



Board of County Commissioners Agenda Request



Requested Meeting Date: 07/22/14

Title of Item: Multi Hazard Mitigation Plan

☒ REGULAR AGENDA ☐ CONSENT AGENDA ☒ INFORMATION ONLY	Action Requested: ☐ Approve/Deny Motion ☐ Adopt Resolution (attach draft) <i>*provide copy of hearing notice that was published</i>	☐ Direction Requested ☐ Discussion Item ☐ Hold Public Hearing*
Submitted by: Sheriff Scott Turner		Department: Sheriff's Office
Presenter (Name and Title): Sheriff Scott Turner		Estimated Time Needed: 15 minutes
Summary of Issue: Draft Multi Hazard Mitigation Plan is attached for review.		
Alternatives, Options, Effects on Others/Comments:		
Recommended Action/Motion: None.		
Financial Impact: Is there a cost associated with this request? ☐ Yes ☐ No What is the total cost, with tax and shipping? \$ Is this budgeted? ☐ Yes ☐ No <i>Please Explain:</i>		

Legally binding agreements must have County Attorney approval prior to submission.

MULTI-HAZARD MITIGATION PLAN

AITKIN COUNTY, MINNESOTA, 2014



This page is intentionally left blank

DRAFT

MULTI-HAZARD MITIGATION PLAN AITKIN COUNTY, MINNESOTA

2014

Contact:

Scott Turner, Aitkin County Sheriff
217 Second Avenue NW, Room 185
Aitkin, MN 56431
(218) 927-7435
sheriff2@co.aitkin.mn.us
www.co.aitkin.mn.us

Prepared By:

Geospatial Analysis Center
College of Liberal Arts
University of Minnesota Duluth
329 Cina Hall
Duluth, MN 55812
Stacey Stark, Director
sstark@d.umn.edu
(218) 726-7438

Arrowhead Regional Development Commission
221 West First Street
Duluth, MN 55802
Bonnie Hundrieser, Senior Planner
bhundrieser@ardc.org
(800) 232-0707

This page is intentionally left blank

DRAFT

Table of Contents

Table of Contents	5
List of Figures	7
List of Tables	7
Section 1 – Introduction.....	9
1.1 Introduction	9
1.1.1 Scope.....	9
1.1.2 Hazard Mitigation Definition.....	10
1.1.3 Benefits of Mitigation Planning	10
1.2 State Mitigation Plan Overview	11
Section 2 – Public Planning Process	12
2.1 Planning Team Information	12
2.2 Review of Existing Plans.....	13
2.3 Planning Process Timeline and Steps	14
Section 3 – Aitkin County Profile	17
3.1 General County Description	17
3.2 Environmental Characteristics	17
3.3 Hydrography	18
3.3.1 Groundwater	18
3.3.2 Lakes.....	18
3.3.3 Rivers.....	19
3.3.4 Wetlands	19
3.4 Climate	19
3.5 Demographics	20
3.6 Economy.....	23
3.7 Aitkin County Community Services & Infrastructure.....	24
3.7.1 Health Care Providers	26
3.7.2 Public Safety Providers/Government Services.....	26
3.7.3 Utilities/Communications	28
3.7.4 Transportation	28
3.8 Land Use and Ownership	29
Section 4 – Risk Assessment	30

4.1	Hazard Identification/Profile.....	30
4.1.1	Hazard Identification.....	30
4.1.2	Vulnerability Assessment by Jurisdiction.....	31
4.1.3	Calculated Priority Risk Index.....	33
4.1.4	Hazard Profiling Concept of Planning.....	35
4.1.5	GIS and Hazus-MH.....	35
4.1.6	National Climatic Data Center (NCDC) Records.....	36
4.1.7	FEMA Declared Disasters.....	37
4.2	Vulnerability Assessment.....	38
4.2.1	Asset Inventory.....	38
4.2.2	Facility Replacement Costs.....	39
4.3	Future Development.....	40
4.4	Hazard Profiles.....	40
4.4.1	Wildfire.....	40
4.4.2	Severe Winter Storms – Blizzards, Ice Storms.....	44
4.4.3	Summer Storms – Thunderstorms, Lightning, Hailstorms, and Windstorms.....	48
4.4.4	Extreme Cold.....	57
4.4.5	Extreme Heat.....	58
4.4.6	Flash Flood and Riverine Flood.....	59
4.4.7	Drought.....	71
Section 5 – Mitigation Strategy.....		73
5.1	Community Capability Assessment.....	73
5.1.1	National Flood Insurance Program (NFIP).....	73
5.1.2	Plans and Ordinances.....	73
5.2	Mitigation Goals.....	74
5.3	Mitigation Actions and Projects.....	78
5.3.1	Hazard Mitigation Actions.....	80
5.3.2	Mitigation Actions by Community.....	83
Section 6 – Plan Maintenance.....		84
6.1	Monitoring, Evaluation, and Updating the Plan.....	84
6.2	Implementation.....	84
6.3	Continued Public Involvement.....	85

APPENDICES	86
AITKIN COUNTY MULTI-HAZARD MITIGATION PLAN, 2014	86
Appendix A Aitkin County Maps	1
Appendix B Aitkin County Critical Facilities	1
Appendix C Aitkin County Hazard Events	1
Appendix D Adopting Resolutions	1
Appendix E Steering Committee Meetings	1
Appendix F Public Meeting Notices and Meeting Notes	1
Appendix G Completed and Deleted Actions from the 2004 Plan	1
Appendix H Mitigation Actions by Jurisdiction	1
Appendix I Works Cited	1

List of Figures

Figure 1. Aitkin County Population, 2010 (Note: dots are randomly distributed within census blocks to reflect density and do not represent residences)	22
Figure 2. Critical Facilities in Aitkin County	25
Figure 3. Fire Departments and Fire Response Times in Aitkin County	27
Figure 4. Conceptual Depiction of a Vulnerability Analysis	33
Figure 5. FEMA-Declared Disasters and Emergencies in Minnesota	37
Figure 6. Wildfires by Cause and Acres Burned, 1985-2013	42
Figure 7. Every Year Aitkin County is Vulnerable to Severe Winter Weather	45
Figure 8. Most Recent Severe Wind and Hail Storms in Aitkin County	51
Figure 9. Damage from tornado in Aitkin County, 8/29/2013	52
Figure 10. Tornado Touchdowns and Paths, Aitkin County	54
Figure 11. Distribution of Estimated Economic Loss by Census Block for Aitkin County in 100-Year Flood	64
Figure 12. Census Block 270019901001127 and 100-Year Floodplain on Big Sandy Lake	65
Figure 13. Census Block 270019901001164 and 100-Year Floodplain on Big Sandy Lake	66
Figure 14. Census Block 270019901001168 and 100-Year Floodplain on Big Sandy Lake	67
Figure 15. Jacobson Fire Department and 100-Year Floodplain	68

List of Tables

Table 1. Multi-Hazard Mitigation Steering Committee 2014	12
Table 2. Planning Documents used for MHMP Planning Process	13
Table 3. Aitkin County Hazard Mitigation Update Meetings	15
Table 4. Aitkin County Population by Community	20
Table 5. Aitkin County Population Change (1940-2010)	23
Table 6. Aitkin County Population Projections (2015-2045)	23
Table 7. Annual Average Employment by Major Industry Sector, Aitkin County	24
Table 8. FEMA MHIRA Natural Hazards in the 2014 Minnesota State Hazard Mitigation Plan	31
Table 9. FEMA MHIRA Other Hazards in the 2014 Minnesota State Hazard Mitigation Plan	31
Table 10. Hazards identified in the 2004 Aitkin County Multi-Hazard Mitigation Plan	32
Table 11. Hazards Faced by Aitkin County using definitions from FEMA MHIRA	32
Table 12. Summary of Calculated Priority Risk Index (CPRI) Categories and Risk Levels	34

Table 13. Priorities of Risks Faced by Aitkin County	35
Table 14. Hazard Risk Analysis Methods for Aitkin County	36
Table 15. National Climatic Data Center Historical Hazards.....	37
Table 16. FEMA-Declared Major Disasters in Aitkin County (1957-2013)	38
Table 17. FEMA-Declared Emergencies in Aitkin County (1976-2013).....	38
Table 18. Aitkin County Critical Infrastructure and Facilities.....	39
Table 19. Aitkin County Total Building Exposure	40
Table 20. North-Central Minnesota Winter Storm Events	45
Table 21. Storms producing hail of greater than 1-inch diameter in Aitkin County 1972-2013.....	49
Table 22. Historic Tornado Events in Aitkin County (1952-2013)	53
Table 23. Aitkin County Historical Floods (1996-2013).....	61
Table 24. Historical Flood Crests for USGS gaging station on the Mississippi River at Aitkin.....	62
Table 25. Aitkin County Total Economic Loss from 100-Year Flood	63
Table 26. Aitkin County Census Blocks with the Greatest Estimated Total Losses in the 100-Year Floodplain	65
Table 27. Aitkin County Properties with Highest Building/Contents Value Intersecting 100-Year Floodplain	67
Table 28. Aitkin County Essential Facilities within estimated 100-Year Flood Boundary.....	68
Table 29. Goals, Strategies, and Objectives from 2014 Minnesota State Hazard Mitigation Plan.....	75
Table 30. STAPLE+E Planning Factors	80
Table 31. All Mitigation Actions for Aitkin County.....	82

SECTION 1 – INTRODUCTION

1.1 Introduction

Hazard mitigation is defined as any sustained action to reduce or eliminate long-term risk to human life and property from hazards. The Federal Emergency Management Agency (FEMA) has made reducing hazards one of its primary goals; hazard mitigation planning and the subsequent implementation of resulting projects, measures, and policies is a primary mechanism in achieving FEMA's goal.

Hazard mitigation planning and preparedness will be the most effective instrument to diminish losses by reducing the impact of disasters upon people and property. Although mitigation efforts will not eliminate all disasters, each county shall endeavor to be prepared as much as possible for a disaster.

The Multi-Hazard Mitigation Plan (MHMP) is a requirement of the Federal Disaster Mitigation Act of 2000 (DMA 2000). The development of a local government plan is required in order to maintain eligibility for certain federal disaster assistance and hazard mitigation funding programs. In order for communities to be eligible for future mitigation funds, they must adopt an MHMP.

Aitkin County is vulnerable to a variety of potential disasters. These hazards, both natural and human caused, threaten loss of life and property in the county. Such hazards as tornadoes, flooding, wildfires, blizzards, straight line winds, ice storms, and hazardous material spills have the potential for inflicting vast economic loss and personal hardship.

This Hazard Mitigation Plan represents the efforts of local agencies in Aitkin County to fulfill the responsibility for hazard mitigation planning. The intent of the plan is to reduce the actual threat of specific hazards by limiting the impact of damages and losses.

1.1.1 Scope

The Aitkin County Sheriff, the University of Minnesota Duluth Geospatial Analysis Center and the Arrowhead Regional Development Commission (ARDC) have combined efforts to update the Aitkin County 2004 Mitigation Plan.

This Hazard Mitigation Plan evaluates and ranks the major natural and technological hazards affecting Aitkin County as determined by frequency of event, economic impact, deaths, and injuries. Mitigation recommendations are based on input from state and local agencies, public input, and national best practices.

University of Minnesota Duluth Geospatial Analysis Center (GAC) is assisting Aitkin County planning staff with performing the hazard risk assessment for 100-year floods using the Hazus-MH GIS tool. In recognition of the importance of planning in mitigation activities, FEMA created Hazards USA Multi-Hazard (Hazus-MH), a powerful geographic information system (GIS)-based disaster risk assessment tool. This tool enables communities of all sizes to predict estimated losses from floods, hurricanes, earthquakes, and other related phenomena and to measure the impact of various mitigation practices that might help reduce those losses. The Minnesota Homeland Security and Emergency Management office has determined that Hazus-MH should play a critical role in Minnesota's risk assessments, and therefore the 100-year flood event hazard analysis is introduced in this plan.

This plan is a multi-jurisdictional plan that covers Aitkin County, including the cities of Aitkin, Hill City, McGrath, McGregor, Palisade, and Tamarack. The Mille Lacs Reservation, part of which lies in Aitkin County, currently has its own All-Hazard Mitigation Plan, updated in 2012.

Members from each of these jurisdictions actively participated in the planning process by attending workgroup meetings, providing information, suggesting mitigation strategies and reviewing the plan document. Each jurisdiction will adopt the plan by resolution after approval by FEMA. Copies of the resolutions can be found in Appendix D in the back of the plan.

Aitkin County has specified the following goals for this Hazard Mitigation Plan:

- ☐ To evaluate and rank the hazards that impact Aitkin County.
- ☐ To determine the extent of existing mitigation programs and policy capabilities within Aitkin County.
- ☐ To create a detailed, working document that will establish a standardized process for ensuring coordination of hazard mitigation efforts and to implement an on-going and comprehensive hazard mitigation strategy.
- ☐ To familiarize state and local officials and the general public about comprehensive hazard mitigation in Aitkin County and obtain their support.

1.1.2 Hazard Mitigation Definition

Hazard mitigation may be defined as any action taken to eliminate or reduce the long-term risk to human life and property from natural and technological hazards. Potential types of hazard mitigation measures include the following:

- ☐ Structural hazard control or protection projects
- ☐ Retrofitting of facilities
- ☐ Acquisition and relocation of structures
- ☐ Development of mitigation standards, regulations, policies, and programs
- ☐ Public awareness and education programs
- ☐ Development or improvement of warning systems

1.1.3 Benefits of Mitigation Planning

The benefits of hazard mitigation planning include the following:

- ☐ Saving lives, protecting the health of the public, and reducing injuries
- ☐ Preventing or reducing property damage
- ☐ Reducing economic losses
- ☐ Minimizing social dislocation and stress
- ☐ Reducing agricultural losses
- ☐ Maintaining critical facilities in functioning order
- ☐ Protecting infrastructure from damage
- ☐ Protecting mental health
- ☐ Reducing legal liability of government and public officials

1.2 State Mitigation Plan Overview

FEMA currently has three mitigation grant programs that are administered by the State of Minnesota: the Hazard Mitigation Grant Program (HMGP), the Pre-Disaster Mitigation program (PDM), and the Flood Mitigation Assistance (FMA) program. The HMGP, PDM and FMA are administered through the Department of Public Safety, Division of Homeland Security and Emergency Management.

SECTION 2 – PUBLIC PLANNING PROCESS

2.1 Planning Team Information

The Aitkin County multi-hazard mitigation planning team is headed by the Aitkin County Sheriff, who is the primary point of contact. University of Minnesota Duluth staff under contract with Aitkin County includes Stacey Stark (GAC Director) and Steve Graham (GAC Research Analyst). UMD GAC also collaborated with the Arrowhead Regional Development Commission (ARDC) to update this plan. Members of the Aitkin County MHMP steering committee include representatives from the public, private, and governmental sectors. Table 1 identifies the planning team individuals and the organizations they represent.

Table 1. Multi-Hazard Mitigation Steering Committee 2014

Organization	Title	Name
Aitkin County Sheriff's Office	Sheriff	Scott Turner
Aitkin County Sheriff's Office	Program Coordinator	Karla White
Aitkin County GIS	Coordinator	Dan Haasken
Aitkin County Highway Dept.	County Engineer	John Welle
Aitkin County Planning & Zoning	Environmental Services Director	Terry Neff
Aitkin County Public Health	Public Health Educator	Stacey Durgin
Aitkin County Maintenance	Maintenance Supervisor	Bill Thompson
City of Aitkin	Mayor	Gary Tibbitts
City of Aitkin	Clerk	Kathy Brophy
City of Aitkin Public Utilities	Manager	Dave Cluff
City of Aitkin Street Dept.	Street Commissioner	Bob Nicko
Hill City	Mayor	Larry Baker
Hill City	Clerk	Diana Gillson
Hill City Public Works	Head of Maintenance / Public Works	George Casper
McGrath	Mayor	Cory Eken
McGrath	Clerk	Dawn Clark
McGregor	Mayor	Jerry Farley
McGregor	Clerk	Judy Cirilli
McGregor Public Works		Larry Paukert
Palisade	Mayor	Charles Carlson
Palisade	Clerk	Gaylene Spolarich
Tamarack	Mayor	Robert Johnson
Tamarack	Clerk	Stephanie Meld
Tamarack Emergency Planning Team		Ellen Cyrus
Aitkin Fire Department / MN DNR Forestry	Fire Chief / DNR Incident Command Team Leader	Brian Pisarek
Jacobson Fire Department	Chief	Dale Thompson
Hill City Fire Department	Fire Chief	Jeremy Nelson
McGrath Fire Department		Bob Dresser

Organization	Title	Name
McGregor Fire Department	Fire Chief	James Carr
Pallsade Fire Department	Fire Chief	Bruce Robinson
Aitkin Public Schools ISD1	Superintendent	Bernie Novak
Hill City Schools ISD2	Superintendent / Principal	Dean Yocum
McGregor Area Schools ISD4	Superintendent / Elementary Principal	Paul Grams
Rice Lake National Wildlife Refuge	Manager	Walt Ford
Savanna Portage State Park	Park Manager	Sandi Weller
U.S. Army Corps of Engineers	Northern Headwaters Section Supervisor	Jeff Steere
East Central Energy	Loss Control / Emergency Preparedness Administrator	Jan Lahtonen
Lake Country Power		
Mille Lacs Energy Cooperative	Operations Manager	Steve Meld
American Red Cross	Disaster Program Manager- Northern Minnesota Region	Tony Guerra
Mille Lacs Band	Emergency Management Coordinator	Monte Fronk
Riverwood Healthcare Center	Emergency Department Manager	Tony Sundholm
Aitkin County Soil and Water Conservation District	District Manager	Steve Hughes

Jurisdictional representatives participating on the Steering Committee were contacted throughout the plan update process to provide feedback on the hazards of concern to their community and the mitigation actions which they would seek to implement upon plan adoption. The list of final mitigation actions was divided into jurisdiction-specific mitigation action charts so that each could see and address those actions that applied specifically to their cities (see Appendix H: *Mitigation Actions by Jurisdiction*).

2.2 Review of Existing Plans

Aitkin County and its local communities utilized a variety of planning documents to direct identification of mitigation strategies and local preparedness. Section 4.4 details the review of plans and programs in place as related to each natural hazard facing Aitkin County; in addition program gaps and deficiencies were reviewed and documented. This review of information was used to inform the identification of hazards, mitigation strategies and actions. Table 2 highlights additional planning documents that were used in this plan.

Table 2. Planning Documents used for MHMP Planning Process

Author(s)	Year	Title	Description	Where Used
Aitkin County	2009	Aitkin County Comprehensive Local Water Management Plan	Aitkin County Comprehensive Local Water Management Plan update.	Sections 3, 5.1.1

Author(s)	Year	Title	Description	Where Used
Minnesota Division of Homeland Security and Emergency Management	2014	Minnesota All-Hazard Mitigation Plan Update	Statewide hazard mitigation plan.	Section 5.2

2.3 Planning Process Timeline and Steps

In order to update the 2004 Aitkin County Hazard Mitigation Plan, UMD consultants worked in coordination with the Aitkin County Sheriff, State of Minnesota Hazard Mitigation officials, ARDC and members of the steering committee. The goals of the updating process were to include more recent data documenting the critical infrastructure and hazards faced by Aitkin County, reformat and reorganize the plan to reflect definitions of hazards as expressed in the 2008 State of Minnesota Multi-Hazard Identification and Risk Assessment Plan, and reflect current hazard mitigation priorities in Aitkin County. Therefore, the new plan includes not only new data documenting the types of hazards faced by County residents and Emergency Planning officials, but also new thinking about how to best address these hazards.

Seven jurisdictions are part of the Aitkin County Multi-Hazard Mitigation Plan. They are Aitkin County and the cities of Aitkin, McGrath, Hill City, Palisade, Tamarack, and McGregor.

Two in-person meetings took place with the Aitkin County Steering Committee. The first meeting was held on September 24, 2013 at the McGregor Community Center in McGregor and served as an introductory kick-off to the plan update. The steering committee was provided with an overview of the purpose, process and timeline for the Aitkin County Multi-Hazard Mitigation Plan update, as well as the role and responsibilities of steering committee members. The second meeting was held on March 20, 2014 at same location. During this meeting the steering committee was provided with an overview of the draft plan's progress and discussed the hazards facing Aitkin County and the development of new mitigation actions to include in the plan. Appendix E provides documentation of steering committee meeting summaries, including participant sign-in sheets and presentation slides.

Between the first and second meetings, steering committee members were also engaged in providing feedback on plans and programs in place or program gaps or deficiencies as they relate to hazards facing the county. This information was used to inform the development of mitigation strategies in the updated plan.

Any new hazards were prioritized according to the Calculated Priority Risk Index (CPRI). New hazard mitigation actions were discussed for inclusion in the plan, and new mitigation actions were analyzed using the STAPLE+E Process. For more information about the planning process see sections 5 and 6.

Public input was sought through meetings and direct conversations (see Appendix F). Two public comment meetings were held in Aitkin County, described in Table 3. These meetings were facilitated by UMD consultants and ARDC, and attended by the Aitkin County Sheriff (See Appendix F). Meetings were publicized using a news release sent to the Brainerd Dispatch, KGIN radio, the News Hopper and the Bargain Hunter; and distribution of an informational meeting flyer to the jurisdictions participating in the MHMP for electronic distribution or posting at key locations within their communities. The flyer was also posted on the Aitkin County Sheriff's Office

Facebook page and on the Aitkin County website. A project website (<http://www.arrowheadplanning.org/default.asp?PageID=1111>) was provided for the public to access draft documents for review and comment. At these meetings members of the public learned about the hazard mitigation process, received an update on the pace of updating the 2004 plan. Meeting attendees were provided with an evaluation and comment form to turn in after the meeting which they attended. The draft plan was revised to include public feedback on mitigation actions following these meetings.

Table 3. Aitkin County Hazard Mitigation Update Meetings

Meeting Type	Date	Location
Steering Committee	9/24/2013	McGregor Community Center
Steering Committee	3/20/2014	McGregor Community Center
Public Meeting	6/17/2014, 3:00 pm	Palisade Community Center
Public Meeting	6/17/2014, 6:30 pm	Aitkin County Sheriff's Office

At the close of these meetings, UMD and ARDC consultants worked with the Aitkin County Sheriff and members of the steering committee to incorporate comments from the public hearings into the overall hazard mitigation plan.

This page intentionally left blank

DRAFT

SECTION 3 – AITKIN COUNTY PROFILE

This section offers a general overview of Aitkin County to provide a basic understanding of the characteristics of the community, such as the physical environment, population, and the location and distribution of services.

3.1 General County Description

Aitkin County is located in north-central Minnesota, approximately 100 miles north of the Minneapolis/St. Paul metropolitan area and 60 miles west of the Duluth/Superior region. According to 2010 U.S. Census data, the county covers 1,995 square miles (1,276,800 acres) and the county's **estimated population** in 2010 was 16,202. Aitkin is the county seat and the largest city in the county. Part of the Mille Lacs Indian Reservation is also located in the county.

The 6 cities in Aitkin County are Aitkin (2,165), McGrath (80), Hill City (633), Palisade (167), Tamarack (94), and McGregor (391). The county has 40 organized townships and 4 unorganized territories. Between 2000 and 2010 the county saw a population growth of 6%.

Aitkin County is richly endowed with lakes, rivers, streams, and hills. Much of the northern part of the county is state forest land, in addition to the Savanna Portage State Park and Grayling State Wildlife Management Area (WMA). The Mille Lacs lake in the southwestern corner of the county is one of the largest lakes in Minnesota, covering over 128,000 acres. State and local government, construction, and services are the largest industries within Aitkin County. The County is connected to the extensive state highway system and the county has three general aviation airports, one in Aitkin (Aitkin Municipal Airport-Steve Kurtz Field), one in McGregor (Isedor Iverson Field), and one in Hill City (Hill City-Quadna Mountain Airport).

3.2 Environmental Characteristics

Aitkin County has a variety of surface landforms that are the result of past glacial activities. The glacial lakes of Upham and Aitkin, which once covered most of the area, influence the topography of the Mississippi River corridor. The landscape is flat and the streams meander through glacial material. The shrub swamp is a distinctive vegetative community with speckled alder, willows, bog birch, and pussy willow shrubs growing 10 to 15 feet tall. Ferns, tall asters, sedges, and wildflowers grow beneath these dense thickets. Agriculture has been a significant land use in the past and many parcels are held in large acreage.

The topography of Aitkin County is the result of glacial activity that occurred over 10,000 years ago. The County has land varying from flat to hilly. This varied topography is due to glacial deposition that formed moraines and left outwash sediments throughout the County. At one time, there were large lakes covering portions of the County. This glacial activity is important to recognize because it created the County's landscape, soil types, and watersheds, and, and therefore, affects the County's development patterns.

Aitkin County has a wide variety of soil types, all of which are acidic. Most of them have reddish brown subsoil and a foundation from glacial drift. Approximately 48% of the County consists of nearly level soils. Organic soils make up nearly 50% of these soils, or encompass about 25% of the county.

Most of the terrain in Aitkin County is used for woodland recreation and wildlife habitat. Not much of the soil is used for farming due to short, cool growing seasons that limit the types of crops suitable for the area.

3.3 Hydrography

Water resources within Aitkin County are very important to the community because they provide recreational and aesthetic value, as well as enhanced economic opportunity. Important water resources include surface and ground water from aquifers, watersheds, lakes, rivers, wetlands, riparian habitats, fish, wildlife, household, livestock, recreation, aesthetic, and industrial uses. Aquifers are supplemented by an average precipitation of 28-inches annually in Aitkin County and flows into three major drainage basins, which are the Great Lakes Basin, the Upper Mississippi River Basin, and the St. Croix River Basin. The county contains 6 major watersheds, including the Mississippi River – Headwaters, St. Louis River, Mississippi River – Brainerd, Rum River, Kettle River, and Snake River watersheds.

The Mississippi River, flowing south into Aitkin County, enters a flat and forested plain, which makes up the bed of glacial Lake Aitkin. The river is deep, slow and sinuous in this stretch, with many oxbows forming islands surrounded by slack water.

3.3.1 Groundwater

The primary water sources within Aitkin County are from the sand plain shallow aquifers. Approximately half of the wells in Aitkin County use sand and gravel aquifers found at depths less than 100 feet, generally situated in the sand plain area. Approximately one-quarter of the wells are in sand and gravel aquifers at depths greater than 100 feet. The remaining wells draw water from bedrock aquifers.

The location and the character of the Onanegozie's Sand Plain Aquifers have the greatest effect on water resources in the County.

3.3.2 Lakes

According to the Minnesota DNR, there are 443 lakes over 2 acres in size in the county, the largest of which is Mille Lacs, (64,895 of its 128,223 acres are in Aitkin County). These lakes cover 112,664 of the county's 1,276,800 acres (8.8%).

Impaired waters are an increasing problem as Aitkin County has many lakes, creeks and rivers that are on the Minnesota Pollution Control Agency Impaired Waters lists, including the Mississippi and Moose Rivers, Mille Lacs, Big Sandy Lake, and Minnewawa Lake (Minnesota Pollution Control Agency). Impaired waters have become a priority issue because they do not meet state water quality standards, they affect growth and health of communities and economies, and the Clean Water Act has a mandate requiring every state to address impairments.

Residents of Aitkin County rely heavily on the quality of water resources in the form of lakes, rivers, wetlands, and other water resources, both for the tourism industry and the quality of life. Surface water has become especially important in Aitkin County recently due to the many inadequate septic systems within the County. The County also has an unknown number of abandoned and improperly sealed wells. The effects of abandoned wells could be substantial in terms of the contamination of water resources.

3.3.3 Rivers

Rivers and streams in Aitkin County combine to create a broad spectrum of recreational opportunities, natural habitats, and scenic views. The abundance of lakes and rivers in the county is a benefit from repeated glaciations. Melting ice created great rivers that carved valleys now occupied by smaller streams. The present day drainage of surface water in Aitkin County is accomplished by several rivers (notably the Mississippi, Snake, Willow, Rice, Sandy, Swan, and Prairie Rivers) and many smaller creeks, brooks and ditches (Aitkin County).

The Upper Mississippi River Drainage includes nearly two-thirds of Aitkin County. Its major tributaries are the Sandy, Willow, Rice and Prairie Rivers. Floods are unusual in areas of swamp and interrupted drainage patterns, but the low areas of the county, especially near Aitkin, have experienced periodic flooding of up to 30,000 acres. In 1951, a Federal Flood Control Project made possible the construction of a 6-mile bypass channel to divert high waters around the city of Aitkin. This project was completed in 1957. A dike, 7,500 feet long, was constructed in 1969 around the northern part of the city of Aitkin. Since the completion of the bypass channel and the dike, flood frequency and severity in and near the city of Aitkin have been greatly reduced (Aitkin County).

3.3.4 Wetlands

Wetlands mapped by the National Wetlands Inventory cover 545,063 acres (851 square miles) in Aitkin County. Wetlands are one of the most efficient natural water filters, as wetland plants and soils clean the water before it goes into groundwater or rivers. After being slowed by a wetland, water moves around plants allowing suspended sediments to drop out and settle on the wetland floor. Plant roots and microorganisms in the soil often absorb nutrients from fertilizer application, manure, leaking septic systems, and municipal sewage. Wetlands also serve as a storage area for excess water during times of flooding.

Wetlands in Aitkin County consist of six types, including wet meadow, shallow marsh, deep marsh, shrub swamp, wooded swamp and bogs.

Exotic plants such as Eurasian watermilfoil and purple loosestrife have invaded many wetlands in Minnesota. The Minnesota DNR has documented both of these invasive species within Aitkin County borders. These plants can take over entire native communities and can threaten native wetland ecosystems.

3.4 Climate

The Climate of Aitkin County is classified as a continental climate regime characterized by wide variations in temperature. Temperatures can range from 100° Fahrenheit in the summer to -47° F in the winter.

The western portion of Aitkin County averages 28-inches of precipitation annually, while the eastern portion averages 30-inches annually. The median seasonal snowfall is 45 inches in the western portion of the county and 50 inches in the eastern portion. Aitkin County averages approximately 115 days each year with snow cover, or about 31.5-percent of the year. The average date of the last frost in the spring in Aitkin County is May 19 with the first fall frost occurring on September 23.

3.5 Demographics

Aitkin is the largest city in Aitkin County and the designated county seat. There are 6 cities, 40 townships and 4 unorganized townships within the county. Part of Districts II and IIa of the Mille Lacs Indian Reservation are also located within the county. The reservation's total population in 2010 was 4,907. According to the 2012 Mille Lacs Reservation All-Hazard Mitigation Plan, the combined population of districts II and IIa was 325. Table 4 summarizes population by community according to the 2010 U.S. Census.

Figure 1 shows Aitkin County population density by census block.

Table 4. Aitkin County Population by Community

Community	2010 Population	% of County
Aitkin	2,165	13.4%
Hill City	633	4.0%
McGrath	80	0.5%
McGregor	391	2.4%
Palisade	167	1.0%
Tamarack	94	0.6%
Aitkin Township	856	5.3%
Ball Bluff Township	278	1.7%
Balsam Township	42	0.3%
Beaver Township	53	0.3%
Clark Township	169	1.0%
Cornish Township	28	0.2%
Davidson Unorganized Territory	42	0.3%
Farm Island Township	1,099	6.8%
Fleming Township	312	1.9%
Glen Township	450	2.8%
Haugen Township	178	1.1%
Hazelton Township	844	5.2%
Hill Lake Township	430	2.7%
Idun Township	259	1.6%
Jevne Township	322	2.0%
Jewett Unorganized Territory	47	0.3%
Kimberly Township	195	1.2%
Lakeside Township	463	2.9%
Lee Township	50	0.3%
Libby Township	45	0.3%
Logan Township	184	1.1%
McGregor Township	105	0.6%
Macville Township	206	1.3%
Malmö Township	337	2.0%
Millward Township	72	0.4%

Community	2010 Population	% of County
Morrison Township	200	1.2%
Nordland Township	972	6.0%
Northeast Aitkin Unorganized Territory	11	0.1%
Northwest Aitkin Unorganized Territory	342	2.1%
Pliny Township	109	0.7%
Rice River Township	136	0.8%
Salo Township	102	0.6%
Seavey Township	61	0.4%
Shamrock Township	1,272	7.9%
Spalding Township	329	2.0%
Spencer Township	518	3.2%
Turner Township	208	1.3%
Verdon Township	45	0.3%
Wagner Township	332	2.0%
Waukenabo Township	316	2.0%
Wealthwood Township	268	1.7%
White Pine Township	34	0.2%
Williams Township	144	0.9%
Workman Township	207	1.3%
Total:	16,202	

Source: U.S. Census, 2013



Population growth trends have an important influence on the needs and demands of a variety of services such as transportation, law enforcement, and emergency response. An understanding of population trends and location of population concentrations is important for making projections regarding potential impacts in the event of a disaster.

In 2010, Aitkin County had a population of 16,202 residents, averaging 9 persons per square mile. Aitkin, the largest city in the county and the county seat, has a population of 2,165.

Aitkin County's population increased 23% between 1990 and 2000, and then grew only 5% from 2000 to 2010. The county's population has fluctuated substantially during the past 70 years, decreasing 36% between 1940 and 1970. While the population has slowly been increasing again, 2010 levels remain below those of 1940. Table 5 below shows the population change in Aitkin County between 1940 and 2010.

Table 5. Aitkin County Population Change (1940-2010)

1940	1950	1960	1970	1980	1990	2000	2010	Change 1940- 2010	Change 2000- 2010
17,865	14,327	12,162	11,403	13,404	12,425	15,301	16,202	-9%	+6%

Source: U.S. Census Bureau, 2013

Aitkin County's population is projected to decline by 14% between 2015 and 2045. Table 6 below shows population projections for Aitkin County until 2045.

Table 6. Aitkin County Population Projections (2015-2045)

2015	2020	2025	2030	2035	2040	2045	Projected Change 2015-2045
17,460	17,488	17,086	16,477	15,809	15,327	15,076	-14%

Source: Minnesota State Demographic Center, 2014

3.6 Economy

In 2012 Aitkin County was dominated by the Education and Health Services industry, with 28% of jobs in the county, and Trade, Transportation & Utilities, with another 26% of jobs. The third largest industry in the county is Leisure and Hospitality, with 14%. Major industrial companies in Aitkin County include Aitkin Iron Works and FLOE International. Other major employers are the County, public schools, and health care centers (Aitkin County Housing Authority).

According to the Minnesota Department of Employment and Economic Development, the number of jobs in the county rose by 2.5% between 2000 and 2012. Table 7 provides an overview of the annual average employment by major industry sector in Aitkin County.

Table 7. Annual Average Employment by Major Industry Sector, Aitkin County

Industry	Number of Jobs/ Percent of Total (2000)	Number of Jobs/ Percent of Total (2012)
Construction	N/A	159/4%
Manufacturing	532/15%	260/7%
Trade, Transportation, Utilities	896/25%	952/26%
Information	62/2%	62/2%
Financial Activities	112/3%	116/3%
Professional and Business Services	165/5%	112/3%
Education and Health Services	836/24%	1,030/28%
Leisure and Hospitality	450/13%	510/14%
Public Administration	355/10%	298/8%
Other Services	125/4%	122/3%
Total Number of Jobs:	3,533	3,621

Source: Minnesota Dept. of Employment and Economic Development

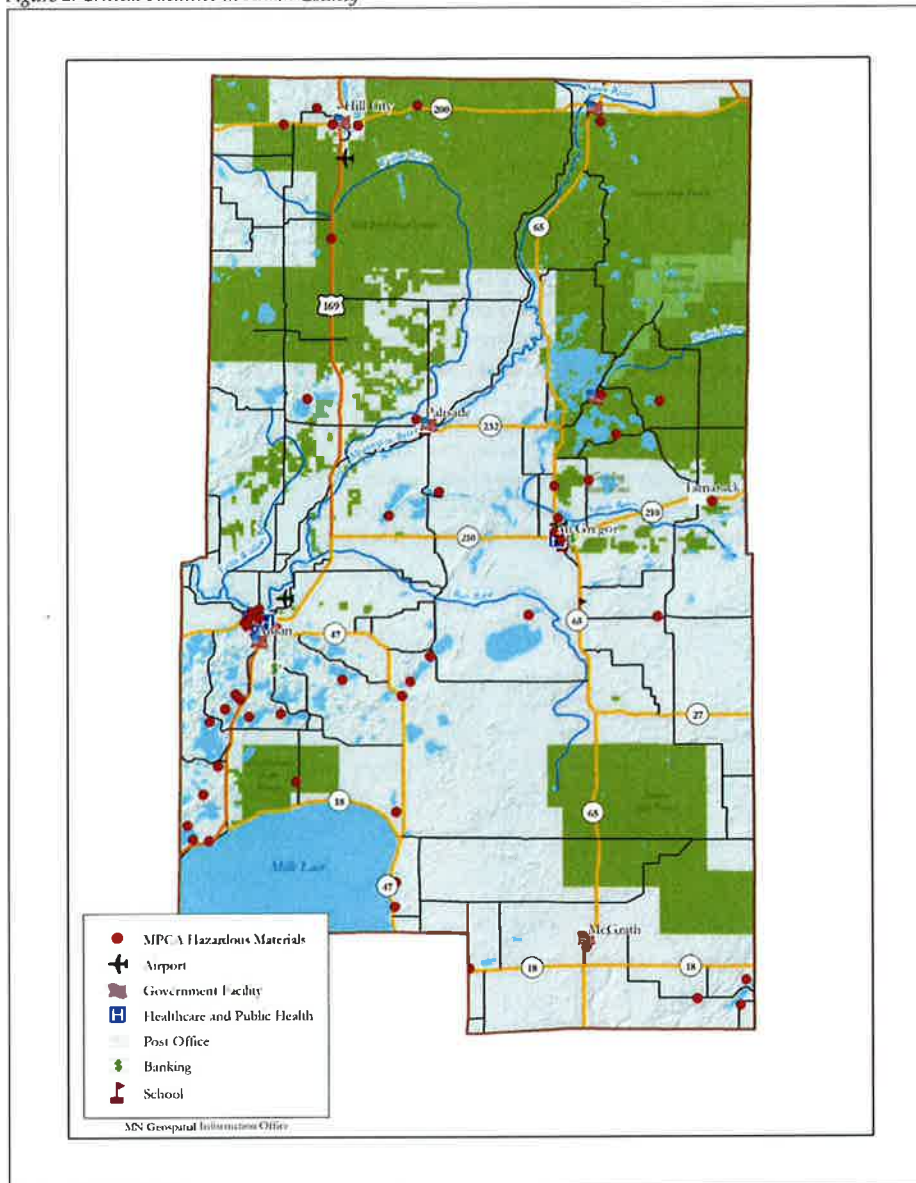
The 2011 median household income was \$41,301 in the county, compared to a Minnesota average of \$56,954. The median household income in Aitkin County increased over 32% from 2000 to 2011. The percent of the county's population living below the poverty level in 2011 was 12.2%, compared to 11.9% for the state of Minnesota.

The Minnesota Department of Employment and Economic Development reported that 78% of the workforce in Aitkin County was employed in the private sector in 2012.

3.7 Aitkin County Community Services & Infrastructure

The following section provides an overview on community services and infrastructure within Aitkin County. Examples of community services include healthcare and public safety, while examples of community infrastructure include power utilities, water and sewer facilities, and the transportation network. Figure 2 below shows critical facilities in the county, and a table of all critical facilities can be found in Appendix B.

Figure 2. Critical Facilities in Aitkin County



3.7.1 Health Care Providers

There is only one hospital located in Aitkin County. The Riverwood Healthcare Center is a 24-bed critical access hospital with primary care clinics in Aitkin, McGregor and Garrison.

Ambulance services are available in the cities of Aitkin and McGregor. If needed, other ambulances come from outside of the county.

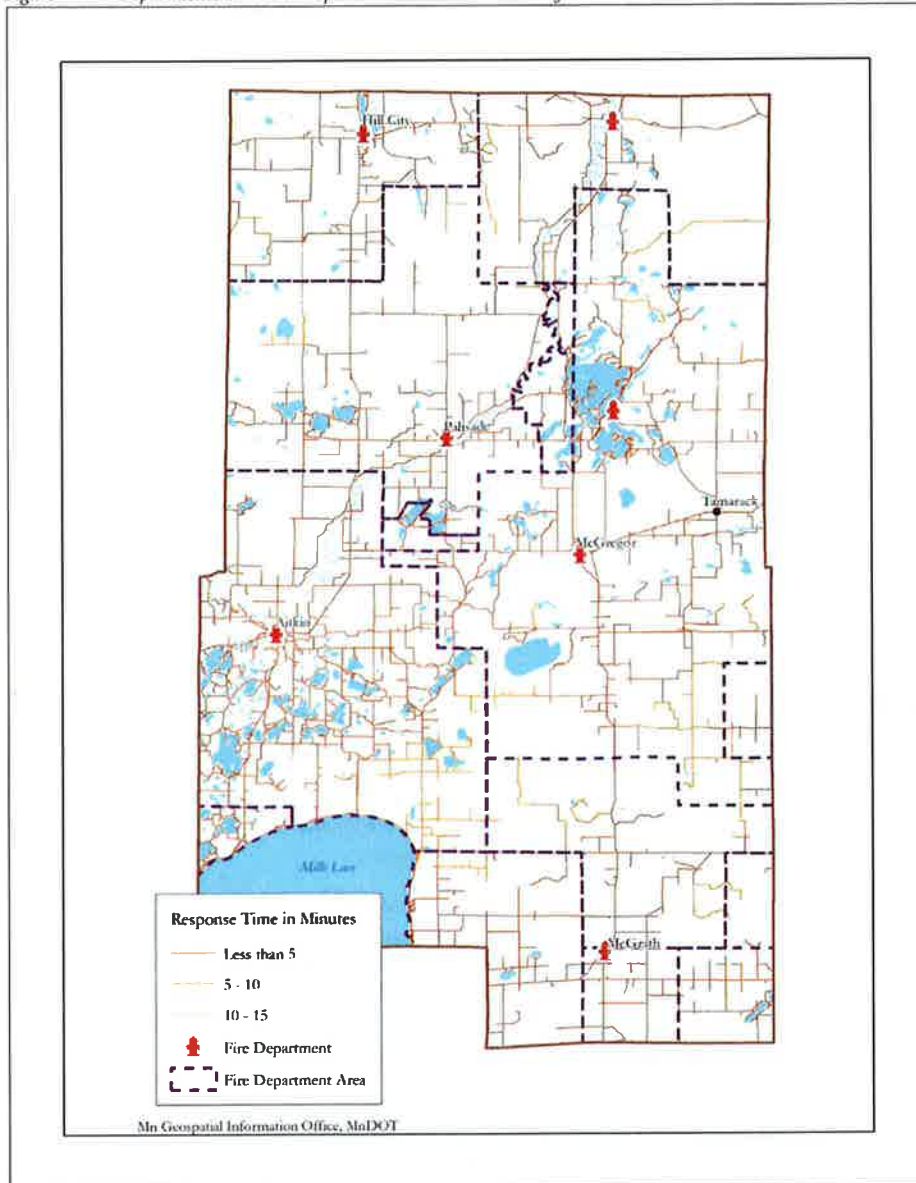
Figure A – 16 in Appendix A depicts health services within Aitkin County.

3.7.2 Public Safety Providers/Government Services

The Aitkin County Sheriff's Department in the city of Aitkin provides services to the entire county. The sheriff is the chief law enforcement officer in the county. The following cities in Aitkin County have police stations: Aitkin, McGregor, and Hill City. Figure A – 4 in Appendix A depicts government and emergency facilities, which includes city halls, fire departments, police departments, sheriff's department, and the Aitkin County Courthouse.

Figure 3 shows fire stations and fire response times in Aitkin County. These drive times were created using ArcGIS Network Analyst and MnDOT road data. Speed limits from the MnDOT highway speed limit database were used when available; all other roads were calculated using either 35 or 55 MPH speed limits, per MnDOT's recommendation. According to this model, all areas of the county are within 15 minutes of a Fire Department, and nearly all areas are within 10 minutes of a Fire Department. Only 2 short road segments southwest of Hill City are in the 10-15 minute range.

Figure 3. Fire Departments and Fire Response Times in Aitkin County



3.7.3 Utilities/Communications

There are 3 electricity providers within Aitkin County: Mille Lacs Energy Cooperative, Lake Country Power, and Minnesota Power. Figure A – 5 in Appendix A depicts Aitkin County utilities including power substations, electric transmission lines, and FM/AM radio towers.

There are several propane and natural gas services in Aitkin County: McGrath Propane and McGregor Propane (both part of Federated Co-Ops Inc.), Lakes Gas, Como Propane, Northern Stare Coop, AmeriGas CAP and Ferrellgas.

Established in 2004, the Allied Radio Matrix for Emergency Response (ARMER) Program, administered in coordination with the Minnesota Statewide Radio Board, manages the implementation of a 700/800 megahertz (MHz) shared digital trunked radio communication system. In Aitkin County, there are 6 ARMER towers. Figure A – 6 shows the ARMER locations.

There are three types of wastewater treatment systems in Aitkin County, including public sewer systems operated by municipalities and sanitary districts, community systems operated by homeowner associations, and individual sewage treatment systems.

Water service in Aitkin County is provided by municipalities, water districts, private water associations, and individual wells.

3.7.4 Transportation

The county transportation system is composed of roads, highways, airports, public transit, railroads and trails, designed to serve all residents, businesses, industries and tourists.

Eight highways administered by the Minnesota Department of Transportation (Mn/DOT) serve Aitkin County. These highways include U.S. Highways and State Trunk Highways, which are the most heavily used in the county. In total, there are 3,462 miles of roadway within Aitkin County.

There are 98 bridges in the county. All county bridges are the responsibility of the County Engineer at the County Highway Department. The bridges are inspected on a rotating basis depending upon the type of structure.

There is one main railroad company operating within Aitkin County. This is the Burlington Northern-Santa Fe (BNSF) Railroad. The largest volumes of goods transported on this railroad are raw materials such as coal to be shipped via the Duluth/Superior Port. The BNSF railroad company is a nationally operated railroad company that serves a variety of industrial and commercial customers. The BSNF operates two main lines in Northeast Minnesota, including the 39.31 miles of track in Aitkin County.

Three airports in the county provide air service. The Aitkin Municipal Airport (Steve Kurtz Field) is a public-use airport 2 miles northeast of the city of Aitkin, with Aitkin County having two-thirds ownership and the City of Aitkin one-third ownership. Situated at an elevation of 1,206 feet, the airport has 2 runways: one asphalt (4,018' long) and one turf (3,335' long). The McGregor Isedor Iverson Airport is owned by the city of McGregor, located at an elevation of 1,228 feet, just north of town. One asphalt runway is extant (3,400' long). The Hill City-Quadna

Mountain Airport lies south of Hill City at an elevation of 1,289 feet. Owned by the city, the airport has one turf runway (2,850').

Arrowhead Transit provides the major public transit services in Aitkin County. Arrowhead Transit is a rural public transit system providing coordinated public transit service to the residents within the eight-county Arrowhead Region of northeastern Minnesota. The Arrowhead Economic Opportunity Agency (AEOA), a private non-profit agency, operates the transit system. The transit system provides Scheduled, Dial-A-Ride, and Rural Rides.

3.8 Land Use and Ownership

According to 2010 U.S. census data, Aitkin County has a total of 1,276,800 acres, of which 111,123 (9%) are covered by water. Forest land is predominant in the county, covering 62% of the county in 2000. Grasslands, shrubs, and wetlands compose 19%, while agricultural areas are another 7%. Urban areas cover 3% (statistics from 2000).

Land ownership categories from the 2008 GAP analysis are shown in Figure A – 9 (Appendix A). Land cover is also mapped in Figure A – 8.

SECTION 4 – RISK ASSESSMENT

The goal of mitigation is to reduce the future impacts of a hazard including loss of life, property damage, disruption to local and regional economies, and the expenditure of public and private funds for recovery. Sound mitigation practices must be based on sound risk assessment. A risk assessment involves quantifying the potential loss resulting from a disaster by assessing the vulnerability of buildings, infrastructure, and people.

Basing risk assessments on the best information available is important in developing effective mitigation actions that benefit communities. Geographic Information System (GIS) tools are not only helpful in producing maps, but they also show structures at risk and may determine damage estimates for potential hazard scenarios. MN Homeland Security and Emergency Management (HSEM) mitigation staff encourages the use of GIS tools in risk assessments because they produce good information to be used in the risk assessment process. In recognition of the importance of planning in mitigation activities, FEMA created Hazards USA Multi-Hazard (HAZUS-MH), a powerful GIS-based disaster risk assessment tool. This tool enables communities to predict estimated losses from floods, hurricanes and other related phenomena and to measure the impact of various mitigation practices that might help reduce those losses. HAZUS-MH was used by Aitkin County Planning staff in the hazard risk assessment wherever applicable.

This assessment identifies the characteristics and potential consequences of a disaster, how much of the community could be affected by a disaster, and the impact on community assets. A risk assessment consists of three components — hazard identification, risk profile, and vulnerability profile. The last step is the risk ranking for each jurisdiction.

HSEM also requested that a standardized risk ranking be done for the five year review. The new methodology falls in line with national standards and also will be used for future updates of the Minnesota All Hazard Mitigation Plan. The new methodology will be explained and used throughout this section.

4.1 Hazard Identification/Profile

4.1.1 Hazard Identification

The cornerstone of the risk assessment is identification of the hazards that affect the jurisdictions. To facilitate the planning process, several sources were employed to ensure that the natural hazards are identified prior to assessment.

The County maintenance of the plan includes continual updates of the hazards identified in the initial plan. Also, FEMA gave more guidance on hazard identification. The mitigation planning team decided to compare the hazards in the initial plan to the current publications to determine if new hazards should be considered or if some should be deleted.

Natural hazards are identified in the FEMA publication “Multi-Hazard Identification and Risk Assessment – A Cornerstone of the National Mitigation Strategy” also known as MHIRA. FEMA Region V developed a list based on state mitigation plans in the region. The list was divided into natural (Table 8) and other hazards (Table 9) as was done in the 2014 Minnesota State Hazard Mitigation Plan.

Table 8. FEMA MHIRA Natural Hazards in the 2014 Minnesota State Hazard Mitigation Plan

Flooding	Hail	Drought
Dam/Levee Failure	Lightning	Extreme Heat
Wildfire*	Winter Storms	Extreme Cold
Windstorms	Erosion	Earthquakes
Tornadoes	Land Subsidence (Sinkholes & Karst)	

*Addressed in the State Mitigation Plan because Minnesota is a heavily forested state compared to other states in Region V.

For the purpose of this plan, FEMA defines other hazards or “man-made hazards” as technological hazards and terrorism. These are distinct from natural hazards primarily in that they originate from human activity. In contrast, while the risks presented by natural hazards may be increased or decreased as a result of human activity, they are not inherently human-induced. The term “technological hazards” refers to the origins of incidents that can arise from human activities such as the manufacture, transportation, storage, and use of hazardous materials. For the sake of simplicity, this guide assumes that technological emergencies are accidental and that their consequences are unintended. The term “terrorism” refers to intentional, criminal, and malicious acts. There is no single, universally accepted definition of terrorism, and it can be interpreted in many ways. For the purposes of this plan, FEMA refers to “terrorism” as the use of Weapons of Mass Destruction (WMD), including biological, chemical, nuclear, and radiological weapons; arson, incendiary, explosive, and armed attacks; industrial sabotage and intentional hazardous materials releases; and “cyber terrorism.”

Table 9. FEMA MHIRA Other Hazards in the 2014 Minnesota State Hazard Mitigation Plan

Terrorism	Nuclear Generating Plant Incidents	Ground and Surface Water Supply Contamination*
Infectious Disease Outbreak	Hazardous Materials Incidents	
Fires (Structures and Vehicles)	Transportation Incidents	

*Addressed in the State Hazard Mitigation Plan because Minnesota has made a high investment in its prized resource, water.

4.1.2 Vulnerability Assessment by Jurisdiction

The steering committee met multiple times to review and update the hazards faced by residents of Aitkin County, update the existing mitigation actions published in the 2004 Hazard Mitigation Plan, and propose new mitigation actions.

To engage in this process the committee drew on a number of data sources. First, the committee examined the hazards identified in the 2004 Aitkin County Hazard Mitigation Plan (Table 10). These existing mitigation actions were discussed and adjusted to reflect the definitions of natural hazards used in the State of Minnesota 2014 Multi-Hazard Identification and Risk Assessment list of natural hazards (Table 8). This was done in order to assure that the risks faced by Aitkin County were categorized the same way as the priority hazards established by the State of Minnesota.

Table 10. Hazards identified in the 2004 Aitkin County Multi-Hazard Mitigation Plan

Natural Hazards	Man-made Hazards
Violent Winter Storms	Fire
Violent Summer Storms	Hazardous Materials
Extreme Temperatures	Water Supply Contamination
Flooding	Wastewater Treatment System Failure
Drought	Dam Failure
Wildfire	Terrorism
Infectious Diseases	
Solar Storms	

While the MHMP mainly deals with natural hazards, this planning took place with the understanding that many non-natural hazards could occur as a result of natural disasters (i.e. disruption in electrical service due to freezing rain causing problems for both utility corporations and those vulnerable populations dependent on electricity for heat).

This plan draws on a variety of data sources including the State of Minnesota and Homeland Security Emergency Management Critical Infrastructure Strategy for the State of Minnesota (2010), FEMA's Local Mitigation Planning How-to Guide Integrating Manmade Hazards into Mitigation Planning (2003), and the State of Minnesota Multi Hazards Identification Risk Assessment.

Based on the committee's comparison of these two sets of hazards, the committee developed a list of hazards faced by Aitkin County to address in the 2014 plan update (Table 11). The steering committee decided that this plan will focus solely on natural hazards because there are other county plans in place which serve as the primary planning documents to address non-natural hazards. The County's Emergency Operations Plan addresses all hazards, and fire departments and Aitkin County Public Health respond to non-natural hazards with more specific plans. Dam failure is not addressed in this plan because the steering committee feels it is well-addressed in dam operator Emergency Operations Plans.

Table 11. Hazards Faced by Aitkin County using definitions from FEMA MHIRA

Natural Hazards		
Severe Winter Storms	Tornadoes	Drought
Thunderstorms	Extreme Cold	Flash Flood
Lightning	Extreme Heat	River Flood
Hailstorms	Windstorms	

* In this plan, Thunderstorms, Lightning, Hailstorms, Windstorms and Tornadoes are grouped under "Severe Summer Storms"; Flash Flood and River Flood are grouped together, and Dam Failure is included in relationship to the natural hazard of flooding.

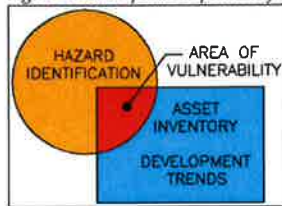
The natural hazards addressed in the 2012 Mille Lacs Reservation All-Hazard Mitigation Plan include wildfire, flooding, violent storms, extreme temperatures, drought, dam failure, earthquakes, sinkholes and land subsidence, landslides, and solar storms and flares.

The committee drew on the Calculated Priority Risk Assessment (CPRI) tool to prioritize each of these hazards. The hazards had already been prioritized based on the CPRI in the 20—report; therefore the committee adopted these same rankings for the updated list of hazards. The methodology of the CPRI is outlined below.

4.1.3 Calculated Priority Risk Index

The vulnerability assessment builds upon the previously developed hazard information by identifying the community assets and development trends and intersecting them with the hazard profiles to assess the potential amount of damage that could be caused by each hazard event. This concept is generally illustrated in Figure 4. A summary of Calculated Priority Risk Index (CPRI) Categories and Risk Levels is shown in Table 12.

Figure 4. Conceptual Depiction of a Vulnerability Analysis



Definitions of CPRI Categories in Table 12

Probability – a guide to predict how often a random event will occur. Annual probabilities are expressed between 0.001 or less (low) up to 1 (high). An annual probability of 1 predicts that a natural hazard will occur at least once per year.

Magnitude/Severity – indicates the impact to a community through potential fatalities, injuries, property losses, and/or losses of services. The vulnerability assessment gives information that is helpful in making this determination for each community.

Warning Time – plays a factor in the ability to prepare for a potential disaster and to warn the public. The assumption is that more warning time allows for more emergency preparations and public information.

Duration – relates to the span of time local, state, and/or federal assistance will be necessary to prepare, respond, and recover from a potential disaster event.

Table 12. Summary of Calculated Priority Risk Index (CPRI) Categories and Risk Levels

CPRI Category	DEGREE OF RISK			Assigned Weighting Factor
	Level ID	Description	Index Value	
Probability	Unlikely	Extremely rare with no documented history of occurrences or events. Annual probability of less than 0.001	1	45%
	Possible	Rare occurrences with at least one documented or anecdotal historic event. Annual probability that is between 0.01 and 0.001.	2	
	Likely	Occasional occurrences with at least two or more documented historic events. Annual probability that is between 0.1 and 0.01.	3	
	Highly Likely	Frequent events with a well-documented history of occurrence. Annual probability that is greater than 0.1.	4	
Magnitude/Severity	Negligible	Negligible property damages (less than 5% of critical and non-critical facilities and infrastructure). Injuries or illnesses are treatable with first aid and there are no deaths. Negligible quality of life lost. Shutdown of critical facilities for less than 24 hours.	1	30%
	Limited	Slight property damages (greater than 5% and less than 25% of critical and non-critical facilities and infrastructure). Injuries or illnesses do not result in permanent disability and there are no deaths. Moderate quality of life lost. Shut down of critical facilities for more than 1 day and less than 1 week.	2	
	Critical	Moderate property damages (greater than 25% and less than 50% of critical and non-critical facilities and infrastructure). Injuries or illnesses result in permanent disability and at least one death. Shut down of critical facilities for more than 1 week and less than 1 month.	3	
	Catastrophic	Severe property damages (greater than 50% of critical and non-critical facilities and infrastructure). Injuries or illnesses result in permanent disability and multiple deaths. Shut down of critical facilities for more than 1 month.	4	
Warning Time	Less than 6 hours	Self-explanatory.	4	15%
	6 to 12 hours	Self-explanatory.	3	
	12 to 24 hours	Self-explanatory.	2	
	More than 24 hours	Self-explanatory.	1	
Duration	Less than 6 hours	Self-explanatory.	1	10%
	Less than 24 hours	Self-explanatory.	2	
	Less than one week	Self-explanatory.	3	
	More than one week	Self-explanatory	4	

The prioritized list of hazards is presented in Table 13 and is based on the ranking of hazards in the 2013 Aitkin County THIRA.

Table 13. Priorities of Risks Faced by Aitkin County

Natural Hazards	
Type	Risk Severity
Wildfire	Moderate
Severe Winter Storm	Moderate
Ice Storm	High
Tornado	High
Straight-line Wind	Moderate
Flood/Flash Flood	Moderate
Extreme Heat	Low
Extreme Cold	Low
Drought	Moderate

4.1.4 Hazard Profiling Concept of Planning

[Need more info here](#)

The risk assessments identify the characteristics and potential consequences of a disaster, how much of the community could be affected by a disaster, and the impact on community assets. A risk assessment consists of three components—hazard identification, risk profile, and vulnerability profile. The last step is the risk ranking for each jurisdiction.

4.1.5 GIS and Hazus-MH

The risk analysis step in this assessment quantifies the risk to the population, infrastructure, and economy of the community. Hazards that can be geographically identified (wildland fires, windstorms, tornadoes, hail, floods) were mapped.

Hazus-MH generates a combination of site-specific and aggregated loss estimates depending upon the analysis options that are selected and the input that is provided by the user. Aggregate inventory loss estimates, which include building stock analysis, are based upon the assumption that building stock is evenly distributed across census blocks/tracts. Therefore, it is possible that overestimates of damage will occur in some areas while underestimates will occur in other areas. With this in mind, total losses tend to be more reliable over larger geographic areas than for individual census blocks/tracts. It is important to note that Hazus-MH is not intended to be a substitute for detailed engineering studies. Rather, it is intended to serve as a planning aid for communities interested in assessing their risk to flood-, earthquake-, and hurricane-related hazards. This documentation does not provide full details on the processes and procedures completed in the development of this project. It is only intended to highlight the major steps that were followed during the project.

Site-specific analysis is based upon loss estimations for individual structures. For flooding, analysis of site-specific structures takes into account the depth of water in relation to the structure. Hazus-MH also takes into

account the actual dollar exposure to the structure for the costs of building reconstruction, content, and inventory. However, damages are based upon the assumption that each structure will fall into a structural class, and structures in each class will respond in a similar fashion to a specific depth of flooding. Site-specific analysis is also based upon a point location rather than a polygon, therefore the model does not account for the percentage of a building that is inundated. These assumptions suggest that the loss estimates for site-specific structures as well as for aggregate structural losses need to be viewed as approximations of losses that are subject to considerable variability rather than as exact engineering estimates of losses to individual structures.

Table 14 shows how the hazards were analyzed for Aitkin County. The parameters for these scenarios were created through GIS, HAZUS-MH, and historical information to evaluate risk.

Table 14. Hazard Risk Analysis Methods for Aitkin County

Hazard Type	HAZUS-MH Analysis	GIS Analysis	Historical Analysis
Wildfire		x	x
Thunderstorms			x
Severe Winter Storms			x
Lightning			x
Windstorm/Tornadoes		x	x
Extreme Cold			x
Extreme Heat			x
Flash Flood	x	x	x
Dam Failure			x
Drought			x
Infectious Disease			x
Hazardous Materials			x
Fire			x
Drinking Water			x

4.1.6 National Climatic Data Center (NCDC) Records

Historical storm event data was compiled from the National Climatic Data Center (NCDC). NCDC records are estimates of damage reported to the National Weather Service (NWS) from various local, state, and federal sources. However, these estimates are often preliminary in nature and may not match the final assessment of economic and property losses related to given weather events.

The NCDC data included 271 reported events in Aitkin County between 1952 and 2013. However, some weather event categories only had available data going back as recent as 2002. No records before 1952 were available. A summary table of events related to each hazard type is included in the hazard profile sections that follow. A full table listing all events, including additional details, is included in Appendix C. NCDC hazard categories used in this plan are listed in Table 15.

Table 15. National Climatic Data Center Historical Hazards

Hazard	
Tornadoes	Hail
Thunderstorm Wind	Flood/Flash Flood
Lightning	Cold/Wind Chill
Heavy Snow/Winter Storm/Winter Weather	

4.1.7 FEMA Declared Disasters

Another historical perspective is derived from FEMA-declared disasters. Thirteen federal disaster declarations in Aitkin County have been made since 1957 (Figure 5).

Figure 5. FEMA-Declared Disasters and Emergencies in Minnesota

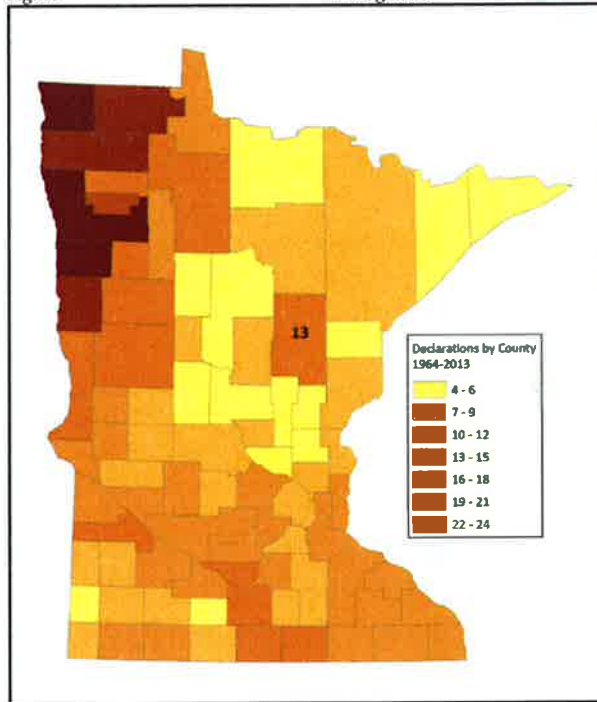


Table 16 and Table 17 show the details of the disasters including payments for Public Assistance (PA) and Individual Assistance (IA), listed under the flooding and severe storms profiles. No declarations were made for the other storms listed in the NCDC database. Reviewing the federal payments for damages from the declared disasters is a way of correlating the impact from the NCDC report.

Table 16. FEMA-Declared Major Disasters in Aitkin County (1957-2013)

Incident	Declaration Date and Disaster Number	Incident Period	Individual Assistance (all affected areas)	Public Assistance (all affected areas)	Public Assistance (Aitkin County)
Severe Storms, Flooding	07/06/2012 DR-4069	06/14/2012 to 06/21/2012	\$0	\$44,715,979	\$1,763,912
Flooding	05/16/2001 DR-1370	03/23/2001 to 07/03/2001	\$0	\$36,227,572	\$424,299
Severe Storms, Winds, Flooding	07/28/1999 DR-1283	07/04/1999 to 08/02/1999	\$0	\$11,679,939	\$54,289
Severe Storms, Flooding	04/08/1997 DR-1175	03/21/1997 to 05/24/1997	\$0	\$0	\$0
Flooding	06/01/1996 DR-1116	03/14/1996 to 06/17/1996	\$0	\$0	\$0
Severe Storm, Thunderstorm, High Winds, Flooding, Tornadoes, Heat	08/18/1995 DR-1064	07/09/1995 to 07/14/1995	\$0	\$0	\$0
Flooding, Severe Storm, Tornadoes	06/11/1993 DR-993	05/06/1993 to 08/25/1993	\$0	\$0	\$0
Severe Storms, Flooding	04/30/1979 DR-582	04/30/1979	\$0	\$0	\$0
Flooding	07/05/1975 DR-473	07/05/1975	\$0	\$0	\$0
Severe Storms, Flooding	08/01/1972 DR-347	08/01/1972	\$0	\$0	\$0
Flooding	04/18/1969 DR-255	04/18/1969	\$0	\$0	\$0
Flooding	03/22/1966 DR-215	03/22/1966	\$0	\$0	\$0
Flooding	04/11/1965 DR-188	04/11/1965	\$0	\$0	\$0

*Note the Public Assistance totals are totals for ALL counties affected in the disaster. Data accessed May 7, 2014.

Table 17. FEMA-Declared Emergencies in Aitkin County (1976-2013)

Incident	Declaration Date and Disaster Number	Incident Period	Individual Assistance (all affected areas)	Public Assistance (all affected areas)
Hurricane Katrina Evacuation	09/13/2005 EM-3242	08/29/2005 to 10/1/2005	\$0	\$2,470,003
Drought	06/17/1976 EM-3013	06/17/1976	\$0	\$0

*Note the Public Assistance totals are for ALL counties affected in the disaster. Data accessed May 7, 2014.

4.2 Vulnerability Assessment

4.2.1 Asset Inventory

The Hazus-MH defaults, critical facilities, and essential facilities have been updated based on the most recent available data sources. The Hazus-MH default essential facilities have been updated based on current data

available from the state and county. The essential facility updates (schools, medical care facilities, fire stations, and police stations) were integrated into the Hazus-MH input database. Other critical facilities identified by the county were geocoded and overlaid with the the Hazus-MH flood model output.

Critical facilities are defined by the Department of Homeland Security in the Automated Critical Asset Management System (ACAMS). Aitkin County has used the 18 sectors included in ACAMS to identify their critical infrastructure and key resources. Aitkin County's key resources include _____

Table 18 below identifies the critical facilities that were added or updated for the analysis. Essential facilities are a subset of critical facilities. Names and locations of all critical facilities are found in Appendix B.

Table 18. Aitkin County Critical Infrastructure and Facilities

ACAMS Category	Number of Facilities
Agriculture and Food	
Banking and Finance	
Chemical and Hazardous Materials	
Commercial Facilities	
Communications	
Dams	
Defense Industrial Base	
Emergency Services	
Energy	
Government Facilities	
Healthcare and Public Health	
Information Technology	
Manufacturing	
National Monuments and Icons	
Nuclear	
Postal and Shipping	
Transportation	
Water	

Insert figures of critical facilities in towns

4.2.2 Facility Replacement Costs

HAZUS-MH MR4 contains the base aggregated general building stock used for estimating building exposure. HAZUS-MH MR4 contains aggregated general building stock updated to Dun & Bradstreet 2006 and 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) classifications instead of actual building counts.

Facility replacement costs and total building exposure are identified in Table 19, which also includes the estimated number of buildings within each occupancy class as calculated by HAZUS general building stock.

Table 19. Aitkin County Total Building Exposure

General Occupancy	Estimated Total Buildings	Total Building Exposure (in \$1000s)
Agriculture	1,517	\$83,409
Commercial	405	\$38,246
Education	13	\$38,830
Government	140	\$24,722
Industrial	45	\$12,430
Religious/Non-Profit	115	\$41,782
Residential	15,782	\$972,529
Total:	18,017	\$1,211,948

4.3 Future Development

Because Aitkin County is vulnerable to a variety of natural and technological hazards, the county government—in partnership with state government—must make a commitment to prepare for the management of these types of events. Aitkin County is committed to ensuring that county elected and appointed officials become informed leaders regarding community hazards so that they are better prepared to set and direct policies for emergency management and county response.

[Need more info here](#)

4.4 Hazard Profiles

4.4.1 Wildfire

A wildfire is an uncontrolled fire spreading through vegetative fuels, posing danger and destruction to property. Wildfires can occur in undeveloped areas and spread to urban areas where structures and other human developments are more concentrated. While some wildfires start by natural causes like lightning, humans cause four out of every five wildfires. Debris burns, arson or carelessness are the leading causes of wildfires. As a natural hazard, a wildfire is often the direct result of a lightning strike that may destroy personal property and public land areas, especially on national and state forest lands. The dangers from wildfire include the destruction of timber, property and wildlife, and injury or loss of life to people living in the affected area or using the area for recreational facilities.

While wildfires are often viewed in a negative light, they are a naturally occurring part of the environment. Wildfires are an important component of healthy forest and prairie ecology, and can be beneficial by reducing dangerously high fuel levels and putting nutrients into the ground that spur new growth. In addition, many flora species require fire for seed germination. However, as people settled this country and began clearing land and

building homes, roads, railroads, and campgrounds, new artificial causes of wildfire arrived on the scene and their frequency and level of destruction increased.

Causes of wildfires vary from state to state. For example, in Florida, lightning ignites approximately half of all wildfires, while in Minnesota lightning causes less than 5 percent of all wildfires. These variations are due to climate, vegetation, topography, and weather. People burning debris cause most wildfires in Minnesota. However, wildfires are also caused by vehicle exhaust, sparks from trains and heavy equipment, camping, smoking, and lightning.

Topography affects the movement of air and fire over the ground surface. The slope and shape of terrain can change the rate of speed at which the fire travels. Weather affects the probability of wildfire and has a significant effect on its behavior. Temperature, humidity and wind affect the severity and duration of wildfires.

Homes threatened by wildfire are primarily those located in the "wildland-urban interface." This is the zone where homes and subdivisions have been located in wildland areas where natural wildfires can have an impact. While wildfires are necessary for healthy ecosystems, they burn whatever fuel is in their path, whether vegetation or buildings.

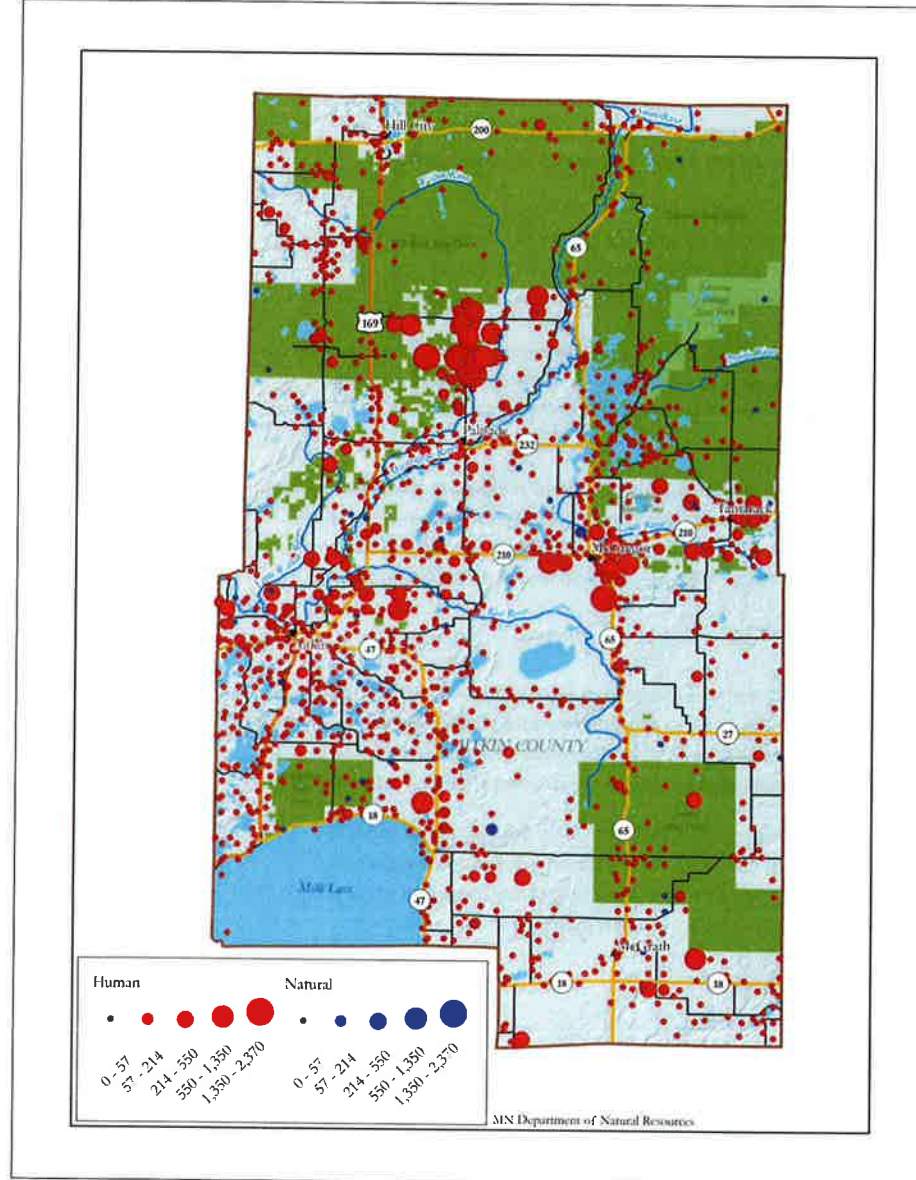
One of the most common causes of a home being damaged or destroyed is due to radiant heat. In a wildfire, radiant heat is the heat given off by burning vegetation. The high temperatures of some wildfires can cause the deck, siding, or roof of a home to ignite, because the fire was too near the home. Studies in western wildfires have shown that approximately 85% of homes surviving a major wildfire had 30-50 feet of defensible space around them, coupled with fire-resistant roofing.

Wildfire History in Aitkin County

Approximately 1,600 wildfires occurred in Minnesota each year on average from 1976-2011 (MN DNR). Wildfires occur throughout the spring, summer and fall, however, most wildfires in Minnesota take place in March, April, and May. During this period, much of the existing vegetation has been killed due to winter temperatures and is dead, brown and combustible. Also, there is little green vegetation to serve as a barrier for a moving wildfire.

The Minnesota DNR tracked 1,956 wildfires in Aitkin County between 1985 and 2013, burning a total of 54,734 acres (Figure 6). These include fires not only on state lands, but also rural private lands for which there is not another agency with primary responsibility. Wildfires that are not included in this data are those that occur on federal and Native American lands, and those that are responded to by local fire departments.

Figure 6. Wildfires by Cause and Acres Burned, 1985-2013



Wildfire and Climate Change

Temperatures are predicted to rise in the state, which could lead to more extreme heat events and associated wildfire risks. As Minnesota's climate changes, weather fluctuations between drought and extreme rain events and increasing temperatures will result in changes to forest composition and/or distribution. The northern boreal forest may give way to more deciduous forests or grassland, with a period of dying or diseased trees during the transition. This weather fluctuation can lead to dry conditions that may cause increased fire risk in both grassland and forest environments.

Relationship to other Hazards

Public Health - Air quality is adversely affected by wildfires.

Floods / Erosion - Floods combined with landslides or severe erosion in areas with steep terrain could occur if a large fire is followed by significant rainfall.

Plans and Programs in Place

Subdivision Standards - Aitkin County Subdivision standards regulate driveways and access roads. Adequate space for access roads is critical for emergency response vehicles to be able to access a property.

Dry Hydrants and Water Access - Aitkin County maintains a GIS database of dry hydrant locations. Individual fire departments are responsible for updating the County with information when new hydrants are installed or existing ones moved. All volunteer fire departments have water transportation capacity.

Wildfire Response - The Minnesota Department of Natural Resources has mutual aid agreements with all fire departments to assist as needed with wildfire response. The Rice Lake Wildlife National Refuge Area has its own personnel and equipment for fire-fighting wildland fires and is also covered by the McGregor Fire Department.

Burning Permits/Restrictions - Regulation of open burning and the use of burning permits has been an important tool in preventing wildfire in Minnesota. Burning permits are required by the MN DNR when the ground is not snow covered. Permits can be obtained from MN DNR Forestry offices, fire wardens or purchased online. When risk of wildfire is very high, burning is not permitted.

National Fire Plan - The USDA Forest Service maintains the National Fire Plan that is updated annually for effective use of national resources to combat wildfires in the United States. Further information in the National Fire Plan can be found at www.fireplan.gov.

Wildfire Condition Monitoring - The MN DNR Division of Forestry collects weather data on a daily basis. This data is monitored by a U.S. Department of Agriculture (USDA) Forest Service computer, which uses the National Fire Danger Rating System to determine daily and forecasted fire danger indices. This information combined with fire weather forecasts from the National Weather Service (NWS) are used to develop short-range guidelines for scheduling detection, equipment standby, and personnel.

Minnesota Interagency Fire Center (MIFC) - Located in Grand Rapids, MN, the purpose of the MIFC is to increase the efficiency and effectiveness of wildfire management by facilitating interagency exchange of fire resources, providing a common point for the collection and dissemination of fire intelligence and streamlining dispatch procedures. These responsibilities include assigning state firefighting crews, tracking resource orders and their

distribution, and dispatching air tankers and helicopters to needed areas. Partners include the MN DNR, USFS, US Fish and Wildlife Service, National Park Service, Bureau of Indian Affairs and the MN Department of Public Safety – Division of Homeland Security and Emergency Management. While firefighting is under local control of the ground crews and local DNR or Forest Service field command, the status of a fire is monitored constantly by the MIFC. If local resources do not contain the fire, the MIFC calls in more help from other stations in the region.

Public Warning and Notification - In the event of emergencies or hazardous conditions that require timely and targeted communication to the public, Aitkin County utilizes the CodeRED Mass Notification System and the Aitkin County Sheriff's Office Facebook page, as well as local news media. Aitkin County promotes the use of NOAA weather radios by critical facilities and the public to receive information broadcast from the National Weather Service.

Firewise Program - In 2012 Aitkin County used funding from the MN DNR Firewise Program to do public education at different events, conduct a broad countywide risk assessment and to make egress improvements in the southeast corner of the county. Aitkin County plans to do more Firewise risk assessments in 2014 with the assistance of local fire departments.

Program Gaps or Deficiencies

Dry Hydrants and Water Access - Not all areas of Aitkin County have good access to water resources for fighting fires. Installation of dry-hydrants and static storage tanks can help alleviate this problem. Some properties dependent on private wells may not have an adequate supply of water for firefighting needs.

Community Wildfire Protection Plan (CWPP) - In 2014 Aitkin County is working on developing a CWPP; currently one is not in place. A CWPP allows communities to develop collaborative strategies to reduce their risk from wildfire and restore healthier, more resilient conditions in their surrounding forests.

4.4.2 Severe Winter Storms – Blizzards, Ice Storms

Blizzards are storms that contain heavy snowfall, strong winds, and cold temperatures. The combination of these elements creates blinding snow with near zero visibility, deep snowdrifts, and life-threatening wind chill temperatures. Blizzards are the most dramatic and destructive of all winter storms that occur within Aitkin County, and are generally characterized as storms bearing large amounts of snow accompanied by strong winds. They have the ability to completely immobilize travel in large areas and can be life-threatening to humans and animals in their path. According to the National Weather Service (NWS), there is no fixed temperature requirement for blizzard conditions, but the life-threatening nature of low temperatures in combination with blowing snow and poor visibility increases dramatically when temperatures fall below 20°F. Blizzards typically occur between October and April; however, they occur most frequently from early November to late March.

Severe Winter Storm History in Aitkin County

An overview of some of the most notable winter storm events affecting the county can be found in Table 20.

Table 20. North-Central Minnesota Winter Storm Events

Date	Type	Cost	Deaths	Injuries	Description
January 1997	Blizzard	N/A	N/A	N/A	21" in Duluth, 23" in Pequot Lakes, 18" in Finlayson, 16" in Two Harbors, and 12" in Babbitt.
October 1991	Blizzard	N/A	N/A	N/A	Halloween Blizzard. Over 28" at MSP, nearly 37" at Duluth. Nasty wind chill conditions, deep snow drifts harsh on wildlife, many roads closed for days. Perhaps one of the largest and longest lasting blizzards in state history.
November 1988	Blizzard	N/A	N/A	N/A	Blizzard struck over most of the state. Winds reached 63 mph at Windom, snow drifts up to 7' high. Snowfalls up to 14" in east central MN.
January 1893	Blizzard	N/A	N/A	N/A	Park Rapids, MN temperature drop of 40° F in less than 5 hours.

Figure 7. Every Year Aitkin County is Vulnerable to Severe Winter Weather



The greatest numbers of blizzards historically have occurred in the months of January, followed by March and November, respectively. Aitkin County, along with all areas of Minnesota, is susceptible to blizzards.

Damages from blizzards can range from human and livestock deaths to significant snow removal costs. Stranded drivers can make uninformed decisions, such as leaving the car to walk in conditions that put them at risk. Because of the blinding potential of heavy snowstorms, drivers are also at risk of collisions with snowplows or other road traffic. Further, drivers and homeowners without emergency plans and kits are vulnerable to the life threatening effects of heavy snow storms such as power outages, cold weather, and inability to travel, communicate, obtain goods or reach their destinations. Heavy snow loads can cause structural damage, particularly in areas where there are no building codes or for residents living in manufactured home parks. The frequency of structural fires tends to increase during heavy snow events, primarily due to utility disruptions and the use of alternative heating methods by residents.

Between the years of 1975 and 1991, there were 49 deaths associated with blizzards statewide, or an average of three deaths per year. Deaths attributable to blizzards have dropped in recent years, primarily due to increased weather awareness and warning capabilities across the state. The economic costs of winter storms are generally not recorded by the NCDC; however, a winter storm in November 2001 resulted in property damage of \$500,000.

Ice storms are described as occasions when damaging accumulations of ice occur due to freezing rain. The terms freezing rain and freezing drizzle warn the public that a coating of ice is expected on the ground and on other

exposed surfaces. Heavy accumulations of ice can bring down trees, electrical wires, telephone poles and lines, and communication towers.

Communications and power can be disrupted for days while utility companies work to repair extensive damage. Ice forming on exposed objects generally ranges from a thin glaze to coatings more than one inch thick. Even small accumulations of ice on sidewalks, streets, and highways may cause extreme hazards to Aitkin County motorists and pedestrians. Sleet does not stick to trees and wires, but sleet of sufficient thickness does cause hazardous driving conditions. Heavy sleet is a relatively rare occurrence, defined as an accumulation of ice pellets covering the ground to a depth of one-half inch or more.

Ice and sleet storms typically occur from October through April. The NWS notes that over 85 percent of ice storm-related deaths are the result of traffic accidents. No freezing rain or freezing drizzle events have been recorded in Aitkin County by the NCDC; however, the entire state of Minnesota is susceptible to these hazards.

Observing winter storm watches and warnings and adequate preparation can usually lessen the impact of blizzard events in Minnesota. Technical advances made in transportation, including safer vehicles and improved construction and maintenance of roads, have also contributed to the decline in deaths related to blizzard events. Historical estimates of dollar losses associated with blizzard events were not available for the purposes of this analysis. However, costs incurred by state and local government for snow removal associated with disaster declaration DR1158 (January 1997) totaled over \$27,300,000 dollars. Blizzards rank ninth out of the 10 natural hazards economically impacting Minnesota according to the statewide risk analysis. The chance that another winter storm affecting Aitkin County will occur is highly probable.

Severe Winter Storms and Climate Change

Historically, winter storms have had a large impact on public safety in Minnesota. This will continue, with a possible increase in snowstorm frequency and annual total snowfall. Winter weather is often a cause of power outages. Pressures on energy use, reduced reliability of services, potential outages and potential rise in household costs for energy are major climate change risks to public health.

The number of heavy snowfall years for the Midwest has fluctuated throughout the 1900-2006 time period. The periods of 1900-1920 and 1960-1985 had numerous years with snowfall totals over the 90th percentile. In the recent three decades, the number of heavy seasonal snowfall totals has been much lower. Despite these generally lower seasonal snowfall totals, some areas of the Midwest have still experienced significant snow totals in the most recent decade. The 100-year linear trends based on decadal values show that the upper Midwest had statistically significant (1% level) upward linear trends in snowstorm frequency from 1901 to 2000 (Kunkel, et al., 2013).

Relationship to other Hazards

Flooding - Melting from heavy snows can cause localized flooding which can impact property and infrastructure such as roads.

Wildland or Structural Fire - Heavy storms that result in large amounts of downed timber can result in an increase of dead or dying trees left standing, thus providing an increased fuel load for a wildfire. There is an

additional risk of increased frequency of structural fires during heavy snow events, primarily due to utility disruptions and the use of alternative heating methods by residents.

Public Safety - Drivers stranded in snowstorms may make uninformed decisions that can put them at risk; residents who are unprepared or vulnerable may not be able to obtain goods or reach their destinations. EMS providers may be slowed by road conditions to respond to emergencies. Ice storms may result in power outages due to downed power lines, putting people at risk for cold temperature exposure and reducing the ability to spread emergency messages to the public via television, radio or computer.

Plans and Programs in Place

Snow Removal - The Aitkin County Transportation Department has capabilities for snow removal and highway treatment in order to maintain safe winter driving conditions. The Department carries out snow removal and ice control operations. Paved routes within Aitkin County receive priority for snow plowing. MnDOT handles snow removal on trunk highways within Aitkin County. The County has agreements with several townships to do snow plowing. All other city and township jurisdictions either have their own equipment for snow removal or contract for services to do so.

Back-up Power - In the courthouse complex there is an emergency generator for the jail, and from that power can be provided to serve the courthouse, boiler room and I.T. office. Across the street there is a small emergency generator that will serve to power EMS, fire and police radio systems. In the city of Aitkin, the fire department has portable generators, one of which is dedicated to water supply and another that can be located as needed.

Burying Power Lines - Burying power lines helps to eliminate loss of power due to snow and ice storms. Mille Lacs Energy Cooperative and Lake County Power work to accommodate requests for installation of underground power lines to residents or businesses receiving connection of new power in areas where it is feasible. East Central Energy buries lines in areas where it makes sense to do so, but does not offer this as a regular customer option.

NOAA Weather Radio Transmitter Towers - The National Weather Service delivers storm warnings and key information during severe winter weather events over its radio towers. The extreme southeastern part of Aitkin County is covered by Pine County. Most of the rest of the County is covered by the Aitkin transmitter which is located northeast of the city of Aitkin. The Coleraine transmitter covers the extreme northeastern part of the county.

School Closings - All school districts within Aitkin County have a school closing policy and communications plan in place if inclement weather or temperatures create a hazardous situation for students or staff. Schools have notification systems which allow them to notify all families who are registered in the school system with up-to-date information.

Public Warning and Notification - In the event of emergencies or hazardous conditions that require timely and targeted communication to the public, Aitkin County utilizes the CodeRED Mass Notification System and the Aitkin County Sheriff's Office Facebook page as well as local news media. Aitkin County promotes the use of NOAA weather radios by critical facilities and the public to receive information broadcast from the National Weather Service.

Public Education and Awareness - Aitkin County promotes the National Weather Service's "Winter Hazard Awareness Week" held in November each year. The event seeks to educate residents on the dangers of winter weather and how to properly deal with it.

Program Gaps or Deficiencies

Backup Power - Not all county facilities have backup power in the event of a disaster.

4.4.3 Summer Storms – Thunderstorms, Lightning, Hailstorms, and Windstorms

Summer storms, including thunderstorms, hailstorms, and windstorms affect Aitkin County on an annual basis. Thunderstorms are the most common summer storm in the county, occurring primarily during the months of May through August, with the severest storms most likely to occur from mid-May through mid-July. Thunderstorms are usually locally produced by cumulonimbus clouds, always accompanied by lightning, and often having strong wind gusts, heavy rain and sometimes hail and tornadoes. Tornadoes are the greatest concerns for Aitkin County.

Lightning

Lightning is caused by the discharge of electricity between clouds or between clouds and the surface of the earth. In a thunderstorm there is a rapid gathering of particles of moisture into clouds and forming of large drops of rain. This gathers electric potential until the surface of the cloud (or the enlarged water particles) is insufficient to carry the charge, and a discharge takes place, producing a brilliant flash of light.

The power of the electrical charge and intense heat associated with lightning can electrocute on contact, split trees, ignite fires, and cause electrical failures. Most lightning casualties occur in the summer months, during the afternoon and early evening. The NCDC has recorded 2 lightning strikes in Aitkin County since 2000, but no deaths or injuries were reported. A 2010 report published by Minnesota Department of Natural Resources (MN DNR) reports a 20-year average of 23 lightning-caused wildfires a year on public land. In 2011, 22 wildfires were caused by lightning in the state. Based on statistics maintained by the MN DNR Division of Forestry, the 22 average lightning-caused wildfires per year resulted in average annual suppression costs totaling \$54,864 dollars and average annual damages totaling \$10,357 dollars.

Lightning and Climate Change

The projected possible intensity and frequency of tornadoes, hail, and damaging thunderstorm winds, the conditions associated with lightning, are uncertain (National Climate Assessment Development Advisory Committee, 2013). Severe rain events are becoming more common and may include an additional risk of lightning.

Hailstorms

Hailstorms are a product of severe thunderstorms. Hail is formed when strong updrafts within the storm carry water droplets above the freezing level, where they remain suspended and continue to grow larger, until their weight can no longer be supported by the winds. Hailstones can vary in size, depending on the strength of the updraft. The NWS uses the following descriptions when estimating hail sizes: pea size is ¼-inch, marble size is ½-inch, dime size is ¾-inch, quarter size is 1-inch, golf ball size is 1 ¾-inch, and baseball size is 2 ¾-inches.

Individuals who serve as volunteer “storm spotters” for the NWS are located throughout the state, and are instructed to report hail dime size (¾-inch) or greater. Hailstorms can occur throughout the year; however, the months of maximum hailstorm frequency are typically between May and August. Although hailstorms rarely cause injury or loss of life, they do cause significant damage to property.

Table 21 shows storms producing hail greater than 1-inch diameter in Aitkin County.

Table 21. Storms producing hail of greater than 1-inch diameter in Aitkin County (1972-2013)

Date	Hail Size (Inches)	Injuries	Date	Hail Size (Inches)	Injuries
8/29/2013	1.75 in.	0	6/13/2001	1.75 in.	0
8/29/2013	1.75 in.	0	8/14/2000	2.00 in.	0
8/04/2012	1.50 in.	0	7/8/2000	1.75 in.	0
7/04/2012	1.50 in.	0	6/1/1998	1.75 in.	0
5/28/2012	1.75 in.	0	9/13/1990	2.00 in.	0
6/17/2010	2.00 in.	0	9/5/1990	2.75 in.	0
6/17/2010	2.00 in.	0	8/4/1986	1.75 in.	0
8/27/2007	2.75 in.	0	6/5/1980	2.75 in.	0
8/27/2007	1.75 in.	0	8/5/1972	2.00 in.	0
8/27/2007	1.75 in.	0			

Source: National Climatic Data Center

According to the 41-year NCDC record, there is a 54% chance of a significant hailstorm any year in Aitkin County and a 27% chance in each year that there will be a hailstorm that produces hail greater than one inch in size.

Hailstorms and Climate Change

Winter storms have increased slightly in frequency and intensity, and their tracks have shifted northward over the U.S. Other trends in severe storms, including the numbers of hurricanes and the intensity and frequency of tornadoes, hail, and damaging thunderstorm winds are uncertain. Since the impact of more frequent or intense storms can be larger than the impact of average temperature, climate scientists are actively researching the connections between climate change and severe storms (National Climate Assessment Development Advisory Committee, 2013).

The occurrence of very heavy precipitation has increased in Minnesota in recent decades and future projections also indicate this will continue (International Climate Adaptation Team, 2013). While it is unknown if this precipitation will occur during severe storms that produce hail, the possibility has not been ruled out.

Windstorms and Tornadoes

Windstorms can and do occur in all months of the year; however, the most severe windstorms usually occur during severe thunderstorms in the warm months. Aitkin County frequently experiences winds blowing at over 50 knots. According to NCDC records, in Aitkin County there have been 77 thunderstorm wind events reported between 1972 and 2012, with wind speeds of up to 61 knots. These winds can inflict damage to buildings and in some cases overturn high profile vehicles.

Associated with strong thunderstorms, downbursts are severe localized downdrafts from a thunderstorm or rain shower. This outflow of cool or colder air can create damaging winds at or near the surface. Winds up to 130 miles per hour have been reported in the strongest thunderstorms. Downburst winds can cause as much damage as a small tornado and are frequently confused with tornadoes because of the extensive damage they cause. As these downburst winds spread out they are often referred to as straight-line winds. They can cause major structural and tree damage over a relatively large area. The most recent severe wind and hail storms in Aitkin County are shown in Figure 8.

Tornadoes are defined as violently-rotating columns of air extending from thunderstorms to the ground, with wind speeds between 40-300 mph (Figure 9). They develop under three scenarios: (1) along a squall line; (2) in connection with thunderstorm squall lines during hot, humid weather; and (3) in the outer portion of a tropical cyclone. Funnel clouds are rotating columns of air not in contact with the ground; however, the column of air can reach the ground very quickly and become a tornado.

Since 2007, tornado strength in the United States is ranked based on the Enhanced Fujita scale (EF scale), replacing the Fujita scale introduced in 1971. The EF scale uses similar principles to the Fujita scale, with six categories from 0-5, based on wind estimates and damage caused by the tornado. The EF Scale is used extensively by the NWS in investigating tornadoes (all tornadoes are now assigned an EF Scale number), and by engineers in correlating damage to buildings and techniques with different wind speeds caused by tornadoes. To see a comparative table of F and EF scales, see <http://www.spc.noaa.gov/faq/tornado/ef-scale.html>.

Figure 8. Most Recent Severe Wind and Hail Storms in Aitkin County

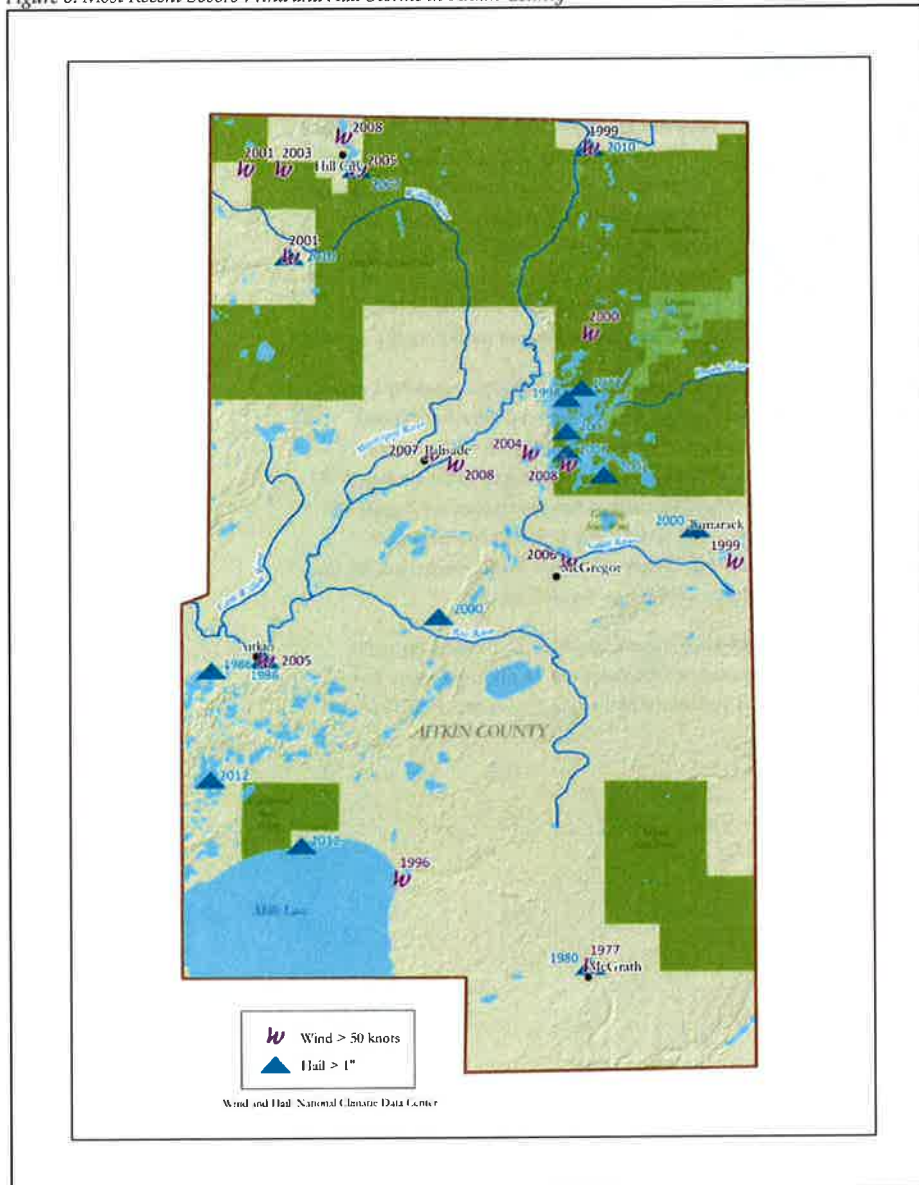


Figure 9. Damage from tornado in Aitkin County, 8/29/2013



In Minnesota, the peak months of tornado occurrence are June and July. The typical time of day for tornadoes in Minnesota ranges between 4:00 P.M. and 7:00 P.M. Most of these are minor tornadoes, with wind speeds under 125 miles per hour. A typical Minnesota tornado lasts approximately ten minutes, has a path length of five to six miles, is nearly as wide as a football field, and has a forward speed of about thirty-five miles an hour and affects less than one-tenth of one-percent of the county warned.

According to the NCDC, 15 tornadoes were reported in Aitkin County between 1952 and 2012, causing 1 death, 3 injuries, and over \$3.5 million dollars in property damage. See Figure 9 above (National Weather Service, 2013). Tornado classification ranged from F0 to F4 on the Fujita Scale. While most of the tornados in Aitkin County have been F0, F1, or F2 classification, tornadoes ranked at F3 and F4 have also occurred, including an F4 in 1969 that caused 2.5 million in property damage. The most recent tornado in the county was on August 29, 2013, in the northwestern portion of the county, rated as an EF1. The Aitkin County Sheriff's Department reported numerous fallen trees and blocked roads. One house north of Remer experienced severe damage, but otherwise property damage was limited to small structures (National Weather Service, 2013).

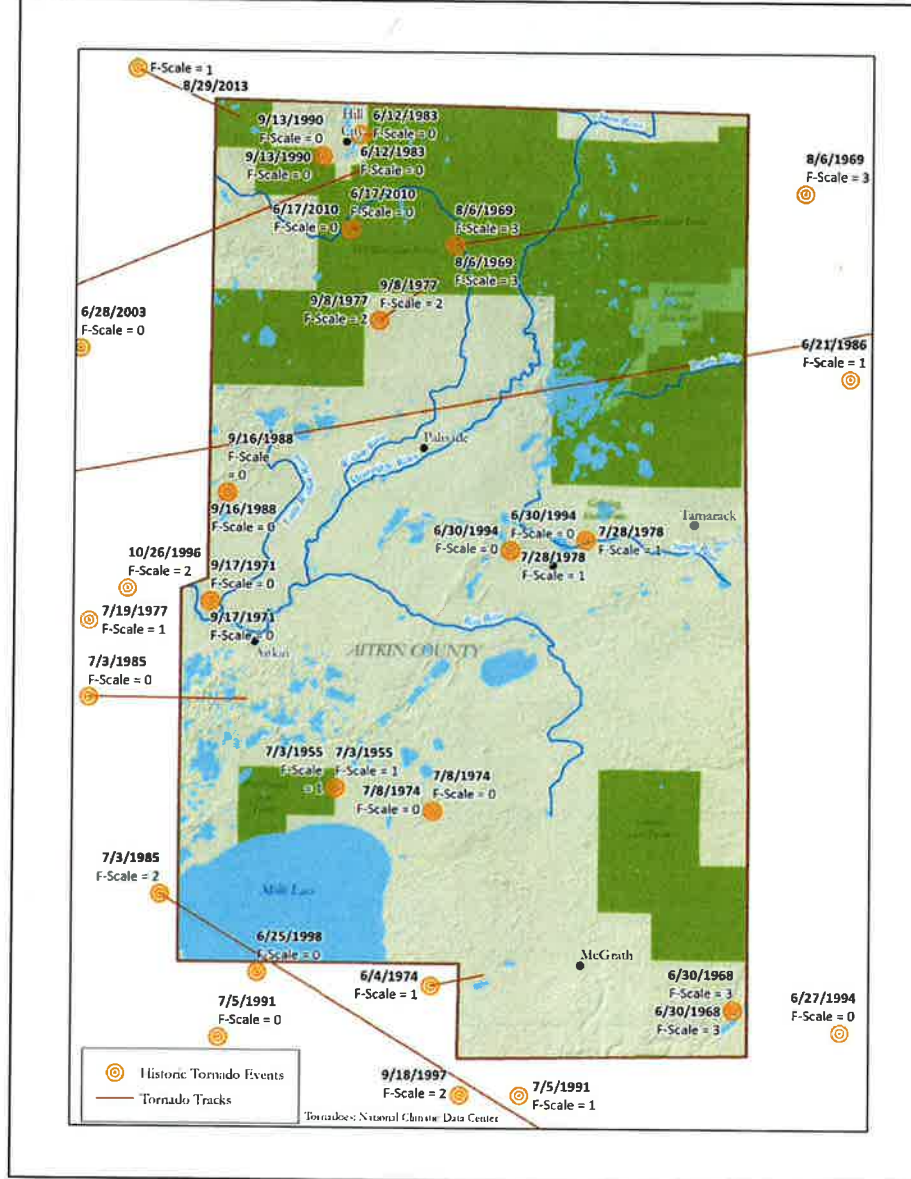
Figure 10 below shows tornado touchdown points and tracks in Aitkin County since 1955. Historic tornado events in the county are listed in Table 22. The county has experienced tornadoes in 14 of the 51 years on record. According to these statistics, there is a 27% chance of a tornado affecting Aitkin County each year.

Table 22. Historic Tornado Events in Aitkin County (1952-2013)

Location or County	Date	Magnitude	Deaths	Injuries	Property Damage	Length in miles	Width in yards
Birch Lake	8/29/2013	EF1	N/A	N/A	N/A	12.8	300
Haypoint	6/17/2010	F0	0	0	0	1	25
McGregor	6/30/1994	F0	0	0	0	0.1	10
Aitkin County	9/13/1990	F0	0	0	0	0.1	10
Aitkin County	7/3/1985	F2	0	0	25K	2	200
Aitkin County	7/3/1985	F0	0	0	250K	3	100
Aitkin County	6/12/1983	F0	0	0	2.5K	3	400
Aitkin County	7/28/1978	F1	0	0	250K	18	880
Aitkin County	9/8/1977	F2	0	0	250K	3.6	660
Aitkin County	6/25/1973	F0	0	0	2.5K	0.8	100
Aitkin County	9/17/1971	F0	0	0	0	0.1	30
Aitkin County	8/6/1969	F3	1	3	250K	12.5	1500
Aitkin County	8/6/1969	F4	0	0	2.5M	10.1	833
Aitkin County	6/30/1968	F3	0	0	2.5K	0.1	10
Aitkin County	7/3/1955	F1	0	0	0.25K	0	33
Aitkin County	7/16/1952	F2	0	0	25K	9.4	333

Source: National Climatic Data Center

Figure 10. Tornado Touchdowns and Paths, Aitkin County



Windstorms/Tornadoes and Climate Change

According to the Federal Advisory Committee Draft National Climate Assessment (NCA), winter storms have increased slightly in frequency and intensity, and their tracks have shifted northward over the U.S. Lack of high-quality long-term data sets make assessment of changes in wind speeds very difficult (Kunkel, et al., 2013). One analysis generally found no evidence of significant changes in wind speed distribution. Other trends in severe storms, including the numbers of hurricanes and the intensity and frequency of tornadoes, hail, and damaging thunderstorm winds are uncertain. Since the impact of more frequent or intense storms can be larger than the impact of average temperature, climate scientists are actively researching the connections between climate change and severe storms (National Climate Assessment Development Advisory Committee, 2013).

Tornadoes and other severe thunderstorm phenomena frequently **cause** as much annual property damage in the U.S. as do hurricanes, and often cause more deaths. Although **recent research** has yielded insights into the connections between global warming and the factors that **cause tornados and severe thunderstorms**, such as atmospheric instability and increases in wind speed with **altitude** (Del Genio, Yao, & Jonas, 2007), these relationships remain mostly unexplored, largely **because of the challenges in observing thunderstorms and tornadoes** and simulating them with computer models (National Climate Assessment Development Advisory Committee, 2013).

Relationship to other Hazards

Flooding - Thunderstorms with heavy amounts of rainfall can cause localized flooding, which can impact property and infrastructure such as roads.

Public Health - Public health can be impacted as a result of wastewater spills due to flooding.

Wildland Fire - Lighting strikes may ignite a wildland fire. Windstorms that result in downed timber increase the fuel load in a forest that may increase the risk of wildfire.

Structural Fire - Lighting strikes may ignite a wildland or structural fire.

Plans and Programs in Place

SKYWARN Program - The National Weather Services (NWS) has a Northland SKYWARN Program, offering annual training sessions to volunteers in Aitkin County. There is a network of trained SKYWARN spotters in Aitkin County. These volunteers help keep their local communities safe by providing timely and accurate reports of severe weather to their local National Weather Service office.

Storm Shelters - Mobile home parks are required to meet Minnesota Department of Health requirements for storm shelters based on number of manufactured homes and date of licensing. Big Sandy Lake Campground is operated by the Army Corps of Engineers and has a root cellar and concrete rest rooms that serve as storm shelters for the public. Savanna Portage State Park uses its restroom facilities as shelters within the main park. A concrete root cellar serves as another storm shelter for the group camp located on Savanna Lake. Hill City School has two rooms designated as tornado shelters, and is designated as a shelter for the Red Cross. The Aitkin Fire Hall is used as a public storm shelter.

Outdoor Warning Sirens - Outdoor warning sirens are in place on the Sandy Lake Indian Reservation, East Lake, and the cities of Aitkin, Tamarack, and Hill City. Sirens are activated in the event of a tornado warning or severe

thunderstorms with winds of 70 mph or greater. Warning sirens are not used for the dual purpose of summoning emergency management workers in the event of an emergency.

Backup Power - For the Courthouse complex there is an emergency generator for the jail, and from that power can be provided to serve the courthouse, boiler room and I.T. Office. Across the street there is a small emergency generator that will power EMS, fire and police radio systems. In the city of Aitkin, the fire department has portable generators, one of which is dedicated to water supply and another that can be located as needed.

Burying Power Lines - Burying power lines helps eliminate loss of power due to severe summer storms. Mille Lacs Energy Cooperative and Lake County Power work to accommodate requests for installation of underground power lines to residents or businesses receiving connection of new power in areas where it is feasible. East Central Energy buries lines in areas where it makes sense to do so, but does not offer this as a regular customer option.

Vegetation Management - The Aitkin County Transportation Department strives to clear the right of way of its improved, high volume roads to reduce tree blowdown in the event of severe summer storms.

School Closings - All school districts within Aitkin County have a school closing policy and communications plan in place if inclement weather or temperatures create a hazardous situation for students or staff. Schools have notification systems which allow them to notify all families who are registered in the school system with up-to-date information.

NOAA Weather Radio Transmitter Towers - The National Weather Service delivers storm warnings and key information during severe winter weather events over its radio towers. The extreme southeastern part of Aitkin County is covered by Pine County. Most of the rest of the county is covered by the Aitkin transmitter which is located northeast of the city of Aitkin. The Coleraine transmitter covers the extreme northeastern part of the county.

Public Warning and Notification - In the event of emergencies or hazardous conditions that require timely and targeted communication to the public, Aitkin County utilizes the CodeRED Mass Notification System and the Aitkin County Sheriff's Office Facebook page, as well as local news media. Aitkin County promotes the use of NOAA weather radios by critical facilities and the public to receive information broadcast from the National Weather Service.

Public Education and Awareness - Aitkin County promotes the National Weather Service's "Severe Weather Awareness Week" held in April each year. The event seeks to educate residents on the dangers of severe summer storm events and highlights the importance of preparing for severe weather before it strikes.

Program Gaps or Deficiencies

Outdoor Warning Sirens - The cities of McGregor and McGrath do not have warning sirens.

Storm Shelters - Not all Aitkin County public schools have designated safe rooms.

Backup Power - Not all county facilities have backup power in the event of a disaster.

4.4.4 Extreme Cold

Wintertime in Aitkin County can be a brutal time, and especially dangerous for disabled citizens and outdoor workers. Record temperature lows and arctic-like wind chill factors can cause cold-related illnesses such as frostbite and hypothermia, which can be deadly. Hypothermia is the greatest and most life-threatening cold weather danger.

In Aitkin County cold winter weather can have severe or fatal impacts. Hypothermia occurs when core body temperature drops below 96°F. Anyone who is exposed to severe cold without enough protection can develop hypothermia. Frostbite occurs when skin tissue and blood vessels are damaged from exposure to temperatures below 32°F. It most commonly affects the toes, fingers, earlobes, chin, cheeks, nose, and other body parts that are often left uncovered in cold temperatures. The NWS issues "Extreme cold" warnings when it feels like -30°F or colder across a wide area for several hours. Extreme cold watches are issued a day or two before the conditions are expected.

Extreme Cold History in Aitkin County

Below zero temperatures occur almost every winter for a period of time. January is the coldest month, with daytime highs averaging 20°F and nighttime lows averaging 0°F. However, these averages do not tell the whole story. Maximum temperatures in January have been as high as 54°F and minimums as low as -47°F below zero (The Weather Channel, 2014).

Extreme cold temperatures affect the county nearly every year. Extremely cold air settled over the area on January 31st of 1996, and remained entrenched through February 4th. A new record low temperature for Minnesota was set in the town of Tower on February 2, 1996, at -60°F. Numerous record low temperatures were set during the period at St. Cloud, Rochester and the Twin Cities. Minneapolis/St. Paul set three new record low temperatures as well as recording the second coldest day on record on February 2, 1996. A mean temperature of 25°F below zero was measured that day with a high of 17°F below and a low of 32°F below zero in the Twin Cities. This was within two degrees of tying the all-time record low temperature set in the Twin Cities and the coldest temperature recorded this century. Many central and southern Minnesota locations set new record low temperatures the morning of the 2nd. The governor closed all schools that day.

Extreme Cold and Climate Change

There is not yet any observable trend related to extreme cold events and climate change in Minnesota. Cold temperatures have always been a part of Minnesota's climate and extreme cold events will continue. However, an increase in extreme precipitation or storm events such as ice storms as the climate changes could lead to a higher risk of residents being exposed to cold temperatures during power outages or other storm-related hazards during extreme cold.

Relationship to other Hazards

Wildfire - Extreme cold directly impacts firefighting, making fire suppression more difficult and increasing the likelihood of equipment damage.

Public Health - Frozen septic systems can lead to the release of increased levels of untreated wastewater into the environment.

Public Safety - Anyone exposed to extremely cold temperatures can develop frostbite and hypothermia. The elderly, children and those who engage in outdoor work or recreation may be most susceptible to the danger of extremely cold temperatures.

Plans and Programs in Place

School Closings - All school districts in Aitkin County have a school closing policy and communications plan in place if inclement weather or temperatures create a hazardous situation for students or staff. Schools have notification systems which allow them to notify all families who are registered in the school system with up-to-date information.

Public Warning and Notification - In the event of emergencies or hazardous conditions that require timely and targeted communication to the public, Aitkin County utilizes the CodeRED Mass Notification System and the Aitkin County Sheriff's Office Facebook page, as well as local news media. Aitkin County promotes the use of NOAA weather radios by critical facilities and the public to receive information broadcast from the National Weather Service.

Public Education and Awareness - Aitkin County promotes the National Weather Service's "Winter Hazard Awareness Week" held in November each year. The event seeks to educate residents on the dangers of winter weather and how to properly deal with it.

Program Gaps or Deficiencies

No program gaps or deficiencies were identified.

4.4.5 Extreme Heat

Human beings need to maintain a constant body temperature if they are to stay healthy. Working in high temperatures induces heat stress when more heat is absorbed into the body than can be dissipated out. Heat illness such as prickly heat, fainting from heat exhaustion, or heat cramps are visible signs that people are working in unbearable heat. In the most severe cases, the body temperature control system breaks down altogether and body temperature rises rapidly. This is a heat stroke, which can be fatal. The NWS issues a heat advisory when, during a 24-hour period, the temperature ranges from 105°F to 114°F during the day, and remains at or above 80°F at night.

Extreme Heat History in Aitkin County

Summer temperatures in Aitkin have reached 100°F (August 1976). July is the warmest month, with an average high of 80°F (The Weather Channel, 2014).

Extreme Heat and Climate Change

Minnesota's average temperature has increased more than 1.5°F since recordkeeping began in 1895, with increased warming happening in recent decades (International Climate Adaptation Team, 2013). Annual temperatures in the Midwest have generally been well above the 1901-1960 average since the late 1990s, with the decade of the 2000s being the warmest on record (Kunkel, et al., 2013). The Midwest has experienced major heat waves and their frequency has increased over the last six decades (Perera, Sanford, White-Newsome,

Kalkstein, Vanos, & Weir, 2012). For the U.S., mortality increases 4% during heat waves compared with non-heat wave days (Anderson & Bell, 2011). During July 2011, 132 million people across the U.S. were under a heat alert – and on July 20 the majority of the Midwest experienced temperatures in excess of 100°F. Heat stress is projected to increase as a result of climbing summer temperatures and humidity (Schoof, 2012).

Relationship to other Hazards

Drought and Wildfire - Dry, hot conditions can reduce the protective moisture of woodlands and increase the risk of wildfire.

Public Safety - Anyone exposed to extreme heat can develop heat exhaustion and heat stroke. The elderly, children and those who engage in outdoor work or recreation may be most susceptible to the danger of extreme heat.

Plans and Programs in Place

School Closings - All school districts in Aitkin County have a school closing policy and communications plan in place if inclement weather or temperatures create a hazardous situation for students or staff. Schools have notification systems which allow them to notify all families who are registered in the school system with up-to-date information.

Public Warning and Notification - In the event of emergencies or hazardous conditions that require timely and targeted communication to the public, Aitkin County utilizes the CodeRED Mass Notification System and the Aitkin County Sheriff's Office Facebook page, as well as local news media. Aitkin County promotes the use of NOAA weather radios by critical facilities and the public to receive information broadcast from the National Weather Service.

Program Gaps or Deficiencies

No program gaps or deficiencies were identified.

4.4.6 Flash Flood and Riverine Flood

Flooding is a significant natural hazard throughout the United States. The type, magnitude, and severity of flooding are functions of the amount and distribution of precipitation over a given area, the rate at which precipitation infiltrates the ground, the geometry and hydrology of the catchment, and flow dynamics and conditions in and along the river channel. Upstream floods, also called flash floods, occur in the upper parts of drainage basins and are generally characterized by periods of intense rainfall over a short duration. These floods arise with very little warning and often result in locally intense damage, and sometimes loss of life, due to the high energy of the flowing water. Flood waters can snap trees, topple buildings, and easily move large boulders or other structures. Six inches of rushing water can upend a person; another 18 inches might carry off a car. Generally, upstream floods cause damage over relatively localized areas, but they can be quite severe. Urban flooding is a type of upstream flood, which involves the overflow of storm drain systems and can be the result of inadequate drainage combined with heavy rainfall or rapid snowmelt. Upstream or flash floods can occur at any time of the year in Minnesota, but they are most common in the spring and summer. 2 flash floods have been recorded in Aitkin County since 2002.

Downstream floods, sometimes called riverine floods, refer to floods on large rivers at locations with large upstream catchments. Downstream floods are typically associated with precipitation events that are of relatively long duration and occur over large areas. Flooding on small tributary streams may be limited, but the contribution of increased runoff may result in a large flood downstream. The lag time between precipitation and the flood peak is much longer for downstream floods than for upstream floods, generally providing ample warning for people to move to safe locations and, to some extent, secure some property against damage.

Flood History in Aitkin County

Flooding in Aitkin County is a major concern because the Mississippi River floodplain consumes a large portion of the County. There has been some flooding in the history of Aitkin County associated with the Mississippi River. In 1950, heavy spring flooding culminated in a substantial flood, ultimately causing the local government to develop a solution to prevent future damages. The Mississippi River Diversion Channel, located north of Aitkin, was part of that solution. It stands as the only diversion channel on the Mississippi river between Lake Aitkin and the Gulf of Mexico. Later in the 1970s, a dike system was established to further protect the city. In an effort to alleviate the threat of future flooding, a vast engineering project was undertaken in the early 1950s to create a diversion channel that would attempt to redirect the high water north of Aitkin. This diversion channel is the only one of its kind along the entire length of the Mississippi. Later in the 1970s, a dike system was established to further protect the city.

In April of 1995, the Mississippi River began rising due to rapid snowmelt and heavy rainfall from a storm system passing over the County. Property damage was minimal, with only one house in Brainerd that reported flooding. However, many secondary roads were washed out or had standing water.

Another area where erosion is a problem by the Mississippi River is along Aitkin County State-aid Highway (CSAH) 10. The riverbank failed most recently on August 16th, 1998. The failure affected one lane of the highway, and the County closed it to traffic. The Aitkin County Board requested a Stream Bank Protection study from the U.S. Army Corps of Engineers in August 1998. The St. Paul District completed the study and the project was approved on May 10, 1999. Rock placement was completed in February 2001. Willow plantings and seeding were completed in November 2001.

In the spring of 2001, lingering snow pack with a high water content, combined with three heavy rainfall events during the month of April, led to significant flooding along parts of the Mississippi River, Sandy River, and Big Sandy Lake. The water level came within four-inches of rendering the City of Aitkin sewage treatment plant inoperative. During this time, the wastewater treatment plant went into emergency operation. Despite sandbagging efforts, thousands of dollars in damage to homes, businesses, and roads occurred. Damage to public property was estimated at \$675,000 countywide. Dollar loss to private property was not available for this study. The 2001 flood reached the third highest elevation since 1895. Flooding in the spring of 1997 also caused considerable flooding damages within Aitkin County.

Aitkin Township is located in a natural floodplain, causing flooding on individual properties when dams are released upstream. In Idun Township flooding is experienced nearly every year resulting in road damages and washouts. Kimberly Township has indicated that flooding from excessive rainfall is a problem and causes roads and culverts to washout. Farm Island Township received money from FEMA to repair road damages caused by heavy rains in April 2001. Flooding in the spring of 2001 also caused road damages in Spencer Township. Logan

Township has two rivers within its borders that have caused damages in the past when water levels have risen above normal. Spring flooding in Shamrock Township on Big Sandy Lake can occur and cause water and ice damages along the lakeshore. Road washouts in the springtime have also been a problem in Lakeside Township.

Another flooding incident occurred on the Big Sandy Lake on 2001 when water levels were raised by the Army Corps of Engineers, resulting in approximately 200 homes being flooded. These houses were all located within the designated flooding easements used by the Army Corps of Engineers. Water levels could have potentially been raised an additional four feet and still been within the range of the existing easement.

Table 23 below lists Aitkin County's historical floods since 1996 as recorded by the NCDC.

Table 23. Aitkin County Historical Floods (1996-2013)

Location or County	Date	Type	Deaths	Injuries	Property Damage
Aitkin	5/1/2013	Flood	0	0	0
Aitkin	4/30/2013	Flood	0	0	0
Libby	7/1/2012	Flood	0	0	0
Aitkin	7/1/2012	Flood	0	0	0
Libby	6/20/2012	Flood	0	0	0
Aitkin	6/17/2012	Flood	0	0	0
Libby	6/1/2012	Flood	0	0	0
Aitkin	6/1/2012	Flood	0	0	0
Aitkin	5/26/2012	Flood	0	0	0
Aitkin	5/5/2011	Flood	0	0	0
Aitkin	4/11/2011	Flood	0	0	0
Nichols	12/7/2010	Flood	0	0	0
Aitkin Airport	11/1/2010	Flood	0	0	0
Aitkin	7/14/2009	Flash Flood	0	0	0
Redtop	7/7/2002	Flash Flood	0	0	0
Highest Value Property Damage:					0

Source: National Climatic Data Center

The National Oceanic and Atmospheric Administration (NOAA) Advanced Hydrologic Prediction Service provides information from gage locations at points along various rivers across the United States. There is one stream gage in Aitkin County, on the Mississippi River at the city of Aitkin.

Table 24. Historical Flood Crests for USGS gaging station on the Mississippi River at Aitkin

Date	Gage Height (Feet)	Streamflow (cfs)
May 20, 1950	22.49	20,000
Jun. 1888	19.80	13,100
Jul. 06, 1905	19.50	12,400
Apr. 29, 1916	19.30	12,000
Jun. 09, 1944	18.80	12,600
Apr. 27, 1948	18.77	12,000
May 12, 1938	18.70	12,000
Jun. 28, 2012	18.61	15,200
1899	18.40	10,900
Jun. 15, 1908	18.20	10,300

HAZUS-MH Hazard Analysis

HAZUS-MH was used to estimate the damages incurred for a 100-year flood event in Aitkin County using a Q3 and a 10-meter DEM (digital elevation model) to create a flood depth grid.

Aitkin County specific building data was sourced from the parcel tax databases and building location point databases included building valuations and occupancy class. Building counts were aggregated from the individual parcel records to the relevant census administrative boundaries. There are an estimated 18,017 buildings in the region with a total replacement value (excluding contents) of \$1.2 billion (2006 dollars). Approximately 87.6% of the buildings (and 80.25% of the building value) are associated with residential housing. Using the Aitkin County general building stock, the Hazus model reported an estimated 403 buildings will be at least moderately damaged. This is over 28% of the total number of buildings in the scenario. There are an estimated 204 buildings that will be completely destroyed.

The total economic loss estimated for the flood is \$73 million dollars, which represents 8.5% of the total replacement value of the scenario buildings. Building losses are broken into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are associated with inability to operate a business because of the damage sustained during the flood. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the flood. The total building-related losses were \$72.6 million dollars. 1% of the estimated losses were related to the business interruption of the region. Residential occupancies made up 72.8% of the total loss.

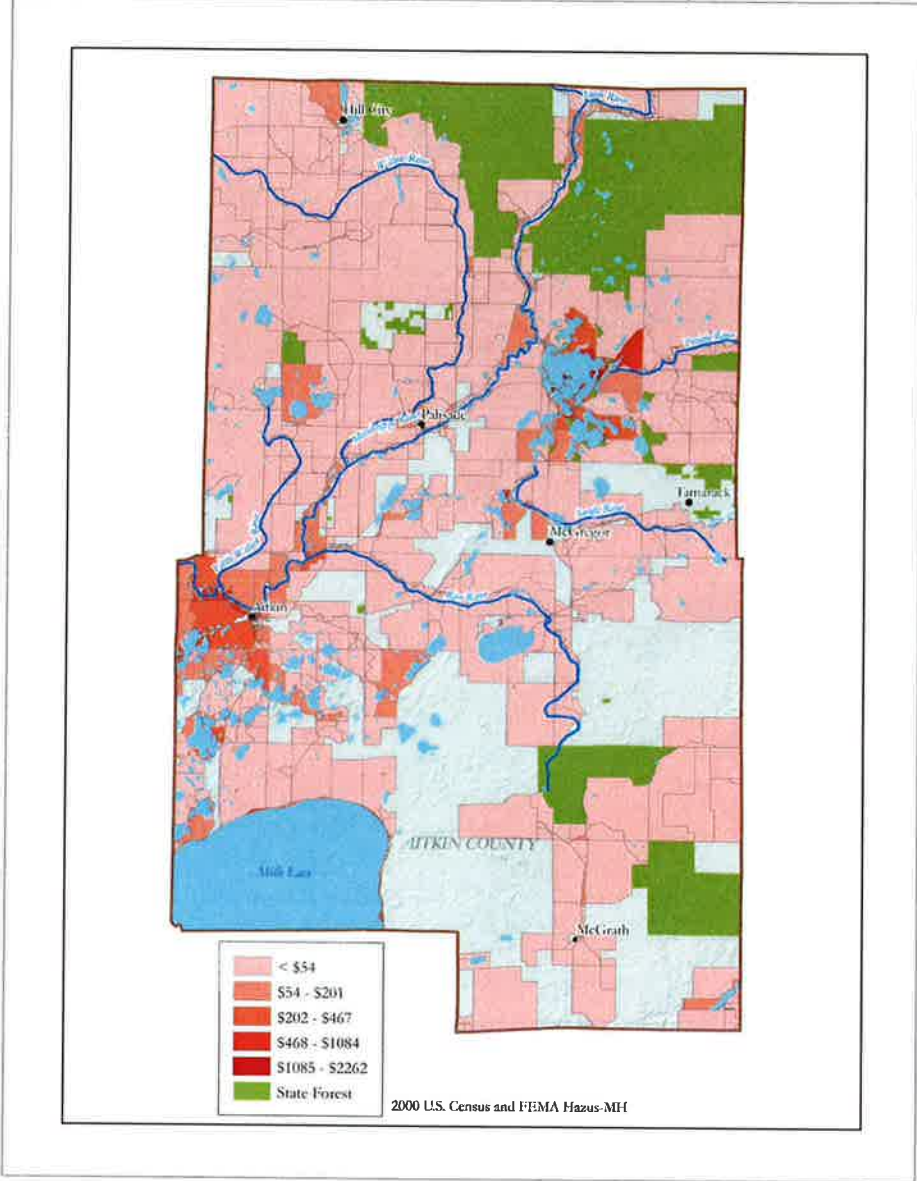
The reported building counts should be interpreted as degrees of loss rather than an exact number of buildings exposed to flooding. These numbers were derived from aggregate building inventories which are assumed to be dispersed evenly across census blocks. HAZUS-MH requires that a predetermined amount 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. The total estimated number of damaged buildings, total building losses, and estimated total economic losses are shown in Table 25. The distribution of economic losses for Aitkin County is depicted in Figure 11.

Table 25. Aitkin County Total Economic Loss from 100-Year Flood

General Occupancy	Estimated Total Buildings	Total Damaged Buildings	Total Building Exposure (In \$1000s)	Total Economic Loss (In \$1000s)	Building Loss (In \$1000s)
Agricultural	1517	9	\$83,409	\$8,382	\$1,144
Commercial	405	7	\$38,246	\$3,855	\$715
Education	13	0	\$38,830	\$1,073	\$164
Government	140	0	\$24,722	\$1,482	\$199
Industrial	45	0	\$12,430	\$479	\$94
Religious/Non-Profit	115	0	\$41,782	\$4,622	\$818
Residential	15,782	394	\$972,529	\$53,193	\$35,387
Total	18,017	410	\$1,211,948	\$73,086	\$38,521

Figure 11. Distribution of Estimated Economic Loss by Census Block for Aitkin County in 100-Year Flood



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 because values are distributed evenly in a census block. The three census blocks showing the highest estimated loss values are shown in Table 26, with their spatial extents shown in Figure 12, Figure 13, and Figure 14.

Table 26. Aitkin County Census Blocks with the Greatest Estimated Total Losses in the 100-Year Floodplain

Census Block Number	Total Estimated Loss	Location
270019901001127	\$2,262	Big Sandy Lake
270019901001164	\$2,256	Big Sandy Lake
270019901001168	\$1,521	Big Sandy Lake

Figure 12. Census Block 270019901001127 and 100-Year Floodplain on Big Sandy Lake

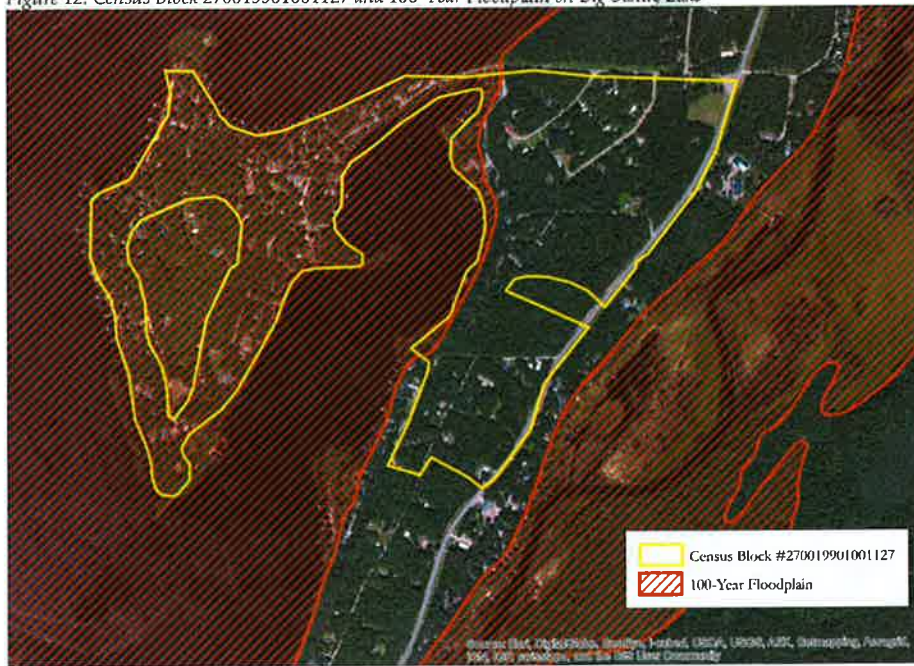
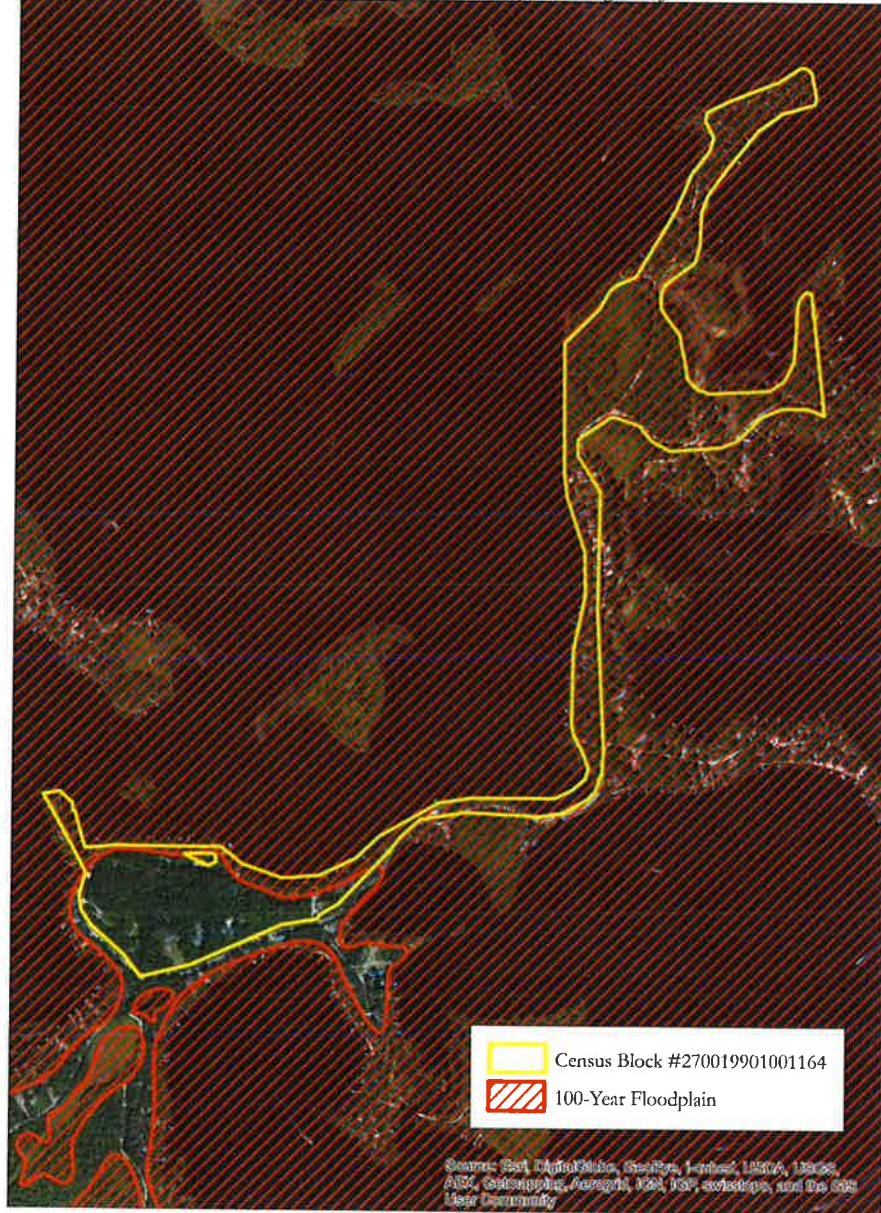
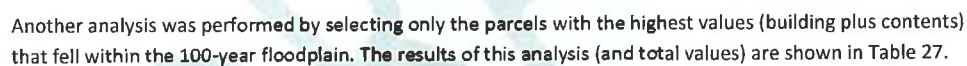


Figure 13. Census Block 270019901001164 and 100-Year Floodplain on Big Sandy Lake





Edited Parcel ID Number	Parcel Building + Contents Total Value	Class Description	Building Area (ft²)
29-1-377600	\$3,015,800	Churches/Non-Profit	34,945
56-0-157800	\$1,573,200	Residential Multi-dwellings (5-9 units)	13,040
56-0-158300	\$1,388,600	Retail Trade	4
56-0-175100	\$1,150,200	Residential Multi-dwellings (5-9 units)	12,686
01-0-051700	\$912,600	General Government Services	1
56-0-158000	\$902,200	Retail Trade	24,810
08-0-019600	\$798,000	General Government Services	12,024
56-0-124307	\$763,600	Retail Trade	26,976
56-0-158200	\$759,800	Retail Trade	10,561
29-0-014404	\$620,100	Single Family Dwelling	11,612
Total	\$11,884,100		

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). Only 1 of the essential facilities (care facilities, fire stations, police stations, and schools) included in the HAZUS-MH analysis falls within the flood boundary, a fire station in Jacobson, with expected damage classified as “At Least Moderate” (Table 28 and Figure 15).

Table 28. Aitkin County Essential Facilities within estimated 100-Year Flood Boundary

Type	Name	Site Address	City
Fire Station	Jacobson Fire Department	68368 198th Avenue	Jacobson

Figure 15. Jacobson Fire Department and 100-Year Floodplain



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 may require accommodations in temporary public shelters. The model estimates 726 households will be displaced due to the flood. Displacement includes households evacuated from within or very near to the inundated area. Of these, the model estimates 794 people (out of a total 2000 census population of 15,301) may seek temporary shelter in public shelters.

HAZUS-MH Debris Generation Analysis

HAZUS estimates the amount of debris that may be generated by the flood. The model breaks debris into three general categories: 1) Finishes (dry wall, insulation, etc.), 2) Structural (wood, brick, etc.) and 3) Foundations (concrete slab, concrete block, rebar, etc.). This distinction is made because of the different types of material handling equipment required to handle the debris.

The model estimates that a total of 33,042 tons of debris may be generated. Finishes composes 37% of the total and structural composes another 37% of the total. If the debris tonnage is converted into an estimated number of truckloads, it will require 1,322 truckloads (@25 tons/truck) to remove the debris generated by the flood.

Flooding and Climate Change

As Minnesota's climate changes, the quantity and character of precipitation is changing. Average precipitation has increased in the Midwest since 1900, with more increases in recent years. The Midwest has seen a 45% increase in very heavy precipitation (defined as the heaviest 1% of all daily events) from 1958 to 2011 (National Climate Assessment Development Advisory Committee, 2013). This precipitation change has led to amplified magnitudes of flooding. Increased precipitation may also show seasonal changes, trending toward wetter springs and drier summers and falls. An example of a recent year with this character was 2012, when many MN counties were eligible for federal disaster assistance for drought, while others were eligible for flooding, and seven were eligible for both in the same year (Seeley, 2013).

Relationship to other Hazards

Severe storms and blizzards - Slow moving thunderstorms and snow melt can contribute to flooding and, under the right circumstances, flash flooding.

Dam Failure - Flood events can compromise the structural integrity of dams.

Public Health - Public health can be affected as a result of wastewater spills due to flooding or power failures.

Water Main Breaks - Surges in water pressure as a result of water pumps starting after power outages can lead to water main breaks.

Plans and Programs in Place

Floodplain Ordinances - The Aitkin County Office of Zoning and Environmental Services and cities within the county have floodplain ordinances in place which regulate development and setbacks on shorelines and include the state floodplain and shoreland standards. These programs set minimum standards for local units of government that regulate development within shoreland and floodplain areas. Aitkin County and the cities of

Aitkin, Hill City, McGregor, and Palisade have adopted floodplain ordinances, though the Hill City and McGregor ordinances need to be amended.

National Flood Insurance Program (NFIP) - The NFIP is a federal program created by Congress to mitigate future flood losses nationwide through sound, community-enforced building and zoning ordinances and to provide access to affordable, federally-backed flood insurance protection for property owners. The NFIP is designed to provide an insurance alternative to disaster assistance to meet the escalating costs of repairing damage to buildings and their contents caused by floods. Participation in the NFIP is based on an agreement between local communities and the federal government that states that if a community will adopt and enforce a floodplain management ordinance to reduce future flood risks to new construction in Special Flood Hazard Areas (SFHAs), the federal government will make flood insurance available within the community as a financial protection against flood losses. Aitkin County and the cities of Aitkin, Hill City, McGregor, and Palisade are members of the National Flood Insurance Program. Aitkin, Hill City, McGregor, and Palisade are FEMA Mapped High Risk Areas. The cities of McGrath and Tamarack are not members of the NFIP, but neither have FEMA Mapped High Risk Areas.

Road Infrastructure and Drainage - Public Works staff at the county, city and township level work on culvert and ditch maintenance to prevent road flooding. Ice dams in culverts are monitored and addressed to reduce road flooding during spring thaws. The County has put a priority on culvert improvements to avoid road washouts.

Stream Gauging - The National Weather Service and the U.S. Geological Society provide real-time websites that gauge stream flow in area streams and rivers. Mississippi River flowage levels for the city of Aitkin can be accessed online and used to inform the public of areas expected to be flooded as the river level rises.

U.S. Army Corps of Engineers (USACE) - The Army Corps of Engineers has a notification list of at-risk properties within Aitkin County. The Army Corps of Engineers also provides hourly updates on flowage at the Big Sandy Lake dam. The USACE also has a GIS inventory of structures and roads within their identified flowage easements.

Repetitive Loss Structures - Aitkin County has the ability to purchase repetitive loss properties. However, there are no repetitive loss properties in the county.

Mississippi River Diversion Channel - The Mississippi River Diversion Channel, located north of Aitkin, was constructed to protect the city of Aitkin from flooding by the Mississippi River. Later in the 1970s, a dike system was established to further protect the city. Local officials continue to advocate for additional infrastructure improvements to reduce the impacts of Mississippi River flooding in the Aitkin, Palisade and Big Sandy Lake areas.

Public Warning and Notification - In the event of emergencies or hazardous conditions that require timely and targeted communication to the public, Aitkin County utilizes the CodeRED Mass Notification System and the Aitkin County Sheriff's Office Facebook page, as well as local news media. Aitkin County promotes the use of NOAA weather radios by critical facilities and the public to receive information broadcast from the National Weather Service.

Program Gaps or Deficiencies

Diversion Channel - Ongoing maintenance and repairs are needed to the Mississippi Diversion Channel north of the city of Aitkin.

Mississippi River Dike Easement - If the city of Aitkin wants to inspect the dike which surrounds the low parts of Aitkin, they do not have an easement to do so and do not have the ability to maintain the dike. With legal authority this would be possible, but landowners have resisted granting an easement to the city.

Beaver Dams and Flood Risk - Beaver dams have impounded many areas with water, and under normal rain events they are not a problem. However, in the event of flash flooding, when beaver dams break road infrastructure is burdened with a major additional flow of water.

Road and Culvert Improvements - Aitkin County strives to constantly improve its road and culvert infrastructure against flooding, but is limited by financial resources to go beyond maintenance on some projects.

4.4.7 Drought

A drought refers to an extended period of deficient rainfall relative to the statistical mean for a region. Drought can be defined according to meteorological, hydrological, socioeconomic, and agricultural criteria. Meteorological drought is qualified by any significant deficit of precipitation. Hydrological drought is manifest in noticeably reduced river and stream flow and critically low groundwater tables. The term agricultural drought indicates an extended dry period that results in crop stress and harvest reduction. Socioeconomic drought refers to the situation that occurs when water shortages begin to affect people and their lives. It associates economic goods with the elements of meteorological, agricultural, and hydrological drought. Many supplies of economic goods (e.g., water, food grains, hydroelectric power) are greatly dependent on the weather. Due to natural variations in climate, water supplies are high in some years but low in others. Fluctuating long-term climate variations make drought difficult to predict.

Drought History in Aitkin County

National Climatic Data Center records show no droughts in Aitkin County. However, the county was part of a 2003 U.S. Department of Agriculture designation of 62 counties in Minnesota as primary agricultural disaster areas due to drought.

The risk of drought in Aitkin County is moderate. A drought may not have a severe impact on human life due to decreased water access; however, droughts in Aitkin County are of particular concern because of the potential for forest fires as well as the impacts lower lake levels have on recreation.

Drought and Climate Change

Droughts have been happening throughout Minnesota's history and it is not yet clear how climate change may impact this (International Climate Adaptation Team, 2013). While there was no apparent change in drought duration in the Midwest over the past century (Dai, 2011), the average number of days without precipitation is projected to increase in the future (National Climate Assessment Development Advisory Committee, 2013).

Even in areas where precipitation does not decrease, projected higher air temperatures will cause increased surface evaporation and plant water loss, leading to drier soils. As soil dries out, a larger proportion of the incoming heat from the sun goes into heating the soil and adjacent air rather than evaporating its moisture, resulting in hotter summers under drier climatic conditions (Mueller & Seneviratne, 2012).

Relationship to other Hazards

Wildfires - A drought situation can significantly increase the risk of wildfire.

Plans and Programs in Place

Aitkin County Comprehensive Water Plan - Aitkin County has a **water plan in place that describes major aquifers and addresses water needs within the County. The Aitkin County Soil and Water Conservation District (SWCD) oversees updating the plan and identifying priorities for surface water and ground quality and quantity. Cities in Aitkin County are covered under the plan.**

Well Monitoring - The Aitkin County SWCD routinely **monitors six wells throughout the county for water levels for ground waters.**

Program Gaps or Deficiencies

No program gaps or deficiencies were identified.

SECTION 5 – MITIGATION STRATEGY

The goal of mitigation is to protect lives and reduce the future impacts of hazards including property damage, disruption to local and regional economies, the amount of public and private funds spent to assist with recovery, and to build disaster-resistant communities. Mitigation actions and projects should be based on a well-constructed risk assessment, provided in Section 4 of this plan. Mitigation should be an ongoing process adapting over time to accommodate a community's needs.

5.1 Community Capability Assessment

The capability assessment identifies current activities used to mitigate hazards. The capability assessment identifies the policies, regulations, procedures, programs, and projects that contribute to the lessening of disaster damages. The assessment also provides an evaluation of these capabilities to determine whether the activities can be improved in order to more effectively reduce the impact of future hazards. The following sections identify existing plans and mitigation capabilities within all of the communities.

5.1.1 National Flood Insurance Program (NFIP)

The NFIP is a federal program created by Congress to mitigate future flood losses nationwide through sound, community-enforced building and zoning ordinances and to provide access to affordable, federally-backed flood insurance protection for property owners. The NFIP is designed to provide an insurance alternative to disaster assistance to meet the escalating costs of repairing damage to buildings and their contents caused by floods. Participation in the NFIP is based on an agreement between local communities and the federal government that states that if a community will adopt and enforce a floodplain management ordinance to reduce future flood risks to new construction in Special Flood Hazard Areas (SFHAs), the federal government will make flood insurance available within the community as a financial protection against flood losses.

Aitkin County and the cities of Aitkin, Hill City, McGregor, and Palisade are members of the National Flood Insurance Program. Aitkin, Hill City, McGregor, and Palisade are FEMA Mapped High Risk Areas. The cities of McGrath and Tamarack are not members of the NFIP, but neither have FEMA Mapped High Risk Areas. According to the 2009 update of the Aitkin County Comprehensive Local Water Management Plan, areas of the base (100-year) flood have been identified by the National Flood Insurance Program. These floodplain areas are represented on Flood Insurance Rate Maps (F.I.R.M.) as of March 15, 1982.

There are no repetitive loss properties in the county.

5.1.2 Plans and Ordinances

Aitkin County and its incorporated communities have a number of plans and ordinances in place to ensure the safety of residents and the effective operation of communities. These include the Comprehensive Land Use Plan, Comprehensive Local Water Management Plan, Comprehensive Recreation Trail Plan, and ordinances relating to law enforcement, land & recreation, environmental services, planning & zoning, and food/beverages/lodging. In Section 4.4 of this plan (*Hazard Profiles*) a review of the plans and programs in place as well as any identified program gaps or deficiencies was included as related to each of the natural hazards addressed in the plan. Information was collected through phone interviews and email surveys with representatives of the County, cities, and school districts. The review of this information was used to inform the development of mitigation strategies for the 2014 plan update.

5.2 Mitigation Goals

In Section 4.0 of this plan, the risk assessment identified Aitkin County as prone to a number of natural and technological hazards. The Steering Committee members understand that although hazards cannot be eliminated altogether, Aitkin County can work toward building disaster-resistant communities.

The goals, strategies and objectives listed in the 2014 Minnesota State Hazard Mitigation Plan were adopted for use in the Aitkin County Plan (Table 29). This framework will allow for integration of the mitigation actions that are listed by Aitkin County and its jurisdictions into the state plan. The state will then be able to develop a statewide strategy that will benefit all of Minnesota.

Table 29. Goals, Strategies, and Objectives from 2014 Minnesota State Hazard Mitigation Plan

Flooding Goal: Reduce deaths, injuries, property loss and economic disruption due to all types of flooding (riverine, flash flooding, dam/levee failure)	
Mitigation Strategy	Objectives
Prevention:	Planning, technical studies, training, adoption of ordinances and legislation, acquisition and use of equipment, establishing shelters, and encouraging participation in NFIP and CRS will be used to prevent or reduce risks to lives and property from flooding.
Property Protection:	Acquisition, repair, or retrofitting of property and acquisition and use of equipment will be used to prevent or reduce risks to property from flooding.
Public Education and Awareness:	Public education and access to information will be used to raise public awareness of risks from flooding in order to prevent or reduce those risks.
Natural Resource Protection:	Stream corridor protection projects and restoration and soil erosion control projects will be used to prevent or reduce risks and increase the protection of natural resources from flooding.
Emergency Services:	Technological improvements, warning systems, responder training, emergency response services, acquisition and use of equipment, and planning will provide emergency services to prevent or reduce the risks to lives and property from flooding.
Structural Improvements:	Construction and maintenance of drains, sewer drainage and separation projects, floodwalls, dams, culverts, levees, roads, bridges, and general flood protection projects will be used to prevent or reduce damages from flooding, loss of services to critical equipment, and the risks they pose to lives, property, and the natural environment.
Wildfire Goal: Reduce deaths, injuries, property loss, natural resource and economic disruption due to wildfire.	
Mitigation Strategy	Objectives
Prevention:	Enforcement of regulations, adoption of ordinances, technical studies, and planning will be used to prevent or reduce wild land fires and the risks they pose to lives, property, and the natural environment.
Property Protection:	Vegetation management, defensible space, and water treatment measures (for example, sprinklers) will be used to prevent or reduce the risk of wild land fires.
Public Education and Awareness:	Public education and access to information will be used to raise public awareness of risks from wild land fires in order to prevent or reduce those risks, specifically the Firewise program.
Emergency Services:	Planning, responder training, acquisition and use of equipment, evacuations, warning systems, technological improvements, and emergency response services will provide emergency services to prevent or reduce risks to lives and property from wild land fires.
Structural Improvements:	New or retrofit construction utilizing fire resistant building materials and installation and maintenance of sprinkler and warning systems will be used to prevent or reduce the risk of wild land fires.
Windstorms Goal: Reduce deaths, injuries, property loss, and economic disruption due to windstorms.	
Mitigation Strategy	Objectives

Prevention:	Planning, training, technical studies, acquisition and use of equipment, adoption of ordinances and legislation, and construction of new or retrofitting safe rooms will be used to prevent or reduce risks from windstorms to lives, property, and economic activity.
Property Protection:	Constructing safe rooms and storm shelters, retrofitting, and vegetation management will be used to prevent or reduce risks to the protection of property from windstorms.
Public Education and Awareness:	Public education, warning systems, and access to information will be used to raise public awareness of risks from windstorms in order to prevent or reduce those risks.
Emergency Services:	Warning systems, responder training, emergency response services, technological improvements, and response and recovery planning will provide emergency services to prevent or reduce risks from windstorms.
Structural Improvements:	Construction of storm shelters and safe rooms and maintenance of other structural projects will be used to prevent or reduce risks from windstorms.
Severe Winter Storms Goal: Reduce deaths, injuries, property loss, and economic disruption due to severe winter storms.	
Mitigation Strategy	Objectives
Prevention:	Acquisition and use of equipment, adoption and enforcement of ordinances and legislation, planning, training, and technical studies will be used to prevent or reduce risk to the protection of lives, property, and economic activity from the risks from severe winter storms.
Property Protection:	Acquisition and use of equipment and vegetation management will be used to prevent or reduce risks to property from severe winter storms.
Public Education and Awareness:	Public education, warning systems, access to information, and outreach projects will be used to raise public awareness of the risks from severe winter storms in order to reduce those risks.
Emergency Services:	Acquisition and use of equipment, emergency response services, warning systems, technological improvements, planning, and responder training will provide emergency services to prevent or reduce risks from severe winter storms.
Structural Improvements:	Structural projects for critical infrastructure will be implemented and maintained to prevent or reduce risks from severe winter storms.
Lightning Goal: Reduce deaths, injuries, property losses, loss of services, and economic disruption due to lightning.	
Mitigation Strategy	Objectives
Prevention:	Planning, technical studies, acquisition and use of equipment, adoption of ordinances and legislation, and establishing shelters will be utilized to prevent or reduce the risks from lightning.
Property Protection:	Retrofits and construction of safe rooms and storm shelters will be used to prevent or reduce the risks to property from lightning.
Public Education and Awareness:	Public education, outreach projects, and access to information will be used to raise public awareness of risks from lightning in order to prevent or reduce those risks.

Emergency Services:	Responder training, warning systems, emergency response services, planning, acquisition and use of equipment, and technological improvements will provide emergency services to prevent or reduce risks to lives and property from lightning.
Structural Improvements:	The construction of safe rooms, shelters, and underground utility lines as well as maintenance of structural projects will be used to prevent or reduce risks from lightning.
Tornado Goal: Reduce deaths, injuries, property loss, and economic disruption due to tornadoes.	
Mitigation Strategy	Objectives
Prevention:	Adoption of ordinances and legislation, acquisition and use of equipment, planning, conducting technical training, studies, and retrofit or construction of safe rooms will be used to prevent or reduce risks to lives, property, and economic activity from tornadoes.
Property Protection:	Constructing safe rooms and storm shelters, and retrofits will be used to prevent or reduce risks to property from tornadoes.
Public Education and Awareness:	Warning systems, IPAWS, public education, and access to information will be used to raise public awareness of risks from tornadoes in order to prevent or reduce those risks.
Emergency Services:	Warning systems, technological improvements, responder training, planning, emergency response services, and acquisition and use of equipment will provide emergency services to prevent or reduce risks from tornadoes.
Structural Improvements:	Construction of storm shelter and safe rooms and maintenance of other structural projects will be used to prevent or reduce risks from tornadoes.
Drought Goal: Reduce economic loss and environmental impacts due to drought	
Mitigation Strategy	Objectives
Prevention:	Planning, acquisition and use of equipment, and technical studies will be used to prevent or reduce risks from drought.
Property Protection:	Water treatment measures will be used to prevent or reduce risks to property from drought.
Public Education and Awareness:	Public education and access to information will be used to raise public awareness of risks from drought in order to prevent or reduce those risks.
Natural Resource Protection:	Planning and implementing watershed plans will be used to prevent or reduce risks from drought.
Structural Improvements:	Technological improvements and acquisition of equipment for structural projects will be used to prevent or reduce risks from drought.
Extreme Heat Goal: Reduce deaths, injuries, and economic disruption due to extreme heat.	
Mitigation Strategy	Objectives
Prevention:	Planning and the acquisition and use of equipment will be used to prevent or reduce risks from extreme heat.
Property Protection:	Acquisition and use of equipment will be used to prevent or reduce risks to property and economic disruption from extreme heat.
Public Education and Awareness:	Public education and access to information will be used to raise public awareness of the risks from extreme heat in order to prevent or reduce those risks.

Structural Improvements:	Planning, responder training, warning systems, establishing shelters, and technological improvements will provide emergency services to prevent or reduce risks from extreme heat.
Extreme Cold Goal: Reduce deaths, injuries, property loss, and economic disruption due to extreme cold.	
Mitigation Strategy	Objectives
Prevention:	Planning and the acquisition and use of equipment will be used to prevent or reduce risks from extreme cold.
Property Protection:	Acquisition and use of equipment will be used to prevent or reduce risks to property and economic disruption from extreme cold.
Public Education and Awareness:	Public education and access to information will be used to raise public awareness of the risks from extreme cold in order to prevent or reduce those risks.
Structural Improvements:	Planning, responder training, warning systems, establishing shelters, and technological improvements will provide emergency services to prevent or reduce risks from extreme cold.

5.3 Mitigation Actions and Projects

Upon completion of the risk assessment and development of the goals and objectives, the planning committee was provided a list of the six mitigation measure categories from the *FEMA State and Local Mitigation Planning How to Guides*. The list of Mitigation Actions by Strategy provided by HSEM was used to assist in identifying mitigation action strategies. The measures are listed as follows:

- **Prevention:** Government, administrative, or regulatory actions or processes that influence the way land and buildings are developed and built. These actions also include public activities to reduce hazard losses. Examples include planning and zoning, building codes, capital improvement programs, open space preservation, and stormwater management regulations.
- **Property Protection:** Actions that involve the modification of existing buildings or structures to protect them from a hazard or removal from the hazard area. Examples include acquisition, elevation, structural retrofits, storm shutters, and shatter-resistant glass.
- **Public Education and Awareness:** Actions to inform and educate citizens, elected officials, and property owners about the hazards and potential ways to mitigate them. Such actions include outreach projects, real estate disclosure, hazard information centers, and school-age and adult education programs.
- **Natural Resource Protection:** Actions that, in addition to minimizing hazard losses, preserve or restore the functions of natural systems. These actions include sediment and erosion control, stream corridor restoration, watershed management, forest and vegetation management, and wetland restoration and preservation.
- **Emergency Services:** Actions that protect people and property during and immediately after a disaster or hazard event. Services include warning systems, emergency response services, and protection of critical facilities.
- **Structural Projects:** Actions that involve the construction of structures to reduce the impact of a hazard. Such structures include dams, levees, floodwalls, seawalls, retaining walls, and safe rooms.

During the steering committee meetings and public meetings participants were presented with the task of individually listing potential mitigation activities using the FEMA evaluation criteria. The evaluation criteria (STAPLE+E) involved the following categories and questions.

Social:

- ☐ Will the proposed action adversely affect one segment of the population?
- ☐ Will the action disrupt established neighborhoods, break up voting districts, or cause the relocation of lower income people?

Technical:

- ☐ How effective is the action in avoiding or reducing future losses?
- ☐ Will it create more problems than it solves?
- ☐ Does it solve the problem or only a symptom?
- ☐ Does the mitigation strategy address continued compliance with the NFIP?

Administrative:

- ☐ Does the jurisdiction have the capability (staff, technical experts, and/or funding) to implement the action, or can it be readily obtained?
- ☐ Can the community provide the necessary maintenance?
- ☐ Can it be accomplished in a timely manner?

Political:

- ☐ Is there political support to implement and maintain this action?
- ☐ Is there a local champion willing to help see the action to completion?
- ☐ Is there enough public support to ensure the success of the action?
- ☐ How can the mitigation objectives be accomplished at the lowest cost to the public?

Legal:

- ☐ Does the community have the authority to implement the proposed action?
- ☐ Are the proper laws, ordinances, and resolution in place to implement the action?
- ☐ Are there any potential legal consequences?
- ☐ Is there any potential community liability?
- ☐ Is the action likely to be challenged by those who may be negatively affected?
- ☐ Does the mitigation strategy address continued compliance with the NFIP?

Economic:

- ☐ Are there currently sources of funds that can be used to implement the action?
- ☐ What benefits will the action provide?
- ☐ Does the cost seem reasonable for the size of the problem and likely benefits?
- ☐ What burden will be placed on the tax base or local economy to implement this action?
- ☐ Does the action contribute to other community economic goals such as capital improvements or economic development?
- ☐ What proposed actions should be considered but be "tabled" for implementation until outside sources of funding are available?

Environmental:

- ☐ How will this action affect the environment (land, water, endangered species)?
- ☐ Will this action comply with local, state, and federal environmental laws and regulations?
- ☐ Is the action consistent with community environmental goals?

Implementation of the mitigation plan is critical to the overall success of the mitigation planning process. The first step is to decide, based upon many factors, which action will be undertaken first. In order to pursue the top priority first, an analysis and prioritization of the actions is important.

Table 30 lists the factors to consider in the analysis and prioritization of actions. Some actions may occur before the top priority due to financial, engineering, environmental, permitting, and site control issues. Public awareness and input of these mitigation actions can increase knowledge to capitalize on funding opportunities and monitoring the progress of an action.

Table 30. STAPLE+E Planning Factors

S – Social	Mitigation actions are acceptable to the community if they do not adversely affect a particular segment of the population, do not cause relocation of lower income people, and if they are compatible with the community's social and cultural values.
T – Technical	Mitigation actions are technically most effective if they provide a long-term reduction of losses and have minimal secondary adverse impacts.
A – Administrative	Mitigation actions are easier to implement if the jurisdiction has the necessary staffing and funding.
P – Political	Mitigation actions can truly be successful if all stakeholders have been offered an opportunity to participate in the planning process and if there is public support for the action.
L – Legal	It is critical that the jurisdiction or implementing agency have the legal authority to implement and enforce a mitigation action.
E – Economic	Budget constraints can significantly deter the implementation of mitigation actions. Hence, it is important to evaluate whether an action is cost-effective, as determined by a cost benefit review, and possible to fund.
E – Environmental	Sustainable mitigation actions that do not have an adverse effect on the environment, comply with federal, state, and local environmental regulations, and are consistent with the community's environmental goals, have mitigation benefits while being environmentally sound.

5.3.1 Hazard Mitigation Actions

Aitkin County and its included municipalities share a common Multi-Hazard Mitigation plan and worked closely to develop it. These people work together with their city councils and the Aitkin County Sheriff to assure that the hazards and mitigation actions included in this plan are accurate and addressed in their jurisdictions. The jurisdictions responsible for each action are:

- ☐ Aitkin County
- ☐ Aitkin
- ☐ McGrath
- ☐ Hill City

- ☐ Palisade
- ☐ Tamarack
- ☐ McGregor

Table 31 lists all mitigation actions for Aitkin County and its jurisdictions. Appendix H contains separate mitigation action tables for each jurisdiction. Each of these mitigation action charts detail the hazard, the mitigation action to address it, the priority ranking for implementation (1=High Priority; 2= Moderate Priority; 3= Low Priority), its current stage of implementation, the timeframe for implementation going forward, the jurisdictions who have identified they will work to implement the action, the responsible parties to carry through with implementation, and comments on how the plan will be implemented through existing planning mechanisms and funding to make implementation happen.

In addition to ranking the hazard mitigation actions using STAPLE+E, the Steering Committee also reports on the status of the mitigation action. Completed and deleted mitigation actions are denoted in Appendix G. Ongoing mitigation actions from the initial review were incorporated into annual reviews by the mitigation team. The status designations are:

- ☐ New – actions have not yet started
- ☐ Ongoing – actions require continuing application
- ☐ In Progress – actions are currently being acted upon
- ☐ Complete – the action is complete
- ☐ Deferred – no progress has been made
- ☐ Deleted – the action is no longer relevant

The mitigation types are defined as follows:

- ☐ P = Prevention
- ☐ PP = Property Protection
- ☐ PE = Public Education
- ☐ NRP = Natural Resource Protection
- ☐ ES = Emergency Services
- ☐ SI = Structural Improvement

Table 31. All Mitigation Actions for Aitkin County

[illegible]

5.3.2 Mitigation Actions by Community

This plan is a multi-jurisdictional plan that covers Aitkin County and the 6 cities of Aitkin, McGrath, Hill City, Palisade, Tamarack, and McGregor. The Aitkin County risks and mitigation activities identified in this plan also incorporate the concerns and needs of townships, school districts, and other entities participating in this plan.

- ☐ Aitkin
- ☐ McGrath
- ☐ Hill City
- ☐ Palisade
- ☐ Tamarack
- ☐ McGregor

Mitigation actions by jurisdiction for the above cities are separated out in Tables H – 1 through H – 6 in Appendix H.

SECTION 6 – PLAN MAINTENANCE

6.1 Monitoring, Evaluation, and Updating the Plan

The Aitkin County Multi-Hazard Mitigation Plan (MHMP) should be considered a living document. The plan should be reviewed at a minimum of every five years. The guidance in this section will function as the primary tool when reviewing progress on the implementation of the Aitkin County MHMP.

Throughout the five-year planning cycle, the Aitkin County Sheriff will reconvene the MHMP steering committee to monitor, evaluate, and update the Multi-Hazard Mitigation Plan as part of its annual Emergency Management Review. Additional stakeholders will be added based on need. If needed, the Aitkin County Sheriff will convene the group to meet on a more regular basis to monitor plan implementation progress and reassess needs and opportunities. This could be done annually, or in response to funding cycles of programs that provide resources for hazard mitigation activities. If there is a need for a special meeting due to new developments or a declared disaster occurring in the county, the team will meet to update pertinent mitigation strategies. Depending on grant opportunities and fiscal resources, mitigation projects may be implemented independently by individual communities or through local partnerships.

The committee will review the MHMP goals and objectives to determine their relevance to changing situations in Aitkin County. In addition, state and federal policies will be reviewed to ensure they are addressing current and expected conditions. The committee will also review the risk assessment portion of the plan to determine if this information should be updated or modified. The parties responsible for the various implementation actions will report on the status of their projects, and will include which implementation processes worked well, any difficulties encountered, how coordination efforts are proceeding, and which strategies should be revised.

Updates or modifications to the MHMP during the five-year planning process will require a public notice and a meeting prior to submitting revisions to the individual jurisdictions for approval. The plan will be updated via written changes, submissions as the committee deems appropriate and necessary, and as approved by the county commissioners.

The GIS data used to prepare the plan was obtained from existing county GIS data as well as other public data sources. This updated Hazus-MH GIS data has been returned to the county for use and maintenance in the county's system. As newer data becomes available, the updated data will be used for future risk assessments and vulnerability analyses.

6.2 Implementation

Aitkin County and its jurisdictions share a common Multi-Hazard Mitigation Plan and work together closely to develop, revise, and implement it. This MHMP provides a comprehensive chart of mitigation actions for Aitkin County and its jurisdictions (see Section 5.3.1, *Hazard Mitigation Actions*). Jurisdictions

participated in the MHMP planning process and identified the specific mitigation strategies that they would seek to implement in their communities during the 5-year planning cycle. These mitigation actions are provided in Appendix H: *Mitigation Actions by Jurisdiction*.

A number of implementation tools are available to address hazards. Many of these tools are below, however, in some cases additional discussion is needed in order to identify what strategies are most appropriate to use. This will be part of an ongoing discussion as Aitkin County looks for opportunities for plan implementation. The following tools should be considered:

Education: In many cases education of residents has been identified as one of the most effective mitigation strategies. [Need more info here](#)

Capital Investments: Capital investments such as fire and ambulance equipment, sprinkler systems and dry hydrants are tools that can limit risks and impacts of natural and man-made hazards.

Data Collection and Needs Assessments: Data collection and needs assessments can aid in gaining a better understanding of threats and allow planning for mitigation strategies accordingly. As resources are limited for this part of the planning process, additional data collection is likely to be an ongoing activity as resources become available.

Coordination: Responsibilities for mitigation strategies run across various county departments, local fire and ambulance departments, city and township governments, and a host of state and federal agencies. Ongoing coordination is an important tool to ensure resources are used efficiently. Coordination can also avoid duplication of efforts or prevent gaps that are created because of unclear roles and responsibilities. The mitigation plan review process can function as a tool to have an ongoing discussion of roles, responsibilities, and opportunities for coordination.

Regional Cooperation: Counties and public safety services providers throughout the North-Central Region of Minnesota often share similar challenges and concerns. In some cases a regional approach may be warranted as a mitigation strategy in order to save resources. Mutual aid agreements are a tool already in use for a number of services. Needs assessments for fire and ambulance services and development of assistance for volunteer recruiting, training, and retention could benefit from a regional approach. Cooperation among counties could also help in lobbying for certain funding priorities that address concerns relating to challenges in service delivery in rural areas. Organizations such as Region V Emergency Management, and the MN Department of HSEM through the Regional Program Coordinator can offer tools and resources to assist in these cooperative efforts.

Regulation: Regulation is an important mitigation tool for Aitkin County. [Need more info here](#)

6.3 Continued Public Involvement

Continued public involvement is critical to the successful implementation of the Aitkin County Multi-Hazard Mitigation Plan. The County and its participating jurisdictions should continue to engage new public stakeholders in planning discussions and project implementation during the five-year cycle of this plan.

APPENDICES

AITKIN COUNTY MULTI-HAZARD MITIGATION PLAN, 2014

Appendix A – Aitkin County Maps
Appendix B – Aitkin County Critical Facilities
Appendix C – Aitkin County Hazard Events
Appendix D – Adopting Resolutions
Appendix E – Steering Committee Meeting
Appendix F – Public Meeting Notices and Meeting Notes
Appendix G – Completed and Deleted Actions from the 2004 Plan
Appendix H – Mitigation Actions by Jurisdiction
Appendix I – Works Cited

Appendix A

Aitkin County Maps

Figure A – 1. Hydrography of Aitkin County

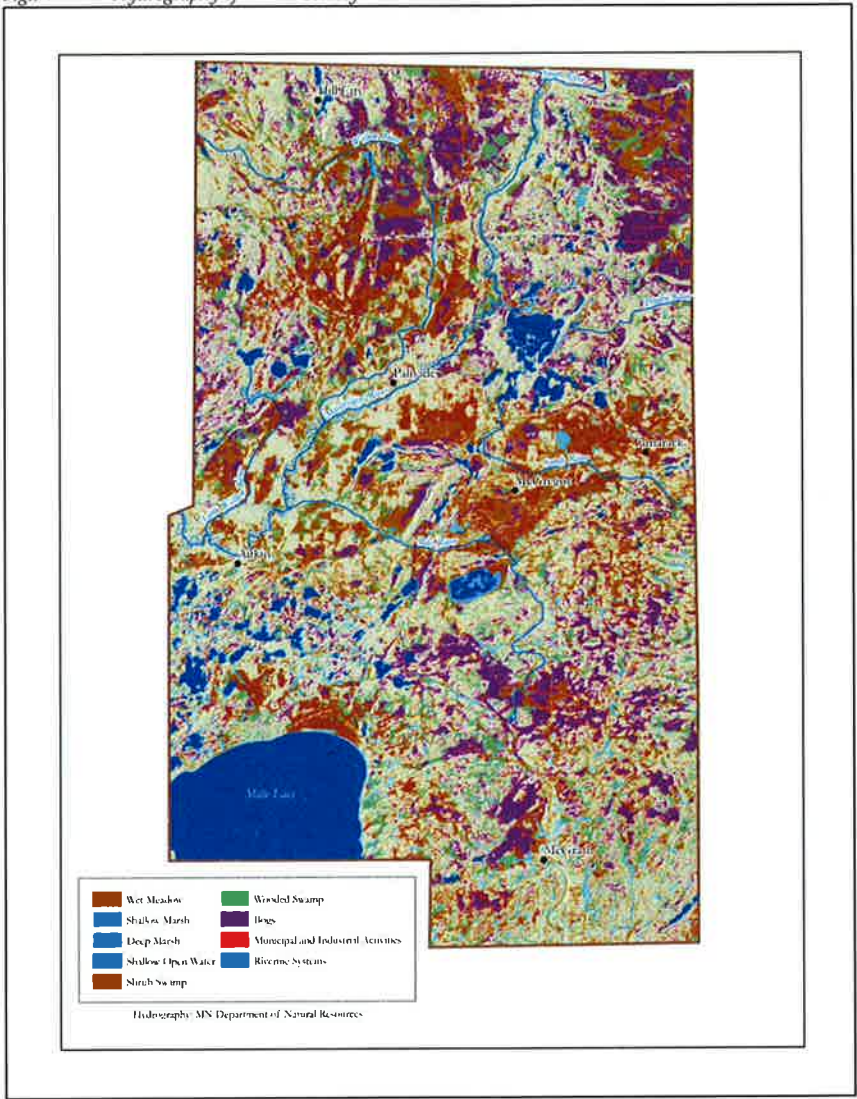


Figure A – 2. Aitkin County Population by Census Block, 2010

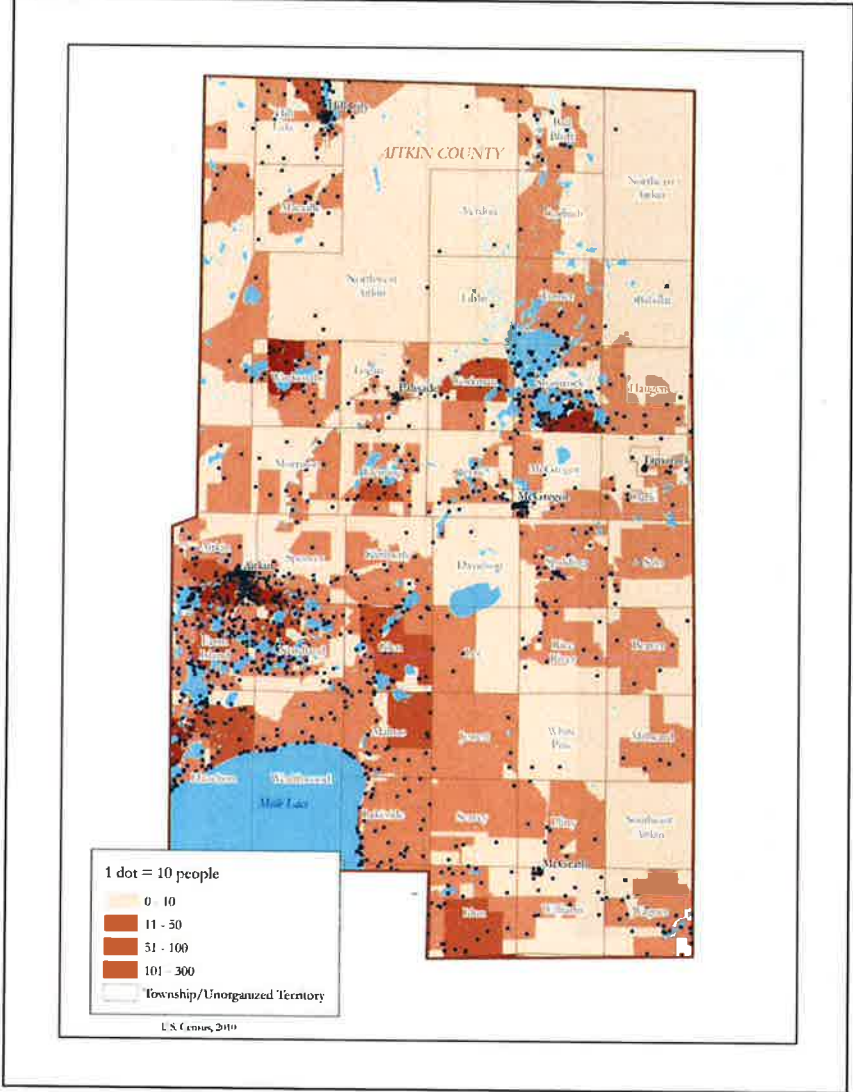


Figure A - 3. Fire Departments and Fire Response Times in Aitkin County

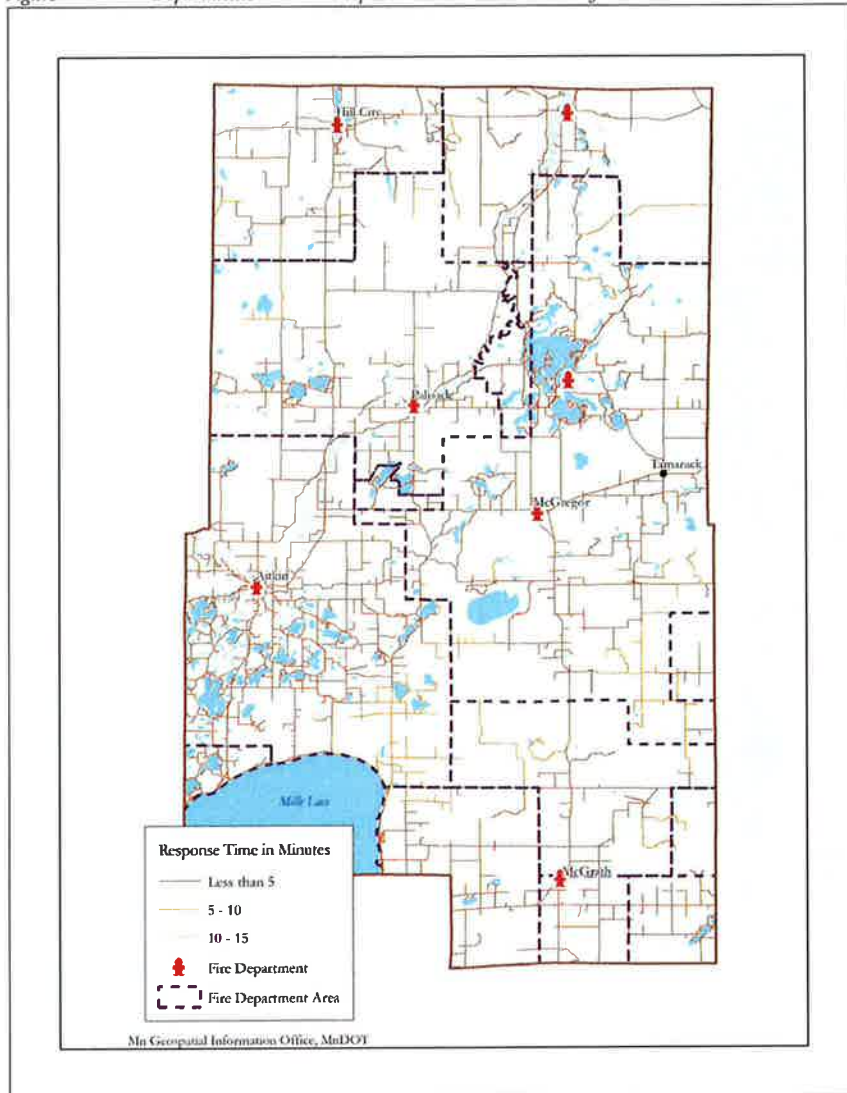


Figure A – 4. Aitkin County Public Safety and Government Services

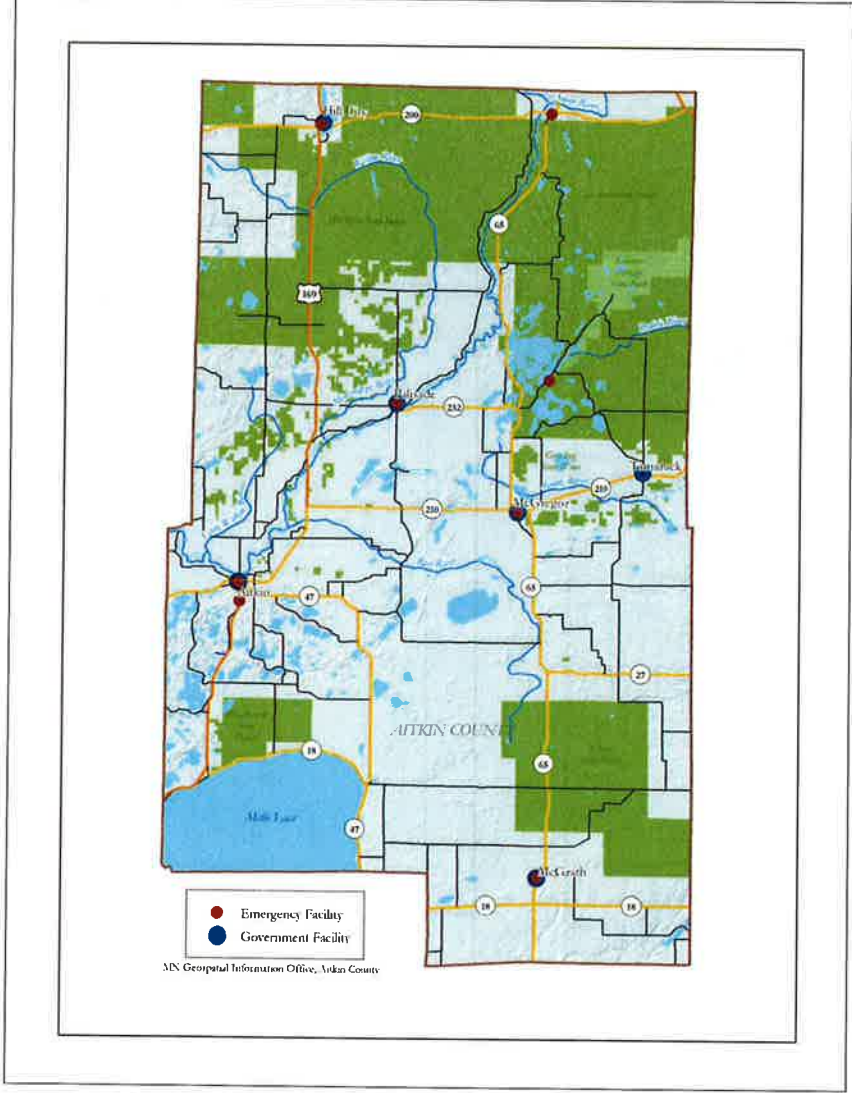


Figure A – 5. Aitkin County Utilities and Communication Infrastructure

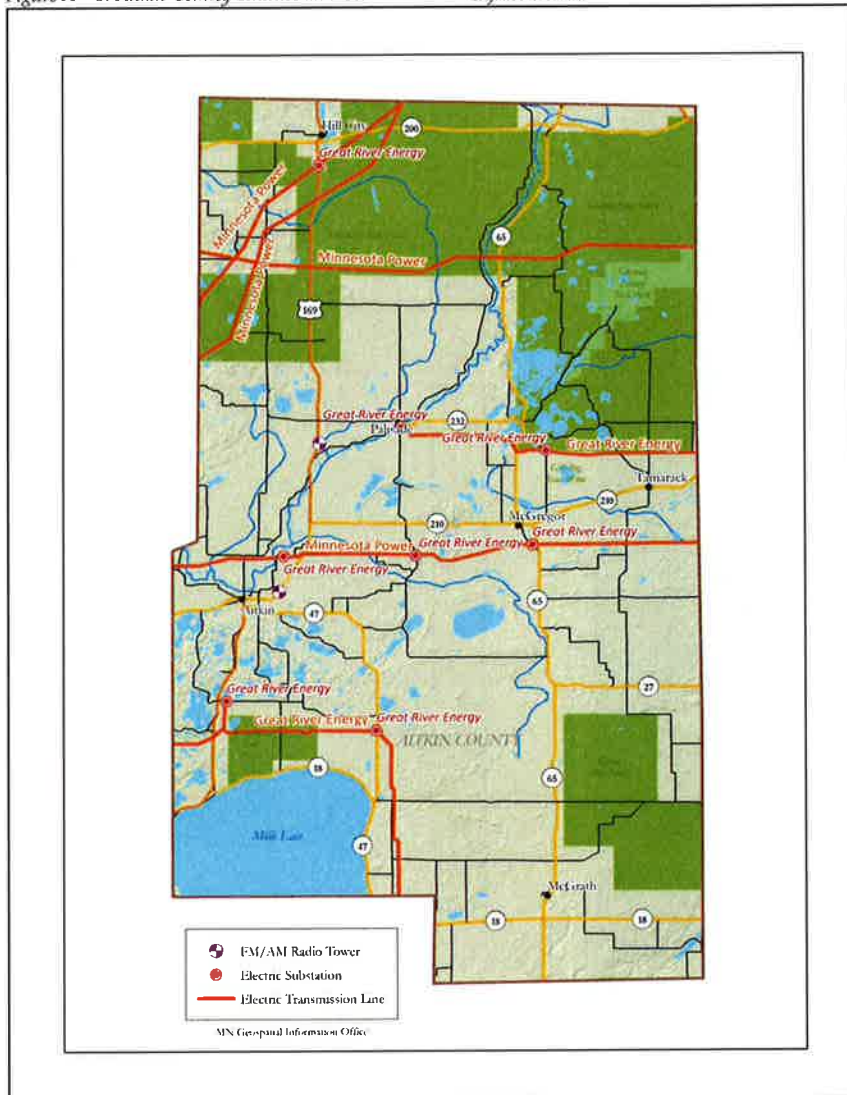


Figure A – 6. Allied Radio Matrix for Emergency Response (ARMER) Sites in Aitkin County

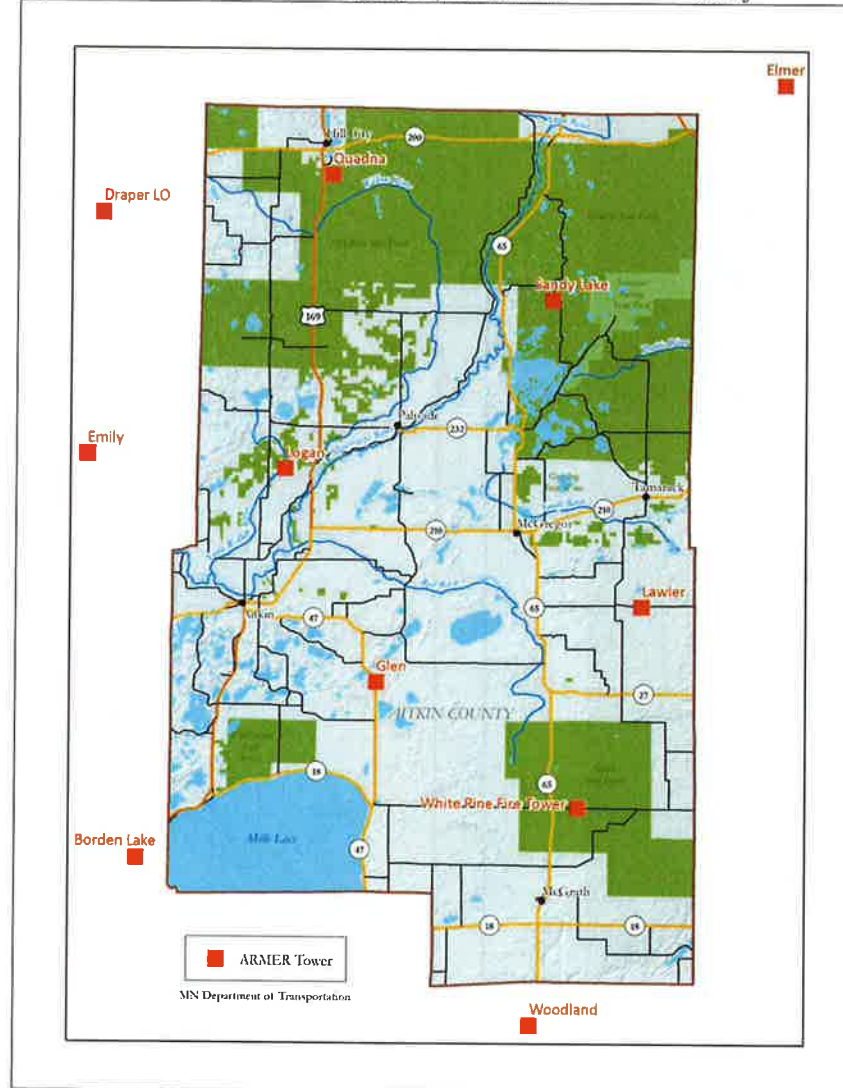


Figure A – 7. Aitkin County Transportation Infrastructure

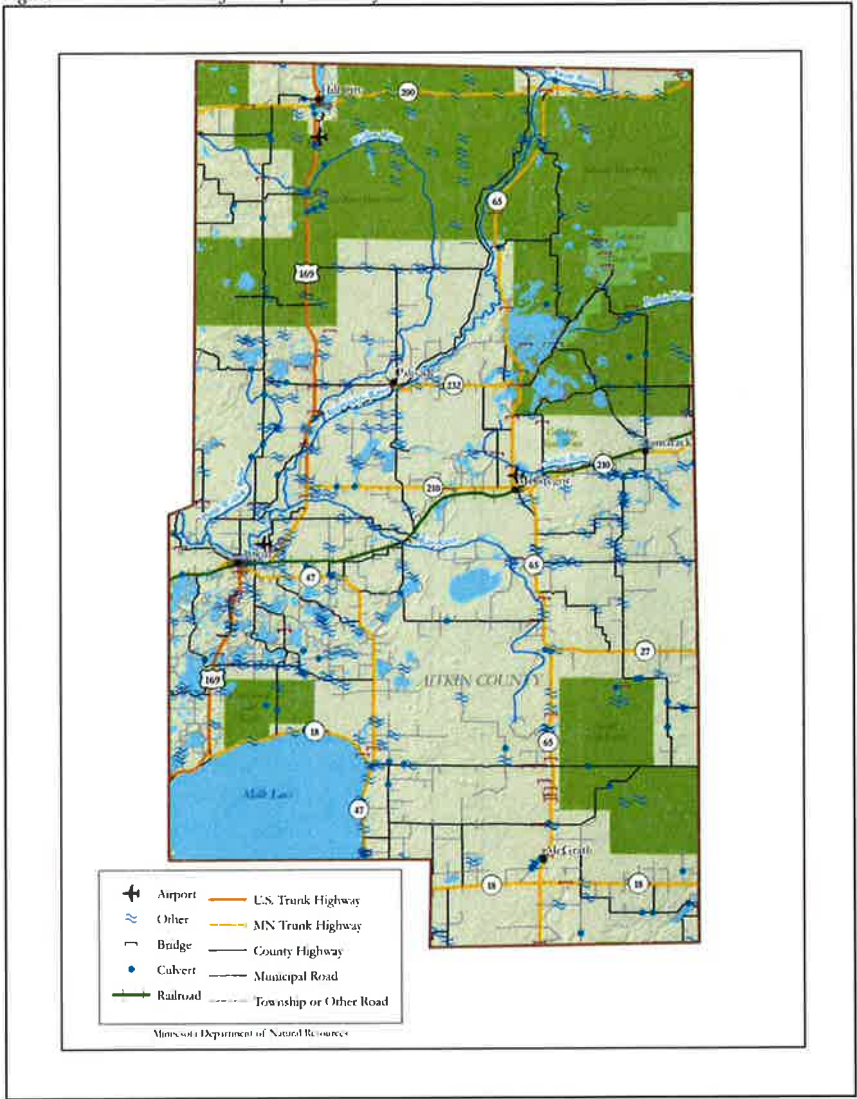


Figure A - 8. Aitkin County Land Cover, National Land Cover Database, 2006

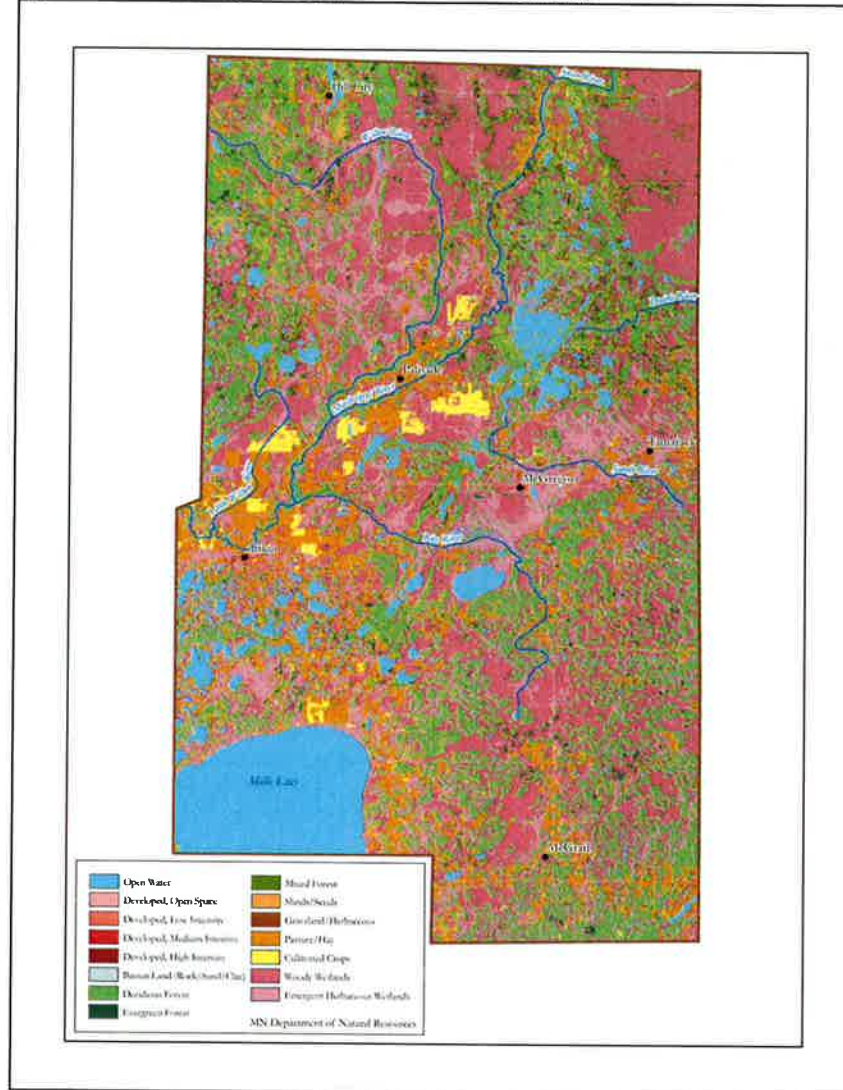


Figure A – 11. Tornado Touchdowns and Paths in Aitkin County

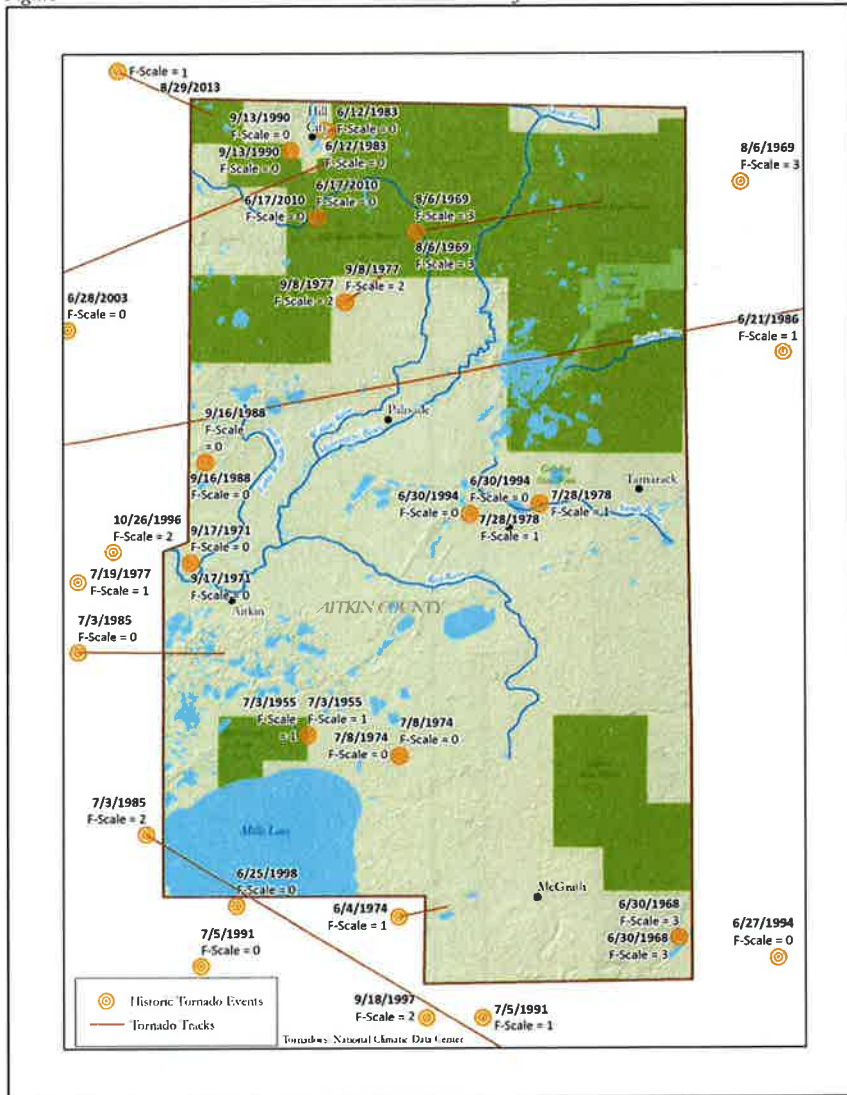


Figure A - 13. Dams with Emergency Action Plans (EAPs) in Aitkin County

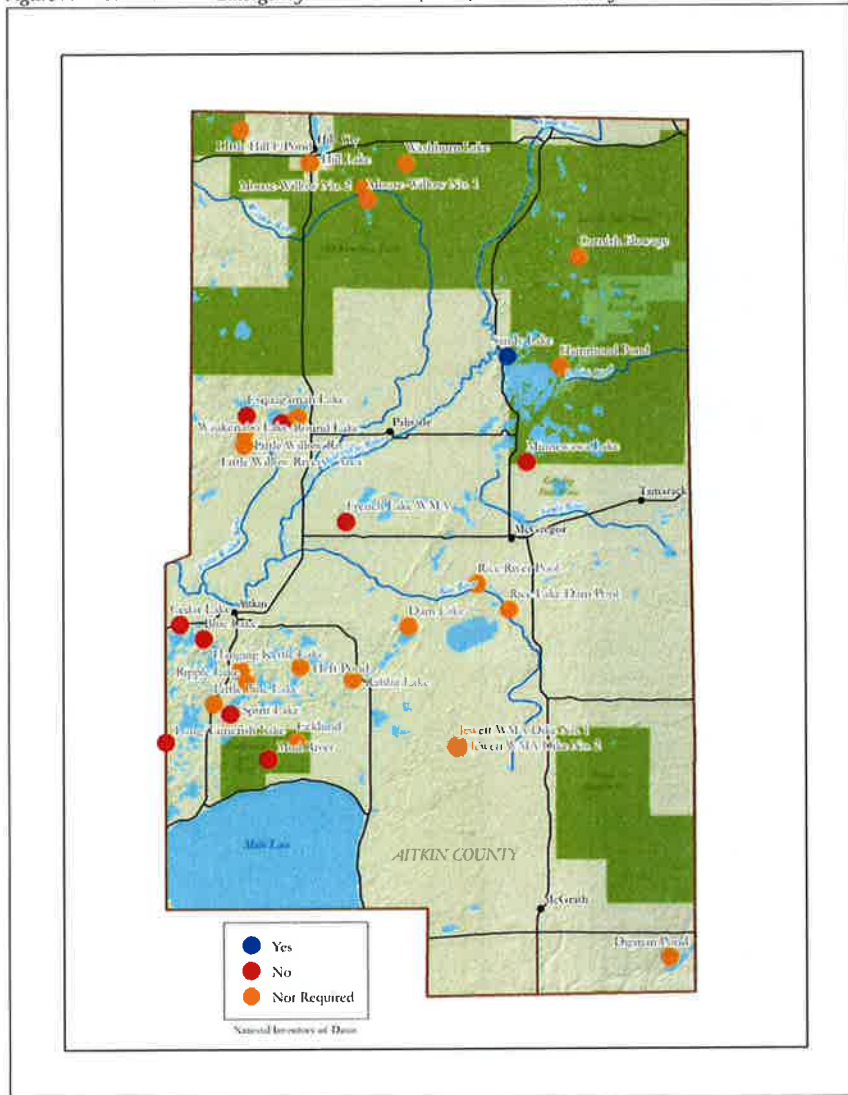


Figure A – 14. Dam Ownership Type in Aitkin County

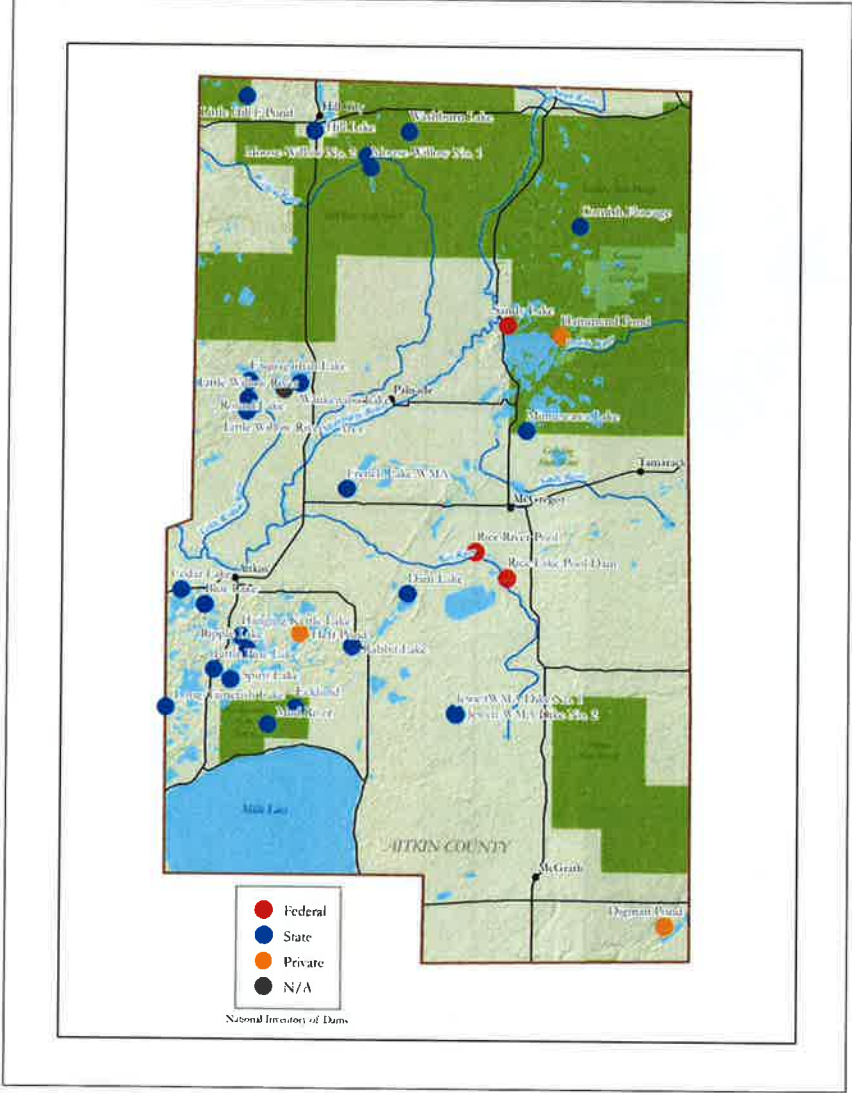


Figure A – 15. Sites with Hazardous or Chemical Waste in Aitkin County

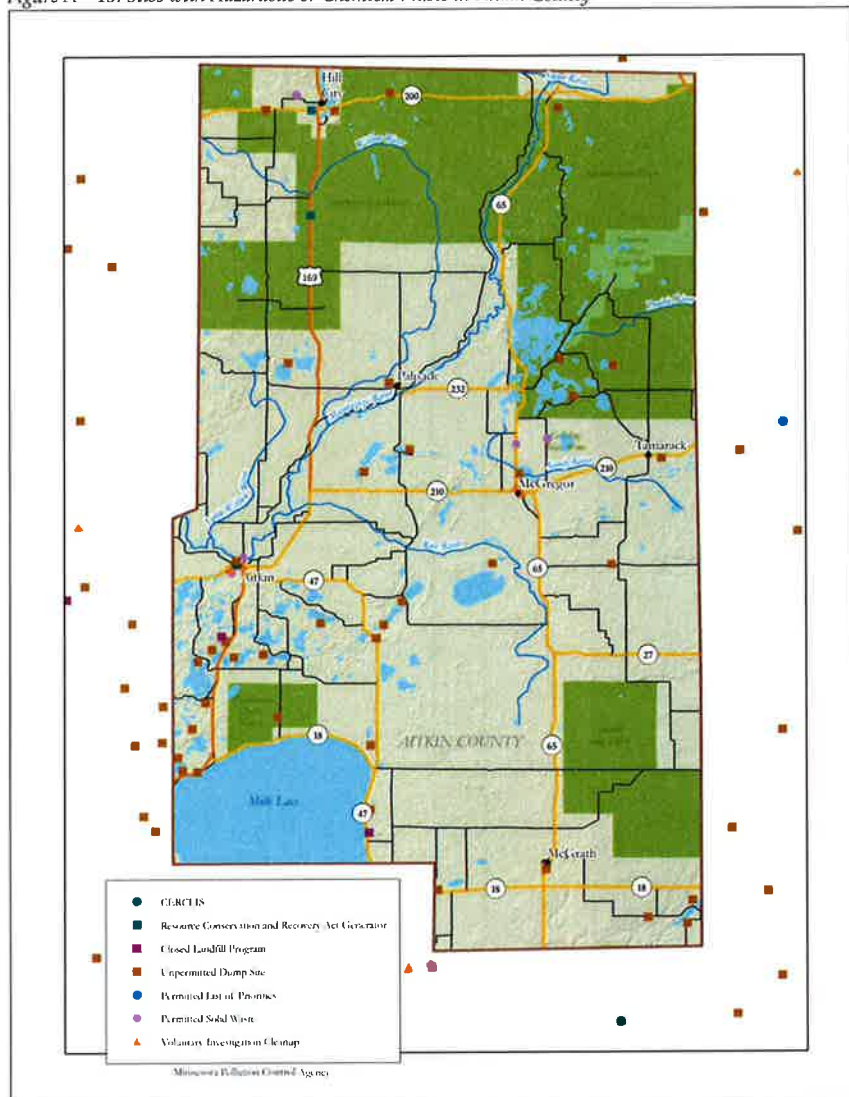


Figure A – 16. Health Care Providers in Aitkin County

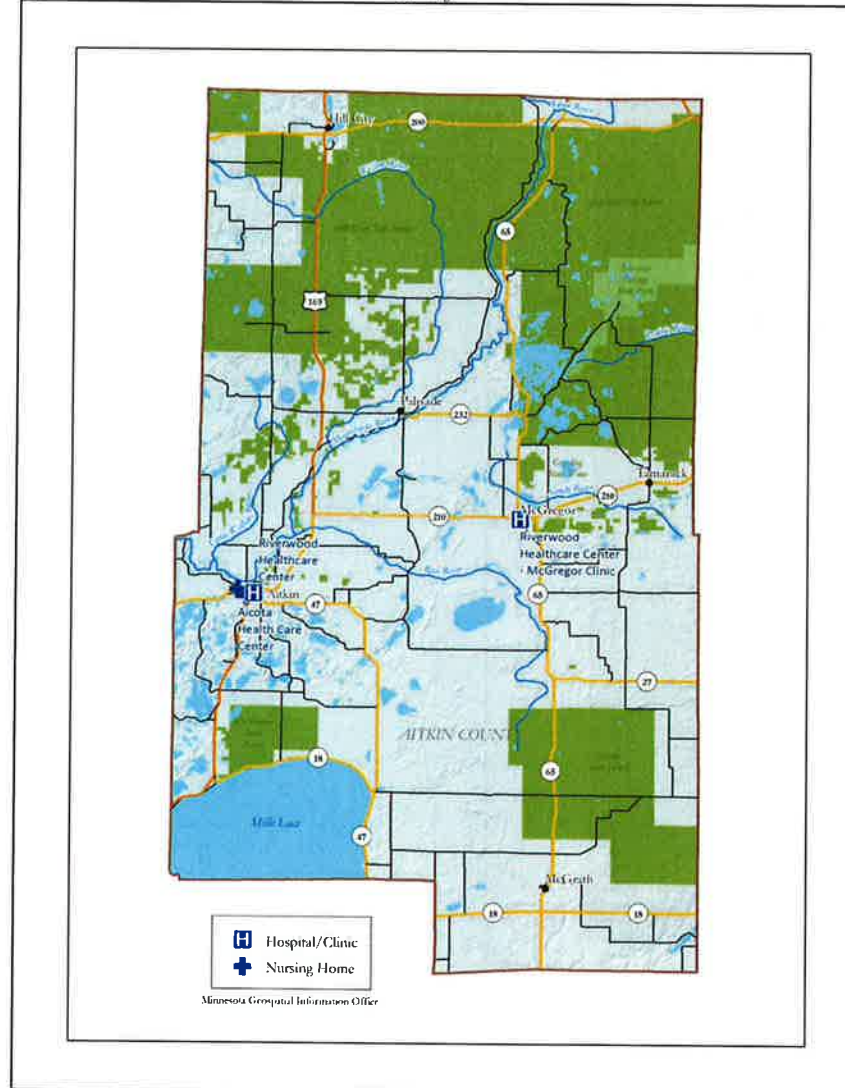


Figure A – 17. Aitkin County Groundwater Contamination Susceptibility and Wells

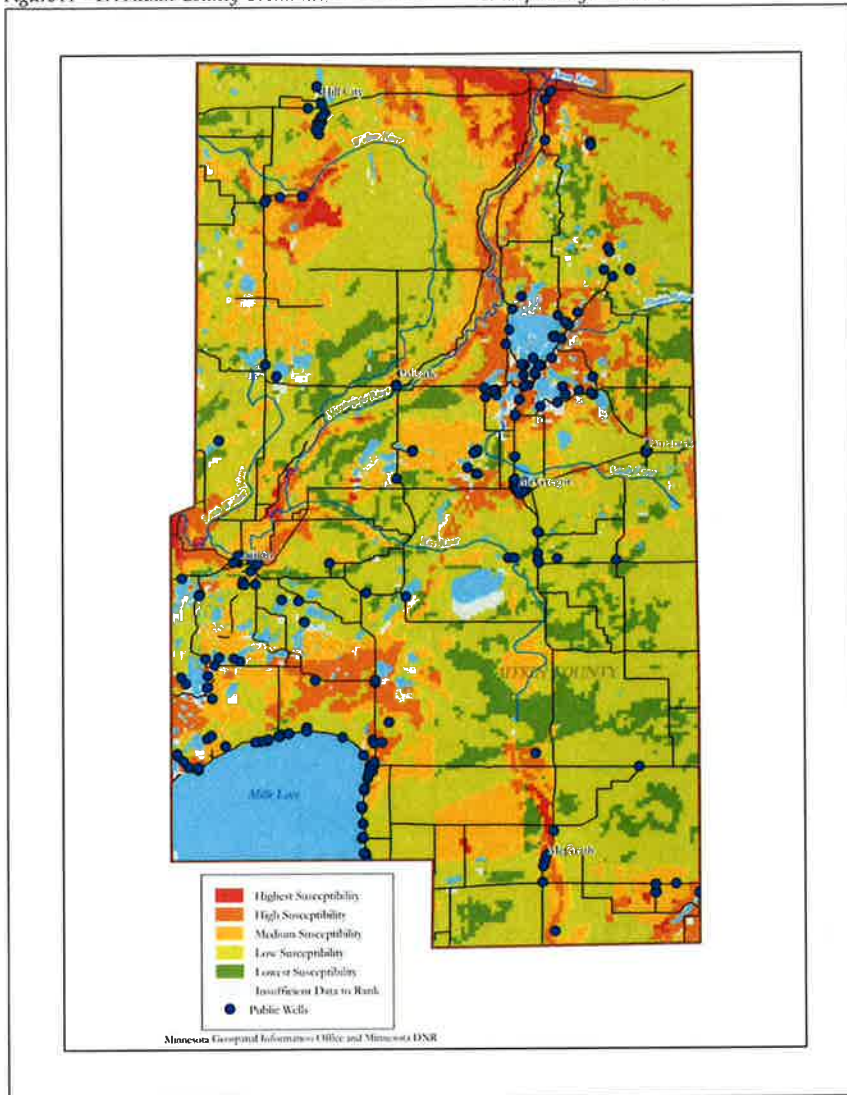


Figure A – 18. Critical Facilities in Aitkin County

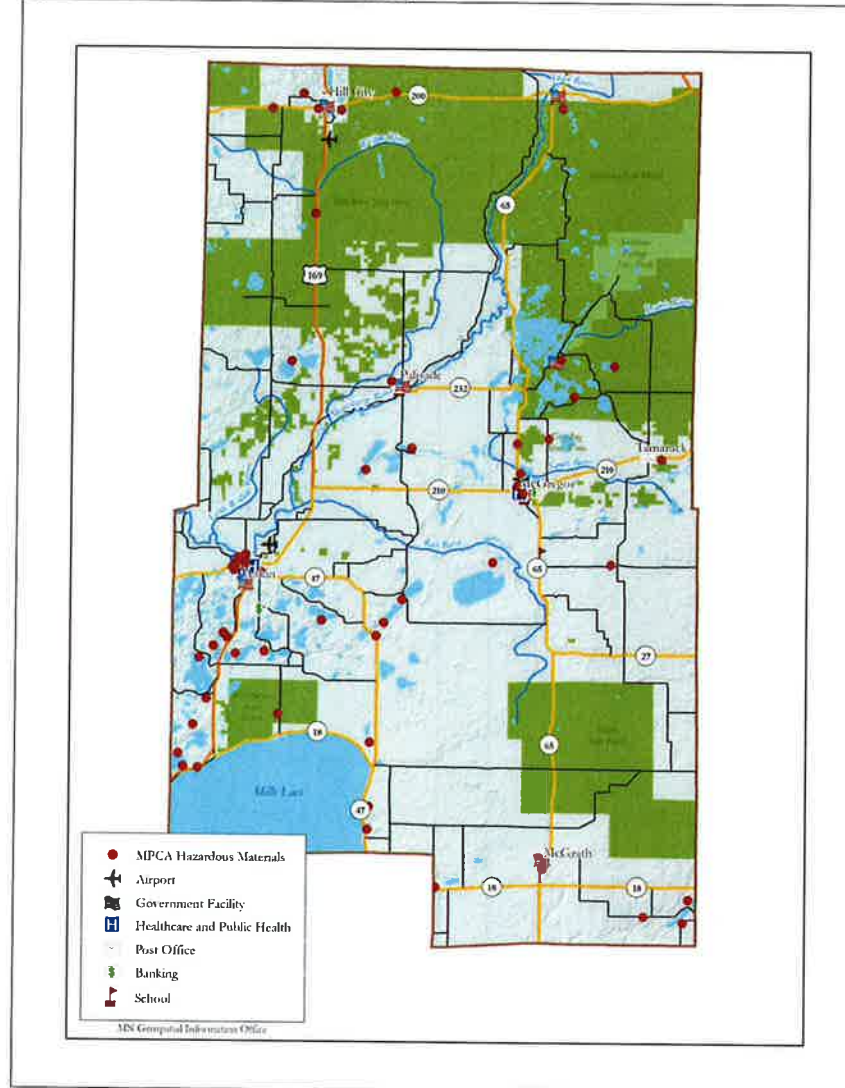


Figure A - 19. Distribution of Estimated Economic Loss by Census Block for Aitkin County in 100-Year Flood

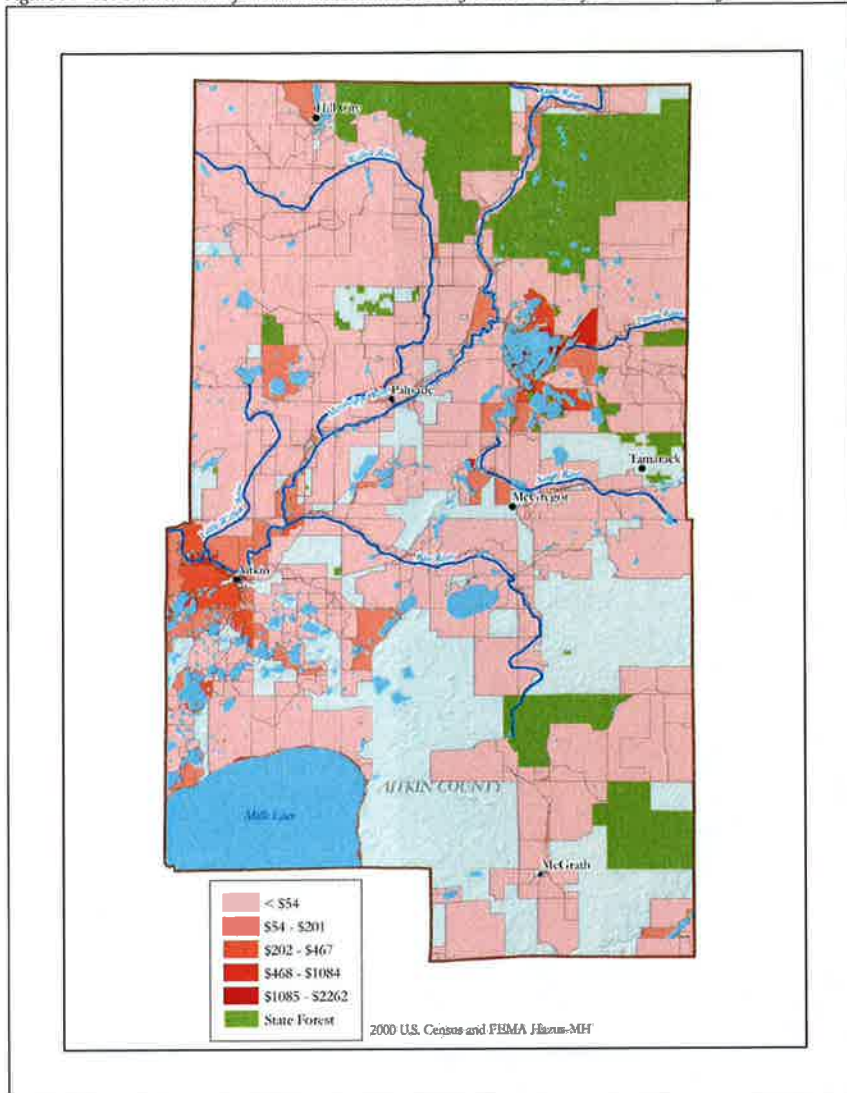


Figure A - 20. Census Block 270019901001127 and 100-Year Floodplain on Big Sandy Lake

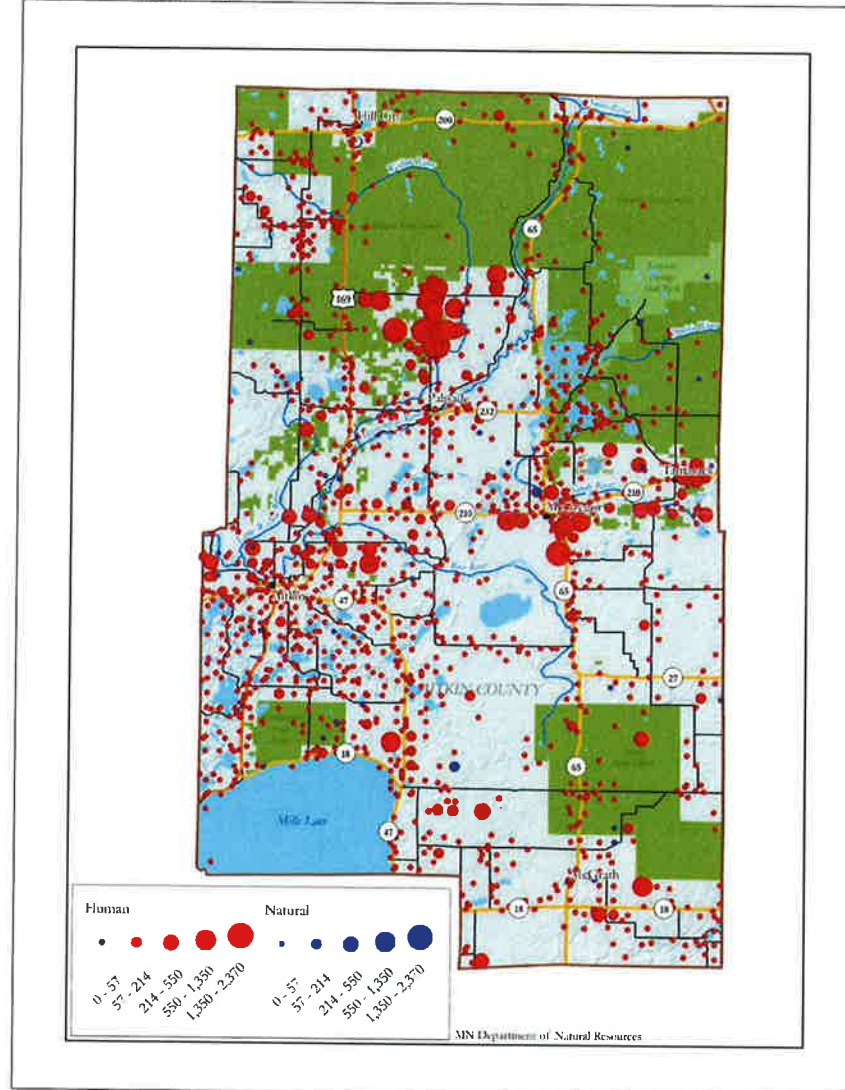


Figure A - 21. Census Block 270019901001164 and 100-Year Floodplain on Big Sandy Lake

Figure A - 22. Census Block 270019901001168 and 100-Year Floodplain on Big Sandy Lake

Figure A - 23. Jacobson Fire Department and 100-Year Floodplain

Figure A - 24. Wildfires by Cause and Acres Burned, 1985-2013



Appendix B

Aitkin County Critical Facilities

AGRICULTURE & FOOD				

BANKING & FINANCE				
Security State Bank of Aitkin	402 Minnesota Ave. N	Aitkin	MN	56431
Bremer Bank	101 Minnesota Ave. N.	Aitkin	MN	56431
Members Co-Operative Credit Union	181st Street NE	Aitkin	MN	56431
People National Bank of Mora	15 Minnesota Ave. S.	Aitkin	MN	56431
Security State Bank	171 Red Oak Drive #500	Aitkin	MN	56431
Grand Timber Bank	204 N. Maddy Street	McGregor	MN	55760
Members Co-Op Credit Union	State Highway 65	McGregor	MN	55760
Woodland Bank	675 U.S. Highway 169	Hill City	MN	55748

[illegible]

DAMS	
Blue Lake	MN
Cedar Lake	MN
Cornish Flowage	MN
Cornish Township	MN
Dam Lake	MN
Digman Pond	MN
Digman Pond	MN
Ecklund	MN
Esquagamah Lake	MN
French Lake WMA	MN
Hammond Pond	MN
Hanging Kettle Lake	MN

DAMS		
Heft Pond		MN
Hill Lake		MN
Jewett WMA Dike No. 1		MN
Jewett WMA Dike No. 2		MN
Lange Pond		MN
Little Hill F Pond		MN
Little Pine Lake		MN
Little Willow River		MN
Little Willow River F Area		MN
Long-Tamefish Lake		MN
Minnewawa Lake		MN
Moose-Willow No. 1		MN
Moose-Willow No. 2		MN
Mud River		MN
Rabbit Lake		MN
Rice Lake Pool		MN
Rice River Pool		MN
Ripple Lake		MN
Round Lake		MN
Sand Lake Dam & Lock		MN
Sandy Lake		MN
Spirit Lake		MN
Washburn Lake		MN
Waukenabo Lake		MN

ENERGY

McGrath Propane		McGrath	MN	56350
McGregor Propane	243 W. Hwy 210	McGregor	MN	55760
Mille Lacs Energy Cooperative	36559 U.S. 169	Aitkin	MN	56431

EMERGENCY SERVICES

Aitkin Police Department	109 1 st Avenue NW	Aitkin	MN	56431
Aitkin County Sheriff's Office	217 2 nd Street NW	Aitkin	MN	56431
Hill City Police Department	125 Lake Avenue East	Hill City	MN	55748
Jacobson Fire Department	68368 198 th Avenue	Jacobson	MN	55752
McGrath Fire Department	303 Main Street	McGrath	MN	56350
McGregor Police Department	101 East Center Ave	McGregor	MN	55760
Palisade Volunteer Fire Department	48052 Nature Avenue	Palisade	MN	56469

INFORMATION TECHNOLOGY

COMMUNICATIONS

POSTAL AND SHIPPING

U.S. Post Office	15 Minnesota Ave N.	Aitkin	MN	56431
U.S. Post Office	133 Lake Avenue	Hill City	MN	55748
U.S. Post Office	300 Main Street W.	McGrath	MN	56350
U.S. Post Office	26 N. Maddy Street	McGregor	MN	55760
U.S. Post Office	301 Main Street	Palisade	MN	56469
U.S. Post Office	275 Main Street N.	Tamarack	MN	55787

GOVERNMENT FACILITIES

Aitkin County Courthouse	209 2 nd Street NW	Aitkin	MN	56431

HEALTHCARE AND PUBLIC HEALTH

Aicota Health Care Center	850 2 nd Street NW	Aitkin	MN	56431
Aitkin County Health & Human Services	204 1 st Street NW	Aitkin	MN	56431
Riverwood Healthcare Center Hospital & Clinic	200 Bunker Hill Drive	Aitkin	MN	56431
Riverwood Healthcare Center – McGregor Clinic	2 East Center Avenue	McGregor	MN	55760

TRANSPORTATION

Aitkin Municipal Airport	1190 Air Park Drive	Aitkin	MN	56431

WATER

NATIONAL MONUMENTS & ICONS

COMMERCIAL FACILITIES

MANUFACTURING				
Aitkin Iron Works	301 Bunker Hill Drive	Aitkin	MN	56431
FLOE International	48473 Minnesota 65	McGregor	MN	55760

Appendix C

Aitkin County Hazard Events

The National Climatic Data Center Database was queried for all notable events on record, through 2013. However, some categories of events do not have records prior to 2002.

Table C - 1. All severe tornado events recorded by NCDC, 1952-2013

Location or County	Date	Magnitude	Deaths	Injuries	Property Damage	Length in miles	Width in yards
1. Shovel Lake	8/29/2013	EF1	0	0	0	NA	NA
2. Haypoint	6/17/2010	F0	0	0	0	1	25
3. McGregor	6/30/1994	F0	0	0	0	0.1	10
4. Aitkin County	9/13/1990	F0	0	0	0	0.1	10
5. Aitkin County	7/3/1985	F2	0	0	25K	2	200
6. Aitkin County	7/3/1985	F0	0	0	250K	3	100
7. Aitkin County	6/12/1983	F0	0	0	2.5K	3	400
8. Aitkin County	7/28/1978	F1	0	0	250K	18	880
9. Aitkin County	9/8/1977	F2	0	0	250K	3.6	660
10. Aitkin County	6/25/1973	F0	0	0	2.5K	0.8	100
11. Aitkin County	9/17/1971	F0	0	0	0	0.1	30
12. Aitkin County	8/6/1969	F3	1	3	250K	12.5	1500
13. Aitkin County	8/6/1969	F4	0	0	2.5M	10.1	833
14. Aitkin County	6/30/1968	F3	0	0	2.5K	0.1	10
15. Aitkin County	7/3/1955	F1	0	0	0.25K	0	33
16. Aitkin County	7/16/1952	F2	0	0	25K	9.4	333
Highest Value Property Damage:					2.5M		

Table C - 2. All severe hail storm events recorded by NCDC, 1972-2013

Location or County	Date	Magnitude	Deaths	Injuries	Property Damage
17. Hill City	8/29/2013	1.75 in.	0	0	0
18. Hill City	8/29/2013	1.75 in.	0	0	0
19. Hill City Quadna Airport	8/29/2013	1.00 in.	0	0	0
20. Cutler	08/04/2012	1.00 in.	0	0	0
21. Wealthwood	08/04/2012	1.50 in.	0	0	0
22. Kimberly	08/04/2012	1.00 in.	0	0	0
23. Cutler	07/04/2012	1.00 in.	0	0	0
24. Wealthwood	07/04/2012	1.50 in.	0	0	0
25. Kimberly	07/04/2012	1.00 in.	0	0	0
26. Bennettsville	05/28/2012	1.75 in.	0	0	0
27. Aitkin	05/28/2012	1.00 in.	0	0	0
28. Jacobson	8/8/2011	1.00 in.	0	0	0
29. McGregor	9/2/2010	1.00 in.	0	0	0
30. Swatara	6/17/2010	2.00 in.	0	0	0

Location or County	Date	Magnitude	Deaths	Injuries	Property Damage
31. Jacobson	6/17/2010	2.00 in.	0	0	0
32. Jacobson	6/17/2010	1.00 in.	0	0	0
33. Hill City	6/17/2010	1.00 in.	0	0	0
34. Aitkin	4/22/2009	1.00 in.	0	0	0
35. Hill City	8/28/2008	0.88 in.	0	0	0
36. Glory	6/27/2008	0.88 in.	0	0	0
37. Hassman	6/27/2008	0.75 in.	0	0	0
38. Hill City	8/27/2007	0.88 in.	0	0	0
39. McGregor	8/27/2007	2.75 in.	0	0	0
40. McGregor	8/27/2007	1.75 in.	0	0	0
41. Hill City	8/27/2007	1.75 in.	0	0	0
42. Hill City	8/27/2007	0.75 in.	0	0	0
43. McGregor	6/7/2007	0.88 in.	0	0	0
44. Aitkin	5/18/2007	0.75 in.	0	0	0
45. Aitkin	4/22/2007	0.75 in.	0	0	0
46. Swatara	7/30/2006	1.00 in.	0	0	0
47. Aitkin	5/29/2006	1.00 in.	0	0	0
48. Aitkin	5/29/2006	1.00 in.	0	0	0
49. McGregor	8/9/2005	1.00 in.	0	0	0
50. Hill City	6/27/2005	0.75 in.	0	0	0
51. Hassman	6/28/2003	0.75 in.	0	0	0
52. Lawler	6/13/2001	0.75 in.	0	0	0
53. Sheshebee	6/13/2001	1.75 in.	0	0	0
54. Tamarack	8/14/2000	2.00 in.	0	0	0
55. Palisade	8/14/2000	0.75 in.	0	0	0
56. Kimberly	7/8/2000	1.75 in.	0	0	0
57. McGregor	6/6/1999	0.75 in.	0	0	0
58. Aitkin	6/6/1999	1.00 in.	0	0	0
59. Hill City	6/16/1998	0.75 in.	0	0	0
60. McGregor	6/1/1998	1.75 in.	0	0	0
61. Aitkin County	6/9/1991	0.75 in.	0	0	0
62. Aitkin County	9/13/1990	2.00 in.	0	0	0
63. Aitkin County	9/5/1990	2.75 in.	0	0	0
64. Aitkin County	7/17/1990	0.75 in.	0	0	0
65. Aitkin County	6/1/1987	1.00 in.	0	0	0
66. Aitkin County	5/10/1987	0.75 in.	0	0	0
67. Aitkin County	8/4/1986	1.75 in.	0	0	0
68. Aitkin County	6/25/1985	0.87 in.	0	0	0
69. Aitkin County	6/5/1980	2.75 in.	0	0	0

Location or County	Date	Magnitude	Deaths	Injuries	Property Damage
70. Aitkin County	7/22/1976	0.75 in.	0	0	0
71. Aitkin County	7/6/1976	1.00 in.	0	0	0
72. Aitkin County	8/5/1972	2.00 in.	0	0	0
73. Aitkin County	8/5/1972	1.00 in.	0	0	0
Highest Value Property Damage:					OK

Table C- 3. All severe thunderstorm wind events recorded by NCDC, 1972-2013

Location or County	Date	Magnitude (knots)	Deaths	Injuries	Property Damage
74. Hill City	8/31/2013	52	0	0	0
75. Libby	8/29/2013	52	0	0	0
76. Kimberly	8/29/2013	52	0	0	0
77. Thorp	8/29/2013	52	0	0	0
78. Thorp	8/29/2013	52	0	0	0
79. Wealthwood	8/4/2012	50	0	0	0
80. Hill City	8/4/2012	50	0	0	0
81. Wealthwood	7/4/2012	60	0	0	0
82. Hill City	7/4/2012	50	0	0	0
83. Hill City	7/2/2012	50	0	0	0
84. Minnewawa	6/19/2012	50	0	0	0
85. Palisade	6/19/2012	50	0	0	0
86. Aitkin	7/10/2011	61	0	0	0
87. Cutler	5/30/2011	50	0	0	0
88. McGregor	8/20/2010	50	0	0	0
89. Rush City Municipal Airport	7/11/2008	60	0	0	0
90. Palisade	7/11/2008	56	0	0	0
91. Hill City	5/17/2008	52	0	0	0
92. Minnewawa	5/17/2008	52	0	0	0
93. Palisade	9/24/2007	52	0	0	0
94. McGregor	7/29/2006	55	0	0	0
95. McGregor	7/29/2006	55	0	0	0
96. Aitkin	8/9/2005	60	0	0	0
97. Hill City	6/27/2005	52	0	0	0
98. Aitkin	9/23/2004	60	0	0	0
99. Palisade	4/28/2004	60	0	0	0
100. Hill City	8/20/2003	55	0	0	0
101. McGregor	7/2/2003	50	0	0	0

Location or County	Date	Magnitude (knots)	Deaths	Injuries	Property Damage
102. McGrath	7/21/2002	50	0	0	0
103. Aitkin	7/8/2002	50	0	0	0
104. Hill City	4/16/2002	50	0	0	0
105. Hill City	8/8/2001	50	0	0	0
106. Swatara	8/8/2001	55	0	0	0
107. Hill City	7/17/2001	52	0	0	0
108. Aitkin	6/13/2001	50	0	0	0
109. Aitkin	6/11/2001	55	0	0	0
110. McGregor	8/14/2000	50	0	0	0
111. Jacobson	8/14/2000	60	0	0	0
112. Hill City	8/14/2000	50	0	0	0
113. Swatara	8/14/2000	60	0	0	0
114. Hill City	8/14/2000	60	0	0	0
115. Palisade	7/25/1999	55	0	0	0
116. Jacobson	7/25/1999	55	0	0	0
117. Tamarack	7/25/1999	60	0	0	0
118. McGregor	7/23/1999	50	0	0	0
119. Aitkin	7/23/1999	61	0	0	0
120. Hill City	7/4/1999	52	0	0	0
121. Hill City	6/26/1999	50	0	0	0
122. McGregor	6/1/1998	50	0	0	0
123. Tamarack	5/15/1998	50	0	0	0
124. Aitkin	6/28/1997	55	0	0	0
125. Jacobson	8/25/1996	50	0	0	0
126. Aitkin	8/6/1996	50	0	0	0
127. Malmo	6/29/1996	55	0	0	0
128. Tamarack	5/17/1996	50	0	0	0
129. Hill City	7/13/1995	N/A	0	0	0
130. Aitkin	7/12/1995	N/A	0	0	0
131. Aitkin County	8/12/1994	60	0	0	0
132. Aitkin	6/19/1994	N/A	0	0	0.5K
133. Aitkin	6/19/1994	N/A	0	0	0
134. Aitkin County	9/17/1992	N/A	0	0	0
135. Aitkin County	6/28/1991	N/A	0	0	0
136. Aitkin County	6/27/1991	N/A	0	0	0
137. Aitkin County	9/5/1990	N/A	0	0	0
138. Aitkin County	8/26/1990	N/A	0	0	0
139. Aitkin County	8/30/1989	N/A	0	0	0
140. Aitkin County	7/4/1986	N/A	0	0	0

Location or County	Date	Magnitude (knots)	Deaths	Injuries	Property Damage
141. Aitkin County	6/3/1986	N/A	0	0	0
142. Aitkin County	6/21/1985	N/A	0	0	0
143. Aitkin County	6/6/1984	N/A	0	0	0
144. Aitkin County	6/16/1979	N/A	0	0	0
145. Aitkin County	8/14/1978	N/A	0	0	0
146. Aitkin County	8/14/1978	N/A	0	0	0
147. Aitkin County	6/7/1977	55	0	0	0
148. Aitkin County	6/7/1977	N/A	0	0	0
149. Aitkin County	7/22/1976	N/A	0	0	0
150. Aitkin County	7/2/1975	N/A	0	0	0
151. Aitkin County	7/2/1975	N/A	0	0	0
152. Aitkin County	7/2/1975	N/A	0	0	0
153. Aitkin County	7/13/1974	N/A	0	0	0
154. Aitkin County	6/25/1973	N/A	0	0	0
155. Aitkin County	8/5/1972	N/A	0	0	0
Highest Value Property Damage:					0.5K

Table C - 4. All extreme flood events recorded by NCDC, 2002-2013

Location or County	Date	Type	Deaths	Injuries	Property Damage
156. Aitkin	5/1/2013	Flood	0	0	0
157. Aitkin	4/30/2013	Flood	0	0	0
158. Libby	7/1/2012	Flood	0	0	0
159. Aitkin	7/1/2012	Flood	0	0	0
160. Libby	6/20/2012	Flood	0	0	0
161. Aitkin	6/17/2012	Flood	0	0	0
162. Libby	6/1/2012	Flood	0	0	0
163. Aitkin	6/1/2012	Flood	0	0	0
164. Aitkin	5/26/2012	Flood	0	0	0
165. Aitkin	5/5/2011	Flood	0	0	0
166. Aitkin	4/11/2011	Flood	0	0	0
167. Nichols	12/7/2010	Flood	0	0	0
168. Aitkin Airport	11/1/2010	Flood	0	0	0
169. Aitkin	7/14/2009	Flash Flood	0	0	0
169. Redtop	7/7/2002	Flash Flood	0	0	0
Highest Value Property Damage:					0

Table C - 5. All severe lightning events recorded by NCDC, 2000-2013

Location or County	Date	Deaths	Injuries	Property Damage
170. Aitkin	6/19/2002	0	0	0
171. Aitkin	7/8/2000	0	0	0
Highest Value Property Damage:				0

Table C - 6. All severe cold/wind chill events recorded by NCDC, 1997-2013

Location or County	Date	Type	Deaths	Injuries	Property Damage
172. Southern Aitkin	12/30/2013	Cold/Wind chill	0	0	0
173. Northern Aitkin	12/30/2013	Cold/Wind chill	0	0	0
174. Northern Aitkin	12/11/2013	Cold/Wind chill	0	0	0
175. Southern Aitkin	1/21/2013	Cold/Wind chill	0	0	0
176. Northern Aitkin	1/21/2013	Cold/Wind chill	0	0	0
177. Southern Aitkin	1/18/2011	Cold/Wind chill	0	0	0
178. Northern Aitkin	2/9/2008	Cold/Wind chill	0	0	0
179. Southern Aitkin	2/9/2008	Cold/Wind chill	0	0	0
180. Southern Aitkin	2/17/2006	Cold/Wind chill	0	0	0
181. Northern Aitkin	2/17/2006	Cold/Wind chill	0	0	0
182. Southern Aitkin	1/14/2005	Cold/Wind chill	0	0	0
183. Northern Aitkin	1/14/2005	Cold/Wind chill	0	0	0
184. Southern Aitkin	1/15/1997	Cold/Wind chill	0	0	0
185. Northern Aitkin	1/15/1997	Cold/Wind chill	0	0	0
Highest Value Property Damage:					0

Table C - 7. All severe winter weather, winter storms, and heavy snows recorded by NCDC, 1996-2013

Location or County	Date	Type	Deaths	Injuries	Property Damage
186. Southern Aitkin	12/2/2013	Heavy Snow	0	0	0
187. Northern Aitkin	12/2/2013	Heavy Snow	0	0	0
188. Southern Aitkin	4/22/2013	Heavy Snow	0	0	0
189. Southern Aitkin	4/11/2013	Heavy Snow	0	0	0
190. Northern Aitkin	3/9/2013	Heavy Snow	0	0	0
191. Southern Aitkin	3/4/2013	Heavy Snow	0	0	0
192. Northern Aitkin	3/4/2013	Heavy Snow	0	0	0
193. Southern Aitkin	2/10/2013	Heavy Snow	0	0	0
194. Northern Aitkin	2/10/2013	Heavy Snow	0	0	0
195. Northern Aitkin	12/9/2012	Heavy Snow	0	0	0

Location or County	Date	Type	Deaths	Injuries	Property Damage
196. Northern Aitkin	12/9/2012	Heavy Snow	0	0	0
197. Northern Aitkin	2/28/2012	Heavy Snow	0	0	0
198. Southern Aitkin	2/28/2012	Heavy Snow	0	0	0
199. Northern Aitkin	12/30/2010	Heavy Snow	0	0	0
200. Northern Aitkin	12/20/2010	Heavy Snow	0	0	0
201. Southern Aitkin	11/29/2010	Heavy Snow	0	0	0
202. Northern Aitkin	5/7/2010	Winter Weather	0	0	0
203. Southern Aitkin	12/23/2009	Winter Storm	0	0	0
204. Northern Aitkin	12/23/2009	Winter Storm	0	0	0
205. Northern Aitkin	4/1/2009	Winter Storm	0	0	0
206. Northern Aitkin	3/31/2009	Winter Storm	0	0	0
207. Southern Aitkin	3/10/2009	Winter Storm	0	0	0
208. Northern Aitkin	3/10/2009	Winter Storm	0	0	0
209. Northern Aitkin	1/3/2009	Heavy Snow	0	0	0
210. Southern Aitkin	12/30/2008	Heavy Snow	0	0	0
211. Northern Aitkin	12/20/2008	Heavy Snow	0	0	0
212. Southern Aitkin	12/13/2008	Winter Storm	0	0	0
213. Northern Aitkin	12/13/2008	Winter Storm	0	0	0
214. Northern Aitkin	4/10/2008	Winter Storm	0	0	0
215. Southern Aitkin	4/10/2008	Winter Storm	0	0	0
216. Northern Aitkin	4/5/2008	Winter Storm	0	0	0
217. Northern Aitkin	12/1/2007	Winter Storm	0	0	0
218. Southern Aitkin	12/1/2007	Winter Storm	0	0	0
219. Northern Aitkin	4/3/2007	Winter Storm	0	0	0
220. Southern Aitkin	4/3/2007	Winter Storm	0	0	0
221. Northern Aitkin	3/1/2007	Winter Storm	0	0	0
222. Southern Aitkin	3/1/2007	Winter Storm	0	0	0
223. Northern Aitkin	2/24/2007	Winter Storm	0	0	0
224. Southern Aitkin	2/24/2007	Winter Storm	0	0	0
225. Northern Aitkin	12/30/2006	Winter Storm	0	0	0
226. Northern Aitkin	2/24/2006	Heavy Snow	0	0	0
227. Southern Aitkin	1/21/2005	Heavy Snow	0	0	0
228. Northern Aitkin	1/21/2005	Heavy Snow	0	0	0
229. Northern Aitkin	1/1/2005	Winter Storm	0	0	0
230. Southern Aitkin	1/25/2004	Heavy Snow	0	0	0
231. Northern Aitkin	1/25/2004	Heavy Snow	0	0	0
232. Northern Aitkin	11/22/2003	Heavy Snow	0	0	0
233. Southern Aitkin	11/22/2003	Heavy Snow	0	0	0
234. Northern Aitkin	3/9/2002	Heavy Snow	0	0	0

Location or County	Date	Type	Deaths	Injuries	Property Damage
235. Southern Aitkin	3/9/2002	Heavy Snow	0	0	0
236. Southern Aitkin	3/7/2002	Heavy Snow	0	0	0
237. Northern Aitkin	3/7/2002	Heavy Snow	0	0	0
238. Southern Aitkin	2/24/2002	Heavy Snow	0	0	0
239. Southern Aitkin	11/26/2001	Winter Storm	0	0	0
240. Northern Aitkin	11/26/2001	Winter Storm	0	0	0
241. Southern Aitkin	2/24/2001	Heavy Snow	0	0	0
242. Northern Aitkin	2/24/2001	Heavy Snow	0	0	0
243. Southern Aitkin	2/7/2001	Heavy Snow	0	0	0
244. Northern Aitkin	2/7/2001	Heavy Snow	0	0	0
245. Southern Aitkin	3/15/2000	Heavy Snow	0	0	0
246. Northern Aitkin	3/15/2000	Heavy Snow	0	0	0
247. Southern Aitkin	2/15/2000	Heavy Snow	0	0	0
248. Northern Aitkin	2/15/2000	Heavy Snow	0	0	0
249. Northern Aitkin	3/8/1999	Heavy Snow	0	0	0
250. Southern Aitkin	3/8/1999	Heavy Snow	0	0	0
251. Southern Aitkin	11/9/1998	Winter Storm	0	0	0
252. Northern Aitkin	11/9/1998	Winter Storm	0	0	0
253. Northern Aitkin	3/31/1998	Heavy Snow	0	0	0
254. Southern Aitkin	3/31/1998	Heavy Snow	0	0	0
255. Southern Aitkin	11/13/1997	Heavy Snow	0	0	0
256. Southern Aitkin	3/13/1997	Heavy Snow	0	0	0
257. Northern Aitkin	3/13/1997	Heavy Snow	0	0	0
258. Southern Aitkin	1/23/1997	Heavy Snow	0	0	0
259. Northern Aitkin	1/23/1997	Heavy Snow	0	0	0
260. Southern Aitkin	1/4/1997	Winter Storm	0	0	0
261. Northern Aitkin	1/4/1997	Winter Storm	0	0	0
262. Northern Aitkin	4/12/1996	Winter Weather	0	0	0
263. Southern Aitkin	4/12/1996	Winter Weather	0	0	0
264. Northern Aitkin	3/24/1996	Heavy Snow	0	0	0
265. Southern Aitkin	3/24/1996	Heavy Snow	0	0	0
266. Southern Aitkin	2/26/1996	Heavy Snow	0	0	0
267. Northern Aitkin	2/26/1996	Heavy Snow	0	0	0
268. Southern Aitkin	1/28/1996	Heavy Snow	0	0	0
269. Northern Aitkin	1/28/1996	Heavy Snow	0	0	0
270. Northern Aitkin	1/17/1996	Heavy Snow	0	0	0
271. Southern Aitkin	1/17/1996	Heavy Snow	0	0	0
Highest Value Property Damage:					0

Appendix D

Adopting Resolutions

Appendix E

Steering Committee Meetings

Aitkin County - Multi-Hazard Mitigation Plan Update

September 24, 2013 Kick-Off Planning Team Meeting
McGregor Community Center, McGregor MN
3:30 – 5:00p.m.

Meeting Summary:

On September 24th, Aitkin County Sheriff Scott Turner convened a group of identified key stakeholders from local jurisdictions and other key agencies or organizations in Aitkin County who are asked to participate on the Aitkin County MHMP planning team.

The meeting was facilitated by Scott Turner and Bonnie Hundrieser, Senior Planner with the Arrowhead Regional Development Commission. Scott opened the meeting with welcoming comments, participant introductions, and background information about the FEMA grant awarded for the 5-year update of the Aitkin County MHMP.

Bonnie then did a powerpoint presentation to provide an overview to the planning team of the purpose and process of the MHMP update, including planning team responsibilities and expected project timeline.

After the presentation, the group engaged in a discussion of questions and answers. Jurisdictions expressed interest in the future opportunity for applying for HMGP grants for potential local mitigation projects. No participants expressed any confusion or concern about the project and the planning process.

The planning team was informed that local jurisdictions and other key stakeholders will be contacted on a one-on-one basis as needed by Hundrieser before the next planning team meeting (slated for February, 2014) for information on relevant plans, policies, etc. in place that will be relevant to the MHMP update process.

Attached to this meeting summary are the following:

1. September 24th Meeting Agenda
2. Participant sign in sheets
3. Powerpoint presentation slides

Meeting summary prepared by:
Bonnie Hundrieser, Senior Planner
Arrowhead Regional Development Commission
Phone: (218) 529-7527
Email: bhundrieser@ardc.org

Aitkin County Multi-Hazard Mitigation Plan Update

***September 24, 2013 Kick-Off Planning Team Meeting
McGregor Community Center, McGregor MN
3:30 – 5:00p.m.***

AGENDA

1. Opening Comments and Introductions (Aitkin County Sheriff Scott Turner)
2. Overview of the Aitkin County Multi-Hazard Mitigation Plan purpose, process, and timeline (Bonnie Hundrieser, Arrowhead Regional Development Commission)
3. Questions

Aitkin County Multi Hazard Mitigation Plan

Kick-Off Meeting

September 24, 2013

Name	Agency/Department	Phone	Email
Brian Pisarek	DNR/Aitkin Field Rice Lake, WI	218-927-4040	brian.pisarek@state.wi.us
Duane King	US Fish & Wildlife Service	218-788-2402	duane_king@fws.gov
Bernie Novak	Aitkin Schools	218-927-2115	bnovak@aitkin.k12.mn.us
Tony Sundholm	Riverwood Healthcare	218-927-5570	tsundholm@riverwoodhealthcare.org
Kathy Drapke	City of Aitkin	218-927-2527	cityclerk@city.aitkin.mn.us
Maure French	MNDC	218-571-4051	maure.french@mn.gov
James Cunniff	Northland State	218-820-1888	jcunniff@state.mn.us
Mayvire Delaney	TARF - TAMARACK AREA Emergency Planning		
Ellen Cykus			
Tony Best	Aitkin Co. Emergency	927-7742	tonybest@aitkin.mn.us
Alison Gillen	City of Hill City	697-2301	cityhall@hillcity-mn.com
Jon Eiden	City of Hill City	697-2500	joneiden@hillcity-mn.com
George Casper	City of Hill City	697-2301	gcasper@hillcity-mn.com
Jeff Moberg	Hill City Police Dept.	259-3885	jeffmoberg@hillcity-mn.com
Stacy Duran	ACWHS	927-7231	stacy.duran@acwhs.org
Maure Madsen	TARF	218-2165	maure.madsen@aitkin.mn.us
Stacy Tyson	Northland Village Assisted Living	768-3550	stacy@northlandvillage.org

**Aitkin County Multi Hazard Mitigation Plan
Kick-Off Meeting**

September 24, 2013

Name	Agency/Department	Phone	Email
Laura Reid	City of Tanqueray/HAEP	206-335-6	L55@tanqueray.net
Jeanne LeBlanc	Riverwood	218-927-2121	jleblanc@riverwood.org
Ann Esperseth	Mille Lacs Energy	218-927-8223	anne@mlcmm.com
Steve Mehl	Mille Lacs Energy	218-927-8229	smehl@mlcmm.com
Larry Pantner	City of McGregor	218-768-2117	cityofmcgregor@pttdnail.com
Paul Grogus	McGregor School	(218) 768-2111	pgrogus@mcgregor.k12.mn.us
Patrick Byssard	Aitkin County	218-927-7276	
Scott Turner	Aitkin County	218-927-7420	scott.turner@co.aitkin.mn.us
Karla White	Aitkin Co	218-927-7434	kwhite@co.aitkin.mn.us

Aitkin County Multi-Hazard Mitigation Plan Update



**Working together towards a safe and
disaster-resilient Aitkin County**

September 24, 2013 • Planning Team Kick Off Meeting

What is Hazard Mitigation?

- HM is sustained action to **reduce or eliminate** long-term risk to people and their property from hazards.
- HM Planning is the process local government use to identify risks and vulnerabilities associated with natural disaster, and develop long-term strategies for protecting people and property from future hazard events.
- HM planning allows communities to strategically plan for and work together to implement activities that are cost effective, technically feasible and environmentally sound **BEFORE** a disaster strikes

About the Plan

- The Multi-Hazard Mitigation Plan (MHMP) is a requirement of the Federal Disaster Mitigation Act of 2000 (DMA 2000). The development of a local government plan is required in order to maintain eligibility for certain federal disaster assistance and hazard mitigation funding programs.
- In order for the National Flood Insurance Program (NFIP) communities to be eligible for future mitigation funds, they **must adopt** an MHMP.

Aitkin County

- This plan is a multi-jurisdictional plan and covers Aitkin County and its 4 cities and 55 townships
- **The County and Cities must adopt the plan.** Townships are covered under the County adoption of the plan.



The MHMP will:

- Include a description of the type, location, extent, and probability of recurrence of all natural hazards that can affect communities
- Develop mitigation goals and prioritize strategies that will reduce or avoid long-term vulnerabilities to hazard
- Identify hazard mitigation projects that can be selected for future funding
- Be developed over the course of 18 months (July 2013 – December, 2014)

What Hazards are Addressed?

- A Multi-Hazard Mitigation Plan looks primarily at natural disasters, including:
 WINTER STORMS, ICE STORMS, THUNDERSTORMS, HAILSTORMS, LIGHTNING, TORNADOES, WINDSTORMS, EXTREME TEMPERATURES, FLOODING, DROUGHT, WILDFIRE, INFECTIOUS DISEASES, EARTHQUAKES, SOLAR STORMS, STRUCTURAL FIRES, HAZARDOUS MATERIALS, WATER SUPPLY CONTAMINATION, WASTEWATER SYSTEM FAILURE, DAM FAILURE, RADIOLOGICAL, TERRORISM
- The non-natural hazards are not required by the DMA 2000 to be addressed in the MHMP, but all sections of the existing Aitkin County plan will be updated, including these sections, as desired by the County.



Recent Incidents in Aitkin County

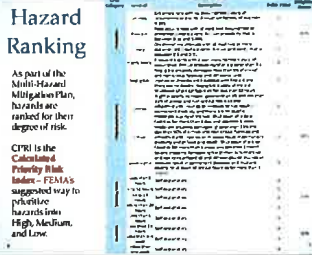
Incident Type	Date/Event Period	Location
Severe Storm, Flooding	06/14/2012 to 06/21/2012	FEMA Disaster Declaration: 07/06/2012 DR-1909 County-wide
Hail Storm, 1.75"	5/29/2012	Farm Island Township
Hill City Tornado	8/29/2013	F1 scale 12 ft wide long 300 yds wide



Hazard Ranking

As part of the Multi-Hazard Mitigation Plan, hazards are ranked for their degree of risk.

CMAA is the Calculated Priority Risk Index - FEMA's suggested way to prioritize hazards into High, Medium, and Low.



Mitigation Strategies

FEMA requires that the following six categories be used to identify mitigation strategies for each hazard identified in the Multi-Hazard Mitigation Plan:

1. PREVENTION
2. PROPERTY PROTECTION
3. PUBLIC EDUCATION AND AWARENESS
4. NATURAL RESOURCE PROTECTION
5. EMERGENCY SERVICES
6. STRUCTURAL PROJECTS

The MHMP Planning Team

- **Role of the Planning Team:**
 1. Provide input on development of the plan.
 2. Rank Hazards, prioritize mitigation strategies and identify projects for implementation.
 3. Assist with public outreach and participate in public meetings.
 4. Review draft plan and provide feedback.
 5. Facilitate final adoption of the MHMP by local government.

Meetings

- **Two public meetings** will be held different parts of the County. Anticipated for Spring, 2014.
- **Three Planning Team Meetings** to review and discuss the MHMP hazard ranking and prioritization of mitigation strategies:
 1. September, 2013 Kick off Meeting
 2. February, 2014 Meeting
 3. June, 2014 Meeting

Aitkin County MHMP Contact:

- **Scott Turner, Aitkin County Sheriff and Emergency Management Coordinator**
- Phone: 218-927-7420
- Email: scott.turner@co.aitkin.mn.us

Aitkin County - Multi-Hazard Mitigation Plan Update

March 20, 2014 Planning Team Meeting #2
McGregor Community Center, McGregor, MN
3:00 – 4:30p.m.

Meeting Summary:

On March 20, 2014 Scott Turner, Aitkin County Sheriff and Emergency Management Director, convened the Aitkin County MHMP planning team for Planning Team Meeting #2 under the Aitkin County MHMP Update planning process. The meeting was facilitated by Scott Turner, Bonnie Hundrieser, Senior Planner with the Arrowhead Regional Development Commission and Stacey Stark, Director of the University of Minnesota Duluth Geospatial Analysis Center.

Sheriff Turner opened the meeting with welcoming comments and participant introductions. Stacey Stark and Bonnie Hundrieser then did a powerpoint presentation covering the following five items:

1. MHMP Planning Team Purpose
2. Aitkin County Community Profile and Asset Inventory
3. Hazards Facing Aitkin County
4. Review and Update Risks and Vulnerabilities
5. Development of Mitigation Actions

During and after the presentation, the group engaged in a discussion regarding hazards facing Aitkin County and the development of mitigation strategies in the following categories of Prevention, Property Protection, Public Education and Awareness, Natural Resource Protection, Emergency Services and Structural Projects. A worksheet was provided to participants to record their ideas for any mitigation actions that may fall into these categories, especially if they relate to a specific jurisdiction.

The planning team was informed of next steps in the MHMP update process, which would include holding two public meetings in different parts of Aitkin County, to be scheduled in May. It was agreed that one meeting would be held at the McGregor Community Center, and another meeting would be held in Hill City.

Attached to this meeting summary are the following:

1. March 20th Meeting Agenda
2. Participant sign in sheets
3. Powerpoint presentation slides

Meeting summary prepared by:

Bonnie Hundrieser, Senior Planner - Arrowhead Regional Development Commission
Phone: (218) 529-7527 / Email: bhundrieser@ardc.org

**Aitkin County Multi-Hazard Mitigation Plan (MHMP) Update
Steering Committee Meeting #2
March 20, 2014**

Meeting Purpose

To review and prioritize the hazards to be included in the MHMP, as well as discuss mitigation actions that address each hazard at the County and jurisdiction level.

AGENDA

1. Welcome and Introductions
2. Status of MHMP Update
3. Aitkin County Community Profile and Asset Inventory
4. Hazard Profiles
5. Review and Prioritization of Hazards (Natural / Technological) for inclusion in MHMP
6. Discussion of Mitigation Strategies and Actions
7. Estimated Timeline of Next Steps
 - March/April – Revisions and additions to MHMP mitigation action chart
 - May – Hold 2 public meetings on draft MHMP; revise as needed
 - June/July – Review by HSEM and FEMA
 - July/August – Revisions if needed
 - September – Review and approval of final plan by HSEM and FEMA. County to proceed with local jurisdictional adoptions of plan.

For questions regarding the Aitkin County Hazard Mitigation Plan Update:

- Bonnie Hundrieser, Senior Planner: Arrowhead Regional Development Commission
218-529-7527, bhundrieser@ardc.org
- Stacey Stark, Director: Geospatial Analysis Center UMD
218-726-7438, slstark@d.umn.edu
- Karla White, Aitkin County Sheriff's Office
218) 927-7436, kwhite@co.aitkin.mn.us

Aitkin County Multi Hazard Mitigation Plan
Second Steering Committee Meeting

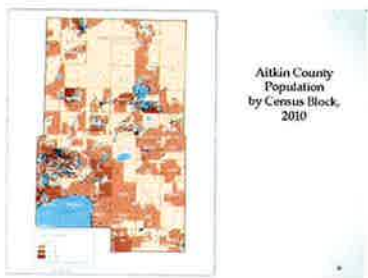
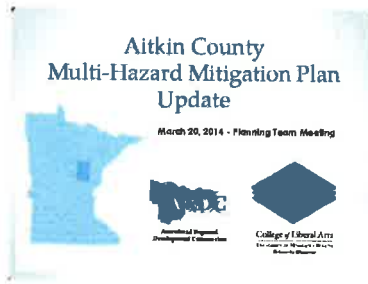
March 20, 2014

Name	Agency/Department	Phone	Email
Mike Proulx	1855 444-1234	321-551-1234	Mike.Proulx@aitkinmn.gov
Karen Proulx	Township	434-3356	255@proulxmn.net
George Wagoner	Hill City	244-0440	
Ellen Cyrus	TANAPPAH	768-2313	
Maxine Doherty	L	768-2230	
Claire Marsden	Tamarack	768-2165	wendy@aitkinmn.gov
Larry Pankert	City of Itasca	765-1717	CityofItasca@aitkinmn.gov
Walt Ford	USFS Rice Lake NW	768-7402	walt_ford@usfs.gov
Stacy Tyson	Northland Village	768-3356	stacy@northlandvillage.org
Tony Gross	Rice Lake NW		
Scott Turner	Aitkin Co Sheriff	218-927-7400	turners@co.aitkin.mn.us
Chessa White	Aitkin Co Sheriff's Office	218-927-7434	kirk@co.aitkin.mn.us

**Aitkin County Multi Hazard Mitigation Plan
Second Steering Committee Meeting**

March 20, 2014

Name	Agency/Department	Phone	Email
Duane King	U.S. Fish & Wildlife Service	218-838-1173	duane.king@fws.gov
Tommy Sundsten	Pine River	218-927-5570	asundsten2@pine-river.com
Ann Espeseth	Mill Lake Energy	218-927-8223	anne@mlenergy.com
Mark Wedel	Aitkin County Board	218-927-6500	mark.wedel@aitkin.org
Dean West	AO HHS	218-927-2256	deanwest@aitkin.org
William McManis	City of Hill City	218-697-2301	cityhall@hillcity-mn.com
Jeff Moden	Hill City PD	218-697-8200	jmoden@hillcity-mn.com
Dean Yocum	Hill City School	218-697-2394	dyocum@hillcity-mn.com
Robert Orsini	Mill Lake Fire	218-232-5136	robert@mill-lake-fire.com

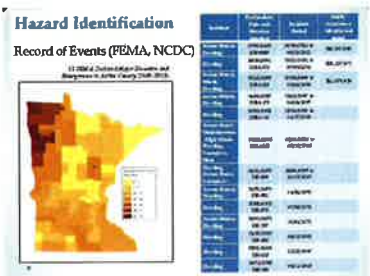
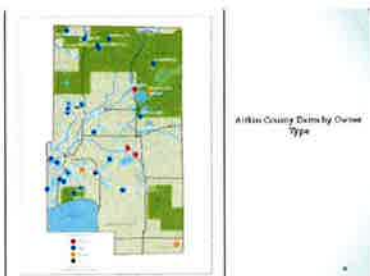
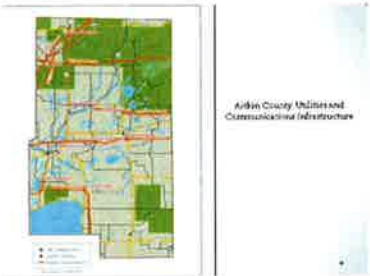


This plan is a multi-jurisdictional plan and covers Aitkin County and its cities, 40 townships and 4 unincorporated territories. The County and Cities must adopt the plan. Townships are covered under the County adoption of the plan.

Community	2010 Population	% of County
Aitkin	2,165	13.61%
Mill City	655	4.00%
McGrath	80	0.50%
McGregor	391	2.40%
Palmer	187	1.16%
Stevens	94	0.58%

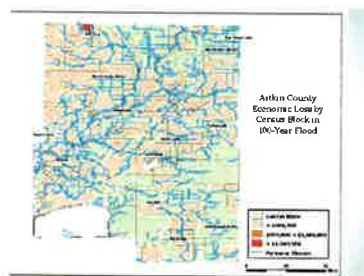
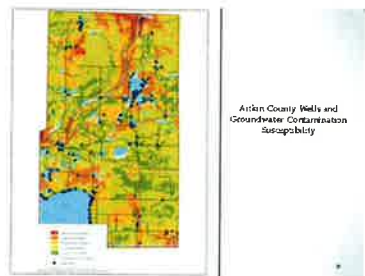
Year	2010	2015	2020	2025	2030	2035	2040	2045	2050	Change 2010-2050
Population	15,815	14,377	12,287	11,401	10,499	9,745	9,201	8,701	8,201	-7,614

Critical Facility Categories	
Agriculture and Food	Governance Facilities
Energy and Power	Healthcare and Public Health
Chemical and Hazardous Materials	Information Technology
Commercial Facilities	Manufacturing
Communications	Natural Resources and Issues
Crime	Nuclear
Defense and Military	Public and Municipal
Emergency Services	Transportation
Finance	Water



Hazard Identification

- Existing County Plans
- Record of Events (FEMA, NCEC)
- GIS and HAZUS-MH (Flood only)
- Hazard Ranking Methodology

FEMA Multi-Hazard Identification and Risk Assessment
Natural Hazards
(and groupings by HSE in MN HMP)

Rash Flood	Tornadoes	Severe Winter Storms
Over Flood	Winds	Extreme Cold
Coastal Flooding *	Thunderstorm	Extreme Heat
Dam / Levee Failure	Lightning	Landslides
Earthquake	Hailstorms	Land Subsidence / Sinkholes
Wildfire	Drought	Erosion (Coastal / Off / Wetland)
	Fog *	Expansive Soils *

Addressed in THS-A, 2010 plan * Not addressed in 2010 State HMP

[illegible]

Hazard Ranking and Prioritization

CPRI Ranking Methodology

Probability (1-4, 4% to score)

Magnitude/Severity (1-4, 30% of score)

Warning Time (1-4, 15% of score)

Duration (1-4, 10% of score)

Ranking Criteria Used in Minnesota State Plan

Ranking	Criteria
High	- Extremely low likelihood of the event occurring or non-occurrence - The event is prevented, greatly diminished or completely isolated in sub-system - Extremely low potential damage to personnel and facilities - The hazard impacts the State only and not at security
Medium	- The hazard is somewhat isolated, affecting only systemically or isolated non-critical systems - The likelihood for the hazard occurring is well established, but is applied over a long time - The hazard occurs or may occasionally occur (hazard) over the year in always with a small event may require backup
Low	- The hazard is generally well isolated and is small or is a minimum level - The likelihood for the hazard occurring is uncertain, requiring a priority evaluation in the State of the hazard event which

Name	Position	Salary	Department
John Smith	Sales Representative	12000	Sales
Jane Doe	Marketing Manager	15000	Marketing
Bob Johnson	Finance Analyst	11000	Finance
Alice Brown	HR Specialist	10000	HR
David Wilson	Sales Representative	12000	Sales
Emily Davis	Marketing Manager	15000	Marketing
Michael Lee	Finance Analyst	11000	Finance
Sarah Kim	HR Specialist	10000	HR
James White	Sales Representative	12000	Sales
Patricia Black	Marketing Manager	15000	Marketing
Christopher Green	Finance Analyst	11000	Finance
Michelle Hall	HR Specialist	10000	HR
Robert King	Sales Representative	12000	Sales
Linda Scott	Marketing Manager	15000	Marketing
William Adams	Finance Analyst	11000	Finance
Elizabeth Taylor	HR Specialist	10000	HR
Thomas Moore	Sales Representative	12000	Sales
Barbara Jackson	Marketing Manager	15000	Marketing
Richard Harris	Finance Analyst	11000	Finance
Deborah Clark	HR Specialist	10000	HR
Kevin Lewis	Sales Representative	12000	Sales
Nancy Walker	Marketing Manager	15000	Marketing
Gregory Hall	Finance Analyst	11000	Finance
Christina Young	HR Specialist	10000	HR
Anthony King	Sales Representative	12000	Sales
Stephanie Scott	Marketing Manager	15000	Marketing
Jonathan Adams	Finance Analyst	11000	Finance
Heather Taylor	HR Specialist	10000	HR
Timothy Moore	Sales Representative	12000	Sales
Kimberly Jackson	Marketing Manager	15000	Marketing
Brandon Harris	Finance Analyst	11000	Finance
Rebecca Clark	HR Specialist	10000	HR
Scott Lewis	Sales Representative	12000	Sales
Christina Walker	Marketing Manager	15000	Marketing
Benjamin Hall	Finance Analyst	11000	Finance
Michelle Young	HR Specialist	10000	HR
David King	Sales Representative	12000	Sales
Angela Scott	Marketing Manager	15000	Marketing
Christopher Adams	Finance Analyst	11000	Finance
Stephanie Taylor	HR Specialist	10000	HR
Jonathan Moore	Sales Representative	12000	Sales
Heather Jackson	Marketing Manager	15000	Marketing
Timothy Harris	Finance Analyst	11000	Finance
Kimberly Clark	HR Specialist	10000	HR
Benjamin Lewis	Sales Representative	12000	Sales
Michelle Walker	Marketing Manager	15000	Marketing
David Hall	Finance Analyst	11000	Finance
Angela Young	HR Specialist	10000	HR
Christopher King	Sales Representative	12000	Sales
Stephanie Scott	Marketing Manager	15000	Marketing
Jonathan Adams	Finance Analyst	11000	Finance
Heather Taylor	HR Specialist	10000	HR
Timothy Moore	Sales Representative	12000	Sales
Kimberly Jackson	Marketing Manager	15000	Marketing
Benjamin Harris	Finance Analyst	11000	Finance
Michelle Clark	HR Specialist	10000	HR
David Lewis	Sales Representative	12000	Sales
Angela Walker	Marketing Manager	15000	Marketing
Christopher Hall	Finance Analyst	11000	Finance
Stephanie Young	HR Specialist	10000	HR
Jonathan King	Sales Representative	12000	Sales
Heather Scott	Marketing Manager	15000	Marketing
Timothy Adams	Finance Analyst	11000	Finance
Kimberly Taylor	HR Specialist	10000	HR
Benjamin Moore	Sales Representative	12000	Sales
Michelle Jackson	Marketing Manager	15000	Marketing
David Harris	Finance Analyst	11000	Finance
Angela Clark	HR Specialist	10000	HR
Christopher Lewis	Sales Representative	12000	Sales
Stephanie Walker	Marketing Manager	15000	Marketing
Jonathan Hall	Finance Analyst	11000	Finance
Heather Young	HR Specialist	10000	HR
Timothy King	Sales Representative	12000	Sales
Kimberly Scott	Marketing Manager	15000	Marketing
Benjamin Adams	Finance Analyst	11000	Finance
Michelle Taylor	HR Specialist	10000	HR
David Moore	Sales Representative	12000	Sales
Angela Jackson	Marketing Manager	15000	Marketing
Christopher Harris	Finance Analyst	11000	Finance
Stephanie Clark	HR Specialist	10000	HR
Jonathan Lewis	Sales Representative	12000	Sales
Heather Walker	Marketing Manager	15000	Marketing
Timothy Hall	Finance Analyst	11000	Finance
Kimberly Young	HR Specialist	10000	HR
Benjamin King	Sales Representative	12000	Sales
Michelle Scott	Marketing Manager	15000	Marketing
David Adams	Finance Analyst	11000	Finance
Angela Taylor	HR Specialist	10000	HR
Christopher Moore	Sales Representative	12000	Sales
Stephanie Jackson	Marketing Manager	15000	Marketing
Jonathan Harris	Finance Analyst	11000	Finance
Heather Clark	HR Specialist	10000	HR
Timothy Lewis	Sales Representative	12000	Sales
Kimberly Walker	Marketing Manager	15000	Marketing
Benjamin Hall	Finance Analyst	11000	Finance

Mitigation Strategies

FEMA requires that the following six categories be used to identify mitigation strategies for each hazard identified in the Multi-Hazard Mitigation Plan:

1. PREVENTION
2. PROPERTY PROTECTION
3. PUBLIC EDUCATION AND AWARENESS
4. NATURAL RESOURCE PROTECTION
5. EMERGENCY SERVICES
6. STRUCTURAL PROJECTS



The screenshot shows a portion of FEMA Form 380, 'Mitigation Strategy Worksheet'. It is a table with columns for 'Hazard', 'Mitigation Strategy', and 'Project'. The table is divided into sections for 'Prevention', 'Property Protection', 'Public Education and Awareness', 'Natural Resource Protection', 'Emergency Services', and 'Structural Projects'. The 'Prevention' section is currently selected, and it contains a table with columns for 'Hazard', 'Mitigation Strategy', and 'Project'. The 'Hazard' column lists 'Flood', 'Hurricane', and 'Tornado'. The 'Mitigation Strategy' column lists 'Flood Insurance', 'Hurricane Preparedness', and 'Tornado Preparedness'. The 'Project' column lists 'Flood Insurance', 'Hurricane Preparedness', and 'Tornado Preparedness'.

Activity	Activity Description	Priority	Impact	Responsible Party	Timeline	Notes
Activity 1	Identify current and potential stakeholders for the project and develop a communication plan to engage them throughout the project lifecycle.	High	Positive	Project Manager	1-3 Months	Key stakeholders include the client, project team, and end-users. Communication plan should be developed and implemented throughout the project lifecycle.
Activity 2	Develop a project charter and obtain approval from the sponsor and steering committee.	High	Positive	Project Manager	1-2 Weeks	Project charter should clearly define the project's purpose, scope, and objectives. Approval from the sponsor and steering committee is essential for project initiation.
Activity 3	Conduct a detailed project scope definition and create a Work Breakdown Structure (WBS).	High	Positive	Project Manager	2-4 Weeks	Scope definition is critical to project success. WBS should break down the project into manageable tasks and sub-tasks.
Activity 4	Develop a project schedule and resource allocation plan.	High	Positive	Project Manager	2-4 Weeks	Schedule should include a Gantt chart and a resource allocation plan. Resource allocation should consider team availability and skill sets.
Activity 5	Identify potential risks and develop a risk management plan.	High	Positive	Project Manager	2-4 Weeks	Risk management plan should identify potential risks, assess their impact, and define mitigation strategies.
Activity 6	Develop a communication plan and establish regular communication channels.	High	Positive	Project Manager	2-4 Weeks	Communication plan should define the frequency and format of communication. Regular communication is essential for project transparency and stakeholder engagement.
Activity 7	Conduct a project kick-off meeting and align the project team.	High	Positive	Project Manager	1-2 Weeks	Kick-off meeting should bring all project team members together to discuss the project's goals, objectives, and roles.
Activity 8	Monitor project progress and report to the steering committee.	High	Positive	Project Manager	Ongoing	Regular reporting to the steering committee is essential for project oversight and decision-making.
Activity 9	Manage project budget and ensure financial control.	High	Positive	Project Manager	Ongoing	Budget management is critical to project success. Regular budget reviews and cost control measures should be implemented.
Activity 10	Manage project quality and ensure deliverables meet requirements.	High	Positive	Project Manager	Ongoing	Quality management is essential for ensuring project deliverables meet the required standards and expectations.
Activity 11	Manage project change and ensure changes are controlled.	High	Positive	Project Manager	Ongoing	Change management is essential for managing project scope creep and ensuring project goals are not compromised.
Activity 12	Close the project and conduct a post-mortem analysis.	High	Positive	Project Manager	1-2 Weeks	Project closure and post-mortem analysis are essential for project completion and learning from the experience.

Upcoming MHMP Timeline

- **March-April** – Early on-going activities to MHMP implementation plan due
- **May** – more specific meetings and an advisory are needed
- **Summer** – roll-out of MHMP and *Think My Region* – Reviews needed
- **September** – Review and approval of final policy, HCB and HMA. Consider program authority provisions of adoption of plan.



Appendix F

Public Meeting Notices and Meeting Notes

Aitkin County Multi-Hazard Mitigation Plan Public Meetings

Tuesday, June 17th, 2014 at 3:00 p.m. – 4:30 p.m. at the Palisade Community Center, located at 48052 Nature Ave in Palisade at the junction of Main Street and Nature Ave and at 6:30 p.m. – 8:00 p.m. at the Aitkin County Sheriff's Office 217 2nd St NW in Aitkin.



Two public meetings regarding the Aitkin County Multi-Hazard Mitigation Plan (MHMP) will be held on Tuesday, June 17th, 2014. The first meeting will be held from 3:00 p.m. – 4:30 p.m. at the Palisade Community Center, located at 48052 Nature Ave in Palisade at the junction of Main Street and Nature Ave and the second meeting will be held from 6:30 p.m. – 8:00 p.m. at the Aitkin County Sheriff's Office 217 2nd St NW in Aitkin. The Plan details the natural hazards that face the County and identifies specific mitigation strategies and actions to reduce the impact of disasters.

In the fall of 2013 Aitkin County received a grant from the Federal Emergency Management Agency (FEMA) to prepare an update of its multi-jurisdictional MHMP. Seven jurisdictions are part of the plan, including Aitkin County and the cities of Aitkin, Hill City, McGregor, McGrath, Palisade and Tamarack.

Public input is a required step in the MHMP planning process. Community members and staff from the County and participating cities are strongly encouraged to attend the scheduled public meetings. The meetings will provide local residents, businesses, agencies and organizations an opportunity to learn about the draft plan, ask questions and provide feedback on mitigation strategies and recommended actions for implementation.

A draft of the Aitkin County Multi-Hazard Mitigation Plan contents is available for public review at www.arrowheadplanning.org/aitkinmhmp.

For more information, contact:

Bonnie Hundrieser, Arrowhead Regional Development Commission
bhundrieser@ardc.org or 218-529-7527



**ARROWHEAD REGIONAL
DEVELOPMENT COMMISSION**

Leading • Planning • Connecting in the counties of Aitkin • Carlton • Cook • Itasca • Koochiching • Lake • St. Louis

June 10, 2014

FOR IMMEDIATE RELEASE

Contact: Bonnie Hundrieser
218-529-7527 (direct)
1-800-232-0707 (toll free)
bhundrieser@ardc.org

NEWS RELEASE

Aitkin County to Hold Public Input Meetings on Multi-Hazard Mitigation Plan

(Duluth, MN) Two public meetings regarding the Aitkin County Multi-Hazard Mitigation Plan (MHMP) will be held on Tuesday, June 17th, 2014. The first meeting will be held from 3:00 p.m. – 4:30 p.m. at the Palisade Community Center, located at 48052 Nature Ave in Palisade at the junction of Main Street and Nature Ave, and the second meeting will be held from 6:30 p.m. – 8:00 p.m. at the Aitkin County Sheriff's Office 217 2nd St NW in Aitkin. The Plan details the natural hazards that face the County and identifies specific mitigation strategies and actions to reduce the impact of disasters.

In the fall of 2013 Aitkin County received a grant from the Federal Emergency Management Agency (FEMA) to prepare an update of its multi-jurisdictional MHMP. Seven jurisdictions are part of the plan, including Aitkin County and the cities of Aitkin, Hill City, McGregor, McGrath, Palisade and Tamarack. Staff from the Arrowhead Regional Development Commission (ARDC) is facilitating the planning process.

Public input is a required step in the MHMP planning process. Community members and staff from the County and participating cities are strongly encouraged to attend the scheduled public meetings. The meetings will provide local residents, businesses, agencies and organizations an opportunity to learn about the draft plan, ask questions and provide feedback on mitigation strategies and recommended actions for implementation.

A draft of the Aitkin County Multi-Hazard Mitigation Plan content is available for public review at www.arrowheadplanning.org/aitkinmhmp. Comments or questions on the plan or public meetings may be directed to Bonnie Hundrieser, ARDC (218) 529-7527 or bhundrieser@ardc.org.

The Arrowhead Regional Development Commission is a regional comprehensive planning and development agency serving the counties of Aitkin, Carlton, Cook, Itasca, Koochiching, Lake and St. Louis in Northeast Minnesota. ARDC's mission is to serve the people of the Arrowhead Region by providing local units of government and citizen groups a means to work cooperatively in identifying needs, solving problems and fostering local leadership.

- 0 -

221 West First Street • Duluth, MN • 55802
218.722.5545 • 800.232.0707 • 218.529.7592 (Fax) • info@ardc.org • www.ardc.org
ARDC is an Equal Opportunity Employer

Appendix G

Completed and Deleted Actions from the 2004 Plan

Appendix H

Mitigation Actions by Jurisdiction

Appendix I

Works Cited

- Aitkin County. (n.d.). Retrieved from <http://www.aitkincountyswcd.org/PDF-Docs/WaterPlan6-24-09Historical-CurrentData.pdf>
- Aitkin County Housing Authority. (n.d.). Retrieved from http://www.co.aitkin.mn.us/housing_authority/Employment-Data.html
- Anderson, G., & Bell, M. (2011). Heat Waves in the United States: Mortality Risk during Heat Waves and Effect Modification by Heat Wave Characteristics in 43 U.S. Communities. *Environmental Health Perspectives*, 210-218.
- Dai, A. (2011). Drought under global warming: a review. *WIREs Climate Change*, 45-65.
- Del Genio, A., Yao, M., & Jonas, J. (2007). Will moist convection be stronger in a warmer climate? *Geophys. Res. Lett.*
- International Climate Adaptation Team. (2013). Adapting to Climate Change in Minnesota. 26.
- Kunkel, K., Stevens, L., Stevens, S., Sun, L., Janssen, E., Wuebbles, D., et al. (2013). Regional Climate Trends and Scenarios for the U.S. National Climate Assessment. *NOAA Technical Report NESDIS*, 142-3, 95.
- Minnesota Department of Public Safety. (2011). *Fire in Minnesota: Annual Report*. St. Paul.
- Minnesota Pollution Control Agency. (n.d.). Retrieved from http://pca-gis02.pca.state.mn.us/eda_surfacewater/index.html?extent
- MN DNR. (n.d.). Retrieved from <http://files.dnr.state.mn.us/forestry/wildfire/historialcharts/firesbyyear.pdf>
- Mueller, B., & Seneviratne, S. (2012). Hot days induced by precipitation deficits at the global scale. *Proceedings from the National Academy of Sciences*, 12,398-12,403.
- National Climate Assessment Development Advisory Committee. (2013). Retrieved from <http://ncadac.globalchange.gov/>
- National Weather Service. (2013). Retrieved from http://www.crh.noaa.gov/news/display_cmsstory.php?wfo=dlh&storyid=96886&source=2
- Perera, E. M., Sanford, T., White-Newsome, J. L., Kalkstein, L., Vanos, J. K., & Weir, K. (2012). Heat in the Heartland. *Climate Change and Your Health*.
- Schoof, J. T. (2012). Scale Issues in the Development of Future Precipitation Scenarios. *Journal of Contemporary Water Research and Education*, 8-16.

Seeley, M. (2013). Current status of climate change in Minnesota. *Preparing Minnesota for Climate Change: A Conference on Climate Adaptation*. St. Paul.

The Weather Channel. (2014). Retrieved from
<http://www.weather.com/weather/wxclimatology/monthly/graph/USMN0008>