate Change in the Great Lakes Region, Michigan fact sheet, Union of Concerned Scientists and the Ecological Society of America, April 2003.

Integrating Human-Caused Hazards Into Mitigation Planning, State and Local Mitigation Planning how-to guide: Federal Emergency Management Agency, September 2002, FEMA 386-7 CD.

Local Hazard Mitigation Planning Workbook: EMD-PUB 207, February 2003, Emergency Management Division, Michigan Department of State Police.

Michigan Hazard Analysis 2012, EMD-PUB 103, July 2012, Emergency Management and Homeland, Security Division / Michigan Department of State Police

National Oceanic and Atmospheric Administration: Weather/Climate Events, Information, Assessments; Climatology and Extreme Events; U.S. Storm Events Data Base; 1950-present, local storm reports, damage reports, etc. from various sources. www.ncdc.noaa.gov

Northwest Michigan County Profiles 2010, Northwest Michigan Council of Governments, November 2002.

Northwest Michigan Council of Governments Website Data, nwm.org.

Planning for a Disaster-Resistant Community: A One-Day Workshop for City and County Planners, Planning Officials, and Consultants: American Planning Association Research Department, American Planning Association, 2002 in cooperation with the Federal Emergency Management Agency, Planning and Mitigation Branch (materials only).

Platte River Watershed Management Plan, Benzie County Conservation District, April 2002.

State and Local Mitigation Planning how to guide: Understanding Your Risks, identifying hazards and estimating losses: Federal Emergency Management Agency, August 2001, FEMA 386-2.

Centerville Township
Natural Hazards Mitigation Plan Adoption Resolution
Resolution #2015-06

WHEREAS Centerville Township, Michigan has a probability to experience risks that may damage commercial, residential and public properties, displace citizens and businesses, close streets and impair infrastructure, and present general public health and safety concerns; and

WHEREAS Leelanau County has prepared a Natural Hazards Mitigation Plan that outlines the community's options to reduce overall damage and impact from natural and technological hazards; and

WHEREAS the Natural Hazards Mitigation Plan of Leelanau County 2016 has been reviewed by community residents, business owners, and federal, state and local agencies, and has been revised to reflect their concerns;

NOW, THEREFORE BE IT RESOLVED THAT;
The Natural Hazards Mitigation Plan of Leelanau County 2016 is hereby adopted as an official plan of Centerville Township, Michigan.

The foregoing resolution offered by Board Member Katrina Pleva

And supported by Board Member James Schwantes

Roll Call Vote:

Aye: Peplinski, Wurm, Kelenski, Pleva, Schwantes

Nay: 0

Absent: 0

Signature: David Wurm - Clerk
Clerk:
Date: 7-8-2015