Grand Traverse County Michigan

Natural Hazards Mitigation Plan

2015

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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 Grand Traverse County is a continuing participant in the update of the Plan. The following is a list of key contributors who were instrumental in the update of the Grand Traverse County Natural Hazards Mitigation Plan:

Grand Traverse County Emergency Management
Gregg Bird

Grand Traverse County Planning Commission

Grand Traverse County Planning Department
John Sych

Grand Traverse County Board of Commissioners
Herb Lemcool

Grand Traverse County Health Department
Wendy Trute

Traverse City Police Department
Jeff O'Brien

Traverse City Fire Department
Jim Tuller

Grand Traverse Band of Ottawa and Chippewa Indians
Joe Hahn

Others

Grand Traverse Central 911
Grand Traverse Metro Emergency Services
Grand Traverse Rural Fire
Peninsula Twp Fire & EMS
Blair Twp Fire & EMS
Grand Traverse Road Commission
Michigan State Police
Traverse City Public Services
Grand Traverse County Public Works
North Flight EMS
Munson Medical Center
FBI, Traverse City Office
Grand Traverse Pavilions
National Cherry Festival
WTCM radio (EAS broadcast station)
Grand Traverse Band of Ottawa & Chippewa Indians
Traverse City Light and Power
Consumers Energy
Tyson Foods
Cherry Capitol Airport
Transportation Safety Administration
Area Commission on Aging
USCG, Air Station Traverse City
American Red Cross

II. FEMA Letter of Approval

JUL 15 2015

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

FEMA

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 adoption documentation for the Grand Traverse County Hazard Mitigation Plan. 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. Grand Traverse County met the required criteria for a multi-jurisdiction hazard mitigation plan and the plan is now approved for the County. Please submit the adoption resolutions for any remaining jurisdictions who participated in the planning process.

The approval of this plan ensures continued availability of the full complement of Hazard Mitigation Assistance (HMA) Grants. All requests for funding, however, will be evaluated individually according to the specific eligibility and other requirements of the particular program under which the application is submitted.

We encourage Grand Traverse County to follow the plan's schedule for monitoring and updating the plan, and continue their efforts to implement the mitigation measures. The expiration date of the Grand Traverse County Plan is five years from the date of this letter. In order to continue project grant eligibility, the plan must be reviewed, revised as appropriate, resubmitted, and approved no later than the plan expiration date.

Please pass on our congratulations to Grand Traverse County for this significant action. If you or the communities have any questions, please contact Kirstin Kuenzi at (312) 408-4460 or Kirstin.Kuenzi@fema.dhs.gov.

Sincerely,

Christine Stack

Christine Stack, Director
Mitigation Division

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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 Grand Traverse 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 Grand Traverse 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, Grand Traverse 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 Grand Traverse County remains a vibrant, safe, enjoyable place in which to live, raise a family, continue to conduct business, and maintain a 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 Grand Traverse County Natural Hazards Mitigation Plan focuses on natural hazards such as drought, wildfires, flooding, shoreline erosion, thunderstorms and high winds, tornadoes, 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 Grand Traverse 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 Grand Traverse 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

Natural Hazards Mitigation Planning Goals for Grand Traverse County
Goal 1: Increase local participation 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 Grand Traverse County

Natural Hazards Mitigation Priority Areas
Priority Area 1: Public infrastructure (culverts, dams, bridges, etc.) located throughout Boardman River communities (Garfield, Blair, Paradise, East Bay, and Union Townships; City of Traverse City) Mitigation Strategies: ***Flooding***
Priority Area 2: Countywide historical record of severe thunderstorms and high wind events that may produce lightning strikes, flash flooding, hail, strong winds, and tornadoes. Mitigation Strategies: ***Severe Thunderstorms/High Winds***
Priority Area 3: Countywide historical record of heavy snow, extreme temperatures, ice damage occurrences Mitigation Strategies: ***Extreme Winter Weather***
Priority Area 4: Countywide potential wildfire/urban interface Mitigation Strategies: ***Wildfire***
Priority Area 5: Countywide potential of (shoreline) erosion and ice damage Mitigation Strategies: ***Erosion***

Table 3: Mitigation Strategies for Grand Traverse County

Frequent Natural Hazard	Mitigation Strategies
Flooding	
	• Drainage improvements in high flooding potential areas
	• Removal of unsafe dams on the Boardman River (2)
	• Continue enforcement of building codes and soil erosion regulations
Severe Thunderstorms/ High Winds	
	• Establish emergency shelters
	• Utilize a ham radio channel for local warnings if primary communications is interrupted
	• Promote the establishment of a robust, interoperable communication system
	• Enhance cooperation with utility companies (tree management, promotion of burying utility lines in new construction, and high outage areas)
	• Identify potential wind damage areas
	• Establish new generators where needed
	• Update the County's debris removal plan
Extreme Winter Weather	
	• Continue enforcement of building code regarding snow load limits through the permitting process
	• Utilize a ham radio channel for local warnings if primary communications is interrupted
	• Promote the establishment of a robust, interoperable communications system
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
Erosion	
	• Drainage control projects
	• Enforcement of soil erosion statutes/permits
	• Enforcement of building and zoning codes for current and future development
	• Enforcement of the grading levels no more than 10%
	• Placement of vegetation and utilizing native vegetation

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 Grand Traverse 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 Grand Traverse 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?

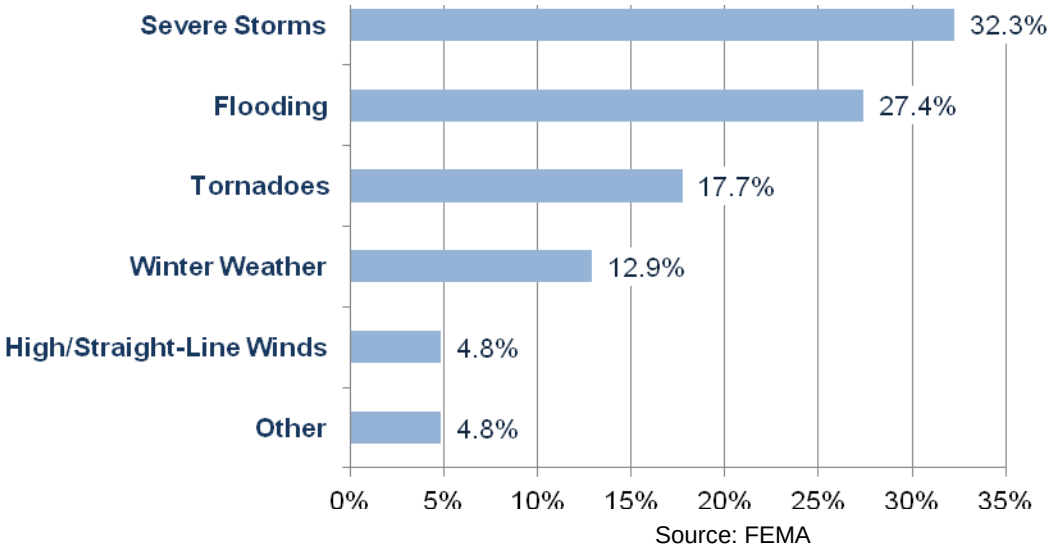
A **hazard** is an event or physical condition that has potential to cause fatalities, injuries, property damage, infrastructure damage, agricultural loss, damage to the environment, interruption of business, or other types of harm or loss. This plan focuses on principle natural hazards that occur in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

Grand Traverse county is approximately 314,700 acres or 492 square miles in area. The predominant land use/land cover is, by far, forest which covers almost 43% of the land area. This is followed by a substantial amount of agricultural land at 14.9%, then wetlands and open land.

Agricultural land is concentrated on Old Mission Peninsula, in the northern halves of Acme and Whitewater Townships, on the fringe of the urban area of Traverse City, and throughout the southern portion of the county.

More intense land uses such as commercial, industrial, institutional and transportation are primarily found in the Traverse City area and to a lesser extent in village areas and in small parcels on major corridors throughout the county.

Commercial land is the largest intensive use category in the county with 3,440 acres. Residential uses are found predominantly in and around Traverse City including Garfield Township and East Bay Township, village areas of Kingsley, Interlochen and Fife Lake, and around the Long Lake and Spider Lake areas.

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.

Community data is provided for planning and implementing natural hazard mitigation strategies.

Table 4: Geographic features

Feature	Measure
Land Area	136 sq. miles
Area in Water	492 sq. miles
Grand Traverse Bay shoreline	66.72 miles
Operating Farms	504

Source: U.S. Census Bureau; Grand Traverse County GIS Department; USDA, National Agricultural Statistics Service

Table 5: Land Use

Classification	Acres	Percent
Residential	33,265	10.6%
Institutional	1,589	0.5%
Recreation	3,025	1%
Commercial	3,440	1.1%
Industrial	901	0.3%
Transportation/Utilities	1,347	0.4%
Agricultural	46,805	14.9%
Open Land	32,421	10.3%
Forest	133,966	42.6%
Wetlands	39,037	12.4%
Barren	1,568	0.5%
Water	17,336	5.5%
TOTAL ACREAGE	**314,700**	

Source: Grand Traverse County Planning & Development Department

Grand Traverse County is comprised of thirteen (13) townships, two (2) villages and one (1) city

Table 6: Population by Municipality

Unit of Government	2010 Count	2013 Estimate	Percent Change 2010 to 2013
Grand Traverse County	86,986	89,987	3.4%
Fife Lake Village	443	451	1.8%
Kingsley Village	1,480	1,517	2.5%
Traverse City (Grand Traverse County only)	14,482	14,827	2.4%
Acme Township	4,375	4,581	4.7%
Blair Township	8,209	8,459	3.0%
East Bay Charter Township	10,663	11,139	4.5%
Fife Lake Township	2,348	2,373	1.2%
Garfield Charter Township	16,256	16,668	2.5%
Grant Township	1,066	1,117	4.8%
Green Lake Township	5,784	6,029	4.2%
Long Lake Township	8,662	9,054	4.5%
Mayfield Township	1,550	1,607	3.7%
Paradise Township	4,713	4,785	1.5%
Peninsula Township	5,433	5,680	4.5%
Traverse City (including Leelanau County)	14,674	15,018	2.3%
Union Township	405	420	3.7%
Whitewater Township	2,597	2,712	4.4%

Source: Grand Traverse County

Table 7: Forecasted Population

Year	Forecasted Population	Percent Increase from 2010
2015	94,044	8.1%
2020	101,164	16.3%
2025	107,105	23.1%
2030	111,925	28.7%
2035	116,081	33.4%
2040	120,127	38.1%

Source: MDOT-Statewide & Urban Model Travel Analysis Section &
U-M Institute for Research on Labor, Employment, and the Economy

In 2010, Grand Traverse County had a total population of 86,986, an increase of 12% from the 2000 population of 77,655 – making it the third fastest growing county in Michigan during this period. Garfield Township's population increased 17% from 2000 to 2010 making it the most populated community in the county.

As of 2013, the estimated total population for Grand Traverse County is 89,987. The projected growth for 2020 is 101,164 and for 2030 is 111,925.

As a tourist destination and an area of many vacation homes, Grand Traverse County experiences an increased population due to its transient population. The annual average transient population is 11% higher than the permanent population counted by the U.S. Census. This translates into an addition of nearly 10,000 to the resident population. The month of July has the highest at 22% higher or almost 20,000.

At 41.3 years, the median age of Grand Traverse County is higher than the state and national median ages. Locally, the lowest median age, 32.6, was in the Village of Kingsley where 31% of the population is under 18 years. The highest median age, 53.4, was in Peninsula Township where 26% of the population is over 65 years. In 2010, 22% of the population was under 18 years and 15% was 65 years or older. In 2040, 36% of the households are projected to be 65 years or older.

There are 41,598 housing units in Grand Traverse County, of which 34,362 are occupied. The average household size is 2.45 persons per household. 38.8% of the households have 2 persons.

Additional population profile information:

- The number of residents 19 years and under is 21,383, or 24.6% of the population.
- The number of residents over 65 years with a disability is 4,042, or 4.6% of the population.
- The total number of residents with a disability is 10,236, or 12.0% of the population.
- The number of residents that have a language barrier or are linguistically isolated is 1,484, or 1.71% of the population. There is an increase of migrant workers in the summer and fall season that do not speak English.
- The number of families in poverty with children is 1,520 or 6.7% of all families.
- The number of households with income less than $15,000 is 9.9%.
- Individuals in poverty is 9,573

Table 8: Poverty Statistics

Poverty	Statistics
Families in poverty	6.7%
Income less than $15,000	9.9%
Population in poverty	9,573

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

Table 9: Economic Census

Industry Description	Number of Establishments	Number of Employees
Manufacturing	178	4,522
Wholesale trade	156	1,347
Retail trade	565	7,035
Information	68	734
Real estate, rental, leasing	150	458
Professional, scientific, technical services	371	2,382
Administrative, support, waste management, remediation services	183	1,327
Educational Services	35	794
Health care, social assistance	396	8,802
Arts, entertainment, recreation	48	345
Accommodation and food services	250	5,501
Other services (except public administration)	274	1,723

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

VII. THE DEVELOPMENT OF THE PLAN

Data Methodology and Map Development

Grand Traverse County staff identified the critical facilities and infrastructure on the base map and provided updated GIS shp files for mapping purposes.

Table 10: Critical Facilities and Infrastructure

2	Airports • Traverse City Cherry Capital Airport – 378,241 passengers (2013) • Green Lake Township Airport http://mdotcf.state.mi.us/public/airportstats/
1	Bus Terminal • Indian Trails in Traverse City
82	Places of Worship (2010) http://www.thearda.com/rcms2010/
1	Coast Guard Air Station
3	Dams – Union Street, Boardman, Sabin
1	Emergency Management Services Facility
14	Fire Stations
45	Government Buildings
1	Hospital – Munson Medical Center
4	Industrial Facilities
5	Law Enforcement
11	Medical Facilities • Primary physicians per 100,000 population is 124.2 (2010) http://www.healthindicators.gov/
9	Mobile Home Parks
10	Post Offices
200	Resort/Recreation
44	Schools/Library
1	Sewage Treatment Facilities • 40.1% public sewer • 58.9% individual septic/cesspool • 1.0% other
10	Utility
9	Water Tower • 39.8% of population on public system or private company (2005) • 60.9% of population on individual wells (2005) http://censtats.census.gov/usa/usa.shtml

Source: Grand Traverse County Data

Flood Data
Flood hazard information may be obtained from the Flood Rate Insurance Maps (FIRM) available for jurisdictions. In order to delineate potential flood plain areas (seasonal floodplains) for each 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:
Grand Traverse County is currently participating in the update of new digital flood maps, which will not be final for 1 to 2 years. The county has only one property that has been identified by the National Flood Insurance Program as having suffered repetitive flood losses. The property is a single-family home located in Blair Township. It had been damaged by floods in 2012 and 2014, with similar amounts of damage occurring during each event. This property should be prioritized for flood mitigation activities, in order to prevent or reduce such losses in the future.

Table 11: NFIP Participation

Municipality	NFIP status	Flood Maps	Year Joined
Acme Township	P	N	1986
Blair Township	P	N	1988
East Bay Township	P	N	1986
Fife Lake Township	NP		
Garfield Township	P	N	1986
Green Lake Township	NP		
Grant Township	NP		
Long Lake Township	P	Y	1988
Mayfield Township	NP		
Paradise Township	P	Y	1986
Peninsula Township	P	N	1986
Union Township	P	Y	1988
Whitewater Township	P	Y	1988
Village of Fife Lake	NP		
City of Traverse City	P	Y	1982

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

Source: Department of Environmental Quality

Fire Data
Modern forest fire data were obtained from the USDA forest service and the Departments of Natural Resources in Minnesota, Wisconsin, and Michigan. Fire regimes data (fire prone areas) were provided by the USDA Forest Service, North Central Research Station located 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

Shoreline Erosion - Shoreline erosion incident zones delineated by the US Geological Service. Digital Elevation Model data was obtained 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 Grand Traverse County.

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 Grand Traverse County included: Drought (Drought), Flood (Flash Flood, Flood, Lakeshore Flood), Hail (Hail), Extreme Winter Weather (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 Grand Traverse 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.

Flood/Flash Flood: 7 events

Table 12: Flood Events

Month	Year	Location	Effect	Damage
February	1986*	County/Statewide	Great Lakes flooding, wave action	NA
January	1993	County/Region	Heavy rainfall and snowmelt	$5,000
March	1993	County/Region	Flooding	NA
April	1993	County/Region	Flood	$5,000,000
July	1999	Traverse City	Secondary street flooding/ basement flooding	NA
July	2000	Traverse City	Street flooding	NA
September	2000	Countywide	Street flooding, power outages, 1 fatality from lightning	NA
April	2001	County (north central)	Flooding along Boardman River	NA
April	2012	Grawn	Boardman River flooded homes	$75,000
October	2012	Grawn	Failure of temporary dam on Boardman River/homes and other property damaged or destroyed	$1,800,000
November	2013	Traverse City	2 in. rain in 1 hour/ roads flooded and impassable	$14,000

Hail: 26 events

Table 13: Hail Events

Month	Year	Location	Effect	Damage
September	1958	Countywide	0.75 in.	NA
May	1970	Countywide	1.75 in.	NA
May	1971	Countywide	0.75 in.	NA
April	1975	Countywide	1.50 in.	NA
July	1980	Countywide	2.00 in.	NA
July	1982	Countywide	1.00 in.	NA
April	1993	Traverse City	1.00 in.	NA
April	1993	Bates	1.00 in.	NA
April	1999	Traverse City	0.75 in.	NA
June	2000	Traverse City	1.00 in./flooding/60 mph gusts	NA
September	2000	Traverse City	1.00 in./flooding/60 mph gusts	NA
June	2003	Fife Lake	0.75 in.	NA
August	2003	Traverse City	0.88 in.	NA
September	2005	Interlochen	0.88 in.	NA
June	2006	Traverse City	0.88 in.	NA
June	2006	Kingsley	0.75 in.	NA
July	2006	Old Mission	0.88 in.	NA
October	2006	Traverse City	1.25 in.	NA
June	2008	Traverse City	1.25 in.	NA
June	2008	Williamsburg	1.00 in.	NA
July	2010	Traverse City	0.88 in.	NA
April	2011	Hannah	0.88 in.	NA
June	2011	Old Mission	1.25 in.	NA
June	2011	Old Mission	1.00 in.	NA
May	2012	Acme	1.00 in.	NA
May	2012	Williamsburg	1.25 in.	NA
May	2012	Fife Lake	1.00 in.	NA
July	2014	Countywide	0.88 in.	NA
July	2014	Countywide	0.75 in.	NA
July	2014	Countywide	0.75 in.	NA
July	2014	Countywide	1.00 in.	NA

Extreme Winter Weather: 105 events

Table 14: Extreme Winter Weather Events

Month	Year	Location	Effect	Damage	Event
January	1993	County/Region	6 - 12 in. snow	$50,000	
April	1993	County/Region	Heavy Snow	$50,000	
December	1993	County/Region	10 - 15 in. snow/ 3 ft. drifts/accidents and injuries	NA	
January	1994	Statewide	.1 - .3 in. ice	$5,000,000	Freezing Rain/ Heavy Snow
January	1997	Countywide	12 - 18 in. snow	NA	
March	1998	County/Region	8 - 12 in. snow/ 45 mph gusts	NA	Blizzard
December	1998	Countywide	6 - 12 in. snow	NA	
January	1999	Countywide	6 - 12 in. snow	NA	
December	2001	Traverse City	20.5 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	NA	
November	2005	County/Region	10 - 17 in. snow	NA	
January	2007	County/Region	11 -13 in. snow	NA	
February	2007	County/Region	-20 to -30 wind chills	NA	Extreme Temp
December	2009	County/Region	6 - 16 in. snow	NA	
December	2010	County/Region	6 -12 in. snow	NA	
March	2011	County/Region	6 - 15 in. snow	NA	
March	2012	County/Region	6 - 14 in. snow/widespread power outages	NA	
April	2012	Statewide	Killing freeze	$15,000,000 (crop)	Extreme Temp
December	2012	County/Region	Trees and power lines down	$12,000	
November	2013	County/Region	8 - 12 in. snow	NA	
January	2014	County/Region	12 - 16 in. snow	NA	
February	2014	County/Region	45 mph winds/ -15 to -25 wind chills	NA	

Severe Thunderstorm/High Wind: 54 events

Table 15: Severe Thunderstorm Events

Month	Year	Location	Effect	Damage	Event
August	1955	Countywide	61 knot winds	NA	
July	1956	Countywide	60 knot winds	NA	
July	1966	Countywide	50 knot winds	NA	
July	1969	Countywide	52 knot winds	NA	
July	1972	Countywide	55 knot winds	NA	

Severe Thunderstorm/High Wind (continued)

Month	Year	Location	Effect	Damage	Event
July	1974	Countywide	65 knot winds	NA	
May	1975	Countywide	50 knot winds	NA	
July	1982	Countywide	52 knot winds	NA	
July	1987	Countywide	70 knot winds	NA	
October	1989	Countywide	50 knot winds	NA	
July	1995	Acme	52 knot winds/ trees down	NA	
April	1997	Traverse City	52 knot winds	NA	
May	1998	Traverse City	50 knot winds/ trees and power lines down	NA	
September	1998	Countywide	52 knot winds/ trees down	NA	
November	1998	County/Region	50 knot winds	NA	
February	1999	Traverse City	50 knot winds/ tree down	NA	
June	1999	Traverse City	52 knot winds/ trees and power lines down	NA	
June	1999	Interlochen	50 knot winds/ trees down	NA	
July	1999	Traverse City	60 knot winds/ trees and power lines down/ straight line wind damage/ structure damages	NA	
August	2000	Countywide	Lightning sparked explosion at oil company in Blair Twp.	$20,000	Lightning
September	2000	Traverse City	50 knot winds	NA	
September	2000	Traverse City	Lightning sparked garage fire/ 1 fatality	$20,000	Lightning
August	2001	Traverse City/ Williamsburg	50 knot winds/ trees and power lines down	NA	
April	2002	Traverse City/ Kingsley	50 - 60 knot winds/ trees and power lines down/ roof damage	$15,000	
April	2002	Old Mission	Fire sparked by lightning destroyed home	$125,000	
July	2002	Traverse City/ Fife Lake	50 - 65 knot winds/ trees and power lines down	NA	
August	2003	Acme	5 knot winds/ tree down	NA	
November	2003	County/Region	68 knot winds/ trees and power lines down/ power outages	$30,000	
August	2004	Traverse City	56 knot winds/ trees down/ crops damaged	$1,000 (crop)	
September	2005	Traverse City	52 knot winds/ structure damage	$45,000	
November	2005	County/Region	40 knots sustained winds/ trees down	$3,000	
November	2005	County/Region	55 knot winds/ trees down/ structure damage	$45,000	
July	2006	Traverse City	51 knot winds/ trees down/ property damage	$3,000	
July	2006	Long Lake	65 knot winds/ over 200 trees down/ property damage	$35,000	
July	2006	Interlochen	50 knot winds/ trees down/ property destroyed	$8,000	

Severe Thunderstorm/High Wind (continued)

Month	Year	Location	Effect	Damage	Event
July	2006	Williamsburg	Structure damage/ crop damage	$5,000	
June	2007	Kingsley	52 knot winds/ trees down	$5,000	
October	2007	Traverse City	52 knot winds/ trees down	$4,000	
June	2009	Interlochen	55 knot winds/ trees and power pole down/ property and structures damaged	$30,000	
June	2009	Karlin	52 knot winds/ trees down	$3,500	
April	2010	Hannah	52 knot winds/ trees down	$4,000	
October	2010	County/Region	55 knot winds/ trees and power lines down/ power outages/ structure damage	$24,000	
May	2011	Hannah	56 knot winds/ trees down	$3,000	
June	2012	Mapleton	52 knot winds/ trees down	$4,000	
June	2012	Monroe Center	64 knot winds/ trees down/ property and structures damaged	$10,000	
July	2002	Traverse City	52 knot winds/ trees down	$3,000	
July	2013	Fife Lake	55 knot winds/ trees down/ structure damage	$15,000	
August	2013	Monroe Center	52 knot winds/ trees down/ structure damage	$11,000	
August	2014	Traverse City	52 knot winds/ trees down	$6,000	

Tornado: 4 events

Table 16: Tornado Events

Month	Year	Location	Effect	Damage
April	1956	Countywide	F4/ 15 miles long, 400 yards wide, 2 deaths and 24 injuries	$250,000
September	1961	Countywide	F2/ 14.4 miles long, 33 yards wide	$25,000
May	1964	Countywide	F2/ 16.6 miles long, 440 yards wide/ structure damage	$250,000
June	1969	Countywide	F3/ 6.4 miles long, 600 yards wide/ trees and power lines down/ homes and property destroyed	$250,000

** Governor and Presidential Hazard Declaration*

Wildfires:
56 wildfires occurred in Grand Traverse County from 1981 to 2010, affecting nearly 212 acres countywide.

Other Potential Natural Hazards

Shoreline Erosion
The Great Lakes experienced record high lake levels in 1985-86, and again in 1997-98. Governors Disaster Declarations for shoreline problems in the State was enacted in 1985-1986 and included Grand Traverse 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 Grand Traverse County Health Department created a pandemic plan that serves as a template for responding to a large-scale outbreak of influenza and other highly infectious respiratory diseases.

Probability of Natural Hazards:

The probability that a natural hazard such as hail, thunderstorm and high wind, tornadoes, and snow and ice will affect this area of Michigan is an annual possibility. 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 an event is connected with tourist activity during the year, the pace of developing second homes, and an increasing base population in northwest, lower Michigan which in turn leads to more development. The events recorded by NOAA show that natural hazard events may be happening more frequently, but the geographic impact of the natural hazards' impact has remained the same in Grand Traverse County.

The areas where natural hazards overlap in Grand Traverse County can include heavy snow that causes trees and power lines down, and then melting, rain and flooding.

Grand Traverse 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:

- Thunderstorms
- High winds
- Heavy rain and effect on agriculture
- Mobile home parks
- National Cherry Festival Emergency Plan
- More communication and notification
- Ingress and egress at campgrounds
- Construction area
- Interlochen Arts Academy area
- Extreme winter weather
- Hail and frost affecting agriculture
- Power outages
- Flooding in the Boardman River area, dams, bridges
- Wildfires – specifically in Cedar Run, Blair Township, Kingsley areas
- Erosion along Grand Traverse Bay and Peninsula Township
- Ice damage

The Natural Hazards Priority Areas have not changed since the original plan. However, the task force altered the chronological order of the priority list and placed "Public infrastructure" as the top priority, due to proposed programming and immediate implementation of pre-disaster mitigation projects that will address flooding hazard issues, should funding become available.

Top Five Natural Hazards Priority Areas

1. **Public infrastructure (culverts, dams, bridges, etc.) located throughout Boardman River communities (Garfield, Blair, Paradise, East Bay, and Union Townships; City of Traverse City)**

   Inadequate drainage infrastructure under South Airport road near the commercial/retail development *Logan's Landing* are causing frequent flooding of the road and nearby property, especially during heavy rain events and the spring snow melt season.

   The Michigan Hazard Analysis of 2012 identifies the Three (3) Dams in the County as a "high hazard", meaning there is development downstream in the dam's hydraulic shadow; and Four (4) Dams as a "significant hazard," meaning structural failure may cause an uncontrollable high volume of water downstream, damaging bridges and other key infrastructure.

   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.

2. **Potential of Severe Thunderstorms and High Winds - Countywide**

   There is a historical record of high wind events and tornadoes in Grand Traverse 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.

   Mobile home parks, campgrounds, construction areas, institutions (schools, places of worship, etc.), and numerous festivals that draw a large number of tourists such as the National Cherry Festival were identified as specific areas of concern.

3. Potential of Extreme Winter Weather - Countywide

Grand Traverse 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.

4. Potential Wildfire/Urban interface - Countywide

Forest types (white/red pine, and white pine and hemlock) within Grand Traverse County are susceptible to wildfires. Additional factors that increase fire risk include dead or dying Ash trees as a result of disease/invasive species, lightning strikes, and human factors such as the number of persons residing, camping, or traveling through the County.

5. Potential of Erosion and Ice damage - 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. Shoreline banks that support roadways may erode and cause the road surface to crack, become unstable, or more prone to deposits of sand, snow, water, and ice.

This hazard is especially relevant to those municipalities that contain residential and commercial development along Grand Traverse Bay (Peninsula, East Bay and Acme Townships; Traverse City) that experience seasonal shifts in water levels and possible ice erosion hazards.

Emergency Warning System Coverage

Mobile warning system: Grand Traverse County uses the CodeRed Emergency Communications Network, which is an electronic high-speed outbound notification service available to the general public.

Tornado/Severe Weather Systems: Manual sirens are located at Metro Station #9 (East Bay Twp), Rural Station #6 (Fife Lake), and the Blair Twp. fire department. Weather alert radios were purchased and distributed to all the schools, nursery schools, and senior homes.

Flood warning system: For dam failures/flooding downstream an active warning system is located at Logan's Landing on South Airport Rd. An inactive system is located on River Road.

Economic Impact Analysis

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

Table 17: Damage Cost by Natural Hazard

Grand Traverse County	Property Damage Cost	Crop Damage Cost
Flood	$6,894,000	NA
Hail or Wildfire	NA	NA
Extreme Winter Weather	$5,112,000	$15,000,000
Tornado	$775,000	NA
Thunderstorm and High Wind	$481,500	$1,000

The Grand Traverse 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 18: Geographic Economic Value

Priority Area	Geography	Population	State Equalized Value
	Grand Traverse County	86,986	$10,648,994,584
3	Boardman river Area	46,306	$5,289,726,800
5	Grand Traverse Bay communities	35,145	$5,463,458,000

VIII. NATURAL HAZARDS MITIGATION GOALS AND OBJECTIVES

The mission of the Grand Traverse 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 Grand Traverse County Planning Commission.

Goal 1: Increase local awareness and participation in natural hazards mitigation
Strategies

- Encourage cooperation and communication between planning and emergency management officials
- Encourage additional local governmental agencies to participate in the natural hazards mitigation process
- Encourage public and private organizations to participate, including organizations who advocate for individuals with functional or access needs

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

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

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

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

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

- Encourage public and business involvement in natural hazards mitigation projects

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 Grand Traverse 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. Potential of flooding along the Boardman River affecting public infrastructure (culverts, dams, bridges, etc.)

Flood Mitigation Strategies

- Drainage improvements in high flooding potential areas, specifically near *Logan's Landing*
- Removal of unsafe dams on the Boardman River
- Continue enforcement of building codes and soil erosion regulations

Priority Area 2. Potential of Severe Thunderstorms and High Winds throughout the County

Thunderstorm, High Winds, and Tornado Mitigation Strategies

- Establish emergency shelters
- Utilize a ham radio channel for local warnings if primary communications is interrupted
- Promote the establishment of a robust, interoperable communication system
- Enhance cooperation with Utility Companies (tree management, promotion of burying utility lines in new construction, and high outage areas)
- Identify potential wind damage areas
- Establish new generators where needed
- Update the County's debris removal plan

Priority Area 3. Potential of Extreme Winter Weather throughout the County

Snow Load Mitigation Strategies

- Continue enforcement of building code regarding snow load limits through the permitting process
- Utilize a ham radio channel for local warnings if primary communications is interrupted
- Promote the establishment of a robust, interoperable communications system

Selection of Feasible Mitigation Strategies (continued)

Priority Area 4. Potential Wildfire/Urban interface throughout the County

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

Priority Area 5. Potential of Erosion and Ice damage throughout the County

Shoreline Erosion Mitigation Strategies

- Drainage control projects
- Enforcement of soil erosion statutes/permits
- Enforcement of building and zoning codes for current and future development
- Enforcement of the grading levels no more than 10%
- Placement of vegetation and utilizing native vegetation

Other mitigation strategies

- Public education and awareness activities
- Work towards uniform mapping and zoning throughout the county for natural hazards mitigation
- Incorporate the Natural Hazards Mitigation Plan into the County's Master Plan and local zoning ordinances if in place.

X. Participation in the Development of the Grand Traverse 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 Record Eagle

Public Notice

PUBLIC NOTICE

The Grand Traverse County Emergency Management Department is requesting public comment on the Natural Hazards Mitigation Plan draft for Grand Traverse County.

The Plan is available for review at the Grand Traverse County Clerk's Office and Grand Traverse County Emergency Management website.

Please send comments by January 25, 2015 to:
Natural Hazard Mitigation Plans
c/o Grand Traverse County Emergency Management
2600 LaFranier Rd.
Traverse City, MI 49686

December 25, 2014-1T 389657

- The Natural Hazards Mitigation Plan was presented to the Grand Traverse County Planning Commission where the meetings are posted in the newspaper and are open to the public. Commission members gave their input and there were no comments from the public.

- The Natural Hazards Mitigation Plan was presented to the Grand Traverse County Board of Commissioners where the meetings are posted in the newspaper and are open to the public. Commissioners gave their input and there were no comments from the public.

- 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 Grand Traverse 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 Grand Traverse County Planning Commission coordinates and reviews local zoning and master plans to ensure consistency across jurisdictional boundaries.

Building permits are issued by the Grand Traverse County Construction Code Department, except in Garfield and Fife Lake townships where they are handled locally.

The Townships/Villages in the priority areas include:

Acme Township – Zoning
Blair Township - Zoning
East Bay Township – Zoning
Fife Lake Township – Zoning
Garfield Township – Zoning
Grant Township – Zoning
Green Lake Township – Zoning
Long Lake Township – Zoning
Mayfield Township – Zoning
Paradise Township – Zoning
Peninsula Township – Zoning
Union Township – Zoning
Whitewater Township – Zoning
Village of Fife Lake – Zoning
Village of Kingsley – Zoning
City of Traverse City - Zoning

Table 17: Plan Participation

County/Township/Others	**Zoning**	**Participation**
Grand Traverse County	No	Task Force meetings, review/development of updated elements: Board of Commissioners Conservation District Emergency Management Coordinator Equalization Department Health Department Planning Commissioners Planning Department Road Commission
Acme Township	Yes	See last bullet point paragraph, above
Blair Township	Yes	See last bullet point paragraph, above
East Bay Township	Yes	See last bullet point paragraph, above
Fife Lake Township	Yes	See last bullet point paragraph, above
Garfield Township	Yes	See last bullet point paragraph, above
Grant Township	Yes	See last bullet point paragraph, above
Green Lake Township	Yes	See last bullet point paragraph, above
Long Lake Township	Yes	See last bullet point paragraph, above
Mayfield Township	Yes	See last bullet point paragraph, above
Paradise Township	Yes	See last bullet point paragraph, above
Peninsula Township	Yes	See last bullet point paragraph, above
Union Township	Yes	See last bullet point paragraph, above
Whitewater Township	Yes	See last bullet point paragraph, above
Village of Fife Lake	Yes	See last bullet point paragraph, above
Village of Kingsley	Yes	See last bullet point paragraph, above
City of Traverse City	Yes	See last bullet point paragraph, above
Grand Traverse Band of Ottawa and Chippewa	Yes	See last bullet point paragraph, above

********The Grand Traverse Band 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 GRAND TRAVERSE COUNTY NATURAL HAZARDS MITIGATION PLAN

Natural Hazards Mitigation Plan Managers and Technical Assistance

The County Board will lead the implementation of the Natural Hazards Mitigation Plan with assistance from the Emergency Management Coordinator and the Administration/Planning Department. Inter- agency partnerships and collaboration are encouraged to accomplish the goals and objectives of the Plan.

- Grand Traverse County Government Staff
- Townships, cities, and villages
- Grand Traverse County Conservation District
- Grand Traverse County Drain Commissioner
- Grand Traverse County Road Commission
- Grand Traverse Band of Ottawa and Chippewa Indians
- Grand Traverse Regional Land Conservancy
- The Watershed Center Grand Traverse Bay
- New Designs for Growth
- 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
- Insurance Companies
- Real Estate Companies

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

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

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

Funding the Implementation of the Plan

To assist with the funding of the proposed natural hazards mitigation strategies, the following 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

Funding the Implementation of the Plan (continued)

- National Oceanic and Atmospheric Administration
- Community, Regional Foundations
- Businesses

Action Agenda

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

Table 19: Action Strategies

Priority and Action Strategies	Responsible Parties	Timeframe
Priority Area 1: Flood Mitigation Strategies		
a. Drainage improvements in high flooding potential areas, including upgrading the twin culverts on S. Airport Rd at *Logan's Landing*	Drain Commissioner Road Commission County Conservation District Emergency Management Department Townships, Villages, City	2-4 years from adoption of the plan
b. Removal of unsafe dams on the Boardman River	County Conservation District County Planning Department Emergency Management Department MI Department of Natural Resources Townships of Garfield, Blair, Paradise, East Bay, City of Traverse City	4-8 years from adoption of the plan
c. Continue enforcement of building codes and soil erosion regulations	County Building Inspector Building Construction Code Dept. County Conservation District	Ongoing
Priority Area 2: Thunderstorms and High Winds Mitigation Strategies		
a. Promote the establishment of the State of Michigan's Primary Radio Communication system for throughout the County	Emergency Management Department County Planning Department Townships, Villages, City	1-2 years from adoption of the plan
b. Have a debris removal plan for safety	Emergency Management Department County Planning Department County Building Inspector Townships, Villages, City	2-4 years from adoption of the plan
c. Utilize ham radio channel for local warnings	Emergency Management Department	1-2 years from adoption of the plan
d. Work with utility companies	Emergency Management Department County Planning Department County Building Inspector Utility Companies	1-3 years from adoption of the plan
e. Tree management	Utility Companies Emergency Management Department Townships, Villages, Private Landowners	1-3 years from adoption of the plan
f. Promotion of burying utility lines in new construction	County Building Inspector Utility Companies Emergency Management Department County Planning Department Townships, Villages, City	1-3 years from adoption of the plan

Priority and Action Strategies	Responsible Parties	Timeframe
Priority Area 2: Thunderstorms and High Winds Mitigation Strategies (continued)		
g. Burying power lines in high outage areas	County Building Inspector Utility Companies Emergency Management Department County Planning Department Townships, Villages, City	1-3 years from adoption of the plan
h. Identify potential wind damage areas	Emergency Management Department County Planning Department Townships, Villages, City	1-2 years from adoption of the plan
i. Establish new generators where needed	Emergency Management Department County Planning Department Townships, Villages, City	2-3 years from adoption of the plan
Priority Area 3: Extreme Winter Weather (Snow Load and Ice Build Up) Mitigation Strategies		
a. Continue enforcement of building code regarding snow load limits through the permitting process	County Building Inspector Townships, Villages, City County Planning Emergency Management Coordinator	Ongoing
b. Promote the establishment of the State of Michigan's Primary Radio Communication system for throughout the County	Emergency Management Department County Planning Department Townships, Villages, City	1-2 years from adoption of the plan
c. Utilize a ham radio channel for local warnings	Emergency Management Department	1-2 years from adoption of the plan
Priority Area 4: Wildfire/Urban Interface Mitigation Strategies		
a. Public education and awareness activities such as programs and brochures regarding fuel management, proper vegetation, fire breaks	County Planning Department Emergency Management Department Building Inspector County Soil Conservation District MI Department of Natural Resources Townships, Villages, City	1-3 years from adoption of the plan
b. Continue enforcement of state fire codes regarding setback requirements	Building Inspector Townships, Villages, City	Ongoing
c. Public education utilizing the MI Department of Natural Resources flyers and the FEMA information at parks and campgrounds	Emergency Management Department County Conservation District MI Department of Natural Resources Townships, Villages Parks and Campgrounds, public and private	1-3 years from adoption of the plan
d. Real estate and insurance agents to distribute information	Emergency Management Department County Planning Department Townships, Villages	1-3 years from adoption of the plan
e. Assess fire suppression access and make improvements	Emergency Management Department County and local fire departments	1-3 years from adoption of the plan
f. Research the MI Department of Natural Resources' State Forest wildfire/urban interface rules or plan	Emergency Management Department County and local fire departments County Planning Department	1-3 years from adoption of the plan

Priority and Action Strategies	Responsible Parties	Timeframe
Priority Area 5: Shoreline Erosion Mitigation Strategies		
a. Drainage control projects	Building Construction Code Dept. Drain Commissioner County Conservation District Emergency Management Department Townships, Villages, City	2-4 years from adoption of the plan
b. Enforcement of soil erosion statutes/permits	Building Construction Code Dept. Drain Commissioner County Conservation District County Planning Department Emergency Management Coordinator MI Department of Environmental Quality U.S. Army Corps of Engineers	Ongoing
c. Enforcement of the building codes	County Building Inspector	Ongoing
d. Enforcement of the grading levels no more than 10%	Building Construction Code Dept. Drain Commissioner County Conservation District County Planning Department	Ongoing
e. Placement of vegetation and utilizing native vegetation	County Building Inspector Building Construction Code Dept. Drain Commissioner County Conservation District County Planning Department Townships of Peninsula, East Bay, Acme, City of Traverse City	Ongoing

Additional Mitigation Strategies

- General Public education and awareness activities
- Work towards uniform mapping and zoning throughout the county for natural hazards mitigation
- Incorporate the Natural Hazards Mitigation Plan into the County's Master Plan and local zoning ordinances if in place.

Monitoring and Evaluation

The Grand Traverse County Natural Hazards Mitigation Plan will be monitored on a regular basis by the Emergency Management Staff and Planning Staff. Because Grand Traverse 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 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. A continual process for updates will take place with annual reviews, monitoring, evaluation, and an accumulation of official feedback and public input through public notices. 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 Grand Traverse County Board of Commissioners.

XII. NATURAL HAZARDS MITIGATION PLAN ADOPTION RESOLUTION

Grand Traverse County

Natural Hazard Mitigation Plan Adoption Resolution

RESOLUTION 92-2015

Whereas; Grand Traverse County, Michigan has experienced 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; Grand Traverse County has developed the Grand Traverse County Natural Hazard Mitigation Plan that outlines the counties options to reduce damages and impacts from natural and technological hazards; and

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

Now, therefore, be it resolved that:

The Natural Hazard Mitigation Plan is hereby adopted as an official plan of Grand Traverse County, Michigan.

Passed this 1st day of July, 2015

Chair, Grand Traverse County Board of Commissioners — **Date** 7-2-15

Grand Traverse County Clerk — **Date** 7-2-15

I HEREBY CERTIFY THIS COPY TO BE A TRUE AND CORRECT COPY OF THE RECORD ON FILE WITH THE OFFICE OF COUNTY CLERK
BONNIE SCHEELE
GRAND TRAVERSE COUNTY CLERK
BY: Bonnie Scheele
CLERK/DEPUTY COUNTY CLERK
DATE: July 2, 2015

NOTE: AN OFFICIAL SIGNED COPY OF A RESOLUTION OF ADOPTION MUST BE SUBMITTED TO THE MICHIGAN STATE POLICE EMERGENCY MANAGEMENT AND HOMELAND SECURITY DIVISION (to comply with the requirements of the Disaster Mitigation Act of 2000).

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.

Community: Any state, area, or political jurisdiction or any Native American Tribe, authorized tribal organization, Alaska native village, or authorized native organization that has the authority to adopt and enforce floodplain management ordinances for the area under its jurisdiction. In most cases, a community is an incorporated city, town, village, township, or an unincorporated area of a county.

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 interest 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 principally 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.

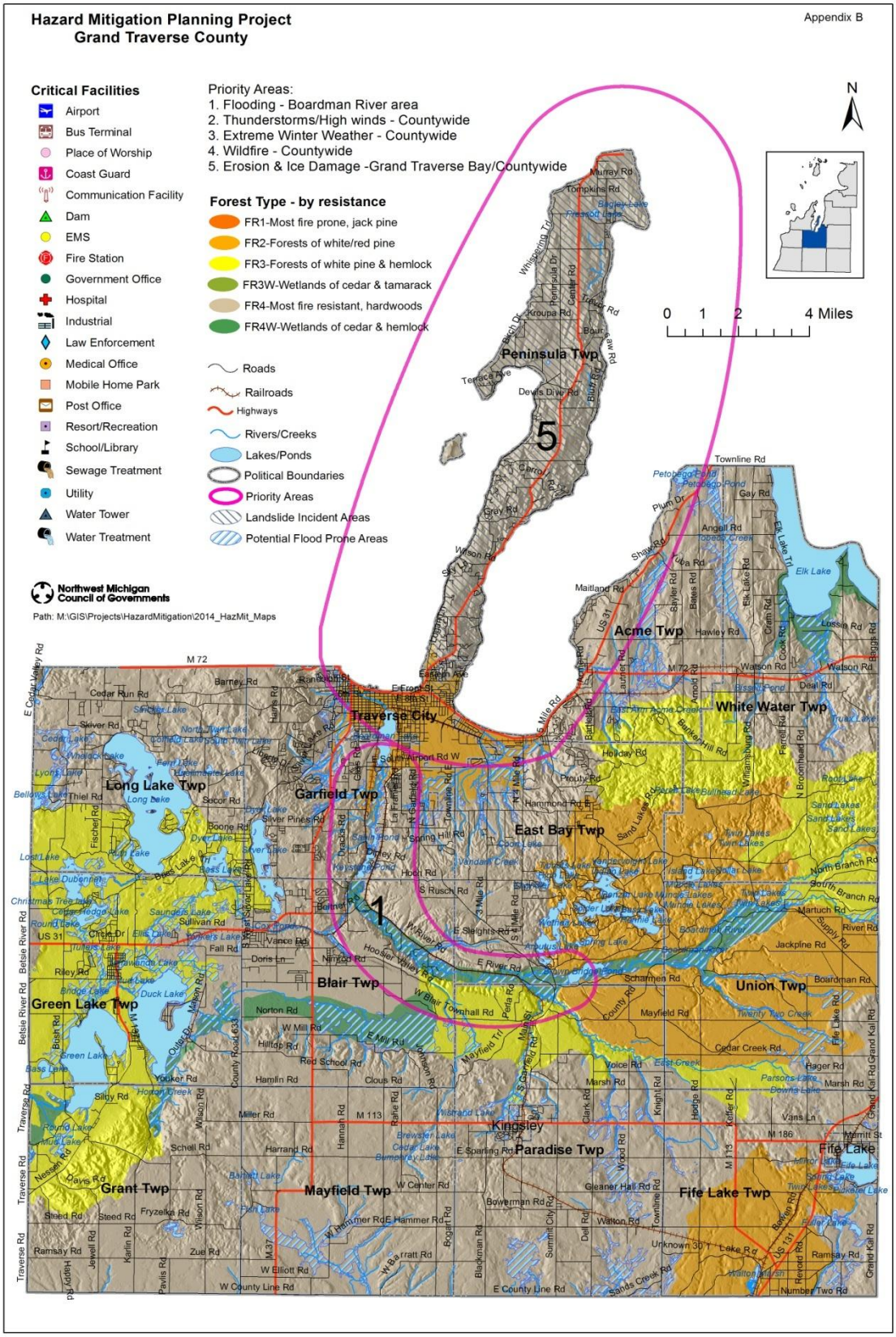
Vulnerability: The level of exposure of human life and property to damage from natural hazards.

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



Appendix B

Hazard Mitigation Planning Project
Grand Traverse County - Northeast

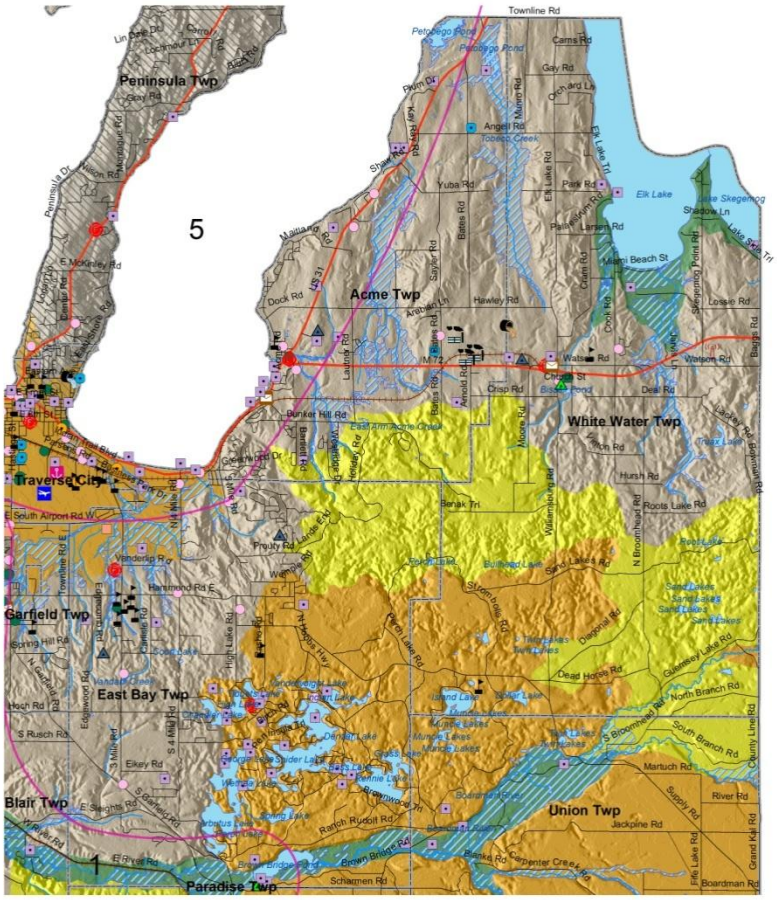
Critical Facilities
- Airport
- Bus Terminal
- Place of Worship
- Coast Guard
- Communication Facility
- Dam
- EMS
- Fire Station
- Government Office
- Hospital
- Industrial
- Law Enforcement
- Medical Office
- Mobile Home Park
- Post Office
- Resort/Recreation
- School/Library
- Sewage Treatment
- Utility
- Water Tower
- Water Treatment

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

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

0 0.5 1 2 Miles

Priority Areas:
1. Flooding - Boardman River area
2. Thunderstorms/High winds - Countywide
3. Extreme Winter Weather - Countywide
4. Wildfire - Countywide
5. Erosion & Ice Damage -Grand Traverse Bay/Countywide



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Appendix B

Hazard Mitigation Planning Project
Grand Traverse County - Northwest

Critical Facilities
- Airport
- Bus Terminal
- Place of Worship
- Coast Guard
- Communication Facility
- Dam
- EMS
- Fire Station
- Government Office
- Hospital
- Industrial
- Law Enforcement
- Medical Office
- Mobile Home Park
- Post Office
- Resort/Recreation
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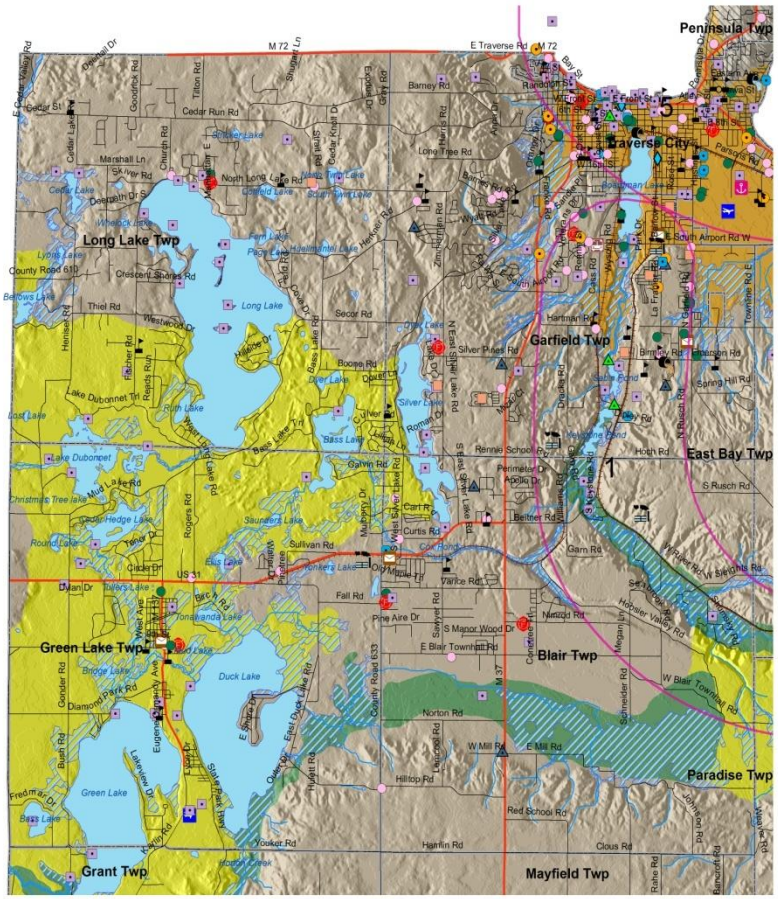
- Potential Flood Prone Areas

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

0 0.5 1 2 Miles

Priority Areas:
1. Flooding - Boardman River area
2. Thunderstorms/High winds - Countywide
3. Extreme Winter Weather - Countywide
4. Wildfire - Countywide
5. Erosion & Ice Damage -Grand Traverse Bay/Countywide



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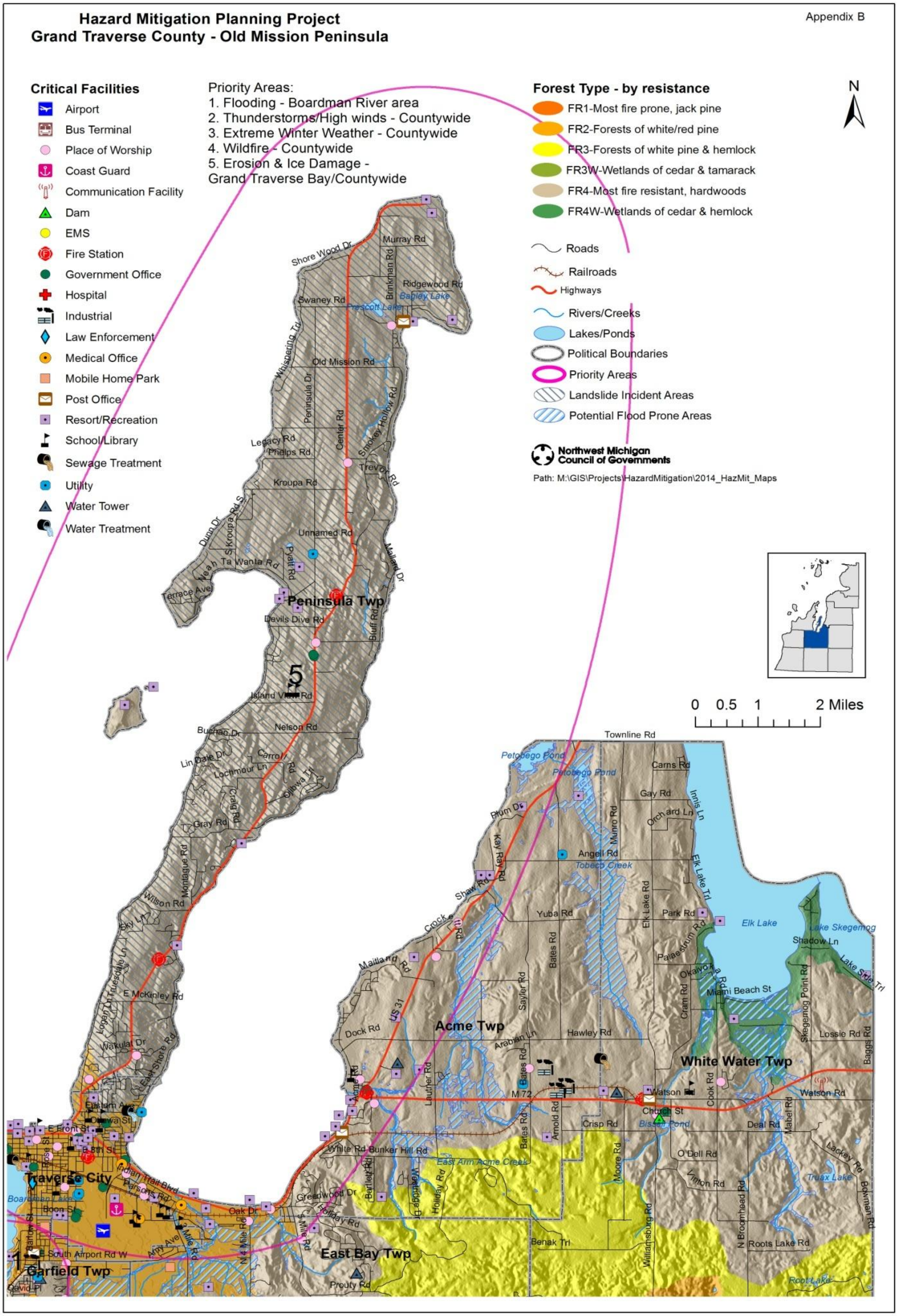
Hazard Mitigation Planning Project
Grand Traverse County - Old Mission Peninsula
Appendix B
Critical Facilities
Airport
Bus Terminal
Place of Worship
Coast Guard
Communication Facility
Dam
EMS
Fire Station
Government Office
Hospital
Industrial
Law Enforcement
Medical Office
Mobile Home Park
Post Office
Resort/Recreation
School/Library
Sewage Treatment
Utility
Water Tower
Water Treatment
Priority Areas:
1. Flooding - Boardman River area
2. Thunderstorms/High winds - Countywide
3. Extreme Winter Weather - Countywide
4. Wildfire - Countywide
5. Erosion & Ice Damage -
Grand Traverse Bay/Countywide
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
Roads
Railroads
Highways
Rivers/Creeks
Lakes/Ponds
Political Boundaries
Priority Areas
Landslide Incident Areas
Potential Flood Prone Areas
Northwest Michigan Council of Governments
Path: M:\GIS\Projects\HazardMitigation\2014_HazMit_Maps
N
0 0.5 1 2 Miles
Peninsula Twp
Acme Twp
White Water Twp
East Bay Twp
Garfield Twp
Traverse City
Elk Lake
Lake Skegemog
Townline Rd
US 31
M 72

Hazard Mitigation Planning Project
Grand Traverse County - South

Critical Facilities
- Airport
- Bus Terminal
- Place of Worship
- Coast Guard
- Communication Facility
- Dam
- EMS
- Fire Station
- Government Office
- Hospital
- Industrial
- Law Enforcement
- Medical Office
- Mobile Home Park
- Post Office
- Resort/Recreation
- School/Library
- Sewage Treatment
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- Water Tower
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- Railroads
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- FR3W-Wetlands of cedar & tamarack
- FR4-Most fire resistant, hardwoods
- FR4W-Wetlands of cedar & hemlock

Priority Areas:
1. Flooding - Boardman River area
2. Thunderstorms/High winds - Countywide
3. Extreme Winter Weather - Countywide
4. Wildfire - Countywide
5. Erosion & Ice Damage -Grand Traverse Bay/Countywide

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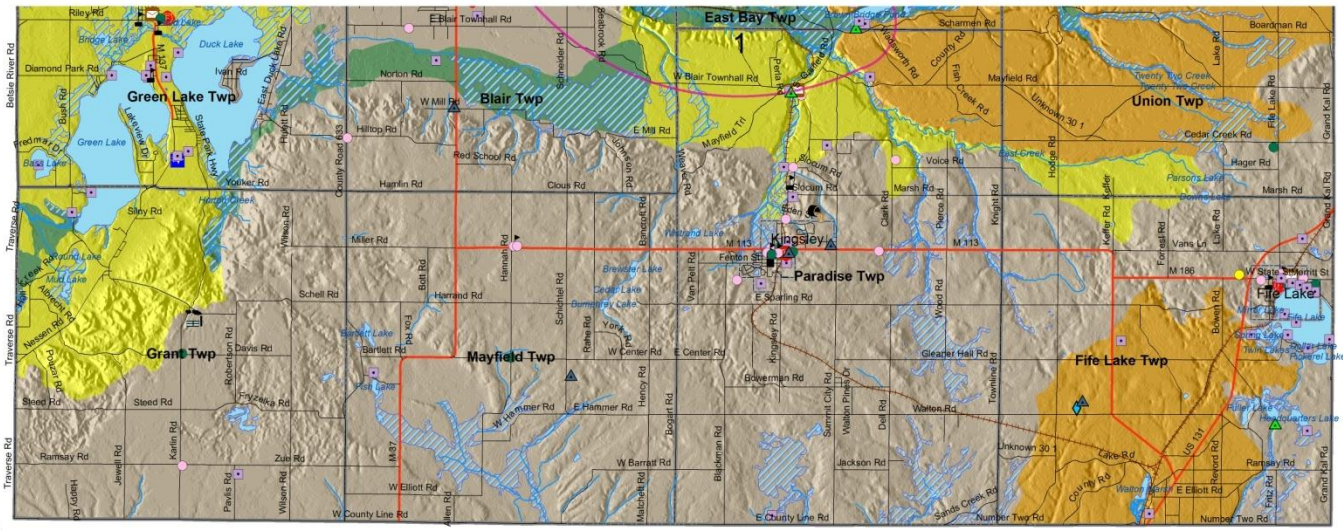
0 0.5 1 2 Miles



Appendix B

Hazard Mitigation Planning Project
Grand Traverse County - Traverse City

Critical Facilities
- Airport
- Bus Terminal
- Place of Worship
- Coast Guard
- Communication Facility
- Dam
- EMS
- Fire Station
- Government Office
- Hospital
- Industrial
- Law Enforcement
- Medical Office
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- FR3-Forests of white pine & hemlock
- FR3W-Wetlands of cedar & tamarack
- FR4-Most fire resistant, hardwoods
- FR4W-Wetlands of cedar & hemlock

0 0.225 0.45 0.9 Miles

Priority Areas:
1. Flooding - Boardman River area
2. Thunderstorms/High winds - Countywide
3. Extreme Winter Weather - Countywide
4. Wildfire - Countywide
5. Erosion & Ice Damage -Grand Traverse Bay/Countywide

Northwest Michigan Council of Governments

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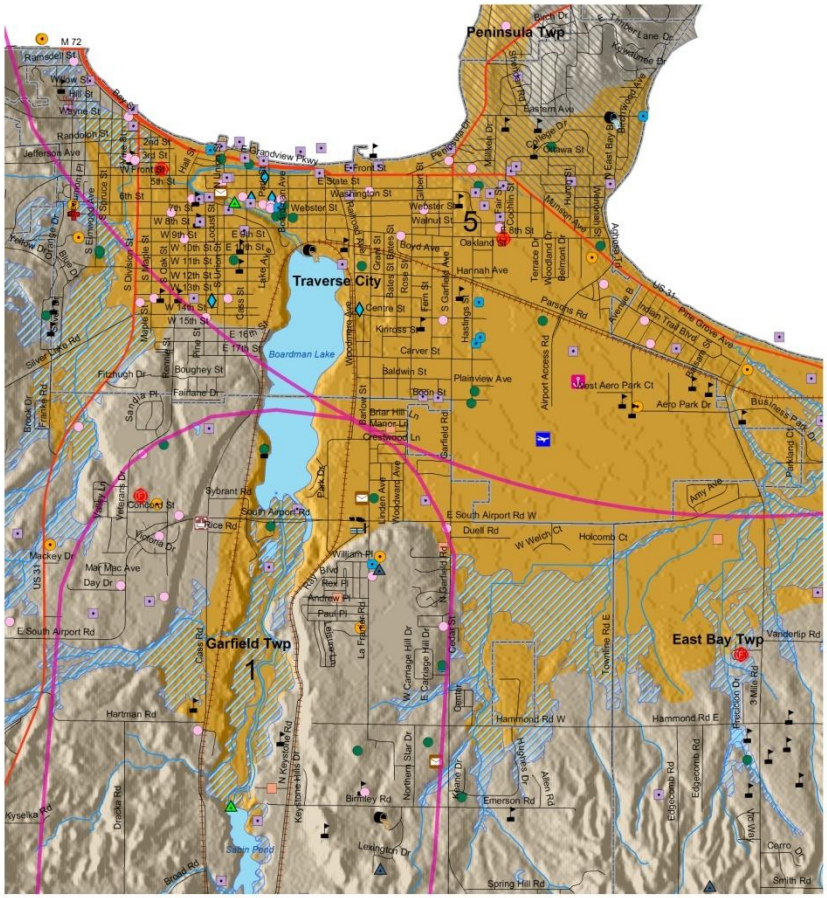
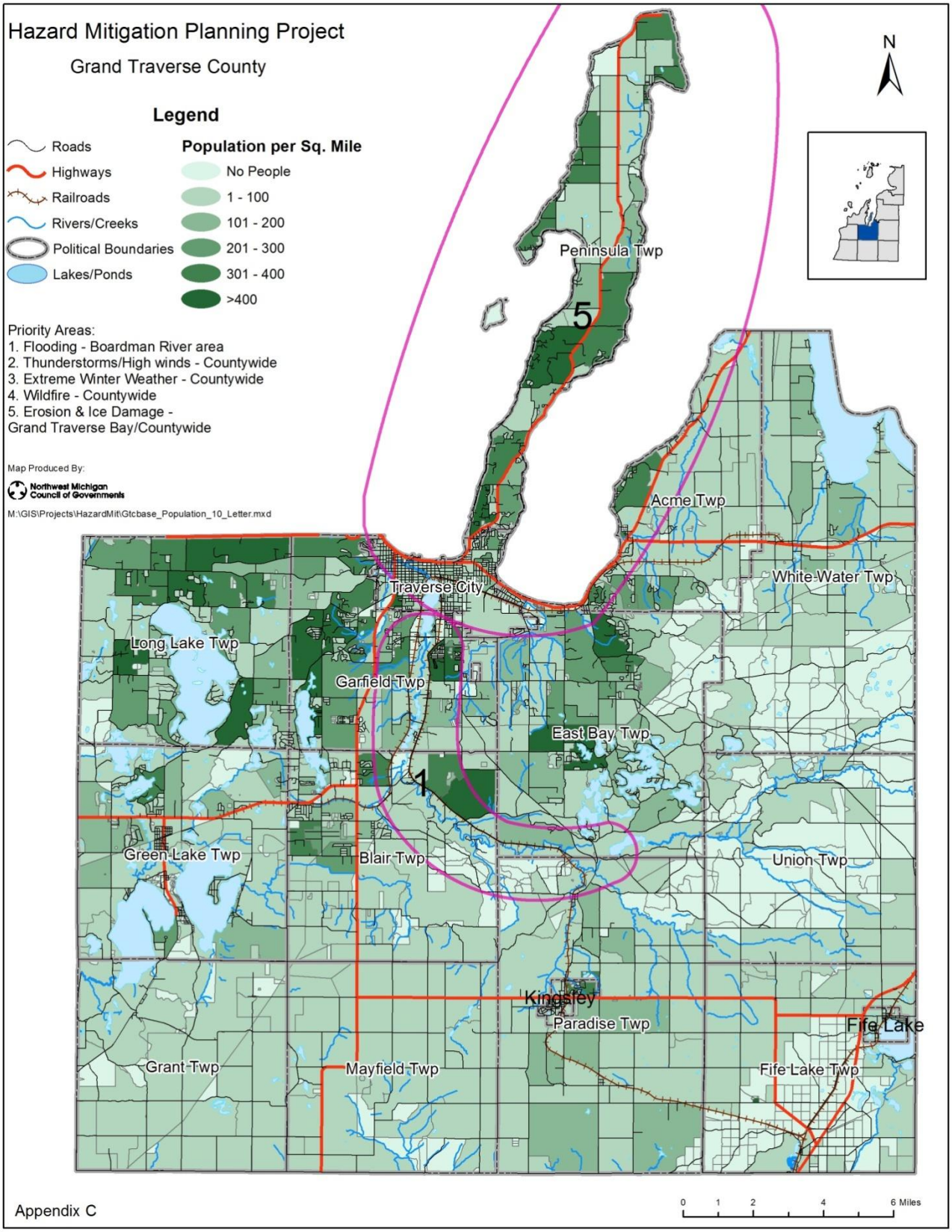
Appendix B



Appendix C

Population Density Map



Appendix D

Risk Assessment Summary Table: GRAND TRAVERSE COUNTY

HAZARD (Years of Record)	Number of Events	Probability**	Geographic Size Affected	Population Impacted	Specific Priority Area	Estimated Damage Known Costs
Flooding (1986 – 2013)	7	Frequent	**County Wide** Boardman River Communities	86,986 46,306	**1**	$6,894,000 property damage
Hail (1958 – 2014)	26	Frequent	**County Wide**	86,986		.75 inch to 2 inch magnitude
Shoreline Erosion	No recorded major events	Rare	Traverse City, Peninsula, East Bay, and Acme Townships	35,145	**5**	
Extreme Winter Weather (1993 – 2014)	105	Frequent	**County Wide**	86,986	**3**	$5,112,000 property damage and power outages $15,000,000 crop damage (statewide)
Severe Thunderstorm/High Winds/Lightning (1955 – 2014)	54	Frequent	**County Wide**	86,986	**2**	$477,500 property damage
Tornadoes	4	Rare	**County Wide**	86,986	**2**	$775,000 property damage
Wildfires (1981 – 2010)	386	Occasional	**County Wide**	86,986	**4**	1300 acres

***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 that once every 30 years.
Frequent - Hazard event is likely to occur more than once every 5 years.

Appendix E

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	**Thunderstorm/Lightning Projects**	**Wildfire Projects**
Flood study for stream, roadways		
Elevate electrical equipment in basements	Lightning protection (grounding/phasing)	Vegetation management for roadways
Floodproof 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 F

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.