DRAFT Hazard Mitigation Plan

Kewaunee County, Wisconsin

Plan Updated – July, 2013

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Acronyms

ACE	Army Corps of Engineers
ADA	Americans with Disabilities Act
ARC	American Red Cross
ARES	Amateur Radio Emergency Services
ASCS	Agriculture Stabilization and Conservation Service
ASL	Above Sea Level
ASPR	Assistant Secretary for Preparedness and Response
BIA	Bureau of Indian Affairs
CAD	Computer Aided Dispatch
CAR	Communities At Risk
CBRNE	Chemical, Biological, Radiological, Nuclear, or Explosive
CDBG	Community Development Block Grant
CERT	Community Emergency Response Team
CFR	Code of Federal Regulations
CI	City
CO	County
COAD	Community Organizations Active in Disaster
CO HWY	County Highway Department
COOP/COG	Continuity of Operations & Continuation of Government
CTH	County Highway
DFIRM	Digital Flood Insurance Rate Map
DHS	U.S. Department of Homeland Security
DNR	Wisconsin Department of Natural Resources
DOD	U.S. Department of Defense
DOJ	U.S. Department of Justice
DOT	Department of Transportation
DTM	Digital Terrain Maps
EAP	Emergency Assistance Program or Emergency Action Plan
EF	Enhanced Fujita Scale
EHS	Extremely Hazardous Substance
EM	Emergency Management
EMS	Emergency Medical Services
EMT	Emergency Medical Technician
EOC	Emergency Operations Center
EOP	Emergency Operating Procedure
EPA	U.S. Environmental Protection Agency
EPCRA	Emergency Planning and Community Right-to-Know Act

F	Fahrenheit or Fujita Scale
FCC	Federal Communications Commission
FCIC	Federal Crop Insurance Corporation
FD	Fire Department
FEMA	Federal Emergency Management Agency
FIRMS	Flood Rate Insurance Maps
FMA	Flood Mitigation Assistance
FOIA	Freedom of Information Act
FOUO	For Official Use Only
FSA	Farm Service Agency
GIS	Geographic Information System
HazMat	Hazardous Materials
HazMit	Hazard Mitigation
HAZUS	Hazards United States
HAZUS-MH	Hazards United States Multihazard
HMGP	Hazard Mitigation Grant Program
HUD	U.S. Department of Housing and Urban Development
HVA	Hazard Vulnerability Analysis
HWY	Highway
ICS	Incident Command System
LE	Law Enforcement
LEPC	Local Emergency Planning Committee
LIO	Land Information Office
LIDAR	Laser Imaging Detection and Ranging
LPDM	Lagrangian particle dispersion
LWC	Land and Water Conservation Department
MABAS	Mutual Aid Box Alarm System
MAP	FEMA's Risk Mapping, Assessment and Planning
MHz	Megahertz
MMI	Modified Mercalli Intensity Scale
MOU	Memorandum of Understanding
MPH	Miles Per Hour
MSDS	Material Safety Data Sheet
NFIA	National Flood Insurance Act
NFIF	National Flood Insurance Fund
NFIP	National Flood Insurance Program
NFPA	National Fire Protection Association
NIDIS	National Integrated Drought Information System
NIMS	National Incident Management System
NOAA	National Oceanic and Atmospheric Administration

NRCS	Natural Resources Conservation Service
NRP	National Response Plan
NWS	National Weather Service
OJA	Office of Justice Assistance
PA	Public Address (System)
PDM	Pre-Disaster Mitigation
PGA	Peak Ground Acceleration
PH	Public Health
PSA	Public Service Announcement
POW	Plan of Work
RACES	Radio Amateur Civil Emergency Service
RES1	Single Family Dwelling
RES2	Manufactured Housing
RFC	Repetitive Flood Claims
SARA	Superfund Amendments and Reauthorization Act
SBA	Small Business Administration
SMART	Spatial Management, Analysis and Resource Tracking
SPI	Standardized Precipitation Index
SRL	Severe Repetitive Loss
STH	State Highway
SWAT	Special Weapons and Tactics
TN	Township
UASI	Urban Area Security Initiative
UC	Unified Command
USDA	U.S. Department of Agriculture
USFS	U.S. Forestry Service
USGS	U.S. Geological Survey
UW	University of Wisconsin
UW Ext	University of Wisconsin – Extension Office
VHF	Very High Frequency
VI	Village
VOAD	Voluntary Organizations Active in Disaster
WEM	Wisconsin Emergency Management
WISP	Wisconsin Irrigation Scheduling Program

Introduction and Background

The Kewaunee County Hazard Mitigation Plan is intended to provide strategies for reducing future damages to public and private infrastructure in the county. The Kewaunee County Emergency Management Office completed the original hazard mitigation plan in 2007 and applied for and received a hazard mitigation update planning grant in 2010. This grant program is sponsored by the Federal Emergency Management Agency (FEMA) and is administered by the state Department of Military Affairs - Wisconsin Emergency Management (WEM.) The procedures used in preparing this plan are based on guidance provided by FEMA and WEM and should therefore be considered consistent with the requirements and procedures in the Disaster Mitigation Act of 2000.

Section 409 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act (P.L. 93-228, as amended) is the impetus for involvement of state and local governments in evaluating and mitigating natural hazards as a condition of receiving federal disaster assistance. Federal Emergency Management Agency (FEMA) rules for implementing Section 409 are in 44 CFR Part 206 Subpart M.

Section 409 states that the county is obligated to try to reduce any hazard that has received relief funding in the past. While Kewaunee County has had few natural disasters, they believe developing and updating a hazard mitigation plan is important because it provides an opportunity for communities to meet this requirement by developing strategies for reduction of potential losses from future natural disasters. Hazard mitigation planning is the process of developing a set of actions designed to reduce or eliminate long-term risk to people and property from hazards and their effects. Completion of the update of this plan should put Kewaunee County in an advantageous position when competing for pre- and post-disaster mitigation project dollars because projects have been pre-identified. The cooperation of government, private and volunteer agencies is essential in mitigation efforts and over the long term it is hoped that implementation of this plan will save taxpayer dollars because less money is needed for post-disaster recovery activities. Furthermore, mitigation planning measures incorporated in economic or community development goals support more comprehensive and effective government. This plan

evaluates the risks that all natural hazards pose to the citizens and property of Kewaunee County by presenting:

- A profile and analysis of past hazardous events
- An assessment of vulnerability of community assets
- Potential hazard mitigation strategies
- Methods for building community support and ensuring plan adoption

Plan Overview

The Kewaunee County Hazard Mitigation Plan provides background information on Kewaunee County and identifies those hazards that have occurred or could occur in the county. It includes a description of each hazard, its frequency of occurrence, appropriate actions in case of emergency and possible steps to mitigate the hazard. These hazards are the basis for the development of all county emergency plans.

A well-prepared plan allows emergency management to act swiftly and efficiently in the event of a hazard, reducing the damage and the cost incurred from displacing residents and businesses. Hazard mitigation activities will be emphasized in the plan as a major component of overall emergency management. The plan is intended to provide strategies for reducing future damages to public and private infrastructure in the county, including flood damage.

Previous Planning Efforts and Legal Basis

The Kewaunee County Emergency Management Office has completed and regularly updates the Kewaunee County Hazard Analysis. This Hazard Vulnerability Analysis (HVA) identifies all likely natural and technological hazards that might or have occurred within the county and is based on the State of Wisconsin's HVA. The local HVA does not generally include detailed mitigation strategies for the identified hazards.

There have also been plans and ordinances completed by individual Kewaunee County departments or municipalities, some of which were used as reference materials for this plan, including:

City of Algoma Municipal Code Book [1]

- Chapter 5 (Volunteer Fire Department) discusses fire protection
- Chapter 14 (Fire Protection) discusses burning permits
- Chapter 15 (Building Regulations)
- Chapter 18 (Zoning Code)
- Chapter 19 (Subdivisions and Platting)
- Chapter 20 (Construction and Effect of Ordinances)
- Chapter 21 (Housing Codes)
- Chapter 23 (Recreational Vehicles and Mobile Homes)
- Chapter 25 (Floodplain Zoning)

City of Kewaunee Municipal Codes [2]

- Chapter 14 (Buildings and Building Regulations)
- Chapter 30 (Fire Prevention and Protection) discusses fire regulations
- Chapter 34 (Floods)
- Chapter 46 (Mobile Homes and Mobile Home Parks)
- Chapter 54 (Offenses and Miscellaneous Provisions)
    - Section 68 discusses open burning
    - Section 123 discusses open fires on public property
- Chapter 94 (Zoning)

Village of Luxemburg Codes[3]

- Chapter 8 (Building Regulations)
    - Section 8.05 discusses Fire District Regulations

[1] http://www.algomacity.org/Municipalcode.htm
[2] http://library.municode.com/index.aspx?clientID=12627&stateID=49&statename=Wisconsin
[3] http://luxemburgusa.com/

- Chapter 9 (Zoning Code)
- Chapter 11 (Licenses and Permits)
    - 11.03 (Mobile Homes and Mobile Home Parks)
- Chapter 16 (Shoreland-Wetland Zoning)
- Chapter 17 (Erosion Control and Stormwater Management)
- Chapter 20 (Floodplain Zoning)

The local hazard vulnerability analysis serves as the starting point for the hazard mitigation plan. Other data on historical events is gathered from the National Weather Service's storm report database, recent news reports, local resources (e.g., website; local community ordinances; local plans such as the comprehensive plan, stormwater management plans, etc.), the FEMA Region V mitigation survey and from the memories of the local planning team members. Team members are presented with this data and asked to rank their concern (likelihood of future occurrences and amount of disruption/damage should it occur) on a five-point scale (very high, high, medium, low, very low). From that, team members, members of the community, survey respondents and other planning participants are asked to determine hazard mitigation strategies that might benefit their communities. Local existing plans are referenced again at this time, with the members and authors of these plans (e.g., comprehensive, stormwater management) serving as core members of the workgroup committee. The selected mitigation strategies are recorded and detail in each chapter as well as in the table in Appendix C.

Mitigation strategies are reviewed over the five years of the plan's life by the leadership staff from the applicable departments (e.g., Emergency Management, Sheriff's Office/Communications, Highway, Land and Water Conservation, Land Information and Zoning) with the elected leaders from the jurisdictions to triage projects and determine what can and should be done within the planning period. These options are usually discussed in open meetings prior to implementation, as required by Wisconsin state law. The determining factor for most projects is obviously budget availability. The units of government have several options for funding implementation including grants, special taxing authority (for the project and/or any matching funds), general purpose revenue from existing budgets and regulatory authority, which can

be used to require that an individual or business complete the project using their funds. The units of government use or improve, if necessary, the mechanisms described above to ensure the implementation of hazard mitigation ideas.

Plan Preparation, Adoption and Maintenance

The Kewaunee County Emergency Management Director contracted with Emergency Planning, Training and Exercise Consulting (EPTEC, Inc.) to draft this plan. A Hazard Mitigation Workgroup was organized from the members of the standing Land Records Committee to oversee the completion of this plan. The committee members include:

- Lori Hucek, Kewaunee County Emergency Management
- Dale Jandrain, Kewaunee County Highway Department
- Andy Wallander, Kewaunee County Land and Water Conservation Department
- Steve Hanson, Land Information Officer
- Glenn Selner, Kewaunee County Zoning Department
- David Cornelius, Kewaunee County Sheriff's Department
- Laura Gallenberger, Kewaunee County Public Health
- Mary Halada, Kewaunee County Public Health
- Lee Dachelet, City of Algoma Fire and Rescue, Algoma Emergency Management Director
- Dick Riederer, City of Algoma Utilities
- Lenora Borchardt – EPTEC, Inc. (Contractor)

An informational brochure was created and copies were distributed throughout the community at local community gathering points such as municipal halls, libraries, etc. Meetings were held with chief elected from the municipalities to explain and gather input regarding the program (e.g., previous occurrences, mitigation strategies.) The FEMA Region V survey was sent to the clerk and chief elected official of every municipality (town, village and city) as well as key county departments (e.g., planning, highway) for completion; surveys were received back from county offices and the incorporated municipalities as well as many of the unincorporated towns. The compiled results of the surveys, along with the cover letter, are in Appendix E.

The committee met to evaluate and incorporate input from local officials and then to review and provide input on the progress of the plan. A public notice was placed in the newspaper to invite

members of the public, local officials, academia and business and industry leaders to review the plan. Comments received were reviewed by the workgroup and incorporated as appropriate. A working draft of the draft plan was distributed to the County Emergency Management Directors from the contiguous counties (i.e., Brown, Door and Manitowoc Counties) and they were asked for input and if they would like to participate in the completion of the plan; offers were declined. A copy of the mitigation brochure and a list of meeting dates and informational sessions to gather public and official input can be viewed in Appendix F.

The Kewaunee County Hazard Mitigation Plan Workgroup reviewed the previous plan and past events records (generally gathered from the National Weather Service); a consensus was reached on the anticipated probability of future events. This probability was designated as “very high,” “high,” “medium,” “low” or “very low” by the workgroup based on their evaluation and experience with the data.

The hazard mitigation strategies from the previous version of this plan were reviewed and progress was reported in Appendix D. The workgroup also, after reviewing the updated draft plan, selected the potential new mitigation projects, which are listed in Appendix C (Summary of Mitigation Strategies) and discussed in more detail in each chapter’s Hazard Mitigation Strategies section. The workgroup participants were given the *Mitigation Ideas: Possible Mitigation Measures by Hazard Type* (Mitigation Ideas, FEMA-R5, 9/02) booklet as an aid to generating ideas. All of the ideas generated during the workgroup meetings were incorporated into the plan and can be found in the Hazard Mitigation Strategies section of each chapter and are summarized in Appendix C. Based on the information collected, each of these projects was assigned a “very high,” “high,” “medium,” “low” or “very low” priority based on the workgroup’s internal consensus assessment during a discussion of the balances of risk, reward, cost effectiveness (cost benefit) and likelihood of local will and funding (local or grant) to complete the strategy.

The municipal leaders were briefed regarding the need to formally adopt this plan as a prerequisite for future mitigation funding eligibility. A draft was sent to Wisconsin Emergency Management (WEM) for review and tentative approval. Based on WEM’s comments, a final draft plan was completed and forwarded to FEMA for determination of approvability. Once deemed approvable by FEMA, a general meeting was held to review the plan with members of the public, local officials, academia and business and

industry leaders. Information and adoption paperwork was provided to the municipal leaders advising them of the need to formally adopt this plan as a prerequisite for future mitigation funding eligibility.

A resolution has been passed by the Kewaunee County Board, the Cities of Algoma and Kewaunee and the Villages of Casco and Luxemburg to accept this plan. The towns were also given an opportunity to adopt this plan and the Towns of XXX chose to adopt it. Scanned copies of the resolutions adopting the plan can be found in Appendix B. The final plan has been submitted to WEM and FEMA for review and certification and notice of acceptance has been received.

The Disaster Mitigation Act of 2000 requires the monitoring, evaluation and updating of the hazard mitigation plan every five years. This hazard mitigation plan is designed to be a "living" document and therefore will be reviewed and updated within five years from its approval date. The Kewaunee County Hazard Mitigation Plan Workgroup will provide leadership and guidance throughout the plan's life cycle (i.e., monitoring, evaluating and updating.) Updates will allow municipal leaders and the public to provide input into the process. The public will be notified of this opportunity via legal public notices.

The process for integrating hazard mitigation actions into other planning mechanisms will be led by the County Emergency Management Director. As she receives information between the five-year update periods (e.g., comprehensive or capital improvement plans) that might be included, it will be added to Appendix G: Inter-Revision Updates. Kewaunee County Emergency Management maintains responsibility and is the point of contact for all issues (e.g., monitoring, updating and evaluating the effectiveness) regarding this plan. Municipalities can contact the County Emergency Management Director to add updated local information to Appendix G at any time. Furthermore, the County Emergency Management Director will include in the Plan-of-Work activities program the distribution of an annual letter and media press release that reaches out to the plan's stakeholders (county offices, municipalities, the public, etc.). The communications will query if there are new elements for the mitigation plan as well as asking if there are any plans (new or updates) in which the mitigation plan can and/or will be used as a source plan. Comments will be received and discussed at an annual publically-noticed open meeting of the county's Emergency Management committee. Note that after a disaster, the Emergency Management

committee may also meet to discuss mitigation strategies that might be applicable. These same stakeholders will be invited to fully participate in the five-year plan update, which will be detailed in the updated plan documents and will fully conform to FEMA's requirements.

During the plan's lifecycle, the county and incorporated municipalities will consider the strategies listed in Appendix C as they annually prioritize "regular" maintenance projects, as they set their annual budgets, after a disaster period and as grants become available that might help off-set the costs of some of the strategies listed within the plan. The latter will be instigated by notice of these opportunities by the County Emergency Management Director. These projects will be reported in the annual letter to the County Emergency Management Director. The Director will keep and compile the inter-revision data for inclusion in the five-year update, which will be coordinated through County Emergency Management beginning at least 18 months prior to expiration and at which time they will report on their progress towards meeting the hazard mitigation goals. The update will bring together many of the same workgroup members as well as any new stakeholders (e.g., elected officials, businesses, academia, members of the public) who respond to the invitation to participate and have an interest in mitigation planning.

The plan participants also recognize this document as an important planning tool within the community and will use this plan as a reference as they complete other related planning. The County Emergency Management Director and the Kewaunee County Land Information Office and Zoning Department will use this plan as they update the Kewaunee County Comprehensive Plan as well as community ordinances such as zoning, shoreland, floodplain, wetland, etc. and in other stand-alone plans such as those for park and recreation, sustainability and farmland preservation and will refer to it as they are involved in the planning and other preparedness activities of their municipalities. Many of these plans are on a regular updating cycle and as they come up for renewal, emergency management will be notified and provide any relevant planning materials (from the hazard mitigation plan and any additional information received since the plan's approval). Municipalities with planning departments have also committed to referring to the mitigation plan in their zoning updates, flood and shoreland planning and in their comprehensive plans. After this plan has passed its reviews from Wisconsin Emergency Management (WEM) and the Federal Emergency Management

Agency (FEMA) and is approved, the County Land Information Office and Zoning Department and the municipalities will receive a copy. They have committed to using and referring to the mitigation plan as they complete their regularly scheduled reviews and updates of the aforementioned plans. Kewaunee County Emergency Management will also refer to this plan in their emergency preparedness activities.

Physical Characteristics of Kewaunee County

General Community Introduction

Kewaunee County was inhabited by the Native American Potowatomi for more than three hundred years before Jean Nicolet set foot on the Kewaunee shore in 1634. The name "Kewaunee" is Potowatomi for "We are lost." Native Americans lost in the fog offshore would cry out "Kewaunee, Kewaunee" hoping to be guided to safety by answering calls from the shore.

With communities founded by immigrants from many nations, including Bohemia, Belgium, Czechoslovakia, Germany, Ireland, Luxemburg and Poland, Kewaunee County contributes to the largest concentration of widely diverse old-world settlements in the United States and is included as part of the Wisconsin Ethnic Settlement Trail.

The countryside is dotted with steeples of churches established by the early settlers. Many have been rebuilt or reconstructed over the years and continue to serve the descendants of their original congregations. Area history is also well-preserved and displayed in more than 100 restored historic homes, churches and commercial buildings, from 18th century log cabins to elegant Victorian mansions and a unique 19th century dungeon and jailhouse museum.

Kewaunee County's two Lake Michigan harbors (Algoma and Kewaunee) have enjoyed a long and colorful maritime past, serving military, commercial and passenger vessels of many nations for more than six centuries. Vessels built by Kewaunee County shipbuilders have sailed the Great Lakes and the seven seas. From the turn of the 20th century through the 1940's, the area's commercial fishing fleet harvested great nets full of fish from Lake Michigan.

Kewaunee County offers a plethora of outdoors activities and sports for both residents and the growing tourism market. Some of the most popular activities include charter fishing for trophy trout and salmon and boating and sailing from the county’s harbors and marinas. Kewaunee County's inland lakes and streams and the waters of Lake Michigan offer swimming, fishing, boating, canoeing, scuba-diving and water-skiing. Inland lakes and wetlands harbor

unique plant and animal (e.g., shorebirds, waterfowl, amphibians, fish, fur-bearing mammals) communities nature observers. Fishing in Kewaunee County lakes yields rainbow trout, perch, bluegills, crappies, bass, bullheads and tiger muskies.

The county's scenic rural roads and the Ahnapee State Trail offer miles of cycling, hiking and cross-country skiing. The Crescent Beach Boardwalk offers views of Lake Michigan and the Algoma shoreline and the Nature Walk, a 1,500-ft. wooden walkway along the Kewaunee River north of Kewaunee, leads to a scenic observation deck.

Kewaunee County provides a wide range of dry-land sports facilities including two public golf courses, a Frisbee golf course, a bowling center, indoor and outdoor Field Archery Ranges, a 5-Stand Sporting Clay Range, two Trap Ranges, a Rifle Range, outdoor tennis courts, an 18-hole miniature golf range, miles of cross-country ski trails, ice-skating rinks, a park with T-Bar Lift for downhill skiing and a tubing run and 123 miles of snowmobile trails.[4]

Plan Area

Kewaunee County is located in east-central Wisconsin. It is bordered on the east by Lake Michigan, on the south by Manitowoc County, on the west by Brown County and on the north by Door County. A small section of the northwest corner of Kewaunee County also touches the Bay of Green Bay.

Kewaunee County is approximately 342.64 square miles making it the 65th (out of 72) largest county in Wisconsin. In Wisconsin, there are three types of sub-county, full-service local government units: towns, which are unincorporated, and villages and cities, which are incorporated. Kewaunee County contains the Cities of Algoma and Kewaunee; the Villages of Casco and Luxemburg and the Towns of Ahnapee, Carlton, Casco, Franklin, Lincoln, Luxemburg, Montpelier, Pierce, Red River and West Kewaunee. (See Appendix A for a map of Kewaunee County.)

[4] http://www.explorewisconsin.com/countypages/kewaunee.html

Geology

Kewaunee County's landscape is generally undulating to gently rolling. The county covers an area of 331 square miles, making it the 65th largest (or 7th smallest) out of 72 Wisconsin counties. It lies on a limestone rock layer known as the Niagara escarpment, which drops sharply toward Green Bay while sloping gently across the county to Lake Michigan. Bedrock outcrops are numerous in the northwestern part of the county.

Northeastern Wisconsin was glaciated several times. Glacial ice scoured the bedrock in some places and deposited more than 100 feet of drift in other places. In areas where the bedrock is at or very near the surface there is a serious hazard of pollutants entering the ground water through fissures and crevices in the bedrock. Approximately 53% of the land area within Kewaunee County exhibit some degree of contamination potential for pollutants entering the groundwater.

The physiography of Kewaunee County is controlled largely by the Niagara Dolomite Formation that underlies most of the county. The county lies in an area of the State classified as having shallow "karst" topography. This type of topography is characterized by shallow soil depth (5 feet or less) to the underlying Niagara Dolomite (limestone) bedrock. In most landscapes, rivers flow across the surface of the land. However, in karst landscapes, rainwater and snowmelt readily flows downward through joints in permeable limestone rocks and invisibly attacks them over time through a solution process called "carbonation". Carbon dioxide from the atmosphere and soil combines with falling rain and snowmelt to form a weak carbonic acid that dissolves calcium carbonate, the main component of limestone. In carboniferous limestone, this process enlarges vertical and horizontal joints and creates complex underground channels. These channels provide easy conduits for transporting unfiltered groundwater contaminants, such as sediment, chlorides, nitrates, bacteria and other microorganisms to local drinking water aquifers.[5]

Topography

Wisconsin lies in the upper Midwest between Lake Superior, the upper peninsula of Michigan, Lake Michigan and the Mississippi

[5] Kewaunee County Land & Water Resource Management Plan 2010 – 2019: Executive Summary

and Saint Croix Rivers. Its greatest length is 320 miles, greatest width 295 miles for a total area 56,066 square miles. Glaciation has largely determined the topography and soils of the state, except for the 13,360 square miles of driftless area in southwestern Wisconsin. The various glaciations created rolling terrain with nearly 9,000 lakes and several areas of marshes and swamps. Elevations range from about 600 feet above sea level along the Lake Superior and Lake Michigan shores and in the Mississippi floodplain in southwestern Wisconsin to nearly 1,950 feet at Rib and Strawberry Hills.

The Northern Highlands, a plateau extending across northern Wisconsin, is an area of about 15,000 square miles with elevations from 1,000 to 1,800 feet. This area has many lakes and is the origin of most of the major streams in the state. The slope down to the narrow Lake Superior plain is quite steep. A comparatively flat, crescent-shaped lowland lies immediately south of the Northern Highlands and embodies nearly one-fourth of Wisconsin. The uplands of southwestern Wisconsin west of the ridges and lowlands and south of the Central Plains make up about one-fourth of the state. This is the roughest section of the state, rising 200 to 350 feet above the Central Plains and 100 to 200 feet above the Eastern Ridges and Lowlands. The Mississippi River bluffs rise 230 to 650 feet. The eastern ridges and lowlands to the southeast of the Central Plains are the most densely populated and have the highest concentration of industry and farms. [6]

Kewaunee County's landscape is generally undulating to gently rolling. It lies on a limestone rock layer known as the Niagara escarpment, which drops sharply toward Green Bay while sloping gently across the county to Lake Michigan. Glacial action was responsible for the outstanding topographic feature, a scenic kettle moraine belt that runs through the central part of the county. This belt extends, almost continuously, southward to Walworth County on Wisconsin' southern boundary.[7]

Approximately eighty percent of Kewaunee County has slopes of less than six percent and about twelve percent of the county has slopes of six to twelve percent. Approximately eight percent of the county has slopes of more than twelve percent.

[6] http://www.uwex.edu/sco/state.html
[7] http://www.rootsweb.com/~wikewaun/general.htm

Lake Michigan, which borders the county on the east, has a mean lake elevation of 580 feet above sea level. The land elevation rises to about 900 feet in Lincoln and Montpelier Townships.[8]

Lake Michigan

Lake Michigan is the third largest Great Lake by surface area and the sixth largest freshwater lake in the world. Because Lake Michigan is joined to Lake Huron at the Straits of Mackinac, they are considered one lake hydrologically.

Shoreline erosion and bluff stability conditions are important considerations in planning for the protection and sound development and re-development of lands located along the Lake Michigan shoreline. Most of the erosion processes along the Lake Michigan shoreline are due to natural weathering. However, human activities can influence this process, causing erosion to accelerate or decelerate. Various factors contribute to bluff and beach erosion. Broad, indirect factors such as changing climate and lake levels affect the more specific, direct factors such as wave action, groundwater seepage, stormwater runoff rates/flow volumes, freeze-thaw action, lake ice movement, the type of bluff and beach material and the type of vegetative cover. Although nothing can be done to eliminate bluff erosion, control measures such as vegetative covers and drainage systems can be implemented to slow down this natural process.[9]

Climate

The Wisconsin climate is typically continental with some modification by Lakes Michigan and Superior. Winters are generally cold and snowy and summers are warm. About two-thirds of the annual precipitation falls during the growing season; this is normally adequate for vegetation although there are occasional droughts. The climate favors dairy farming and the primary crops are corn, small grains, hay and vegetables. Storm tracks generally move from west to east and southwest to northeast.

The average annual temperature varies from 39°F in the north to about 50°F in the south with statewide extreme records of 114°F

[8] Kewaunee County Land & Water Resource Management Plan 2010 – 2019: Executive Summary
[9] Ozaukee Land Guide, 2001

(Wisconsin Dells, 7/13/1936) and minus 55ºF (Couderay, 2/2 & 4/1996.) During more than one-half of the winters, temperatures fall to minus 40ºF or lower and almost every winter temperatures of minus 30 or colder are reported from northern stations. Summer temperatures above 90 average two to four days in northern counties and about 14 days in southern districts. During marked cool outbreaks in summer months, the central lowlands occasionally report freezing temperatures.

The freeze-free season ranges from around 80 days per year in the upper northeast and north-central lowlands to about 180 days in the Milwaukee area. The pronounced moderating effect of Lake Michigan is well-illustrated by the fact that the growing season of 140 to 150 days along the east-central coastal area is of the same duration as in the southwestern Wisconsin valleys. The short growing season in the central portion of the state is attributed to a number of factors, among them an inward cold air drainage and the low heating capacities of the peat and sandy soils. The average date of last spring freeze ranges from early May along the Lake Michigan coastal area and southern counties to early June in the northernmost counties. The first autumn freezes occur in late August and early September in the northern and central lowlands and in mid-October along the Lake Michigan coastline. However a July freeze is not entirely unusual in the north and central Wisconsin lowlands.

The long-term mean annual precipitation ranges from 30 to 34 inches over most of the Western Uplands and Northern Highlands, then diminishes to about 28 inches along most of the Wisconsin Central Plain and Lake Superior Coastal area. The higher average annual precipitation coincides generally with the highest elevations, particularly the windward slopes of the Western Uplands and Northern Highlands. Thunderstorms average about 30 per year in northern Wisconsin to about 40 per year in southern counties and occur mostly in the summer. Occasional hail, wind and lightning damage are also reported.

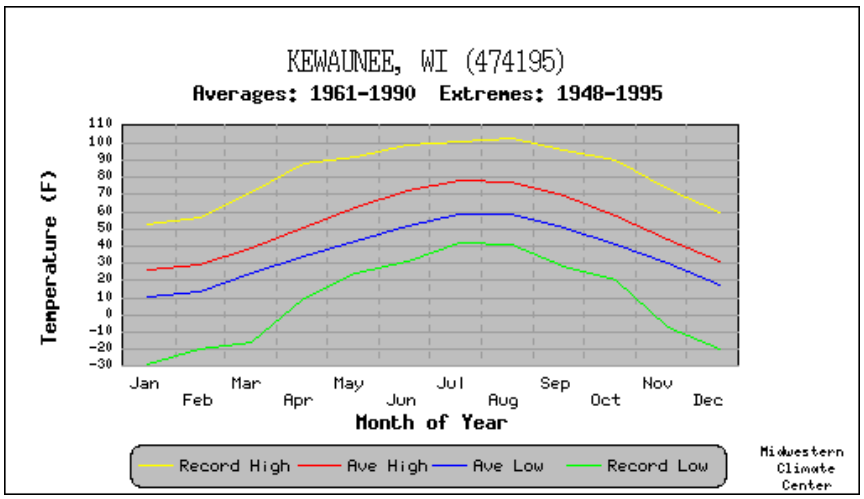
The average seasonal snowfall varies from about 30 inches at Beloit to well over 100 inches in northern Iron County along the steep western slope of the Gogebic Range. Greater average snowfall is recorded over the Western Uplands and Eastern Ridges than in the adjacent lowlands. The mean dates of first snowfall of consequence (an inch or more) vary from early November in northern localities to early December in southern Wisconsin counties. Average annual duration of snow cover ranges from 85

days in southernmost Wisconsin to more than 140 days along Lake Superior. The snow cover acts as protective insulation for grasses, autumn seeded grains, alfalfa and other vegetation.

In Kewaunee County, the median date of the last frost in spring is May 10th, the median date of the first frost in fall is October 8th and the range of the growing season is from 133 to 182 days with 156 days being the median.[10]

Climate Normals	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Ave Daily High (F°)	25.6	29.1	38.8	50.1	61.9	71.8	77.8	76.4	68.6	56.9	43.8	30.5
Ave Daily Low (F°)	10.3	13.1	23.6	33.7	42.2	51.0	58.0	57.8	50.5	40.4	29.9	16.8
Growing Degree Days	0	0	7	54	183	353	529	510	318	118	18	1
Heating Degree Days	1457	1229	1048	693	404	150	28	42	171	508	843	1283
Cooling Degree Days	0	0	0	0	0	42	121	107	9	0	0	0
Ave Precipitation (")	1.39	1.26	2.18	2.71	2.92	3.28	3.03	3.45	3.52	2.36	2.29	1.78
Ave Snowfall (")	11.7	9.2	7.3	1.9	0.0	0.0	0.0	0.0	0.0	0.0	1.9	9.8

Data from the weather station at Kewaunee 5 S, latitude 44°26' N, longitude 87°31' W, elevation 650 ft. [11]



Data Provided by the Midwestern Regional Climate Center [12]

[10] http://www.uwex.edu/sco/state.html
[11] http://www.wisconline.com/counties/kewaunee/climate.html
[12] http://mrcc.sws.uiuc.edu/

Hydrology

The land in Wisconsin drains into Lake Superior, Lake Michigan and the Mississippi River. The Mississippi and St. Croix Rivers form most of the western boundary. About one-half of the northwestern portion of the state is drained through the Chippewa River, while the remainder of this region drains directly into the Mississippi or St. Croix and into Lake Superior. The Wisconsin River has its source at a small lake nearly 1,600 feet above mean sea level on the Upper Michigan boundary and drains most of central Wisconsin. Most of its tributaries also spring from the many lakes in the north. Except for the Rock River, a Mississippi River tributary which flows through northern Illinois, eastern Wisconsin drains into Lake Michigan.

Most of the streams and lakes in the state are ice-covered from late November to late March. Snow covers the ground in practically all the winter months except in extreme southern areas. Flooding is most frequent and most serious in April due to the melting of snow and spring rains. During this period, flood conditions are often aggravated by ice jams which back up the flood waters. Excessive rains of the thunderstorm type sometimes produce tributary flooding or flash flooding along the smaller streams and creeks.[13]

Groundwater reservoirs are recharged by direct precipitation. Spring is a prime time for recharge because evapotranspiration is low and melting snow and rainfall infiltrate and percolate the water table on unfrozen ground. Fall is another prime time for high recharge. During the summer, groundwater levels drop because precipitation is lower causing losses to evaporation and transpiration to exceed precipitation. In addition, groundwater is lost to surface waters by discharge in the form of springs.[14] The winter period normally lacks infiltration because of frozen ground.

Groundwater resources constitute an extremely valuable element of the natural resource base of Kewaunee County. The groundwater reservoir not only sustains lake levels and provides the base flow of streams in the county but also comprises a major source of water for domestic, municipal and industrial water users. Like surface water, groundwater is susceptible to depletion in quantity and to deterioration in quality.

[13] http://www.uwex.edu/sco/state.html
[14] DeVaul, 1967.

There are 15 lakes in Kewaunee County covering a total of 251 acres (0.39 square miles.) There are also four rivers that flow in the county including the Ahanapee, East Twin, Kewaunee and the Neshota. (See Appendix A for a map of county waterways.)

The major watershed is the Lake Michigan Watershed. The minor watersheds are the Ahnapee River, the East Twin River, the Kewaunee River, the Red River and Little Sturgeon Bay, the Stony Creek and the West Twin River Watersheds. (See Appendix A for a map of county watersheds.)

Soil Types

The soil of Kewaunee County (see Appendix A: Maps) is similar to that found throughout Wisconsin. Many of the soils of Wisconsin are young soils: entisols and inceptisols. Mature soils include mollisols, alfisols and spodosols. Histosols occur in wetland areas. Soils denoted with the suffix "p" are most likely to include mollisols and soil group J includes most of the histosols. Alfisols dominate in areas originally covered by deciduous forest, spodosols in coniferous areas. Steep slopes are more likely to consist of less-developed soils since erosion strips away material nearly as fast as soil can develop.

Kewaunee County's primarily clay loam soils are well suited for growing a variety of crops including corn, alfalfa, soybeans, small grains and vegetables. In Kewaunee County, farmers face the challenge of making a living from the land, while protecting the natural resources through sound farming practices. Proper management of agricultural lands to control erosion, remove excess water, minimize pollution and provide a good economic return is necessary for the Kewaunee County agriculture industry to remain strong.

Wetlands

According to the Wisconsin Department of Natural Resources, Kewaunee County has approximately 27,436 acres of wetlands (approximately 12.5% of its total area). This is 0.5% of the total statewide acreage of wetlands.[15]

[15] http://www.dnr.state.wi.us/org/water/fhp/wetlands/acreage.shtml

Land Use

Land use in Kewaunee County is mixed and can be summarized as follows:[16]

- Agricultural Land 168,902 acres (76.7%)
- Barren Land 1,421 acres (>1%)
- Forested Wetland 17,373 acres (7.9%)
- Grassland 7,502 acres (3.4%)
- Urban Areas 1,524 acres (>1%)
- Wetland Vegetation 9,519 acres (4.3%)
- Wooded Areas 13,994 acres (6.4%)

Outside of the cities of Algoma and Kewaunee land is primarily used for farming. Dairy farming is the leading agricultural endeavor with the main crops including alfalfa, corn, soybeans, oats and winter wheat. Within the cities, manufacturing; health care, education and social services; retail services and construction are currently leading industries and are projected to continue to grow.

Vegetation

Vegetation throughout the region is made up of areas of mostly maple, hemlock and yellow birch. The north-central portion of the county contains an area of conifer swamp.[17]

[16] http://kewauneeco.org/LWCD_Web_Site/images/LWRM%20Plan%20Executive%20Summary.pdf
[17] http://www.wisconline.com/counties/kewaunee/index.html

Demographics

Human Settlement Patterns

Kewaunee County's rich history dates all the way back to the seventeenth century and the famous French explorer, Jean Nicolet. When he visited in 1634, it was the site of a large Potowotami village. Forty years later, on November 1, 1674, Father Jacques Marquette celebrated the Holy Sacrifice of Mass in what is now Kewaunee. The event is commemorated with an historical marker.

More than a hundred years later, in 1795, Jacques Veau, a French trader, established a trading post at the mouth of the Kewaunee River. The first permanent European settlement began in 1836, when rumors of gold having been found near the mouth of the Kewaunee River led to "gold fever". Preparations were made to lay out a city which was confidently expected to rival Chicago in importance.

Joshua Hathaway, a prosperous land developer, purchased lots in Kewaunee, and was commissioned by the district surveyor to lay out the town. He arranged the area in wide avenues averaging 75 feet, with 50x150 foot lots. Lots started selling that fall, but when the gold boom turned bust, the land speculators moved on.

In 1837, the Chicago firm of Montgomery & Patterson built a mill on the Kewaunee River about three miles from the outlet. The mill was abandoned soon after and reverted to Joshua Hathaway, the original owner, who sold it in 1843 to John Volk of Illinois. In 1850-51, a pier was built into Lake Michigan, and Volk began to expand, building a water mill on the river and a steam mill on the lake.

Kewaunee County was separated from Door County on April 16, 1852 and organized independently the following November. Settlement began in earnest around the same time, as land sales were opened up and Yankees flocked to the area from the East Coast. They were followed by a large influx of European immigrants, including many Bohemians. Kewaunee was incorporated as a Village in 1873, and became a City twenty years later. Kewaunee's natural harbor was a major factor in the development of the early settlement.

The first recorded visit by a sailing craft was the schooner Rochester in 1847. In the summer of 1856, the side wheel steamer Cleveland began making regular trips along the west shore as far as Green Bay, stopping at Kewaunee. In 1859, a second pier was constructed to accommodate the rapidly growing schooner and steamer traffic, which served both commercial and passenger uses. In 1859, the citizens called several meetings to make plans for developing the harbor, but the Civil War intervened, and work on the present-day harbor was not begun until 1881.

In 1891, the City of Kewaunee was one of the great marine ports of the northern lakes. Rail service came to Kewaunee in 1891, with the building of the Kewaunee, Green Bay and Western Railroad. Kewaunee's transportation links were further enhanced in 1892, when the first car ferry service across Lake Michigan was instituted between Kewaunee and Frankfort, Michigan.

During the late nineteenth and early twentieth centuries, The City of Kewaunee was a prosperous community with a thriving economy, based at first on its proximity to Wisconsin's northern forest and excellent transportation connection, and later on its diverse retail and manufacturing base.[18]

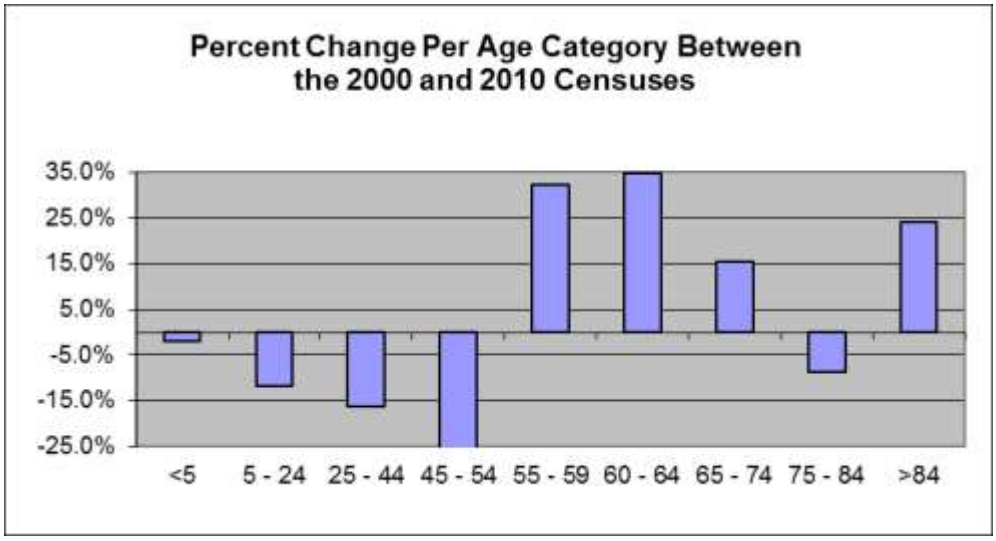
Population

The population of Kewaunee County has been growing since 1940 although the rate of growth is slower than the State of Wisconsin overall. As a generalized trend, population has primarily been growing fastest in the villages of Kewaunee County.

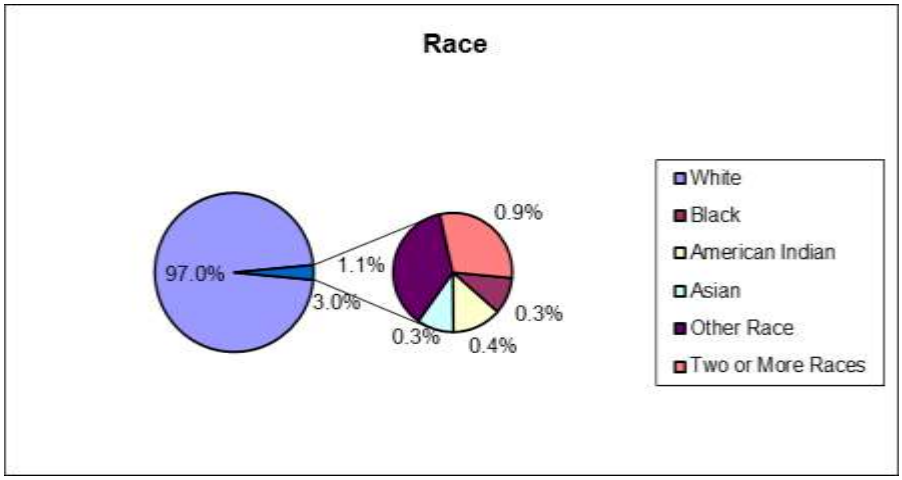
According to the 2010 U.S. Census Bureau survey report[19], there are 20,574 people residing in Kewaunee County's 8,239 households with an average of 2.48 people per household. This is an increase of 18 households, or 0.1%, over the 2000 census when 8221 households were reported. The 2010 U.S. census numbers indicate that the median household income is $54,783 and that the per capita income is $24,936. Approximately 8.7% of the people live below the poverty line. The 2010 census also indicated that there are approximately 9304 housing units within the county, 86.7% of which are traditional, one-unit attached homes. 80.5% of homes are owned by the families residing in them and the median home value is $147,200.

[18] http://www.kewaunee.org/Kewaunee-History.html
[19] http://factfinder2.census.gov/faces/nav/jsf/pages/index.xhtml

The population of Kewaunee County rose from 20,187 to 20,574 between the 2000 and 2010 censuses. This is an increase of 387 people—a population growth rate of almost 2%.

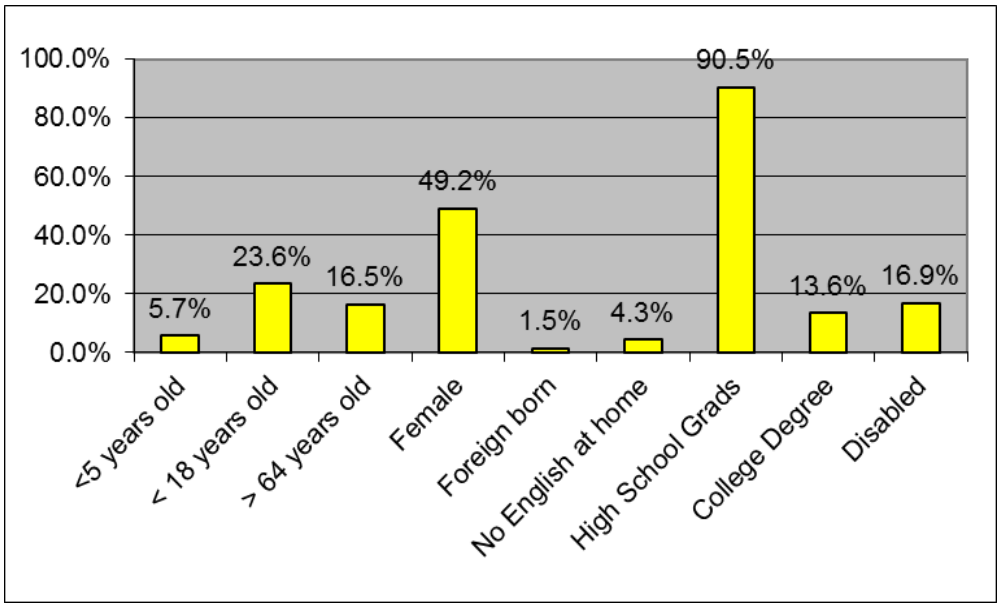


According to the 2010 U.S. Census, the overwhelming majority of people in Kewaunee County reported that they were white. People of Hispanic or Latino origin were counted either as a subcategory of those reporting that they were white, as another race or as two or more races. Hispanic/Latino individuals totaled 2.3% of those three categories. There are no Native American tribal lands located within Kewaunee County.



Other miscellaneous demographic information reported by the census bureau is detailed in the following chart. These figures

identify potential needs for special consideration in a disaster response or recovery operation planning and implementation.[20]



* "Disabled" as a census category was not collected in 2010. The reported number is from the 2000 census.

The county contains the Cities of Algoma and Kewaunee and the Villages of Casco and Luxemburg. There are also 10 towns including Ahnapee, Carlton, Casco, Franklin, Lincoln, Luxemburg, Montpelier, Pierce, Red River and West Kewaunee.

Transportation Network

Kewaunee County has a good transportation network with state highways connecting the population centers. Highway 42, a north-south road, runs along the eastern border of the county and connects the county to Manitowoc and Door Counties as well as connecting the Cities of Kewaunee and Algoma. Highway 29 runs west from the City of Kewaunee into Brown County. Highway 54 connects the City of Algoma to the Villages of Casco and Luxemburg and eventually to Brown County. Highway 57 runs along the far northwestern section of the county. There is also a large network of county and local roads that comprise the rest of the road network.

[20] http://quickfacts.census.gov/qfd/states/55/55047.html

This street and highway system within the county serves several important functions; including providing movement of vehicular traffic; providing access for vehicular traffic to abutting land uses; providing for the movement of pedestrians and bicycles and serving as a location for utilities and storm water drainage facilities.

The county and municipal governments of Kewaunee County maintained these roads to provide a safe and efficient transportation system. With continued maintenance, these roads will continue to serve the population effectively.

Land Use and Development Trends

Development trends in Kewaunee County mirror that of Wisconsin in general. The footprints of the cities and villages are expanding to redevelop more of the surrounding agricultural and undeveloped areas into suburban housing. The still considerable amount of rural agricultural area not being developed is slowly altering from small, family farms to larger, and sometimes corporate, concerns.

Kewaunee County is committed to planning appropriate growth and the elected officials monitor on-going development. To that end, the following projects were identified for future development within the county:

Kewaunee County

- Construct a mile of road (CTH AB) from the Door County line south to Duvall.

Village of Casco

- CTH C upgraded and re-blacktopped
- Repair damaged curbs, gutters and sewer

Public Safety Support

Medical

The Kewaunee County Office of Emergency Management, city and county emergency services responders, hospital emergency staff and various departments have developed medical and mass casualty plans. These plans will be used in the event of a disaster.

There are no hospitals within Kewaunee County; most people receive care from the hospitals in Brown, Door or Manitowoc Counties. These hospitals will coordinate with responding agencies to ensure the best utilization of services and the least injury or loss of life from a disaster situation. It should also be noted that area hospitals have reciprocal verbal agreements for transferring critical patients during a disaster.

Kewaunee County relies wholly on volunteer staff for pre-hospital emergency medical services. (See County First Responder Districts Map in Appendix A for district boundary details.) Pre-hospital medical units include Algoma Rescue, Kewaunee Rescue, Luxemburg Rescue and Viking Rescue.

Each of these departments provides monthly training to their staff and Kewaunee County Emergency Management participates in disaster exercises with area hospitals at least once per year as required by the Radiological Emergency Preparedness (REP) program. County emergency medical technicians, ambulances, police, county sheriff's deputies and volunteers participate in these and other periodically scheduled exercises.

Fire Service

Kewaunee County includes six separate fire districts (i.e., Algoma, Carlton, Denmark, Kewaunee, Luxemburg, Tisch Mills), all of which are staffed by on-call volunteer firefighters. (See the County Fire Districts Map in Appendix A.)

Hazardous materials (HazMat) response is provided by the Brown County Level B team. A-level HazMat response is sponsored by the State of Wisconsin and is provided by Northeast Regional Response Team #3 from the combined Appleton and Oshkosh Fire Departments.

Law Enforcement

Several departments in Kewaunee County are responsible for law enforcement duties within the county. The Cities of Algoma and Kewaunee and the Village of Luxemburg have full-time law enforcement officers. The Kewaunee County Sheriff's Department provides deputies for the rest of the county. Also, the Wisconsin State Patrol provides limited coverage from their district office in Fond du Lac County.

Archaeological and Historical Resources

The Wisconsin Historical Society has a listing of archaeological sites that have been identified in Kewaunee County; this list is available to governmental agencies upon request. The National Register of Historic Places also has a listing of 12 locations in Kewaunee County. As mitigation projects are considered, the county is committed to ensuring that archaeological and historical sites are preserved.

Historic Sites[21]		
Historic Site Name	**Street Address**	**City**
Ahnapee Brewery	115 Navaro Street	Algoma
Art Dettman Fishing Shanty	Church Street at the Ahnapee River	Algoma
Daniel Lyons Shipwreck	East of Stoney Creek, Lake Michigan	Algoma
George Halada Farmstead	E-1113 County Trunk Highway F, Town of Montpelier	Ellisville
Kewaunee County Sheriff's House and Jail	Court House Square, junction of Dodge and Vliet streets	Kewaunee
Kewaunee Post Office	119 Ellis Street	Kewaunee
Major Wilbur Fr. Browder (tugboat)	Harbor Park, Kilbourn Street	Kewaunee
Marquette Historic District	Roughly bounded by Lake Michigan and Center, Juneau and Lincoln streets	Kewaunee
Massart Farmstead	North of Casco on County Road C	Casco
Melvin W. & Mary Perry House	519 Third Street	Algoma
Pilgrim Family Farmstead	SW of Kewaunee on Church Road	Kewaunee
St. Lawrence Catholic Church	Junction of County Road AB and County Highway J	Stangelville

[21] http://www.wisconsinhistory.org/hp/register/

All of these sites are known to the State Historical Society of Wisconsin and are protected sites. If there is concern that a mitigation project will impact one of these or any other identified or suspected archeological site, the county will work with the proper authorities to ensure that all applicable laws and regulations are followed.

Hazard Analysis and Previous Mitigation Projects

The following sections identify those hazards that have occurred or could occur in Kewaunee County. Each includes a description of a hazard and its frequency of occurrence. Also included is a section that describes the general vulnerabilities of the community and its infrastructure to each particular type of hazard. More detailed and specific analyses will be conducted as projects are identified for inclusion in grant applications. As part of the application process, the methodology of data collection and future development patterns will be addressed. Estimates of potential dollar losses and the methodology used to arrive at those estimates will also be described during this application process.

Wisconsin Emergency Management (WEM) completed and regularly updates the State Hazard Mitigation Plan, which was last revised in 2011. This plan describes the hazards that have occurred or are most likely to occur within the state and includes the frequency of occurrence, potential impacts and suggested actions to mitigate the hazard. This plan is the basis for the development of all emergency management plans and is distributed upon revision to county emergency government directors and other stakeholder agencies.

The Kewaunee County Emergency Management Director develops and annually updates a listing of all hazards that have occurred or could occur within the county. This listing includes the definition, frequency of occurrence and actions to mitigate the hazard. In general, the threat of most hazards is consistent throughout the county. The only hazard where there were differences identified within the county was for flooding and for that hazard, specific locations are identified.

For this plan the Kewaunee County Hazard Mitigation Plan Workgroup reviewed the past events records and an internal workgroup consensus was reached on the anticipated probability of future events. This probability was designated as “very high,” “high,” “medium,” “low” or “very low” by the workgroup based on their evaluation and experience with the data, the table of those rankings follows:

Hazard	Likelihood of Occurrence*	Severity of Effects if It Does Happen*	Misc. Notes
Coastal Erosion	Medium	City of Algoma – High Rest of County - Medium	Co Zoning has 125' setback and state regulations only require 75'
Drought/Dust Storm	Medium	Agriculture – Medium Other losses - Low	
Earthquake	Low	Very Low	
Flood – Flash Flood & River Flood	Low	Low	
Flood – Dam Break	Low	Medium	Forestville Dam (Door Co) would flood Algoma. Brummerville Dam is being removed.
Fog	High	High	
Forest Fire	Very Low	Low	
Wildfire	Low	Low	
Landslide	Low	Low	
Karst	Shallow Area – High	Groundwater Contamination - High	
Severe Temperature	Medium	Property Loss – Low Injury/Death – Medium	
Hail	Low	Low	
Lightning	High	Rural – Medium Urban - Low	
Thunderstorm	High	N/A (discussed in lighting, wind, flood & other chapters)	
Tornado	Medium	Medium	
Derecho (High Wind)	High	Medium	
Winter Storm (Snow & Ice)	High	Medium	
Utility Failure	Medium/High	Medium/High	

The emphasis in the following sections is on mitigation activities for each hazard as a major component of overall emergency management. Mitigation or prevention activities reduce the degree of long-term risk to human life and property from natural and man-made hazards. The cooperation of government, academia, the private sector and volunteer agencies is essential in mitigation efforts. The Kewaunee County Emergency Management Office is committed to working with municipalities and the private sector to ensure that county mitigation information is shared and it is incorporated into their planning as appropriate. It is important to note that while Kewaunee County is committed to hazard mitigation, an assessment of the risk of natural disasters is considered overall generally low. This assessment is reflected in

the lack of historical disasters plus a review of geographic, meteorological and other conditions reduces the county's ability to have many hazard mitigation strategies that meet a cost-benefit analysis county-wide as well as within the municipalities.

Each community will be given a copy of the plan to use as a reference during their own preparedness activities (i.e., planning, training, permitting, zoning.) Communities that have their own comprehensive plan will reference this mitigation plan and its contents in the next scheduled plan update during public meetings, workgroup sessions and as texts are written. Municipalities that do not have comprehensive plans either are under the purview of and request assistance from the Kewaunee County or have their own planning departments. Members of the County Land Information Office and Zoning Department and municipal planning departments were included on the Hazard Mitigation Workgroup and are aware of the benefits and requirements to using this plan as they go about their preparedness activities. At this time, general themes and ideas from the previous mitigation plan were included as the county and municipalities discussed the updates of the applicable coordinating plans (e.g., comprehensive, flood, storm water) but there are no direct examples of text or specific ideas that can be listed as having come from the hazard mitigation plan.

Kewaunee County and its municipalities have a history of identifying, planning and completing hazard mitigation projects including these, which received supplemental funding[22]:

Community Development Block Grant (CDBG) Emergency Assistance Program (EAP) Projects: Kewaunee County does not have any current EAP projects.

It was noted by the workgroup that there are several opportunities for grant funding from various federal and state resources including:

- **HMGP** - The Hazard Mitigation Grant Program (HMGP) is authorized by Section 404 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act, as amended. The key purpose of HMGP is to ensure that the opportunity to take critical mitigation measures to reduce the risk of loss of life and property from future disasters is not lost during the reconstruction process following a disaster. HMGP is available, when authorized under the Presidential major disaster

[22] http://emergencymanagement.wi.gov/mitigation/docs/2011%20State%20of%20Wisconsin%20Hazard%20Mitigation%20Plan.pdf

declaration, in the areas of the state requested by the governor.[23]

- **PDM** - The Pre-Disaster Mitigation (PDM) program is authorized by Section 203 of the Stafford Act, 42 U.S.C. 5133. The PDM program is designed to assist States, Territories, Indian Tribal governments, and local communities to implement a sustained pre-disaster natural hazard mitigation program to reduce overall risk to the population and structures from future hazard events, while also reducing reliance on Federal funding from future major disaster declarations.[24]
    - Pre-Disaster Mitigation (PDM) Projects Funded in the State
        - 2002 ($15,520) - Technical assistance Personnel, travel, and supplies
        - 2003 ($32,834) - Technical assistance Personnel, travel, and supplies
        - 2003C ($176,812) - Technical assistance Personnel, travel, and supplies
        - 2005C State of Wisconsin ($182,010) - Development of structure inventory database
        - 2005C ($88,480) - Technical assistance Personnel, travel, and supplies
        - 2006C ($22,141) - Technical assistance Personnel, travel, and supplies
        - 2007C ($70,092) - Technical assistance Personnel, travel, and supplies
        - 2008C ($23,897) - Technical assistance Personnel, travel, and supplies
        - 2008C ($18,906) - Technical assistance LPDM; personnel, travel, and supplies
        - 2009C ($25,579) - Technical assistance Personnel, travel, and supplies
        - 2010C ($47,859) - Technical assistance Personnel, travel, and supplies
    - PDM Plans Funded in the State
        - 2003C Kewaunee County ($36,000) - New Plan is approved
        - 2007C ($402,574) - Update Agreement with UW for HAZUS flood risk assessment

[23] http://www.fema.gov/hazard-mitigation-grant-program
[24] http://www.fema.gov/pre-disaster-mitigation-grant-program

        - 2010C Kewaunee County ($23,038) - Update In planning process

- **FMA** - The Flood Mitigation Assistance (FMA) program is authorized by Section 1366 of the National Flood Insurance Act of 1968, as amended with the goal of reducing or eliminating claims under the National Flood Insurance Program (NFIP). The Repetitive Flood Claims (RFC) program has the goal of reducing flood damages to individual properties for which one or more claim payments for losses have been made under flood insurance coverage and that will result in the greatest savings to the National Flood Insurance Fund (NFIF) in the shortest period of time.[25]

    - Flood Mitigation Assistance (FMA) Projects Funded in the State
        - 2003 ($16,320) - Technical support for applicants Personnel, travel, supplies
        - 2005l ($11,464) - Technical assistance to subgrantees Personnel, travel, supplies
        - 2007 ($4,020) - Technical assistance to subgrantees Personnel, travel, supplies
        - 2010 ($8,9940 - Technical assistance to subgrantees Personnel, travel, supplies

- **SRL** - The Severe Repetitive Loss (SRL) program is authorized by Section 1361A of the NFIA has the goal of reducing flood damages to residential properties that have experienced severe repetitive losses under flood insurance coverage and that will result in the greatest amount of savings to the NFIF in the shortest period of time.[26]

- **RFC -** The Repetitive Flood Claims (RFC) grant program was authorized by the Bunning-Bereuter-Blumenauer Flood Insurance Reform Act of 2004 (P.L. 108–264), which amended the National Flood Insurance Act (NFIA) of 1968 (42 U.S.C. 4001, et al). Up to $10 million is available annually for the Federal Emergency Management Agency (FEMA) to provide RFC funds to assist states and communities to reduce flood damages to insured properties that have had one or more claims to the National Flood Insurance Program (NFIP). FEMA

[25] http://www.fema.gov/flood-mitigation-assistance-program
[26] http://www.fema.gov/severe-repetitive-loss-program

may contribute up to 100 percent of the total amount approved under the RFC grant award to implement approved activities, if the applicant has demonstrated that the proposed activities cannot be funded under the FFMA program. [27]

- **406 Mitigation –** The Public Assistance-Section 406 Mitigation Funding may be considered by FEMA in a federal disaster declaration to fund mitigation measures to a public facility damaged by the event that enhance the facility's ability to resist similar damage in future events. This funding is authorized under Section 406 of The Robert T. Stafford Disaster Relief and Emergency Assistance Act and provides discretionary authority to fund mitigation measures in conjunction with the repair of the disaster-damaged facilities, which usually present themselves during the repair efforts. The mitigation measures must be related to eligible disaster-related damages and must directly reduce the potential for future, similar disaster damages to the eligible facility. This work is performed on the parts of the facility that were actually damaged by the disaster and the mitigation provides protection from subsequent events. Mitigation measures must be determined to be cost-effective, technically feasible, and in compliance with statutory, regulatory and executive order requirements. In addition, the measure cannot cause a negative impact to the facility's operation, surrounding areas, or susceptibility to damage from another hazard.[28]

- **CDBG** – The U.S. Department of Housing and Urban Development (HUD) Community Development Block Grant-Disaster (CDBG) Recovery Assistance provides flexible grants to help cities, counties and states recover from Presidentially-declared disasters, especially in low-income areas, subject to availability of supplemental appropriations. In response to disasters, Congress may appropriate additional funding for the CDBG program as disaster recovery grants to rebuild the affected areas and provide crucial seed money to start the recovery process. Since CDBG Disaster Recovery assistance may fund a broad range of recovery activities, HUD can help communities and neighborhoods that otherwise might not recover due to limited resources. Disaster Recovery grants often supplement the disaster programs of FEMA, the SBA and

[27] http://www.fema.gov/repetitive-flood-claims-program
[28] http://www.fema.gov/public-assistance-local-state-tribal-and-non-profit/hazard-mitigation-funding-under-section-406-0

the U.S. Army Corps of Engineers (i.e., these funds can be used for the local matching requirement of other federal grants).[29]

- **Municipal Flood Control Grant Program** - This Wisconsin Department of Natural Resources (DNR) grant is available to all cities, villages, towns, tribes and metropolitan sewerage districts. Assistance is provided with items such as the acquisition of property, vacant land, structure removal, flood proofing, administrative support and others.[30]

- **Dam Removal Grant Program** - This Wisconsin DNR grant is available to all cities, villages, towns, tribes and metropolitan sewerage districts and provides 100% of eligible project costs up to a maximum of $50,000 to remove a dam. Assistance is provided with items such as: the acquisition of property, vacant land, structure removal, flood-proofing, administrative support and others.[31]

[29] http://portal.hud.gov/hudportal/HUD?src=/program_offices/comm_planning/communitydevelopment/programs/drsi
[30] http://dnr.wi.gov/Aid/MunFloodControl.html
[31] http://dnr.wi.gov/aid/damremoval.html

All Hazards

One of the bedrock principles of emergency management is to approach issues from an all-hazards perspective. This is generally very cost effective because it accomplishes preparedness and/or mitigation goals for many types of disasters with one resource. Some of the all hazards mitigation projects that Kewaunee County would like to accomplish are detailed in the following sections.

The planning committee also used the all hazards approach to identify mitigation goals for the county and all of its municipalities. The purpose hazard mitigation plan is to identify hazard areas, to assess the risks, to analyze the potential for mitigation and to recommend mitigation strategies where appropriate. Potential mitigation projects will be reviewed using criteria that stress the intrinsic value of the increased safety for people and property in relation to the monetary costs to achieve this (i.e., a cost-benefit analysis). With that in mind, the planning goals for this entire plan, as determined by the mitigation planning committee were:

- **Objective 1:** To preserve life and minimize the potential for injuries or death.
- **Objective 2:** To preserve and enhance the quality of life throughout Kewaunee County by identifying potential property damage risks and recommending appropriate mitigation strategies to minimize potential property damage.
- **Objective 3:** To promote countywide planning that avoids transferring the risk from one community to an adjacent community, where appropriate.
- **Objective 4:** To identify potential funding sources for mitigation projects and form the basis for FEMA project grant applications.

Vulnerability

Perhaps the largest risk that falls under the all-hazards banner is the continuing challenge of securing funding to keep up with the rapid technological changes and advances in the public safety communications infrastructure. Another vulnerability is the fact that not all agencies that work together in disaster response and recovery can communicate with one another (i.e., are interoperable).

The first concern is having an open channel with the public both on an on-going and on an emergency basis. Good communications are critical to give the members of the public the time to prepare themselves for disaster ahead of time. Messages of this nature might include hazardous weather safety information, floodplain information, etc. It is also critical for citizens to receive accurate and timely information during and after a disaster. As technologies have improved, there is a need to ensure that the county employs the technologies that are:

- Most commonly used by the public (e.g., internet, cellular telephones, television media),
- Available during a disaster (e.g., cellular phones may be overloaded, electrical power for televisions might not be available),
- Redundant so that if one system is out, others may be available,
- Integrated so that all of the communications technologies can work together in an overall communications strategy and
- As cost-efficient as possible.

The second concern is the lack of a robust communications system for first responders in Kewaunee County. This could impact safety by not allowing response staff the ability to manage a disaster response and recovery operation adequately. This could impact responder and citizen safety as well as operational effectiveness.

Hazard Mitigation Strategies

In general, most of the projects that can be done with current budgetary dollars are not capital improvement projects and are not very expensive. Projects that require significant capital outlays are, for the most part, grant-dependent. Since the profile (e.g., economic, geographic) of an area may change between the identification of a project in this plan and the availability of grant funds, projects will be identified within the plan and be slated for detailed study and analysis at such time as grants become available. The detailed study will identify the types and numbers of existing and future structures, the potential dollar losses to vulnerable structures and the lead agency or department who will manage the project. At that time, grant-eligible projects will be evaluated using the appropriate grant criteria for factors such as:

- Overall benefit to the community

- Economic feasibility (i.e., a cost-benefit analysis)

Compliance with environmental, social justice and other laws Most of the hazard mitigation strategies listed below are not “bricks and mortar” changes. Rather, they are enhancements to computer and radio equipment and plans that allow better communication with the public in times of crisis and therefore do not reduce effects for existing or future buildings and infrastructure.

Warning and Communication Plans

Warning and communication plans are vital in a time of crisis to reduce property damage and human casualties. An advance plan allows the appropriate authorities to perform their emergency duties in an efficient manner.

Kewaunee County will maintain the following:

- Facilities, systems and procedures to activate warning and communication capabilities,
- Systems to support communications, including:
  - Telephone and radio to notify public personnel
  - Local television, radio and newspaper to spread warning information
  - Local law enforcement and fire and rescue communications
  - An emergency communications center,
- Kewaunee County Sheriff’s Department dispatch staff to receive and distribute warning information to the public and emergency management agencies.

During an emergency, the general public receives information by sirens, NOAA weather radio, local broadcast or printed media, door-to-door notification by emergency services personnel and/or a mobile public address system. It should be noted that the ability to use the NOAA weather radio system for an expanded list of emergency messages is a positive move that makes this alert and warning tool even more valuable. As a result, Kewaunee County will continue to promote increased use of these radios among the public.

Methods for notification of the special needs populations include door-to-door warnings, foreign language media messages and closed-caption television messages. Other notices and procedures can be found in Kewaunee County's Emergency Operations Plan which is reviewed and updated on a regular schedule.

Kewaunee County should be capable of the following:

- Disseminating emergency warning and notification to the public though its county-wide warning systems;
- Supporting emergency management operations;
- Providing adequate warning and communication systems;
- Planning for alternative means and resources in the event of a warning or communication system breakdown.

Kewaunee County will prepare facilities, systems and procedures to activate warning and communication. During an emergency, Kewaunee County will deliver prompt and accurate warnings to businesses and residents. The county budget to maintain warning and communication systems has thus far been sufficient but there are several expensive projects on the horizon that are a source of concern for the community. The county would like to complete several enhancement projects include the following:

- The County Emergency Management Department would like to equip all of the special facilities in the county with National Oceanic and Atmospheric Administration (NOAA) weather radios. These radios would relay messages regarding traditional weather concerns such as tornados and thunderstorms. NOAA also has alerted emergency management officials that other types of emergency messages such as terrorism alerts and missing children notifications can be released via their system. This enhanced capability makes these radios an excellent tool for initial alert and notification to staff in these special facilities. This project is a high priority and the estimated cost, which will have to be secured through grants, will be $400,000. The county emergency management office will also work to encourage all households to purchase a weather radio.

- Purchased 200 radios (80 left). CBRFs and nursing homes received radios with assistance from Public Health.
- Campaign in spring to encourage NOAA radio use. Suggest radios as Christmas gifts on Facebook. Advertise via Facebook and Code Red (reverse 911).
- Going forward with assistance from Sheriff's Office; Algoma, Luxemburg and Kewaunee Police Departments.

- The Kewaunee County public safety communications equipment is not adequate to manage the traffic expected of it. For example, all fire and EMS traffic is on the same channel. During exercises and actual responses, it has become clear that the county needs to have two more frequencies. The equipment on the towers is also old and the cost of repairs is likely to increase and the availability of parts for repairs to decrease as time goes on. The estimated cost of a total upgrade of this system is $4,000,000. The project would be led by the Emergency Management Office with significant input from the Sheriff's Department.

  - Two additional frequencies are needed. Replace old equipment on the radio towers.
  - Complete narrow-banding requirements.

Website

Kewaunee County has a general web site (http://www.kewauneeco.org/) with links to various departmental/agency pages. The hazard mitigation workgroup identified a need to have a repository for emergency preparedness information for individuals and families and decided that the Emergency Management Department should host this information on their site at (http://www.kewauneeco.org/LEPC/). The department currently has a page with links to agencies such as Wisconsin Emergency Management, the Federal Emergency Management Agency, American Red Cross and NOAA. The county also included fact sheets and emergency prepared information on a few hazards. In recognition of the importance of the internet as a communication tool, especially in pre-planning activities, the Emergency Management Department will review their web pages on a regular schedule to ensure that important information and links for general preparedness topics are available.

The county would like to be able to use the website to relay information during an emergency.

Kewaunee County also has a link to its geographical information system (GIS) mapping data from the county homepage. From this site, (http://kewaunee.ims.ruekert-mielke.com/) citizens can access information about the soils, hydrology, zoning and other features of the county.

Both of these websites are an important part of the county's efforts to provide quality information to its citizens. The county plans to publicize these resources so that people are aware of them and how to access them. All of these projects are being covered by the existing county budget.

COOP/COG Planning

As part of the Federal Fiscal Year (FFY) 2002 Supplemental Planning Grant, Kewaunee County Emergency Management began Continuity of Operations/Continuity of Government (COOP/COG) planning. This planning is done to identify the critical functions that each county department must have operational within 12 hours of a catastrophe. Kewaunee County would like to continue COOP/COG disaster planning. One element of this plan is having alternate emergency facilities such as Emergency Operations Centers (ECOs), Joint Public Information Centers (JPICs) and Emergency Operating Facilities or EOFs, which would be used in a nuclear power plant incident.

A portion of Kewaunee County is in the Emergency Planning Zone (EPZ) for both the Kewaunee and Point Beach Nuclear Power Plants. Because of this, Dominion Energy provides some support for the county's emergency operations to be use in a nuclear power plant emergency. Dominion purchased a building in Green Bay to use as alternate EOC/JPIC/EOF and Kewaunee County Emergency Management will be working with the company to equip the facility using grant money and budget funds. The estimated cost of equipping this facility, beyond what Dominion has already contributed, is $75,000 - $80,000.

- Completed a new county EOC in Luxemburg and moved to the facility in 2012.
- No alternate site has been identified as of yet because the new primary EOC project took precedence.

EPCRA Awareness

Kewaunee County believes that it is important for citizens to be aware of the requirements for reporting, usage and disposal of hazardous materials. Some awareness projects are required by the Emergency Planning and Community Right-to-Know (EPCRA) Program. Kewaunee County conducts two awareness campaigns in March and August. The March campaign usually occurs in conjunction with a Clean Sweep, which is a project where, for a defined period of time, citizens can deliver household hazardous wastes to a collection point without charge. Recurring projects such as these are led by the Emergency Management Department and are funded from a grant managed by Wisconsin Emergency Management (WEM) and by county budget dollars. Special projects have varying costs and there may be grants available to fund them.

Coastal Erosion

All 15 coastal counties in Wisconsin can experience erosion, flooding and damage to shoreline structures. Coastal erosion is a naturally occurring process that can accelerate during times of high water or wave action. For example, bluff erosion is more likely to occur during major storm events due to wave action upon the shoreline. The effects of wave-induced erosion are usually greater during those periods when the level of the water is high. The freezing and thawing of lake ice also contribute to erosion.

Lake Michigan coastal erosion in Port Washington.

Physical Characteristics

Coastal erosion is defined as the wearing-away of land and the loss of beach, shoreline or dune material over a period of time as a result of natural coastal processes or human influences. Characteristics such as supply of sand and processes such as sea level change, currents, tides, waves and wind are natural factors that contribute to the rate of erosion. Human-caused contributors to erosion include dredging tidal entrances, jetty and groin construction, hardening shorelines with seawall, beach nourishment and construction of harbors and sediment-trapping dams.

Coastal erosion affects Wisconsin along the shoreline of Lakes Michigan and Superior. Along the Great Lakes, cyclical changes in lake levels, disruption of long shore transport of beach building material and storms all influence the rate of erosion. According to the National Research Council, a congressionally chartered, non-profit organization that provides science and technology advice, annual variability in wave climate and lake levels causes the rates of bluff and dune erosion along the shores of the Great Lakes to vary from near zero to tens of feet per year.

As high-lake levels increase, bluff recession rates also increase. Increasing assaults by wave action against the base of the bluff cause erosion and beach-building sediments. Navigational improvements and dredge-material disposal practices deplete both tributary and shore land sources of sediment. Removing these sediments from the shore system contributes to erosion. Ice ridges that form and break up each winter along the shoreline cause erosion by trapping sand in floating fragments of ice that are carried offshore into deep water. This continual natural process is one of the principal mechanisms by which sand is lost from the near shore system.[32]

C
Coastal Erosion along Lake Michigan

[32] USGS, 1992

Frequency of Occurrence

Coastal erosion is usually a gradual process, and sudden incidents prompting emergency action are rare. Such rare events include strong storms with high winds or heavy wave action that can cause sudden failure of bluffs.

All 15 coastal counties in Wisconsin experience erosion, flooding and damage to shoreline structures. Coastal erosion is a naturally occurring process that can accelerate during times of high water or wave action. For example, bluff erosion is more likely to occur during major storm events due to wave action upon the shoreline. The effects of wave-induced erosion are usually greater during those periods when the level of water is high. The freezing and thawing of lake ice also contribute to erosion.

Record snowfall in northern Wisconsin in 1996 was followed by near record high-water levels in 1997. However, unusually mild weather and light snowfall in the winters of 1998–1999 and 1999–2000 brought lake levels to below long-term averages. According to the U.S. Army Corps of Engineers' Monthly Bulletin of Lake Levels for the Great Lakes, lake levels are more than one foot below normal in Lake Michigan. Water levels on Lake Michigan recovered somewhat in 2001 but remained below normal. Heavy above average rainfall in April 2002 [133% of average] improved low lake levels by as much as eight inches in summer 2002.

Many areas of the Wisconsin Great Lakes coast are vulnerable to bluff erosion. In general, the erodible sections of the Lake Michigan shore are found between the Illinois State line to the Sturgeon Bay Canal in Door County, and in the northeastern part of Brown County on Green Bay. Along the remainder of the Lake Michigan shore, bluff erosion is limited to smaller segments of bays and clay banks.[33] In January, 2006 a 900' x 60' area fell from the bluffs in Ozaukee County; on average, there losses are two to three feet per year.

Water levels in the Great Lakes fluctuate on both a seasonal and long-term basis. Seasonally, the lakes are at their lowest levels during the winter when much of the precipitation is held on land as snow and ice. The highest seasonal levels are during the summer when snowmelt from the spring thaw and summer rains contributes to the water supply. Long-term variation of lake levels depends on precipitation and evaporation trends in the Great Lakes watershed. Lake levels rise when net water supply exceeds outflow and above

[33] Springman and Born, 1979

average lake levels can persist for extended periods even after the conditions that caused them have ended. The water volume of the Great Lakes is large and outflow from natural outlets is limited. Flow regulation structures exist in Lakes Ontario, Michigan and Superior, but their influence is limited by their size. Controlled releases strive to simulate long-term averages in an effort to serve multiple interests. The source of about 40% of Lake Superior's annual water supply is from the snowpack around its shores. Lakes Michigan and Huron get up to 30% of their yearly supply from Superior's snowmelt when it flows into the lower lakes.[34]

Kewaunee County has a high probability of coastal erosion in the future and the likelihood of damage due to coastal erosion is considered medium.

Vulnerability

Existing maps depicting rates of coastal erosion and the FEMA HAZUS-MH inventory of structures in the coastal zone provided the basis for estimating the potential vulnerability and losses from this hazard. The number and types of structures subjected to high and low risk of erosion were determined from these data. The erosion risk zones were established based on the distance in miles from the Coastal Area Boundary. The high erosion risk zone is defined as the area within 1/4 mile of the Coastal Area Boundary; the low erosion risk is 1/2 mile from the boundary.

The high erosion risk loss estimate for Kewaunee County includes 1,374 residential structures, 13 commercial structures and 1 government structure for a total of 1,388 structures. The estimated cost of residential loss is $24,912,580, commercial loss is $203,400 and government loss is $15,800.

The low erosion risk loss estimate for Kewaunee County includes 1,977 residential structures, 14 commercial structures and 1 government structure. The estimated cost of residential loss is $68,407,240, commercial loss is $435,480 and government loss is $31,600.

Based upon structure type and dimensions, including square footage, replacement values were estimated. The estimated

[34] Detroit Free Press, March 18, 2000

replacement value was assumed to be equal to the value of a total loss of the structure due to erosion.

Replacement values for coastal structures were estimated and could be verified in future risk assessments.[35]

Hazard Mitigation Strategies

The goal of coastal erosion mitigation activities is to reduce, in a cost effective manner, the loss of lives and property due to these events.

Coastal property owners are acutely aware of hazards during periods of high-water levels and especially right after a damaging storm or a bluff failure but this awareness can fade over time if low lake levels slow the erosion rate. Lake levels were above long-term averages from 1996 to 1998. The last period of significantly higher lake levels was in 1985 to 1986, resulting in $16 million of documented damage to public facilities alone.[36]

The most effective mitigation measures are ensuring that municipalities, builders and homeowners all understand safe building procedures and that local zoning measures are current, understood and enforced. (Note: the current county ordinance, found in the Shoreland and Floodplain Ordinance, requires a 25' set-back from the bluff.) A team was established to review/evaluate the plans, which is now complete. The Army Corps of Engineers was brought in to provide expert opinions and accepted updates should be completed by 2014.

In summer 2012, FEMA began conducting a comprehensive study of flood hazards for Lake Michigan and the rest of the United States Great Lakes[37] through FEMA's Risk Mapping, Assessment and Planning (MAP) Program. Data from this study will eventually be

[35] Wisconsin Hazard Mitigation Plan, Coastal Erosion Sections in 4.2 and 4.5 and http://www.seagrant.wisc.edu/Communications/LakeLevels/index.html
[36] WCMP, 1992
[37] http://www.greatlakescoast.org

used to convey coastal flood hazard risk through revised Flood Insurance Rate Maps (FIRMs) (i.e., regulatory products) and new risk planning and assessment products and datasets (i.e., non-regulatory products and datasets). The goal of Risk MAP is to support actions that make communities safer from flooding. The Risk MAP[38] program wants to achieve continued improvement of flood hazard information for the National Flood Insurance Program (NFIP); to promote increased awareness and understanding of flood risk; to increase community engagement; and to identify and support actions that local stakeholders can take to reduce natural hazard risks. Kewaunee County and its coastal communities will support this activity as requested and invited by FEMA.

Over time, ensuring adequate zoning measures and providing good public information regarding coastal erosion to those potentially affected will be the best strategies to reduce damages to existing or future buildings and infrastructure but the county also plans to continue studying the coastal erosion issue and will conduct any remediation actions that can be funded via grants or local dollars.

- The public has easy access to the Land Records information via website. Information regarding permits can also be accessed.
- Will continue to discuss safe building procedures with residents when they come in for permits.
- NR115 will be updated on shoreland permitting in 2014.

[38] http://www.fema.gov/plan/prevent/fhm/rm_main.shtm

Drought and Dust Storms

Two types of drought occur in Wisconsin: agricultural and hydrologic. Agricultural drought is a dry period that reduces crop yields. Hydrologic drought is a dry period of sufficient length and intensity to affect lake and stream levels and the height of the groundwater table. These two types of drought may, but do not necessarily, occur together.

Agricultural drought in a Wisconsin corn field in 2012.

Dust storms result from a combination of high winds and dry, loose soil conditions. While high winds and periods of drought have each occurred in Kewaunee County, there has never been a recorded dust storm event. Since natural hazards that have occurred in the past are more likely to occur in the future, it is unlikely that a dust storm event will occur in Kewaunee County. This assertion is further bolstered by the fact that there is very little irrigation done within the county and that the soils in Kewaunee County are not prone to blowing. While there are concerns about topsoil erosion and some mitigation activities may be planned that would reduce the effects of these types of events, they will not be a major focus of this plan.

Physical Characteristics

The understanding that a deficit of precipitation has different impacts on groundwater, reservoir storage, soil moisture, snowpack and streamflow led the development of the Standardized Precipitation Index (SPI) in 1993. The SPI quantifies the precipitation deficit for multiple time scales. These time scales reflect the impact of drought on the availability of the different water

resources. Soil moisture conditions respond to precipitation anomalies on a relatively short scale. Groundwater, streamflow, and reservoir storage reflect longer-term precipitation anomalies. For these reasons, the SPI is calculated for 3-, 6-, 12-, 24- and 48-month time scales.

The SPI calculation for any location is based on the long-term precipitation record for a desired period. This long-term record is fitted to a probability distribution, which is then transformed into a normal distribution so that the mean SPI for the location and desired period is zero. Positive SPI values indicate greater than median precipitation and negative values indicate less than median precipitation. Because the SPI is normalized, wetter and drier climates can be represented in the same way and wet periods can also be monitored using the SPI.

The classification system shown in the SPI values table (below) defines drought intensities resulting from the SPI. The criteria for a drought event are also defined for any of the time scales. A drought event occurs any time the SPI is continuously negative and reaches an intensity of -1.0 or less. The event ends when the SPI becomes positive. Each drought event, therefore, has a duration defined by its beginning and end and an intensity for each month that the event continues. The positive sum of the SPI for all the months within a drought event can be termed the drought's "magnitude." Current SPI maps for the United States can be found at http://www.ncdc.noaa.gov/oa/climate/research/prelim/drought/spi.html

SPI Values[39]	
2.0+	Extremely wet
1.5 to 1.99	Very wet
1.0 to 1.49	Moderately wet
-0.99 to 0.99	Near normal
-1.0 to 1.49	Moderately dry
-1.5 to -1.99	Severely dry
-2.0 and less	Extremely dry

The Palmer Index is an older scale and is used more often by governmental organizations. It is effective in determining long-term drought (i.e., over several months) and is not as good with short-term forecasts (i.e., weeks.) It uses zero as normal; drought is shown in terms of negative numbers and excess moisture is

[39] http://www.drought.unl.edu/whatis/indices.htm#spi

reflected by positive figures. The future incidence of drought is highly unpredictable and may also be localized, making it difficult to determine probability with any accuracy.

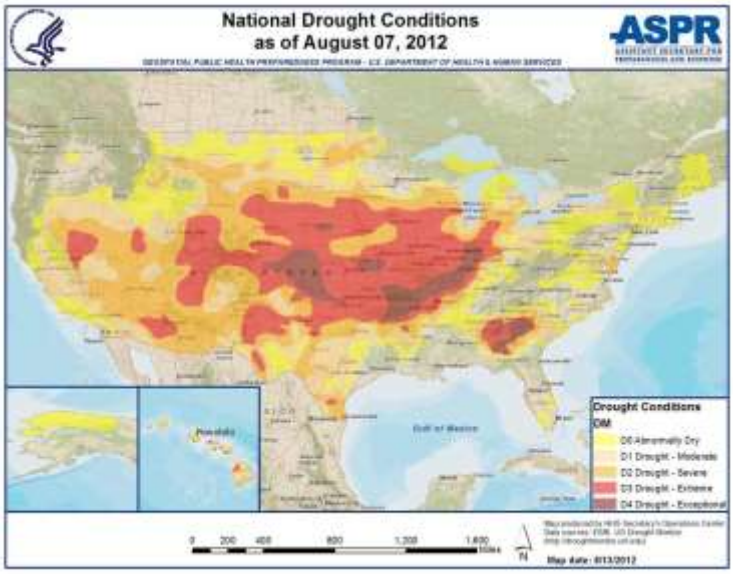
Drought conditions may vary from below-normal precipitation for a few weeks to a severe lack of normal precipitation for several months. Drought primarily affects agricultural areas because the amount and timing of rainfall has a significant impact on crop production. The severity of a drought cannot therefore be completely measured in terms of precipitation alone but must include crop yields.

Frequency of Occurrence

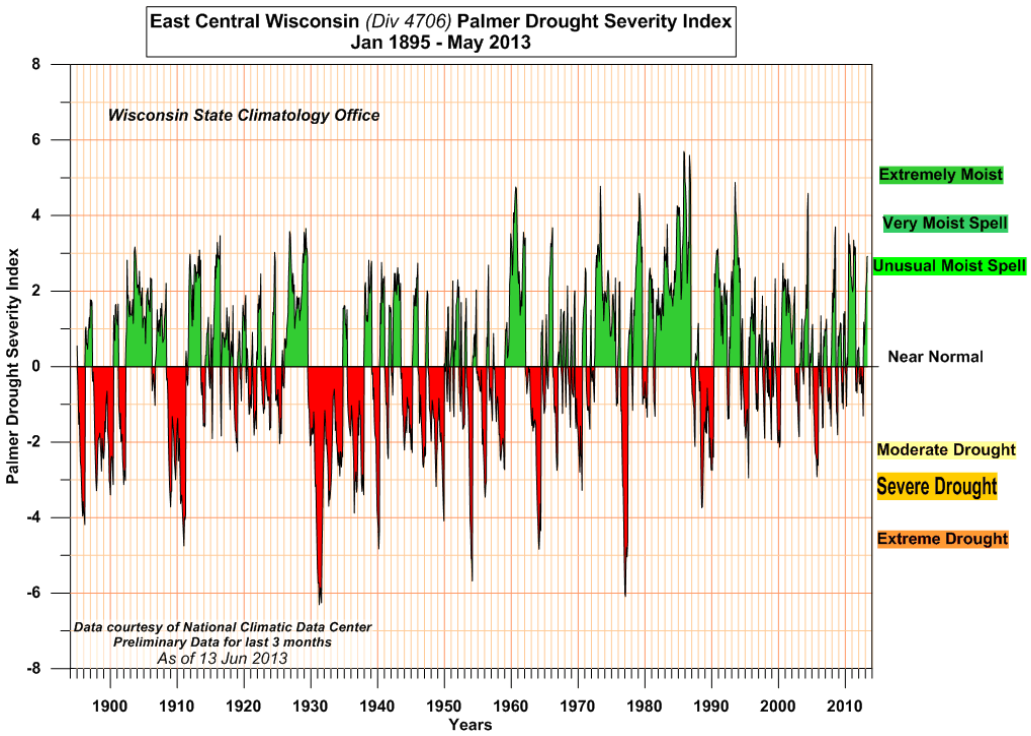
Drought is a relatively common phenomenon in Wisconsin and has occurred statewide in 1895, 1910, 1939, 1948, 1958, 1976, 1988, 1992, 2003, 2005 and 2012. The 1976 drought received a Presidential Emergency Declaration with damage to 64 Wisconsin counties, including Kewaunee. Estimated losses of $624 million primarily affected the agricultural sector. Reports show that Kewaunee County was as affected as the rest of the state in this drought, receiving money for emergency feed programs for livestock and for increased fire protection of its wilderness areas. It should be noted that only 19% ($119,434,924) of this loss was compensated by any federal program.

The 2012 heat wave resulted in significant droughts across more the half the country as well as increases in heat related illnesses and deaths. July, 2012 was the hottest month in US history, eclipsing the record set during the heart of the Dust Bowl in 1936. The worst of the heat was in the Midwest, the Plains and along the Eastern Seaboard. Most of the contiguous US had record and near-record warmth for the seven-month period, except the Pacific Northwest, which was near average. The August 7, 2012 Drought Monitor map shows 52.27% of the United States and Puerto Rico in moderate drought or worse with Kewaunee County in the D0 – Abnormally Dry category to not significantly affected.[40]

[40] 2012 Heat & Drought Federal Report, HHS ESF 8, UPDATE #2, U.S. Department of Health and Human Services, Assistant Secretary for Preparedness and Response



The Palmer Index chart for the years between January 1895 and May 2013 in East Central Wisconsin, which includes Kewaunee County, follows:[41]



As can be seen from the frequency table above, Kewaunee County regularly experiences drought to at least a moderate level two to

[41] http://www.aos.wisc.edu/~sco/clim-watch/graphics/pdsi-ts-06-l.gif

three times every ten years. While drought is a regular occurrence, it is generally very difficult to predict with any accuracy but according to the Wisconsin Hazard Mitigation Plan, "the NWS and National Integrated Drought Information System (NIDIS) are improving methodology to accurately forecast drought conditions. Both organizations use a combination of current and historical precipitation, streamflow, ground water, and crop data to perform short-term and long-term forecasts.[42]

On July 15, 2005, the Governor declared a drought emergency for the entire state of Wisconsin. This declaration, the first since August 2003, allowed farmers access to additional water for crop irrigation. The National Weather Service recorded three drought and no dust storm events for Kewaunee County between 1 January 1950 and 31 March 2013.

Year	Date	Location	Human Losses	Damage Losses	Miscellaneous
1999	3/1	Kewaunee Co.	Death/Injury: 0	Property/Crop: $0	Drought
2005	7/19	Kewaunee Co.	Death/Injury: 0	Property/Crop: $0	Drought
2005	8/1	Kewaunee Co.	Death/Injury: 0	Property/Crop: $0	Drought

Considering past occurrences, it can be surmised that Kewaunee County has a medium probability of drought occurrence in the future and the likelihood of damage due to drought is considered medium for agricultural losses and low for other types of losses. The probability of dust storm and damages due to dust storms would be very low.

Vulnerability

Droughts and dust storms could impact Kewaunee County disproportionately because a large portion of the land area is used for agricultural activities. Drought generally impacts farm output by reducing crop yields and the health and product output (e.g., milk) of livestock. As a result, a drought will seriously impact the economy of the entire county. Dust storms impact farms in the long term by blowing away the top levels of soil, which are the richest. This could economically impact the county by reducing its long-term viability for farming. The concern for agricultural losses due to drought is difficult to estimate because each incident will impact the county differently based on the length of the drought, when it occurs in the planting season and which crops were planted in

[42] State of Wisconsin Hazard Mitigation Plan, p. 3-100

various locations in that particular season but one can see, by looking at the agricultural statistics listed below, that this sector is an important part of the Kewaunee County economy and that the losses could be staggering:

- Average size of farms: 190 acres
- Average value of agricultural products sold per farm: $114,551
- Average value of crops sold per acre for harvested cropland: $193.92
- The value of livestock, poultry, and their products as a percentage of the total market value of agricultural products sold: 76.66%
- Harvested cropland as a percentage of land in farms: 72.41%
- Average number of cattle and calves per 100 acres of all land in farms: 35.43
- Corn for grain: 24016 harvested acres
- All wheat for grain: 7867 harvested acres
- Soybeans for beans: 13006 harvested acres
- Vegetables: 2,285 harvested acres
- Land in orchards: 151 acres[43]

Drought is also a major risk factor for wildfire and can reduce the amount of surface water available for recreational activities (e.g., boating, fishing, water skiing) and for wildlife. This is important because, for example, low water levels can lead to an outbreak of disease (e.g., botulism) in migratory bird pools.

Prolonged drought can also impact the groundwater reserves. This can reduce the ability of the municipal water services and rural individuals on wells to draw adequate fresh water. This may especially impact rural homeowners who tend to have wells that are not drilled as deeply as municipal wells. In Kewaunee County, the population that lives outside of the cities and villages (approximately 11,823 or 57.3%) are generally on well water. There could also be a safety risk during dust storms if they are severe enough to reduce the visibility of the roadways for drivers.

Hazard Mitigation Strategies

The goal of drought and dust storm mitigation activities is to ensure that the water resource, on which all of the county relies for living,

[43] http://www.city-data.com/county/Kewaunee_County-WI.html

farming, industry and fire protection, is available even during times of scarcity.

The Village of Luxemburg and the Cities of Algoma and Kewaunee have ordinances in their municipal codes that regulate the usage of water during times of drought. To mitigate the effect of hydrologic drought, the following actions are being taken:

- Identification of areas with potential ground water level problems,
- Inspections of wells in those areas for adequate depth and construction and
- Adoption of water usage regulations during drought conditions.

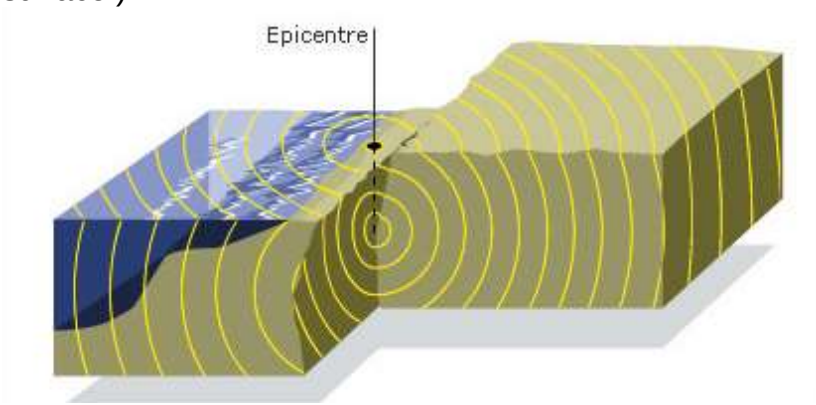
Conservation and water usage regulation information is available to members of the general public on a regular basis and outreach campaigns occur during periods of drought. The County Emergency Management Department will continue placing high-quality water conservation website links on their preparedness information page. The costs associated with these measures vary by program and will be paid for from the regular operating budget.

Kewaunee County farmers can contact the Kewaunee County University of Wisconsin Extension Office or the Department of Consolidated Farm Services Agency for information and guidance related to drought. Various federal and state publications are available from these agencies on ground water movement, the hydrologic cycle, irrigation methods and crop insurance. These agencies will also be the lead agencies in obtaining emergency food and water supplies for agricultural use. The UW – Extension Office will also increase efforts to conserve milk house water.

The hazard mitigation strategies listed above primarily involve providing information on water conservation measures to farmers and the public. Water conservation will ensure that the resource is available for critical residential, business and agricultural uses (drinking, food irrigation, manufacturing, firefighting) and good farming practices may help prevent erosion of the topsoil found in Kewaunee County. Since drought and dust storms are not hazards that affect buildings or traditional infrastructure (e.g., bridges, culverts) these strategies did not need to be designed to reduce damages to existing or future buildings and infrastructure.

Earthquakes

An earthquake is a shaking or sometimes violent trembling of the earth which results from the sudden shifting of rock beneath the earth's crust. This sudden shifting releases energy in the form of seismic waves (wave-like movement of the earth's surface.)[44]



Physical Characteristics

Earthquakes can strike without warning and may range in intensity from slight tremors to great shocks. They can last from a few seconds to over five minutes and they may also occur as a series of tremors over a period of several days. The actual movement of the ground during an earthquake is seldom the direct cause of injury or death. Casualties usually result from falling objects and debris because the shocks have shaken, damaged or demolished buildings and other structures. Movement may trigger fires, dam failures, landslides or releases of hazardous materials that compound an earthquake's disastrous effect.

Earthquakes are measured by two principle methods: seismographs and human judgment. The seismograph measures the magnitude of an earthquake and interprets the amount of energy released on the Richter Scale, a logarithmic scale with no upper limit. For example, an earthquake measuring 6.0 on the Richter Scale is ten times more powerful than a 5.0 and 100 times more powerful than a 4.0. This is a measure of the absolute size or strength of an earthquake and does not consider the effect at any specific location. The Modified Mercalli Intensity (MMI) Scale

[44] http://news.bbc.co.uk/2/shared/bsp/hi/pdfs/earthquake_guide.pdf

measures the strength of a shock at a particular location (i.e., intensity.)

A third less often used way of measuring an earthquake's severity involves comparing its acceleration to the normal acceleration caused by the force of gravity. The acceleration due to gravity, often noted "g," is equal to 9.8 meters per second. Peak Ground Acceleration (PGA) measures the rate of change of motion relative to the rate of acceleration due to gravity and is expressed as a percentage. These three scales can be roughly correlated, as expressed in the table that follows:[45]

Earthquake PGA, Magnitude and Intensity Comparison Table			
PGA [%g]	**Magnitude [Richter]**	**Intensity [MMI]**	**Description [MMI]**
<0.17	1.0 - 3.0	I	I. Not felt except by a very few under especially favorable conditions.
0.17 - 1.4	3.0 - 3.9	II - III	II. Felt only by a few persons at rest, especially on upper floors of buildings. III. Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibrations similar to the passing of a truck. Duration estimated.
1.4 - 9.2	4.0 - 4.9	IV - V	IV. Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like heavy truck striking building. Standing cars rock noticeably. V. Felt by nearly everyone; many awakened. Some dishes, windows broken. Unstable objects overturned. Pendulum clocks may stop.
9.2 - 34	5.0 - 5.9	VI - VII	VI. Felt by all, many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight. VII. Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken.
34 - 124	6.0 - 6.9	VII - IX	VIII. Damage slight in specially designed structures; considerable damage in ordinary substantial buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned. IX. Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations.
>124	7.0 and higher	VIII or higher	X. Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent. XI. Few, if any [masonry] structures remain standing. Bridges destroyed. Rails bent greatly. XII. Damage total. Lines of sight and level are distorted. Objects thrown into the air.

[45] Wald, Quitoriano, Heaton and Kanamori, 1999

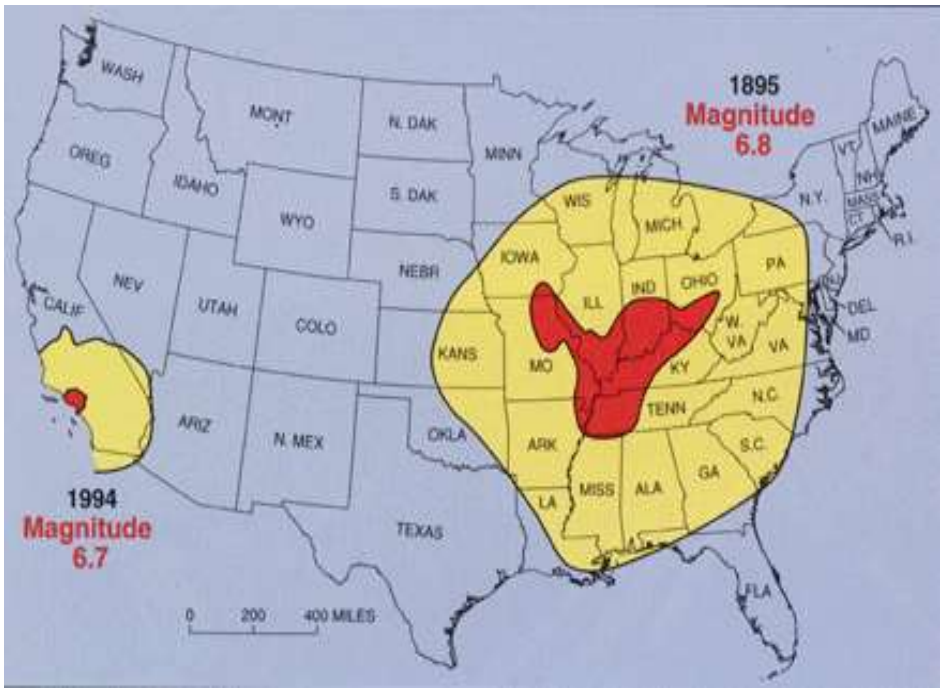
Most of Wisconsin's occurrences have not been severe, with only one registering 5.1 on the Richter Scale.

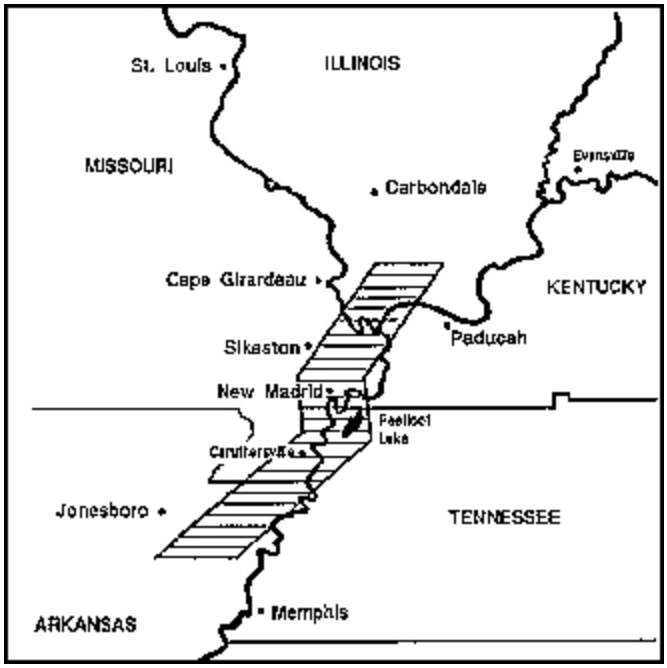
Frequency of Occurrence

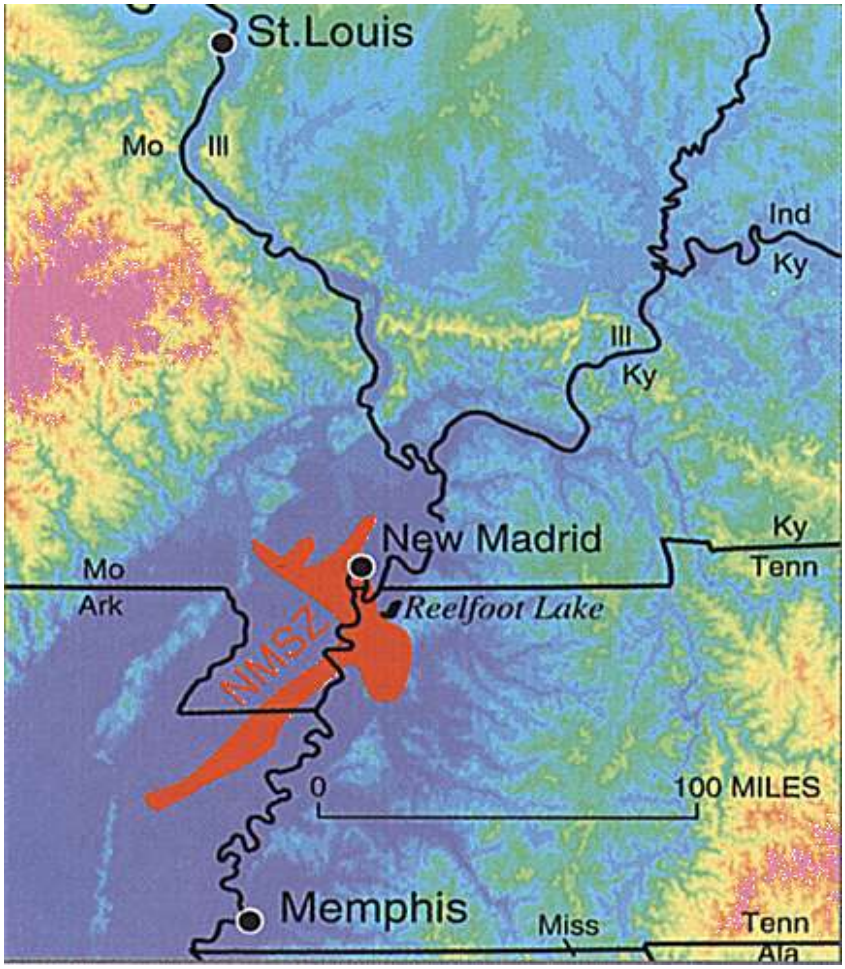
Earthquakes that have affected Wisconsin from 1899 to 1987 are listed in the table that follows. The most severe earthquake in Wisconsin was the record earthquake of 1811, centered along the New Madrid Fault. Most earthquakes that do occur in Wisconsin are very low in intensity and can hardly be felt. These very minor earthquakes are fairly common, occurring every few years. Events of moderate magnitude have occurred in locations in Illinois and Michigan. Those and other stronger earthquakes centered in other parts of the country have been felt primarily in Southern Wisconsin.

Date	Location	Latitude North	Longitude West	Maximum Intensity	Magnitude
10/12/1899	Kenosha	42º 34'	87º 50'	II	3.0
3/13/1905	Marinette	45º 08'	87º 40'	V	3.8
4/22/1906	Shorewood	43º 03'	87º 55'	II	3.0
4/24/1906	Milwaukee	43º 03'	87º 55'	III	--
1/10/1907	Marinette	45º 08'	87º 40'	III	--
5/26/1909	Beloit	42º 30'	89º 00'	VII	5.1 (max)
10/7/1914	Madison	43º 05'	89º 23'	IV	3.8
5/31/1916	Madison	43º 05'	89º 21'	II	3.0
7/7/1922	Fond du Lac	43º 47'	88º 29'	V	3.6
10/18/1931	Madison	43º 05'	89º 23'	III	3.4
12/6/1933	Stoughton	42º 54'	89º 15'	IV	3.5
11/7/1938	Dubuque	42º 30'	90º 43'	II	3.0
11/7/1938	Dubuque	42º 30'	90º 43'	II	3.0
11/7/1938	Dubuque	42º 30'	90º 43'	II	3.0
2/9/1943	Thunder Mountain	45º 11'	88º 10'	III	3.2
5/6/1947	Milwaukee	43º 00'	87º 55'	V	4.0
1/15/1948	Lake Mendota	43º 09'	89º 41'	IV	3.8
7/18/1956	Oostburg	43º 37'	87º45'	IV	3.8
7/18/1956	Oostburg	43º 37'	87º45'	IV	3.8
10/13/1956	South Milwaukee	42º 55'	87º52'	IV	3.8
1/8/1957	Beaver Dam	42º 32'	98º48'	IV	3.6
2/28/1979	Bill Cross Rapids	45º 13'	89º46'	--	<1.0 MoLg
1/9/1981	Madison	43º 05'	87º55'	II	--
3/13/1981	Madison	43º 37'	87º45'	II	--
6/12/1981	Oxford	43º 52'	89º39'	IV-V	--
2/12/1987	Milwaukee	42º 95'	87º84'	IV-V	--
2/12/1987	Milwaukee	43º 19'	87º28'	IV-V	--
6/28/2004	Troy Grove, IL	41º 46'	88º91'	IV	4.2

The nearest major active fault is the New Madrid Fault, stretching along the central Mississippi River Valley in Missouri. In recent years, considerable attention has focused on seismic activity in the New Madrid seismic zone that lies within the central Mississippi Valley, extending from northeast Arkansas through southeast Missouri, western Tennessee and western Kentucky to southern Illinois. Scientists at the Center for Earthquake Information have computed a set of probabilities that estimates the potential for different magnitude earthquakes to occur at the New Madrid Fault. Even an 8.3 magnitude earthquake at the New Madrid Fault, however, would cause only minor damage in the southeastern corner of Wisconsin. At this time it is not possible to predict the exact date, duration or magnitude of an earthquake.




St. Louis
ILLINOIS
MISSOURI
Carbondale
Cape Girardeau
KENTUCKY
Sikeston
Paducah
New Madrid
Jonesboro
TENNESSEE
ARKANSAS
Memphis


St.Louis
Mo
Ill
Ind
Ky
Ill
Ky
New Madrid
Ky
Tenn
Mo
Ark
Reelfoot Lake
NMSZ
0
100 MILES
Memphis
Miss
Tenn
Ala

As seen on the map in Appendix A, the earthquake threat to Kewaunee County is considered very low (the 50-year acceleration probability is 2%.) Minor damage (e.g., cracked plaster, broken windows) from earthquakes has occurred in Wisconsin but most often the results have been only rattling windows and shaking ground. There is little risk except to structures that are badly constructed. Most of the felt earthquakes reported have been centered in other nearby states. The causes of these local quakes are poorly understood and are thought to have resulted from the still-occurring rebound of the earth's crust after the retreat of the last glacial ice. The likelihood of damage from an earthquake is also very low.

Vulnerability

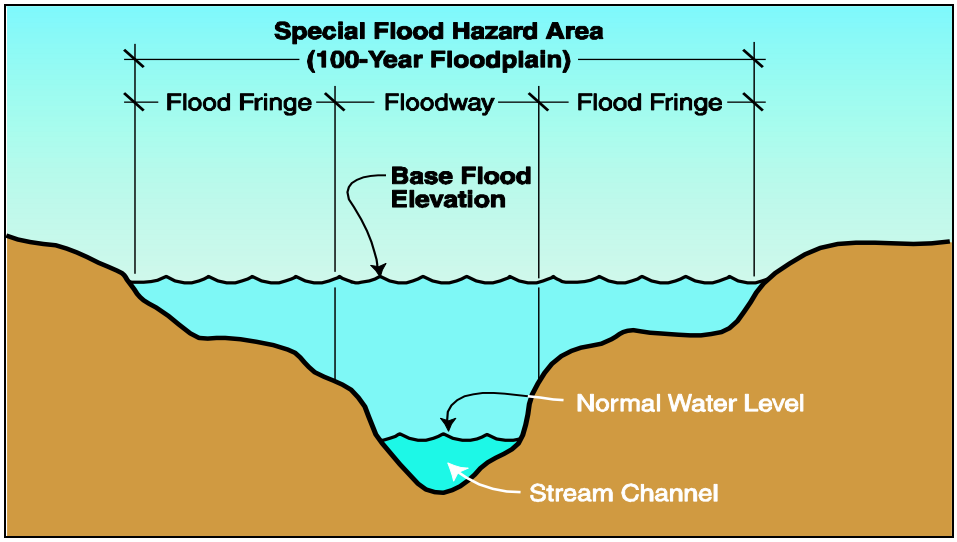
Any impact in the community from earthquake would likely be due to a few broken windows and personal effects that fell in the earthquake. The damage to critical infrastructure and buildings would be negligible.

Hazard Mitigation Strategies

Since Kewaunee County is not likely to suffer directly from a severe earthquake, the community impacts are not considered significant and mitigation planning for this hazard is not necessary. The goal for this section of the plan is therefore to educate on the low risks of earthquake damage in Kewaunee County.

Flooding and Dam Failure

Flooding is defined as a general condition of partial or complete inundation of normally dry land (i.e., the floodplains) from the overflow of inland waters or the unusual and rapid accumulation or runoff of surface waters from any source. Floodplains are the lowlands next to a body of water that are susceptible to recurring floods.[46]



Floods are common in the United States, including Wisconsin, and are considered natural events that are hazardous only when adversely affecting people and property.

Physical Characteristics

Major floods in Wisconsin usually have been confined either to specific waterways or to locations that receive intense rainfall in a short period of time.

Flooding that occurs in the spring due to snow melt or during a period of heavy rain is characterized by a slow build-up of flow and velocity in rivers and streams over a period of days. This build-up continues until the river or stream overflows its banks, for as long as a week or two, then slowly recedes. Generally the timing and

[46] FEMA, August 2001

location of this type of flooding is fairly predictable and allows ample time for evacuation of people and property.

For prediction and warning purposes, floods are classified by the National Weather Service into two types: those that develop and crest over a period of approximately six hours or more and those that crest more quickly. The former are referred to as "floods" and the latter as "flash floods". Flash flooding occurs solely from surface runoff as a result of intense rainfalls. Flash flooding occurs less frequently in Wisconsin than flooding associated with spring snow melt. This type of flooding, however, is unpredictable. These are a particular concern in Kewaunee County because the topographical profile of the county is generally flat.

Generally, the amount of damage from flooding is a direct consequence of land use. If the ground is already saturated, stripped of vegetation or paved, the amount of run-off increases, adding to the flooding. There are also some clay soils in Kewaunee County. These are heavy soils that require more detention and contribute more to surface flooding than sandy or loamy soils. There is concern regarding the loss of topsoil and erosion due to flooding.

Terms commonly used when referring to flooding are "100-year flood" and "flood plain." A "100-year flood" is defined as a flood having a one percent chance of being equaled or exceeded in magnitude in any given year.

Flood Probability Terms Table[47]

Flood Recurrence Intervals	Percent Chance of Occurrence Annually
10 year	10.0%
50 year	2.0%
100 year	1.0%
500 year	0.2%

The Wisconsin Department of Natural Resource (DNR), working with local zoning offices, has designated flood plain areas as those

[47] State of Wisconsin Hazard Mitigation Plan.

places where there is the greatest potential for flooding. Flooding may also occur due to a dam breach or overflow. Dams are barriers built across a waterway to store, control or divert water and a dam failure is a failure of the dam that causes downstream flooding. Failures may be caused by technological events (e.g., materials failure) or by natural events (e.g., landslide, earthquake) with flooding being the most common result.

According to the Wisconsin Department of Natural Resources (WDNR) Dam Safety Program here are approximately 3,800 dams in existence in the State of Wisconsin. Since the late 19th century, more than 700 dams have been built, then washed out or removed. Since 1967, approximately 100 dams have been removed. Almost 60% of the dams in Wisconsin are owned by a former company or private individual, 9% by the State of Wisconsin, 17% by a municipality such as a township or county government and 14% by other ownership types.

The federal government has jurisdiction over most large dams in Wisconsin that produce hydroelectricity - approximately 5% or nearly 200 dams. The Wisconsin Department of Natural Resources regulates the rest of the dams. A dam with a structural height of over 6 feet and impounding 50 acre-feet or more, or having a structural height of 25 feet or more and impounding more than 15 acre-feet is classified as a large dam. There are approximately 1,160 large dams in the State of Wisconsin.

Kewaunee County has two active dams of note. The Bruemmerville Dam is a private, older, mill-type dam on the Ahnapee River that does not have a regular program of maintenance and/or is not subject to regulatory inspection. The DNR/Dana Farm dam is a newer dam on the Kewaunee River. This dam is monitored and maintained by the Wisconsin Department of Natural Resources (DNR.) Following is a table that lists all of the dams in the DNR database:[48]

Dam Official Name (Popular Name)*	Size	Latitude	Longitude	Owner Type	Waterway Name (Downstream City)
Algoma (Kewaunee Co.)	Small	44.6077706	-87.4720242	County	Silver Creek
Degrave	Small	44.3923143	-87.6702885	Private	
Erwin Doehler	Small	44.4160837	-87.6611895	Private	Un-named ditch
John Doehler (Two Dikes)	Small	44.4181714	-87.6669143	Private	Un-named ditch
Ferron Dam	Small	44.6216575	-87.4509081	Private	Unnamed
Henry Iwen	Large	44.3923143	-87.6702885	Private	Silver Creek
John Joski	Small	44.5134009	-87.4921711	Private	Unnamed
Krause	Large	44.6387053	-87.4546431	Private	Tr Ahnapee

[48] http://dnrmaps.wi.gov/imf/imf.jsp?site=SurfaceWaterViewer.damsafety

Reinhart Krause	Small	44.6347861	-87.4297363	Private	Tr-Ahnapee River
Ken Langer	Small	44.3565528	-87.6002376	Private	Tr-Mishicott River
Earle Peggs	Small	44.4360495	-87.7439976		Tr-Scarboro Creek
John Pelnar 3	Small	44.4787436	-87.5800245	Private	Tr-Kewaunee River
Scarboro Dam		44.5244498	-87.6455074		Scarboro Creek
Seyk's Mill Dam		44.4627539	-87.5589034		Kewaunee River
Milo Sidwell	Small	44.3837997	-87.7437105	Private	Tr-Buck Creek
Steffel Dam	Small	44.4509255	-87.7112181	Private	
Stoller Dam	Small	44.6095194	-87.5026743	US Fish & Wildlife	
Tisch Mills Dam		44.341682	-87.6111165		East Twin River
Van Handle Dam	Small	44.4310195	-87.6768721	Private	Unnamed
Waterstreet Dam	Small	44.4813802	-87.5595061		Unnamed
Roy Waterstreet	Small	44.4823728	-87.5619868	Private	Tr-Kewaunee River
WI Public Service Corp.	Small	44.3554031	-87.5397692	Private	Unnamed Lake Michigan Tr
Zellner	Small	44.3466244	-87.6030024	Private	Tr-East Twin River

Kewaunee County has no electric power-generating dams and there are no dams in other counties that pose a significant flooding risk to the citizens of Kewaunee County.

One potential effect of flooding is erosion. Erosion is defined as the removal of soil by the force of waves, currents and/or ice at a lakeshore or streambank or by the power of wind or water on open land. Erosion is a natural process that can be accelerated by natural disasters (e.g., flooding, heavy rains, strong winds, drought) or by human activity (e.g., removal of plants/trees, tilling.) The county and municipalities monitor streambanks, especially after heavy rains and flash flooding, to check for erosion.

Watersheds

The major Kewaunee County watershed is the Lake Michigan. There are six minor watersheds. The maps in Attachment D show the watershed boundaries and 100-year flood plains for the entire county. Following is a brief description of each watershed from the Kewaunee County Land & Water Resource Management Plan:[49]

Ahnapee River

The Ahnapee River Watershed (TK04) covers portions of northeastern Kewaunee County and southern Door County. Approximately 55,890 acres (65%) of the watershed lie within the boundaries of Kewaunee County.

[49] www.**kewaunee**co.org/LWCD

Nonpoint source water pollution, mainly from sedimentation and nutrient enrichment, are documented as likely causing degradation of the water quality in these streams. The Ahnapee River is included on the state's 303(d) list of impaired surface waters. The Ahnapee River watershed is also particularly susceptible to groundwater pollution due to its shallow soils and exposed, fractured dolomite bedrock.

The water quality objectives for the Ahnapee River watershed are to reduce sedimentation and nutrient enrichment from nonpoint source pollution.

East Twin River

The East Twin River watershed (TK02) covers portions of southeastern Kewaunee County and northeastern Manitowoc County. Approximately 59,205 acres (49%) of the watershed lie within the boundaries of Kewaunee County.

Within the East Twin River watershed approximately 13% of the stream miles are fully supporting their potential biological use; approximately 15% of the stream miles are partially supporting their potential biological use; and approximately 37% of the stream miles are classified as "unknown" as far as whether or not they are supporting their potential biological use. Approximately 35% of the stream miles are classified as "threatened" as far as whether or not they are supporting their potential biological use. Krok Creek, a tributary of the East Twin River, is classified as an Exceptional Resource Water due to its designation as a Class I trout water.

The water quality objectives for the East Twin River watershed are to reduce sedimentation and nutrient enrichment from nonpoint source pollution, as well as reduce habitat degradation within the watershed area.

Kewaunee River

The Kewaunee River watershed traverses central Kewaunee County and eastern Brown County. Approximately 73,472 acres (83%) of the watershed are located within the boundaries of Kewaunee County.

Within the Kewaunee River watershed approximately 30% of the stream miles are fully supporting their potential biological use; approximately 38% of the stream miles are partially supporting their potential biological use; 6% of stream miles are not supporting their potential biological use; and approximately 26% of the stream miles are classified as "unknown" as far as whether or not they are supporting their potential biological use.

The Kewaunee River is included on the state's 303(d) list of impaired surface waters. Little Scarboro Creek, a tributary to the Kewaunee River is classified in NR 102.10 as an Outstanding Resource Water. Roger's Creek and a portion of Casco Creek, both tributaries of the Kewaunee River, are classified in NR 102.11 as Exceptional Resource Waters.

The water quality objectives for the Kewaunee River watershed are to reduce sedimentation and nutrient enrichment from nonpoint source pollution.

Red River and Little Sturgeon Bay

The Red River/Sturgeon Bay watershed (TK07) covers portions of northwestern Kewaunee County, southwestern Door County, and northeastern Brown County. Approximately 13,798 acres (22%) of the watershed lies within the boundaries of Kewaunee County.

Within the Red River/Sturgeon Bay watershed approximately 40% of the stream miles are fully supporting their potential biological use, approximately 38% of the stream miles are partially supporting their potential biological use, approximately 6% of the stream miles are not supporting their potential biological use, and approximately 16% of the stream miles are classified as "unknown" as far as whether or not they are supporting their potential biological use. The Red River/Sturgeon Bay watershed is also particularly susceptible to groundwater pollution due to its shallow soils and exposed, fractured dolomite bedrock.

The water quality objectives for the Red River watershed are to reduce sedimentation and nutrient enrichment from nonpoint source pollution, as well as reduce habitat degradation within the watershed area.

Stony Creek

The Stony Creek watershed (TK05) covers portions of northeastern Kewaunee County and southeastern Door County. Approximately 4,431 acres (7%) of the watershed lie within the boundaries of Kewaunee County.

Within the Stony Creek watershed approximately 58% of the stream miles are fully supporting their potential biological use and approximately 42% are partially supporting their potential biological use. Stony Creek is included on the state's 303(d) list of impaired surface waters.

The water quality objectives for the East Twin River watershed are to reduce sedimentation and nutrient enrichment from nonpoint source pollution.

West Twin River

The West Twin River watershed (TK01) covers portions of southwestern Kewaunee County, southeastern Brown County, and northwestern Manitowoc County. Approximately 13,346 acres (12%) of the watershed lie within the boundaries of Kewaunee County.

Within the West Twin River watershed approximately 19% of the stream miles are fully supporting their potential biological use, approximately 41% of the stream miles are partially supporting their potential biological use, 1% of the stream miles are not supporting their potential biological use and approximately 39% of the stream miles are classified as "unknown" as far as whether or not they are supporting their potential biological use. The West Twin River is included on the state's 303(d) list of impaired surface waters.

The water quality objectives for the West Twin River watershed are to reduce sedimentation and nutrient enrichment from nonpoint source pollution, as well as reduce the turbidity levels within the river.

Floodplain Regulations

Floodplain regulations have been in place in the cities, villages and towns of Kewaunee County for many years. The Department of

Natural Resources requires that each municipality approve regulations that meet DNR guidelines. These regulations and guidelines result from the value of Wisconsin lakes and waterways and a desire to preserve them and to protect the people who reside near them. Unregulated development can lead to loss of lives and property during floods.

Chapter 614, Laws of Wisconsin 1965, requires counties to adopt regulations giving all lands within 300 feet of navigable rivers or streams protection from haphazard development. Under this legislation, Kewaunee County has adopted a zoning ordinance which gives a measure of protection to watersheds. The law protecting flood plains was created to meet the following objectives:

- Reduce the hazards to life and property from flooding.
- Protect flood plain occupants from a flood which is or may be caused by their own land use, which is or may be undertaken without full realization of the danger.
- Protect the public from the burden of extraordinary financial expenditures for flood control and relief.

Encroachment on flood plains, including structures or fill, reduces the flood-carrying capacity.

Frequency of Occurrence

Wisconsin has experienced several major floods during the last two decades. The 1973 and 1986 floods revealed that no flood plains or urban areas in Wisconsin can be considered safe from damages. Mill-dams have developed leaks on occasion but have not caused any flooding problems.

Kewaunee County historically does not have a serious flooding problem. Kewaunee County has been included in two Presidential Disaster Declarations (in 1973 and 1990) based on the fact that they were contiguous to other counties with more damage.

- FEMA-376-DR-WI: on April 27, 1973, the President declared a Major Disaster as a result of severe storms and flooding. Kewaunee County was eligible for both Public and Individual Assistance as well as Hazard Mitigation.

- FEMA-874-DR-WI: on July 13- Aug 30, 1990, the President declared a Major Disaster as a result of severe storms, flooding and tornado. Kewaunee County was eligible for both Public and Individual Assistance as well as Hazard Mitigation.

Following is a table with the two flood events, with no flash flooding events, recorded by the National Weather Service between 1 January 1950 and 1 May 2013.

Year	Date	Location	Human Losses	Damage Losses	Miscellaneous
1996	06/16	Kewaunee County	Deaths: 0 Injuries: 0	Property: $0 Crop: $56K	
2007	03/13	Kewaunee County	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	

The following table summarizes damages attributed to flooding in Kewaunee County by the National Flood Insurance Program through May 1, 2013. There are no repetitive loss properties in Kewaunee County.

Kewaunee County NFIP Loss Claims				
Jurisdiction	**Total Loss**	**Closed Loss**	**Closed Without Payment**	**Total Payments**
City of Algoma	7	3	4	$5,240.38
City of Kewaunee	1	1	0	$55,322.25
Kewaunee County	4	1	1	$10,485.51

A careful review of the geography and history of flooding in Kewaunee County leads to a belief that there is a low probability of flooding in the future and a low probability of damage and losses due to flooding. This flooding could occur due to river flooding, flash flooding or dam failure.

Vulnerability

After flooding, whether caused by a storm or dam failure, there is often damage. Potential vulnerabilities due to flooding events can include flooded public facilities and schools, many of which are the community's shelters needed when individual housing is uninhabitable. Utilities are also vulnerable in floods, which can bring down electric lines/poles/transformers, telephone lines and

can disrupt radio communications. The loss of communications can impact the effectiveness of first response agencies, which need to communicate via two-way radio to mount emergency response and recovery activities. The public media communications utilized by emergency managers to provide timely and adequate emergency public information can also be impacted.

Residential structures may suffer from flooded basements, damaged septic systems and damaged functionals (e.g., HVAC systems, clothes washers and driers.) Homes may also be impacted by sewer back-up and, if the home is not properly cleaned after a flood, bacterial growth and mold may impact the home's air quality and cause illness among the occupants.

Businesses can suffer building and equipment damage similar to homes. Businesses may lose expensive product stored in basement or other low areas as well as the ability to operate from their facility. If the facility must close, its owners and employees will most likely suffer economic hardships beyond what their personal losses may have entailed. Agricultural business losses involve the loss of standing crops and harvests that are damaged by flooded storage facilities in the immediate time period. On a longer time scale, the erosion of rich topsoil by floodwaters can degrade the land and impact future crop yields.

Perhaps one of the most expensive types of flood damage is that to roadways, which are washed out, inundated and/or covered by debris, blocking access to emergency and general public traffic. An example of roadway damage can be seen in this picture from the August, 2010 flooding in Wisconsin.

Wisconsin Emergency Management provided a flood analysis for Kewaunee County using HAZUS-MH. The full report can be found in Appendix E and details the potential losses of property and critical facilities.

Hazard Mitigation Strategies

Kewaunee County is committed to remaining compliant with the requirements of the National Flood Insurance Program (NFIP) and all other state and federal laws. According to the NFIP, the following communities participate in the program:

- Kewaunee County. Please note that the county participation covers the unincorporated municipal areas (i.e., the towns).
- City of Algoma
- City of Kewaunee
- Village of Casco
- Village of Luxemburg

There are no areas in Kewaunee County which have had special flood areas identified by FEMA but are not in the NFIP program. One hazard mitigation strategy selected is to inform the public about the availability of flood insurance; this task will be carried out by the County Emergency Management Office.

The plan is intended to identify areas that are particularly susceptible to flooding, assess the risks, analyze the potential for mitigation and recommend mitigation strategies where appropriate. The goals of this plan are:

- Goal 1: To reduce, in a cost effective manner, the loss of lives and property due to these events. Another part of this goal is to promote safety and health in areas that have been or are prone to be flooded.
- Goal 2: To preserve and enhance the quality of life throughout Kewaunee County by identifying potential property damage risks and recommending appropriate mitigation strategies to minimize potential property damage during/due to flooding.

- Goal 3: To promote countywide planning that avoids transferring the risk from one community to an adjacent community.
- Goal 4: To ensure that all communities in Kewaunee County participate in the NFIP so that all county residents have access to affordable flood insurance coverage.
- Goal 5: To identify potential funding sources for mitigation projects and form the basis for project grant applications through FEMA's Pre-Disaster Mitigation (PDM) and/or Flood Mitigation Assistance (FMA) programs.

Short term actions that can lessen the effects of flooding include:

- Issuance of early warnings through flood advisory bulletins,
- Dissemination of instructions to the public through the media,
- Preparation of congregate care facilities and
- Evacuation of people and property.

Temporary protective measures such as sandbagging, protection of buildings and other structures and cut-off of gas and electricity may also be implemented. Presently, Kewaunee County maintains a limited stock of sandbags to assist with flood containment.

The current emphasis in flood mitigation is on long-range actions. Such actions include the adoption of proper flood plain zoning ordinances and land use planning. It has been shown that flood plain management reduces the cost of damages attributed to flooding. The mitigation measures contained within this plan should be consistent with other comprehensive planning activities. The Kewaunee County Zoning Department enforces county zoning ordinances related to flood plains.

There is a need for review and updating of some of the flood-related data, information, plans and projects in the county including:

- The County Highway Department will use budgeted funding to work with the municipalities to ensure that a list of areas prone to roadway flooding is kept current. These areas will be evaluated for mitigation projects. The County Emergency Management Office will also assist with seeking grant funding sources for larger projects.

- Many of the planning decisions must be based on good mapping data. The data in Kewaunee County is not of the currency and detail that would be most useful for good flood management planning. The county would like to acquire new topographical maps with two-foot contour intervals for selected areas of high population. The estimated cost for this project is $186,000 so the project can only be done with grant funding or a technology advancement that reduces the costs significantly. The Water and Land Conservation Department will continue to monitor grant offerings and cost estimates to determine if this project can be brought into a feasible cost range.

    - LIDAR flight completed in Spring 2012.
    - New air photos were completed in 2013 and are being submitted to FEMA.
    - Awaiting new flood maps to be sent to Land Records.

- The county would also like to collect data regarding critical facilities and infrastructure that are in hazard areas so that the information is available for the next update and for mitigation measure decision-makers.

Kewaunee County has some history of damage to buildings and infrastructure due to floods. In addition to the strategies listed above that deal with public information and planning, the community can make current and future buildings and infrastructure more disaster-resistant by:

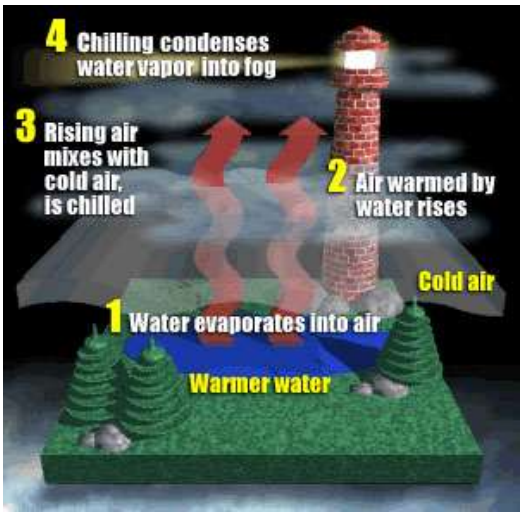
- Using its maps and hydrology studies to ensure that properties at risk are identified and, as available, appropriate grants are sought and secured to mitigate losses. Good data also ensures that decision-makers can create and enforce appropriate zoning and/or building regulations to make any new structures disaster-resistant.

- Target old structures for buy-out and convert the land to open, public lands. This also eliminates future damages by preventing building on this land.

- Pre-identifying infrastructure (roads, bridges, culverts, shoulders) prone to flooding and directing current and future budgetary dollars to making the infrastructure disaster-resistant as it is scheduled for routine maintenance.

Fog

Because of its location between Lake Michigan and Green Bay, Kewaunee County has a long history dealing with fog, which at its most basic definition is a cloud based on the ground rather than in the atmosphere.[50] As mentioned in the General Community Introduction section of this document, Native Americans lost in the offshore fog would call out "Kewaunee, Kewaunee," which is Potowatomi for "We are lost," hoping an answering call from the shore would guide them to safety. European settlers adopted the call for the official name of the community.[51]



Physical Characteristics

Fog occurs when the air near the ground is saturated with moisture and condenses on tiny particles suspended in the air. These particles are called cloud condensation nuclei and actually attract water vapor molecules to their surfaces. Once condensation occurs on these tiny surfaces, the resulting liquid drops can remain suspended in the air because their weight causes them to descend slowly to the ground or be carried around by wind. The dew-point temperature, or saturation vapor pressure, can be reached by either adding more water vapor to the air or cooling the air down to the dew-point temperature. Fog is classified by the dominant formation process and exists as long as processes continue to

[50] http://www.fi.edu/weather/events/fog.html
[51] http://www.explorewisconsin.com/countypages/kewaunee.html

maintain saturated conditions. There are several basic types of fog: [52]

- Radiation Fog is caused by cooling close to the earth's surface. The earth gives off long-wave radiation which on a clear night travels out into space. If the temperature drops to the dew point close to the ground, radiation fog can form. Radiation fog is also known as ground fog. The fog normally disappears soon after sunrise as the sun's warmth evaporates it.
    - Valley Fog is one type of Radiation Fog that forms in mountain valleys during winter and can be more than 1,500 feet thick. Often, the winter sun is not strong enough to evaporate the fog during the day. When the air cools again the following night, the fog often becomes thicker, which makes it even harder for the sun to burn it off the following day. These fogs can last for several days until strong winds blow the moist air out of the valley. The tendency for cool, dense air to pool at the bottom of valleys also enhances valley fog.
- Advection Fog results from the movement (advection) of warm, moist air from the south over a colder land mass. During the winter this is common when snow covers much of the Midwest. The snow cools the bottom portion of the moist airmass often resulting in condensation. The thickest advection fog usually forms during nights with light winds because humid air near the ground is not mixed with the drier air above. With light winds, the fog near the ground can become thick and reduce visibilities to zero; usually the fog burns off during the day but it can last many days if it is thick enough to block out the sun's light. This type of fog can occur almost anywhere in the United States, especially during winter warm-ups and early spring thaws. It can be widespread and very dangerous to commuters and aircraft travel.
- Evaporation Fog around Wisconsin is caused by cold air crossing over warmer bodies of water. The water

[52] http://www.jsonline.com/weather/wtmj/fogtypes.stm, http://www.usatoday.com/weather/tg/wadvfog/wadvfog.htm, http://www.usatoday.com/weather/tg/wfallfog/wfallfog.htm, http://www.usatoday.com/weather/tg/wrainfog/wrainfog.htm, http://www.usatoday.com/weather/wfog.htm, http://www.cimms.ou.edu/~cortinas/1014/l12_3.html

evaporates its moisture into the colder air which immediately condenses it into clouds and fog. This is what looks like steam over Lake Michigan, inland lakes and rivers on a cold autumn or winter day. This rising fog can be found above thermal pools in Yellowstone National Park and is what you see when cool rain hits hot pavement. This may also be called "steam fog" or "sea smoke" when it forms over oceans. Sometimes this fog is lifted quickly and forms rotating whirls of fog known as *steam devils*.

- Upslope Fog is common near the Rockies, including the Denver area. If the winds are out of the east, the air flows up as it rises in elevation approaching the mountains. This can cool the air to its dew point and result in widespread fog.
- Rain Fog is created when late afternoon or evening showers and thunderstorms during the spring and summer leave the ground soaked just as the sun sets. Though the rain usually stops overnight, the high humidity level created by the rainfall won't allow the moisture to evaporate and as a result, fog forms. This occurs especially at times when there are light winds. As the air warms up the next morning, this rain-enhanced fog will usually burn off by midday.
- Precipitation Fog forms when rain or snow falls. As precipitation falls into drier air below the cloud, the liquid drops or ice crystals evaporate or sublimate directly into water vapor. The water vapor increases the moisture content of the air while cooling the air. This often saturates the air below the cloud and allows fog to form.

Frequency of Occurrence

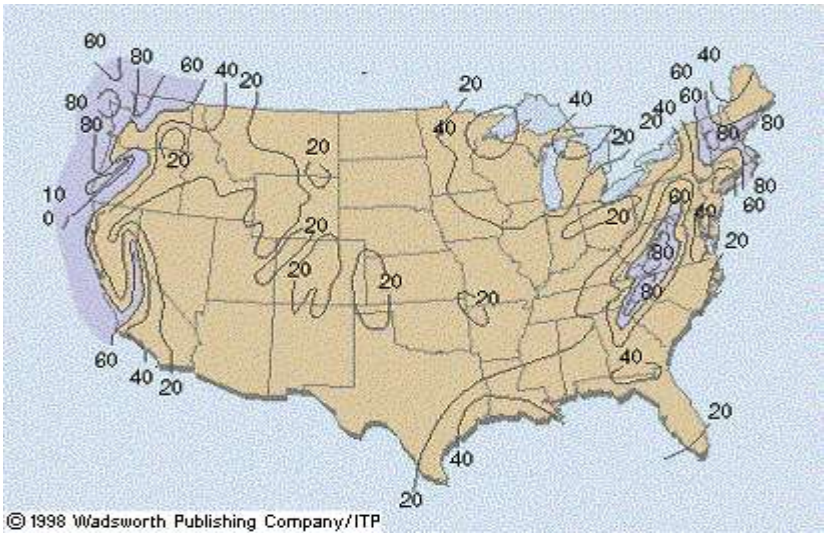
Some locations on this planet have weather conditions that are conducive to making fog frequently such as:[53]

- San Francisco, California with an average of 18 days of heavy fog each year
- Cape Disappointment, Washington is the foggiest place on the western U.S. coast with an average of 106 days of heavy fog per year.

[53] http://www.jsonline.com/weather/wtmj/fogplaces.stm

- The foggiest area on the east coast of the United States is found along the rockbound coast of Maine. Moose Peak Lighthouse on Mistake Island, at an elevation of 72 feet, averages 1580 hours of heavy fog each year. Many other locations have problems with fog, such as Eastport, Maine with 65 days annually and Portland, with 55 days of heavy fog each year.
- Inland areas with regular heavy fog include parts of the Appalachian Mountains such as a peak area in West Virginia that averages over 100 days each year. Elkins, at an elevation of 1948 feet has about 81 days annually with heavy fog.
- Milwaukee averages about 26 days with some heavy fog and this is comparable to the fog seen in Kewaunee County.

Average Annual Number of Days with Heavy Fog in the United States



Kewaunee County is geographically susceptible to issues with heavy fog. The National Weather Service reports 13 fog events in the county between 1 January 1950 and 31 March 2013.

Year	Date	Location	Human Losses	Damage Losses
1996	3/18	Kewaunee County	Deaths: 0 Injuries: 0	Property: $0 Crop: $0
	5/9	Kewaunee County	Deaths: 0 Injuries: 0	Property: $0 Crop: $0
	5/17	Kewaunee County	Deaths: 0 Injuries: 0	Property: $0 Crop: $0
	6/10	Kewaunee County	Deaths: 0 Injuries: 0	Property: $0 Crop: $0

Year	Date	Location	Human Losses	Damage Losses
	9/6	Kewaunee County	Deaths: 0 Injuries: 0	Property: $0 Crop: $0
	9/21	Kewaunee County	Deaths: 0 Injuries: 0	Property: $0 Crop: $0
	10/16	Kewaunee County	Deaths: 0 Injuries: 0	Property: $0 Crop: $0
	10/21	Kewaunee County	Deaths: 0 Injuries: 0	Property: $0 Crop: $0
1997	1/2	Kewaunee County	Deaths: 0 Injuries: 0	Property: $0 Crop: $0
	3/1	Kewaunee County	Deaths: 0 Injuries: 0	Property: $0 Crop: $0
1999	12/12	Kewaunee County	Deaths: 0 Injuries: 0	Property: $0 Crop: $0
2000	1/9	Kewaunee County	Deaths: 0 Injuries: 0	Property: $0 Crop: $0
	2/24	Kewaunee County	Deaths: 0 Injuries: 0	Property: $0 Crop: $0

Considering its geographical location, Kewaunee County has a high probability of fog occurrence in the future and the likelihood of damage due to fog is also considered high.

Vulnerability

Fog is a concern for the boaters, both commercial and recreational, who travel on Lake Michigan. While the U.S. Coast Guard does not publish reports showing the statistics for fatalities, injuries and property damage due to boating accidents involving fog, one can make a reasonable supposition that this is a concern based on the history of events in Kewaunee County. Boaters caught in heavy fog may strike another vessel, dock or natural feature such as a rock or bluff. The loss of a vessel may be compounded by the fact that most fog occurs when the temperatures are colder and victims forced to evacuate their vessel may suffer from hypothermia more readily than they would in warmer months. Boaters may lose their way in the fog and fog makes it much more difficult for rescuers to find the victims to provide aid.

Perhaps the largest vulnerability to fog is due to automobile traffic crashes. According to the Wisconsin Department of Transportation, dense fog contributes to hundreds of car accidents per year in the state. Following are the Wisconsin Department of Transportation's statistics for fog-related traffic crashes from 1999-2004:

Death and Injury Statistics for Fog-Related Traffic Crashes						
	1999	2000	2001	2002	2003	2004
Total Crashes	1259	1008	1066	595	772	1141
Fatal Crashes	14	12	19	12	11	16
People Killed	15	13	22	22	11	19
Injury Crashes	528	445	425	238	274	423
People Injured	777	643	593	372	391	615
Property Damage Crashes	717	551	622	345	487	702

Traffic Conditions at the Time of Fog-Related Traffic Crashes						
	1999	2000	2001	2002	2003	2004
Total Crashes	1259	1008	1066	595	772	1141
Daylight	467	340	295	158	257	398
Dark/Lighted	130	107	130	324	80	140
Dark/Unlit	547	439	491	46	343	456
Dusk	9	18	16	56	7	16
Dawn	99	101	126	9	77	122
Unknown Light Conditions	7	3	8	2	8	9

Some notable fog-related traffic crashes in the area of eastern Wisconsin (which includes Kewaunee County) follow:

- On the morning of Friday, October 11, 2002, 50 vehicles were involved in a massive vehicle accident on Interstate 43 in Sheboygan County near Cedar Grove, Wisconsin. This accident was the deadliest pile-up in Wisconsin history with ten individuals killed (including Nadine Boltz, a Kewaunee resident) and over 40 people injured. Of the injured, seven were in critical condition and one was in serious condition at area hospitals immediately after the incident. 28 other people were treated and released for injuries ranging from burns to broken bones. The accident occurred as cars heading south collided into one another as some vehicles slowed down in a dense fog. This led to a chain reaction as numerous cars were unaware of the scene hidden behind a veil of fog. Chad Kruse, a driver interviewed after the accident, described it by saying, “I entered the wall of fog, like someone took a blanket and threw it over the windshield.” At the same time but separate from this incident, four other accidents occurred nearby on the

interstate; all the individuals involved with these accidents survived. [54]

- Fourteen people were injured in January 1996 in a 26-car pileup on southbound I-43 near Ozaukee County Highway KK. The first driver struck said he had missed his exit because of heavy fog and had slowed down to look for another when he was hit from behind. [55]

[54] http://www.stoutonia.uwstout.edu/2002-2003/stories/021024/ne_04.html
[55] The Fog, The Deadliest Traffic Crash in Wisconsin History; Trooper Tim Austin; Wisconsin Trooper, Callan Publishing Ins., Minneapolis, MN; Spring 2003.

- In March 1990, three people were killed and 31 injured in a 52-vehicle pileup on the Tower Drive Bridge in Green Bay after dense fog and smoke from nearby paper mills created a "white wall" that reduced visibility to less than 10 feet. The accident was believed to be triggered when a tanker truck overturned and a ruptured gas tank ignited. Vehicles following too closely on the fog-shrouded bridge slammed into the tanker and were engulfed by a sheet of flames. [56]

Because Kewaunee County has a smaller population and does not have a major interstate, it is at less risk for very large, multi-car traffic accidents. The county does however have a major road, State Highway 42, which tracks right alongside Lake Michigan and does frequently have the kind of heavy fog that can lead to traffic accidents such as those listed above. While Highway 42 is not an interstate, it is a main thoroughfare for travelers within the county or going through to Door County, a major Wisconsin tourist destination.

It is also important to note that, as a smaller county, response to an accident relies on volunteer fire and EMS responders who generally have longer response times than the full-time departments found in more heavily populated areas. Also, there is no hospital within the county and crash victims will need to be transported to Door, Manitowoc or Brown County facilities for treatment. These factors can severely affect the medical outcomes of crash victims.

As seen in the true examples above, fog-related incidents can cause death, injury and property loss to the vehicle owners and occupants and their insurance companies. Responding governmental agencies also may suffer losses due to the cost of response, for damage done to roadways and structures due to fires and for potential injuries to responders working in a reduced-visibility zone. Citizens may be impacted by the closure of roadways and delay of activities; businesses may suffer losses due to the absence of workers due to delay, injury and/or death and because of the delay of product on the roadways and direct loss of product in the crash (e.g., due to fire).

[56] http://www.jsonline.com/news/state/oct02/87083.asp

Hazard Mitigation Strategies

One strategy for assisting boaters in the fog is to have a lighthouse with visual and audio signaling. Both Kewaunee and Algoma have operational lighthouses.

Kewaunee Lighthouse History

There is a lighthouse in the City of Kewaunee that was built after a mid-nineteenth century rumor of a gold strike brought droves of immigrants to the area. This boom time led the civic leaders to improve the harbor and fueled a construction binge with the hopes of rivaling Chicago as Lake Michigan's supreme port city. With the construction of the piers and dredging of the river at Kewaunee in 1892, a pair of range lights with Fifth Order Fresnel lenses was installed on the pier in 1891; these lights were designed to be visible for a distance of fifteen miles. In 1909, a diaphone fog signal horn was installed due to the frequent thick blankets of fog. At the same time, a large fog signal building was constructed immediately behind the front-range light to contain the steam power-plant for the fog signal and to provide housing for the keepers when long periods of fog required their constant presence.

The light after construction of the fog signal building in 1909

The station in 1931 after rmoval of the front range light

The front-range light was removed from the pier in 1931 when a new tower with a forty-five foot focal plane was constructed on the roof of the fog signal building and the old lantern room and lens moved onto the new tower. Though it is now illuminated by an automated electric four-bulb changer, the old Fifth Order Fresnel still displays its fixed white light from this new tower. The diaphone fog signal originally installed at Kewaunee was removed from the tower and was slated for shipment to the Smithsonian Institute when a private organization had the unit diverted to Duluth where it

was rebuilt and installed in the South Breakwater Light, where it works to this day. Unfortunately for Kewaunee, their aspirations to rival Chicago were short-lived when, because of better rail-lines, Manitowoc assumed pre-eminence as Wisconsin's major northern port. [57]

Algoma Lighthouse History

Ahnapee, an Indian name for "land of the great gray wolf" was a growing fishing town in 1871 when a fire swept from Green Bay, destroying thousands of acres of land. Local residents prepared for the worst by waiting beside boats on the lakefront with their valuables, planning on venturing out into the lake to avoid the approaching flames. Fortunately, torrential rains doused the fire at the last minute and saved the town.

Revitalized after their narrow escape, Ahnapee's city fathers began lobbying the federal government for funds to enlarge the town's harbor, which was home to a growing number of commercial fishing vessels. Responding with back-to-back $25,000 appropriations in 1870 and 1871, the Army Corps of Engineers was dispatched to Ahnapee to construct improved protective piers and begin dredging the river mouth. As a direct result of these improvements, by 1879, Ahnapee's commercial fishing fleet had grown to become the largest on Lake Michigan and the town was formally renamed "Algoma," another Indian name meaning "park of flowers."

After pleas to the federal government for the erection of navigation aids at the harbor entrance went unheeded, local maritime interests took matters into their own hands, establishing and maintaining a couple of post lights at the outer ends of the piers. Finally realizing

[57] http://www.nightbeacon.com/zlighthouses/lakemich/individuallights/Kewaunee_Pierhead_Lighthouse.htm

the need to provide official illumination at Ahnapee, Ninth District Engineer Major William Ludlow requested a surprisingly low appropriation of $2,500 in his annual report for 1890 for the construction of a pair of range lights on the north pier. In order to keep the cost as low as possible, Ludlow's plans called for a the erection of a simple post light at the outer end of the north pier and the erection of a taller timber framed beacon approximately 200 feet along the pier. Congress made the requested appropriation on March 3, 1891, however, with the Corps of Engineers in Algoma erecting new piers, work could not begin on the new ranges until completion of the piers in late 1892.

The new north pier on which the range was to be erected was of a unique design, being both split and offset at its midpoint. Since the ranges were to be located on the detached outer pier section, construction would necessarily begin with the erection of an elevated bridge across the gap to provide access to the outer pier. A contract for furnishing the prefabricated timber bridge was awarded to a ship builder in Manitowoc while work began on preparing the pier for the installation of the bridge components on their arrival. Since the pier would frequently be battered by waves over its surface, it was imperative that the new timber components be anchored securely to the piers. To this end, some of the stone within the pier cribs was removed, and 12" square timbers were bolted to the crossties within the cribs to serve as anchoring points for the bridge bents. On the arrival of the bridge components from Manitowoc, the 10-foot tall bridge was erected across the gap, and work began on the erection of the lights themselves.

To form the Front Range, an eighteen-foot tall post was erected at the outer end of the pier and a lens lantern was placed atop the pole at a focal plane of 22 feet. Thirty-three yards behind the front range, the rear range light consisted of a typical timber framed skeletal pyramidal pierhead beacon with its upper section enclosed to serve as both a workroom and as shelter for the keeper during inclement weather. Capped with a square timber gallery, a cast iron decagonal lantern was centered on the gallery also containing a lens lantern similar to that installed on the Front Range. Standing 34 feet in height from the top of the pier to the ventilator ball, the 80 candlepower rear range light sat at a focal plane of 34 feet and was visible for a distance of nine miles at sea in clear weather. Work on the new lights continued into December with the lights finally being tested on December 23. With ice clogging the harbor, the decision was made to delay exhibition of the lights until the opening of the following navigation season.

Ole Hansen was appointed as keeper of the new lights and exhibited them for the first time on the evening of March 1, 1893. 1894 saw the erection of a small wooden oil storage shed on shore at the foot of the pier and the rear range light was upgraded to a Fifth Order Fresnel lens on June 5, 1895 with a resulting increase in its range of visibility to 11 miles. To make passage along the north pier safer during high seas, 400 feet of elevated walk was installed on the pier in 1897.

Photo courtesy of: U.S. Coast Guard
The original Lighthouse constructed in 1893.

Rear Range Light in winter. The front range post light can be seen caked in ice

An additional 338 feet was added to the elevated walk in 1900. In 1902 the Lighthouse Board requested that $3,500 be appropriated for the construction of a dwelling at the station which unfortunately fell on deaf ears, as seen by the fact that Congress ignored the request despite the Boards restatement of the need for the appropriation in each of its annual reports for the following six years.

The 1908 tower section

By 1907, the old wooden beacon was found to be in significantly deteriorated condition and while funds continued to be unavailable for a new dwelling, the old wooden beacon was demolished, and replaced by a cast iron cylindrical tower in 1908. Constructed of 5/16" steel plates, the tower was eight feet in diameter at the base and tapered to seven feet in diameter beneath the gallery and stood twenty-six feet high to the top of the ventilator ball. The new tower was capped by a decagonal cast iron lantern room, and

outfitted with the Fifth Order Fresnel lens from the old rear range beacon.

Finally, sixteen years after the establishment of the station, an appropriation was made for the construction of a dwelling and a compact hip-roofed house was erected on the hill on the north side of the river overlooking the pier.

In order to render the light visible for a greater distance, a twelve-foot tall cylindrical steel base was brought in from Muskegon in 1932 and installed on the pier. The old 1908 tower was then lifted and secured on top of the cylinder, effectively increasing the tower's focal plane to its current forty-two feet. Also at this same time, a $100,000 harbor improvement project was undertaken, which included capping both the North and South piers with concrete and the installation of remotely controlled electrically operated diaphone fog signal on the pier.[58]

Photo courtesy of: U.S. Coast Guard
The 1932 height addition

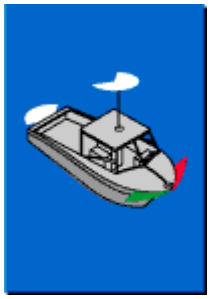
The Algoma Lighthouse as it looks currently.

U.S. Coast Guard Navigation Aids

The U.S. Coast Guard marks the waters of the United States and its territories with the U.S. Aids to Navigation System. This system employs a simple arrangement of colors, shapes, numbers and light characteristics to mark navigable channels, waterways and obstructions adjacent to these. Aids to Navigation can provide a

[58] http://www.terrypepper.com/lights/michigan/algoma/algoma.htm

boater with the same type of information drivers get from street signs, stop signals, road barriers, detours and traffic lights. These aids may be anything from lighted structures, beacons, day markers, range lights, fog signals and landmarks to floating buoys. Each has a purpose and helps with determining location, getting from one place to another or staying out of danger. The goal of the U.S. Aids to Navigation System is to promote safe navigation on the waterway. An example of this system follows showing the proper display of navigation lights for a power-driven vessel less than 65.5 feet/20 meters in length:[59]



The Coast Guard also offers boater safety classes, public informational materials and emergency rescue services for boaters.[60]

The goal of fog mitigation activities is to reduce the loss of lives and property due to these events. There are few cases where infrastructure would be impacted by fog so there is little that the community can do to plan future buildings and infrastructure in a way that will mitigate these problems. Most mitigation measures will involve public information about the largest danger: automobile and boating crashes.

To help prevent automobile crashes, there are some signs along State Highway 42 warning of the potential rapid onset of fog. The Kewaunee County Emergency Management Office will also use current budget dollars to place a link on their website's preparedness page to explain safe driving procedures for driving in the fog.

59 http://www.uscgboating.org/safety/fedregs/equ_nav.htm

60 http://www.uscgboating.org/safety/aton/system.htm

Forest and Wildfires

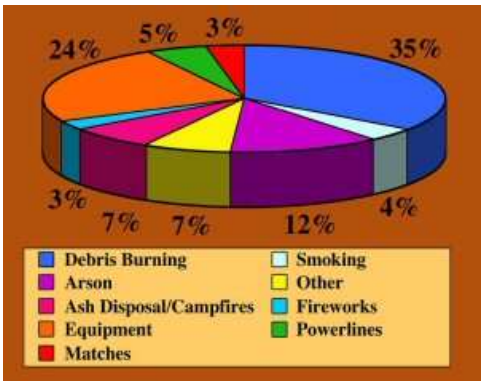
The forest fire and wildfire (fires on open or agricultural land) season in Kewaunee County begins sometime in March and continues through November, although fires can occur at any time during any month of the year. Generally speaking, however, fires are more likely to occur whenever vegetation is dry as a result of a winter with little snow or a summer with sparse rainfall.

The Wisconsin Department of Natural Resources (DNR) is responsible for forest fire protection on approximately 18 million acres of forest and wild land in Wisconsin. The U.S. Forest Service maintains forest fire protection on two million acres of this land while local fire departments retain responsibility for the remaining wooded acreage.

Each town in Kewaunee County requires residents to apply for a permit prior to burning activities. Municipal ordinances for the Cities of Algoma and Kewaunee and the Village of Luxemburg can be found in the Previous Planning Efforts and Legal Basis section.

Physical Characteristics

According to the Wisconsin Department of Natural Resources, there are approximately 1,500 fires annually that burn over 5,000 acres of the land that they protect; over 90% of these fires are human-caused. It should be noted that these figures do not include areas of the state where a local fire department has primary responsibility for service. [61]



61 Source: http://dnr.wi.gov/forestry/fire/fire-ps.htm

Frequency of Occurrence

While the total number of open fires in Wisconsin has decreased over the years, the potential danger to lives and property remains due to the increased encroachment of development into previously open lands. Overall, the probability for a forest fire in Kewaunee County is very low and the probability of a wildfire is low. The probability of damage from forest or wildfire is also considered low. There have been no forest or wildfire events recorded since 1950 by the National Weather Service.

Vulnerability

Forest and wildfires can impact the ecology of the open lands of Kewaunee County which exist primarily as wetlands along undeveloped lakeshore and as agricultural lands. A disruption to the area from fire could erase the usability of this habitat for wildlife and/or farming for many years.

In 2003, the National Association of State Foresters produced a Field Guidance for Identifying and Prioritizing Communities-at-Risk (CAR). The purpose of the guide was to provide states with a nationally consistent approach for assessing and displaying the risks to communities from wildfire. The DNR, in cooperation with its federal and tribal partners, began working on the statewide assessment of Communities-at-Risk in 2004.

Communities-at-Risk is a model to identify broad areas of the state that are at relatively high exposure to resource damage due to wildfire. Results of the model can then be used by local governments developing Community Wildfire Protection Plans (CWPP) and by the DNR to reduce local risks of wildland fire by prioritizing hazard mitigation and fire protection efforts.

The approach used in this risk assessment model is based on the “Methodology” section of the NASF Field Guidance document which recommends assessing and mapping four factors:

- Historic Fire Occurrence
- Hazard
- Values Protected
- Capabilities

Modifications to this methodology were made to fit the GIS mapping data layers available for Wisconsin. The Wisconsin DNR uses three factors to assess Communities-at-Risk to wildfire damage:

- Hazard – the relative likelihood that an ignited wildfire will achieve sufficient intensity to threaten life or property based on land cover type and historic fire regime.

- WUI (Values at Risk) – the relative vulnerability of each 2000 census block to wildfire damage based on housing density and spatial relationship with undeveloped vegetation based on housing density and proximity to vegetation (Wisconsin's Wildland-Urban Interface). Wisconsin's WUI was layered with a weighted vegetation layer to accentuate proximity to flammable vegetation.

- Ignition Risk – the relative likelihood of a wildfire ignition within a given 30-m pixel based on historic fire occurrence, population density and proximity to a potential ignition source.

Models were developed in GIS to create statewide grids representing each of the three weighted {Hazard (40%), WUI (30%) and Risk (30%)} inputs. This composite grid represents communities-at-risk (CAR) on a 0-9 scale of threat, with zero representing no threat and nine a very high threat. The data was then represented by municipal civil divisions (MCDs), which are city and village boundaries. Quantitative markers were assigned for five threat levels: very low, low, moderate, high, and very high and those MCD's determined to have a high or very high threat of wildfire were considered CARs. 337 communities met the requirements for being "at risk."

Communities in Wisconsin vary considerably in size. This is particularly evident in a north-south pattern, with larger more rural towns in northern Wisconsin and smaller, more urban towns in southern Wisconsin. Because of this variation in size, the potential for missing areas of high risk due to smoothing out by other parts of the town was greater for larger towns. For this reason, WI DNR incorporated a "Community of Concern" category to identify those towns that have portions of their town in high risk of wildfire but were not otherwise included as a Community-at-Risk. A Community of Concern was determined to be an area of at least two contiguous

square miles at high or very high risk; 237 communities were named as Communities of Concern.[62]

As can be seen on the map in Appendix A, in Kewaunee County, no communities were identified as Communities at Risk or as Communities of Concern.

Because Kewaunee County has little forested area, there are no DNR Ranger Stations nearby. There are also no designated federal lands in Kewaunee County but there are several state and local natural areas including:

- **Kewaunee Nature Walk** (Kewaunee) – A 1,500 foot boardwalk path and observation deck over marshlands along the Kewaunee River where various waterfowl congregate.

- **Red River Park** (Hwy 57, Dyckesville) - This county park provides access to fishing and boating on Green Bay, private boat rentals, boat ramp, playground, picnic tables, grills, shelters and restrooms.

- **Little Scarboro Fishing and Wildlife Areas** (Luxemburg) - Scarboro Creek is a Class III trout stream stocked annually with brown trout. The Little Scarboro Fishing Area is open to the public and provides opportunities to catch stocked and native brook and brown trout. The Little Scarboro Wildlife area is open to public hunting for rabbit, grouse, pheasant, deer and squirrel.

- **Ahnapee State Trail** (Algoma to Sturgeon Bay) – This trail along the Ahnapee River is a 15.3-mile hiking, bicycling, horseback and snowmobile path that passes through meadows, rolling farmland and cedar glades teeming with wildlife. The railroad bridge has recently been replaced and the Kewaunee County portion of the trail has been newly resurfaced.

Along the lakeshores are undeveloped natural lands, including wetlands. Also, a large percentage of the county is open agricultural land which is susceptible to wildfire, especially in periods of drought.

[62] Wisconsin State Hazard Mitigation Plan, pp 4-74 through 4-77.

Hazard Mitigation Strategies

Government at all levels is developing mitigation programs in fire control and firefighting tactics with the goal of protecting lives and property from loss due to forest and wildfire. The Wisconsin Department of Natural Resources (DNR) does not have a forestry office in Kewaunee County and also does not pre-stage resources (e.g., rangers, equipment, supplies) there. If there was a large wildfire for which local firefighters would request state assistance, the DNR may be able to provide limited assistance based upon their deployment level at that time.

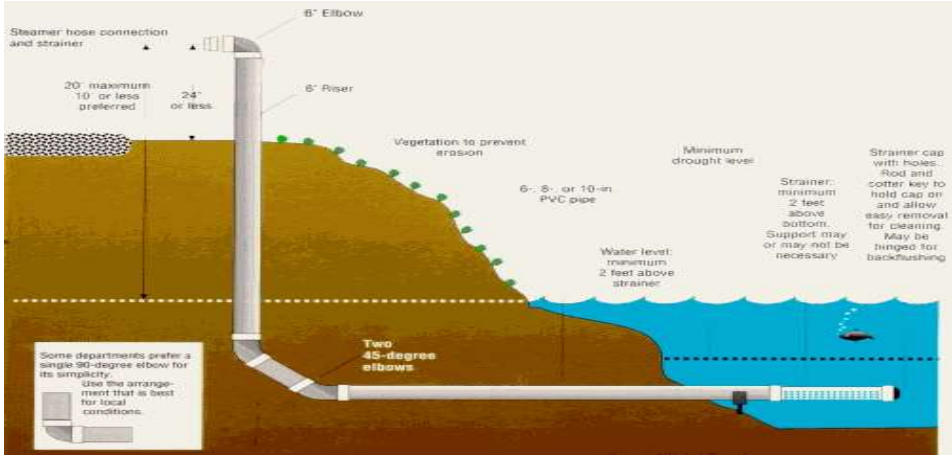
Locally, fire wardens are appointed to enforce burning regulations and restrictions based on the conditions of the area. Local fire departments attend regular trainings on fire-fighting tactics to keep their skills honed. The Kewaunee County Emergency Management Office assists local departments and their staff with available grant applications for training, exercising, equipment and planning as able and requested. The County Emergency Management Office and local fire departments, as part of their regular public-awareness campaigns, also use budgetary dollars to provide information to homeowners on protecting their homes and other buildings from wildfire and share information on fire safety and fire-resistant construction. This campaign often happens in conjunction with October's Annual Fire Safety Week.

There is no water storage that can be used for firefighting in the Town of Montpelier. This makes firefighting for structural and wildfires a difficult proposition. Currently mutual aid resources must be requested and used as ferries to move water to the scene. This is an inefficient use of resources and delays the effective and timely fighting of fires in the town. The Luxemburg Fire Department and the County Highway Department would like to apply for a grant to create a dry hydrant system; the estimated cost would be $25,000.

A dry hydrant (see picture below) is a non-pressurized pipe system permanently installed in existing lakes, ponds and streams that provides a suction supply of water to a fire department tank truck. Dry hydrants have the following features:

- Use a non-pressurized pipe system.
- Use relatively inexpensive piping materials and other supplies.
- Are permanently installed in existing lakes, ponds, streams and cisterns.

- Provide a means of access whenever needed, regardless of weather.
- Allow years of simple operation with a minimum of maintenance.



When a dry hydrant is placed in a location with all-weather road access, it allows more water to be distributed in less time, the water can be applied effectively on the fire and fire fighter safety is improved.[63] The following photos depict dry hydrant systems.[64]

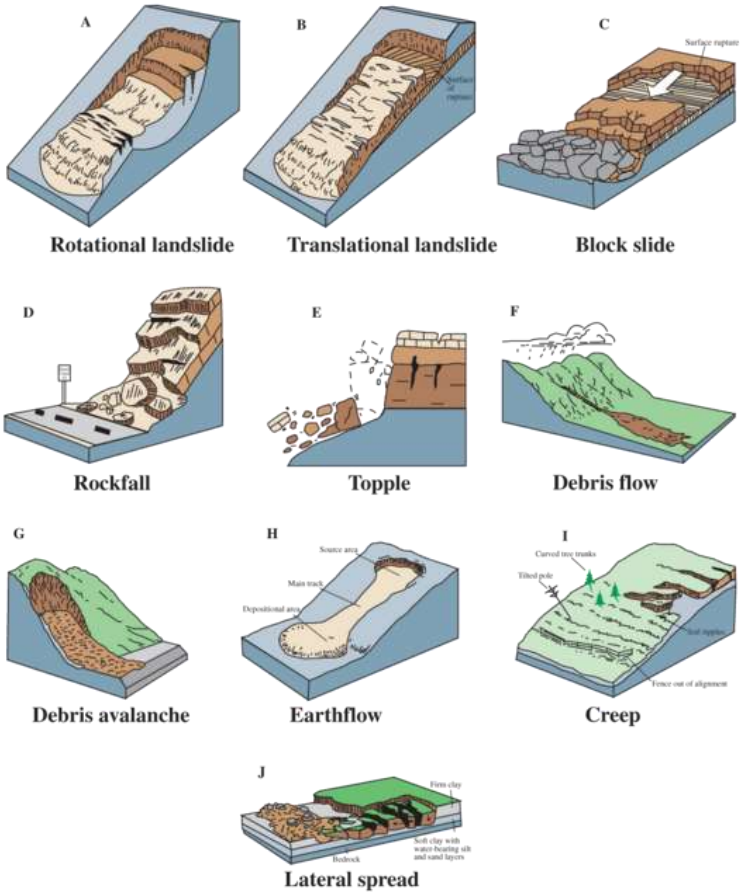
[63] http://www.co.larimer.co.us/wildfire/dry_hydrant_concept.htm
[64] http://www.firehydrant.org/info/northstar.html

The hazard mitigation strategies listed above primarily involve providing information on general fire safety measures to the public for residential and commercial structures and providing ongoing training to the firefighters who fight these types of fires. These measures are designed to provide basic fire safety information with the hopes that implementation will protect property and, most importantly, lives. If a large fire does start, the pre-positioned equipment and continual, high-quality training should help to reduce losses to buildings and infrastructure within the county by providing an effective fire-fighting force.

Landslide

The term landslide includes a wide range of ground movement such as rock falls, deep failure of slopes and shallow debris flows. Although gravity acting on an over-steepened slope is the primary reason for a landslide, there may be other contributing factors. Factors likely to be seen in Kewaunee County include:

- erosion by rivers creating over-steepened slopes
- rock and soil slopes being weakened through saturation by snowmelt or heavy rains
- excess weight from the accumulation of rain or snow, stockpiles of rock or ore, waste piles or from man-made structures stressing weak slopes to failure [65]



[65] http://landslides.usgs.gov/html_files/nlic/page5.html and http://www.eoearth.org/article/Landslide

Physical Characteristics

Landslides may include any combination of natural rock, soil or artificial fill and are classified by the type of movement and the type of material. The types of movement are slides, flows, lateral spreads and falls and topples; a combination of two or more landslide movements is a complex movement:

- Slides: straight or rotating downward displacements along one or more failure surfaces of soil or rock as a single intact mass or a number of pieces
- Flows: a rapid, downhill mass movement of a “slurry” comprised of loose soil, rocks, organic matter, air and water
- Lateral spreads: large movements of rock, fine-grained soils or granular soils distributed laterally
- Falls and Topples: masses of rocks or material that rapidly detach from a steep slope or cliff that free-fall, roll or bounce.

Almost any steep or rugged terrain is susceptible to landslides under the right conditions. The most hazardous areas are steep slopes on ridges, hills and mountains; incised stream channels and slopes excavated for buildings and roads. Slide potentials are enhanced where slopes are destabilized by construction, heavy rainfall, floods or river erosion. Debris flows generally occur during intense rainfall on water saturated soil. Surface runoff channels along roadways and below culverts are common sites of debris flows.

Landslides often occur together with other major natural disasters thereby exacerbating relief and reconstruction efforts:

- Floods and landslides are closely related and both involve precipitation, runoff and ground saturation that may be the result of severe thunderstorms
- Landslides into a reservoir may indirectly compromise dam safety or a landslide may even affect the dam itself.
- Wildfires may remove vegetation from hillsides, significantly increasing runoff and landslide potential.

Landslide from fire damage in CO[66]

Sinkholes can form naturally in areas with karst geology (i.e., areas with limestone or other bedrock that can be dissolved by water.) As the limestone rock under the soil dissolves over time from rainfall or flowing groundwater, a hollow area may form underground into which surface soil can sink. Sinkholes also can be caused by human activity such as collapsed, abandoned underground mines. Even though sinkholes have not been a factor in any natural disaster, identifying areas with karst conditions is important for not only public safety and protection of structures but because karst features provide direct conduits to groundwater. Areas with karst conditions are vulnerable to groundwater contaminants from pollutants entering a sinkhole, fissure or other karst feature.

Enlarged fracture in Brown County, WI[67]

[66] http://landslides.usgs.gov/html_files/landslides/slides/slide15.htm
[67] http://www.uwex.edu/wgnhs/enlargedjoint.htm

Frequency of Occurrence

According to the U.S. Geological Survey, landslides are a widespread geologic hazard, occurring in all 50 states where they cause on average $1 to $2 billion in damages and more than 25 fatalities annually. Landslides pose serious threats to highways; railroads and structures that support fisheries, tourism, timber harvesting, mining and energy production. Expanding urban development and other land uses have increased the incidence of landslide disasters in the United States.

Even though there have been no recent reports of landslide in Kewaunee County, Wisconsin Emergency Management has determined that Kewaunee County has a moderate susceptibility and a moderate incidence of landslide. The hazard exists primarily in the area along Lake Michigan and in the small northwestern portion of the county on the Bay of Green Bay (See the map in Appendix A.) Unfortunately, these are areas where development is occurring. This leads to a rating of a moderate likelihood of a landslide in the coastal areas and a low likelihood in the rest of the county. In the moderate belt, there is a moderate to high probability of damage due to a landslide.

The karst potential map in Appendix A shows that Kewaunee County primarily has deep karst features in the county but there are shallow karst features in small areas. The presence of this geologic feature supports the high probability of complications (e.g., sinkholes, fissures to groundwater) to residents. The good news is that the complications due to karst geology have a low probability of causing significant damage, injury or death.

Sinkhole in Monroe County, WI[68]

[68] http://www.uwex.edu/wgnhs/cavesink.htm

Vulnerability

The most likely consequences of landslides in Kewaunee County is to erode road and structural foundations that were built on or near eroding coastal bluffs. There are a few private roads (e.g., driveways) or public access roads below the bluff structures; these could be temporarily blocked, restricting access to a few structures, due to debris that has fallen on them.

Cincinnati, Ohio[69]

Karst geology, which has been identified in Kewaunee County, can lead to sinkholes under structures such as homes, businesses, roadways and railroads causing economic losses and possible injury to residents and the community. It is also important to note that a large portion of citizens in Kewaunee County rely on private well water systems that can be contaminated by hazardous materials finding direct paths through the karst features into groundwater supplies.

Hazard Mitigation Strategies

The goal of landslide mitigation activities is to reduce, in a cost effective manner, the loss of lives and property due to these events. Although the physical cause of many landslides cannot be removed, geologic investigations, good engineering practices and effective enforcement of land-use management regulations can reduce landslide hazards. Karst features should be considered in land use planning, stormwater management and hazardous materials planning to avoid possible damage to structures due to sinkholes or contamination of groundwater. Kewaunee County will continue to work with its municipal partners to ensure that areas at

[69] http://landslides.usgs.gov/html_files/landslides/slides/slide8.htm

risk of landslide and karst-related complications are identified and mitigation strategies are employed as appropriate, especially when considering the placement of future buildings and infrastructure. The county will also continue to communicate the importance of well water testing.

Severe Temperatures

Characteristics

Temperature extremes can cause disruption of normal activities for the population, property loss and even the loss of life, especially among the more vulnerable members of our population such as children and the elderly.

Physical Characteristics: Heat

Heat emergencies are a result of the combination of very high temperatures and very humid conditions. The Heat Index estimates the relationship between these two conditions and reports them as a danger category, as can be seen in the following table.[70]

Heat Index and Disorders Table			
Danger Category		**Heat Disorders**	**Apparent Temperatures [°F]**
IV	Extreme Danger	Heatstroke or sunstroke imminent.	>130
III	Danger	Sunstroke, heat cramps, or heat exhaustion likely; heat stroke possible with prolonged exposure and physical activity.	105-130
II	Extreme Caution	Sunstroke, heat cramps, and heat exhaustion possible with prolonged exposure and physical activity.	90-105
I	Caution	Fatigue possible with prolonged exposure and physical activity.	89-90

The major risks to people due to extreme heat are:

- Heatstroke – a potentially lethal medical emergency where the ability of the person to thermo-regulate is compromised resulting in the rise of the body's core temperature to above 105 degrees Fahrenheit.

- Heat Exhaustion – a less threatening medical condition where the victim complains of dizziness, weakness and/or fatigue. The victim may have a normal or slightly elevated temperature and usually can be successfully treated with fluids.

[70] FEMA, 1997; NWS, 1997

- Heat Syncope – a sudden “faint” or loss of consciousness usually brought on by exercising in warmer weather than one is accustomed to; usually no lasting effect.

- Heat Cramps – muscular cramping brought on by exercising in warmer weather than one is accustomed to; no lasting effect.

Extreme heat conditions may also affect pets and livestock, decreasing agricultural output by the latter. Crops may also suffer reduced yield due to extremely hot conditions.

Physical Characteristics: Cold

Wind chill is a relationship between wind and cold that is based on the rate of heat loss from exposed skin. As the wind speed increases, heat is drawn from the body, driving down skin temperature and, eventually, body core temperature. The following table illustrates this relationship.[71]

Wind Chill Chart

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

Frostbite Times: 30 minutes, 10 minutes, 5 minutes

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

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

Effective 11/01/01

T

The major risks to people due to extreme cold are:

[71] National Weather Service: http://www.nws.noaa.gov/om/windchill/index.shtml

- Hypothermia – occurs when, due to exposure to cold, the body is unable to maintain its proper core temperature. It may occur in temperatures above freezing and may lead to death.

- Frostbite – describes local cooling, usually to an extremity, which occurs when exposure to cold air or liquid causes constriction of the blood vessels. There are three degrees of frostbite:

    - Frostnip – brought on by direct contact with a cold object or exposure to cold air or water. Tissue damage is minor and response to treatment is usually very good.

    - Superficial Frostbite – involves the skin and subcutaneous layers

    - Freezing – is deep frostbite in which the skin, subcutaneous layers and deeper structures (e.g., muscles, bone, deep blood vessels, organ membranes) of the body are affected and can become frozen.

- Chilblains - lesions that occur from repeated/chronic exposure of bare skin to temperatures of 60 degrees Fahrenheit or lower.

- Trench foot – a condition that occurs when the lower extremities remain in cool water for a prolonged period of time.

Frequency of Occurrence: Heat

Wisconsin has been affected by several bouts of extreme heat including during the Dust Bowl period from 1934-1936. Other heat events occurred in 1979, 1995, 2001 and 2011. Excessive heat events recorded by the National Weather Service between 1 January 1950 and 31 March 2013 are outlined below: [72]

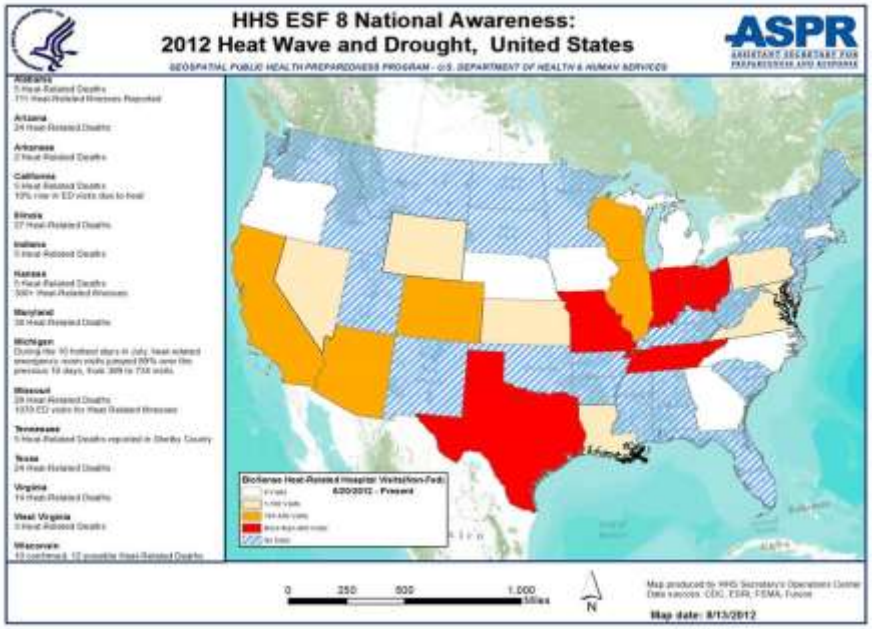
Year	Date	Location	Human Losses	Damage Losses	Miscellaneous
1999	7/23	Kewaunee County	Deaths: 3	Property: $0	Excessive heat

[72] http://www.ncdc.noaa.gov/stormevents/

Year	Date	Location	Human Losses	Damage Losses	Miscellaneous
			Injuries: 0	Crop: $0	
2012	7/16	Kewaunee County	Deaths: 3 Injuries: 0	Property: $0 Crop: $0	Heat

It should be noted that during the summer of 2012 much of the country, including Kewaunee County, experienced a heat wave, resulting in significant droughts across more the half the country as well as increases in heat related illnesses and deaths. July was the hottest month in US history, eclipsing the record set during the heart of the Dust Bowl in 1936. The worst of the heat was in the Midwest, the Plains and along the Eastern Seaboard. Most of the contiguous US had record and near-record warmth for the seven-month period, except the Pacific Northwest, which was near average.

With the increase in heat-related illnesses comes an increase in emergency department (ED) admission across the country. Dehydration, heat exhaustion and heat stroke were the most common cause for patients' heat-related ED admissions. Most heat-related visits occurred in patients between the ages of 19 and 70. In Wisconsin, there were ten confirmed and possibly 12 heat-related deaths.[73]



[73] 2012 Heat & Drought Federal Report, HHS ESF 8, UPDATE #2, U.S. Department of Health and Human Services, Assistant Secretary for Preparedness and Response

According to the State of Wisconsin Hazard Mitigation Plan, extreme heat is the number-one weather killer in Wisconsin with most of the heat deaths attributed to major heat waves. As can be seen by the historical tables, Kewaunee County, like the rest of the state, is likely to experience extreme heat events every two to three years with extended, major heat waves occurring about every two decades. The workgroup therefore felt that there was a medium likelihood of occurrence in any given year. The committee also felt that the loss of property, primarily crop and livestock output has a high likelihood of occurring in a drought year. The loss of life or injury to people has a medium likelihood of occurrence for the general population but the committee recognized that the likelihood increases for certain populations such as the elderly, chronically ill, children, those who work outdoors and those with limited financial resources (i.e., to pay for heating and air conditioning).

Frequency of Occurrence: Cold

Wisconsin regularly has extreme cold temperatures as part of its winter climate. Following is a chart that outlines severe cold events that have been recorded by the National Weather Service in Kewaunee County between 1 January 1950 and 31 March 2013: [74]

Year	Date	Location	Human Losses	Damage Losses	Miscellaneous
1994	01/13	Statewide	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	Cold
1995	02/10	Northern Wisconsin	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	Cold
1995	12/09	Statewide	Deaths: 2 Injuries: 21	Property: $0 Crop: $0	Cold
1996	01/30	Kewaunee County	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	Extreme cold
1996	02/01	Kewaunee County	Deaths: 1 Injuries: 0	Property: $0 Crop: $0	Extreme cold
2006	2/17	Kewaunee County	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	Extreme cold/wind chill
2008	01/30	Kewaunee County	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	Extreme cold/wind chill
2008	02/10	Kewaunee County	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	Extreme cold/wind chill

[74] http://www.ncdc.noaa.gov/stormevents/

As can be seen in the above chart of cold and extreme cold temperature events, there are few years where a cold event does not occur in Kewaunee County and extreme cold happens once or twice, on average, per decade. After examining this data, the workgroup believed that cold and/or extreme cold has a medium likelihood of occurrence in any given year. Since there are no crops out during the winter and most properties (homes, businesses, barns) are insulated for this climate, the loss of property due to temperature extremes is not high although individuals may suffer damage due to water main breaks and other such problems. They further believed that the loss of life or injury to people has a medium likelihood of occurrence among the general population when there are cold/extreme cold weather events. Again, the workgroup recognized that people who work outdoors, who have limited financial resources, the elderly, the young and the chronically ill have a higher risk profile.

Vulnerability

Vulnerability to temperature extremes is generally assessed on an individual basis with the most vulnerable sections of our community's population having the greatest risk. These people may include the elderly, the very young and the chronically ill. People from economically disadvantaged backgrounds, especially those listed in the categories above, are even more vulnerable since they are least able to afford the cost of adequate heating or air conditioning systems.

The Kewaunee County social services agencies are aware of many of these people who reside in our communities and they, along with the public health department, have plans and access to economic assistance programs to help these people in times of concern.

It is unlikely that infrastructure and buildings will be affected by either severe heat or cold. Buildings that are not well-designed or maintained for the Wisconsin climate may have affects such as water pipes bursting during extreme cold but this is unlikely for most buildings and infrastructure. The impact of losing these types of buildings may be problematic to the individuals who own and/or reside in these structures but it is not likely to be a community-wide problem; there are social support agencies that could work with impacted individuals to manage the effects of severe temperatures.

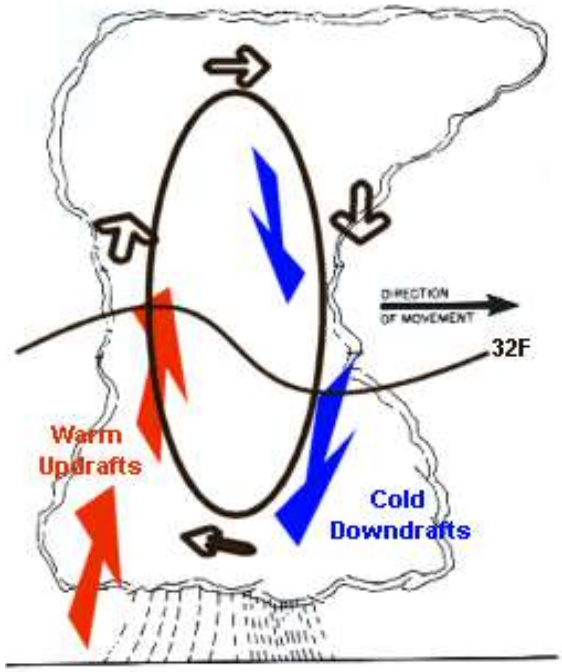
Hazard Mitigation Strategies

The goal of severe temperature mitigation activities is to reduce, in a cost effective manner, the loss of lives and property due to these events. Temperature extremes are difficult for a community to mitigate and the risks are to the health and safety of citizens, animals and crops. There are no strategies that need to be employed to reduce damages to buildings and infrastructure.

The Kewaunee County Emergency Management Office participates in the statewide public information campaigns for Winter and Heat Awareness Weeks each year and provides preparedness pamphlets and links to information on its website.

Storms: Hail

Studies of thunderstorms indicate that two conditions are required for hail to develop: sufficiently strong and persistent up-draft velocities and an accumulation of liquid water in a super-cooled state in the upper parts of the storm. Hailstones are formed as water vapor in the warm surface layer rises quickly into the cold upper atmosphere. The water vapor is frozen and begins to fall; as the water falls, it accumulates more water vapor. This cycle continues until there is too much weight for the updraft to support and the frozen water falls too quickly to the ground to melt along the way. The graphic below depicts hail formation:[75]



Injury and loss of life are rarely associated with hailstorms, however extensive property damage is possible, especially to crops.

[75] Source: NWS, January 10, 2003

Physical Characteristics

Hail may be spherical, conical or irregular in shape and can range in size from barely visible in size to grapefruit-sized dimensions. Hailstones equal to or larger than a penny are considered severe.

Hail Size Estimates[76]	
Size	**Inches in Diameter**
Pea	1/4 inch
Marble/mothball	1/2 inch
Dime/Penny	3/4 inch
Nickel	7/8 inch
Quarter	1 inch
Ping-Pong Ball	1 1/2 inch
Golf Ball	1 3/4 inches
Tennis Ball	2 1/2 inches
Baseball	2 3/4 inches
Tea cup	3 inches
Grapefruit	4 inches
Softball	4 1/2 inches

Hail falls in swaths that can be from twenty to one hundred miles long and from five to thirty miles wide. A hail swath is not a large continuous path of hail but generally consists of a series of hail cells that are produced by individual thunderstorm clouds traveling in the same area.

Frequency of Occurrence

Hailstorms usually occur from May through August and Wisconsin averages two or three hail days per year. According to the Wisconsin State Hazard Mitigation Plan, since 1982, Kewaunee County reported 15 hail events but fortunately none have led to loss of life and only two have led to injury. Kewaunee County averages 0.5 days of hail per year in most of the county with the far northwestern portion of the county averaging 0.5 – 1 days of hail per year (See the map in Appendix A). Based on these averages, Kewaunee County has a low probability of hail occurrence and as a result, the likelihood of damage due to hail is also considered low.

[76] NWS, January 10, 2003

Most hail damage occurs in rural areas because maturing crops are susceptible to bruising and other damage caused by hailstones. The four months of hailstorm activity correspond to the growing and harvesting seasons for most crops. Following is a table that shows the 32 hail events recorded by the National Weather Service between 1 January 1950 and 31 March 2013. [77]

Year	Date	Location	Human Losses	Damage Losses	Miscellaneous
1959	7/05	Kewaunee County	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	1.75 inch
1967	6/15	Kewaunee County	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	1.75 inch
1973	8/17	Kewaunee County	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	1.00 inch
1979	5/18	Kewaunee County	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	1.00 inch
1981	7/17	Kewaunee County	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	1.00 inch
1991	5/28	Kewaunee County	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	1.75 inch
1992	6/17	Kewaunee County	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	1.00 inch
	6/17	Kewaunee County	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	1.00 inch
	6/17	Kewaunee County	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	2.50 inch
	6/17	Kewaunee County	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	2.50 inch
1994	7/23	Ellisville	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	1.00 inch
1996	5/19	Kewaunee	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	1.00 inch
	8/25	Luxemburg	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	0.75 inch
1998	3/29	Norman	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	1.00 inch
2000	7/13	Rosiere	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	1.00 inch
	7/13	Rio Creek	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	1.00 inch
	7/13	Alaska	Deaths: 0 Injuries: 2	Property: $0 Crop: $0	1.00 inch
2001	6/16	Luxemburg	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	0.75 inch
2003	4/15	Luxemburg	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	1.00 inch
	4/15	Luxemburg	Deaths: 0	Property: $0	1.00 inch

[77] http://www.ncdc.noaa.gov/stormevents/

Year	Date	Location	Human Losses	Damage Losses	Miscellaneous
			Injuries: 0	Crop: $0	
	8/03	Luxemburg	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	0.75 inch
2004	7/13	Algoma	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	1.00 inch
2005	5/06	Luxemburg	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	0.88 inch
	9/13	Algoma	Deaths: 0 Injuries: 0	Property:$1,000 Crop: $0	1.75 inch
2006	7/01	Algoma	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	0.75 inch
	7/01	Algoma	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	1.75 inch
	7/17	Kewaunee	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	1.75 inch
	7/17	Kewaunee	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	1.00 inch
2007	7/05	Casco	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	0.75 inch
	7/05	Rio Creek	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	0.75 inch
	4/05	Luxemburg	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	0.75 inch
2008	8/06	Dyckesville	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	0.75 inch
	8/06	Casco	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	1.00 inch
2010	9/06	Euren	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	1.25 inch
2011	4/10	Kewaunee	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	1.75 inch
	4/10	Kewaunee	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	1.00 inch
	4/10	Kewaunee	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	1.00 inch
	4/10	Kewaunee	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	2.00 inch
	5/22	Dyckesville	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	1.00 inch
	6/08	Kewaunee Co.	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	1.00 inch
2012	7/30	Stangelville	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	1.00 inch

It should be noted that this table represents only the hail incidents reported to the National Weather Service. One limitation of the source data is that it showed no property or crop loss, death or injury while it is likely that there was some loss incurred.

After a careful review of the data by the workgroup, it was believed that there has been more accurate record-keeping and recording since the 1990's but that the table also shows an increasing frequency in the occurrence of hailstorms, with Kewaunee County having a hailstorm usually at least once per year. With that understanding, it was decided that the probability of hail is moderate to high.

Vulnerability

Hail, typically occurring in conjunction with thunderstorms and lightning, can damage many types of infrastructure. Public and private vehicles (e.g., campers, boats, cars, trucks) are liable to have their windshields cracked, bodies dented and paint damaged as a result of hail. This damage can occur, depending on the size of the hail, whether the vehicle is moving through the storm or is stationary. Hail on the roadway can also cause vehicles to slide off the road. Vehicle damage and iced roadways are of particular concern when you consider the need for emergency vehicles such as police cars, fire trucks and ambulances to quickly move to assist victims in a disaster.

Hail can also damage critical infrastructure such as street signs, electric lines/poles/transformers, telephone lines and radio communication equipment. These pieces of infrastructure are needed by both first response agencies and the general community to ensure safe transport; warm, safe homes and good internal and external communications abilities.

Residential and business properties are liable to receive damage to signs, siding, billboards, trees and windows. Manufactured housing is particularly vulnerable to damage due to its lower construction standards.

Hail can be particularly damaging to agricultural concerns, damaging farm buildings, standing crops and livestock. As described previously, the agricultural sector is an important economic driver in Kewaunee County.

Hazard Mitigation Strategies

The goal of mitigating for hail is to reduce the amount of financial loss due to these events. Insurance is the most widely used adjustment for crop and property damages due to hail. Hail crop insurance is available from two sources: from commercial stock and mutual companies and from the Federal Crop Insurance Corporation (FCIC). Farmers rarely purchase insurance coverage up to the full value of the losses that would result from a severe hailstorm. The Kewaunee County UW Extension Office distributes information on various hail insurance options.

In the event of major damage, a team composed of county and federal agricultural agency representatives and the county emergency management director have primary responsibility for assessing and documenting hail damage. Federal emergency assistance is available in the form of low-interest loans when a Presidential Disaster is declared or when the FmHA declares that a county is eligible for aid. Damage from hailstorms alone is generally not extensive enough to invoke a disaster declaration.

The Emergency Management Office also provides information to citizens for personal preparedness during spring severe weather awareness week and via its website and informational pamphlets distributed in public areas around the county on a regular basis.

The hazard mitigation strategies listed above primarily involve providing information on safety measures and insurance to the public for agricultural concerns and residential and commercial structures. These measures provide basic safety information but, since there is little one can do to prevent hail damage, these measures will do little to reduce damages to existing or future buildings and infrastructure, although the recommended insurance may make recovery easier.

Storms: Lightning

Lightning is a phenomenon associated with thunderstorms; the action of rising and descending air separates and builds-up positive and negative charge areas. When the built-up energy is discharged between the two areas, lightning is the result.[78]

Formation of Lightning

Lightning may travel from cloud to cloud, cloud to ground, or if there are high structures involved, from ground to cloud.

Physical Characteristics

The temperatures in a lightning stroke rise to 50,000°F (Fahrenheit). The sudden and violent discharge which occurs in the form of a lightning strike is over in one-millionth of a second.

Lightning damage occurs when humans and animals are electrocuted, fires are caused by a lightning stroke, materials are vaporized along the lightning path or sudden power surges cause damage to electrical or electronic equipment. Lightning, an underestimated hazard, kills more people in an average year than do hurricanes or tornadoes.

[78] University Corporation for Atmospheric Research [UCAR]

Frequency of Occurrence

Nationwide, forty-five percent of the people killed by lightning have been outdoors, about sixteen percent were under trees, six percent were on heavy road equipment and thirty-three percent were at various unknown locations. Less than ten percent of the deaths involved individuals inside buildings; these deaths were primarily due to lightning-caused fires.

Wisconsin has a high frequency of property losses due to lightning. Insurance records show that annually one out of every fifty farms has been struck by lightning or had a fire which may have been caused by lightning. Generally, rural fires are more destructive than urban fires because of limited lightning protection devices, isolation, longer response times and inadequate water supplies. Kewaunee County has a high probability of lightning occurrence; the likelihood of damage due to lightning is considered medium for the more rural areas of the county and low for the more urban areas of the county at any one location within it. This was determined by recognizing that while lightning usually happens in conjunction with thunderstorms, and that Wisconsin and Kewaunee County generally have several severe thunderstorms per summer, the specific location of a lightning strike is small when compared to the size of the county overall, which moderates its likelihood in any given location.

Following is a table that shows the lighting events recorded by the National Weather Service between 1 January 1950 and 31 March 2013.

Year	Date	Location	Human Losses	Damage Losses	Miscellaneous
1999	07/03	Kewaunee	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	Lightning

Vulnerability

Lightning, which often occurs in conjunction with thunderstorms and hail, can damage many types of infrastructure such as electric lines/poles/transformers, telephone lines and radio communication equipment. These pieces of infrastructure are needed by both first response agencies and the general community to ensure safe

transport; warm, safe homes and good internal and external communications abilities.

Residential and business properties are liable to receive damage either as a result of a lightning strike causing a fire or other type of direct damage or by overloading electronic equipment (e.g., computers, televisions) that have not been properly connected to a surge protector. This latter concern is especially important to business and government, which in modern America rely on computers and other electronic equipment to manage the large amounts of data manipulated in our information-based economy.

Lightning can damage agricultural assets including farm buildings, standing crops and livestock. It is also one of the major sources of ignition for forest and wildfires.

Hazard Mitigation Strategies

The goal of lightning mitigation activities is to reduce, in a cost effective manner, the loss of lives and property due to these events. The two primary ways to effectively reduce lightning losses are modifying human behavior and protecting structures (e.g., using fire resistant materials in building construction). The use of fire resistant materials will make existing buildings and future construction less likely to catch fire or will minimize fire damage and spread due to lightning strike. Surge protectors limit data losses.

The Kewaunee County Emergency Management Office has awareness and educational materials in print and on the website that inform the public of safety procedures to follow during a lightning storm. The office also has materials available on fire-resistant construction methods and materials. Severe summer weather safety information is also emphasized during Tornado Awareness Week.

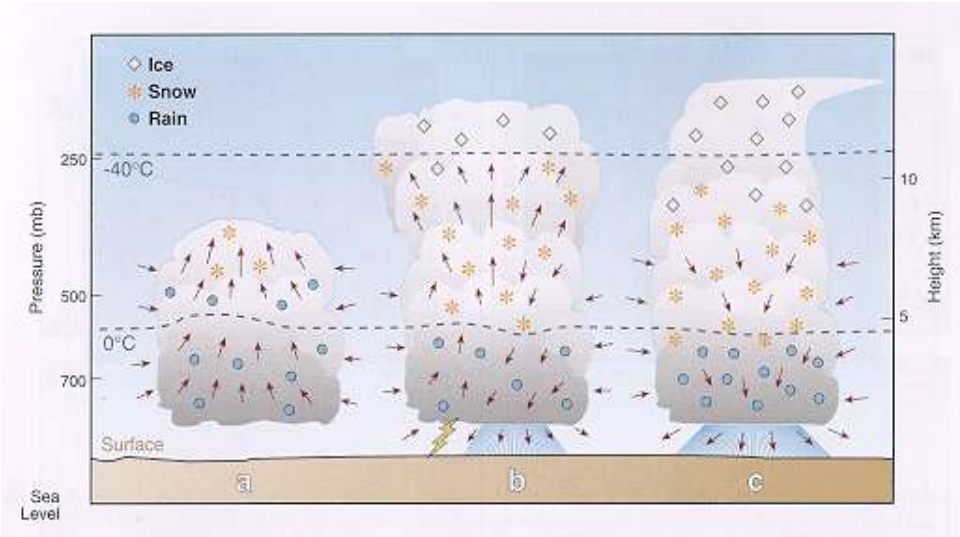
Storms: Thunderstorms

There are three distinct stages of development for thunderstorms (birth, growth, maturity), each of which can be seen in the following schematic.

In the first stage of development, an updraft drives warm air up beyond condensation levels where clouds form.

The second stage of development occurs as levels of water vapor in the expanding cloud rise past saturation and the air cools sufficiently to form solid and liquid particles of water. At this point, rain or snow begins to fall within the cloud.

A thunderstorm's mature stage is marked by a transition of wind direction within the storm cells. The prevailing updraft which initiated the cloud's growth is joined by a downdraft generated by precipitation. Lightning may occur soon after precipitation begins. Hail and tornadoes may also develop during this stage.[79]



Physical Characteristics

A thunderstorm often is born, grows, reaches maturity and dies in a thirty-minute period. The individual thunderstorm cell often travels between thirty and fifty miles per hour. Strong frontal systems may create one squall line after another, each composed of many

[79] National Weather Service - Flagstaff

individual thunderstorm cells. These fronts can often be tracked across the state from west to east with a constant cycle of birth, growth, maturity and death of individual thunderstorm cells.

Frequency of Occurrence

Thunderstorm frequency is measured as the number of days per year with one or more incidents. There are approximately 100,000 thunderstorms in the United States every year and approximately 10% of those are considered severe (i.e., has at least ¾" hail, winds of at least 58 mph or a tornado). Most Wisconsin counties, including Kewaunee County, average between 30 and 40 thunderstorm days per year although a portion of southwestern and south-central Wisconsin average 40 to 50 thunderstorm days per year. In Kewaunee County there are typically several severe thunderstorms per year. Thunderstorms can occur throughout the year with the highest frequency during the months of May through September. The majority of storms occur between the hours of noon and midnight.

The probability of thunderstorms occurring in Kewaunee County is high as these storms usually occur one or more times each year during the summer in Wisconsin. Damage from thunderstorms usually is a result of the hail, lightning, winds and/or flash flooding that can occur as part of the storm. The likelihood of damage from these causes is discussed in the appropriate chapters, although one can see from the historical data listed below, property and crop damage occurs frequently in thunderstorms and can range from $1,000 to $500,000 (1994) per storm with combined property and crop damages in the $5,000 - $20,000 range being the most common.

The following chart lists the thunderstorms that have been recorded in Kewaunee County by the National Weather Service between 1 January 1950 and 31 March 2013.

Year	Date	Location	Human Losses	Damage Losses	Miscellaneous
1970	5/21	Kewaunee County	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	Thunderstorm with winds
1970	5/21	Kewaunee County	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	Thunderstorm with winds
1970	5/21	Kewaunee County	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	Thunderstorm with winds

Storms: Thunderstorms

Year	Date	Location	Human Losses	Damage Losses	Miscellaneous
1970	5/21	Kewaunee County	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	Thunderstorm with winds
1970	6/17	Kewaunee County	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	Thunderstorm with winds
1982	8/03	Kewaunee County	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	Thunderstorm - 69 knot winds
1982	8/03	Kewaunee County	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	Thunderstorm - 69 knot winds
1982	8/03	Kewaunee County	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	Thunderstorm - 69 knot winds
1983	7/03	Kewaunee County	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	Thunderstorm with winds
1984	7/23	Kewaunee County	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	Thunderstorm with winds
1984	10/17	Kewaunee County	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	Thunderstorm with winds
1985	7/09	Kewaunee County	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	Thunderstorm with winds
1985	8/05	Kewaunee County	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	Thunderstorm with winds
1987	7/11	Kewaunee County	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	Thunderstorm with winds
1987	7/11	Kewaunee County	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	Thunderstorm with winds
1988	8/12	Kewaunee County	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	Thunderstorm with winds
1989	5/24	Kewaunee County	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	Thunderstorm with winds
1989	5/24	Kewaunee County	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	Thunderstorm with winds
1991	9/09	Kewaunee County	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	Thunderstorm with winds
1994	7/06	Algoma	Deaths: 0 Injuries: 0	Property: $500K Crop: $50K	Thunderstorm with winds
1994	7/23	Ellisville	Deaths: 0 Injuries: 0	Property: $1K Crop: $1K	Thunderstorm with winds
1994	7/23	Stangelville	Deaths: 0 Injuries: 0	Property: $1K Crop: $1K	Thunderstorm with winds
1996	8/25	Algoma	Deaths: 0 Injuries: 0	Property: $5K Crop: $0	Thunderstorm with winds
1997	6/24	Kewaunee	Deaths: 0 Injuries: 0	Property: $1K Crop: $0	Thunderstorm with winds
1998	5/31	Stangelville	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	Thunderstorm with winds
1998	06/25	Casco	Deaths: 0 Injuries: 0	Property: $1K Crop: $0	Thunderstorm with winds
1998	9/01	Kewaunee	Deaths: 0 Injuries: 0	Property: $30K Crop: $0	Thunderstorm with 50-knot winds
1998	9/26	Kewaunee	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	Thunderstorm with 50-knot winds

Year	Date	Location	Human Losses	Damage Losses	Miscellaneous
1999	06/06	Algoma	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	Thunderstorm with 60-knot winds
1999	6/06	Alaska	Deaths: 0 Injuries: 0	Property: $50K Crop: $0	Thunderstorm with winds
1999	6/06	Algoma	Deaths: 0 Injuries: 0	Property: $15K Crop: $0	Thunderstorm with winds
1999	7/08	Stangelville	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	Thunderstorm with 50-knot winds
2001	6/16	Luxemburg	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	Thunderstorm with 50-knot winds
2001	6/30	Luxemburg	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	Thunderstorm with 50-knot winds
2001	6/30	Algoma	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	Thunderstorm with 50-knot winds
2001	6/30	Kewaunee	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	Thunderstorm with 50-knot winds
2001	7/22	Kewaunee	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	Thunderstorm with 50-knot winds
2001	8/09	Algoma	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	Thunderstorm with 50-knot winds
2001	8/09	Algoma	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	Thunderstorm with 50-knot winds
2001	8/09	Kewaunee	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	Thunderstorm with 52-knot winds
2002	7/30	Kewaunee County	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	Thunderstorm with 55-knot winds
2003	4/15	Algoma	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	Thunderstorm with 50-knot winds
2004	7/13	Luxemburg	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	Thunderstorm with 52-knot winds
2005	9/13	Casco	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	Thunderstorm with 52-knot winds
2006	7/30	Luxemburg	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	Thunderstorm with 50-knot winds
2007	7/05	Norman	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	Thunderstorm with 52-knot winds
2008	4/25	Thirty Daems	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	Thunderstorm with 50-knot winds
2008	4/25	Pilsen	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	Thunderstorm with 50-knot winds
2010	8/20	Rosiere	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	Thunderstorm with 56-knot winds
2011	7/17	Rio Creek	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	Thunderstorm with 52-knot winds

Vulnerability

Thunderstorms, which often produce hail and lightning and may occasionally spawn tornadoes, high wind storms or flash flooding, can damage many types of infrastructure. Kewaunee County's thunderstorm vulnerabilities due to associated hail, lightning, winds and flood waters are discussed in the other hazard chapters of this plan.

Hazard Mitigation Strategies

The goal of mitigating against thunderstorms is to save lives, preserve health and reduce property damage by employing the types of cost-effective measures discussed in this section.

The Kewaunee County Emergency Management Office has prepared severe weather safety information that it disseminates to the public in the following manner:

- During Tornado Awareness Week, the media provides viewers with extensive coverage of storm safety tips and emergency procedures.

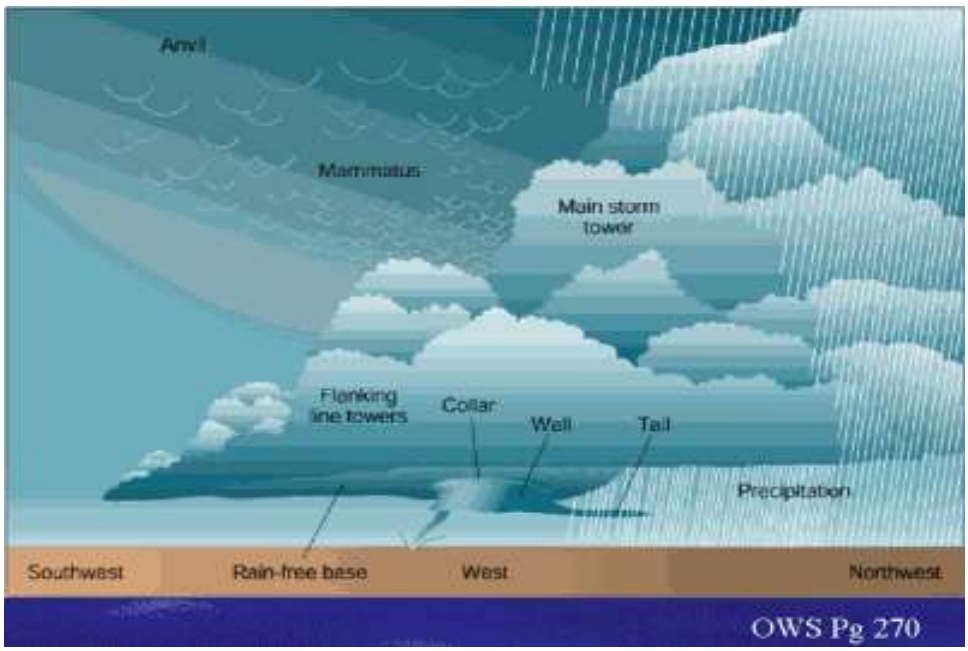
- The Kewaunee County Emergency Management Department assists the National Weather Service (NWS) with conducting tornado spotter training programs. Municipal first responders serve as the backbone of the spotter network in the county. At a Tornado Watch, municipal departments are paged and respond to areas within their communities to serve as spotters.

- Kewaunee County promotes early warning to the public. The county has current Emergency Alert System (EAS) hardware but lacks the money for installing the hardware and training the staff in the proper usage of it. A full discussion of this topic is in the Tornado chapter.

The damage to buildings and infrastructure in a thunderstorm is generally caused by components of the storm such as hail, flooding, lightning or wind. A discussion of strategies to reduce effects on existing and future buildings and infrastructure is discussed in the chapters that discuss each of these components in detail.

Storms: Tornadoes and High Winds

A tornado is a violently rotating, funnel-shaped column of air. The lower end of the column may or may not touch the ground. Average winds in the tornado are between 173 and 250 miles per hour and can produce winds exceeding 300 miles per hour. It should also be noted that straight-line winds may reach the same speeds and achieve the same destructive force as a tornado.



A derecho is a widespread, long-lived, violent, convectively-induced straight-line windstorm that is associated with a fast-moving band of severe thunderstorms usually taking the form of a bow echo. Derechos blow in the direction of movement of their associated storms; this is similar to a gust front except that the wind is sustained and generally increases in strength behind the "gust" front. A warm weather phenomenon, derechos occur mostly in summer, especially July, in the northern hemisphere. They can occur at any time of the year and occur as frequently at night as in the daylight hours.

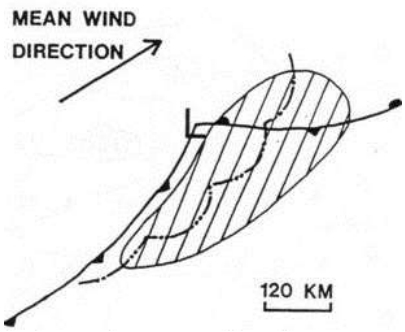
The traditional criteria that distinguish a derecho from a severe thunderstorm are *sustained* winds of 58 mph during the storm as opposed to gusts, high and/or rapidly increasing forward speed and geographic extent (typically 250 nautical miles in length). In addition, they have a distinctive appearance on radar (bow echo);

several unique features, such as the rear inflow notch and bookend vortex and usually manifest two or more downbursts. There are three types of derechos:

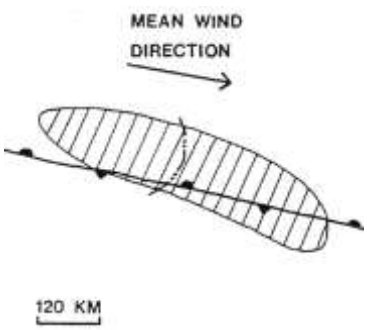
- Serial: Multiple bow echoes embedded in a massive squall line typically around 250 miles long. This type of derecho is usually associated with a very deep low. Also because of embedded supercells, tornadoes can easily spin out of these types of derechos.

- Progressive: A small line of thunderstorms take the bow-shape and can travel for hundreds of miles.

- Hybrid: Has characteristics of a serial and progressive derechos. Hybrid derechos are associated with a deep low like serial derechos but are relatively small in size like progressive derechos.[80]



Serial Derecho



Progressive Derecho

Physical Characteristics

Tornadoes are visible because low atmospheric pressure in the vortex leads to cooling of the air by expansion with condensation and formation of water droplets. They are also visible as a result of the airborne debris and dust in its high-winds. Wind and pressure differential are believed to account for ninety percent of tornado damage in most cases. Because tornadoes are associated with storm systems, they usually are accompanied by hail, torrential rain and intense lightning.

[80] http://en.wikipedia.org/wiki/Derecho

Tornadoes typically produce damage in an area that does not exceed one-fourth mile in width or sixteen miles in length. Tornadoes with track lengths greater than 150 miles have been reported although such tornadoes are rare.

Tornadoes damage severity is measured by the Fujita Tornado Scale, which assigns an "F" ("Fujita") value from 0 – 5 to denote the wind speed.

The Fujita Tornado Scale[81]		
Category	**Wind Speed**	**Description of Damage**
F0	40-72 mph	Light damage. Some damage to chimneys; break branches off trees; push over shallow-rooted trees; damage to sign boards.
F1	73-112 mph	Moderate damage. The lower limit is the beginning of hurricane speed. Roof surfaces peeled off; mobile homes pushed off foundations or overturned; moving autos pushed off roads.
F2	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	158-206 mph	Severe damage. Roofs and some walls torn off well-constructed houses; trains overturned; most trees in forest uprooted; cars lifted off ground and thrown.
F4	207-260 mph	Devastating damage. Well-constructed houses leveled; structures with weak foundations blown off; cars thrown and large missiles generated.
F5	261-318 mph	Incredible damage. Strong frame houses lifted off foundations and carried considerable distance to disintegrate; automobile-sized missiles fly through the air in excess of 100-yards; trees debarked.

On 1 February 2007, the National Weather Service began rating tornadoes using the EF-scale. It is considerably more complicated than the F-scale and it will allow surveyors to create more precise assessments of tornado severity. Below is a comparison between the Fujita Scale and the EF Scale:

Fujita Scale			Derived EF Scale		Operational EF Scale	
F Number	**Fastest ¼ mile (mph)**	**3 Second Gust (mph)**	**EF Number**	**3 Second Gust (mph)**	**EF Number**	**3 Second Gust (mph)**
0	40-72	45-78	0	65-85	0	65-85
1	73-112	79-117	1	86-109	1	86-110
2	113-157	118-161	2	110-137	2	111-135
3	158-207	162-209	3	138-167	3	136-165
4	208-260	210-261	4	168-199	4	166-200
5	261-318	262-317	5	200-234	5	Over 200

Downburst Characteristics

Downburst damage is often highly localized but resembles damage caused by a tornado. In some cases, even an experienced

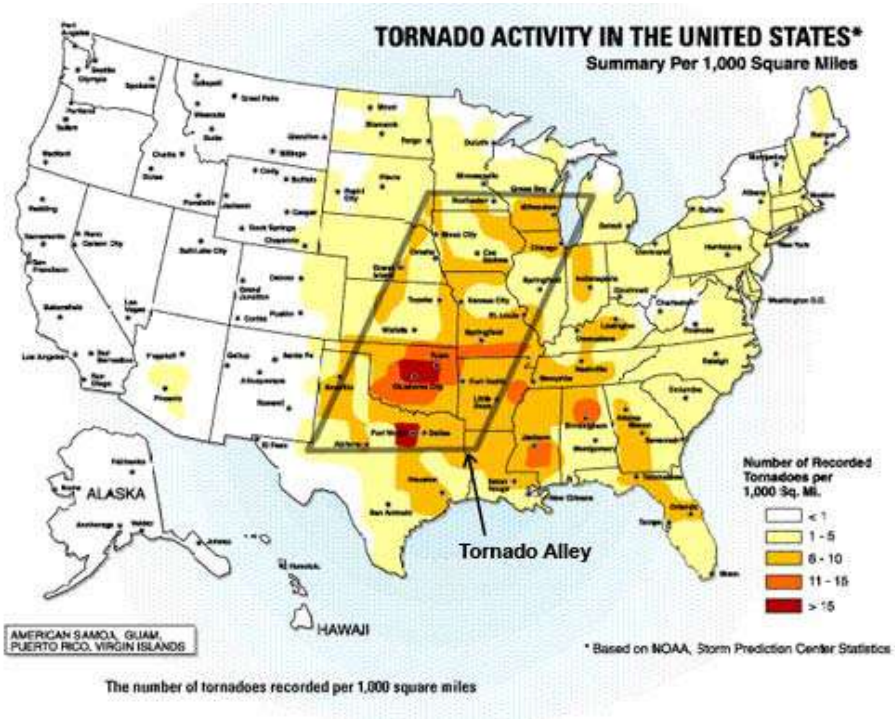
81 FEMA, 1997

investigator cannot identify the nature of a storm without mapping the direction of the damaging winds over a large area. There are significant interactions between tornadoes and nearby downbursts.

A classic downburst example occurred on 4 July 1977 when a severe thunderstorm moved across Northern Wisconsin. Extensive areas of tree and property damage, somewhat like a tornado, were reported. After an aerial survey was completed to map both direction and F-scale intensity of the damaging winds it was determined that no evidence of a tornado was found anywhere within the path of the damage swath, which was 166 miles long and 17 miles wide. The survey revealed that there were scattered local centers from which straight-line winds diverged outward. These local wind systems were identified as downbursts with at least 25 specific locations recognized by the low-flying aircraft.

Frequency of Occurrence

Wisconsin lies along the northern edge of the nation's tornado belt, which extends northeastward from Oklahoma into Iowa and across to Michigan and Ohio. Winter, spring and fall tornadoes are more likely to occur in southern Wisconsin than in northern counties.



Wisconsin's tornado season runs from the beginning of April through September with the most severe tornadoes typically occurring in April, May and June. Tornadoes, have, however, occurred in Wisconsin during every month except February. Many tornadoes strike in late afternoon or early evening but they do occur at other times. Deaths, injuries and personal property damage have and will continue to occur in Wisconsin.

According to the National Weather Service, Kewaunee County had high winds, funnel clouds and seven tornadoes between 1 January 1950 and 31 March 2013. Between these dates, the county had no deaths, one injury and approximately $2.2M in damages due to these storms. The probability of Kewaunee County being struck by a tornado in the future is medium and the likelihood of damage from future tornadoes is also medium. All parts of Kewaunee County are equally susceptible to tornadoes.

Year	Date	Date/Location	Human Losses	Damage Losses	Miscellaneous
1969	7/02	Kewaunee County	Deaths: 0 Injuries: 0	Property: $25K Crop: $0	F1 tornado
1970	4/22	Kewaunee County	Deaths: 0 Injuries: 0	Property: $250K Crop: $0	F2 tornado
	4/22	Kewaunee County	Deaths: 0 Injuries: 1	Property: $250K Crop: $0	F2 tornado
1972	7/20	Kewaunee County	Deaths: 0 Injuries: 0	Property: $25K Crop: $0	F1 tornado
1978	5/08	Kewaunee County	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	Tornado
	5/08	Kewaunee County	Deaths: 0 Injuries: 0	Property: $250K Crop: $0	Tornado
1994	4/24	Luxemburg	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	F0 tornado
	11/18	Kewaunee County	Deaths: 0 Injuries: 1	Property: $10K Crop: $0	High winds
1997	4/06	Kewaunee County	Deaths: 1 Injuries: 0	Property: $149K Crop: $0	High winds
1998	3/09	Kewaunee County	Deaths: 0 Injuries: 0	Property: $15K Crop: $0	High winds
	6/27	Kewaunee County	Deaths: 0 Injuries: 0	Property: $30K Crop: $0	High winds – 61 knots
	11/10	Kewaunee County	Deaths: 1 Injuries: 1	Property: $1million Crop: $0	High winds – 63 knots
1999	3/17	Kewaunee County	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	Strong winds
	12/25	Kewaunee County	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	Strong winds
2000	3/25	Kewaunee County	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	Strong winds
	4/05	Kewaunee County	Deaths: 0	Property: $0	Strong winds

Year	Date	Date/Location	Human Losses	Damage Losses	Miscellaneous
			Injuries: 0	Crop: $0	
	04/20	Kewaunee County	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	Strong winds
	06/21	Kewaunee County	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	Strong winds
2001	09/23	Kewaunee County	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	Strong winds
	10/25	Kewaunee County	Deaths: 0 Injuries: 1	Property: $0 Crop: $0	Strong winds
	12/05	Kewaunee County	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	Strong winds
2002	02/11	Kewaunee County	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	Strong winds
	03/09	Kewaunee County	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	Strong winds
	05/09	Kewaunee County	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	Strong winds
	11/30	Kewaunee County	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	Strong winds
2005	11/13	Kewaunee County	Deaths: 0 Injuries: 0	Property: $3K Crop: $0	High winds – 57 knots
2010	10/26	Kewaunee County	Deaths: 0 Injuries: 0	Property: $200K Crop: $0	High winds – 50 knots
2011	5/22	Algoma	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	Funnel cloud
	9/29	Kewaunee County	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	High winds – 52 knots

Vulnerability

Injury to people is a primary concern in tornado and high wind events. Two of the highest risk places are mobile home parks and campgrounds; Kewaunee County has several of each type of property. Both have high concentrations of people in a small area, generally have structures that provide less protection than standard construction homes and none of the listed facilities below provides storm shelters. Other places of interest in these types of events include critical emergency facilities such as hospitals and public works/highway garages, police stations and fire departments, which contain equipment and services needed by the public after a tornado.

Mobile Home Parks	
Park Name	**Location**
Algoma Beach	City of Algoma
Big Lake Estates, LLC	City of Algoma
Lucy Rueckl, Rueckl Construction	Village of Luxemburg
Kewaunee Trailer Park	City of Kewaunee
Lakeview Heights Trailer Court	Town of Pierce

Campgrounds	
Campground Name	**Location**
Ahnapee River Trails Campground	Town of Ahnapee
Big Lake Campgrounds	Algoma
Cedar Valley Campground	Town of Casco
Kewaunee Village RV Park	Kewaunee
Mapleview Campsites	Town of Carlton
Timber Trails Campground	Town of Ahnapee

Schools, in addition to holding children, are the major category of structure used as community disaster shelters and their loss might affect the community on several levels (e.g., the death or injury of children, the loss of a community housing shelter.) School gymnasiums are often the specific location of the community shelter but they are especially vulnerable in tornadoes because the large-span roof structure is often not adequately supported.

Community infrastructure such as power lines, telephone lines, radio towers and street signs are often vulnerable to damage from tornadoes and high winds and can be expensive to replace. The loss of radio towers that hold public safety communications repeaters can adversely impact the ability of first responders to mount an effective response; damage to towers that hold public media equipment may adversely impact the ability to distribute adequate public information.

Residential property is likely to have siding and roofing materials removed, windows broken from flying debris and garages blown down due to light construction techniques. Perhaps one of the largest types of loss on private property is due to tree damage, which is generally not covered by federal disaster assistance.

Business properties are at risk for having damage to infrastructure such as signs, windows, siding and billboards. Agricultural buildings, such as barns and silos, are also generally not

constructed in a manner that makes them wind resistant, which can lead to the loss of livestock and harvest. Standing crops are also at risk from high winds and tornadoes.

The State of Wisconsin Hazard Mitigation Plan reports that in the 7 tornadoes experienced by Kewaunee County from 1950-2010, they had no deaths, six injuries and a total of just over $500,000 in damages with an average of over $78,000 per event. The planners estimated future annual losses at approximately $9,016. (Note all amounts in 2008 dollars.)[82]

Hazard Mitigation Strategies

The goal of tornado and high wind mitigation activities is to reduce, in a cost effective manner, the loss of lives and property due to these events. Kewaunee County has a history of damage to buildings and infrastructure due to tornadoes and high winds. Some strategies below will deal with public information and alert and notification while others will enable the community to make current and future buildings and infrastructure more disaster-resistant by enacting more “bricks and mortar” solutions.

An effective warning system is the single most important resource for alerting the public to a tornado hazard, which is critical to the main goal of saving lives and reducing property losses. Forecasting of tornadoes is difficult, however, because of the suddenness of their onset, their relatively short duration, the extreme variability of a tornado striking area, limited knowledge of tornado dynamics and the limitations of the weather observation system. The Emergency Management Office promotes the use of NOAA weather radios for public alert and notification especially in schools and other high-population facilities.

Local emergency notification procedures are in place for disseminating warnings and safety information using the outdoor sirens and the local radio station. Currently, outdoor sirens are activated at a Tornado Warning only. (Note: municipal first responders are paged out to act as tornado spotters at a Tornado Watch.) After the siren activation, a statement explaining actions to take due to the Tornado Warning are read at the radio station. An outdoor warning siren system consisting of 18 sirens currently reaches less than 50% of the population. Thirteen sirens are owned

[82] State of Wisconsin Hazard Mitigation Plan, pp. 3-50 through 3-56.

by the Kewaunee Nuclear Power Plant, two each are owned by the City of Algoma and the Village of Luxemburg and one is owned by the Village of Casco. The system is tested weekly during the entire year. The county, with the assistance of the nuclear power plants, invested in upgrading the siren computer system to include a capability to monitor the sirens and notify staff if repairs are needed or if there are security problems. The county and the plant are working together to complete another upgrade that will include placing a battery back-up on all of the sirens and expanding the system by five sirens, which will be placed outside of the Emergency Planning Zone (i.e., the 10-mile planning zone around a nuclear power plant.) The cost of these upgrades will be provided by the plant. The office also continues to evaluate various technologies to determine if they can be effectively integrated into the county's alert and notification systems.

During the past several years, there has been a statewide Tornado Awareness Week in late March or April. Media information packets are distributed to reemphasize and alert the public to tornado warning procedures. Kewaunee County actively promotes tornado safety public information as well as other summer severe weather public awareness and educational efforts. Kewaunee County also assists the National Weather Service with sponsoring tornado spotter training. Most of the tornado spotters in Kewaunee County are affiliated with municipal first response departments.

Kewaunee County Emergency Management assists personnel in schools and businesses, public facility managers and individuals with determining "best available" tornado safety areas. The Emergency Management Office also offers weather alert radios for purchase at a discount from retail costs.

The county recognizes mobile home parks and campgrounds are particularly vulnerable locations for people and property during a tornado. To help mitigate the danger, the county plans projects that include:

- Providing information via the website to builders and owners of manufactured and mobile homes regarding the use of tie-downs with ground anchors.
- Provide information to the municipalities regarding the tie-downs for mobile homes in the state regulations.
- Identifying and constructing tornado shelters in mobile home parks and campgrounds as grant funding is available. The U. S.

Department of Commerce Community Development Block Grants may be an avenue to achieve the necessary funding. If grant funding is not available, park owners will be encouraged to plan shelters on their properties.

- Ensure adequate coverage by outdoor warning sirens for campgrounds and mobile home parks. Some of the facilities are near sirens and should be able to hear them but others would need to have the power of the siren boosted or would need a new siren installed in the area. The County Emergency Management Office will work with vendors to determine needs and costs to ensure adequate coverage.

The City of Algoma would like to explore options for creating a storm shelter space for the residents of the Algoma Trailer Park. There is interest in a better sheltering option in the park's community. Options may include planning to open an existing space earlier, upgrade an existing space or build a new sheltering facility. It should be noted that some residents have functional needs.

The City of Kewaunee and the Village of Luxemburg would each like to explore options for sheltering trailer park residents at their parks. There are no shelters available near either trailer park and it might be difficult to get to the shelter quickly in a fast-moving storm.

Storms: Winter

Due to its position along the northern edge of the United States, Wisconsin, including Kewaunee County, is highly susceptible to a variety of winter weather storm phenomena.

Picture of snow drifts after the "Groundhog Day Blizzard" in 2011.[83]

Physical Characteristics

The National Weather Service descriptions of winter storm elements are:

- Heavy snowfall - Accumulation of six or more inches of snow in a 12-hour period or eight or more inches in a 24-hour period.
- Blizzard - An occurrence of sustained wind speeds in excess of 35 miles per hour (mph) accompanied by heavy snowfall or large amounts of blowing or drifting snow.
- Ice storm - An occurrence when rain falls from warmer upper layers of the atmosphere to the colder ground, freezing upon contact with the ground and exposed objects near the ground.
- Freezing drizzle/freezing rain - Effect of drizzle or rain freezing upon impact on objects with a temperature of 32 degrees Fahrenheit or below.

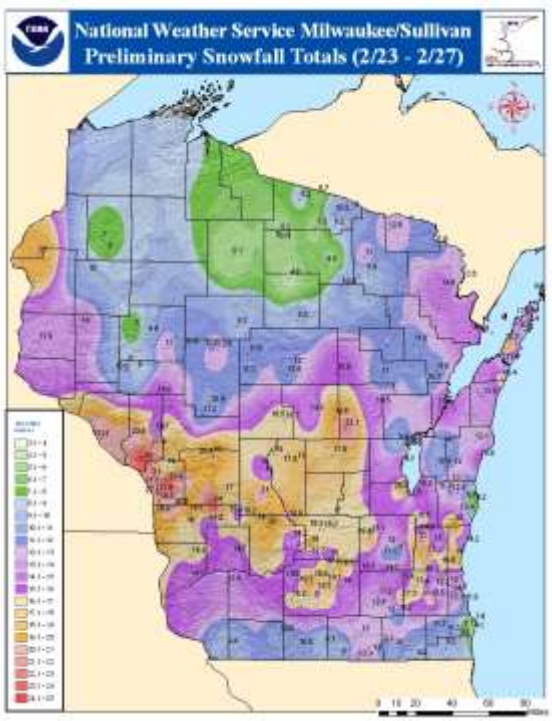
[83] http://readywisconsin.wi.gov/news/Top%20Weather%20Events%20in%20Wisconsin%20for%202011.pdf

- Sleet - Solid grains or pellets of ice formed by the freezing of raindrops or the refreezing of largely melted snowflakes. This ice does not cling to surfaces.
- Wind chill - An apparent temperature that describes the combined effect of wind and low air temperatures on exposed skin.

In Wisconsin, the winter storm season generally runs from November through March and Wisconsin residents are most familiar with heavy snowstorms, blizzards, sleet and ice storms. The majority of Wisconsin snowfalls are between one and three inches per occurrence, although heavy snowfalls that produce at least ten inches may occur four or five times per season. Northwestern Wisconsin encounters more blizzards than the southeastern portions of the state.

Damage from ice storms can occur when more than half of an inch of rain freezes on trees and utility wires, especially if the rain is accompanied by high winds. Another danger comes from an accumulation of frozen rain pellets on the ground during a sleet storm, which can make driving hazardous.

Frequency of Occurrence



Annual snowfall in Wisconsin varies between thirty inches in southern counties to one hundred inches in the north. Kewaunee County averages between 36 and 48 inches of annual mean snow depth in most of the county but a section of the county averages between 48 and 72 inches. Storm tracks originating in the southern Rockies or Plains states and that move northeastward

produce the heaviest precipitation, usually six to twelve inches. Low-pressure systems originating in the northwest (Alberta) tend to produce only light snowfalls of two to four inches. Snowfalls associated with Alberta lows occur more frequently with colder weather.

Although massive blizzards are rare in Wisconsin, blizzard-like conditions often exist during heavy snowstorms when gusty winds cause blowing and drifting of snow. For example, near blizzard conditions existed in Wisconsin in February, 2011 when record snowfalls were recorded in many areas and very strong northeast winds were gusting from 45 to 60 mph for an extended period of time. [84]

Both ice and sleet storms can occur at any time throughout the winter season from November to April. Ice storms of disastrous proportions occurred in central Wisconsin in February 1922 and in southern Wisconsin in March 1976. A Presidential Disaster Declaration occurred as a result of the 1976 storm. Utility crews from surrounding states were called in to restore power, which was off for up to ten days in some areas.

Kewaunee County received a Presidential Emergency Declaration (FEMA-3163-DR-WI) for snow removal for the storm period December 11-31, 2000. Kewaunee was included in this declaration because they were contiguous to other counties with more extensive costs. The county did experience very heavy snowfall and blowing and drifting snow that affected safe travel on the roadways. There were no power outages associated with this storm and the major concern was providing timely emergency medical services to citizens. EMS districts worked with the highway department to ensure that equipment could get to emergency calls. The total cost of this disaster to Kewaunee County (including all municipalities) was $61,936.16.

The probability that there will be severe winter storms in Kewaunee County is medium and the likelihood that those storms will cause significant damage is also medium. The table shows little property damage, but does not take into account the public costs of managing the snow and ice as well as the costs of managing utility repair to power, telephone and water lines. The following table details Kewaunee County's winter storm statistics (i.e., snow and

[84] http://readywisconsin.wi.gov/news/Top%20Weather%20Events%20in%20Wisconsin%20for%202011.pdf and http://www.crh.noaa.gov/mkx/?n=020211_blizzard

ice events) as reported by the National Weather Service including human loss and injury and property damage estimates from 1 January 1950 through 31 March 2013.[85]

Year	Date	Location	Human Losses	Damage Losses	Miscellaneous
1994	01/05	Central and southern WI	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	Heavy snow
1994	01/26	Northeastern, central and southern WI	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	Heavy snow/ice storm
1995	01/19	Kewaunee County	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	Heavy snow
1995	11/26	Central and southern WI	Deaths: 0 Injuries: 1	Property: $0 Crop: $0	Heavy snow
1995	12/09	Northeastern and east-central WI	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	Heavy snow
1995	12/13	Central WI	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	Ice storm
1996	01/03	Kewaunee County	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	Heavy snow
1996	01/23	Kewaunee County	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	Heavy snow
1996	01/25	Kewaunee County	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	Heavy snow
1996	01/26	Kewaunee County	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	Winter storm
1996	02/06	Kewaunee County	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	Freezing rain
1996	02/07	Kewaunee County	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	Freezing rain
1996	02/26	Kewaunee County	Deaths: 0 Injuries: 1	Property: $0 Crop: $0	Ice storm
1996	12/23	Kewaunee County	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	Heavy snow
1997	01/09	Kewaunee County	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	Heavy snow
1997	02/04	Kewaunee County	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	Heavy snow
1997	03/13	Kewaunee County	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	Heavy snow
1997	10/26	Kewaunee County	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	Snow
1998	01/08	Kewaunee County	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	Winter storm
1998	01/14	Kewaunee County	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	Heavy snow

[85] http://www.ncdc.noaa.gov/stormevents/

Year	Date	Location	Human Losses	Damage Losses	Miscellaneous
1998	3/08	Kewaunee County	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	Winter storm
1999	1/02	Kewaunee County	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	Winter storm
2000	1/03	Kewaunee County	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	Winter storm
	12/18	Kewaunee County	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	Heavy snow
2001	2/08	Kewaunee County	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	Winter storm
2002	1/31	Kewaunee County	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	Heavy snow
	2/01	Kewaunee County	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	Heavy snow
	3/02	Kewaunee County	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	Winter storm
2003	4/04	Kewaunee County	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	Winter storm
2004	1/09	Kewaunee County	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	Heavy snow
	1/14	Kewaunee County	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	Heavy snow
	1/26	Kewaunee County	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	Winter storm
	2/05	Kewaunee County	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	Heavy snow
2005	1/18	Kewaunee County	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	Winter storm
	1/21	Kewaunee County	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	Winter storm
	2/20	Kewaunee County	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	Heavy snow
2006	2/16	Kewaunee County	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	Blizzard
	2/16	Kewaunee County	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	Winter storm
2007	1/14	Kewaunee County	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	Winter storm
	2/24	Kewaunee County	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	Winter storm
	4/11	Kewaunee County	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	Winter storm
	12/01	Kewaunee County	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	Winter storm
2008	1/29	Kewaunee County	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	Winter storm
	2/14	Kewaunee County	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	Heavy snow
	2/17	Kewaunee County	Deaths: 0	Property: $0	Winter storm

Year	Date	Location	Human Losses	Damage Losses	Miscellaneous
			Injuries: 0	Crop: $0	
	12/08	Kewaunee County	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	Heavy snow
	12/19	Kewaunee County	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	Heavy snow
2009	2/26	Kewaunee County	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	Winter storm
	3/08	Kewaunee County	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	Winter storm
	12/26	Kewaunee County	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	Heavy snow
2010	12/11	Kewaunee County	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	Winter storm
2011	1/31	Kewaunee County	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	Heavy snow
	2/01	Kewaunee County	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	Heavy snow
	2/20	Kewaunee County	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	Winter storm
	3/22	Kewaunee County	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	Winter storm
	4/19	Kewaunee County	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	Heavy snow
2012	3/02	Kewaunee County	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	Heavy snow
2013	1/30	Kewaunee County	Deaths: 0 Injuries: 0	Property: $0 Crop: $0	Winter storm

Vulnerability

Winter storms present a serious threat to the health and safety of affected citizens and can result in significant damage to property. Heavy snow or accumulated ice can cause the structural collapse of homes, commercial buildings and agricultural structures; down power lines or isolate people from assistance or services by impeding transportation by the general public, emergency responders and public transportation resources.

The loss of electrical service and/or the blocking of transportation routes can adversely affect the ability of commercial enterprises to conduct business. This economic injury can affect both the business owner and employees unable to work during this period.

Hazard Mitigation Strategies

The goal of winter storm mitigation activities is to reduce, in a cost effective manner, the loss of lives and property due to these events. Communities prepare for severe winter weather by ensuring that plowing and sanding equipment is operational and available to handle potential emergencies. Funding is budgeted for the overtime hours of extra personnel but in a large emergency this may not be adequate. Redundant communication modes (e.g., radio, telephone) exist between government, police, fire, EMS, hospitals and highway departments. The Kewaunee County Emergency Operations Plan provides for coordination of public safety support agencies such as the American Red Cross and for resource acquisitions during winter emergencies.

Winter safety information is prepared and distributed to the media and the public by the Kewaunee County Emergency Management Office during Winter Awareness Week in November. Preparedness information is also available from display racks in the emergency management office and from the website. During a storm, the public is advised to monitor local radio, television and NOAA weather alert radios for up-to-date forecasts.

The County Highway Department also has within its annual operating budget funds designated to deploy wooden lattice snow fencing along state and county roads. This fencing blocks the blowing and drifting of snow on the roadways.

The hazard mitigation strategies listed above primarily involve providing information on general safety measures to the public. These measures provide basic safety information but, since the response to winter storms is primarily a government and/or corporate function comprised of tasks such as clearing roads of snow and ice and repairing downed utility lines, there are few measures that can be employed to reduce damages to existing or future buildings and infrastructure.

Utility Failure

A utility emergency is a disruption to the building services, usually defined as electrical power, water, natural gas and/or sewage that restricts the ability of people to safely occupy the facility. Electrical power or natural gas outages are often caused by a fuel shortage caused by an oil embargo, power failure or natural disaster. Disruptions to the water and sewage systems are often the direct result of a natural disaster (e.g., flooding) or are indirect losses due to another failure (e.g., a power outage disrupts the pumping of water and/or sewage).

Physical Characteristics

Modern society is very dependent on electrical power for normal living and is therefore quite disrupted by loss of power. Most power outages last from about fifteen minutes to one hour. If longer, the utilities will inform the local news media of the anticipated duration of the outage.

Thunderstorms with lightning are a possible cause of power failure. Fuel shortages can be caused by localized imbalances in supply. Labor strikes, severe cold weather or snowstorms also can cause a local shortage.

Utility providers to Kewaunee County include:

- Electricity: Wisconsin Public Service (WPS) and Algoma Utilities (City of Algoma)
- Natural Gas: WPS
- Telephone: AT&T and CenturyTel (Casco)
- Cable Television: Charter
- Water/Sewer: a large percentage of the county's residents, primarily those in the more rural townships, rely on individual wells and septic systems for service. Many municipalities provide services in the cities and villages including the Cities of Algoma and Kewaunee, and Villages of Casco and Luxemburg.

Electrical substation

The water and sewage systems are most often a function of a municipal system and are usually found in more urbanized areas. Rural water is often provided by individual wells found on each property and sewage is managed by a septic system, also found on each individual property. Both municipal and individual systems are vulnerable to flooding, which can overwhelm the sewage systems and contaminate both municipal and private wells. Both types of systems are also vulnerable to electrical power loss because the electrical system powers the pumps and lift stations that move and treat the water and sewage.

Frequency of Occurrence

Kewaunee County has approximately 6-10 short power outages (i.e., lasting less than six hours) per year but does not have a history of extended power outages although the possibility always exists that a man-made or natural disaster could affect the power system for an extended period of time. Due to the mostly rural nature of Kewaunee County, brown-outs (i.e., times when, because of high power demand, areas are purposefully turned off of the power grid) are not a strategy used by the power companies that provide service.

In general, Kewaunee County has a medium likelihood of utility loss with a medium risk of damage, death or injury due to a loss. Obviously, power outages are more likely to occur and the severity is greater in areas of higher human population (i.e., urban areas)

but the loss of power to rural customers, while affecting fewer people, generally lasts longer and can be as life-threatening, especially if a person with special needs (e.g., the elderly, the young, those on special medical equipment) is involved.

Vulnerability

The failure of a utility to function can have wide-ranging impact in Kewaunee County. People, especially special needs populations, in residential properties may not be able to safely live in their homes because of inadequate heat, the inability to cook, etc. Most schools and both of the nursing homes in Kewaunee County have emergency power generators for their facilities. Businesses, including the utilities themselves, may lose money due to the inability to produce goods and services for which they can bill and they may be non-operational due to damaged infrastructure, which can be very expensive to replace and/or repair. Critical infrastructure such as hospitals, schools and governmental facilities may not be able to operate or may have to operate at a reduced capacity due to the loss of utility services. EPCRA facilities may not be able to adequately control and contain their chemicals and there may be a release of hazardous materials that can impact people or the environment.

Agricultural assets may be impacted by the loss of utilities because extreme temperatures reduce the volume of livestock products and products such as milk may not be able to be properly stored. Modern farms also require on a large amount of automation for feeding, watering and managing the wastes of the facility.

Finally, transportation on roadways may become unsafe due to the loss of directional and street lights.

It should be noted that the Kewaunee Nuclear Power Plant is within the county's boundaries and the Point Beach Nuclear Power Plant is just over the southern border of the county (i.e., in Manitowoc County.) These plants together provide 20% - 25% of the power used in the State of Wisconsin. There are several large transmission lines that take the power from the generating stations to the rest of the electrical power grid, many of which originate or run through Kewaunee County. The loss of these lines could seriously impact the delivery of electrical power to other citizens in Wisconsin.

There is also a natural gas pipeline that runs to Casco and Luxemburg by County Road S.

Hazard Mitigation Strategies

The goal of mitigating against utility failure is to save lives, preserve health and reduce property damage by employing the types of cost-effective measures discussed in this section.

Kewaunee County has worked directly with the utility companies and first responders to formulate emergency plans. There is a long and strong relationship with the electrical power companies due in part to the presence of the nuclear power plants. The county does not have as strong a relationship with the natural gas pipeline owners and would like to open dialog with the company so they become a partner in the emergency planning process. This project would be led by the Emergency Management Office and any costs would be covered by the department budget. Kewaunee County would also like to explore preparedness (planning, training, exercising) options concerning the high pressure water line running from Green Bay to Lake Michigan. There is a concern that a rupture could affect the entire underground area around buried pine.

During a fuel or power shortage, residents, schools, industry and businesses will be asked to take measures to conserve fuel. If the fuel shortage reaches the critical stage, all non-essential facilities will be closed down and contingency plans will be put into effect.

In the event of a prolonged power outage, Kewaunee County has generators available to provide power for radio communication and EOC operation. Also, evacuation and shelter arrangements have been prepared in case of a severe power outage.

Non-Natural Disasters

As the communities in Kewaunee County completed their risk assessments, some non-natural disasters came to light. The communities decided to include an additional chapter in this plan so that all of their concerns, and their mitigation planning for these concerns, is represented in one location for reference and to guide actions throughout the plan's lifespan. The primary issue that will be addressed in this chapter is Manure Spills.

Manure Spill Incidents

Kewaunee County is concerned about the possibility of a manure spill, which is defined as a release of manure from a manure holding tank (pit) or while in transport to a field, which could potentially contaminate groundwater or surface water. Contaminated groundwater could potentially impact municipal and private drinking water wells. This is an especially large concern in Kewaunee County where karst geology can create a direct pathway for contaminants to get to the aquifer (i.e., drinking/well water) prior to filtration through the soil.

[86]

[86] http://www.flickr.com/photos/20387582@N02/3239653560/

Physical Characteristics

Liquid manure stored in manure tanks or ponds has a low solids content, giving it a consistency and therefore physical properties similar to that of water. As a result, liquid manure, when released in a spill, flows in the same manner as water, thereby placing surface water and conduits to groundwater at risk of contamination.

Additional Concerns

According to the Wisconsin Department of Agriculture, Trade and Consumer Protection, the decomposition of manure in storage or handling systems generates gases, some of which are toxic, explosive and oxygen displacing. The most hazardous gases are hydrogen sulfide (H^2S), ammonia (NH^3), methane (CH^4) and carbon dioxide (CO^2). Dangerous levels of these gases can accumulate in and around manure management systems particularly when manure is being agitated or otherwise disturbed.

- Hydrogen sulfide levels may increase a thousand-fold during agitation. This extremely toxic gas is the most dangerous manure gas as it is colorless, heavier than air and may cause death in seconds at high concentrations. While hydrogen sulfide is commonly known for its rotten egg odor, the odor is not detectable by the human sense of smell at higher concentrations. It affects the eyes and the respiratory and central nervous systems.
- Ammonia is lighter than air, has a sharp pungent odor and at higher concentrations, it may cause permanent lung damage. Ammonia causes irritation of the eyes and respiratory tract and it is generally found in higher concentrations in poultry manure.
- Methane is highly flammable. A spark from equipment, open flames, smoking materials, faulty wiring or welding could provide an ignition source for an explosion or fire. Methane is odorless, colorless and lighter than air. By displacing air at high concentrations, methane which is itself non-toxic, can become an asphyxiant and will cause rapid breathing, dizziness and fatigue.
- Carbon dioxide is heavier than air and will displace oxygen. Carbon dioxide exposure may result in headaches and dizziness. Death by asphyxiation is possible at high concentrations.

While manure is the primary source for the hazardous gases addressed here, the decomposition of other organic material, such as milking center waste, waste feed, feed leachate and any combination of these materials, may pose similar risks.[87]

Frequency of Occurrence

Small manure spills occur frequently and, while they can be a contributing factor to environmental degradation, they rarely and immediately affect the health and safety of the population. Following is a table listing the reported manure spills in Kewaunee County from 2010 through October, 2013.

Spiller	Amount Spilled (gallons)	Miscellaneous Information
Rolling Hills Dairy	100	
DeBroux Custom Work	100	Full tanker rolled over going around a corner.
L & M Industries	3,500	Clamp broke free from hose. Manure flowed about 80 yards downstream about 40 yards from wetland.
Waste Control Services	500	Operator opened the wrong valve while operating pump. Opened manure valve releasing manure into the ditch.
Lake to Lake Customs	500	Sheer pin broke on tank allowing manure to backfill and overflow into the road ditch. Manure flowed down stream just about to Casco Creek that feeds into the Lake Michigan.
Chris Engebose	150,000	Manure pit was filled to the top and the farmer was going to pump the following day. Farmer left and returned a few hours later to discover the pit was more than half empty. One of the lower retention boards broke allowing manure to escape from the pit. A sand dike was placed.
Pagel's Ponderosa	Unknown amount	After field application, manure got into the field tile and into river.

[87] http://www.datcp.state.wi.us/arm/agriculture/land-water/conservation/ pdf/ManureGasSafetyReport.pdf

Marty Goral	50	Field application ran into the ditch.
Rolling Hills Dairy	300	Hole in the manure line as they injected and manure was leaking out.
Dairy Dreams	3,000	Power failure allowed tank to overflow. Manure ran in ditch and culvert pipe.
Wakker Dairy	100	Pressure valve on manure truck released causing manure to spill on roadway.
Rolling Hills Dairy	2,000	Small slurry storage overtopped and ran into the ditch and into the grass waterway. Overtopping believed to be caused from the rain the day before and throughout the night.
L & M Industries	5,000	Pipe going under the culvert sprung a leak and spilled into ditch.
Kinnard Farms	6,000	Pipe froze causing manure to spill into the field behind the manure pit. This area is near a fresh water spring and creek that leads to Casco Creek.
Wakker Dairy	150	The manure line broke while pumping manure from pit to field.
John Ledvina Farm	5,000	Malfunction with a pump which caused the manure to start overflowing onto the lawn, into the barn and property around the barn.
L & M Industries	5,000	Connection fell apart on the manure hauler causing manure to spill into a drainage ditch.
Steinhorst Farm	8,000	Valve stuck on the pump causing the spill onto the gravel driveway.
Pagels Ponderosa	1,000	FRAC tank was overfilled during manure hauling. Manure spilled onto the roadway and into ditch.
Deer Run Dairy	700	Floor drains overran in digester building. Manure was contained within 75' from building and most of it froze on top of the snow.
L & M Industries	4000 manure	Tanker tipped over in ditch. Berm was made to contain manure to ditch and field.

Large spills of the type that are seriously, immediately and directly dangerous are very rare and Kewaunee County has a low probability of experiencing one of those types of incidents.

Vulnerability

Wisconsin, like many places in the United States, is seeing the closure of traditional, small family farms and is seeing more industrial, large-scale farms opening and operating. These businesses, due to the scale of their operations, are much more likely to see the large manure quantities that require transport and storage facilities that may fail. Kewaunee County expects, like the rest of the state, to see industrial farming increase in the future. Large manure spills from whatever the source can negatively affect the environment by, for example, changing the chemistry of local surface water to increase algae blooms and/or reduce oxygen so that fish and other aquatic life are negatively affected. Large spills can also put biological pathogens from the manure into surface water and contaminate ground water, which is of particular concern for homes that have private wells.[88]

Hazard Mitigation Strategies

The goal of agricultural manure spill mitigation activities is to reduce, in a cost effective manner, reduce environmental damage and public health crises due to these events. Hazard mitigation strategies include providing public information to livestock producers regarding mitigation measures to protect against the hazards of a commercial manure spill, which will be provided with the animal waste permit and creating and instituting notification procedures for manure spills for Land Conservation and

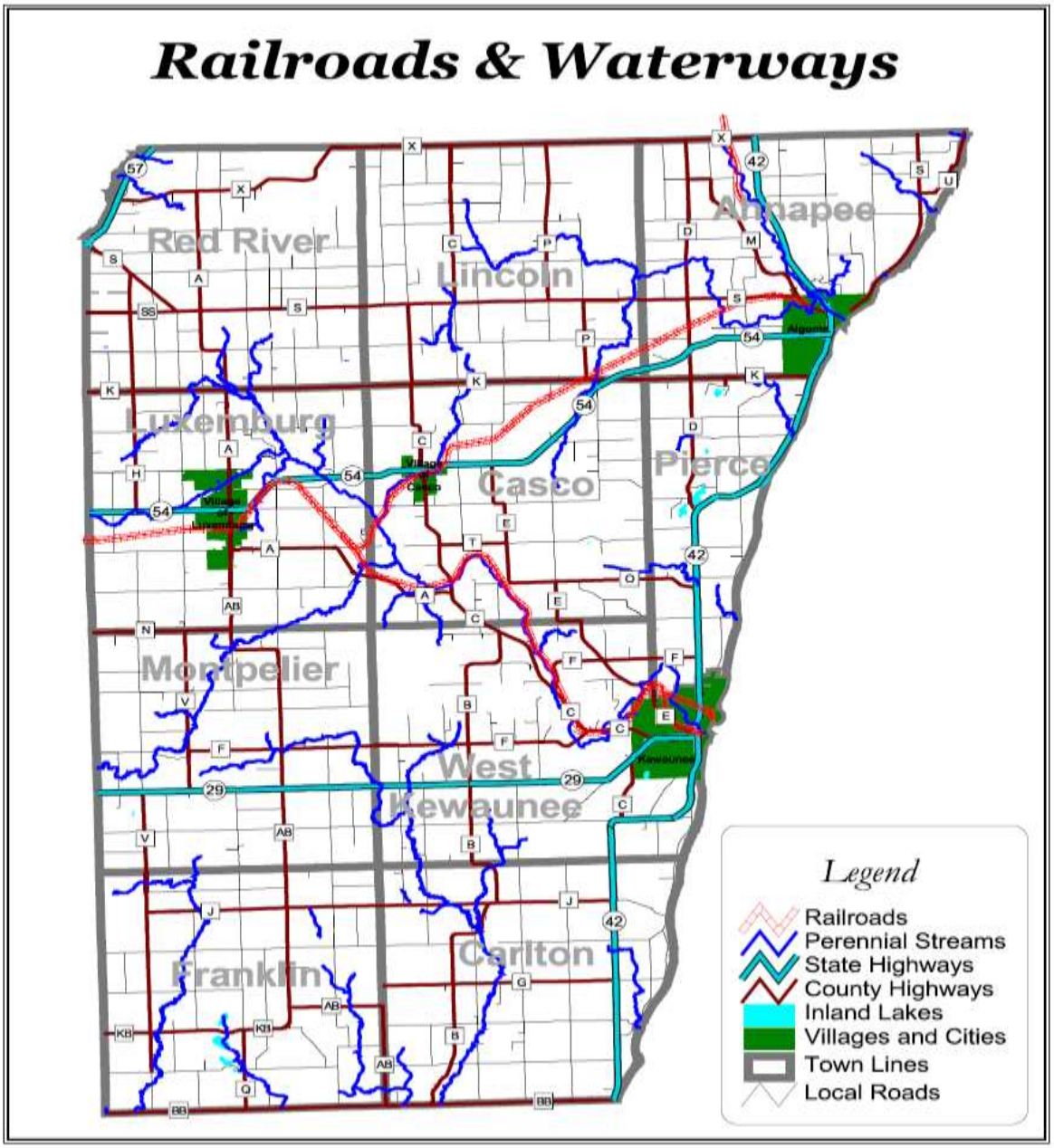
[88] www.ars.usda.gov/is/pr/2008/081001.htm

Emergency Management, which will help reduce and/or minimize fines for farmers.

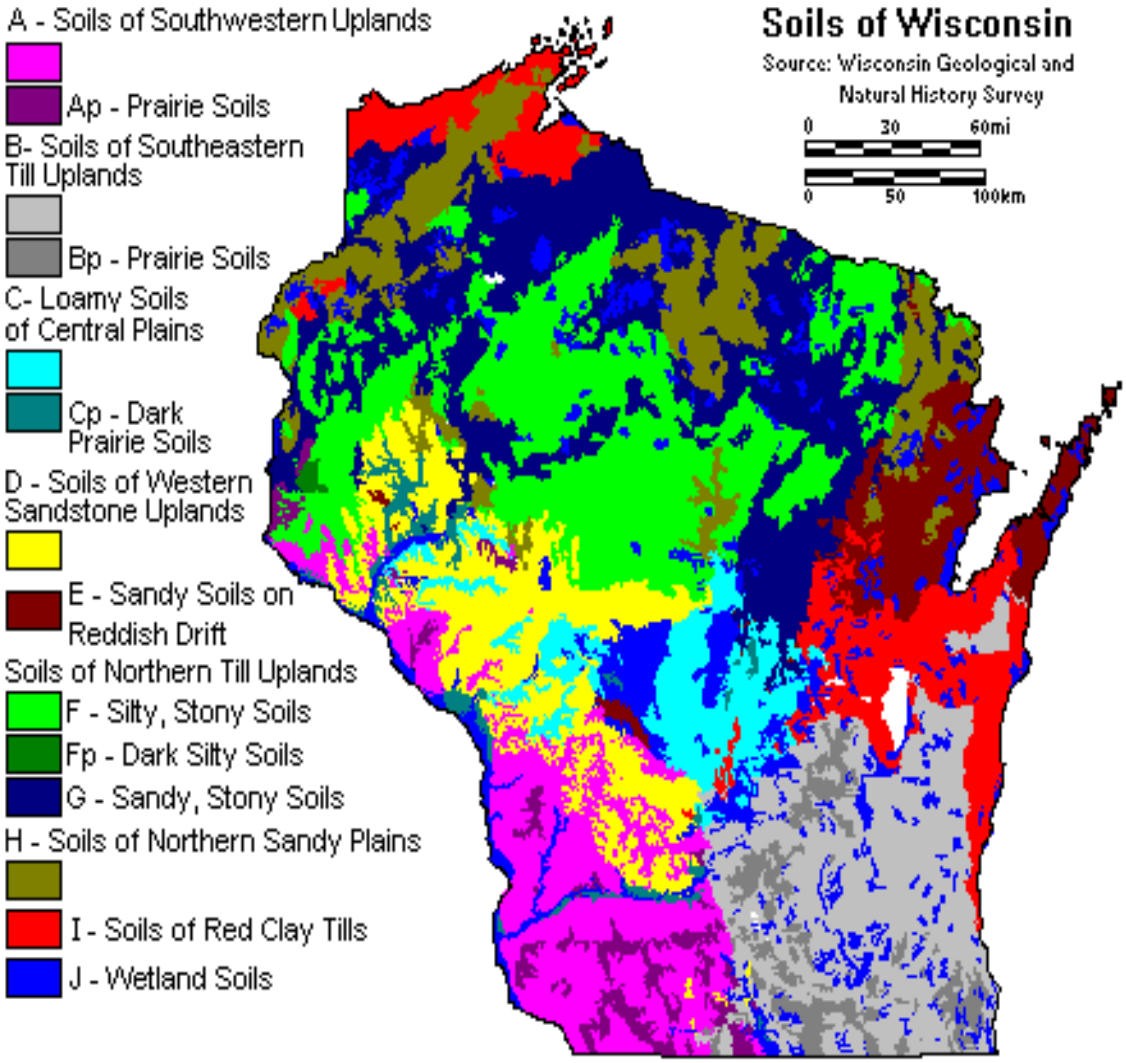
The Village of Casco, with the help and support of Kewaunee County, would like to explore options for protecting its creeks from potential manure spills. The creeks in Casco lead to the Kewaunee River, which flows into Lake Michigan. There is a desire to plan mitigation measures to protect water quality as well as the flora and fauna along the waterways.

Appendix A: Maps

Kewaunee County MCD and Transportation Routes

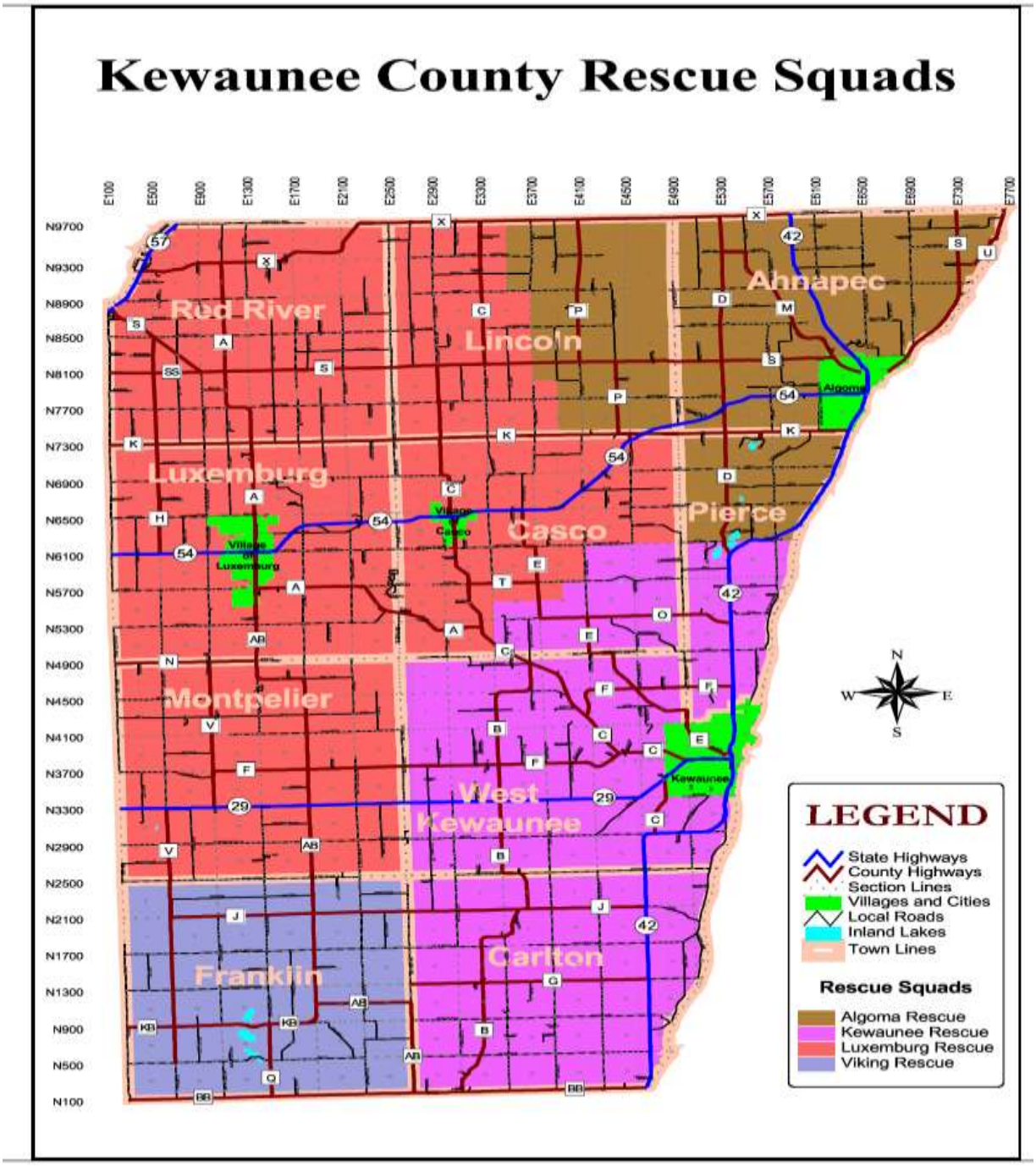


Soils Types[89]

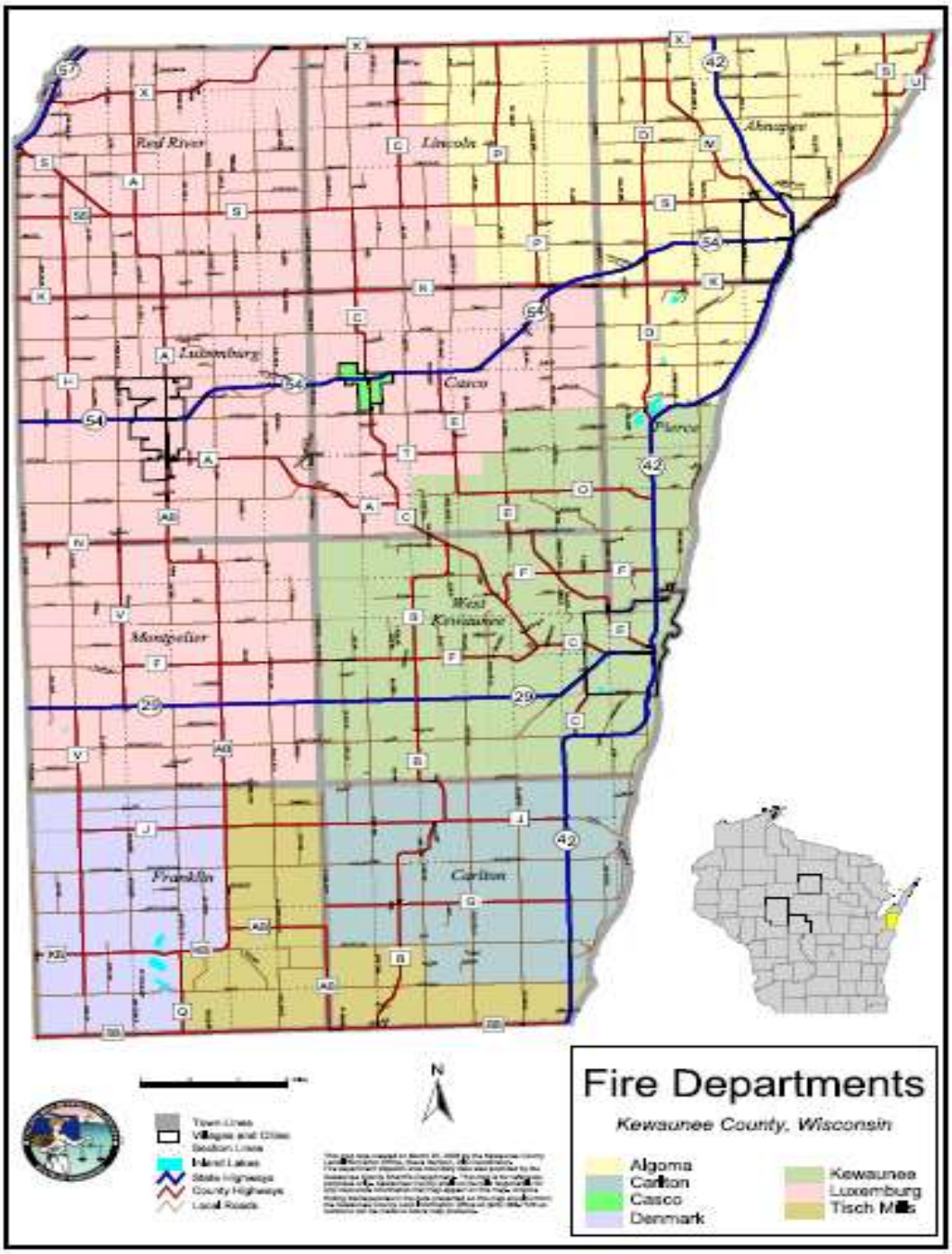


[89] Source: *Soils of Wisconsin* compiled by F. D. Hole, 1973; Wisconsin Geological and Natural History Survey Map, scale (approx.) 1: 3,150,000.

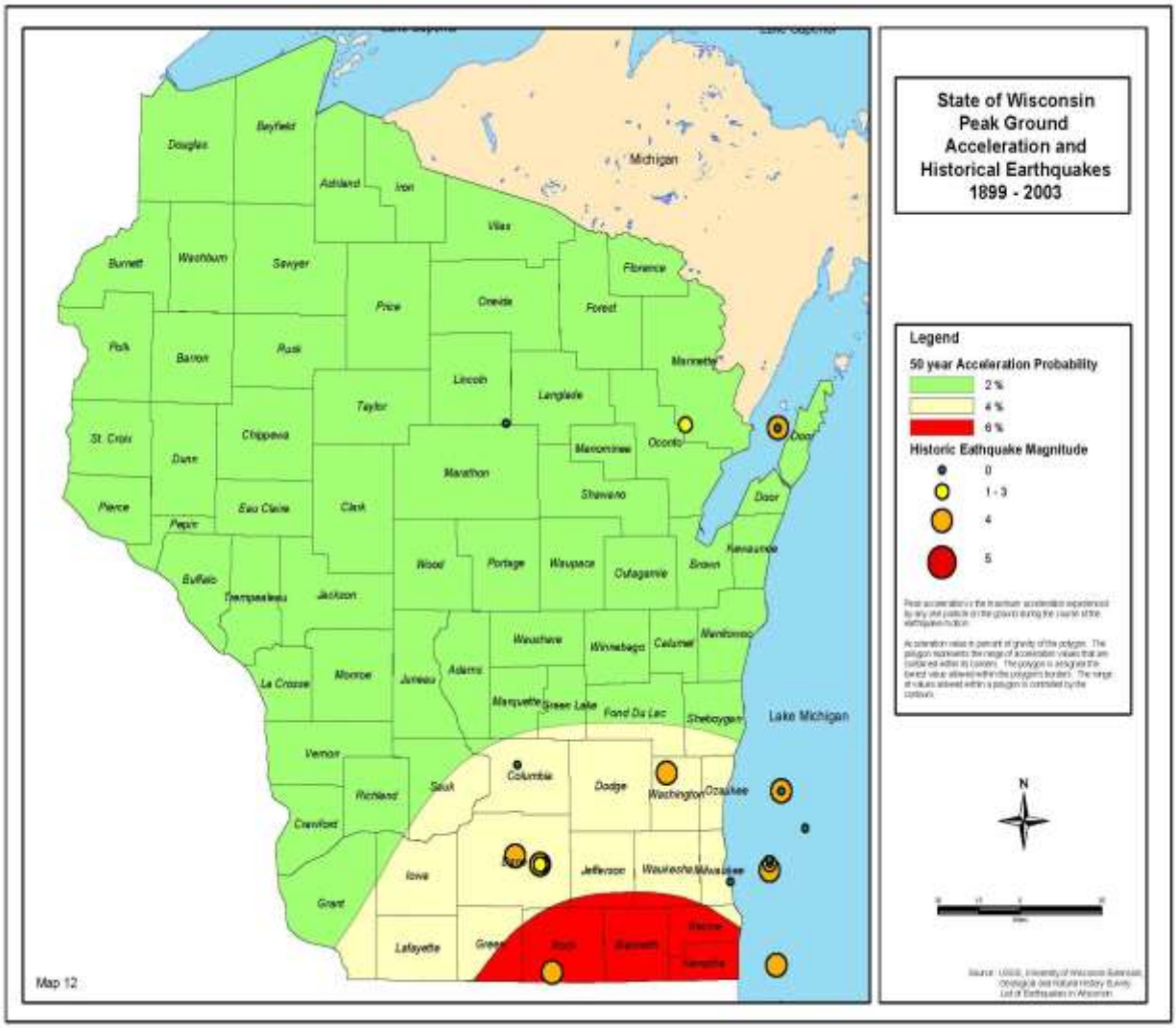
Kewaunee County EMS Service Areas



Kewaunee County Fire Districts

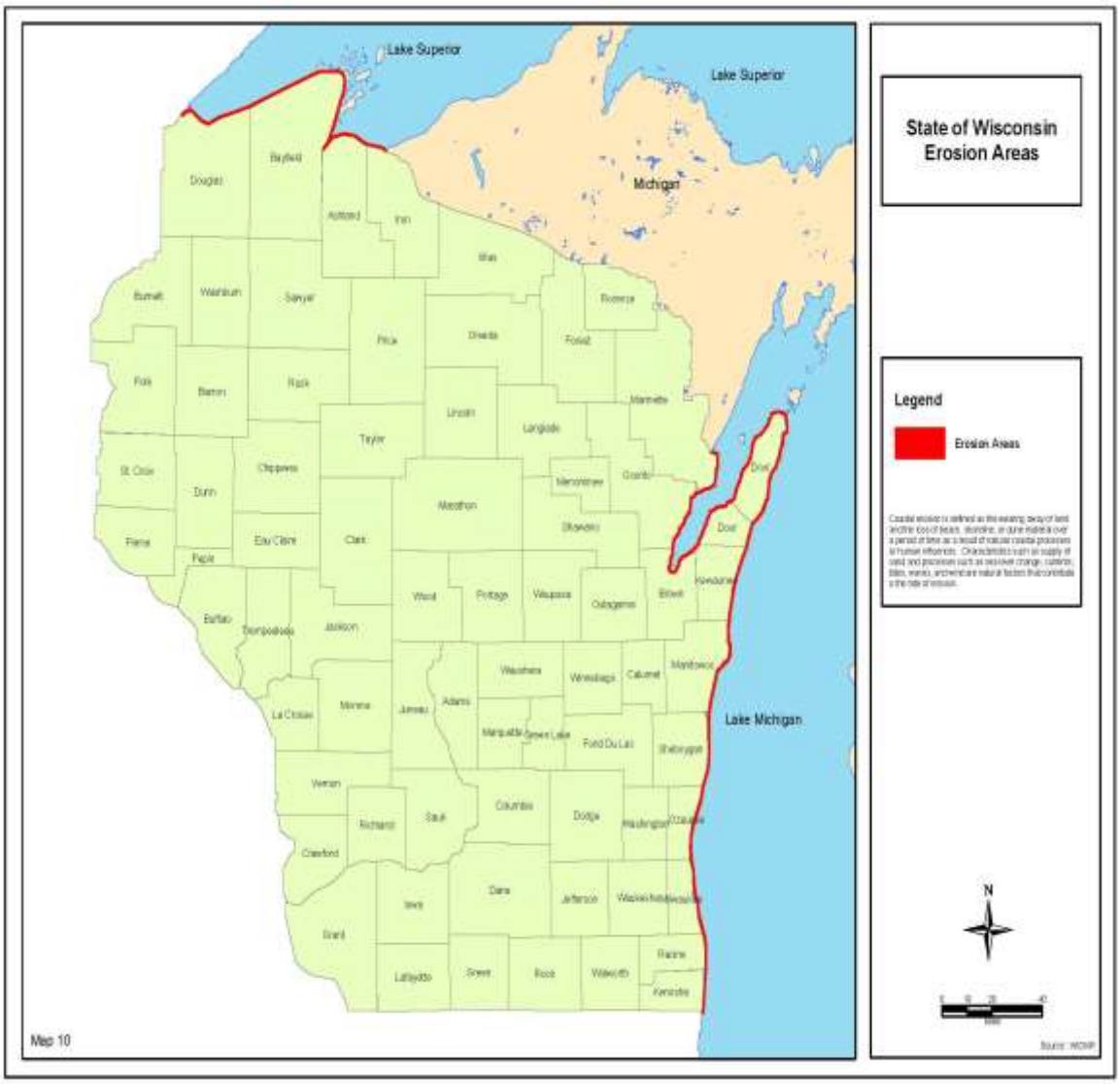


Earthquakes in Wisconsin[90]



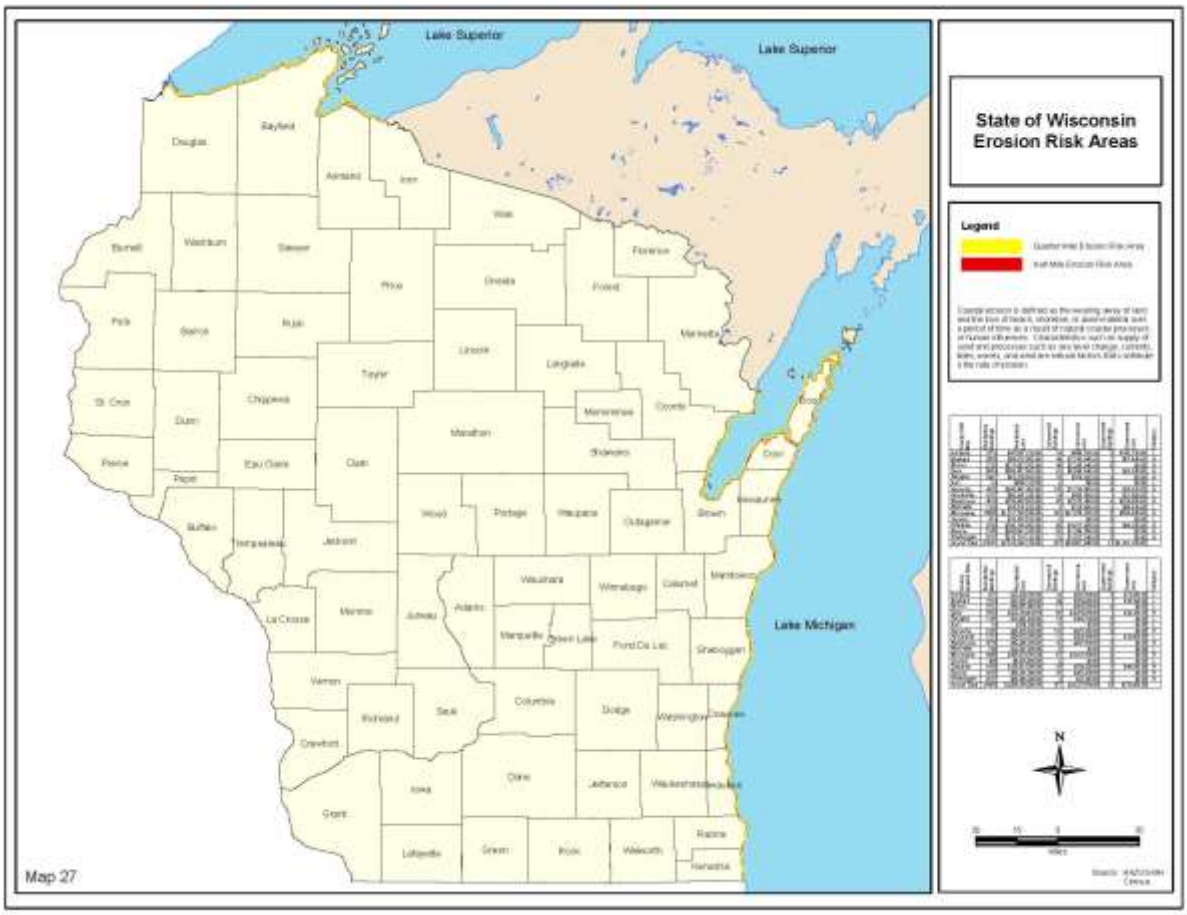
[90] Wisconsin Emergency Management, State Hazard Mitigation Plan

Erosion Areas in Wisconsin[91]



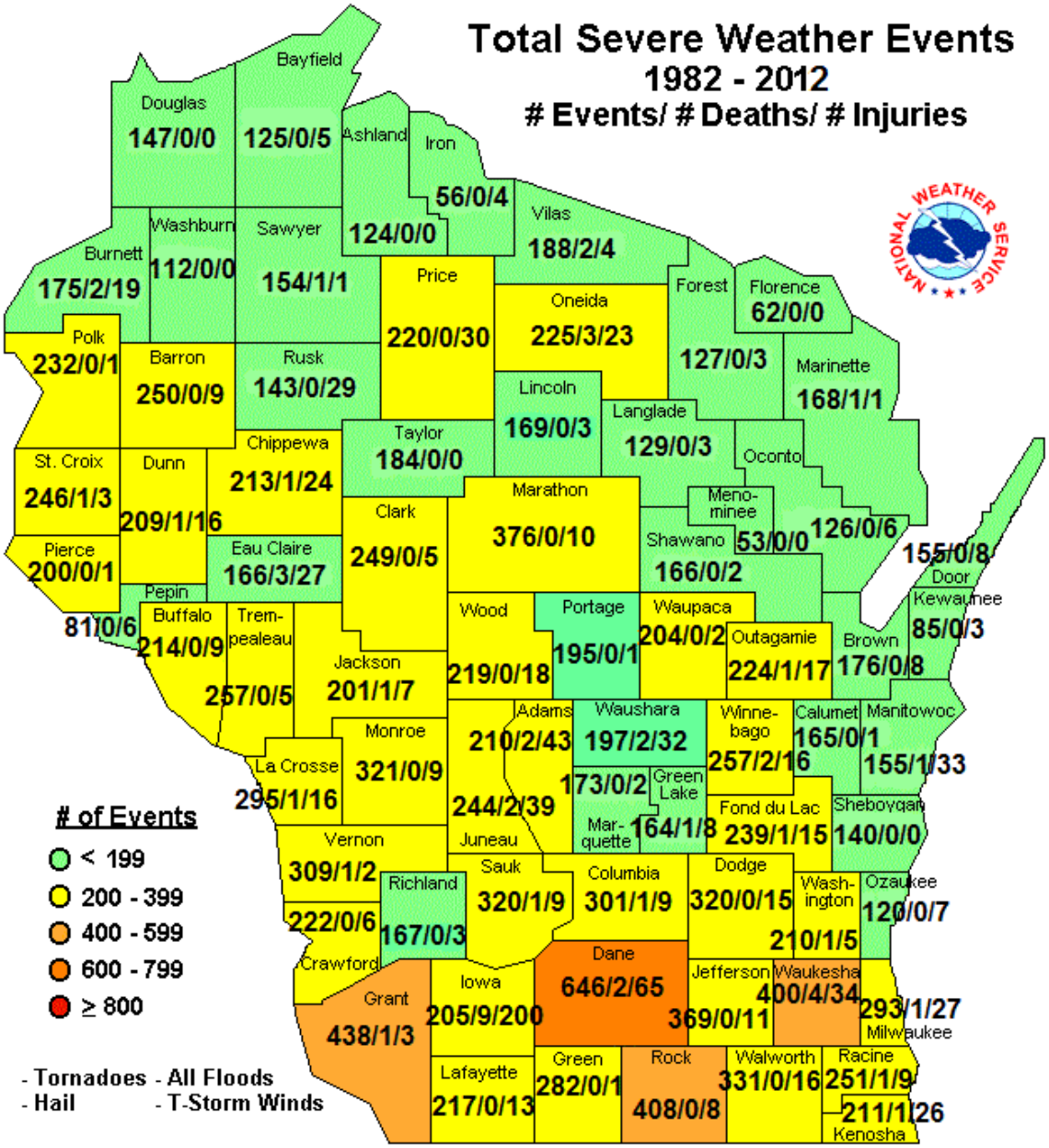
[91] Wisconsin Emergency Management, State Hazard Mitigation Plan

Erosion Risk Areas[92]



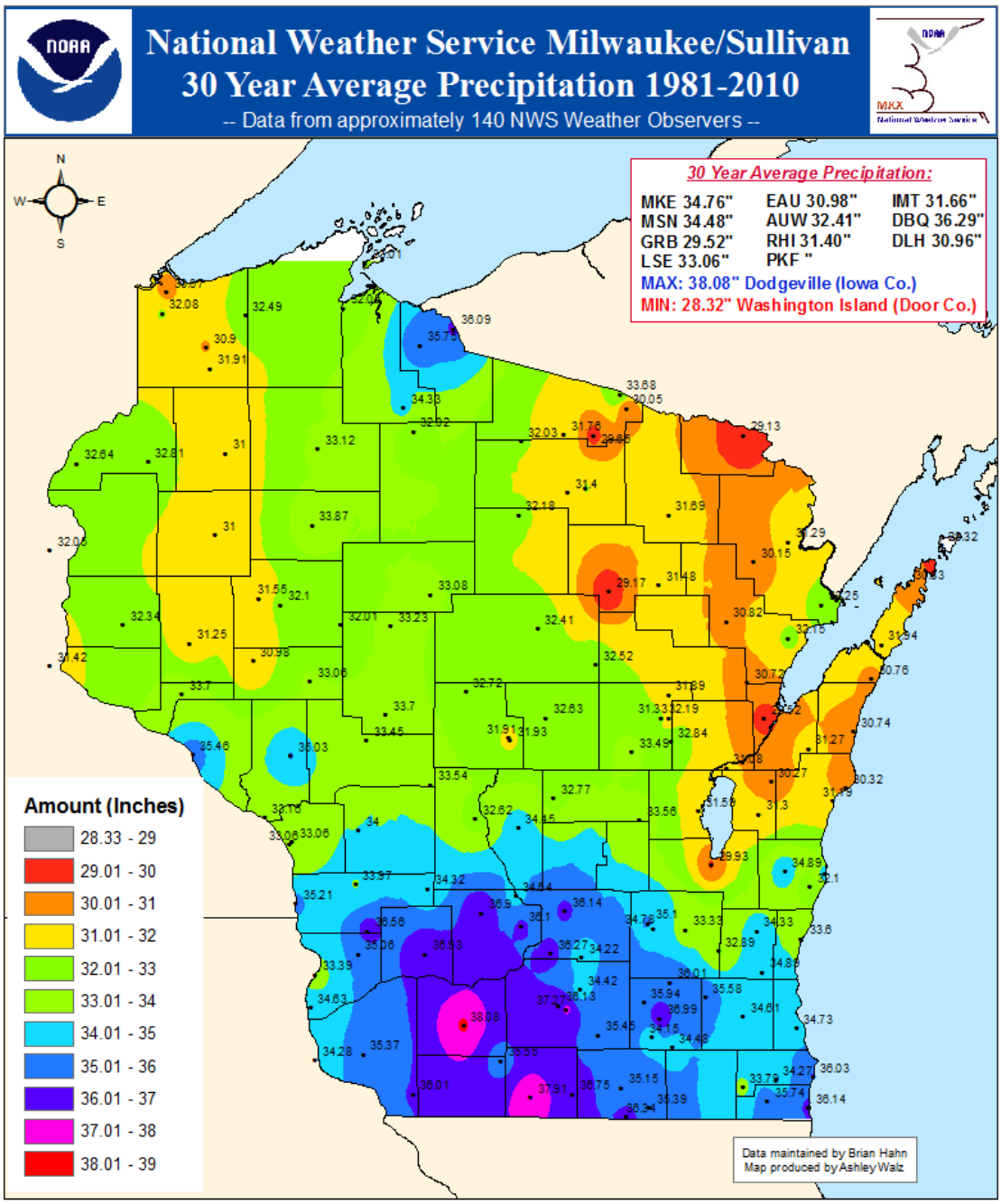
[92] Wisconsin State Hazard Mitigation Plan

Wisconsin Total Severe Weather Events[93]



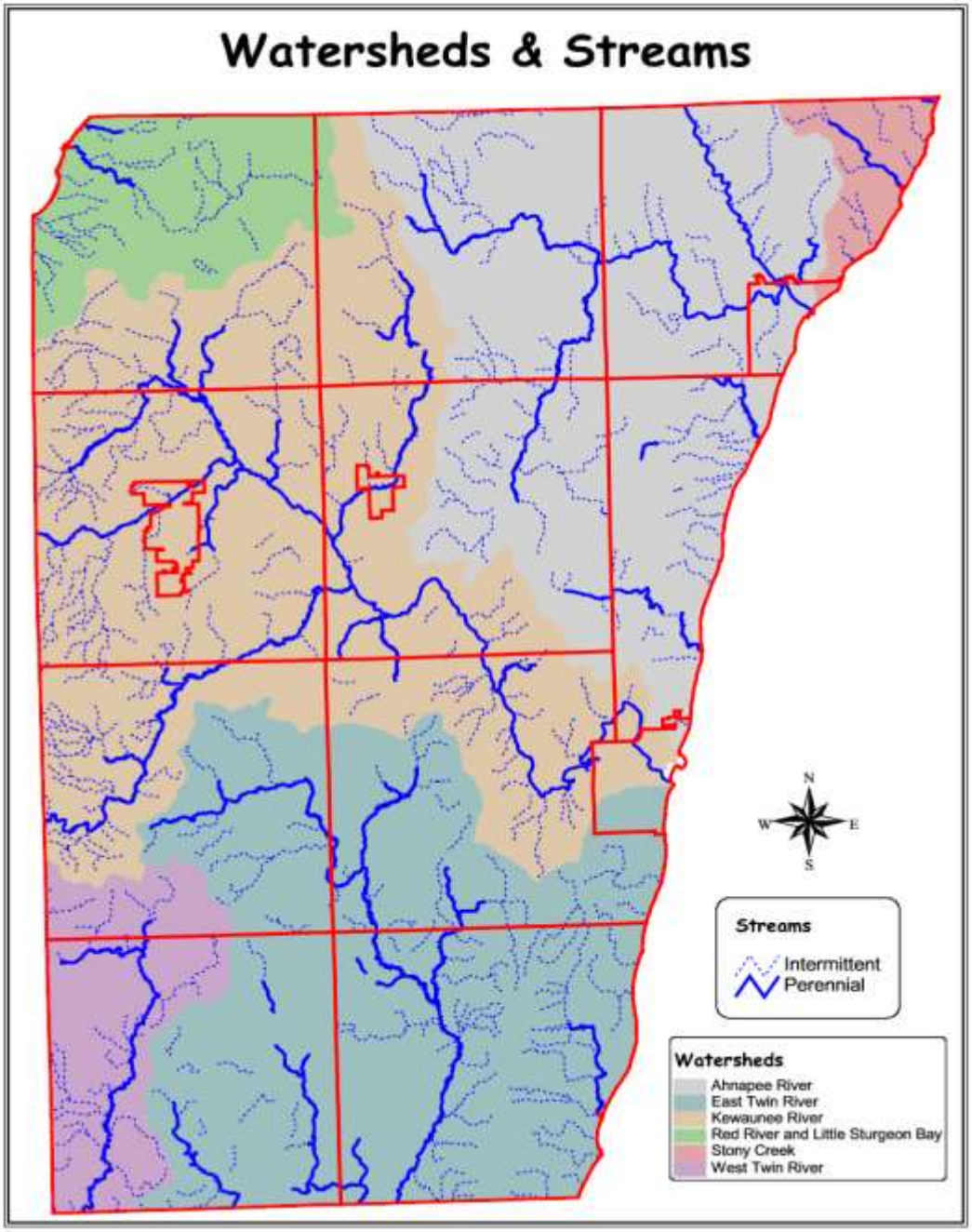
[93] Wisconsin Emergency Management, State Hazard Mitigation Plan

Wisconsin Annual Precipitation[94]

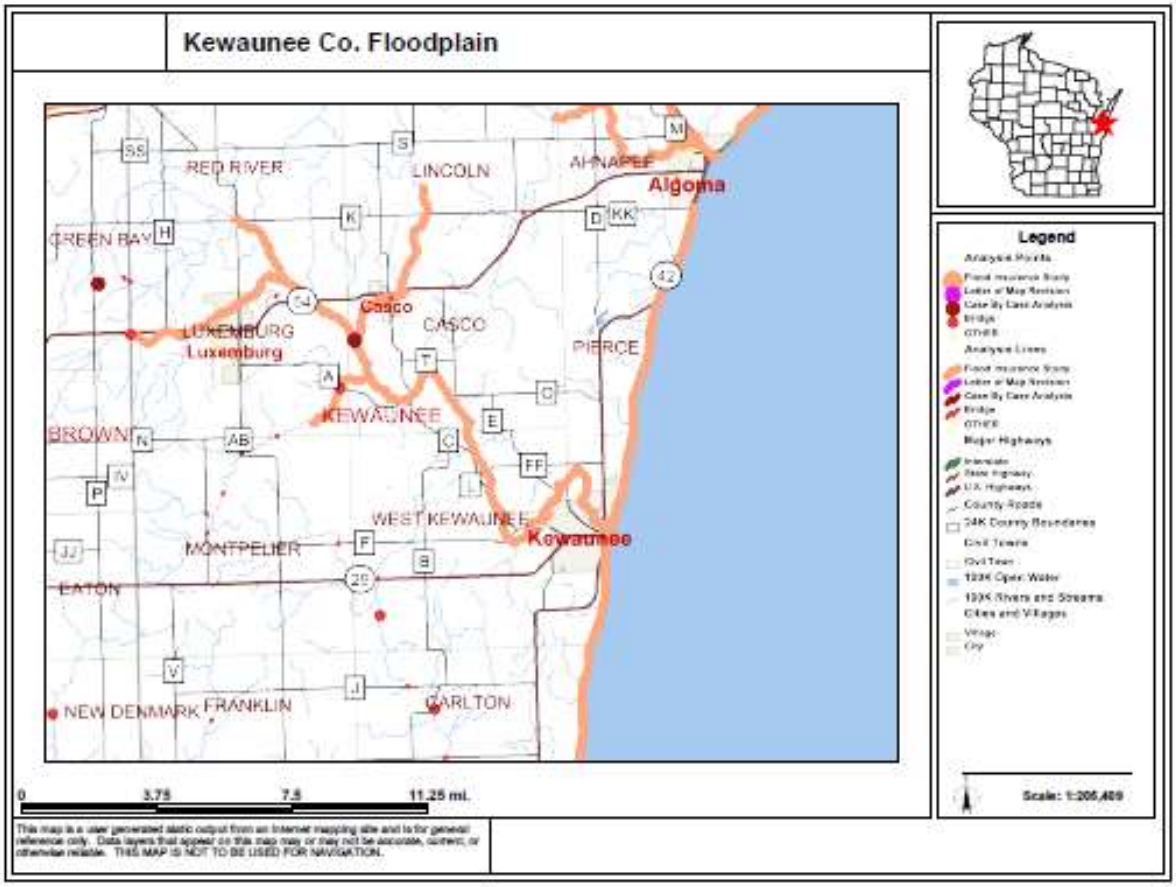


[94] http://www.crh.noaa.gov/images/mkx/climate/avg_30_year_precip.png

Kewaunee County Watersheds & Streams

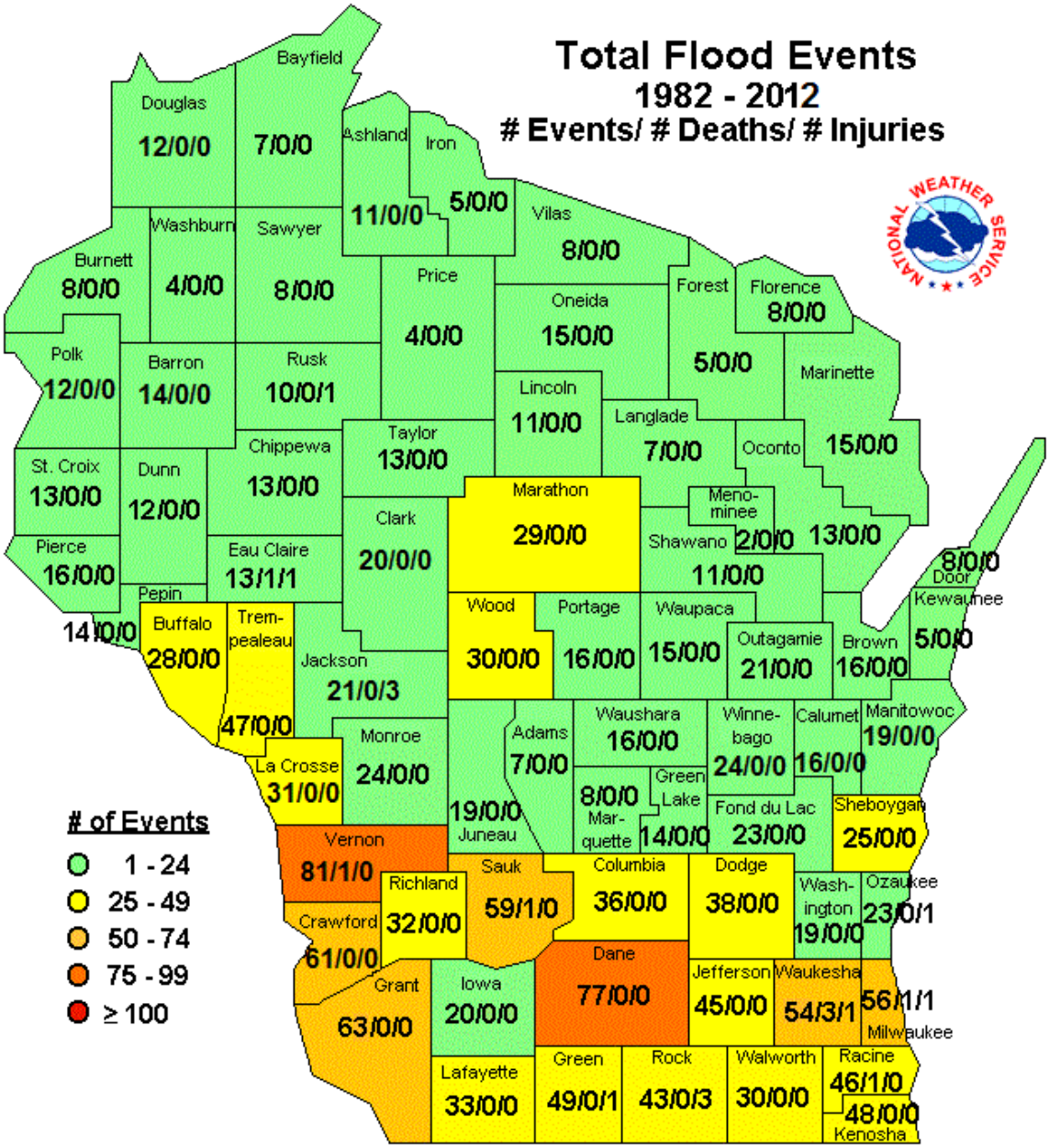


Kewaunee County Floodplain[95]



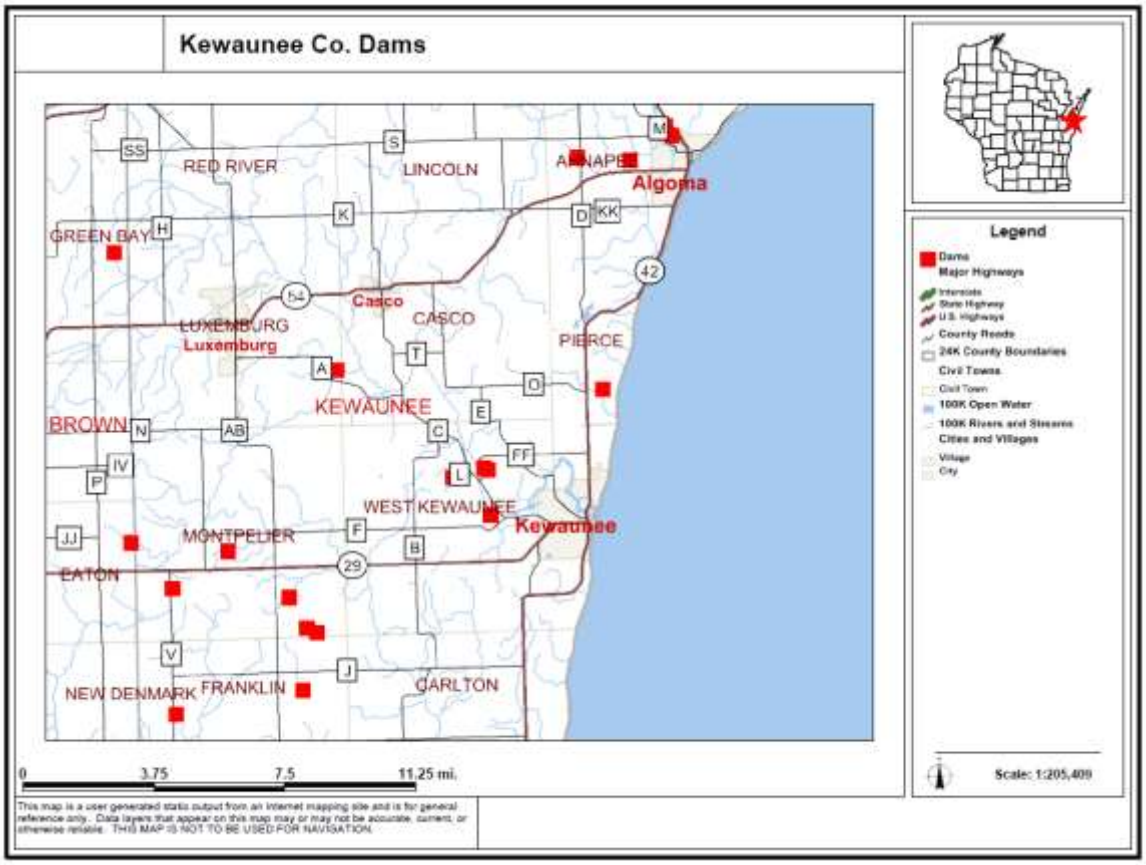
[95] http://dnrmaps.wi.gov/imf/imf.jsp?site=SurfaceWaterViewer

Wisconsin Total Flood Events[96]



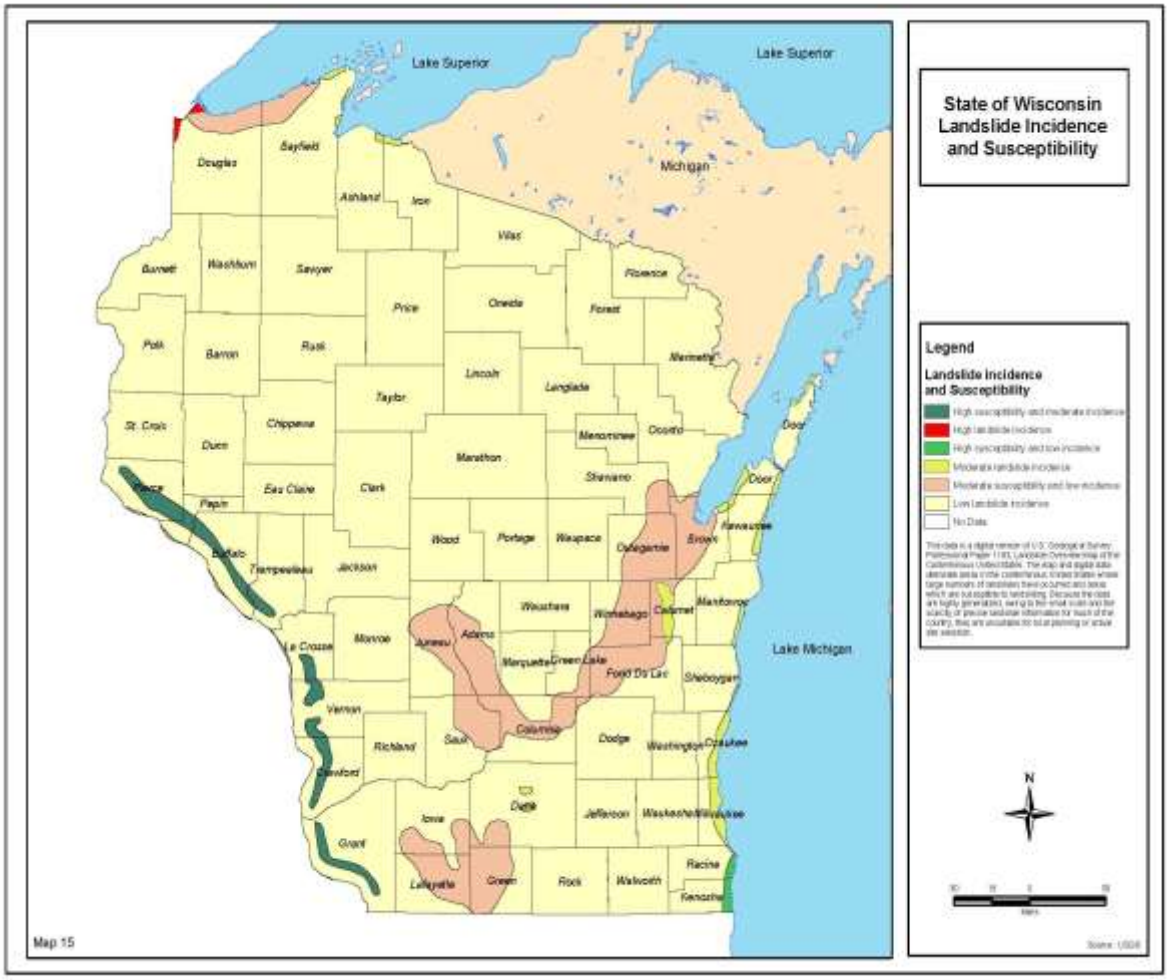
[96] Wisconsin Emergency Management, State Hazard Mitigation Plan

Kewaunee County Dams[97]



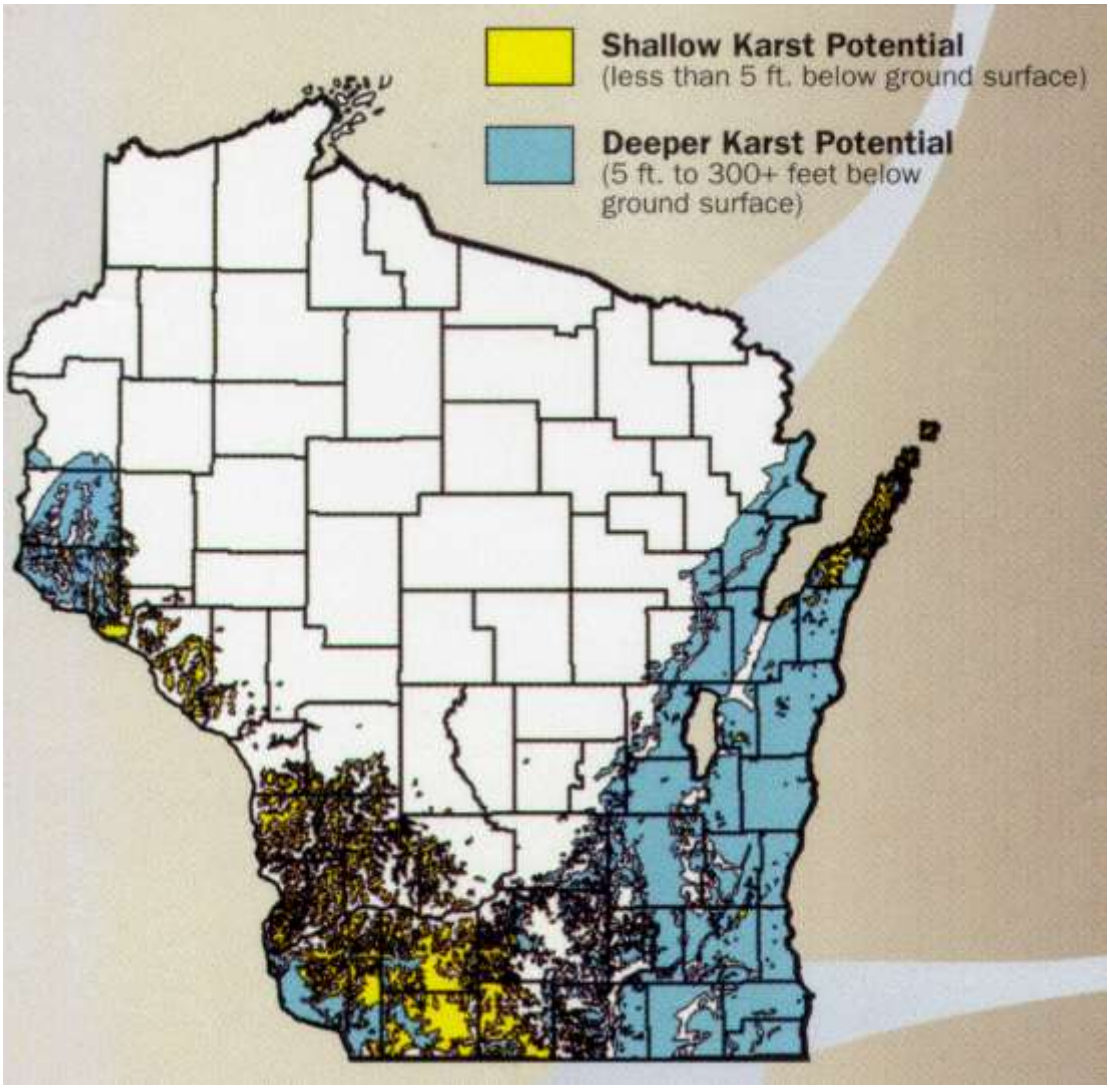
[97] http://dnrmaps.wi.gov/imf/imf.jsp?site=SurfaceWaterViewer

Landslide Incidence and Susceptibility[98]



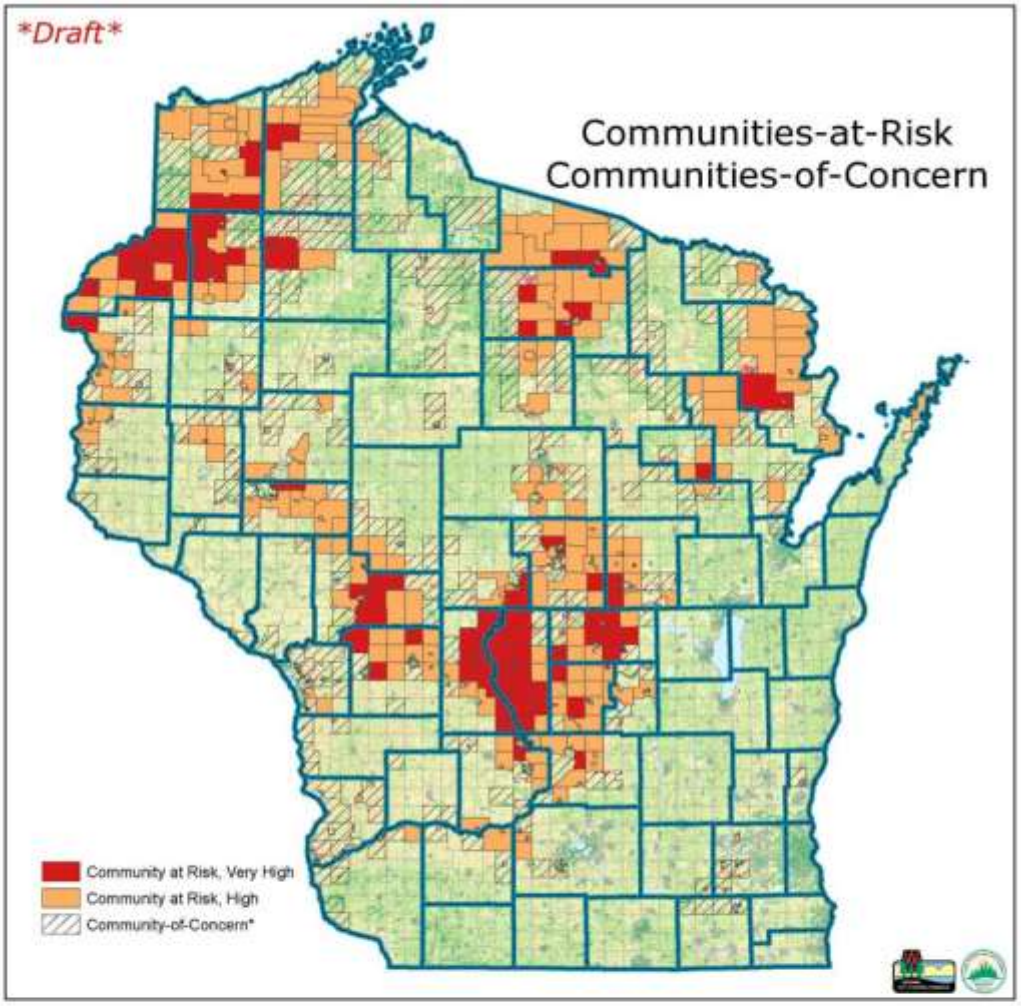
[98] Wisconsin State Hazard Mitigation Plan

Karst Potential[99]



[99] Wisconsin State Hazard Mitigation Plan

Wildfire Communities-at-Risk[100]



Introduction to Communities-at-Risk

The purpose of this model is to identify broad areas of the state that are at relatively high exposure to resource damage due to wildfire.

As mandated by the NASF, Wisconsin's Communities-At-Risk are divided into three categories:

1) Very High
2) High
3) Community of Concern*

Defining Community

For Wisconsin, Communities-at-Risk are reported at the MCD (municipal civil division) level*. MCD was chosen due to its identifiable legal boundaries, ease in reporting, and usage in the development of Community Wildfire Protection Plans.

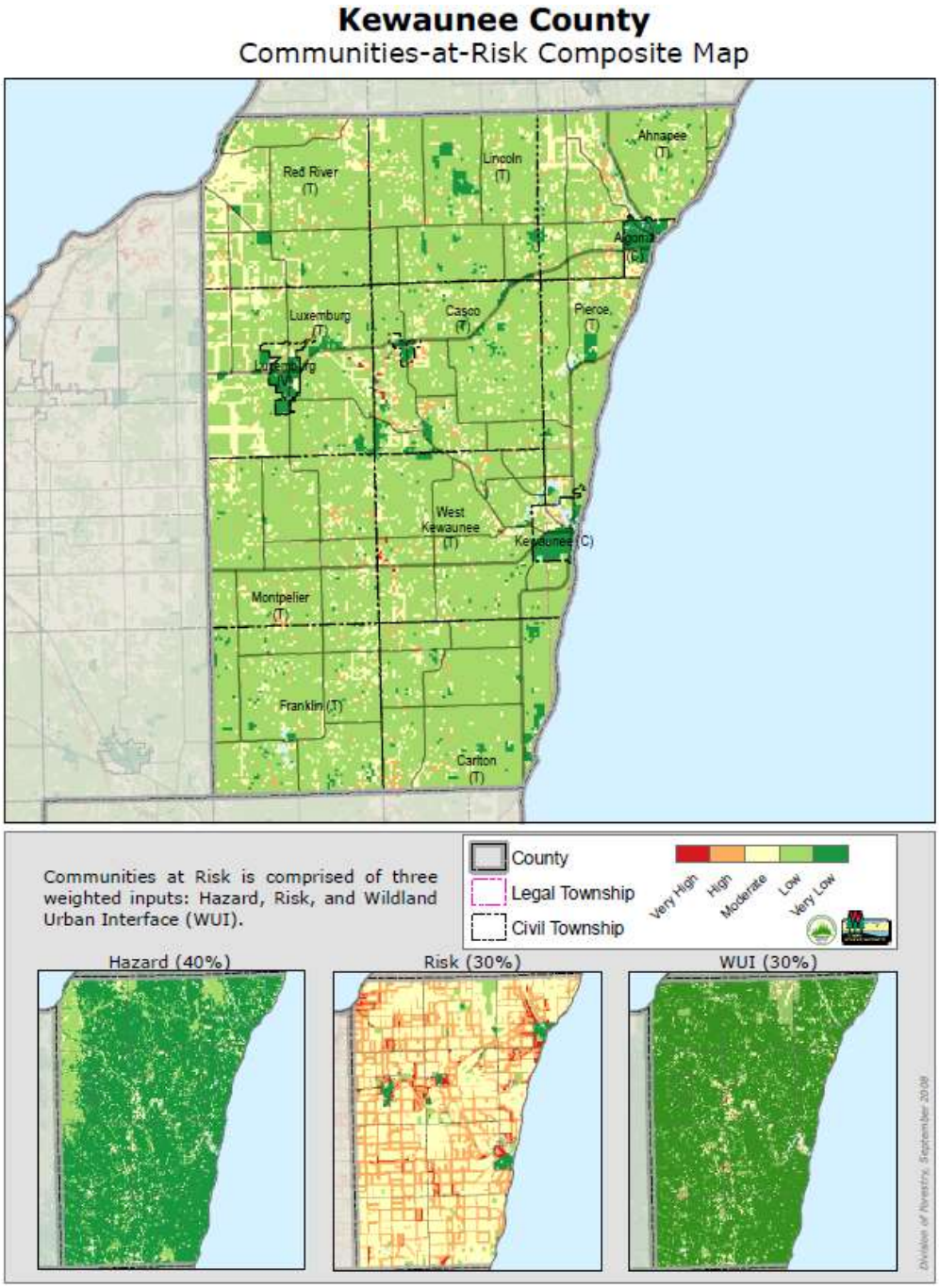
** Menominee County is an exception due to its lack of MCD's (civil townships). Therefore, Menominee county is reported by legal township.*

** A Community of Concern is a Wisconsin DNR concept whereby it is demonstrated that a significant portion of the community (more than 2 adjoining square miles) are at high or very high risk, but where the community as a whole falls below the Community-at-Risk threshold.*

10/5/07

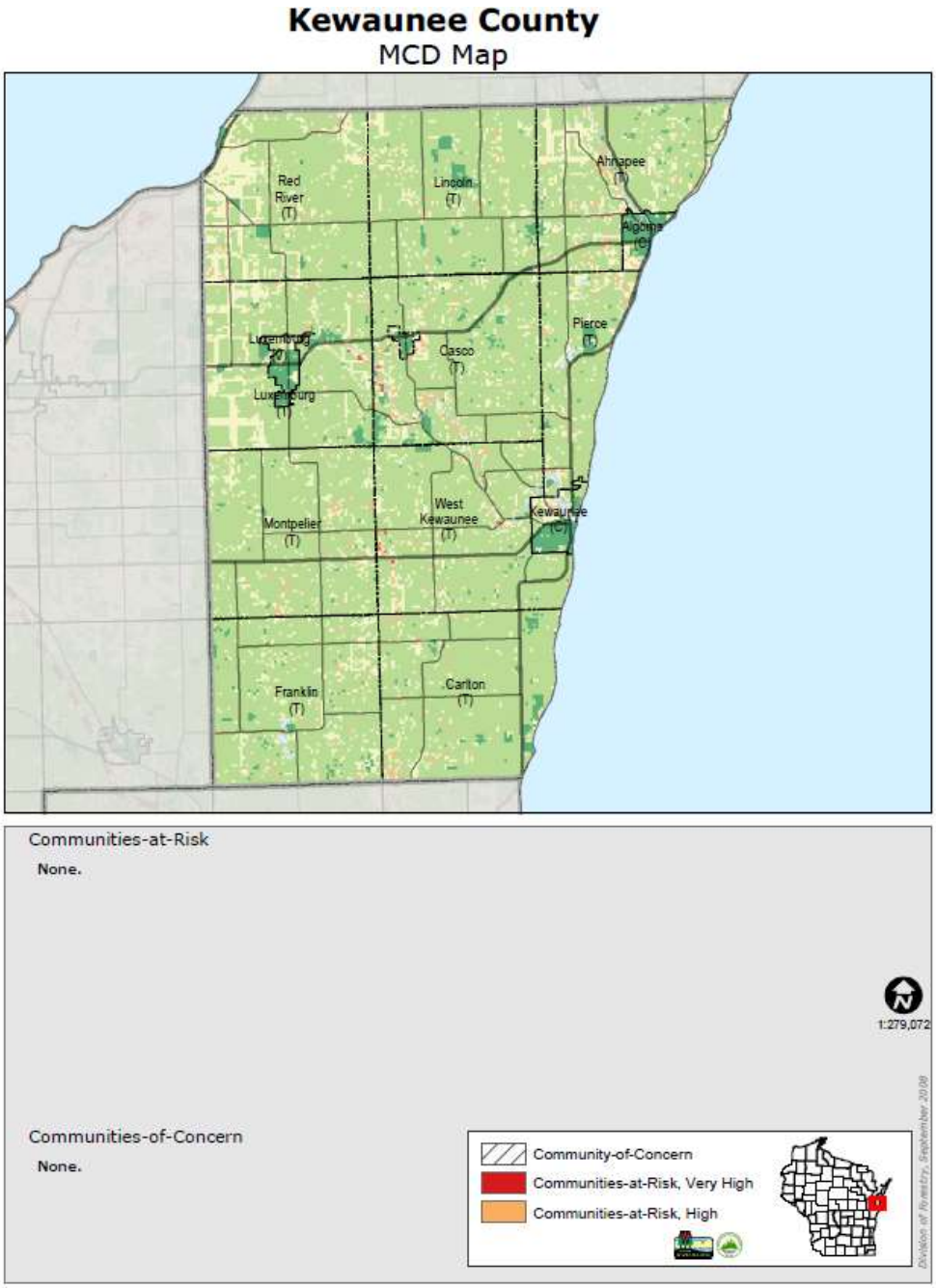
[100] Wisconsin Department of Natural Resources

Wildfire Communities-at-Risk Composite Map[101]



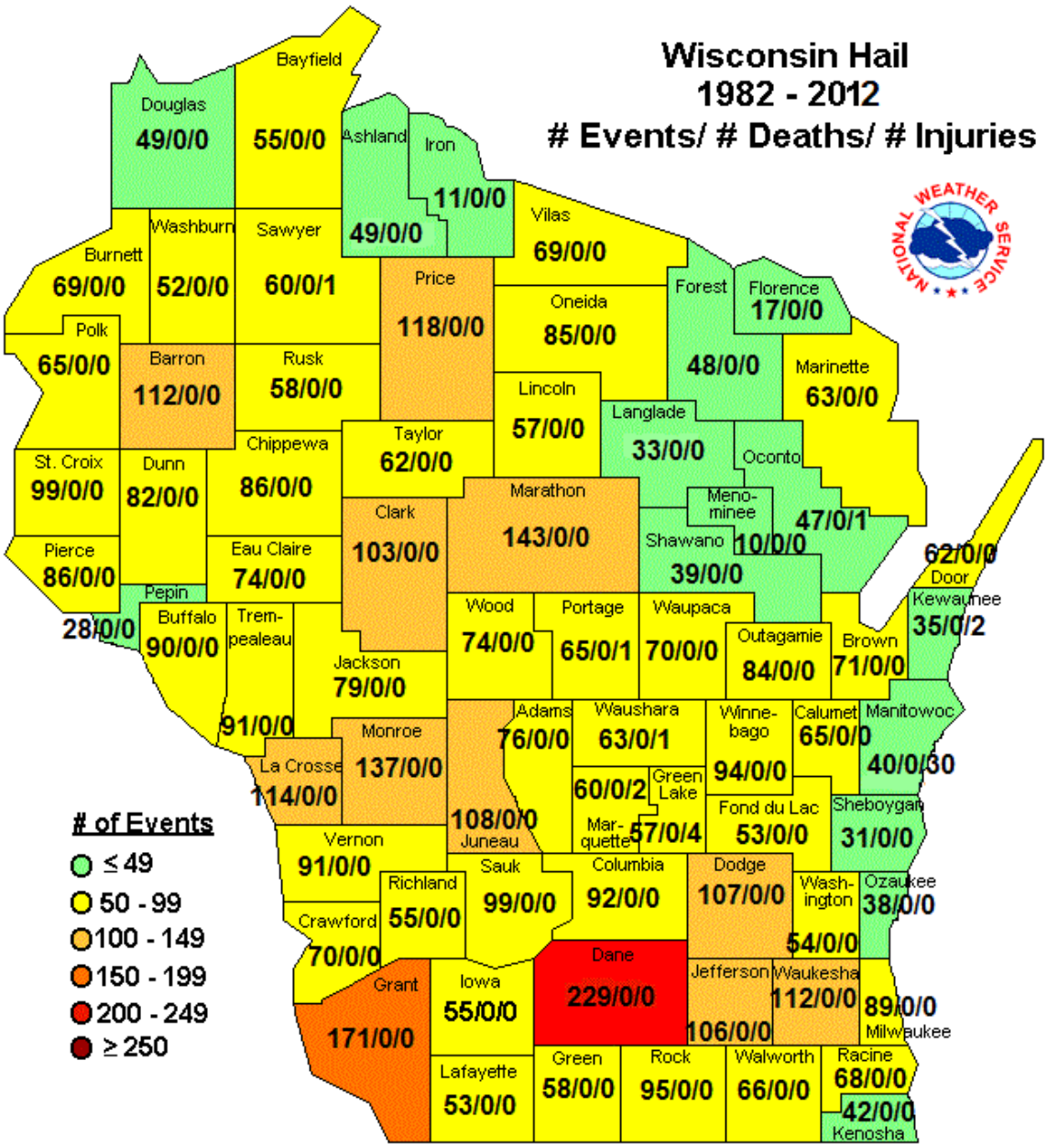
[101] Wisconsin Department of Natural Resources

Wildfire Communities-at-Risk Municipal Map[102]



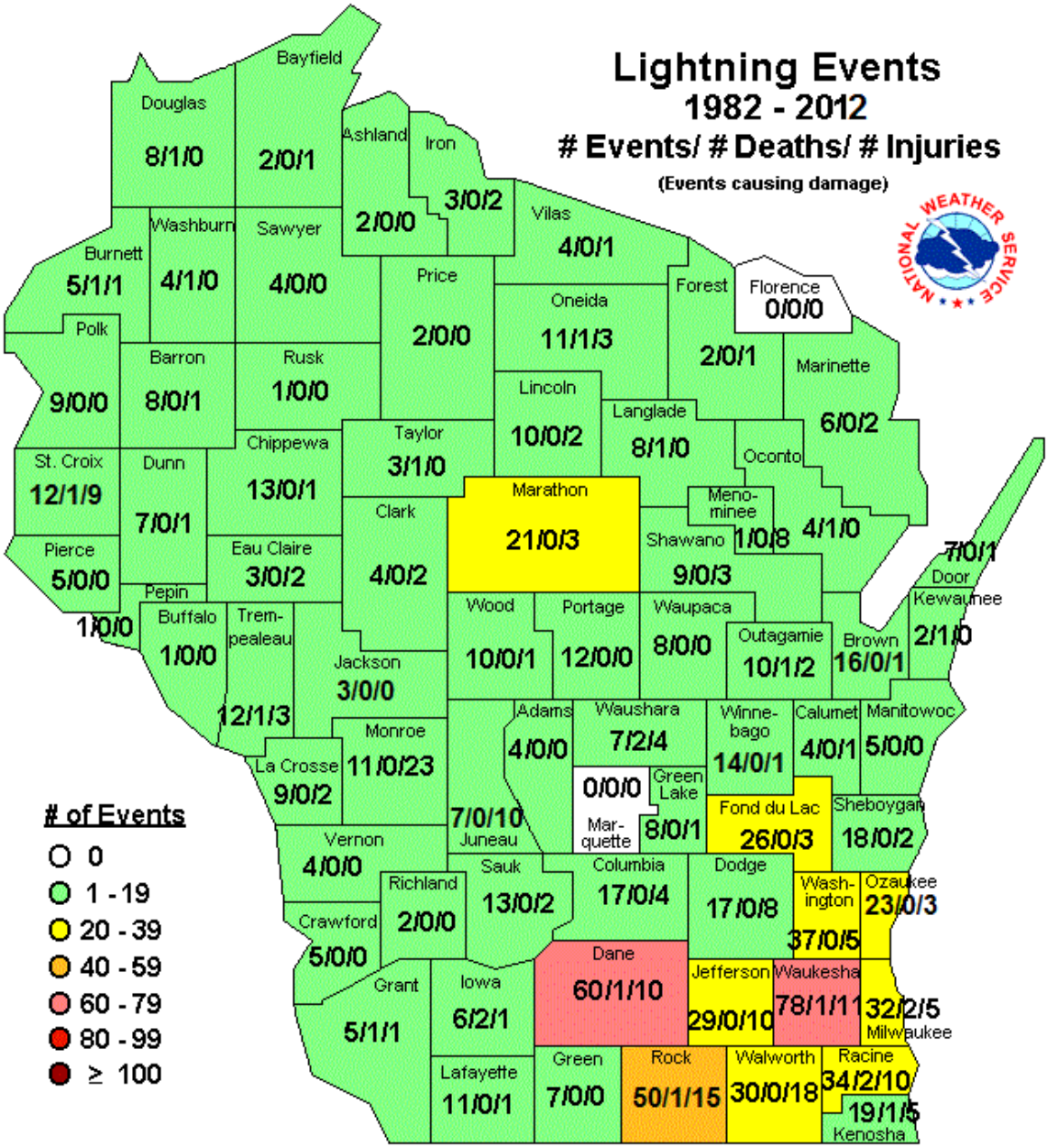
[102] Wisconsin Department of Natural Resources

Wisconsin Hail[103]



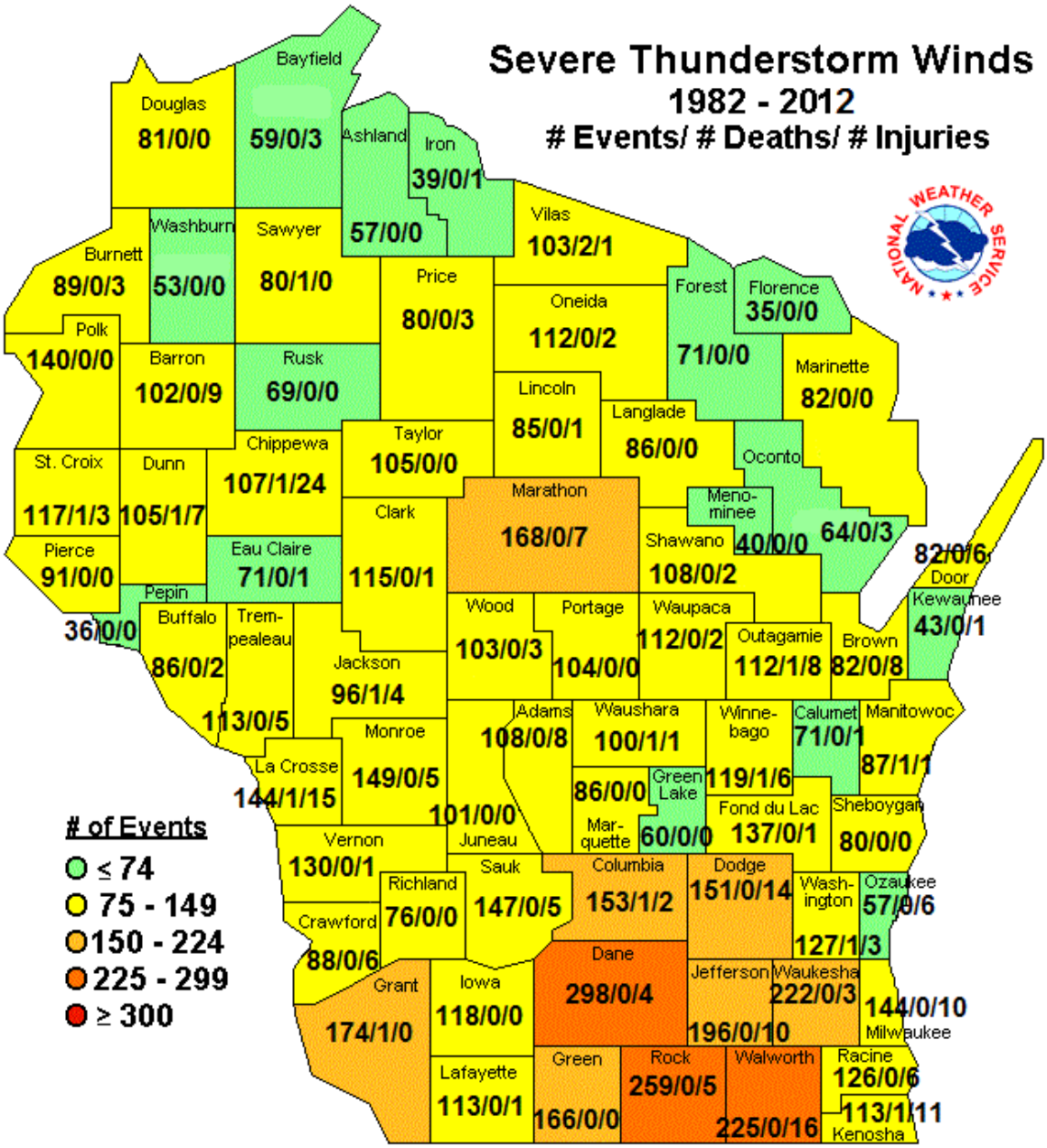
[103] Wisconsin Emergency Management, State Hazard Mitigation Plan

Wisconsin Lightning[104]



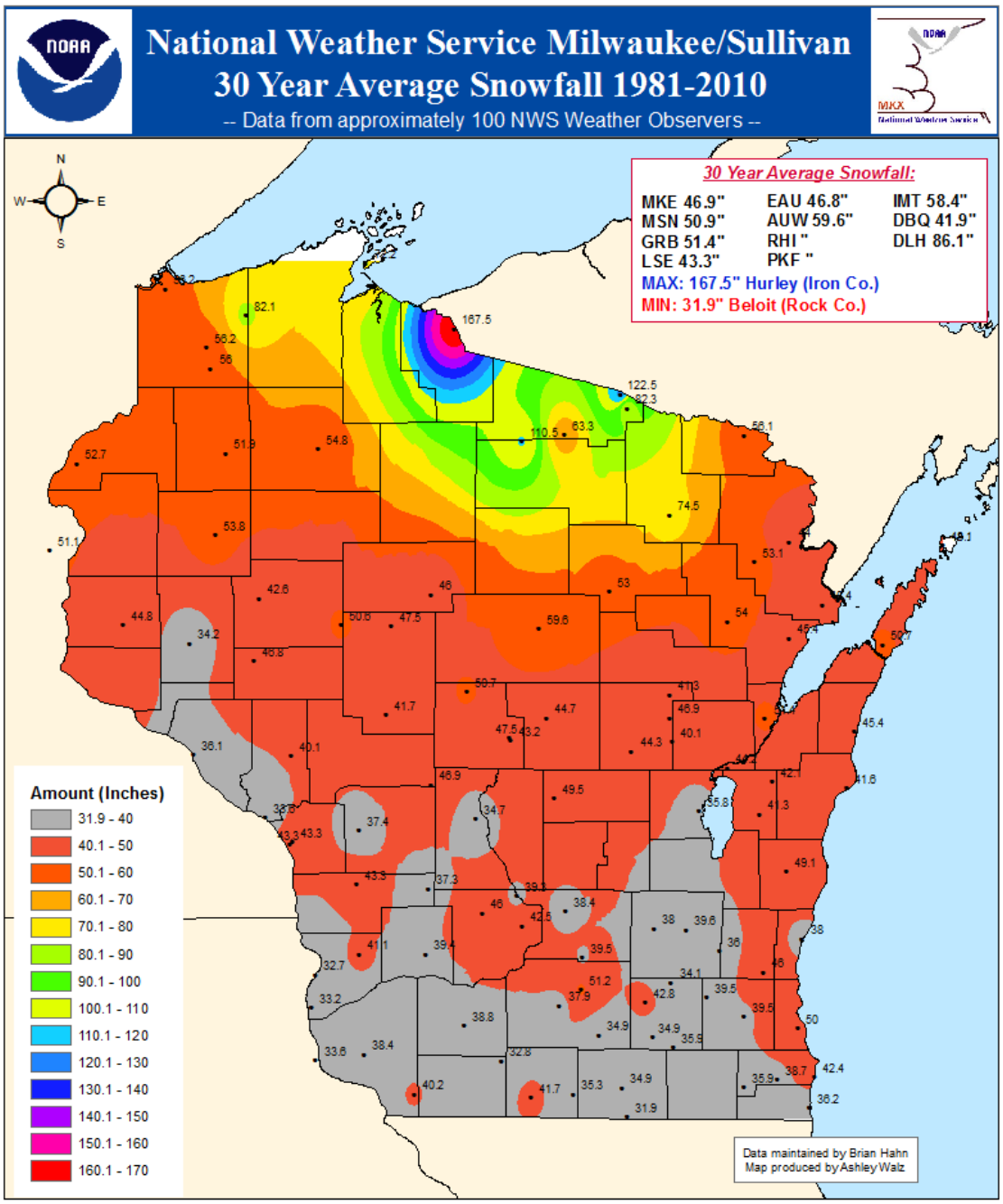
[104] Wisconsin Emergency Management, State Hazard Mitigation Plan

Wisconsin Severe Thunderstorm Winds[105]



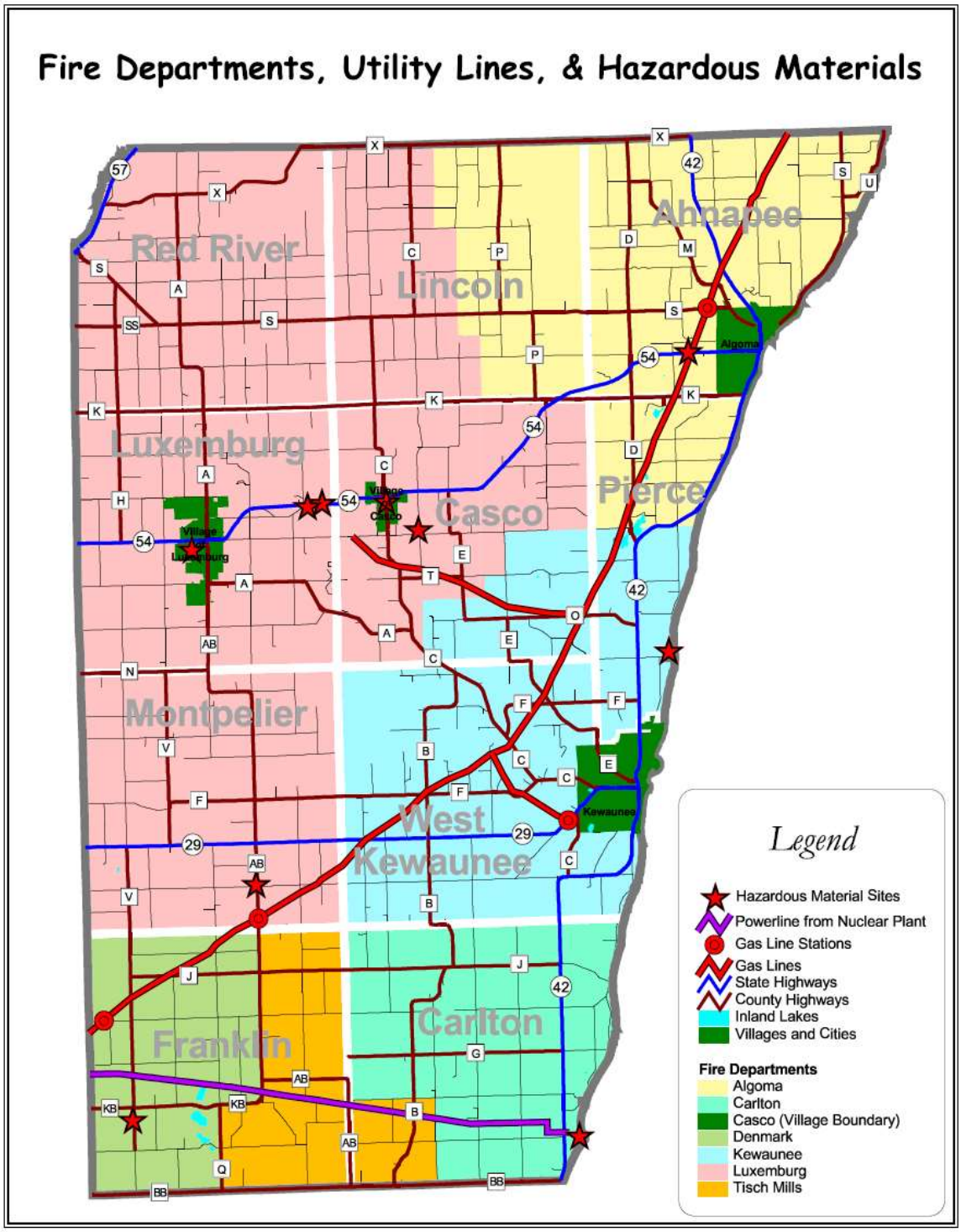
[105] Wisconsin Emergency Management, State Hazard Mitigation Plan

Wisconsin Average Seasonal Snowfall[106]

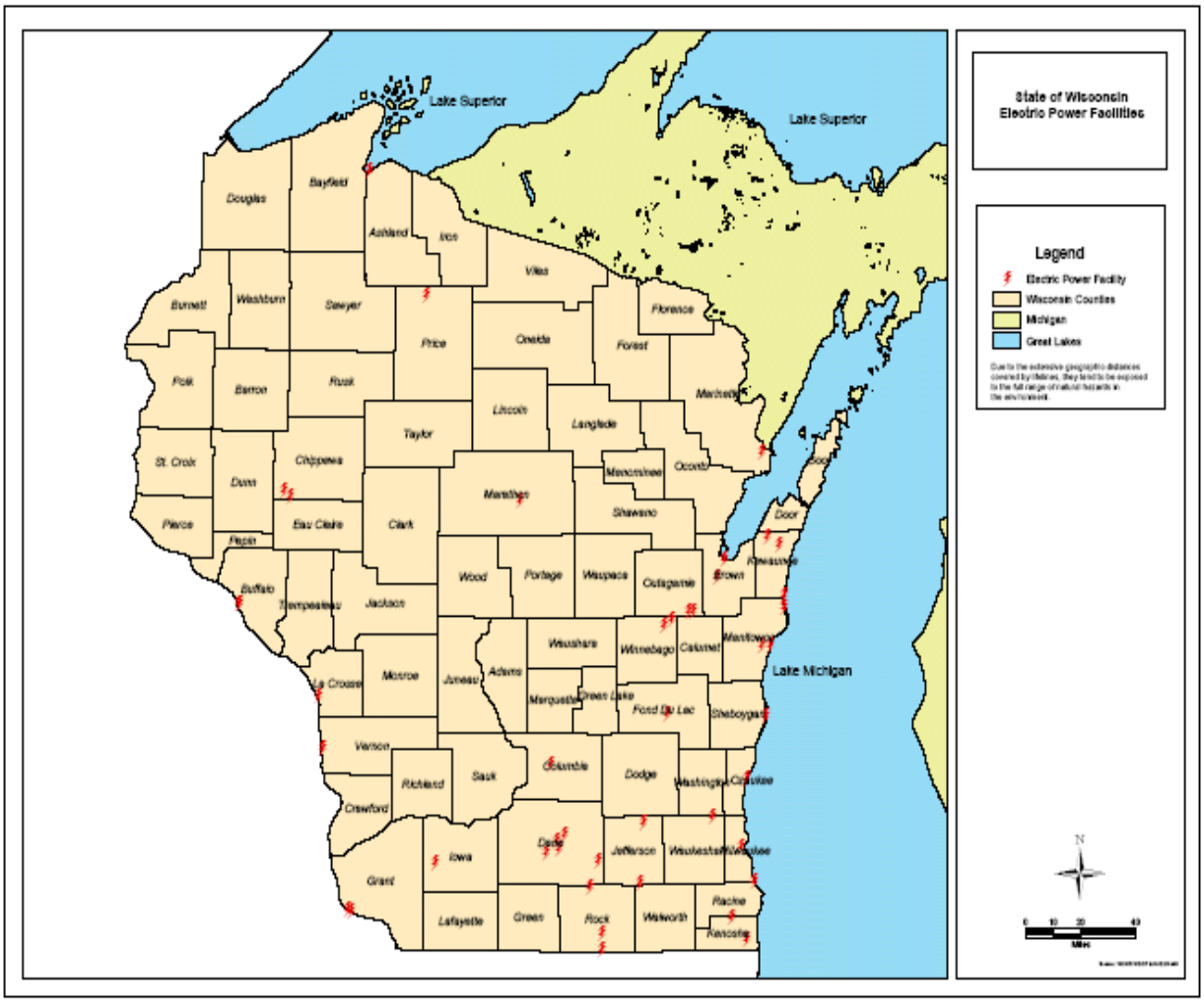


[106] http://www.crh.noaa.gov/images/mkx/climate/avg_30_year_snowfall.png

Utility Line and Hazardous Materials

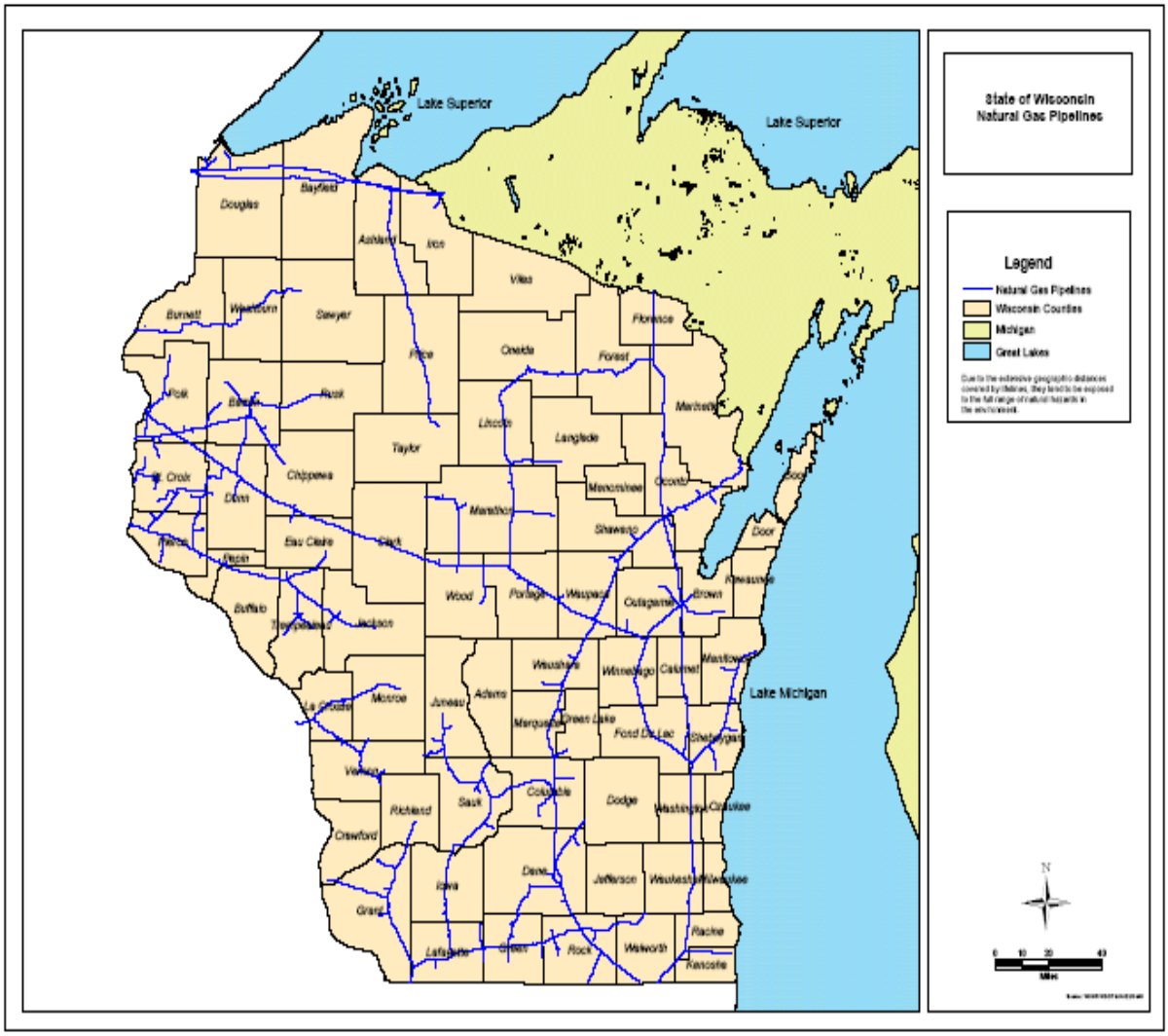


State of Wisconsin Electric Power Facilities[107]



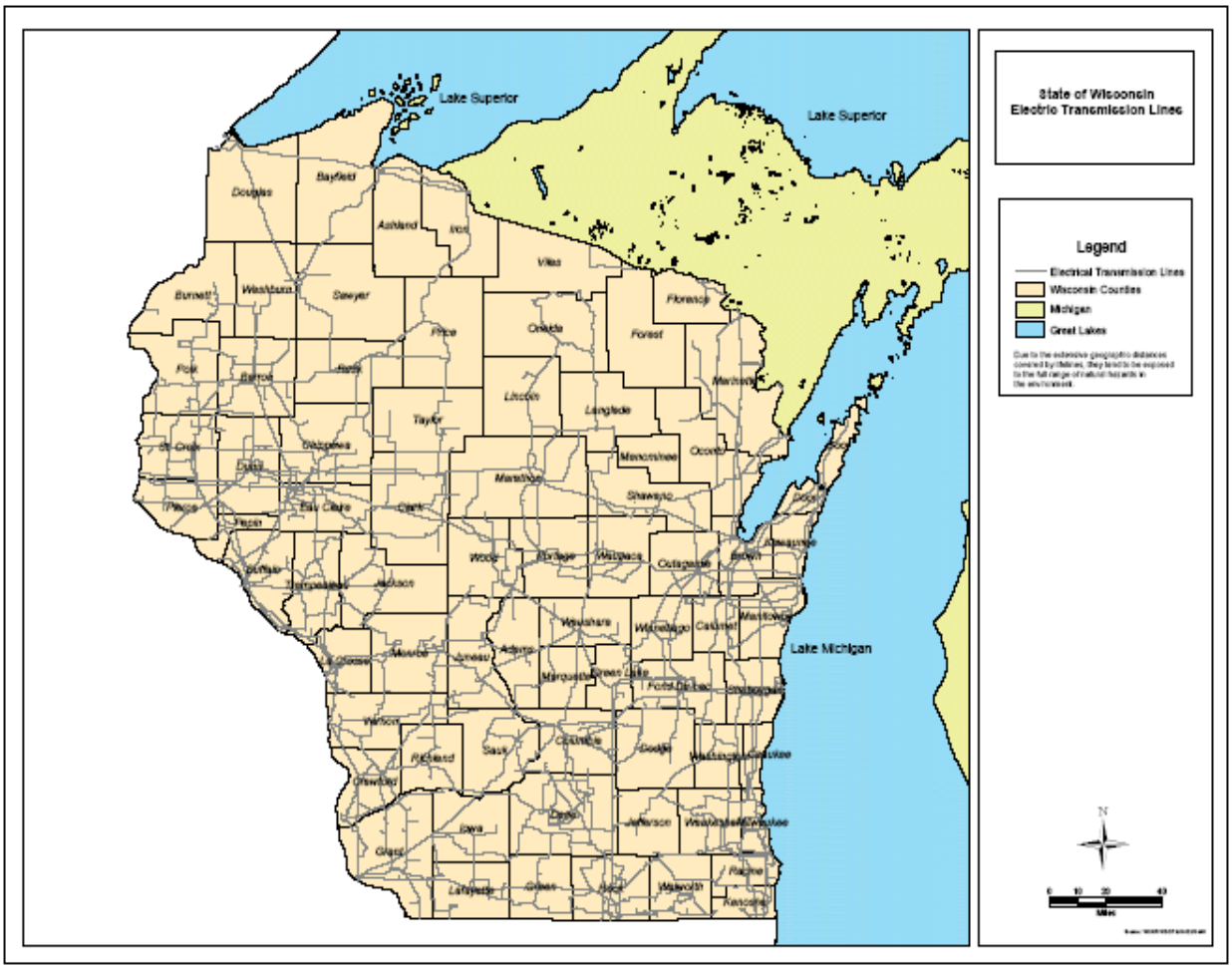
[107] State of Wisconsin Hazard Mitigation Plan

Natural Gas Pipeline[108]s



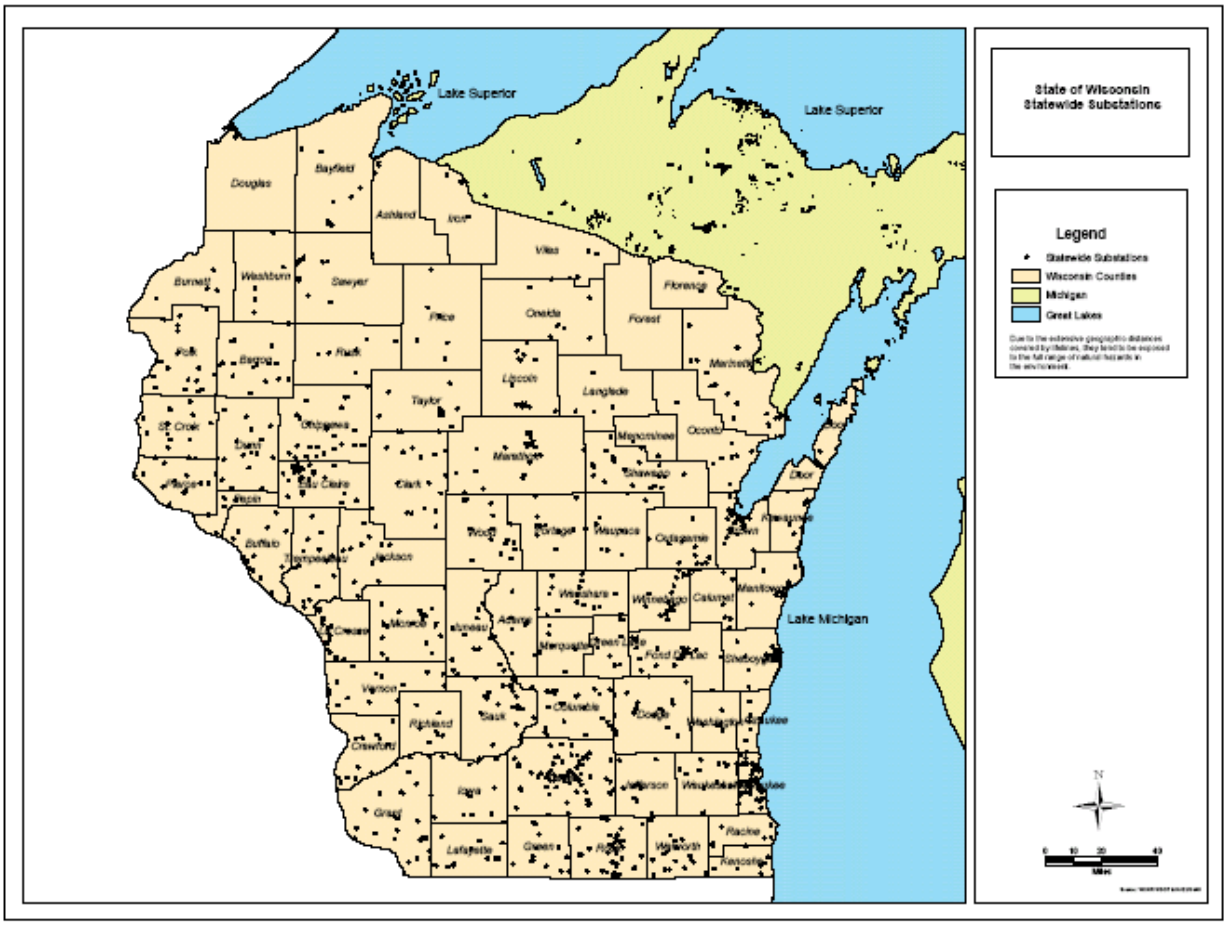
[108] Wisconsin State Hazard Mitigation Plan

State of Wisconsin Electric Transmission Lines[109]



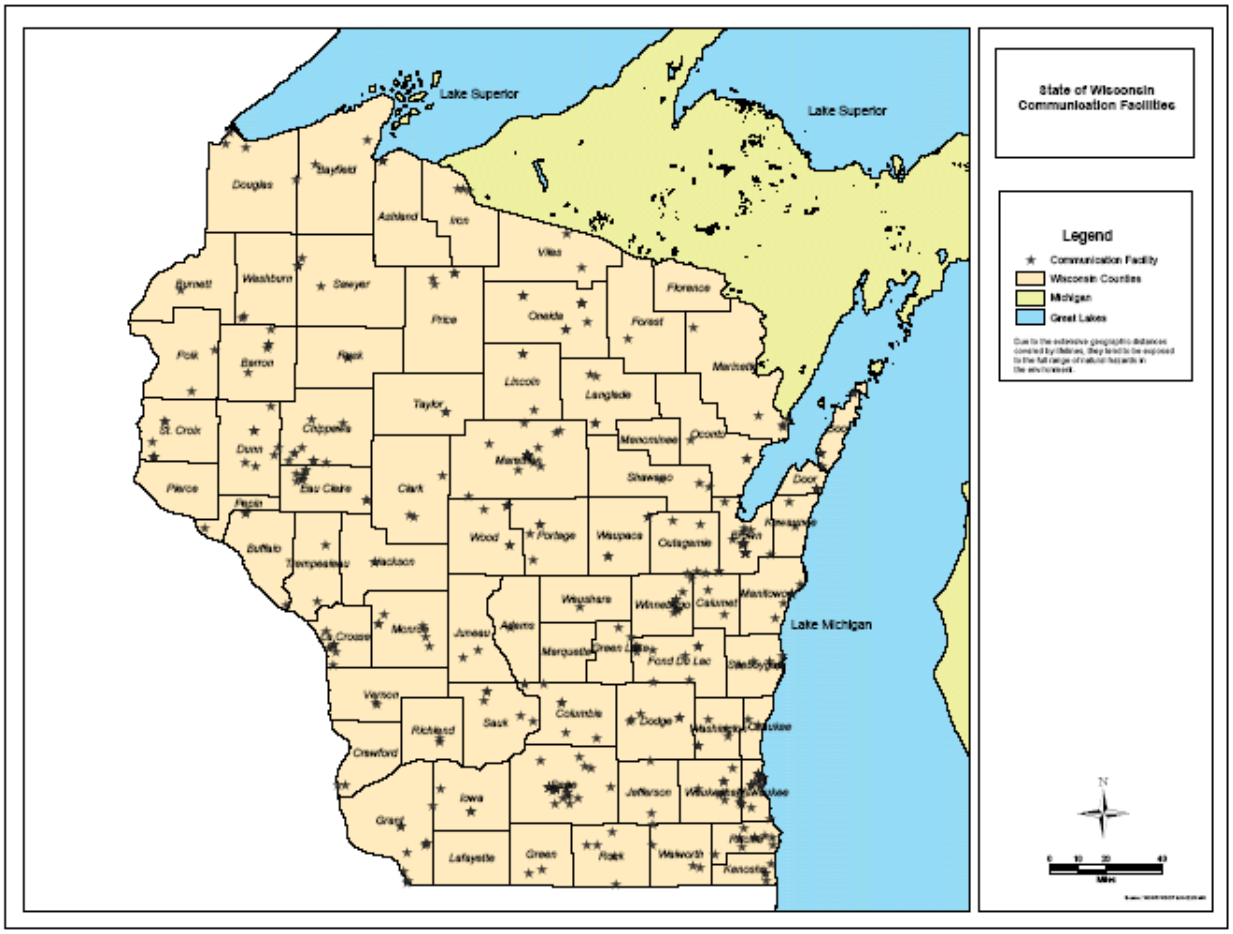
[109] State of Wisconsin Hazard Mitigation Plan

State of Wisconsin Statewide Substations[110]



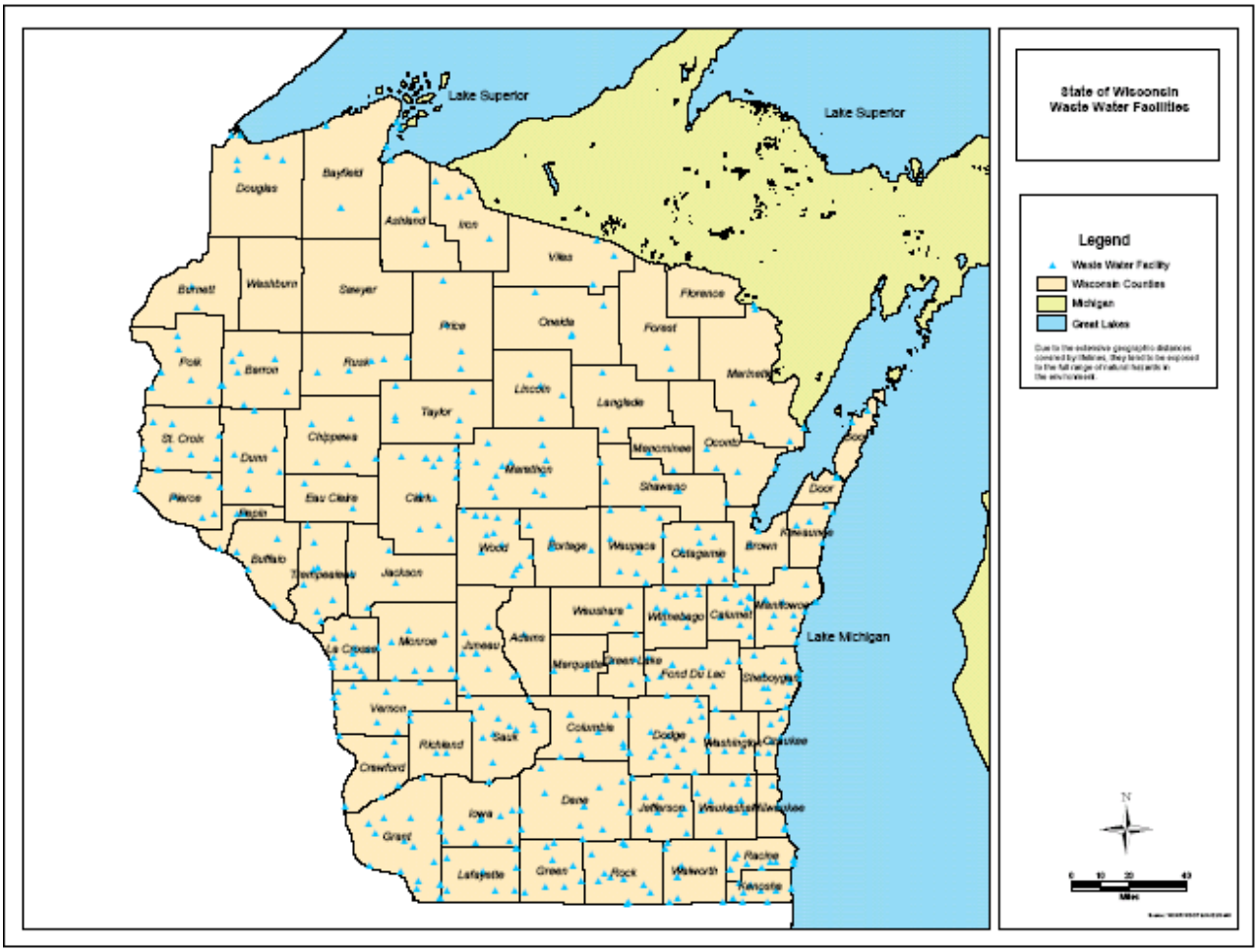
[110] State of Wisconsin Hazard Mitigation Plan

State of Wisconsin Communication Facilities[111]



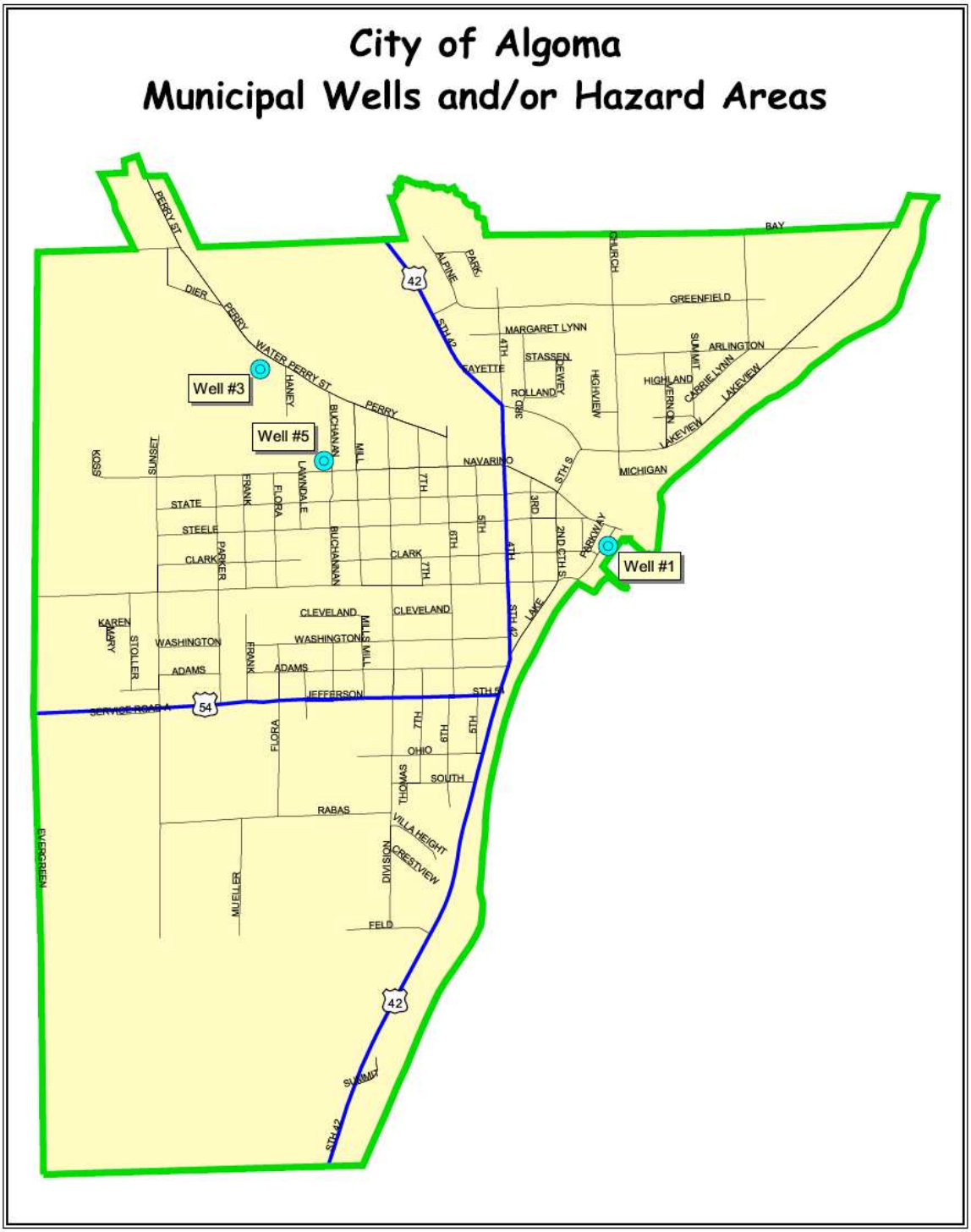
[111] State of Wisconsin Hazard Mitigation Plan

State of Wisconsin Waste Water Facilities[112]



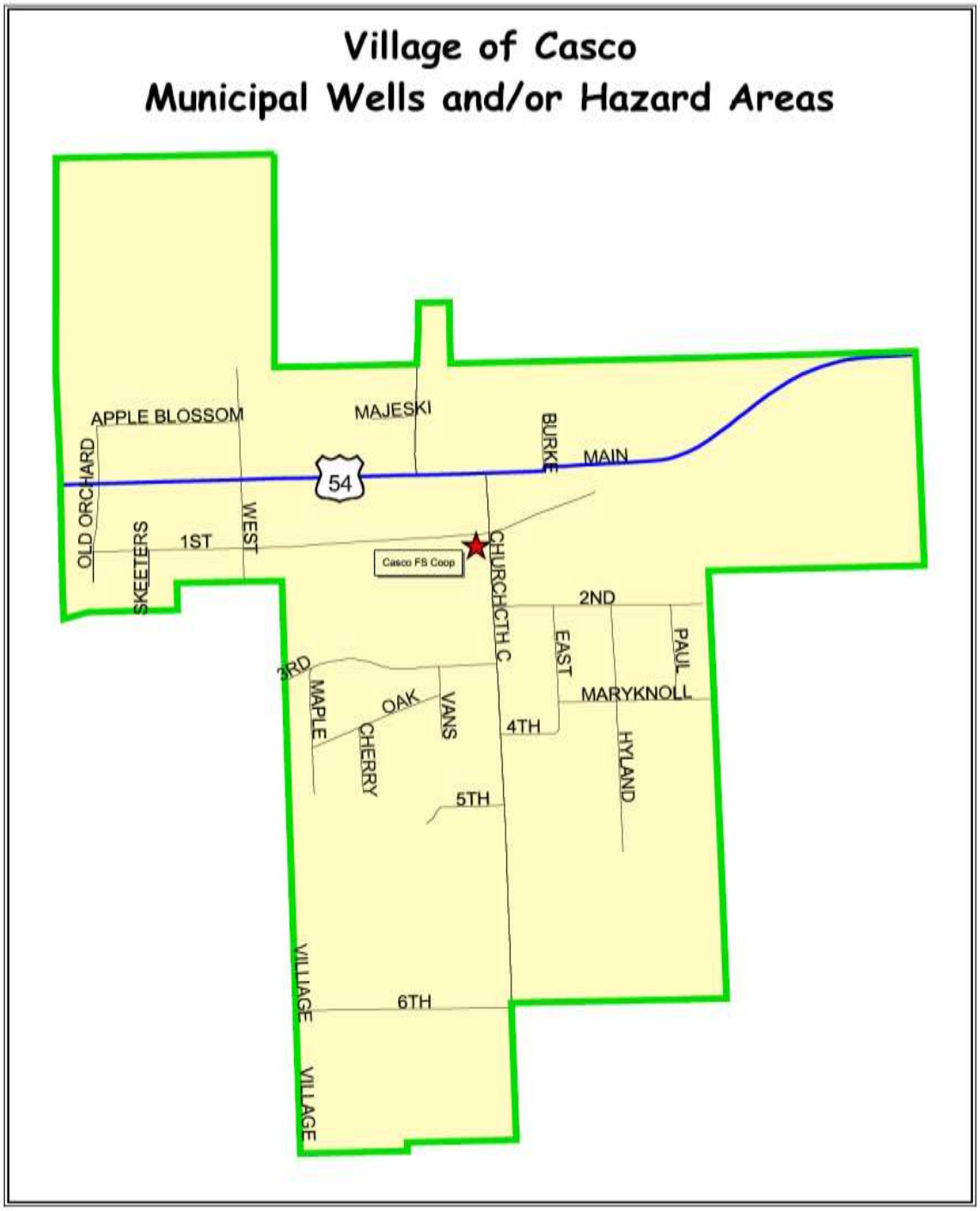
[112] State of Wisconsin Hazard Mitigation Plan

City of Algoma Municipal Wells and/or Hazard Areas

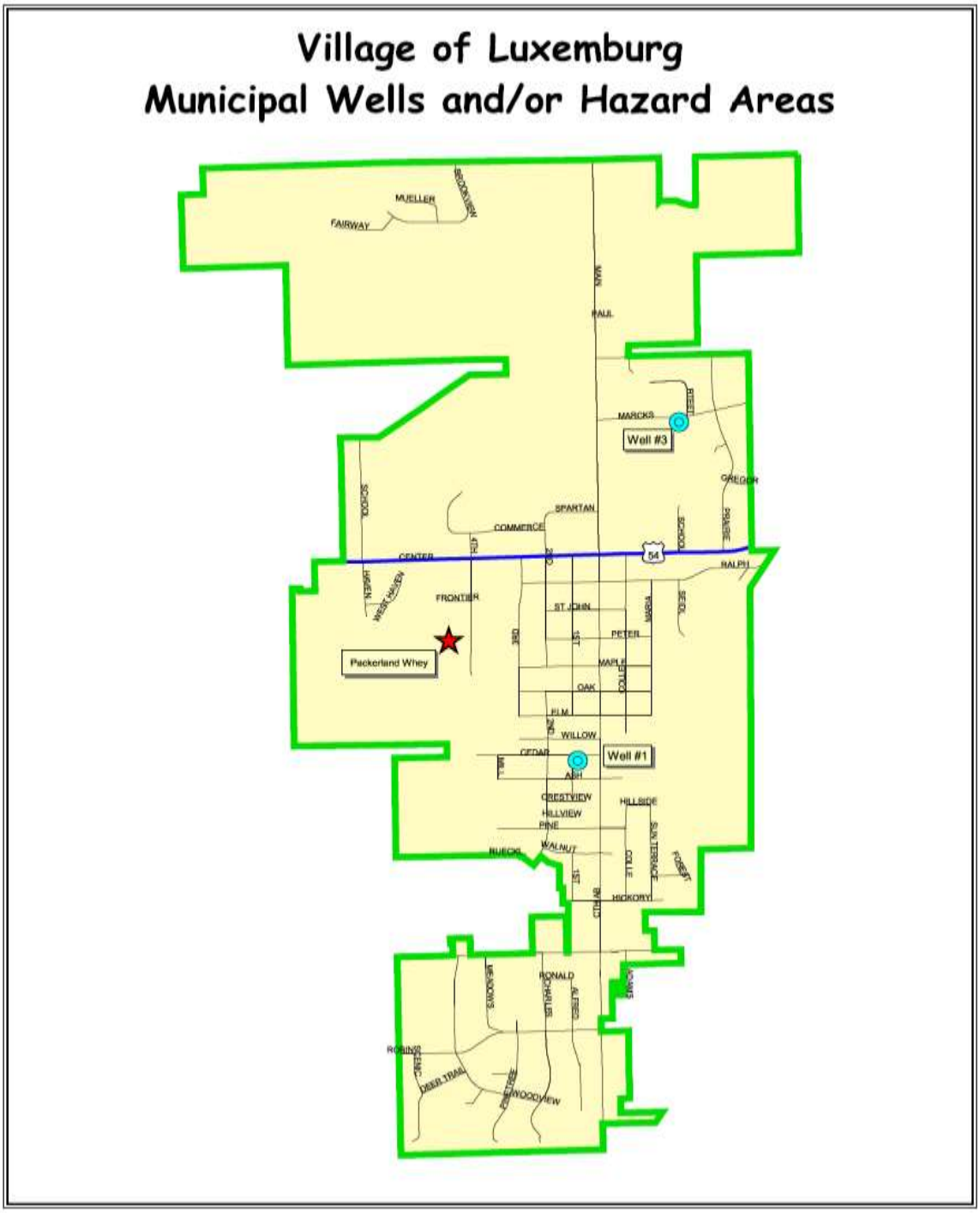


City of Kewaunee Municipal Wells and/or Hazard Areas

Village of Casco Municipal Wells and/or Hazard Areas



Village of Luxemburg Municipal Wells and/or Hazard Areas



Appendix B: Plan Adoptions

This plan has been adopted by Kewaunee County and its major municipal bodies including the Cities of Algoma and Kewaunee and the Villages of Casco and Luxemburg.

The Towns of Ahnapee, Carlton, Casco, Franklin, Lincoln, Luxemburg, Montpelier, Pierce, Red River and West Kewaunee were also given an opportunity to adopt this plan. The Towns of Franklin, Lincoln, Montpelier and Pierce adopted the plan. Scanned copies of those municipalities that adopted this plan follow.

Appendix C: Summary of Mitigation Strategies

Summary of Mitigation Strategies							
Hazard Type	**Mitigation Measures**	**Costs of Project**	**Responsible Management**	**Project Timetable**	**Project Priority**	**Community(ies) Benefitting**	**Comments**
All Hazards	Equip special facilities (e.g., large businesses, schools and nursing homes) with National Oceanic and Atmospheric Administration (NOAA) weather radios. Encourage citizens to have weather radios in their homes.	~$400,000 As grants available	EM Dept. / PH	Ongoing	Medium	Kewaunee Co; CIs of Algoma and Kewaunee; Vis of Casco and Luxemburg; TNs of Ahnapee, Carlton, Casco, Franklin, Lincoln, Luxemburg, Montpelier, Pierce, Red River and West Kewaunee.	• Purchased 200 radios (80 left). CBRFs and nursing homes received radios with assistance from Public Health. • Campaign in spring. Suggest radios as Christmas gifts on Facebook. Advertise via Facebook and Code Red (reverse 911). • Going forward with assistance from Sheriff's Office; Algoma, Luxemburg and Kewaunee Police Departments.
	Continue to add/update Emergency Management Department links on the existing county web site (e.g., ARC, FEMA, WEM) especially focusing on preparedness bulletins. Publicize the website to let citizens know about its capabilities (including those described above.)	Covered by Dept. annual budget	EM Dept.	Ongoing	Low	Kewaunee Co; CIs of Algoma and Kewaunee; Vis of Casco and Luxemburg; TNs of Ahnapee, Carlton, Casco, Franklin, Lincoln, Luxemburg, Montpelier, Pierce, Red River and West Kewaunee.	• Reviewed at least monthly. • Linked to LEPC website. • Includes GIS information for the county.
	Update and improve the county's communications system for first responders.	~$2M As grants available	EM Dept.	Ongoing	High	Kewaunee Co; CIs of Algoma and Kewaunee; Vis of Casco and Luxemburg; TNs of Ahnapee, Carlton, Casco, Franklin, Lincoln, Luxemburg, Montpelier, Pierce, Red River and West Kewaunee.	• Two additional frequencies needed. Replace old equipment on the radio towers. • Narrow-banding. • Part of $4M project.

Summary of Mitigation Strategies							
Hazard Type	**Mitigation Measures**	**Costs of Project**	**Responsible Management**	**Project Timetable**	**Project Priority**	**Community(ies) Benefitting**	**Comments**
	Ensure the community is aware of the proper reporting, use and disposal of hazardous materials.	Covered by Dept. annual budget	EM Dept.	Ongoing	Medium	Kewaunee Co; CIs of Algoma and Kewaunee; Vis of Casco and Luxemburg; TNs of Ahnapee, Carlton, Casco, Franklin, Lincoln, Luxemburg, Montpelier, Pierce, Red River and West Kewaunee.	• The EM Office conducts two awareness campaigns in spring and fall, usually in conjunction with a clean sweep in spring. • Hosting a pharmaceutical collection in September 2013. Daily collection at Sheriff's Dispatch.
	Move county COOP/COG planning forward by making an Alternate Emergency Operations Center/Joint Information Center operational.	~$75,000 - 80,000	EM Dept.	Ongoing	High	Kewaunee Co; CIs of Algoma and Kewaunee; Vis of Casco and Luxemburg; TNs of Ahnapee, Carlton, Casco, Franklin, Lincoln, Luxemburg, Montpelier, Pierce, Red River and West Kewaunee.	• Completed a new county EOC in Luxemburg and moved to the facility in 2012. • Some assistance is being provided by the nuclear power plants. • No alternate site has been identified yet because the new primary EOC project took precedence.
Coastal Erosion	Ensure that municipalities, builders and homeowners understand and follow safe building zoning regulations.	Covered by Dept. annual budget	Zoning Dept.	Ongoing	Medium	Kewaunee Co; CIs of Algoma and Kewaunee; Vis of Casco and Luxemburg; TNs of Ahnapee, Carlton, Casco, Franklin, Lincoln, Luxemburg, Montpelier, Pierce, Red River and West Kewaunee.	• Public now has easy access to the Land Records information via website. Information regarding permits can be accessed there. • Will continue to discuss with residents when they come in for permits. • NR115 will be updated on shoreland permitting in 2014.
Drought and Dust Storms	Provide information to farmers via website links or brochures regarding water conservation measures that can be employed during a drought.	Covered by Dept. annual budget	UW-Ext.	Ongoing	Low	Kewaunee Co; CIs of Algoma and Kewaunee; Vis of Casco and Luxemburg; TNs of Ahnapee, Carlton, Casco, Franklin, Lincoln, Luxemburg, Montpelier, Pierce, Red River and	Push to conserve milk house water.

Summary of Mitigation Strategies							
Hazard Type	**Mitigation Measures**	**Costs of Project**	**Responsible Management**	**Project Timetable**	**Project Priority**	**Community(ies) Benefitting**	**Comments**
						West Kewaunee.	
Flooding and Dam Failure	*Advise the public about the availability of flood insurance.	Covered by Dept. annual budget	EM Dept.	Ongoing	Low	Kewaunee Co; CIs of Algoma and Kewaunee; Vis of Casco and Luxemburg; TNs of Ahnapee, Carlton, Casco, Franklin, Lincoln, Luxemburg, Montpelier, Pierce, Red River and West Kewaunee.	• Zoning requires elevation surveys if near flood plain. • New air photos were done in 2013 and submitted to FEMA. Waiting for new flood maps to be sent to Land Records now
	*Complete a LIDAR flight in Spring 2012: • Acquire new topographical maps for the entire county with two (2) foot contour intervals. • Update FEMA flood maps.	$186,000 $90,000	Zoning / LWCD LIO	As grants available	High	Kewaunee Co; CIs of Algoma and Kewaunee; Vis of Casco and Luxemburg; TNs of Ahnapee, Carlton, Casco, Franklin, Lincoln, Luxemburg, Montpelier, Pierce, Red River and West Kewaunee.	New air photos were done in 2013 and are being submitted to FEMA. Also waiting for new flood maps to be sent to Land Records.
	*Ensure that plans are reviewed and updated regularly	Covered by Dept annual budget	Zoning	Ongoing	Medium	Kewaunee Co; CIs of Algoma and Kewaunee; Vis of Casco and Luxemburg; TNs of Ahnapee, Carlton, Casco, Franklin, Lincoln, Luxemburg, Montpelier, Pierce, Red River and West Kewaunee.	Flood ordinances and flood maps are kept up-to-date and adopted
	*Explore if residents express an interest in flood mitigation measures (e.g., buyouts, elevations, floodproofing, etc.) countywide.	Covered by Dept annual budget	EM Dept	Ongoing	Medium	Kewaunee Co; CIs of Algoma and Kewaunee; Vis of Casco and Luxemburg; TNs of Ahnapee, Carlton, Casco, Franklin, Lincoln, Luxemburg, Montpelier, Pierce, Red River and	FEMA's PDM & FMA grants are potential funding sources for buyout.

Summary of Mitigation Strategies							
Hazard Type	**Mitigation Measures**	**Costs of Project**	**Responsible Management**	**Project Timetable**	**Project Priority**	**Community(ies) Benefitting**	**Comments**
						West Kewaunee.	
	Work with the municipal Depts. of Public Works to identify areas prone to road flooding & discuss mitigation strategies & funding sources.	Covered by Dept. annual budget	CO HWY	Ongoing	Medium	Kewaunee Co; CIs of Algoma and Kewaunee; Vis of Casco and Luxemburg; TNs of Ahnapee, Carlton, Casco, Franklin, Lincoln, Luxemburg, Montpelier, Pierce, Red River and West Kewaunee.	Quarterly presentations at Town's Association meeting.
Fog	Provide public information via website links or brochures regarding safe driving procedures in the fog.	Covered by Dept. annual budget	EM Dept.	Ongoing	Low	Kewaunee Co; CIs of Algoma and Kewaunee; Vis of Casco and Luxemburg; TNs of Ahnapee, Carlton, Casco, Franklin, Lincoln, Luxemburg, Montpelier, Pierce, Red River and West Kewaunee.	Signs exist on the roads in particularly dangerous areas warning of fog potential. Annual Spring awareness campaign.
Forest and Wildfires	Provide information to homeowners on protecting homes and structures from wildfires, fire safety and on fire-resistant construction.	Covered by Dept. annual budget	EM Dept. / Local Fire Departments / PH / UW-Ext.	Ongoing	Low	Kewaunee Co; CIs of Algoma and Kewaunee; Vis of Casco and Luxemburg; TNs of Ahnapee, Carlton, Casco, Franklin, Lincoln, Luxemburg, Montpelier, Pierce, Red River and West Kewaunee.	• "Firewise" program, kids' fair, website, newspaper campaigns. • October Fire Safety Week. • May Safety Day.
	Provide ample training and exercise opportunities for volunteer fire fighters for larger fires.	Covered by Dept. annual budget	Local Fire Departments	Ongoing	Medium	Kewaunee Co; CIs of Algoma and Kewaunee; Vis of Casco and Luxemburg; TNs of Ahnapee, Carlton, Casco, Franklin, Lincoln, Luxemburg, Montpelier, Pierce, Red River and	Regular training and exercises.

Summary of Mitigation Strategies							
Hazard Type	**Mitigation Measures**	**Costs of Project**	**Responsible Management**	**Project Timetable**	**Project Priority**	**Community(ies) Benefitting**	**Comments**
						West Kewaunee.	
	Create a dry hydrant system for Town of Montpelier because there is no water storage capability.	~$25,000 As grants available	Luxemburg Fire Dept. / CO HWY	As grants available	High	TN of Montpelier	Unable to complete during the last PDM plan's life-span due to lack of funding. Carrying forward in case grants become available.
Landslide	Work with municipal partners to ensure good land-use planning to prevent development in areas prone to landslide.	Covered by Dept. annual budget	Zoning & LWCD	Ongoing	Low	Kewaunee Co; CIs of Algoma and Kewaunee; Vis of Casco and Luxemburg; TNs of Ahnapee, Carlton, Casco, Franklin, Lincoln, Luxemburg, Montpelier, Pierce, Red River and West Kewaunee.	
	Identify and communicate with residents in karst prone areas: • Provide brochures discussing sinkholes and mapping sinkholes. • Discuss well sampling program.	$5-10,000 grant funding $20,000 grant funding	LWCD	Ongoing	Medium	Kewaunee Co; CIs of Algoma and Kewaunee; Vis of Casco and Luxemburg; TNs of Ahnapee, Carlton, Casco, Franklin, Lincoln, Luxemburg, Montpelier, Pierce, Red River and West Kewaunee.	
	Communicate importance of well water testing.	$45 / sample	LWCD	Ongoing	Med	Kewaunee Co; CIs of Algoma and Kewaunee; Vis of Casco and Luxemburg; TNs of Ahnapee, Carlton, Casco, Franklin, Lincoln, Luxemburg, Montpelier, Pierce, Red River and West Kewaunee.	• 400 wells tested. • 28% of wells tested are positive for chlorides, nitrates and bacteria. • Annual campaign in the spring.
Severe Temperatures	Continue public informational campaigns about severe weather on the website and during Winter and Heat Awareness Weeks.	Covered by Dept. annual budget	EM Dept.	Ongoing	Medium	Kewaunee Co; CIs of Algoma and Kewaunee; Vis of Casco and Luxemburg; TNs of	Completed annually during Winter and Heat Awareness Weeks.

Summary of Mitigation Strategies							
Hazard Type	**Mitigation Measures**	**Costs of Project**	**Responsible Management**	**Project Timetable**	**Project Priority**	**Community(ies) Benefitting**	**Comments**
						Ahnapee, Carlton, Casco, Franklin, Lincoln, Luxemburg, Montpelier, Pierce, Red River and West Kewaunee.	
Storms: Hail	Continue offering information regarding insurance to farmers for potential crop losses due to hail damage.	Covered by Dept. annual budget	UW Ext.	Ongoing	Low	Kewaunee Co; CIs of Algoma and Kewaunee; Vis of Casco and Luxemburg; TNs of Ahnapee, Carlton, Casco, Franklin, Lincoln, Luxemburg, Montpelier, Pierce, Red River and West Kewaunee.	Awareness activities are done during tornado awareness week in April.
Storms: Lightning	Continue offering public information about safety procedures during a lightning storm and safe building construction.	Covered by Dept. annual budget	EM Dept.	Ongoing	Low	Kewaunee Co; CIs of Algoma and Kewaunee; Vis of Casco and Luxemburg; TNs of Ahnapee, Carlton, Casco, Franklin, Lincoln, Luxemburg, Montpelier, Pierce, Red River and West Kewaunee.	Awareness activities are done during tornado awareness week in April.
Storms: Thunderstorms	Provide public information via website and print materials regarding thunderstorm safety.	Costs vary	EM Dept.	Ongoing	Low	Kewaunee Co; CIs of Algoma and Kewaunee; Vis of Casco and Luxemburg; TNs of Ahnapee, Carlton, Casco, Franklin, Lincoln, Luxemburg, Montpelier, Pierce, Red River and West Kewaunee.	Awareness activities are done during tornado awareness week in April.
Storms: Tornadoes and High Wind	Coordinate the construction of tornado shelters in areas where deficient especially in trailer parks and parks.	Costs vary	EM Dept.	As grants available	Medium	Kewaunee Co; CIs of Algoma and Kewaunee; Vis of Casco and Luxemburg; TNs of	Apply for Department of Commerce's CDBG and/or FEMA PDM for funding assistance

Summary of Mitigation Strategies							
Hazard Type	**Mitigation Measures**	**Costs of Project**	**Responsible Management**	**Project Timetable**	**Project Priority**	**Community(ies) Benefitting**	**Comments**
						Ahnapee, Carlton, Casco, Franklin, Lincoln, Luxemburg, Montpelier, Pierce, Red River and West Kewaunee.	
	Explore options for creating a storm shelter space for the residents of the Algoma Trailer Park.	Unknown	EM Dept.	As grants available	Medium	City of Algoma	Options may include planning to open an existing space earlier, upgrade an existing space or build a new sheltering facility. It should be noted that some residents have functional needs.
	Explore options for sheltering trailer park residents.	Unknown	EM Dept.	As grants available		City of Kewaunee and Village of Luxemburg	There are no shelters available near either trailer park and it might be difficult to get to the shelter quickly in a fast-moving storm.
	Promote tornado awareness, including home safety measures (e.g., saferooms) and offer access to tornado spotter classes	Costs vary	EM Dept.	Ongoing	Medium	Kewaunee Co; CIs of Algoma and Kewaunee; Vis of Casco and Luxemburg; TNs of Ahnapee, Carlton, Casco, Franklin, Lincoln, Luxemburg, Montpelier, Pierce, Red River and West Kewaunee.	Awareness activities are done during tornado awareness week in April. There may be grants available for publicizing information about the construction of saferooms.
Storms: Winter	Continue the use of wooden lattice snow fencing by the roads.	Covered by Dept. annual budget	Co. Highway Dept.	On-going	Low	Kewaunee Co; CIs of Algoma and Kewaunee; Vis of Casco and Luxemburg; TNs of Ahnapee, Carlton, Casco, Franklin, Lincoln, Luxemburg, Montpelier, Pierce, Red River and West Kewaunee.	Completed and carried forward.
	Promote winter hazards	Covered	EM Dept.	Ongoing	Medium	Kewaunee Co; CIs of	Done during winter weather

Summary of Mitigation Strategies							
Hazard Type	**Mitigation Measures**	**Costs of Project**	**Responsible Management**	**Project Timetable**	**Project Priority**	**Community(ies) Benefitting**	**Comments**
	awareness including home and travel safety measures.	by Dept. annual budget				Algoma and Kewaunee; Vis of Casco and Luxemburg; TNs of Ahnapee, Carlton, Casco, Franklin, Lincoln, Luxemburg, Montpelier, Pierce, Red River and West Kewaunee.	awareness week in November
Utility Failure	Continue working with the owner of the natural gas pipeline especially as it relates to emergency preparedness, response and recovery.	Covered by Dept. annual budget	EM Dept.	Ongoing	High	Kewaunee Co; CIs of Algoma and Kewaunee; Vis of Casco and Luxemburg; TNs of Ahnapee, Carlton, Casco, Franklin, Lincoln, Luxemburg, Montpelier, Pierce, Red River and West Kewaunee.	Completed and carried forward.
	Explore preparedness (planning, training, exercising) options concerning the high pressure water line running from Green Bay to Lake Michigan.	Unknown	EM Dept.	Ongoing	Medium	Kewaunee Co; CIs of Algoma and Kewaunee; Vis of Casco and Luxemburg; TNs of Ahnapee, Carlton, Casco, Franklin, Lincoln, Luxemburg, Montpelier, Pierce, Red River and West Kewaunee.	There is a concern that a rupture could affect the entire underground area around buried pine.
Non-Natural Disasters	Complete a manure spill plan for Kewaunee County.	Unknown	EM Dept.	Ongoing	Medium	Kewaunee Co; CIs of Algoma and Kewaunee; VIs of Casco and Luxemburg; TNs of Ahnapee, Carlton, Casco, Franklin, Lincoln, Luxemburg, Montpelier, Pierce, Red River and West Kewaunee.	Have 3-4 spills per month from new high-density farms operating in the county.

Summary of Mitigation Strategies							
Hazard Type	**Mitigation Measures**	**Costs of Project**	**Responsible Management**	**Project Timetable**	**Project Priority**	**Community(ies) Benefitting**	**Comments**
	Explore options for protecting creeks from potential manure spills.	Covered by Dept. annual budget (plan); Unknown project funding sources	EM Dept.	2018	Low	Village of Casco	The creeks in Casco lead to the Kewaunee River, which flows into Lake Michigan. Looking for mitigation measures to protect water quality as well as the flora and fauna along the waterways.

* Designates an element that supports the NFIP.

Appendix D: Report on Previous Mitigation Strategies

Summary of Mitigation Strategies						
Hazard Type	**Mitigation Measures**	**Costs of Project**	**Responsible Management**	**Project Timetable**	**Project Priority**	**Comments**
All Hazards	Equip special facilities (e.g., large businesses, schools and nursing homes) with National Oceanic and Atmospheric Administration (NOAA) weather radios. Encourage citizens to have weather radios in their homes.	~$400,000	EM Dept. / PH	Ongoing / As grants available	Medium	• Purchased 200 radios (80 left). CBRFs and nursing homes received radios with assistance from Public Health. • Campaign in spring. Suggest radios as Christmas gifts on Facebook. Advertise via Facebook and Code Red. • Going forward with assistance from Sheriff's Office; Algoma, Luxemburg and Kewaunee Police Departments.
	Continue to add/update Emergency Management Department links on the existing county web site (e.g., ARC, FEMA, WEM) especially focusing on preparedness bulletins. Publicize the website to let citizens know about its capabilities (including those described above.)	Covered by Dept annual budget	EM Dept.	Ongoing	Low	Reviewed at least monthly.
	Create a website for people to receive the most current information regarding an ongoing disaster.	Covered by Dept annual budget	EM Dept.	Ongoing	Low	Done / Linked to LEPC website. Website also currently includes GIS information for the county.
	Install a Reverse Enhanced 9-1-1 system into the County Dispatch Center.	$4M ($1.1M in grants)	Sheriff's Office	2009	Very High	Installation complete; updated LE/Fire/EMS in December 2012.
	Update GIS address files so that 9-1-1 emergency calls from cellular telephones can be located in	~$10,000	Land Information Dept. /	2012	High	Addressing completed and put into 9-1-1 CAD in March 2012.

Summary of Mitigation Strategies						
Hazard Type	**Mitigation Measures**	**Costs of Project**	**Responsible Management**	**Project Timetable**	**Project Priority**	**Comments**
	space.		Sheriff's Office			
	Ensure the community is aware of the proper reporting, use and disposal of hazardous materials.	Covered by Dept. annual budget	EM Dept.	Ongoing	Medium	The EM Department conducts two awareness campaigns in spring and fall, usually in conjunction with a clean sweep in spring.
Coastal Erosion	Ensure that municipalities, builders and homeowners understand and follow safe building zoning regulations.	Covered by Dept. annual budget	Zoning	Ongoing	Medium	Discuss with residents when they come in for permits.
Drought and Dust Storms	Provide public information via website links or brochures regarding water conservation measures that can be employed by citizens in a drought.	Covered by Dept. annual budget	EM Dept.	2007	Low	Linked to DNR page 2011.
	Provide information to farmers via website links or brochures regarding water conservation measures that can be employed during a drought.	Covered by Dept. annual budget	UW Ext.	2007	Low	Push to conserve milk house water.
Flooding and Dam Failure	Advise the public about the availability of flood insurance. Advise municipalities not in the program.	Covered by Dept. annual budget	EM Dept.	Ongoing	Low	• Zoning requires elevation surveys if near flood plain. • Completed 2010 with link to FEMA.
	Completed a LIDAR flight in Spring 2012: • Acquire new topographical maps for the entire county with two (2) foot contour intervals. • *Update FEMA flood maps.*	186,000 $90,000	2012	As grants available	High	Completed 2012.
	Collect data regarding critical facilities and infrastructure that are in hazard areas so that the information is available for the next	$75,000	LWCD	As grants available	High	WEM completed HAZUS project for County.

Summary of Mitigation Strategies						
Hazard Type	**Mitigation Measures**	**Costs of Project**	**Responsible Management**	**Project Timetable**	**Project Priority**	**Comments**
	update and for mitigation measure decision-makers.					
	Work with the municipal Depts. of Public Works to identify areas prone to road flooding & discuss mitigation strategies & funding sources.	Covered by Dept. annual budget	CO HWY	Ongoing	Medium	Quarterly presentations at Town's Association meeting.
	Retaining Wall to curb streambed erosion near CTH S.	$150,000	CO HWY	As grants available	Low	Temporary fix in place. Grant funding did not come through.
	Replace the Bruemmerville Dam to protect the Willow Road Bridge.	$1.4M	Parks Department	As grants available	High	Was originally planned to be replaced. It was removed instead in summer 2012.
Fog	Provide public information via website links or brochures regarding safe driving procedures in the fog.	Covered by Dept. annual budget	EM Dept.	Ongoing	Low	Signs exist on the roads in particularly dangerous areas warning of fog potential. Annual Spring awareness campaign.
Forest and Wildfires	Provide information to homeowners on protecting homes and structures from wildfires, fire safety and on fire-resistant construction.	Covered by Dept. annual budget	EM Dept. / Local Fire Departments / UW-Ext.	Ongoing	Low	• "Firewise" program, kids' fair, website, newspaper campaigns. • October Fire Safety Week. • May Safety Day. • "National Night Out" (annually in August) also includes fire safety educational info
	Provide ample training and exercise opportunities for volunteer fire fighters for larger fires.	Covered by Dept. annual budget	Local Fire Departments / EM Dept.	Ongoing	Medium	Regular training and exercises.
	Create a dry hydrant system for Town of Montpelier because there is no water storage capability.	~$25,000	Luxemburg Fire Dept. / CO HWY	As grants available	High	Unable to complete during the last PDM plan's life-span due to lack of funding. Carrying forward in case grants become available.
	Mapped fill stations.	*$2,000*	*Land Information Dept. / Fire Departments / EM Dept*	*2009*	*Medium*	*Completed in 2009*
Landslide	Work with municipal partners to	Covered by	Zoning /	Ongoing	Low	LWCD and Zoning presentation to Pierce

Summary of Mitigation Strategies						
Hazard Type	**Mitigation Measures**	**Costs of Project**	**Responsible Management**	**Project Timetable**	**Project Priority**	**Comments**
	ensure good land-use planning to prevent development in areas prone to landslide.	budget	LWCD			Town Board in 2008.
	Communicate importance of well water testing.	*$45 / sample*	*LWCD*	*2007 / Ongoing*	*Med*	• *400 wells tested.* • *28% of wells tested are positive for chlorides, nitrates and bacteria.* • *Annual campaign in the spring.*
Severe Temperatures	Continue public informational campaigns about severe weather on the website and during Winter and Heat Awareness Weeks.	Covered by budget	EM Dept.	Ongoing	Medium	Completed annually during Winter and Heat Awareness Weeks.
Storms: Hail	Continue offering information regarding insurance to farmers for potential crop losses due to hail damage.	Covered by Dept budget	UW-Ext.	Ongoing	Low	Awareness activities are done during tornado awareness week in April.
Storms: Lightning	Continue offering public information about safety procedures during a lightning storm and safe building construction.	Covered by Dept. budget	EM Dept.	Ongoing	Low	Awareness activities are done during tornado awareness week in April.
Storms: Thunderstorms	Provide public information via website and print materials regarding thunderstorm safety.	Costs vary	EM Dept.	Ongoing	Low	Awareness activities are done during tornado awareness week in April.
Storms: Tornadoes and High Wind	Coordinate the construction of tornado shelters in areas where deficient especially in trailer parks and parks.	Costs vary	EM Dept.	As grants available	Medium	• Apply for Department of Commerce's CDBG for funding assistance if it is available. • Funding was not available during this plan's life-span.
	Provide information (via website) to builders and owners of manufactured and mobile homes about the benefits of using tie-downs with ground anchors.	Covered by Dept. budget	EM Dept.	Ongoing	Low	Information available on website as of 2011 and upon request.
	Provide information to the townships regarding requiring mobile home tie-downs in the	Covered by Dept. budget	EM Dept.	Ongoing	Low	Information available on website as of 2011 and upon request.

Summary of Mitigation Strategies						
Hazard Type	**Mitigation Measures**	**Costs of Project**	**Responsible Management**	**Project Timetable**	**Project Priority**	**Comments**
	regulations.					
	Install the Emergency Alert System (EAS) hardware that currently exists within the county. Train staff on the proper usage of the hardware.	$50, 000 (local installation only) $150,000 (Incudes Brown Co. installation)	EM Dept.	As grants available	Medium	The project was not completed because there was no funding available.
	Begin the process of ensuring adequate coverage by outdoor warning sirens for campgrounds and mobile home parks by testing the siren coverage areas and determining the needs and costs.	Covered by Dept. budget	EM Dept.	2008	Medium	• No longer need in the county. • Process now completed via Code Red (reverse 911). The owner is alerted and they notify campers.
	Promote tornado awareness, including home safety measures (e.g., saferooms) and offer access to tornado spotter classes.	Costs vary	EM Dept.	Ongoing	Medium	Awareness activities are done during tornado awareness week in April. There may be grants available for publicizing information about the construction of saferooms.
Storms: Winter	Continue the use of wooden lattice snow fencing by the roads.	Covered by Dept. budget	CO HWY	On-going	Low	Completed and carried forward.
	Promote winter hazards awareness including home and travel safety measures.	Covered by Dept. budget	EM Dept.	Ongoing	Medium	Done during winter weather awareness week in November
Utility Failure	Contact the owner of the natural gas pipeline and enter into dialog, especially as it relates to emergency preparedness, response and recovery.	Covered by Dept. budget	EM Dept.	Ongoing	High	Completed and carried forward.

* Designates an element that supports the NFIP.

Items in italics are strategies not originally listed in the plan but that were added and completed over the plan's five-year life-span.

Appendix E: HAZUS Vulnerability Assessment

Kewaunee County Vulnerability Report

Identify Hazards

A flood risk assessment was prepared for Kewaunee County. The following flood hazards have been identified.

Wisconsin has experienced several major floods during the last three decades. The 1973, 1986 and 1990 floods revealed that no flood plains or urban areas in Wisconsin can be considered safe from damages. Mill-dams have developed leaks on occasion but have not caused any flooding problems. Kewaunee County historically does not have a serious flooding problem, with only one flood reported in Kewaunee County by the National Weather Service between January 1, 1950 and July 31, 2006. Kewaunee County has been included in two Presidential Disaster Declarations (in 1973 and 1990) based on the fact that they were contiguous to other counties with more damage. The following summarizes damages attributed to flooding in Kewaunee by the National Flood Insurance Program through December 19, 2003: Seven property losses in the City of Algoma and one property loss each in the City of Kewaunee and the Village of Luxemburg. There are no repetitive loss properties in Kewaunee County.

It should be noted that there has been some localized flooding primarily caused by heavy rainfall and run-off. A careful review of the geography and history of flooding in Kewaunee County leads to a belief that there is a low probability of flooding in the future and a low probability of damage and losses due to flooding. This flooding could occur due to river flooding, flash flooding or dam failure.

HAZUS-MH Hazard Analysis

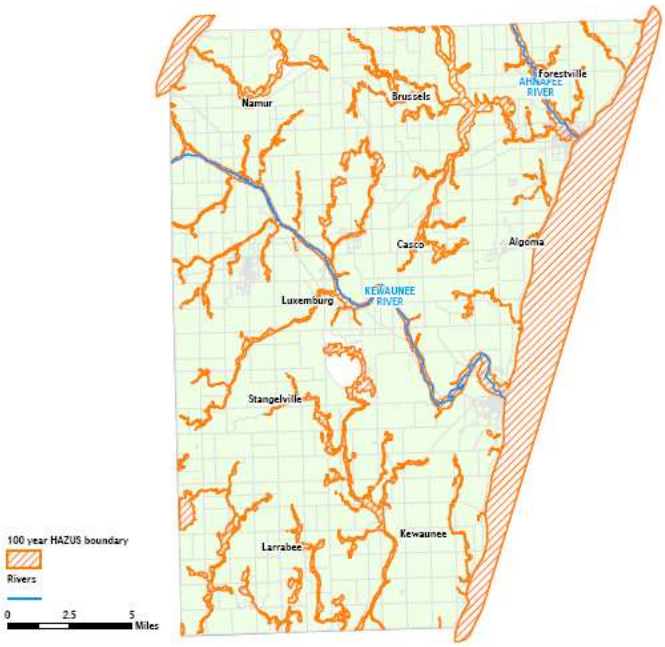
Flood analysis for Kewaunee County was performed using HAZUS-MH MR3 released in July 2007. The bundled aggregated general building stock was updated to Dun & Bradstreet 2006. Building valuations were updated to R.S. Means 2006. Building counts based on census housing unit counts are available for RES1 (single-family dwellings) and RES2 (manufactured housing) instead of calculated building counts.

The site specific inventory (specifically Schools, Hospitals, Emergency Operation Centers, Fire Stations and Police Stations) was updated using the best available statewide information.

HAZUS-MH was used to generate the flood depth grid for a 100-year return period calculated for 1 square mile drainage areas. The riverine model was determined from a user provided USGS 30m DEM and peak discharge values obtained for 17 reaches tabulated in the Kewaunee County Flood Insurance Study. The coastal model was built from the 100-year stillwater elevations provided in the Kewaunee County Flood Insurance Study.

Figure 1 depicts the flood boundary from the HAZUS-MH analysis. The majority of damages due to flooding occur along the Ahnapee River and the Kewaunee River.

Figure 1: Kewaunee County HAZUS-MH Analysis (100-Year Flood)



HAZUS-MH Aggregate Loss Analysis

HAZUS-MH was used to estimate the damages for a 100-year flood event in Kewaunee County. An estimated 147 buildings will be damaged totaling $22.5 million in building losses and $57 million in total economic losses. The total estimated number of damaged buildings, total building losses, and estimated total economic losses are shown in Table 1.

HAZUS-MH estimates 10 census blocks with losses exceeding $1 million. The distribution of losses is shown in Figure 2.

HAZUS-MH aggregate loss analysis is evenly distributed across a census block. Census blocks of concern should be reviewed in more detail to determine the actual percentage of facilities that fall within the flood hazard areas. The aggregate losses reported in this study may be overstated. Examples are provided in Figure 3.

Table 1: Kewaunee County Total Economic Loss - 100-Year Flood

General Occupancy	Estimated Total Buildings	Total Damaged Buildings	Total Building Exposure X 1000	Total Economic Loss X 1000	Building Loss X 1000
Agricultural	1	0	$40,617	$1,068	$221
Commercial	31	0	$207,075	$14,972	$4,335
Education	0	0	$39,899	$436	$58
Government	1	0	$8,835	$511	$72
Industrial	29	8	$85,219	$16,545	$3,570
Religious/Non-Profit	3	0	$13,535	$1,286	$168
Residential	7,328	139	$1,122,388	$22,291	$14,096
Total	**7,393**	**147**	**$1,517,568**	**$57,109**	**$22,520**

The reported building counts should be interpreted as degrees of loss rather than as exact numbers of buildings exposed to flooding. These numbers were derived from aggregate building inventories which are assumed to be dispersed evenly across census blocks. HAZUS-MH requires that a predetermined amount of square footage of a typical building sustain damage in order to produce a damaged building count. If only a minimal amount of damage to buildings is predicted, it is possible to see zero damaged building counts while also seeing economic losses.

Figure 2: Kewaunee County Total Economic Loss - 100-Year Flood

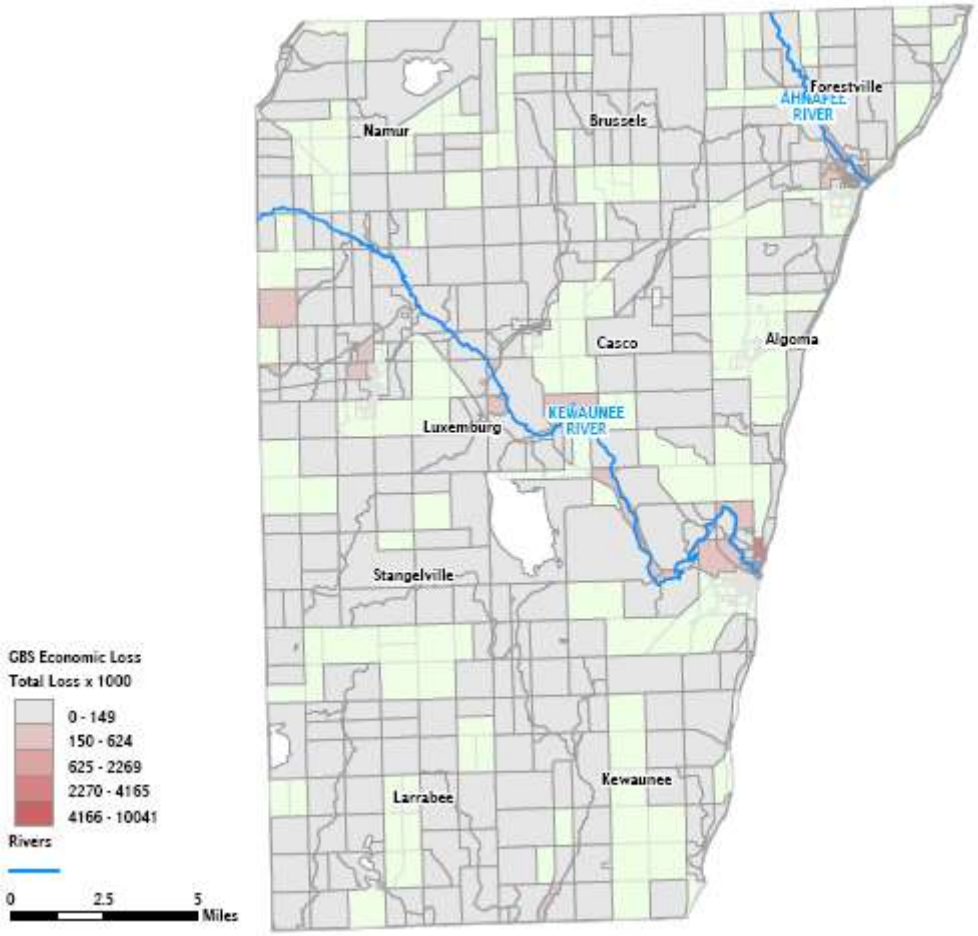


Figure 3a: Flood Damage Exposure in Luxemburg

Figure 3a shows census blocks overlaid with the flood boundary and orthophoto of Luxemburg. Census block 550619604002036 has an estimated building loss of $43 thousand with a combined replacement cost of $191 thousand. HAZUS-MH estimates that 14 buildings are within the calculated flood boundary for this block. However, the orthophoto shows this area to be mainly forest, with no buildings at risk.

Figure 3b: Flood Damage Exposure in Casco

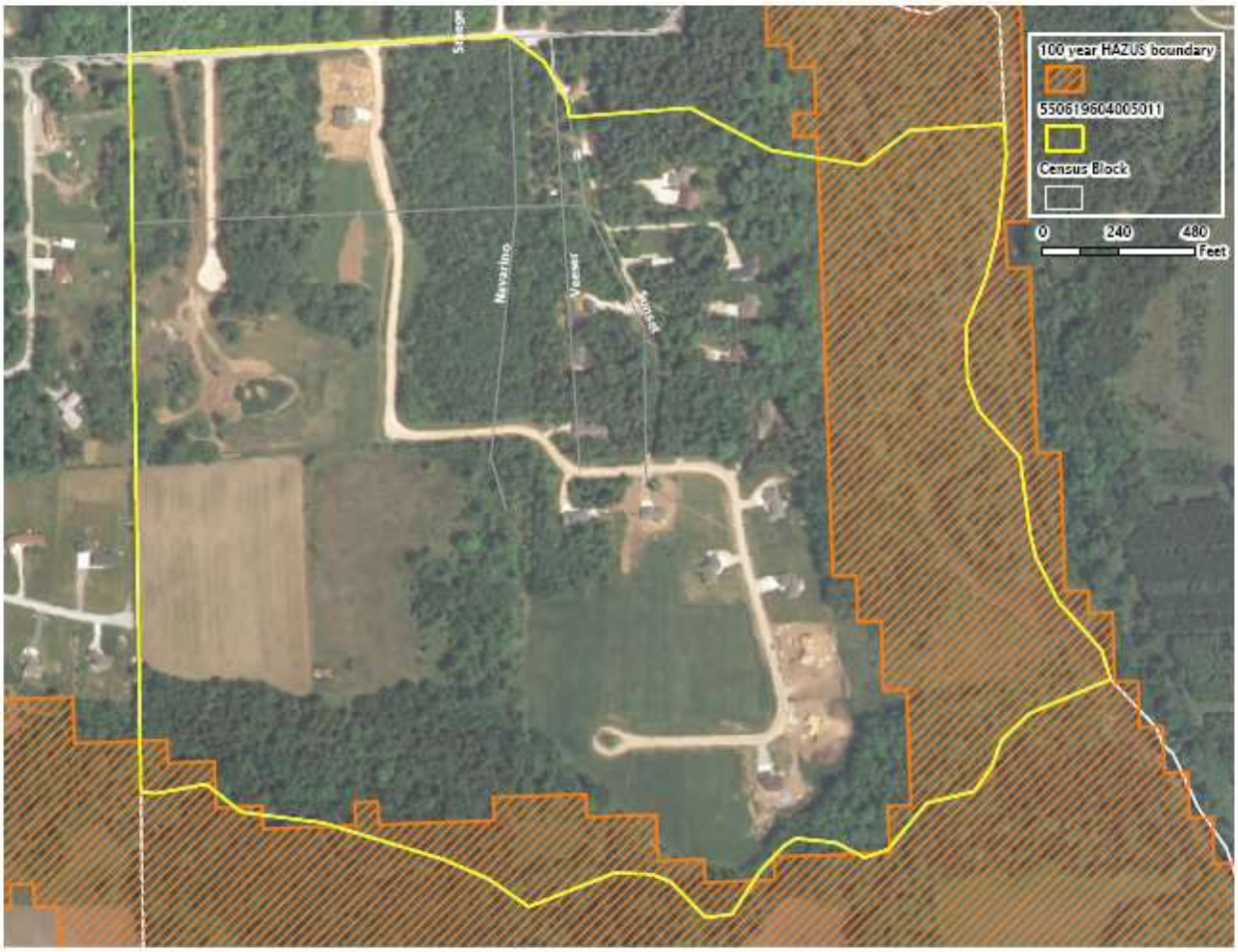


Figure 3b shows census blocks overlaid with the flood boundary and orthophoto of Casco. Census block 550619604005011 has an estimated building loss of $170 thousand with a combined replacement cost of $280 thousand. HAZUS-MH estimates that 22 buildings are within the calculated flood boundary for this block. However, the orthophoto shows this area to be mainly forest, with no buildings at risk.

HAZUS-MH Essential Facility Loss Analysis

Essential facilities encounter the same impacts as other buildings within the flood boundary: structural failure, extensive water damage to the facility, and loss of facility functionality (i.e. a damaged police station will no longer be able to serve the community).

The HAZUS-MH analysis identified one Fire Station and one Police Station that may be subject to flooding. A list of the essential facilities within Kewaunee County is included in Tables 2 and 3. A map of essential facilities potentially at risk to flooding is shown in Figure 4.

Table 2: Kewaunee County Essential Facility Loss - 100-Year Flood

Class	Building Count	At Least Moderate Damage	At Least Substantial Damage	Loss of Use
Care Facilities	2	0	0	0
EOC	0	0	0	0
Fire Stations	7	1	0	0
Police Stations	6	1	0	0
Schools	18	0	0	0
Total	**33**	**2**	**0**	**0**

Table 3: Kewaunee County Damaged Essential Facilities

Facility Name
Tisch Mills Fire Department
Kewaunee Police Department

Figure 4: 100-Year Flood Boundary Overlaid with Essential Facilities

Figure 4b: 100-Year Flood Boundary Overlaid with Essential Facilities

HAZUS-MH Shelter Requirement Analysis

HAZUS-MH estimates the number of households that are expected to be displaced from their homes due to the flood and the associated potential evacuation. HAZUS-MH also estimates those displaced people that will require accommodations in temporary public shelters. The model estimates 564 households will be displaced due to the flood. Displacement includes households evacuated from within or very near to the inundated area. Of these 587 people (out of a total population of 20,187) will seek temporary shelter in public shelters.

HAZUS-MH State Property Loss Analysis

The flood boundaries were overlaid with the State of Wisconsin property boundaries as provided by the Department of Natural Resources. Table 4 provides a list of state properties impacted by the flood boundary. Figures 5a and 5b show examples of the inundated areas.

Table 4: Kewaunee County State Property Flood Inundation

State Property	Percent Inundated	Acres Inundated
C.D. (Buzz) Besadny Fish And Wildlife Area	38%	988
Ahnapee State Trail	18%	103

Figure 5a: Boundary of 100-Year Flood Overlaid with State of Wisconsin Properties

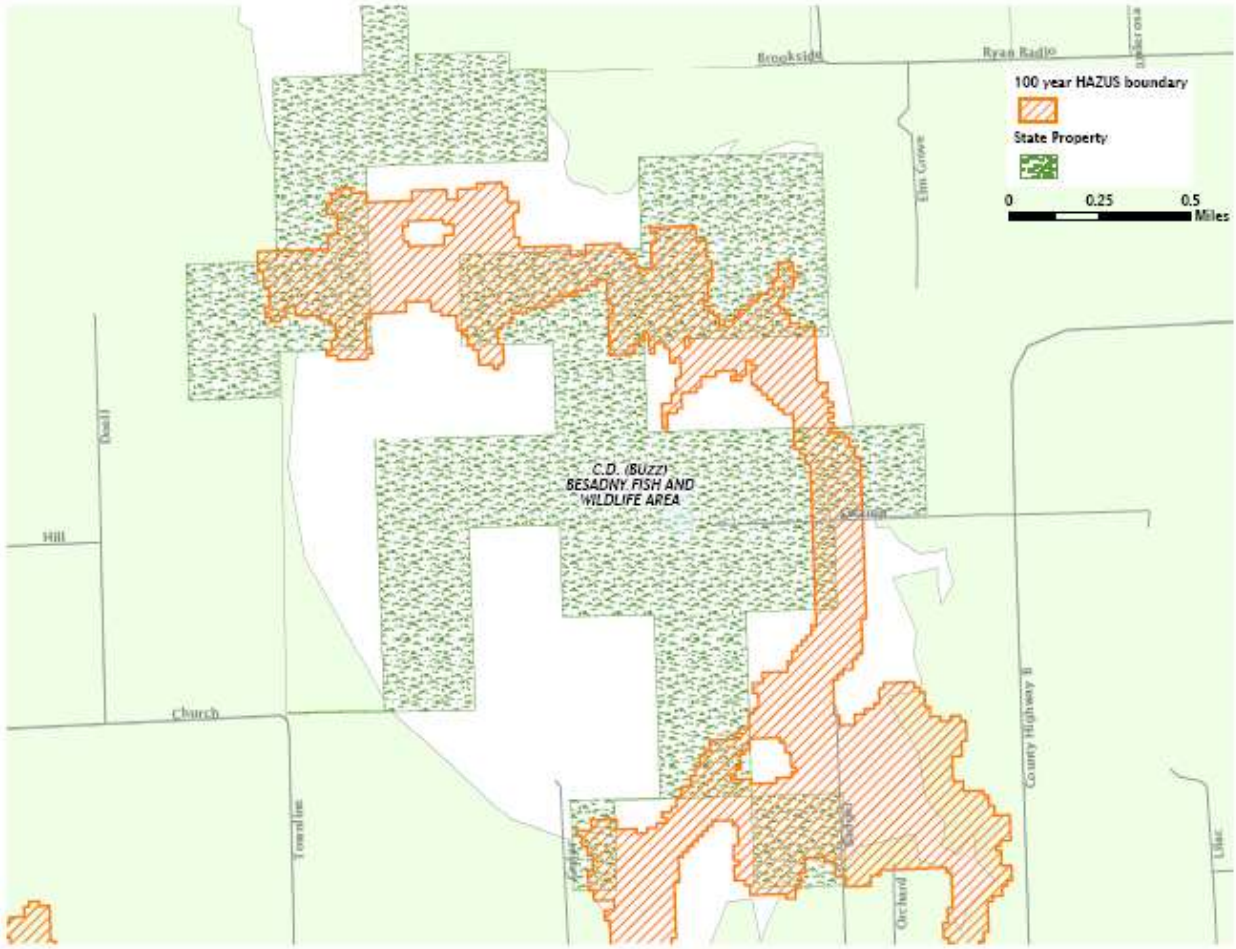
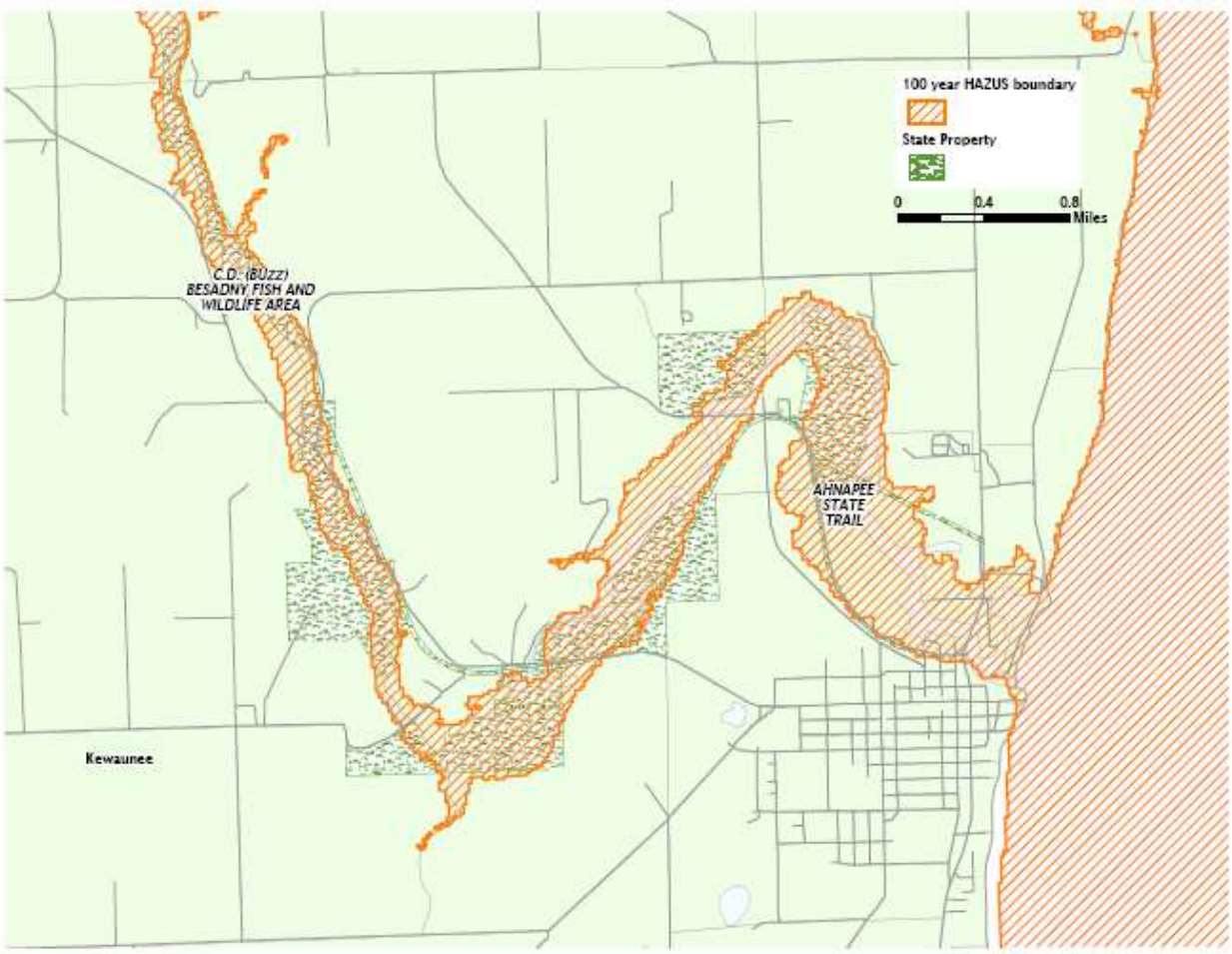


Figure 5b: Boundary of 100-Year Flood Overlaid with State of Wisconsin Properties



Appendix F: Community Input

Kewaunee County believes in the importance of gathering public input from interested parties in the community. To achieve this goal, the Emergency Management Office took every opportunity available to utilize various methods to publicize the opportunity for people to participate in the planning process and to gather input from interested parties. The table that follows outlines the major opportunities that were created to discuss the plan. The table includes dates of workgroup meetings, meetings with public officials and media opportunities.

DATE	SUMMARY OF OPPORTUNITY
6/20/2011	FEMA Region V PDM Survey is sent to lead departments from the county and each municipality's (i.e., city, village, town) elected officials with the request that the survey be placed on the next community meeting agenda and completed at that meeting. These meetings are posted (per WI state law) and open to the public. Over the next few months, the municipalities completed and returned the surveys.
6/20/2011	Press release regarding the beginning of the planning process is released (including an invitation to the general public to be part of the workgroup) to the area media outlets.
6/24/2011	Press release is placed on the Kewaunee County Star News newspaper and reprinted/posted in the Green Bay Press Gazette's online newspaper.
6/26/11	Press release is placed on the Green Bay Press Gazette's online newspaper.
6/29/11	Press release is printed in the county's newspaper.
11/28/11	PDM plan update process is introduced to the attendees of the Kewaunee Town's Association meeting for municipal elected officials. The meeting agenda is posted to the general public per WI state law and the public may attend.
11/29/11	PDM Update workgroup meeting.
8/15/12	Participated in FEMA meeting regarding the Lake Michigan Coastal Flood Risk.
	Contiguous county's EM Directors received draft plan with an invitation to comment on the plan.
	Legal public notice released inviting the public to review and

	comment on the plan.
	Press release sent to the media inviting the public to review and comment on the plan.
	Review, discussion and adoption of the plan placed on county and municipal meeting agendas, which were posted (per WI state law) prior to the meeting and the meeting itself is open to the public.

One of the main ways people were made aware of the plan was the publication of a brochure (following) that was widely distributed in the public buildings around the community including the City/County Courthouse and the library. The purpose of this brochure was to provide a general overview of the mitigation planning process, the impetus for planning and the scope of the final result.

Date: 20 June 2011
To: Town, Village or City Leader
From: Lori Hucek, EM Director
Re: Pre-Disaster Mitigation (PDM) Plan

Kewaunee County, like the rest of the State of Wisconsin, is vulnerable to a variety of disasters. Wisconsin has incurred disaster-related damages totaling $3 billion in the last three decades but future losses can be reduced through mitigation activities. A recent study by the Multi-hazard Mitigation Council shows that each dollar spent on mitigation saves society an average of four dollars. Since 1993 more than 400 disasters have occurred in the United States, affecting communities in all 50 states, costing the country over $500 million dollars per week and killing over 24,000 people.

Mitigation actions reduce or eliminate the long-term risk to human life and property from hazards. These preventative actions can be as simple as elevating a furnace in a basement that sometimes has water on the floor. Mitigation can also have a comprehensive approach such as relocating buildings out of the floodplain or strengthening critical facilities to prevent wind damage and provide stronger shelter.

In an effort to better prepare Kewaunee County to manage its vulnerability to disaster, Kewaunee County Emergency Management applied for and received a PDM planning grant. This goal of this grant is to complete an approvable plan update, which will serve as a roadmap that outlines potential cost-effective hazard mitigation activities, some of which might be available for future grant funding. The plan is designed to look at the risks and vulnerabilities that the county faces from natural disaster and to highlight mitigation strategies that might reduce future losses to life and property. As part of this planning process, **I need your help.**

The first step is asking that you please place an item on your **next** municipal meeting agenda to complete the attached survey. This very short survey will help us to identify the concerns that you have in your municipality and to capture ideas that you have for making your community safer and more disaster resistant. Please return your completed surveys to our consultant as soon as possible but **no later than August 31st**:

Lenora Borchardt
EPTEC, Inc.
7027 Fawn Lane
Sun Prairie, WI 53590-9455
FAX: 608-834-0802

After receiving your surveys, the information will be incorporated into the draft plan, which is being guided by a workgroup of interested agencies and public members. I would like to extend an offer for anyone from your leadership council, your municipal staff or your general community to contact me if they would like to join the workgroup.

Finally, after the workgroup has a final draft, we will be sending copies of the plan to each of you for final review and adoption. It is important to note two things:

- Adoption of this plan will not cost your community anything. You will not be committing to completing any of the projects listed; instead it is a list of triaged ideas that can be accomplished should the funding and will to complete them become available.
- If you do not adopt this plan, your community will not be eligible to apply for and receive mitigation project funding in the future.

Let me thank you in advance for the assistance that you are providing. This small investment of your time will help make our community a safer, healthier and more disaster-resistant community for years to come.

If you are interested in more information about the plan or would like to provide input into the plan, please feel free to contact me at (920) 487-5257.

KEWAUNEE COUNTY NATURAL HAZARDS PREPAREDNESS AND MITIGATION QUESTIONNAIRE

1. In the past five years, has your community experienced a natural disaster such as a severe windstorm, flood, wildfire, earthquake, etc.?
   - No
     - Kewaunee County Highway Dept.
     - City of Algoma
     - City of Kewaunee
     - Village of Casco
     - Town of Ahnapee
     - Town of Luxemburg

If YES, which of these natural disasters occurred? (Please check all that apply.)

Event	When event last occurred:				
	Within past year	1-5 years ago	5-15 years ago	More than 15 years ago	Never
Drought		Cty Land & Water T. of Franklin	T. of West Kewaunee	T. of Carlton T. of Franklin T. of Montpelier	V. of Luxemburg
Dust Storm					Cty Land & Water V. of Luxemburg T. of Franklin T. of West Kewaunee
Earthquake					Cty Land & Water V. of Luxemburg T. of Franklin T. of West Kewaunee
Flood		T. of Montpelier	Cty Land & Water	T. of Red River	V. of Luxemburg T. of Franklin T. of West Kewaunee
Lakeshore Erosion	Cty Land & Water	T. of West Kewaunee		T. of Carlton	V. of Luxemburg T. of Franklin
Landslide/ Debris Flow					V. of Luxemburg T. of Franklin T. of West Kewaunee
Wildfire					Cty Land & Water V. of Luxemburg T. of Franklin T. of West Kewaunee
Windstorm/ Tornado	T. of Franklin T. of Montpelier	T. of Franklin	Cty Land & Water T. of Franklin T. of West Kewaunee	T. of Franklin	V. of Luxemburg
Severe Winter Storm	V. of Luxemburg T. of Franklin T. of Montpelier	Cty Land & Water T. of Carlton T. of Franklin T. of West Kewaunee	T. of Franklin	T. of Franklin	

2. For which of the following natural disasters do you think your community is at risk? (Check the appropriate box for each hazard.)

Event	Extremely Concerned	Very Concerned	Concerned	Somewhat Concerned	Not Concerned
Drought	T. of Carlton	T. of Franklin	V. of Casco T. of Luxemburg	Cty Land & Water V. of Luxemburg T. of Montpelier	Cty Highway C. of Algoma C. of Kewaunee T. of Red River
Dust Storm			T. of Luxemburg		Cty Highway Cty Land & Water C. of Algoma C. of Kewaunee V. of Casco V. of Luxemburg T. of Luxemburg T. of Montpelier T. of Red River
Earthquake					Cty Highway Cty Land & Water C. of Algoma C. of Kewaunee V. of Casco V. of Luxemburg T. of Luxemburg T. of Montpelier T. of Red River
Flood			T. of Luxemburg T. of Montpelier	Cty Highway C. of Kewaunee	Cty Land & Water C. of Algoma V. of Casco V. of Luxemburg T. of Red River
Lakeshore Erosion	T. of Carlton	Cty Highway	Cty Land & Water C. of Kewaunee	C. of Algoma	V. of Casco V. of Luxemburg T. of Luxemburg T. of Montpelier T. of Red River
Landslide/ Debris Flow					Cty Highway Cty Land & Water C. of Algoma C. of Kewaunee V. of Casco V. of Luxemburg T. of Luxemburg T. of Montpelier T. of Red River
Wildfire			Cty Highway V. of Casco T. of Luxemburg	Cty Land & Water T. of Montpelier	C. of Algoma C. of Kewaunee V. of Luxemburg
Windstorm/ Tornado	T. of Ahnapee T. of Franklin T. of Luxemburg	Cty Highway V. of Casco V. of Luxemburg T. of Montpelier	C. of Algoma C. of Kewaunee		Cty Land & Water T. of Red River
Severe Winter Storm/ Ice Storm	V. of Luxemburg T. of Ahnapee T. of Carlton T. of Franklin T. of Luxemburg	Cty Highway V. of Casco T. of Montpelier	C. of Algoma C. of Kewaunee		T. of Red River

3. Has your community had damage to facilities or infrastructure (e.g., roads, public buildings, utilities?)

Kewaunee County

- We have not had any major damage in the last five years. Some damage to electrical wires has accured during wind storms this past summer. – Kewaunee County Highway Dept.

Cities

- No – City of Algoma
- No – City of Kewaunee

Villages

- No building damage; utility outage from downed tree during wind storm/freezing rain – Village of Casco
- No – Village of Luxemburg

Towns

- No – Town of Ahnapee
- Minor washouts in ditches by culverts – Town of Carlton
- Roads, utilities – Town of Franklin
- Roads, but not in last 15 years – Town of Luxemburg
- Flood Damage to Roads – Town of Montpelier
- Tornado damage to buildings – Town of Montpelier
- No – Town of Red River
- No – Town of West Kewaunee

4. What facilities or infrastructure in your community do you think are especially vulnerable to damage during a natural disaster?

Kewaunee County

- Electric utilities would be vulnerable during a severe ice storm or tornado. – Kewaunee County Highway Dept.

Cities

- Sewer System, Water System, Electric Power } depending on type of disaster - City of Algoma
- Sewer treatment plant. Water plant. – City of Kewaunee

Villages

- As mentioned above, utility outage from downed trees. Many trees throughout the village – Village of Casco
- Fresh or drinking water supply (wells – tower – pump stations, buildings – Village of Luxemburg

Towns

- Roads/ditches/bridges – Town of Ahnapee
- Town Hall/Fire Dept. – Town of Carlton
- Roads, utilities, public building – Town of Franklin
- Roads, but not in last 15 years – Town of Luxemburg
- All Buildings & Roads – Town of Montpelier
- Culverts and bridges – Town of Red River
- Roads – Town of West Kewaunee

5. How important do you think each of the following projects are in mitigating (i.e., lessening the impacts of) a natural disaster in your community?

Project	Very	Somewhat	Neutral	Not Very	Not

	Important	Important		Important	Important
Protecting private property	V. of Casco V. of Luxemburg T. of Carlton T. of Luxemburg	Cty Highway Cty Land & Water C. of Algoma C. of Kewaunee T. of Franklin T. of Montpelier			T. of Red River T. of West Kewaunee
Protecting critical facilities (hospitals, fire stations, etc.)	Cty Highway Cty Land & Water V. of Casco T. of Carlton T. of West Kewaunee	C. of Kewaunee T. of Red River	T. of Montpelier		T. of Luxemburg
Preventing development in hazard areas	T. of Carlton T. of West Kewaunee	Cty Highway Cty Land & Water C. of Algoma C. of Kewaunee V. of Casco V. of Luxemburg T. of Franklin T. of Montp T. of Red River elier			T. of Luxemburg
Enhancing the function of natural features (streams, wetlands)	Cty Land & Water C. of Kewaunee	C. of Algoma V. of Casco V. of Luxemburg T. of Franklin T. of Red River	T. of Carlton T. of Luxemburg T. of Montpelier T. of West Kewaunee	Cty Highway	
Protecting historical and cultural landmarks	C. of Kewaunee	C. of Algoma V. of Casco V. of Luxemburg T. of Carlton	Cty Land & Water T. of Luxemburg T. of Montpelier T. of West Kewaunee	Cty Highway	T. of Franklin T. of Red River
Promoting cooperation among public agencies, citizens, non-profit organizations and businesses	Cty Highway Cty Land & Water V. of Casco V. of Luxemburg T. of Ahnapee T. of Carlton	C. of Algoma C. of Kewaunee T. of Franklin T. of Montpelier T. of West Kewaunee	T. of Luxemburg T. of Red River		
Protecting and reducing damage to utilities	Cty Highway Cty Land & Water C. of Algoma C. of Kewaunee V. of Casco V. of Luxemburg T. of Ahnapee T. of Carlton T. of West Kewaunee	T. of Luxemburg T. of Franklin T. of Montpelier T. of Red River			
Strengthening emergency services	Cty Land & Water C. of Algoma V. of Casco V. of Luxemburg T. of Carlton T. of Luxemburg T. of West Kewaunee	Cty Highway C. of Kewaunee T. of Franklin T. of Montpelier	T. of Red River		

6. What ideas do you have for your community to mitigate natural disasters?

Kewaunee County

- Co-operation between neighboring counties for relief services is important. – Kewaunee County Highway Dept.

Cities

- Preventative maintenance on infrastructure – City of Algoma
- No – City of Kewaunee

Villages

- Good communications among emergency departments (i.e. Fire, Rescue, Police & Emergency Management) – Village of Casco
- Follow the plan that is in place – Village of Luxemburg

Towns

- None – Town of Ahnapee
- None – Town of Carlton
- None – Town of Franklin
- More warnings by siren or phone – Town of Luxemburg
- None at this time – Town of Montpelier
- None at this time – Town of Red River

7. Do you have any community building projects (e.g., subdivisions, office/industrial parks, roads) slated to be built in the near future? If so, what is the project called and what is its location?

Kewaunee County

- Because we are a County Highway Department, road building is important to us. This summer we have a mile of road (AB) to be built from the Door County line south to Duvall.– Kewaunee County Highway Dept.

Cities

- No – City of Algoma
- No – City of Kewaunee

Villages

- County “C” upgraded and re-blacktopped in 2011, also to include damaged curb and gutter and some sewer repair – Village of Casco
- Not right now – Village of Luxemburg

Towns

- Maintenance of roads – Town of Ahnapee
- No – Town of Carlton
- No – Town of Franklin
- No – Town of Luxemburg
- None at this time – Town of Montpelier
- No – Town of Red River
- No – Town of West Kewaunee

20 June 2011

For More Information, Contact Lori Hucek, 920-487-5257
For Immediate Release

KEWAUNEE COUNTY STARTS HAZARD MITIGATION PLAN UPDATE

(Algoma, WI) Kewaunee County, like the rest of the State of Wisconsin, is vulnerable to a variety of disasters. Wisconsin has incurred disaster-related damages totaling $3 billion in the last three decades but future losses can be reduced through mitigation activities. A recent study by the Multi-hazard Mitigation Council shows that each dollar spent on mitigation saves society an average of four dollars. Since 1993 more than 400 disasters have occurred in the United States, affecting communities in all 50 states, costing the country over $500 million dollars per week and killing over 24,000 people.

Mitigation actions reduce or eliminate the long-term risk to human life and property from hazards. These preventative actions can be as simple as elevating a furnace in a basement that sometimes has water on the floor. Mitigation can also have a comprehensive approach such as relocating buildings out of the floodplain or strengthening critical facilities to prevent wind damage and provide stronger shelter.

In an effort to better prepare Kewaunee County to manage its vulnerability to disaster, Lori Hucek, Kewaunee County Emergency Management Director, applied for and received a Pre-Disaster Mitigation (PDM) planning grant. This goal of this grant is to complete an approvable plan, which will serve as a roadmap that outlines potential cost-effective hazard mitigation activities, some of which might be available for future grant funding. Hazard mitigation plans and projects reduce overall risks to the population and structures while also reducing reliance on funding from actual disaster declarations. The rigorous building standards adopted by 20,000 communities across the country are saving the nation more than $1.1 billion a year in prevented flood damages.

The plan is designed to look at the risks and vulnerabilities that the county faces from natural disaster and to highlight mitigation strategies that might reduce future losses. As part of this planning process, Hucek is assembling a workgroup to review and guide the planning activities. The workgroup is reviewing initial background information about Kewaunee County and has begun identifying strategies that might help. Hucek stated, “I am very excited about this part of the planning process. The input from the workgroup can have long-lasting impacts, making Kewaunee County safer and more disaster-resistant.”

FEMA has recognized the importance of having members of the community involved in the process and Hucek would like to ensure that all interested members of the community have an opportunity to provide input into the plan. If

you are interested in more information about the plan or would like to provide input into the plan, please contact Lori Hucek at 920-487-5257.

###

Kewaunee County starts hazard mitigation plan update[113]

11:00 PM, Jun. 24, 2011 |
Written by **Kewaunee County Star-News**

Like the rest of Wisconsin, Kewaunee County is vulnerable to a variety of disasters.

Wisconsin has incurred disaster-related damages totaling $3 billion in the last three decades, but future losses probably can be reduced through mitigation activities. A recent study by the Multi-Hazard Mitigation Council shows that each dollar spent on mitigation saves society an average of four dollars.

Mitigation actions reduce or eliminate the long-term risk to human life and property from hazards. These preventative actions can be as simple as elevating a furnace in a basement that sometimes has water on the floor. Mitigation also can have a comprehensive approach, such as relocating buildings out on the floodplain or strengthening critical facilities to prevent wind damage and provide stronger shelter.

In an effort to better prepare Kewaunee County to manage its vulnerability to disaster, Lori Hucek, Kewaunee County Emergency Management director, applied for and received a Pre-Disaster Mitigation (PDM) planning grant.

The goal of this grant is to complete an approvable plan, which will serve as a roadmap that outlines potential cost-effective hazard mitigation activities, some of which might be available for future grant funding.

Hazard mitigation plans and projects reduce overall risks to the population and structures while also reducing reliance on funding from actual disaster declarations. The rigorous building standards adopted by 20,000 communities across the country are saving the nation more than $1.1 billion a year in prevented flood damages.

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[113] http://www.greenbaypressgazette.com/apps/pbcs.dll/article?AID=/201106250407/GPG1008/106250439

Hucek said, "I am very excited about this part of the planning process. The input from the workgroup that can have long-lasting impacts, making Kewaunee County safer and more disaster resistant."

The Federal Emergency Management Agency has recognized the importance of having members of the community involved in the process, and Hucek would like to ensure that all interested members of the community have an opportunity to provide input into the plan.

For more information about the plan or to provide input into the plan, contact Lori Hucek at (920) 487-5257.

Kewaunee County disaster plan input sought[114]

8:27 AM, Jun. 26, 2011 |

Input is being sought from the public on a hazard-mitigation plan for Kewaunee County.

The plan would examine ways in which the county is vulnerable to damage from natural disasters, in an effort to stave off future losses. Statewide, Wisconsin has incurred $3 billion in disaster-related losses in the past 30 years, said Kewaunee County Emergency Management Director Lori Hucek.

To learn more about the Kewaunee County plan, or to provide input, call Hucek at (920) 487-5257.

— Doug Schneider/Press-Gazette

[114] http://www.greenbaypressgazette.com/apps/pbcs.dll/article?AID=/201106260407/GPG0101/106260580

WEDNESDAY, June 29, 2011 THE COUNTY TRIBUTE PAGE 3

KEWAUNEE COUNTY STARTS HAZARD MITIGATION PLAN UPDATE

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The plan is designed to look at the risks and vulnerabilities that the county faces from natural disaster and to highlight mitigation strategies that might reduce future losses. As part of this planning process, Hucek is assembling a workgroup to review and guide the planning activities. The workgroup is reviewing initial background information about Kewaunee county and has begun identifying strategies that might help.

Hucek stated, "I am very excited

Cont. on page 5

Kewaunee County Starts Hazard Mitigation Plan Update

From page 3

about this part of the planning process. The input from the workgroup can have long-lasting impacts, making Kewaunee County safer and more disaster-resistant.

FEMA has recognized the importance of having members of the community involved in the process and Hucek would like to ensure that all interested members of the community have an opportunity to provide input into the plan. If you are interested in more information about the plan or would like to provide input to the plan, please contact Lori Hucek at 920-487- 5257.

Town's Association Mtg p1

COURSE SIGN-IN

~~Class:~~ _____ **Date:** 11-28-11 **Location:** Carlton

Name (Please Print)	~~Social Security No.~~	Department
David Hardtke	[redacted]	Town of Carlton
Tom Kruse		West Kew
Orin VanSutton		West Kewa
Ken Papkhan		Carlton
Kurt Burmeister		Peirce
Frank Wisnicky		Peirce
Pam Nuphals		Casco Town
Barb Porath		Casco Town
Richard Workos		Franklin
James Ward		"
Katie Duckett		"
Edith Lauscher		Casco Town
Joan Rawlings		Franklin
Pat Wotachek		Carlton
Dale Jandrain		Highway
Lori Hurd		Kew Co EM

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~~COURSE~~ SIGN-IN

~~Class:~~ Towns Assoc Mtg Date: 28 Nov 11 Location: TN Carlton

Name (Please Print)	~~Social Security No.~~	Department
Linda Sinkula		Town of Carlton
Steve Tadisch		Town of Carlton
Linda Vonet		Town of Luxemburg
Marilyn Barrett		"
David Barrett		"
Leonard Wachal		"
Jerry Bertrand		"
LARRY KIRCHMAN		TOWN OF LINCOLN
John Delmore		Scott Const. Inc.
Joe Lukes		Town of Casco
Barry Fenendael		"
Perry Pavlat		"
Tim Strnad		Town of Lincoln
Dale Engebose		Town of Lincoln
Rod Cherney		Town of Montpelier
Mark Wessely		"

Towns Assoc Mtg

COURSE SIGN-IN

p3

Class: _____ **Date:** 28 Nov 11 **Location:** TN Carlton

Name (Please Print)	~~Social Security No.~~	Department
David Von Dangen		town of Montpelier
Sandy Lebouse		" "
Chuck Wagner		Red River
Andy Wallander		Coo. Co. LUCU
Ken Draper		Ahnapee
Gary Pape		Ahnapee
Mary Bohman		Ahnapee
Scott Jabs		MONTPELIER
Kevin Lang		"
James Jorst		Red River
Chuck Kinnard		Red River
Gene Selby		Red River
Mark LaPlante		Red River

~~COURSE~~ SIGN-IN

Class: PDM Workshop Mtg **Date:** 29 Nov 11 **Location:** Kewaunee

Name (Please Print)	Social Security No.	Department
Mary Halada		Public Health
Lori Hucik		Emerg. Mgmt
Laura Gallenberger		Public Health
Lee Dachelet	[redacted]	Algoma FIRE + Rescue Emergency Management Director Algoma
Dick Riederer		Algoma Utilities
Glenn Selner		Zoning
Dale Jandrain		Highway/Solid Waste
Dana Cornelius		Sheriff Dept.
Andy Wallanueir		Land & Water
Steve Hanson		CIO
Lenora Borchardt		EPTEC

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

July 12, 2012

Mr. Bob Weidner
County Board Chairperson, Kewaunee County
810 Lincoln Street
Kewaunee, Wisconsin 54216

Re: Invitation to Attend Community Meetings Regarding Lake Michigan Coastal Flood Risk

Dear Mr. Weidner:

The Federal Emergency Management Agency (FEMA) is conducting a comprehensive study of flood hazards for Lake Michigan and the rest of the United States Great Lakes through FEMA's Risk Mapping, Assessment, and Planning (MAP) Program. Data from this study will eventually be used to convey coastal flood hazard risk through revised Flood Insurance Rate Maps (FIRMs), also known as regulatory products, and new risk planning and assessment products and datasets, also referred to as non-regulatory products and datasets. Please see enclosed Risk MAP Flood Risk Products Fact Sheet. More information about the Great Lakes Coastal Flood Study may be found at http://www.greatlakescoast.org.

The goal of Risk MAP is to support actions that make communities safer from flooding. The Risk MAP program wants to achieve continued improvement of flood hazard information for the National Flood Insurance Program (NFIP); to promote increased awareness and understanding of flood risk; to increase community engagement; and to identify and support actions that local stakeholders can take to reduce natural hazard risks. For additional information on the Risk MAP Program, please visit http://www.fema.gov/plan/prevent/fhm/rm_main.shtm.

The first phase of the Risk MAP process is Discovery. Through Discovery, input provided by communities will help FEMA to better understand local coastal flood risk data and needs, and characterize local conditions that contribute to coastal flood risk.

Your Discovery Meeting is scheduled to occur:

Date/Time:	Wednesday, August 15, 2012; 2:00 - 4:00 pm CT
Location:	Neville Public Museum
Address:	210 Museum Place Green Bay, Wisconsin 54303

Please save this date on your calendar. At the meeting, we will review the coastal flood risk data we have gathered to date and discuss your community's coastal floodplains, mitigation plan and projects, coastal flood risk concerns, and coastal floodplain management activities. This discussion will allow us to better identify your community's coastal flood hazard needs and subsequent Risk MAP regulatory and non-regulatory products and datasets that can be delivered during the Risk MAP project. We will also discuss how the coastal flood risks and needs are related to mapping, risk assessment, Hazard Mitigation planning, and grant programs available to eligible communities. To best facilitate this discussion, we would like to request your help in inviting community leaders, emergency managers, GIS specialists, engineers, outreach specialists, and local planners to the meeting. Please RSVP to FEMA's study contractor (STARR) Scott Banjavcic at (312) 780-7755 or email to GreatLakesFloodStudy@starr-team.com no later than **August 3, 2012.** Please reference the Discovery Meeting date and time in your RSVP.

Mr. Bob Weidner
July 12, 2012
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So that we can better prepare for the upcoming Discovery Meeting, we are asking local communities to participate in an Information Exchange conference call and WebEx. This call will provide an overview of FEMA's Risk MAP program and the Discovery process, and will allow us to review with you our request for the exchange of coastal flood risk and hazard mitigation data, and to learn more about your community's coastal flood hazard risks and needs, in advance of the Discovery Meeting. The partnership and exchange of data between FEMA, the State, and your community is vital to the success of identifying flood risks and needs that may impact your citizens.

The Information Exchange conference call is scheduled to occur:

Date/Time:	Monday, July 23, 2012; 2:00 - 3:00 pm CT
Link to WebEx:	http://e-meetings.verizonbusiness.com/nc/join.php
Meeting Number:	445288484
Call in number:	1-866-398-2885
Participant Code:	197462

If you or another community representative is unable to attend the Information Exchange conference call, we ask that you fill out and return the enclosed data request form by **August 3, 2012**. This is the same data request form that will be discussed during the conference call. The completed form can be sent to:

Via e-mail:	GreatLakesFloodStudy@starr-team.com
By mail:	Scott Banjavcic CDM Smith/STARR 125 S. Wacker Drive, Suite 600 Chicago, Illinois 60606

We look forward to working with you to reduce the risks associated with coastal flooding and increase your community's resiliency for the long term. To learn more about Discovery, please visit http://www.fema.gov/library and search keywords "Discovery brochure" or contact Ken Hinterlong, FEMA Region V Senior Engineer, at (312) 408-5529, or by email at ken.hinterlong@fema.dhs.gov . We look forward to discussing this with you during the Information Exchange call and/or seeing you at the upcoming Discovery Meeting.

Sincerely,

Christine Stack

Christine Stack
Division Director
Mitigation Division, FEMA Region V

Enclosures: Risk MAP Flood Risk Products Fact Sheet
Community Discovery Coastal Data Request Form

cc: Glenn Selner, Zoning Administrator, Kewaunee County
Gary Heinrichs, Wisconsin Department of Natural Resources
Katie McMahan, Wisconsin Department of Natural Resources
Meg Galloway, Wisconsin Department of Natural Resources

GOVERNMENTAL & PUBLIC INPUT

Planning creates a way to solicit and consider input from diverse interests. Successful community mitigation begins with a commitment from government officials throughout the county.

Involving stakeholders is essential to building community-wide support for the plan. In addition to emergency managers, the planning process involves other government agencies (e.g., zoning, floodplain management, public works, community and economic development), businesses, civic groups, environmental groups and schools. Vital information provided by these groups helps insure that the plan is workable within the framework of the community's priorities.

ADOPTION OF THE PLAN

Local units of government participating in a multi-jurisdictional planning process must adopt the final plan for the municipality to be eligible for future mitigation funds including grants available through FEMA. **Local units (i.e., towns, villages, cities) that do not participate would be ineligible to receive such funds** until such time that they meet these requirements and adopt a plan.

HISTORY

Since 1993 more than 400 disasters have occurred in the United States, affecting communities in all 50 states, costing the country over **$500 million dollars per WEEK and killing over 24,000 people**.

MITIGATION PLANNING FACTS

- A recent study by the Multi-hazard Mitigation Council shows that each dollar spent on mitigation saves society an average of four dollars.
- The rigorous building standards adopted by 20,000 communities across the country are saving the nation more than $1.1 billion a year in prevented flood damages.
- Hazard mitigation plans and projects reduce overall risks to the population and structures while also reducing reliance on funding from actual disaster declarations.
- Since 1993 more than 400 disasters have occurred in the United States, affecting communities in all 50 states, costing the country over **$500 million dollars per WEEK and killing over 24,000 people**.

NOTES:_____

_____

_____

For further information please contact:

Kewaunee County

Emergency Management

416 Fremont Street
Algoma, WI 54201
(920) 487-2940

Pre-Disaster Mitigation Planning

Creating Safe,

Sustainable

Communities

Prepared by:
Kewaunee County Emergency Management
416 Fremont Street
Algoma, WI 54201

WHAT IS HAZARD MITIGATION?

Hazard mitigation is sustained action taken to reduce or eliminate long-term risk to people and their property from hazards.

Floods, ice storms, tornadoes and forest/wild fires – these are all functions of the natural environment and only become hazardous when they threaten our "built" environment with destruction. These hazards will occur one day. When this happens, the results can be appreciably different from past outcomes if our community takes action today.

RISK REDUCTION

The goal of risk reduction is to reduce the risk to life and property, which includes existing structures and future construction, in the pre- and post-disaster environments. This is achieved through regulations, local ordinances, land use and building practices and mitigation projects that reduce or eliminate long-term risk from hazards and their effects.

WHY DEVELOP A PLAN?

Mitigation plans form the foundation for a community's long-term strategy to reduce disaster losses and break the cycle of disaster damage, reconstruction and repeated damage. The planning process is as important as the plan itself. It creates a framework for risk-based decision-making to reduce damages to lives, property and the economy from future disasters.

State, tribal and local governments are required to develop a hazard mitigation plan as a condition for receiving certain types of non-emergency disaster assistance. The Robert T. Stafford Disaster Relief and Emergency Assistance Act (Public Law 93-288), as amended by the Disaster Mitigation Act of 2000, provides the legal basis for state, local and tribal governments to undertake a risk-based approach to reducing risks from natural hazards through mitigation planning.

Like many other people, the residents of Merkel, Texas didn't think much about flooding. Besides, it had not flooded in Merkel for 45 years. It wasn't until the heavy rains in the summer of 2007 that residents realized flooding can hit anyone, at any time. After the flooding finally subsided, officials knew they had to do something: mitigate.

REQUIRED INFORMATION

- Flood maps
- Identification of potential hazards
- History of occurrences
- Hazard impact projections
- Location of critical facilities
- Identification of high-risk facilities (schools, fire station, nursing homes, etc.)
- Location of repetitive loss structures
- Development & prioritization of mitigation projects
- Other materials as identified

HAZARD MITIGATION PLANNING PROCESS

1. **Organize Resources**- From the start, communities should focus the resources needed for a successful mitigation planning process. Essential steps include identifying and organizing interested members of the community, particularly those with the technical expertise required during the planning process.

2. **Assess Risks**- Communities next need to identify the characteristics and potential consequences of natural hazards. It is important to understand how much of the community can be affected by specific hazards and what the likely impacts would be for important community assets.

3. **Develop a Mitigation Plan**- Armed with an understanding of the risks posed by natural hazards, communities need to determine what their priorities should be and then look at possible ways to avoid or minimize the undesired effects. The result is a natural hazard mitigation plan and strategy for implementation.

4. **Implement the Plan & Monitor Progress**- Communities can bring the plan to life in a variety of ways ranging from implementing specific mitigation projects to changes in the day-to-day operation of the local government. To ensure the success of an on-going program, it is critical that the plan remains effective. Thus, it is important to conduct periodic evaluations and make revisions as needed.

Appendix G: Inter-Revision Updates

This plan will undergo major revisions every five years per the FEMA requirements. Kewaunee County has recognized that there may be information that should be added to the plan between the five year updates but that the costs of continuous updates, printing and distribution cannot be excessive. This section is designed to hold that information that is gathered between the five year updates. It is felt that only having to reproduce and distribute one section between updates will lessen the costs to the county.

Potential Areas of Concern Identified: