Benzie County Michigan

Natural Hazards Mitigation Plan

Draft 12/11/14

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.

Following is a list of the key contributors to the Plan who participated in the development of the Benzie County Natural Hazards Mitigation Plan:

Benzie County Emergency Management Coordinator

Frank Post

Benzie County Township Association

Almira Township	Mark Roper, Supervisor
Benzonia Township	James Sheets, Supervisor
Blaine Township	Tom Campbell, Supervisor
Colfax Township	Ron Evitts, Supervisor
Crystal Lake Township	Amy Ferris, Supervisor
Gilmore Township	Carl Noffsinger, Supervisor
Homestead Township	Jessica Wooten, Supervisor
Inland Township	Paul Beechraft, Supervisor
Joyfield Township	Matt Emery, Supervisor
Lake Township	William Robinson, Supervisor
Platte Township	Paul Solem, Supervisor
Weldon Township	Ronald Hitesman, Supervisor

Benzie County Municipal Governments

City of Frankfort	Joshua Mills, Superintendent
Village of Benzonia	Timothy Flynn, President
Village of Beulah	Dan Hook, President
Village of Elberta	Diane Jenks, President
Village of Honor	Dennis Rodzik, President
Village of Lake Ann	Cathy Werts, Clerk
Village of Thompsonville	Charles Syer, President

Benzie County Equalization Director

Thomas Longanbach

Benzie County Road Commission

Heather Jamison

Benzie County Planning Commission

Chairperson: Peg Minster
Vice Chair: Nena Bondarenko
Secretary: Susan Zenker
Members: Lori Hill
Adrian Poulisse
Glen Rineer
Don Tanner

Benzie County Sheriff's Office
Ted Schendel

Benzie County Emergency Medical Services
Craig Johnson

Benzie County Central Dispatch
Ronald Berns

Benzie County Area Fire Departments

Almira Township Fire Department	Steven Adams, Chief
Benzonia Township Fire Department	John Hanmer, Chief
Frankfort Fire Department	Charles Thompson, Chief
Homestead Township Fire Department	Frank Walterhouse, Chief (Retired) AJ Zirkel, Chief
Inland Township Fire Department	David Cutway, Chief
Thompsonville Fire Department	James McGirr, Chief

Grand Traverse Band of Ottawa and Chippewa Indians

Special thanks to Michael Woods and his staff at Northwest Michigan Council of Governments in putting together the significant amount of information to make this plan possible

II. LETTER OF TRANSMITTAL

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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 Benzie 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 Benzie 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, Benzie 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 Benzie County remains a vibrant, safe, enjoyable place in which to live, raise a family, maintain a tourist base, and continue to conduct business.

V. 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.

To meet this requirement, the Michigan State Police provided funding to regional planning agencies throughout the State of Michigan to work with individual counties in developing their Hazard Mitigation Plans. For northwest, lower Michigan the ***Northwest Michigan Hazard Mitigation Planning Project*** was coordinated by the Northwest Michigan Council of Governments (NWMCOG) and included the ten county area of Emmet, Charlevoix, Antrim, Kalkaska, Missaukee, Wexford, Grand Traverse, Leelanau, Benzie, and Manistee. NWMCOG worked with the Task Forces and developed plans for each of the counties. These plans included 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 Benzie County Natural Hazards Mitigation Plan focuses on natural hazards such as drought, wildfires, flooding, shoreline erosion, thunderstorms and high winds, tornadoes, and severe 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 Benzie 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 Benzie 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:

Natural Hazards Mitigation Planning Goals for Benzie 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

Natural Hazards Mitigation Priority Areas
Priority Area 1: Lake Ann Area (Village of Lake Ann, Almira Township) – increased development in and around the pine plantations that have a high fire load, possible lightning strikes as starters; Sleeping Bear Dunes National Lakeshore Area (National Park Service) – wildfire/development interface Mitigation Strategies: ***Wildfire***
Priority Area 2: Countywide heavy snow, extreme temperatures, ice damage occurrences, specifically along the Crystal Lake area (Lake, Benzonia, Crystal Lake Townships, Village of Beulah) Mitigation Strategies: ***Severe Winter Weather***
Priority Area 3: Countywide high wind damage - downed trees and power lines, downed trees over roads, usually during the month of November Mitigation Strategies: ***High Winds***
Priority Area 4: Platte River area (Village of Honor, Homestead Township), Betsie Lake M-22 area (Village of Elberta, Crystal Lake Township), East side of Upper Herring Lake (Blaine Township) Mitigation Strategies: ***Flooding***
Priority Area 5: Municipalities along Lake Michigan (Lake, Crystal Lake, Gilmore, Blaine Townships, Village of Elberta); Crystal Downs Area; Michabou Shores; Village of Honor and Homestead Township Mitigation Strategies: ***Erosion***

Frequent Natural Hazard	Mitigation Strategies
Wildfire	
	• Public education, awareness, alertness – become a FIREWISE community
	• Work with campgrounds on a notification system regarding fire danger; create areas of refuge involving imminent fire dangers at campgrounds; and establish evacuation routes from campgrounds
	• Develop new building and zoning codes
	• Adjustments in the planning, design, and development process for area structure County Building Inspector
	• Continue Building code enforcement for new construction
	• Public education, awareness, alertness – become a FIREWISE community
Snow and Ice	
	• Continue Building code enforcement for new construction
	• Public education
High Winds	
	• Continue Building code enforcement for new construction
	• Tree management by power companies
	• Create shelters for campground areas
	• Public education for structural elements and tree management
	• Continue Building code enforcement for new construction
Flood	
	• Public education
	• Mapping of flood prone areas
	• Reduce potential of flooding by identifying flood prone structures and raise foundations
	• Wetland protection
	• Enforcement of storm water and drainage control statutes and ordinances
Erosion	
	• Public Education
	• Promote the relocation of structures
	• Drainage control and placement of vegetation, utilizing native vegetation
	• Enforcement of soil erosion statutes/permits
	• Enforcement of building codes
Various	
	• Work on a multi-hazard warning plan
	• Working with other governmental entities, organizations, businesses, and the public
	• Incorporating the Plan's natural hazards mitigation concepts, strategies, and policies into existing elements of Benzie County's Master Comprehensive Plan 2020

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 Benzie 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 Benzie 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

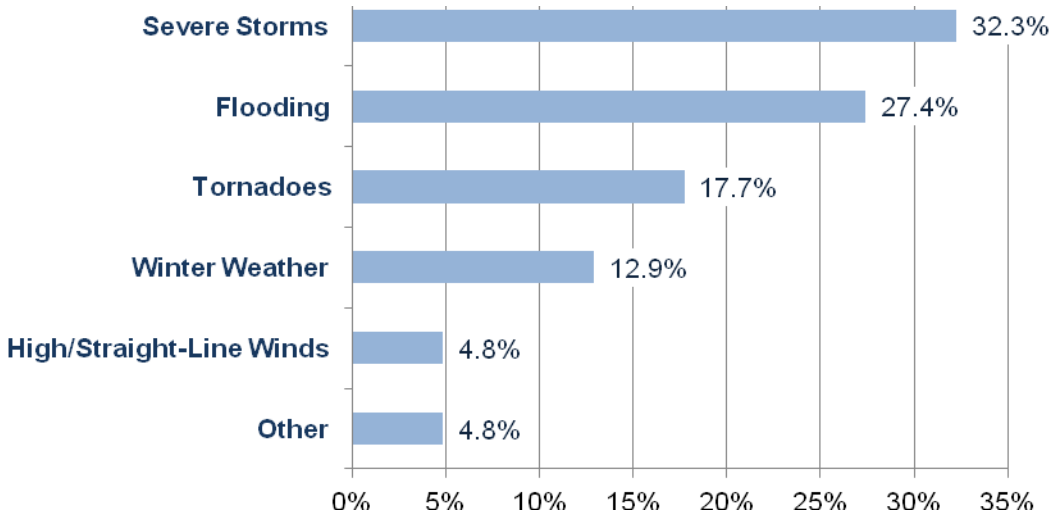
What is a Hazard?

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 Table x). 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)



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

Benzie County is located in the northwest corner of Michigan's Lower Peninsula with its western border on Lake Michigan with a section of Sleeping Bear Dunes National Lakeshore located in the northwest corner. The county is covered with a rolling terrain, with many lakes and rivers throughout the area. The most prominent lake is Crystal Lake with many smaller lakes and rivers.

The community data located below is provided to describe Benzie County for planning and implementing the mitigation strategies. Please refer to Appendix E, Resources.

Major Geographic Features of Benzie County

Feature	Measure	Percent
Area in Water	16,960 acres	
Forest Lands	146,600 acres	65.6
Wetlands	34,294 acres	24.6
Farmland (2012)	20,646 acres	
Operating Farms (2012)	181	NA
Miles of Great Lakes shoreline	60 miles	NA
Inland Lakes	57	NA

Source: US Agricultural Census, 2012; County Data

County Resident Profile

The total County population is **17,525**. The projected growth for 2020 is 19,237 and for 2030 it is 20,678. The population numbers are from the 2010 Census for the **12 Townships, 1 city and 6 major villages** covered by this plan are:

Township/City/Village	Population	Township/City/Village	Population
Almira Township	3,377	Platte Township	354
Benzonia Township	1,888	Weldon Township	255
Blaine Township	551	Village of Benzonia	497
Colfax Township	503	Village of Beulah	342
Crystal Lake Township	957	Village of Elberta	372
Gilmore Township	449	Village of Honor	328
Homestead Township	2,029	Village of Lake Ann	268
Inland Township	2,070	Village of Thompsonville	441
Joyfield Township	799	City of Frankfort	1,286
Lake Township	759		

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

County Resident Profile (continued)

- There are 12,199 *Housing Units* in Benzie County with an average household size of 2.37 people per household. 44.5% of households have 2 persons.
- The number of residents 65 years and over is 20.6% of the population.
- The number of residents 19 years and under is 23.17% of the population.
- The number of residents over 65 with a disability is 7.8% of the population.
- The total number of residents with disability is 16.9% of the population.
- The number of residents that have a language barrier or are linguistically isolated is less than 1% of the population.
- Percent below poverty level (February 2014 Poverty level: $19,790 Family of 3 and $11,670 Family of 1)

Poverty	Statistics
Families in poverty	7.0%
Income less than $15,000	9.8%
Population in poverty	13.0%

Source: US Census Bureau, 2010: American Fact Finder

2012 Economic Census

Industry Description	Number of Establishments	Number of Employees
Manufacturing	23	397
Wholesale trade	5	NA
Retail trade	73	487
Information	7	NA
Real estate, rental, leasing	15	NA
Professional, scientific, technical services	31	62
Administrative, support, waste management, remediation services	24	NA
Educational services	1	0-19
Health care, social assistance	30	343
Arts, entertainment, recreation	17	28
Accommodation and food services	57	1013
Other services (except public administration)	45	141
Wholesale trade	5	29

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

VII. THE DEVELOPMENT OF THE PLAN

Data Methodology and Map Development

Benzie County staff identified the critical facilities and infrastructure on the base map with the Northwest Michigan Council of Governments' GIS staff then digitizing the facilities as point files. Natural hazards points, polygons, and population centers data was then added to the base maps utilizing the following:

Critical Infrastructure

1 Airport
2 Airstrips
5 Bridges
1 Child Care
1 Church
2 Communications Facilities

- MPSCS Tower Site

10 Community Shelters
8 Dams
5 Fire Stations
2 Fish Hatcheries
26 Government Buildings Including:

- Almira Township Office
- Benzie County Council on Aging
- Benzie County Emergency Medical Services (2 Facilities)
- Benzie County Government Center
- Benzie County Transportation Authority (Benzie Bus)
- Benzie County Resource Center
- Benzie County Road Commission Garage
- Benzonia Township Office
- Beulah Village Office
- Blaine Township Office
- Colfax Township Office
- Crystal Lake Township Office
- Elberta Village Office
- Frankfort City Office
- Gilmore Township Office
- Homestead Township Office
- Honor Village Office
- Inland Township Office
- Joyfield Township Office
- Lake Ann Village Office
- Lake Township Office
- Platte Township Office
- Platte Grange Hall
- Thompsonville Village Office
- Tribal Community Building
- Weldon Township Office

9 Hazardous Materials Sites or Facilities
8 Hospital and Medical Facilities

- Primary physicians per 100,000 population 1998 is 49.0

1 Military/US Coast Guard
3 Police Stations/Jails
4 Resort/Recreation
6 Schools/Bus Garage

4 Senior Citizen Apartments/Center
9 Waste/Water/Sewage Treatment Facilities

- Water: 20.9% public system or private company; 76.5% individual wells;
- Sewer: 20.9% public sewer; 76.9% individual septic/cesspool; 2.2% other

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.

There are currently no communities in Benzie County that participate in the National Flood Insurance Program (NFIP).

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 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 Benzie County.

Natural Hazard 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 Benzie 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 Benzie County, according to the NOAA Storm Even Database; January 1950 – August 2014.

Flooding/Flash Flood: 3 events

Month	Year	Location	Effect	Damage
March	1993	Countywide	NA	NA
April	1993	Countywide	NA	NA
September	2000	Countywide	Flash flooding, wash out of secondary roads	NA

Hail: 14 events

Month	Year	Location	Effect	Damage
June	1955	Countywide	1.75 in.	NA
July	1982	Countywide	1.75 in.	NA
July	1987	Countywide	0.75 in.	NA
April	1993	Frankfort	0.75 in.	NA
May	2002	Honor	1.25 in.	NA
August	2003	Lake Ann	0.75 in.	NA
September	2003	Frankfort	0.75 in.	NA
September	2005*	Lake Ann	0.75 in.	NA
September	2005*	Elberta	0.75 in.	NA
June	2006	Lake Ann	0.75 in.	NA
July	2006	Honor	1.00 in.	NA
October	2006	Benzonia	3.25 in.	NA
October	2006	Honor	1.00 in.	NA
June	2007	Benzonia	1.00 in.	NA

Extreme Winter Weather: 24 events

Month	Year	Location	Effect	Damage	Event
January	1993	County/Region	6 – 12 in. snow	$50,000	Heavy Snow
March	1993	County/Region	.2 - .4 in. ice	NA	Freezing Rain
April	1993	County/Region	NA	$50,000	Heavy Snow

Month	Year	Location	Effect	Damage	Event
December	1993	County/Region	10 – 15 in. snow/ 3 ft. drifts	NA	Heavy Snow
January	1994	Statewide	.1 - .3 in. ice	$5,000,000	Freezing Rain/Heavy Snow
March	1994	County/Region	.2 - .4 in. ice	NA	Freezing Rain
December	1996	Countywide	8 – 12 in. snow	NA	Heavy Snow
December	1998	County/Region	6 – 12 in. snow	NA	Heavy Snow
January	1999	County/Region	6 – 12 in. snow	NA	Heavy Snow
January	2000	County/Frankfort	NA	NA	Heavy Snow
February	2001	County/Region	1/4 in. thick covering	NA	Ice Storm
December	2001	County/Region	Over 12 in. snow	NA	Heavy Snow
March	2002	County/Region	10 – 16 in. snow	NA	Heavy Snow
December	2002	County/Region	1 in. thick covering	NA	Ice Storm
January	2004	County/Region	Over 20 in. snow	NA	Heavy Snow
January	2005	County/Frankfort	Over 12 in. snow	NA	Heavy Snow
February	2007	Countywide	-20 to -30 wind chills	NA	Extreme Temp
February	2007	Countywide	Over 12 in. snow	NA	Heavy Snow
February	2007	County/Lake Ann	12 – 15 in. snow	NA	Heavy Snow
February	2008	County/Region	Over ½ in. covering	NA	Ice Storm
April	2012	Statewide	Killing freeze	$15,000,000 (crop)	Extreme Temp
March	2012	Countywide	Over 20 in. of snow	NA	Heavy Snow
March	2013	Lake Ann	Over 12 in. of snow	NA	Heavy Snow
January	2014	Countywide	12 – 16 in. of snow	NA	Heavy Snow

Severe Thunderstorm, High Wind: 15 events

Month	Year	Location	Effect	Damage
July	1995	Frankfort	Downed tree and power lines	$1,000
November	1998	Frankfort	80 - 90 mph gusts	NA
August	2003	Frankfort	70 mph gusts	$15,000
November	2003	County/Region	High wind	$155,000
August	2004	County/Lake Ann	52 knot winds	$12,000
September	2005*	Frankfort	52 knot winds	$6,000
September	2005*	Lake Ann	52 knot winds/ trees down/ vehicles damaged	$12,000
November	2005	County	50 knot winds/ trees and power lines down	$8,000

Month	Year	Location	Effect	Damage
November	2005	County	52 knot winds/ trees down	$5,000
July	2006	Frankfort	60 knot winds	$60,000
July	2006	Thompsonville	52 knot winds/ trees down	$4,000
August	2008	Frankfort	54 knot winds	$8,000
June	2010	Watervale	55 knot winds/ trees down/ roof damage	$16,000
October	2010	Countywide	55 knot winds	$4,000
August	2013	Frankfort	54 knot winds	$8,000

Tornado: 4 events

Month	Year	Location	Effect	Damage
April	1956*	County	F4/ 19 miles long, 400 yards wide, 2 deaths and 24 injuries	$250,000
July	1983	County	F1	NA
June	1986	County	F1/ 1 mile longs and 20 yards wide	$3,000
October	1989	County	F1/12 miles long, 20 yards wide	$25,000

** Governor and Presidential Hazard Declaration*

Other (according to the Michigan Hazard Analysis of 2012)

Shoreline Erosion

Benzie County is identified as a High Risk Erosion Area with the Lake Michigan and Crystal Lake shorelines at risk. The Great Lakes experienced record high lake levels in 1985-86, and again in 1997-98. The National Climatic Data Center indicates that there have been no lake surf erosion events reported in Benzie County since 1950. While there were Governors Disaster Declarations for shoreline problems in the state in 1985-1986, these declarations did not include Benzie 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 drowning's 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. Out of 17 events, 8 occurred in Lake Michigan waters, including Benzie County.

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).

Wildfires

169 wildfires occurred in Benzie County from 1981 to 2010, affecting nearly 280 acres countywide.

Pandemics or other Public Health Emergencies

Naturally occurring pandemics may cause widespread precautions around the world. The Benzie – Leelanau District 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

Natural hazards such as hail, thunderstorm and high wind, tornadoes, snow and ice, flooding, and shoreline erosion that will affect Northwest Michigan is a perennial concern. The magnitude and severity depends on the season, which determines temperature, moisture in the air, ice cover on the lakes, etc. Additionally, the severity of an event is directly proportional with tourist activity throughout the year, the pace of residential development, and an increasing base population that affects overall land use in the region. The events recorded indicate that natural hazard events may be occurring more frequently, but the geographic impact of the natural hazards' impact has remained the same in Benzie County.

The areas where natural hazards overlap in Benzie 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.

Benzie County Natural Hazards Task Force and Public Input

The Benzie Natural Hazards Task Force comprised of members from the County Township Association (CTA), which are stakeholders in leadership positions representing their individual townships, and 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 met several times to analyze and update the hazard priority maps, goals & objectives, hazard priority areas, mitigation measures, and the action item agenda.

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

- Seasonal populations (summer)
- Tribal lands and facilities: High winds, storms
- US-31/Reynolds Rd. propane filling facility (2 bulk propane tanks)
- *Magna Continental* – water tower supplies Fire Department
- Low-head barrier – fish latter/lamprey barrier located at the Old Homestead Dam site
- Two dams US-31 S and M-115: Rice Creek Mill Pond
- Graceland Fruit plant in Frankfort and Gilmore Twp.
- Lake Michigan erosion – a lot of areas; Crystal Downs/Grace Road development
- Lower Herring dam – environmental; flooding when Lake Michigan rises and recedes
- Oil and Gas wells (48 total)
- Gas pipeline to Kingsley
- Grass Lake flooding dam – ecological
- Crystal Mountain – large winter population and seasonal summer; residential, resort, hotel, water park, propane/natural gas, sewage treatment plant, direct groundwater wells – no tank or tower
- Flooding: Honor area, Platte River (flash flooding); South Street bridge (Platte River) US 31
- Erosion: Honor area
- Fish Hatchery – dam/weir where they take care of high water on the Platte River
- Outlet dam from Crystal Lake to Lake Michigan controls lake levels
- Frankfort airport (paved)
- Sleeping Bear Dunes National Lakeshore area – wildfire management

- Fire load areas
- High winds causing downed trees, power lines, etc. over roads
- Lake Ann area – fire load vs. rapid development within pine plantations (potential lightening)
- North Almira Township dam (Gristmill)
- Ice damage along Crystal Lake and Platte Lake; ice blockage issues around South Street and Zimmerman Road
- Severe winter weather – snow loads; extreme temperatures (cold); freezing small village water systems
- Countywide festivals
- Communications Towers (15)

Natural Hazards Priority Areas were narrowed to the top 5 significant according to the Task Force.

Top Five Natural Hazards Priority Areas

1. **Potential Wildfire Areas: Lake Ann Area (Village of Lake Ann, Almira Township), Sleeping Bear Dunes National Lakeshore**

   There has been an increase in residential development specifically around Crystal Lake and the eastern part of the county. In addition to the forest types that are most fire prone in these areas, 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 these areas.

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

2. **Severe Winter Weather potential each year throughout the County – heavy snow, extreme temperatures, ice damage occurrences along Crystal Lake (Lake, Benzonia, Crystal Lake Townships, Village of Beulah)**

   Benzie 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.

3. **High Wind damage potential throughout the County**

   There is a historical record of high wind events and Tornadoes in Benzie 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. Ice damage may occur when high winds push lake water and ice past the shoreline, affecting public infrastructure and residential areas.

4. **Potential Flooding: (Platte, Betsie, and Herring River Basins)**

   High water tables, as a result of high precipitation years, may seep into basements and/or cause frost damage. In addition to the riverine floodplain, other flooding may involve low-lying

areas that collect water runoff; 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. According to the Michigan Hazard Analysis report, one dam in Benzie County is listed as a "Significant Hazard" should failure occur.

5. **Erosion Areas - Lake Michigan Coast (Lake, Crystal Lake, Gilmore, Blaine Townships, Village of Elberta, Crystal Downs development, Michabou Shores, and Village of Elberta). Other Erosion Areas include the Village of Honor area (Village of Honor, Homestead Township)**

   Shoreline or soil erosion hazards involve the loss of property or necessitate the relocation of homes (as occurred in the Crystal Downs development) 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.

Emergency Warning System Coverage

There are no emergency warning systems in operation in Benzie County.

Economic Impact Analysis

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

1. Flooding $5,000,000
2. Thunderstorm and High Wind $171,000
3. Tornadoes $25,000
4. Snow and Ice $5,055,000

The Benzie 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 22% increase to account for the average seasonal population within the county.

Priority Area(s)	Geography	Population	State Equalized Value
	Benzie County	17,525	$1,498,125,725
1	Sleeping Bear Dunes	*1.5 million visitors annually*	*Federal Government Property*
1	Almira Township	2,811	$155,471,700
1	Village of Lake Ann	268	$15,039,700
1, 4	Lake Township	759	$72,540,700
2	Crystal Lake Shoreline	1,107	$225,469,600
3, 4	City of Frankfort	1,286	$101,187,400
4, 5	Village of Honor area	851	$56,804,900
4	Betsie Lake M-22 area	238	$21,672,400
4	East side of Upper Herring Lake Area	191	$19,207,844
5	Lake Michigan Coastal Area	645	$62,152,800

VIII. NATURAL HAZARDS MITIGATION GOALS AND OBJECTIVES

The mission of the Benzie 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 Benzie 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 for possible future funding
- Encourage the application for project funding from diverse entities

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

- Encourage public and business involvement in natural hazards mitigation projects

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 Missaukee 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.

Area 1: Potential Wildfire Areas (Lake Ann Area, Sleeping Bear Dunes National Lakeshore, Crystal Lake, And Eastern Benzie County):

Wildfire Mitigation Strategies

- Develop new building and zoning codes such as a 25 foot cleared space between houses/structures; defensible space
- Adjustments in the planning, design, and development process for area structures
- Public education, awareness, and alertness – become a FIREWISE community; fuel management, diversity of and native vegetation; homeowner property maintenance
- Visit campgrounds to advise campers of critical fire levels
- Building code enforcement on new construction

Area 2: Severe Winter Weather potential each year throughout the County – heavy snow, extreme temperatures, ice damage occurrences on Crystal Lake (Lake Benzonia, Crystal Lake Townships, Village of Beulah)

Snow Load and Ice Build Up Mitigation Strategies

- Adoption of stricter snow load building codes
- Public education
- Building code enforcement (only for new construction)

Area 3: High Wind potential throughout the County which cause downed trees over roads and downed power lines.

High Winds Mitigation Strategies:

- Shelters for Campground areas – Betsie River Campground, Lake Michigan Campground on the Platte River in Sleeping Bear Dunes National Lakeshore; Lake Ann Baptist Camp
- Public Education for structural elements and tree management and promoting anchoring and tie downs for structures that need it
- Building code enforcement for new construction
- Building code enforcement for pavilions
- Tree management by power companies on power line easements

Area 4: Potential Flooding: (Platte, Betsie, and Herring River Basins) including:

Honor/Platte River flash flooding area (U.S. Highway 31)
Platte River Bridge (M-22)
South Street Bridge (U.S. Highway 31)
Betsie Lake (M-22)
East side of Upper Herring Lake (Mick and Garvan Roads)
Crystal Lake Outlet (M-115)

Flood Mitigation Strategies

- Mapping of flood prone areas (Blueberry Creek/Trout Pond area off of US 31 west of Honor
- Wetland protection
- Enforcement of stormwater/drainage control statutes/ordinances and other state and county ordinances – The County is working on creating a new 50 foot and 100 foot building/septic development setback for residential and commercial entities on all water bodies in Benzie-Leelanau Health Department enforcement of "The Sanitary Code" and proposed as 50 to 75 feet for Crystal Lake and the Betsie River; presently only a 25 foot set back
- Enforcement of building codes
- Public education

Area 5: Lake Michigan Coastal Erosion Area located in the Crystal Downs development, Michabou Shores, and Village of Elberta (Lake, Crystal Lake, Gilmore, Blaine Townships, and Village of Elberta); Other Erosion Areas include the Village of Honor area (Village of Honor, Homestead Township)

Shoreline Erosion Mitigation Strategies

- Promote the relocation of structures – property owner's expense or demolition
- Drainage control and placement of vegetation, utilizing native vegetation
- Enforcement of soil erosion statutes/permits – water levels rising at new construction sites; and enforcement of the grading levels no more than 10%
- Enforcement of building codes (there is building now where no one would have built before)
- Public Education

X. PARTICIPATION IN THE DEVELOPMENT OF THE BENZIE COUNTY NATURAL HAZARDS MITIGATION PLAN

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

A. Public Notice

The Benzie County Office of Emergency Management is requesting public comment on the Natural Hazards Mitigation Plan draft for Benzie County. The Plan is available for review at:

Benzie County Clerk's Office
448 Court Place
Beulah, Michigan 49617

Please send comments by January 15th, 2015 to:

Natural Hazard Mitigation Plan
Benzie County Office of Emergency Management
448 Court Place
Room 134
Beulah, Michigan 49617

Public Notices were published in the Benzie County Record Patriot – no comments were received.

B. The Natural Hazards Mitigation Plan was presented to the Benzie 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 9 comments from the public and Planning Commission members. These comments included items that corrected information incorporated into the plan.

C. The Natural Hazards Mitigation Plan was presented to the Benzie County Board of Commissioners where the meetings are posted in the newspaper and are open to the public. Commissioners provided input and there were no comments from the public.

D. The county emergency manager attended the township, city and village meetings and presented the proposed plan to the respective boards and commissions for their review and comment.

E. 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. 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.

F. In addition, the townships and villages 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.

The Townships/Villages in the priority areas include:

- Village of Lake Ann - Zoning
- Almira Township - Zoning
- Lake Township - Zoning
- Benzonia Township - Zoning
- Crystal Lake Township - Zoning
- Village of Beulah - Zoning
- Village of Honor - Zoning
- Homestead Township - Zoning
- Blaine Township - Zoning
- Gilmore Township - Zoning
- Village of Elberta – Zoning
- City of Frankfort – Zoning

Participation Layout:

County/Township/Others	Zoning	Participation
Benzie County	No	Task Force meetings, review of draft plans: County Commissioners Emergency Management Coordinator Equalization Department Fire Department Planning Commissioners Planning Department
Almira Township	Yes	See last bullet point paragraph, above
Benzonia Township	Yes	See last bullet point paragraph, above
Blaine Township	Yes	See last bullet point paragraph, above
Colfax Township	No	See last bullet point paragraph, above (No Zoning at present but is being considered)
Crystal Lake Township	Yes	See last bullet point paragraph, above
Gilmore Township	Yes	See last bullet point paragraph, above
Homestead Township	Yes	See last bullet point paragraph, above
Inland Township	Yes	See last bullet point paragraph, above
Joyfield Township	No	See last bullet point paragraph, above (No Zoning at present but is being considered)
Lake Township	Yes	See last bullet point paragraph, above
Platte Township	Yes	See last bullet point paragraph, above
Weldon Township	Yes	See last bullet point paragraph, above
Village of Benzonia	Yes	See last bullet point paragraph, above
Village of Beulah	Yes	See last bullet point paragraph, above
Village of Elberta	Yes	See last bullet point paragraph, above
Village of Honor	Yes	See last bullet point paragraph, above
Village of Lake Ann	Yes	See last bullet point paragraph, above
Village of Thompsonville	Yes	See last bullet point paragraph, above
City of Frankfort	Yes	See last bullet point paragraph, above
Grand Traverse Band of Ottawa and Chippewa Indians	No	Task Force meetings, review of draft plans

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

XI. IMPLEMENTATION OF THE BENZIE 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.

- Benzie County Government
- Local governments such as townships, cities, and villages
- Benzie County Conservation District
- Benzie County Road Commission
- Grand Traverse Band of Ottawa and Chippewa Indians
- Grand Traverse Regional Land Conservancy
- 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
- U.S. National Park Service, Sleeping Bear Dunes National Lakeshore
- 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 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
- U.S. Department of Agriculture Forest Service Wildland Fire Management Program
- U.S. Army Corps of Engineers
- U.S. Department of Housing and Urban Development
- Michigan Department of Environmental Quality
- Michigan Department of Natural Resources
- Community, Regional Foundations
- Businesses

Action Agenda

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

Priority and Action Strategies	Responsible Parties	Timeframe
Priority Area 1: ***Wildfire Mitigation Strategies***		
a. Public education, awareness, alertness – become a FIREWISE community	County Planning Department Emergency Management Coordinator Building Inspector Township, Village	1-4 years from adoption of the plan
b. Work with campgrounds on a notification system regarding fire danger; create areas of refuge involving imminent fire dangers at campgrounds; and establish evacuation routes from campgrounds	Emergency Management Coordinator County Conservation District State/County Campground Managers Township, Village	1-3 years from adoption of the plan
c. Develop new building and zoning codes	County Planning Department Emergency Management Coordinator Building Inspector Township, Village	1-3 years from adoption of the plan
d. Adjustments in the planning, design, and development process for area structure County Building Inspector	County Building Inspector County Planning Department Emergency Management Coordinator Township, Village	1-3 years from adoption of the plan
e. Continue Building code enforcement for new construction	County Building Inspector	Ongoing
Priority Area 2: ***Snow Load and Ice Build Up Mitigation Strategies***		
a. Continue Building code enforcement for new construction	Building Inspector	Ongoing
b. Public education	County Building Inspector County Planning Emergency Management Coordinator Townships, Villages	1-3 years from adoption of the plan
Priority Area 3: ***High Winds Mitigation Strategies***		
a. Continue Building code	County Building Inspector	Ongoing

enforcement for new construction		
b. Tree management by power companies	Emergency Management Coordinator Power Companies	Ongoing
c. Create shelters for campground areas	Emergency Management Coordinator County Planning County Building Inspector Townships, Villages	2-5 years from adoption of the plan
d. Public education for structural elements and tree management	Emergency Management Coordinator County Building Inspector County Soil Conservation District Townships, Villages	1-3 years from adoption of the plan
Priority Area 4: ***Flood Mitigation Strategies***		
a. Public education	County Planning Emergency Management Coordinator County Soil Conservation District Drain Commissioner Townships, Villages	1-3 years from adoption of the plan
b. Mapping of flood prone areas	FEMA Emergency Management Coordinator Drain Commissioner County Soil Conservation District MI Department of Environmental Quality	1-3 years from adoption of the plan
c. Reduce potential of flooding by identifying flood prone structures and raise foundations	FEMA Emergency Manage Coordinator Private Land Conservancies or other Non-profit conservation organizations	1-3 years from adoption of the plan
d. Wetland protection	County Planning Emergency Management Coordinator County Soil Conservation District MI Department of Environmental Quality Townships, Villages Non-profit conservation organizations	2016
e. Enforcement of storm water and drainage control statutes and ordinances	County Planning County Building Inspector Emergency Management Coordinator Drain Commissioner	Ongoing

	County Soil Conservation District MI Department of Environmental Quality US Army Corps of Engineers	
f. Enforcement of building codes	County Building Inspector	Ongoing
Priority Area 5: ***Shoreline Erosion Mitigation Strategies***		
a. Public Education	County Planning Emergency Management Coordinator County Soil Conservation District Townships, Villages	1-3 years from adoption of the plan
b. Promote the relocation of structures	FEMA Emergency Management Coordinator County Planning MI Department of Environmental Quality U.S. Army Corps of Engineers Townships, Villages	2-5 years from adoption of the plan
c. Drainage control and placement of vegetation, utilizing native vegetation	County Conservation District Drain Commissioner County Planning Emergency Management Coordinator Townships, Villages	1-3 years from adoption of the plan
d. Enforcement of soil erosion statutes/permits	County Soil Conservation District County Planning Emergency Management Coordinator MI Department of Environmental Quality U.S. Army Corps of Engineers	Ongoing
e. Enforcement of building codes	County Building Inspector	Ongoing

Additional Mitigation Strategies

- Work on a multi-hazard warning plan
- Working with other governmental entities, organizations, businesses, and the public
- Incorporating the Plan's natural hazards mitigation concepts, strategies, and policies into existing elements of Benzie County's Master Comprehensive Plan 2020

Watershed management plans have been developed within the County. Proposed watershed strategies are located in the Platte River Watershed Management Plan.

- Development standards for public facilities and infrastructure
- Effect of accumulated development on community systems and facilities

Monitoring and Evaluation

The Benzie County Natural Hazards Mitigation Plan will be monitored on a regular basis by the Emergency Management Coordinator and the Township Association.

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 Benzie County Board of Commissioners.

XII. NATURAL HAZARDS MITIGATION PLAN ADOPTION RESOLUTION

THIS PAGE WILL HAVE COPY OFTHE ADOPTED RESOLUTION

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 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.

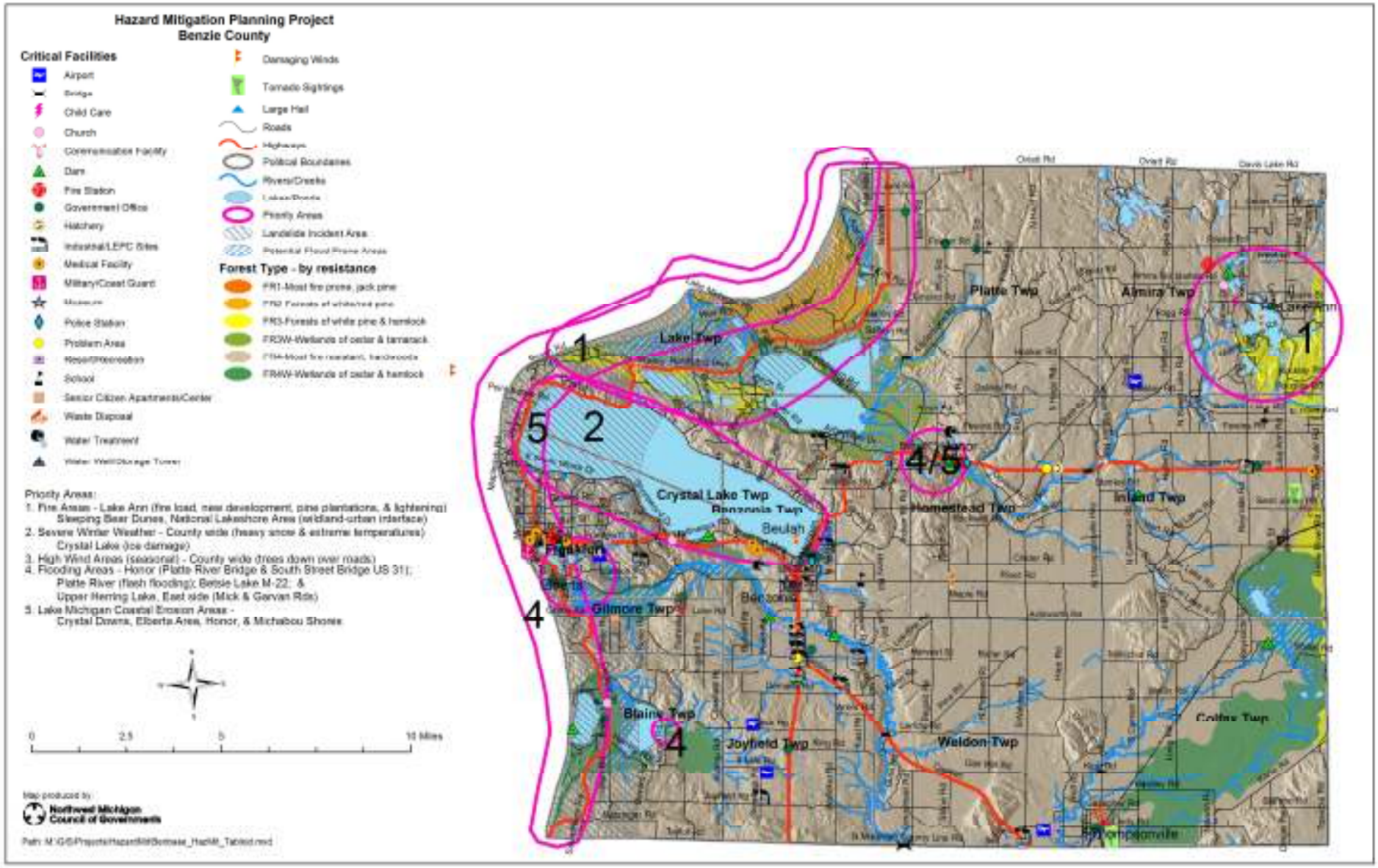
Urban/wildland interface: A developed area, also known as the "I-zone," occupying the boundary between an urban or settled area and a wildland characterized by vegetation that can serve as fuel for a forest fire.

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

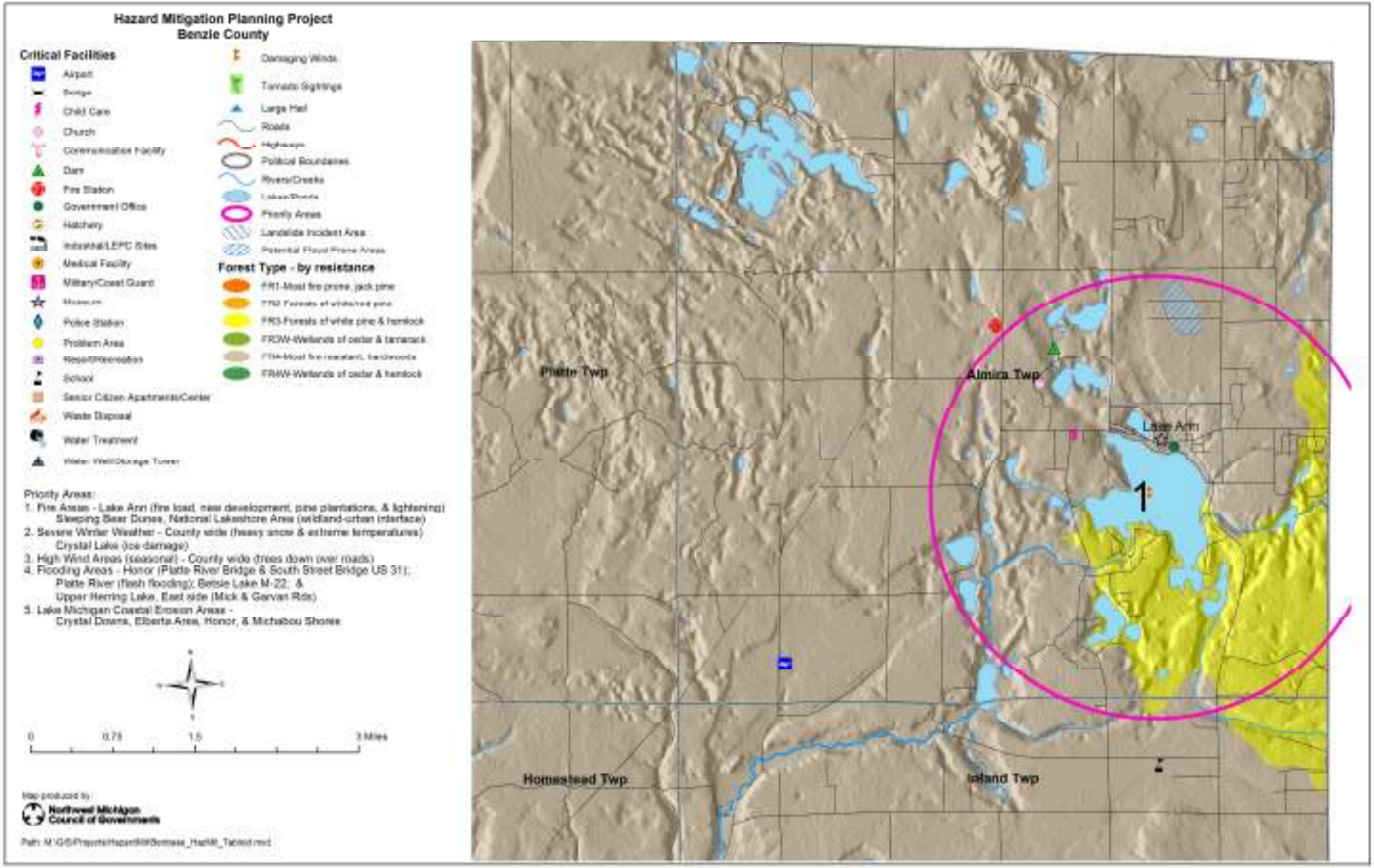
Watershed management: The implementation of a plan or plans for managing the quality of flow of water within a watershed, the naturally defined area within which water flows into a particular lake or river or its tributary. The aims of watershed management are holistic and concern the maintenance of 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.

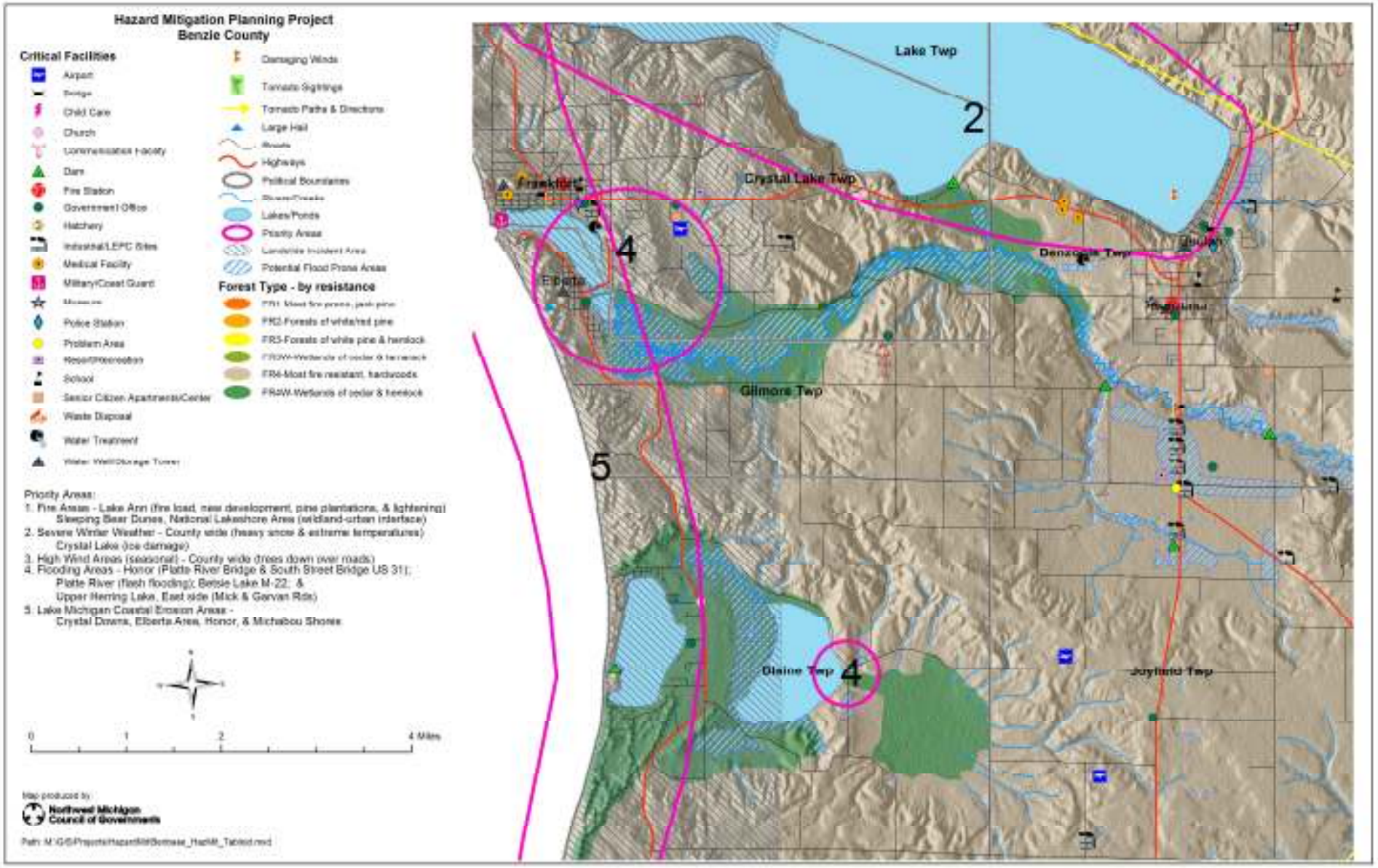
Appendix B - Detail Maps-Full County



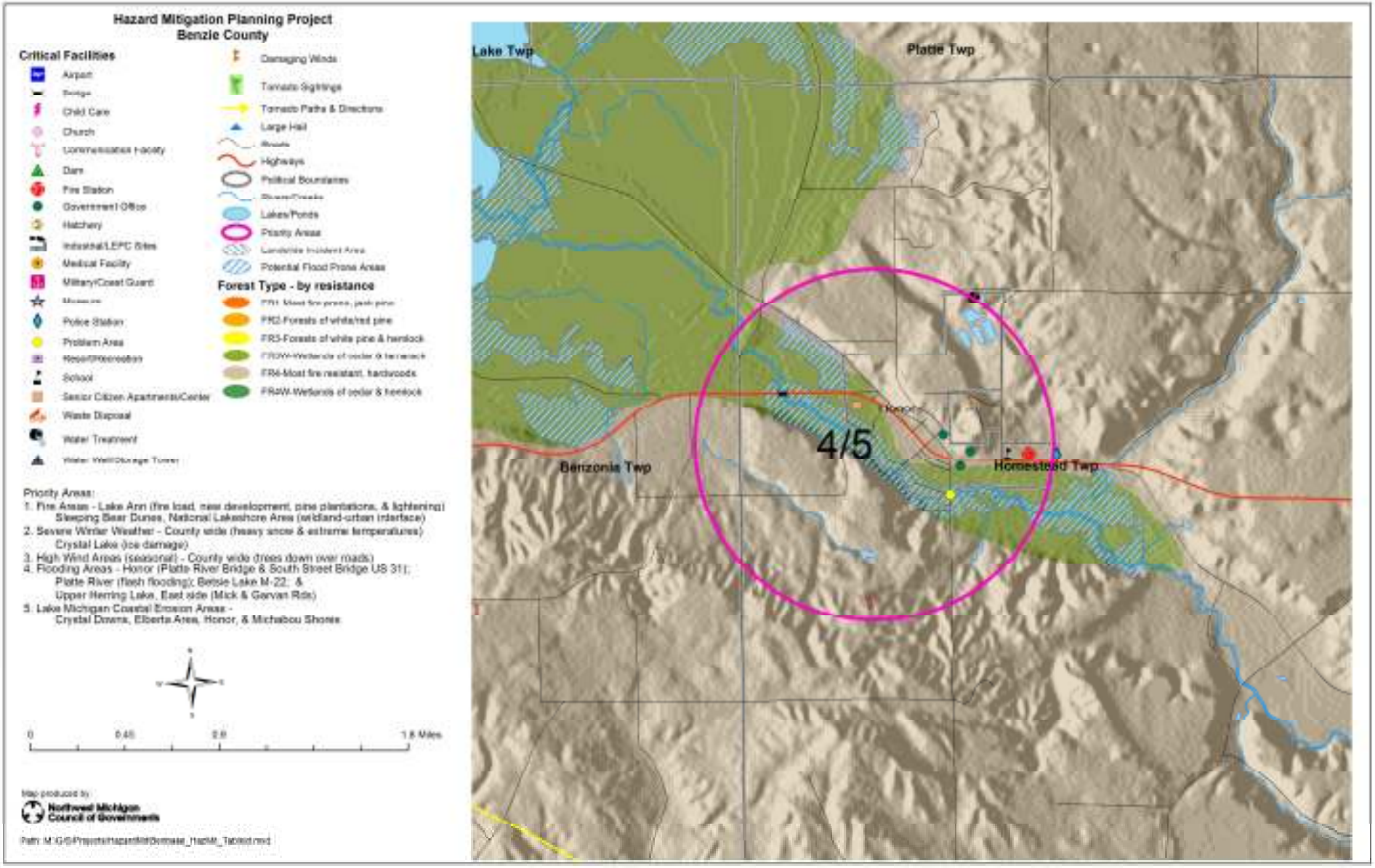
Appendix B - Detail Maps-Priority Areas – Northeast Benzie County



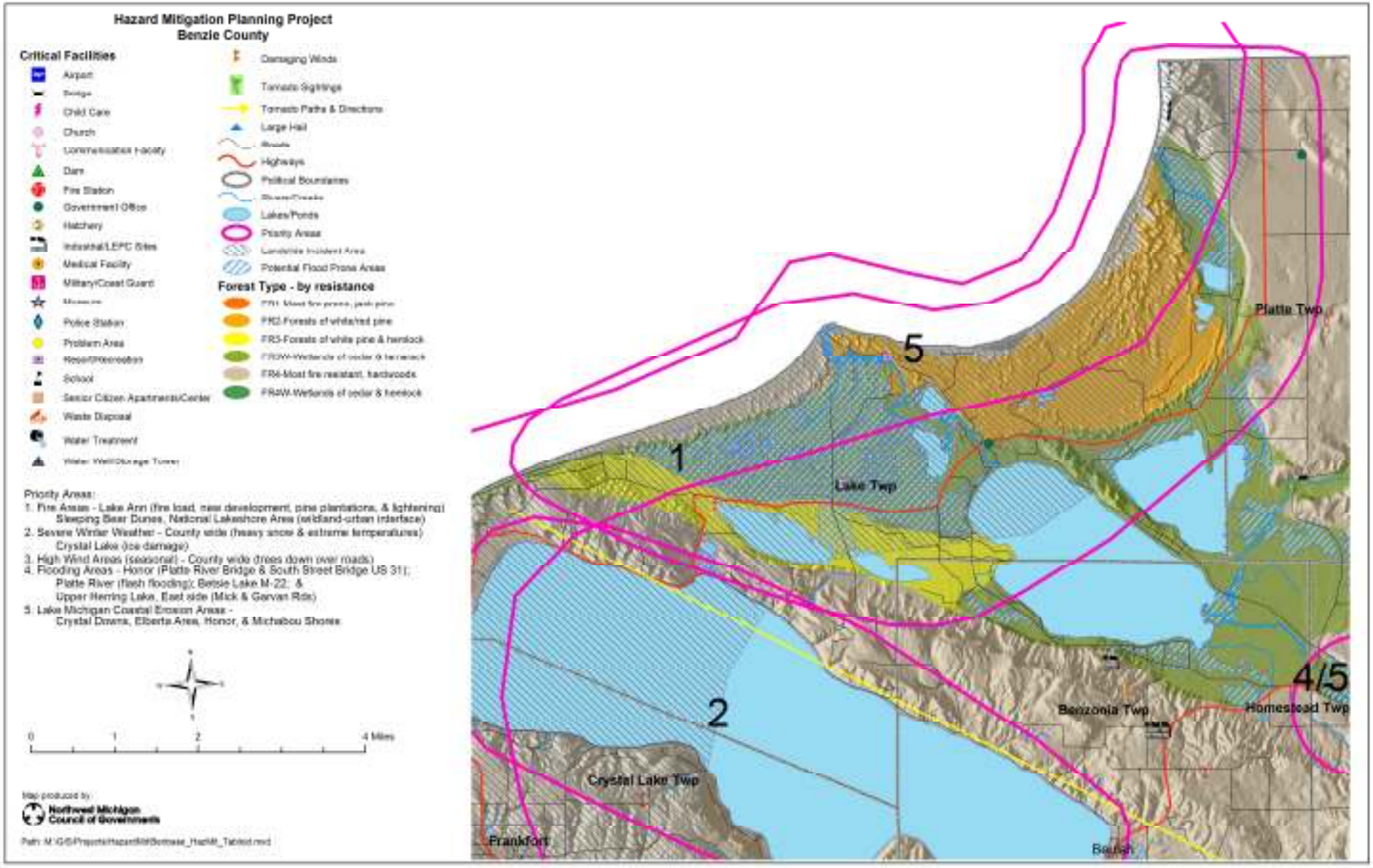
Appendix B - Detail Maps-Priority Areas – Southwest Benzie County



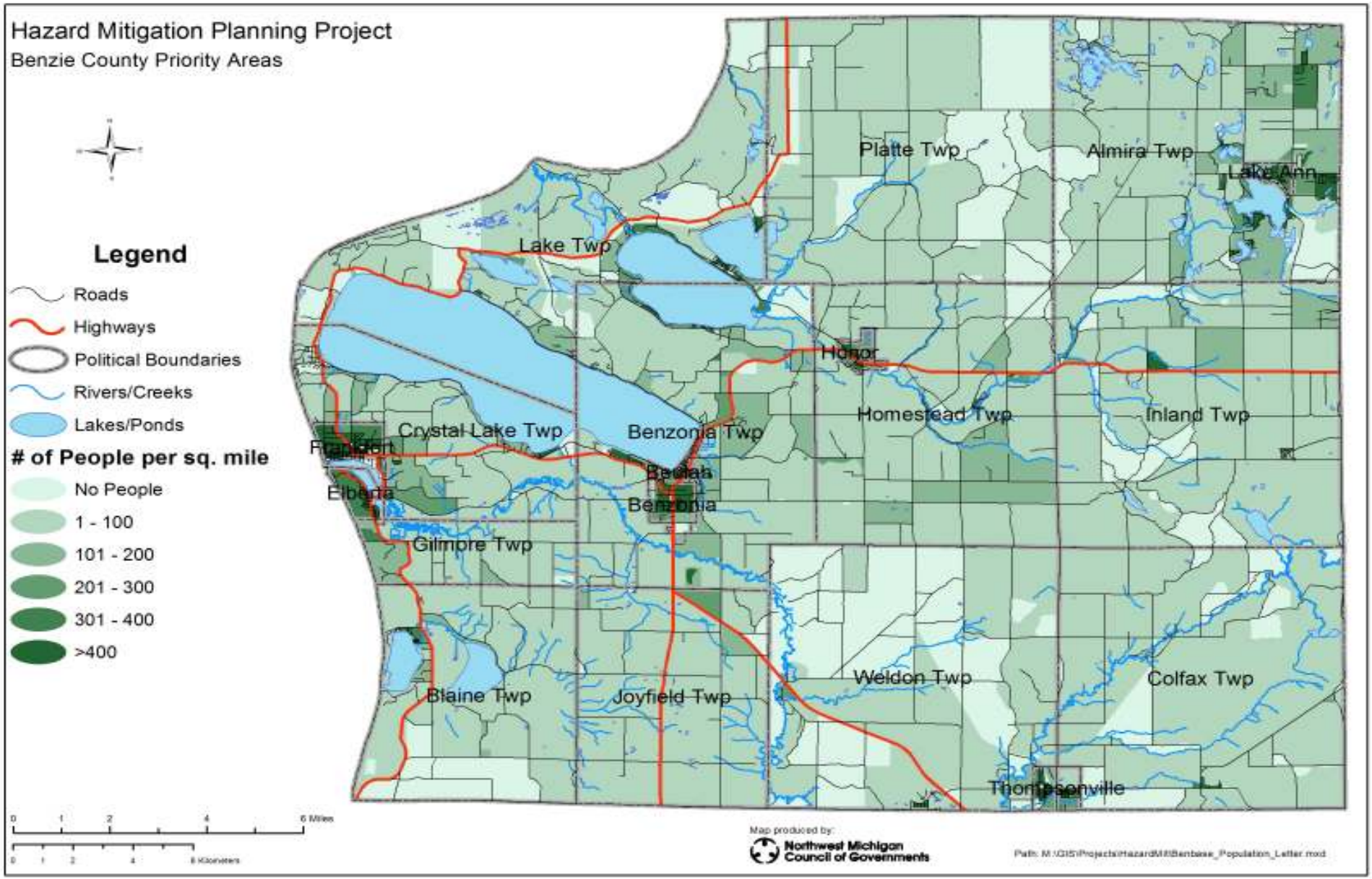
Appendix B - Detail Maps-Priority Areas – Central Benzie County



Appendix B - Detail Maps-Priority Areas – Northwest Benzie



Appendix C - Detail Maps-Population Density Map



Appendix D - Risk Assessment Worksheet

Risk Assessment Summary Table: BENZIE COUNTY

HAZARD (Years of Record)	Number of Events	Probability**	Geographic Size Affected	Population Impacted	Specific Priority Area	Estimated Damage Costs
Flooding (1993 – 2014)	3	Occasional	**Honor/Platte River-South Street Bridge US 31-Platte River Bridge** County and Region	1,043	**4**	Property damage - $5,005,000
Hail (1955 – 2014)	14	Frequent	County Frankfort Honor Lake Ann	15,998 1,513 2,078 2,811		.75 inch to 3.25 inches
Shoreline Erosion (1950 – 2014)	NA	Occasional	**Lake Michigan Coastal Erosion Areas-Crystal Downs, Grace Road**	3,000	**5**	**NA**
Extreme Winter Weather - heavy snow, freezing rain, ice storm, extreme cold temperature (1993 – 2014)	15	Frequent	**Crystal Lake Area** **County-wide** County and Region	2,300 15,998	**2**	Property damage - $5,100,000 and $15,000,000 Statewide
Thunderstorms and High Winds (1995 – 2014)	10	Frequent	**Western portion of County** County and Region	3,000 15,998	**3**	Property damage - $269,000
Tornadoes (1956 – 2014)	4	Occasional	County	15,998		$278,000
Wildfire (1981 – 2010)	169	Frequent	County	15,998	**2**	

***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	**T-storm/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, March 2006, 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.