CHAPTER I
INTRODUCTION

Background

This plan is an update of the Charles Mix County Pre-Disaster Mitigation Plan, which was approved by FEMA in April 2015. The purpose of the plan is to prevent or reduce losses to people and property that may result from future hazard events in Charles Mix County. The plan identifies and analyzes the hazards that the county is susceptible to, and proposes a mitigation strategy to minimize future damage that may be caused by those hazards. The document will serve as a strategic planning tool for use by Charles Mix County in its efforts to mitigate against future disaster events.

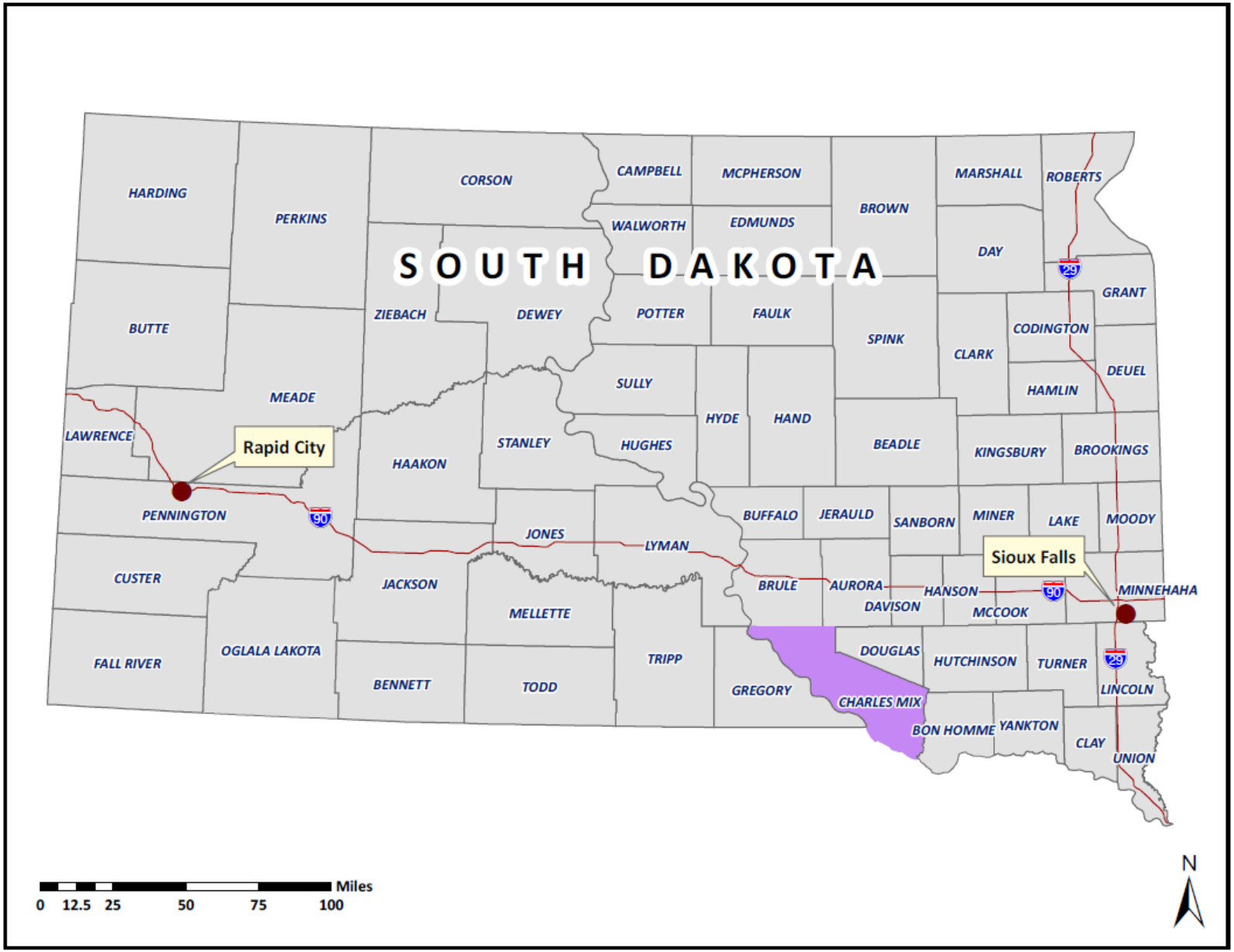
This is a multi-jurisdictional plan. All of the municipalities located within Charles Mix County were invited to participate in the plan's development, as they had when the current plan (that is, the plan now being updated) was being developed. Following is the list of municipalities that chose to participate in the plan's development by having a representative attend the planning meetings, by providing input into the plan, and by passing a resolution supporting and adopting the plan:

- Charles Mix County
- City of Geddes
- City of Lake Andes
- Town of Pickstown
- City of Platte
- City of Wagner

Production of the plan was the ultimate responsibility of the Charles Mix County Emergency Management Director, who served as the county's point of contact for all activities associated with this plan. Input was received from a disaster mitigation planning team that was put together by the Emergency Management Director as shown in **Table 1.1**.

The plan itself was written by an outside contractor, Planning & Development District III of Yankton, South Dakota, one of the state's six regional planning entities. The office has an extensive amount of experience in producing various kinds of planning documents, including municipal ordinances, land use plans, and zoning ordinances, and it is an acknowledged leader in geographic information systems (GIS) technology in South Dakota. Furthermore, its staff has written disaster mitigation plans for all sixteen of the counties in the District's planning area, including Charles Mix County's current plan.

Figure 1.1 – County Location



The following staff members of Planning & Development District III were involved in the production of the plan. John Clem, a Community Development Specialist, was the project manager and author of the plan. Assisting Mr. Clem was Harry Redman, a Geographic Information Systems Professional, who produced maps for the plan, directed the floodplain risk analysis (see **Chapter III**), and completed the county land cover analysis (see **Chapter II**).

Development of Planning Team

The initial planning stages for this plan update began in 2018 when an application was submitted to FEMA for Hazard Mitigation Grant Program (HMGP) funds to help pay for the update. The HMGP funds were awarded to the County in October 2019. Following this, John Clem and the Charles Mix County Emergency Management Director began to develop the methodology and strategy to be used to update the plan.

The first step was to organize the disaster mitigation planning team, the group of individuals representing the participating jurisdictions and other stakeholders at the planning team meetings. These individuals provided information and various documents that were used to produce the plan, reviewed drafts of the plan as it was being assembled, and reviewed and approved the final version of the plan. Personnel at the county and municipal level with the authority to regulate development were a priority for inclusion on the team. Invited to participate on the planning team were representatives from the following groups:

- Charles Mix County (county commissioners, planning/zoning officials, floodplain administrator, GIS staff, director of equalization, highway superintendent, etc.)
- Municipalities (city council members, finance officers, public works staff, etc.)
- Other entities, including the Wagner Community Memorial Hospital, the Platte Health Center, the Charles Mix Electric Association, the Randall Community Water District, and the U.S. Army Corps of Engineers

Each individual on the planning team had at least one of the following attributes to contribute to the planning process:

- Significant understanding of how hazards affect the county and participating jurisdictions.
- Substantial knowledge of the county's infrastructure system.
- Resources at their disposal to assist in the planning effort, such as maps or data on past hazard events.
- The authority to help implement the mitigation strategy that was developed.

Table 1.1 lists the planning team members, including their attendance at the planning meetings that were held as the plan was being developed.

Table 1.1 – Participation in Plan Development

Name	Representing	Position	Meeting Attendance	
			Mtg 1 05/20/20	Mtg 2 --/--/--
Mike Kotab	Charles Mix County	Emergency Manager	X	
John Clem	Planning District III	Plan author	X	
Danielle Davenport	Charles Mix County	Auditor	X	
Rebecca Brunsing	City of Wagner	Finance Officer	X	
Shauna Meyerink	City of Platte	Finance Officer	X	
Amanda Frandsen	City of Lake Andes	Council member	X	
Carol Berndt	Town of Pickstown	Finance Officer	X	
Mark Fortuna	Town of Pickstown	Public Works	X	
Dick Rysavy	Town of Dante	Mayor	X	
Ann Rysavy	Town of Dante	Resident	X	
Mike Dangel	Charles Mix Electric Coop	Manager	X	
Rick Bergen	Randall Water District	Manager	X	
Jim Duba	Platte Health Center	Director	X	

Outreach Effort

Throughout the plan's development, efforts were made to obtain involvement in the plan beyond just the planning team. A press release was posted on community websites prior to the first planning meeting, and social media also was used to get the message out to the public. Outreach also was made to emergency management directors in nearby counties, as well as the South Dakota Office of Emergency Management.

At the end of the process, a press release announcing the completion of the plan was posted on community websites, and the plan was made available for review at the Charles Mix County emergency management office. See **Appendix A** for documentation of the public outreach effort.

Planning Meetings

Several meetings were held to develop the plan, as described in further detail below. The primary purpose of the first meeting was to inform the planning team members about the mitigation planning process and to develop the risk assessment. After this initial meeting, additional meetings were held in each participating jurisdiction to develop the mitigation strategy, including the specific mitigation actions to be included in the plan. A final meeting reconvened the planning team members at the end of the process to review a first draft of the completed plan and to discuss how the plan will be implemented.

The planning process associated with the plan's development was relaxed and informal, and free-flowing discussion was always encouraged. No subcommittees were formed, no votes were taken or motions made, and decisions were made by mutual consensus of the planning team members. Everyone's opinion was respected, nobody was discouraged from voicing their opinion, and no one was made to feel any less important than anyone else. Leadership and guidance at the meetings was provided by Planning & Development District III staff and/or the Charles Mix County Emergency Management Director.

Planning Team Meeting 1 – Introduction and Risk Assessment [1]

The first meeting of the planning team introduced the participants to the mitigation planning process (this was a quick discussion, as most of the participants had helped develop the county's current plan and so were already familiar with the process). Discussion occurred about how the plan would be developed in the coming months, and about the basic goals to be achieved with the mitigation plan. Discussion also occurred about how to get broader public input into the planning process, and whether any other potential stakeholders not already present should be invited to participate in the planning process.

Following this, the county's current disaster mitigation plan was reviewed, particularly the risk assessment section. The team also reviewed the hazards identified in the State of South Dakota Hazard Mitigation Plan. Following this, the team determined which hazards it wanted to focus on with this plan.

Representatives from each participating jurisdiction discussed how each specific hazard affected their community, and described their existing resources and capabilities to mitigate against the hazards. As part of this process, the team especially considered the vulnerability of the most important community assets and critical facilities in each jurisdiction. The assets are listed in **Chapter III** and shown on the hazard vulnerability maps included at the end of that chapter.

With the hazards and community assets identified, the risk assessment was completed by the Planning & Development District III office using various methods as discussed in **Chapter III**. The results of the risk assessment, which included a summary of the textual information presented in **Chapter III**, maps showing hazard-prone areas in each jurisdiction, and tables showing the value of property potentially at risk in the jurisdictions, were then distributed to the planning team members. To assist in the development of the mitigation strategy, a list of potential mitigation actions based on FEMA's guidance document *Mitigation Ideas: A Resource for Reducing Risk to Natural Hazards* also was distributed.

Jurisdictional Meetings – Develop Mitigation Strategy

Following the initial planning team meeting, meetings were held in each participating jurisdiction to develop the mitigation strategy, focusing on the specific mitigation actions to be included in the plan for each jurisdiction. The meetings took place during city council

[1] Due to the Coronavirus situation, this meeting was conducted via telephone conference call. The second planning team meeting also was conducted over the phone.

meetings, which ensured that a broad representation of people would be present, and also ensured that the process was open to public involvement.

The process began with a review of the list of proposed mitigation actions included in the current mitigation plan, with discussion following about the progress that had been made on implementing the actions. A list showing progress on the actions is included in **Chapter IV**.

The focus then turned toward identifying the actions to be included in this plan. The starting point for this discussion was the list of potential mitigation actions based on FEMA's *Mitigation Ideas: A Resource for Reducing Risk to Natural Hazards* that had been distributed to the planning team members. The jurisdictions were encouraged to consider a wide range of mitigation actions, whether or not they seemed likely to be achievable in the foreseeable future. After some discussion, consensus was reached about the mitigation actions to include in the plan. Details about the actions, such as estimated cost, the party responsible for implementation, and potential funding sources, were discussed. Prioritization of the actions also was determined. The final list of actions proposed by the participating jurisdictions is presented in **Chapter IV** (see **Table 4.2**).

Planning Team Meeting 2 – Plan Review and Plan Implementation

Following the jurisdictional meetings, the Planning & Development District III office completed a first draft of the plan. After this, the planning team was brought together again to review the draft, and to discuss how the plan will be implemented. The team considered how the plan will be incorporated into the existing planning mechanisms at the county and local levels, and who will be responsible for ensuring the mitigation actions identified in the plan will be carried out. Maintenance of the plan also was discussed, specifically how the plan will be monitored, evaluated, and updated in the coming years.

After the meeting, some additional information was added to the plan based on discussion at the meeting. A press release announcing the completion of the plan was posted on the community websites, and the plan was made available for review at the Charles Mix County emergency management office before the plan was submitted to the South Dakota Office of Emergency Management.

Acknowledgements

The Planning & Development District III office would like to thank the members of the Charles Mix County Disaster Mitigation Planning team for participating in the planning meetings that were held, and for supplying information that was used to develop the plan. We would particularly like to thank County Emergency Management Director Mike Kotab for arranging the planning team meetings and for coordinating with the participating jurisdictions.

Thanks also are extended to Jim Poppen, Martin Christopherson, Kyle Kafka, and Marc Macy at the South Dakota Office of Emergency Management for information and guidance in developing the plan.

CHAPTER II
COMMUNITY PROFILE

Background

This chapter serves as a basic introduction of the county. Topics addressed in this chapter cover the county's physical conditions, its population and socio-economic characteristics, utilities and infrastructure, and services. Following chapters are devoted to assessing risks in the county, presenting the mitigation strategy, and discussing how the plan will be implemented.

General Description

Charles Mix County is located in southeast South Dakota, as shown in **Figure 1.1**. The county covers 1,098 square miles in area. There are seven incorporated municipalities located within the county - Dante, Geddes, Lake Andes, Pickstown, Platte, Ravinia, and Wagner. The county seat is located in Lake Andes, and Wagner has the largest population. **Figure 2.1** shows the county's communities and road network. Unincorporated communities within the county include Marty, Academy, and Greenwood.

There are also a number of other populated places located within Charles Mix County, including three Hutterite colonies, each of which has approximately 125 to 150 residents [2]. Also, there are several recreational areas located along the Missouri River that contain a mixture of permanent housing and seasonally-occupied private camping areas. The two largest recreational areas are North Point, which is located just northwest of Pickstown (**Figure 2.2**), and Platte Creek (**Figure 2.3**), located several miles southwest of Platte.

Physical Characteristics

The landscape in Charles Mix County is mostly open, and the terrain is generally level, except along the Missouri River, where wooded draws characterize the landscape. Much of the land in the county is devoted to agricultural production, primarily row crops such as corn, soybeans, and wheat, and there is also a considerable amount of pastureland.

[2] Hutterite Colonies are rural, agriculturally-based communities occupied by descendants of German people who cling to many of their traditional ways. There are more than 400 Hutterite colonies located in the north-central United States and Canada.

Figure 2.1 – Political Map

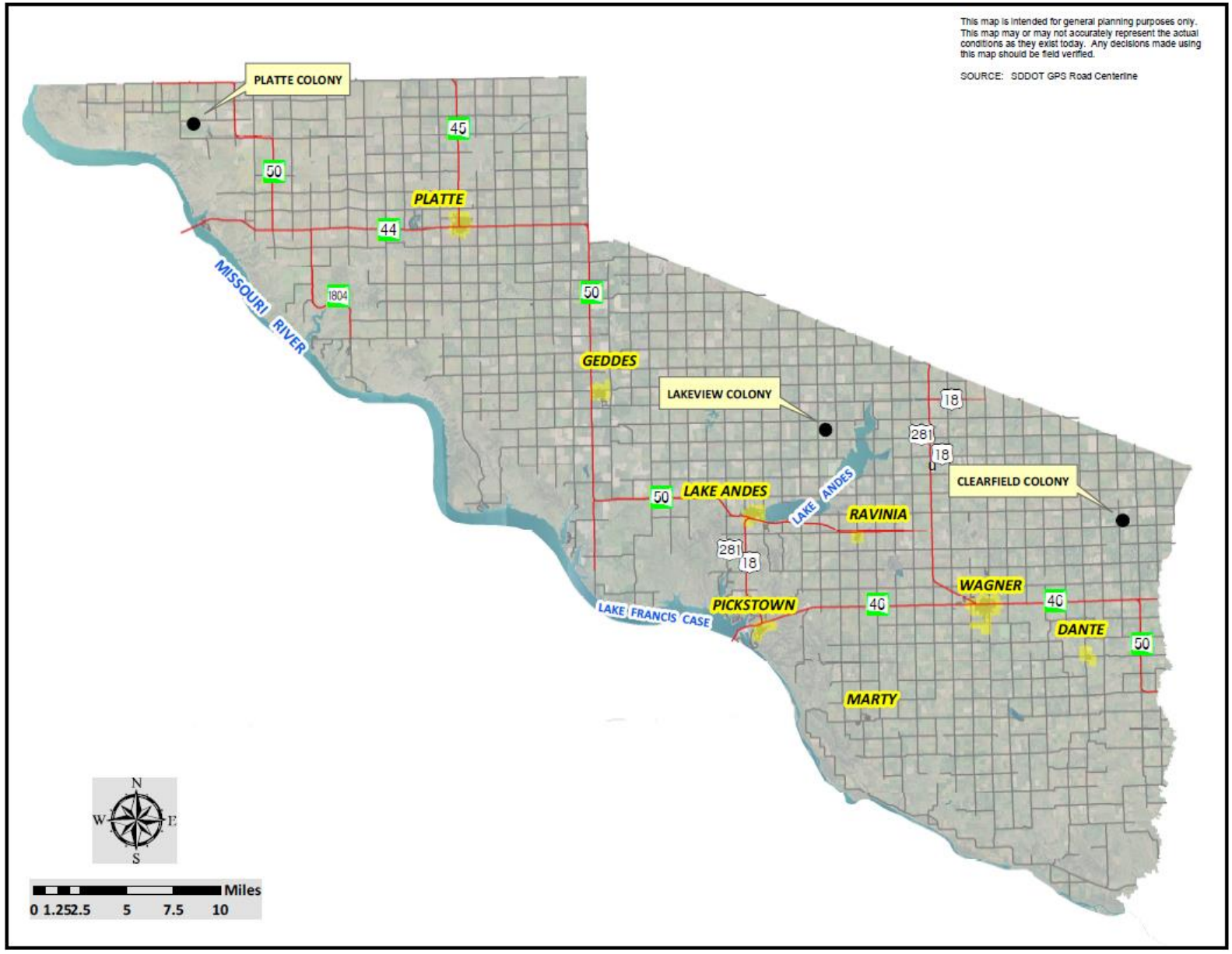


Figure 2.2 – North Point Recreation Area

Figure 2.3 – Platte Creek Recreation Area

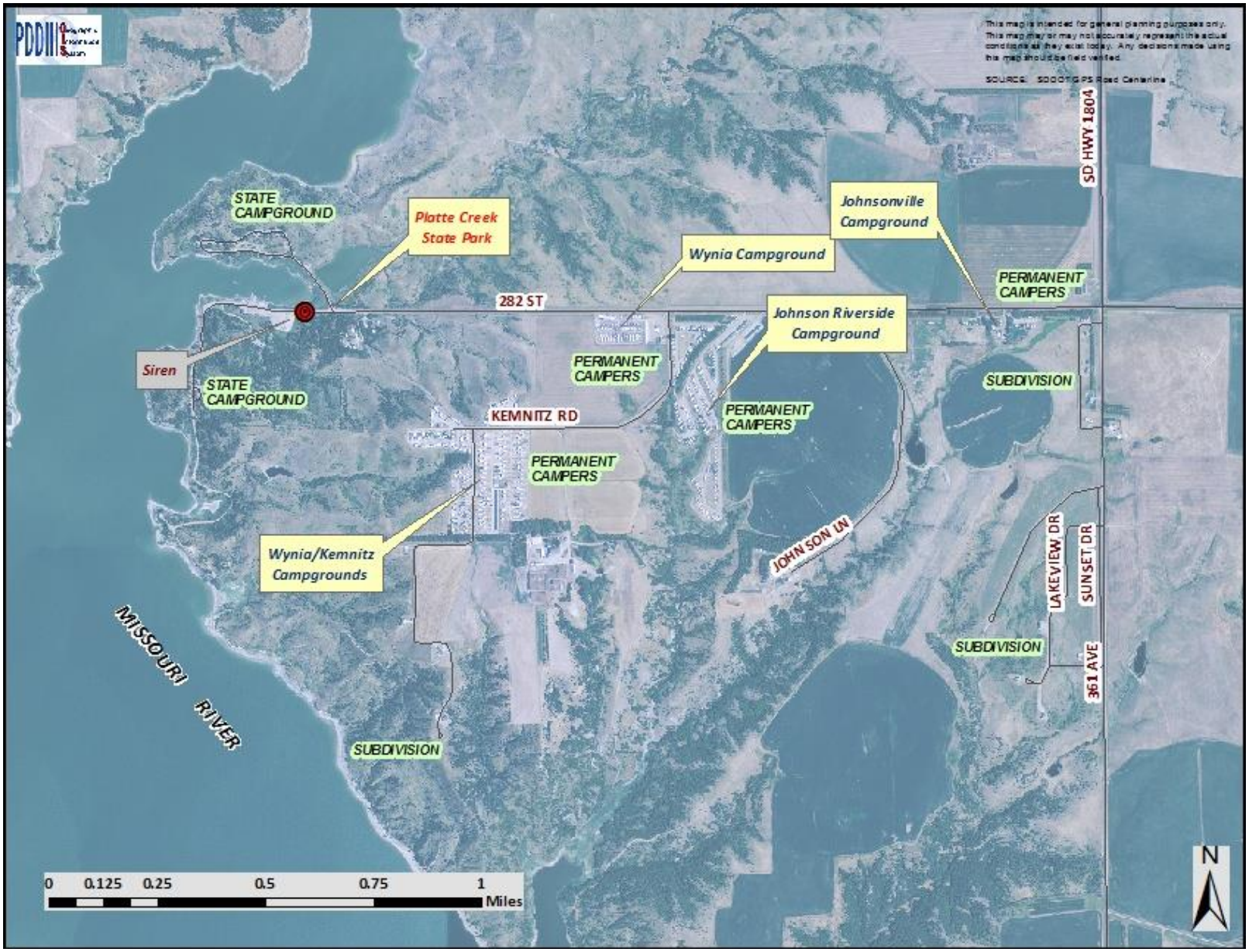


Table 2.1 provides a breakdown of the land cover in Charles Mix County. The table is based off satellite imagery downloaded from the United States Geological Service at http://www.mrlc.gov/, which was then processed using ArcGIS computer mapping software. As the table shows, the predominant types of land cover in the county are cultivated crops, pasture land, and grassland, which together comprise approximately 87 percent of the county's area. Developed land makes up only a very small fraction of the land area. **Figure 2.4** is a graphic representation of the county's land cover.

Table 2.1 - Vegetative Land Cover

Cover Type	Square Miles	% of Total Area
Cultivated crops	478.2	41.6
Pasture land	322.9	28.1
Grassland and Shrub/Scrub	197.1	17.1
Open water	58.2	5.1
Developed land (open space)	39.2	3.4
Forested land	25.8	2.2
Wetlands	24.5	2.1
Developed land (low to high intensity)	3.7	0.3
Barren land	0.5	----
Total Area	**1150.1**	

Source: http://www.mrlc.gov/index.php

Most soil in the county is fertile and well-drained, and therefore conducive to agriculture, as long as there is sufficient soil moisture. Excessive slopes and rocky soils are rare. Drainage is generally good, but there are many wetlands in the county, some of which are now used as waterfowl or wildlife production areas, while others have been drained for farming.

The climate of Charles Mix County is characterized as sub-humid and continental, which means that summers are often hot and winters can be very cold. There are no large bodies of water or mountain ranges to mitigate against these extremes. High temperatures in summer can exceed 100 degrees Fahrenheit [3], while winter lows can drop below -20 degrees. Precipitation averages about 20 to 25 inches per year, most of which occurs during the spring and early summer; winter snow is not frequent, but snow cover on the ground is fairly constant during many winters. Blizzards and other types of winter storms are a definite hazard. Following is climate data in the county as reported from the Wagner weather station.

Table 2.2 - Monthly Climate Conditions in Charles Mix County (1916 – 2011)

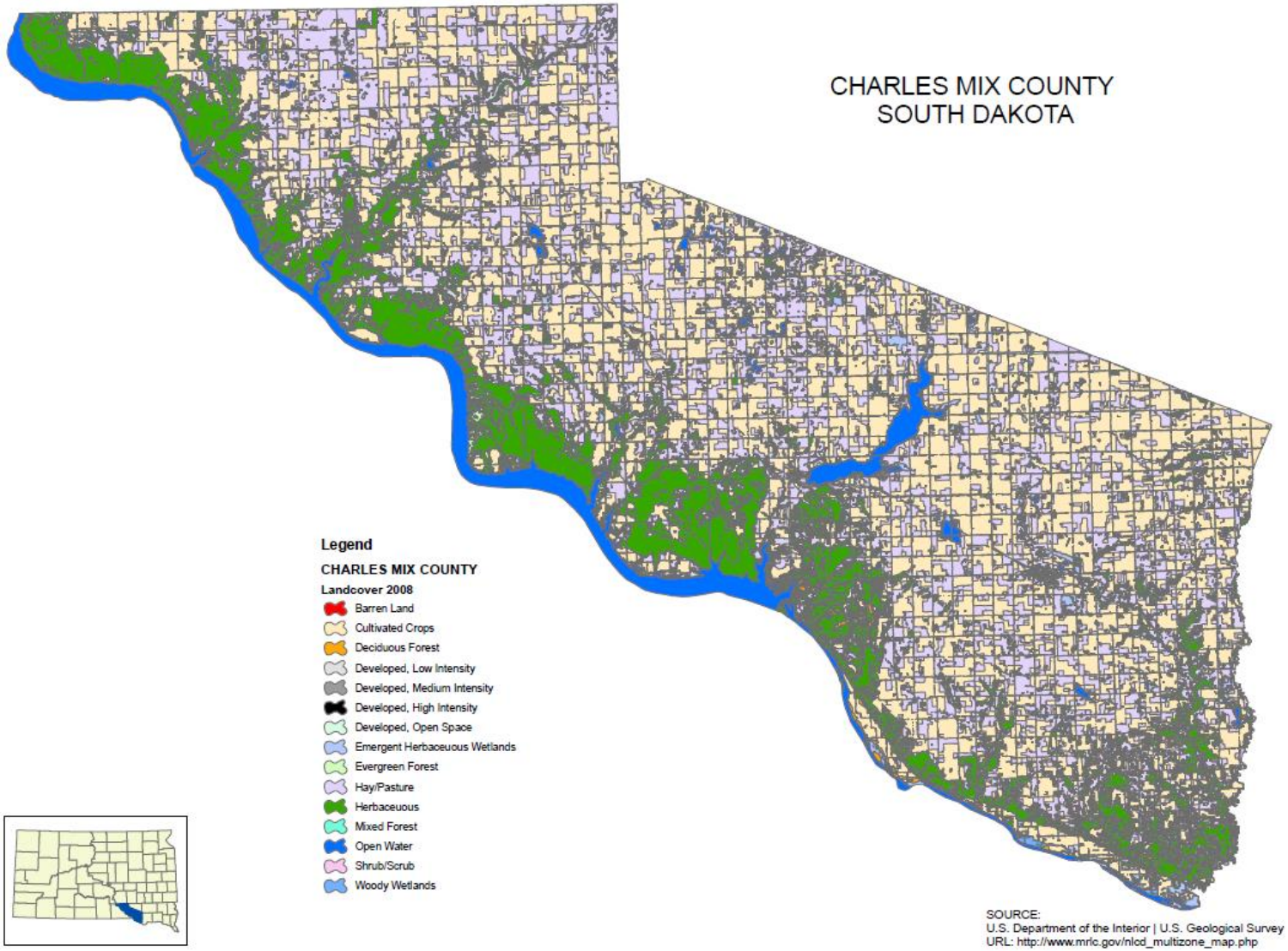
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ave High	30.9	36.2	47.7	62.7	74.5	84.0	91.0	88.7	79.3	65.7	47.5	34.6
Ave Low	8.9	13.8	23.7	36.1	47.5	57.6	63.5	61.3	51.2	38.6	24.8	13.9
Ave Precipitation	0.7	0.9	1.6	2.7	3.5	3.8	2.8	2.7	2.5	1.7	1.0	0.8
Ave Snowfall	7.3	7.9	8.6	3.4	0.1	0.0	0.0	0.0	0.0	0.9	4.7	7.9
Ave Snow Depth	3	3	1	0	0	0	0	0	0	0	1	2

Source: High Plains Regional Climate Center (http://www.hprcc.unl.edu/data/historical/)

The average high and low are in degrees Fahrenheit; the precipitation figures are in inches

[3] According to the National Weather Service, Sioux Falls, South Dakota has averaged about two days per year of 100 degree temperatures since records began to be kept in 1893.

Figure 2.4 - County Land Cover



The impact that climate change may have on the county is difficult to predict with any certainty. The South Dakota Hazard Mitigation Plan discusses climate change in some depth, analyzing its possible impacts for each of the hazards affecting the state. According to the plan, mean temperatures have been increasing in the northern Great Plains region where South Dakota is located, especially in the winter. This trend may lead to increased evaporation and drought frequency, which will compound water scarcity problems. Across South Dakota, there is a long-term trend of increasing annual precipitation, among the highest in the country. The majority of this increase is occurring in the spring and fall seasons, and there is high confidence that precipitation extremes will increase in frequency and intensity that could exacerbate flooding.

Communities that are already the most vulnerable to weather and climate extremes will be stressed even further by more frequent extreme events occurring within an already highly variable climate system. According to the plan, increased demand for water and energy will constrain development, stress natural resources, and increase competition for water. New agricultural practices will be needed to cope with changing conditions. Still, there is no consensus as of yet on climate change science, and therefore it is difficult to make any definitive plans for climate change at this time.

Socioeconomic Description

Charles Mix County is sparsely populated. The county had a Census 2010 population of 9,129, and a population density of only 8.3 people per square mile. In comparison, the State of South Dakota, which is one of the least densely populated states in the nation, has a population density of 11.1 per square mile, and the national figure is 89.5. Charles Mix County has been experiencing a steady population decline for the last several decades, although the population has stabilized since 1990 and is expected to increase slightly in the near future.

Table 2.3 – Charles Mix County Population Change

Pop 1950	Pop 1960	Pop 1970	Pop 1980	Pop 1990	Pop 2000	Pop 2010	Pop 2017 Estimate	Pop 2030 Projected
15,558	11,785	9,994	9,680	9,131	9,350	9,129	9,319	9,757

Sources: U.S. Census (http://factfinder2.census.gov/faces/nav/jsf/pages/index.xhtml); University of South Dakota Governmental Research Bureau

Table 2.4 provides basic demographic information for the county. The table shows that a relatively high proportion of the county's population is composed of minorities, primarily Native Americans. The table also shows that the county has a relatively high percentage of both the young and old.

Table 2.4 - Racial and Age Characteristics (2010)

Entity	White Population	Black Population	American Indian Population	Asian Population	Other Racial Group	Population Under 20	Population 65 and Over	Median Age
Charles Mix Co.	63.9%	0.0%	32.2%	0.2%	3.7%	32.4%	17.8%	39.0
South Dakota	85.3%	1.5%	8.8%	1.1%	3.3%	27.6%	14.6%	36.8
United States	73.9%	12.6%	0.8%	5.0%	7.7%	26.3%	13.7%	37.4

Source: U.S. Census (factfinder.census.gov/faces/nav/jsf/pages/index.xhtml)

Charles Mix County's economy is dependent to a large extent upon agriculture. Industry and manufacturing are not a significant part of the local economy. In part because of the lack of high wage occupations, income levels in the county are well below state figures, as shown in **Table 2.5**. Poverty and unemployment rates tend to be fairly high among the county's Native American population, which may contribute to the county's lower than average socioeconomic standing.

Table 2.5 - Socioeconomic Characteristics (2010)

Entity	Median Family Income	Family Poverty Rate	High School Grad or Higher	Bachelor's Degree or Higher
Charles Mix Co.	$51,974	15.4%	85.2%	16.1%
South Dakota	$62,967	8.7%	90.1%	26.0%
United States	$64,585	10.9%	85.7%	28.5%

Source: U.S. Census (http://factfinder2.census.gov/faces/nav/jsf/pages/index.xhtml)

Infrastructure and Utilities

Transportation

Charles Mix County's main transportation routes are SD Highway 50, US Highway 18, US Highway 281, SD Highway 44, and SD Highway 45. There are no active railroad lines in the county, although there are plans to rehabilitate the old Napa Rail Line that once connected the communities of Dante, Wagner, Ravinia, Lake Andes, Geddes, and Platte. It is not known when the railroad line might be reactivated. Lake Andes, Platte, and Wagner each have a municipal airport suitable for small aircraft. The Wagner airport has a runway long enough to accommodate small jets.

Utilities

Water service is provided throughout Charles Mix County by the Randall Community Water District. The water district serves rural county residents individually, including those in Dante and Ravinia, and provides bulk water to the municipalities of Geddes, Lake Andes, Pickstown, Platte, and Wagner. Each of the towns has its own wastewater collection and treatment system, except for Dante. Residents there, and in all the rural areas of the county, rely on septic systems.

Solid waste service is provided by the Southern Missouri Recycling and Waste Management District, which operates a landfill located about 1.5 miles west of Lake Andes. Most of the household waste generated within Charles Mix County ends up at the landfill. Designated rubble sites are located outside the larger towns in the county.

Electric power is provided to rural county residents by the Charles Mix Electric Association, which also supplies power to the Fort Randall Casino, a major power user. NorthWestern Energy serves all municipal users, except those in Pickstown, which has its own municipal power system. Natural gas is not available anywhere in the county.

Telephone service is provided by the Fort Randall Telephone Company, which serves Dante, Lake Andes, Pickstown, Ravinia, and Wagner; and Midstate Communications, which serves Geddes and Platte. Cellular phone service is available throughout the county, but there are still some areas where signals are weak or non-existent.

Services

Medical Services

Basic medical service is available within Charles Mix County at medical clinics in Geddes, Lake Andes, Platte, and Wagner. More advanced service is available at the Platte Health Center and the Wagner Community Memorial Hospital, both of which are classified as critical access hospitals. The Indian Health Service operates a facility in Wagner, which is available for Native Americans. People needing serious medical attention can be transported to trauma center hospitals in Sioux Falls or elsewhere.

Fire and Emergency Response

Several fire departments are based in Charles Mix County; they are located in Academy, Dante, Geddes, Lake Andes, Platte, Ravinia, and Wagner. Each department has basic firefighting and rescue equipment, and they all respond to structural fires, wildland fires, and to accident situations. The Platte, Wagner, and Lake Andes departments, being larger than the others, have a greater array of equipment and can respond to more serious situations. See **Table 3.5** for more information about the departments.

Education

High schools are located in Lake Andes, Marty, Platte, and Wagner. Post-secondary education is offered at the Yankton Sioux Tribe's Ihanktonwan Community College in Marty.

CHAPTER III
RISK ASSESSMENT

Background

The risk assessment process provides the foundation for the rest of the mitigation planning process. It sets the stage for identifying mitigation goals and actions to help Charles Mix County become disaster resilient and keep county residents safe, and it answers the following questions: What are the hazards that could affect Charles Mix County? What could happen as a result of those hazards? How likely are the possible outcomes? When the outcomes occur, what are the likely consequences and losses?

As outlined in the South Dakota Hazard Mitigation Plan, the Federal Emergency Management Agency defines risk assessment terminology as follows:

- **Hazard**—A hazard is an act or phenomenon that has the potential to produce harm or other undesirable consequences to a person or thing.
- **Vulnerability**—Vulnerability is susceptibility to physical injury, harm, damage, or economic loss. It depends on an asset's construction, contents, and economic value of its functions.
- **Exposure**—Exposure describes the people, property, systems, or functions that could be lost to a hazard. Generally, exposure includes what lies in the area the hazard could affect.
- **Risk**—Risk depends on hazards, vulnerability, and exposure. It is the estimated impact that a hazard would have on people, services, facilities, and structures in a community. It refers to the likelihood of a hazard event resulting in an adverse condition that causes injury or damage.
- **Risk Assessment**—The process of measuring the potential loss of life, personal injury, economic injury, and property damage resulting from hazards.

According to FEMA's mitigation planning guidance, the basic components of the risk assessment are: 1) identifying hazards that affect the community, 2) profiling the hazards, 3) conducting an inventory of community assets, and 4) estimating losses. This process measures the potential loss of life, personal injury, economic injury, and property damage resulting from natural hazards by assessing the vulnerability of people, buildings and other property, and infrastructure to natural hazards.

After reviewing the risk assessment section of the current plan, the planning team decided that no major changes were needed to the risk assessment. However, many of the tables have been updated with more current information, including **Table C.2** in **Appendix C**, which lists significant hazard events in the county. Also, it was felt that the flood risk analysis needed

to be updated, because the information in the current plan was becoming dated and because of the major flooding impacts that occurred in the county in 2019. This analysis was done under the director of Harry Redman, GIS specialist with Planning & Development District III.

Identifying Hazards

The planning team began the risk assessment by reviewing the South Dakota Hazard Mitigation Plan, focusing on the hazards identified in that plan. The team also reviewed the risk assessment section of the county's current mitigation plan, and it was decided that all of the hazards discussed in that plan should be kept for this update, with no other hazards added or deleted.

The team then reviewed historical records of hazard events that have occurred in the county, relying on the National Climatic Data Center's Storm Events Database. See **Appendix C** for a list of the storm events.

After reviewing these sources, the planning team settled on the hazards they wanted to address in this plan, those that they considered to pose a significant threat to the county. Following are the hazards addressed in this plan as selected by the team:

- **Winter storms (includes blizzards, heavy snow, icing, and high wind events)**
- **Summer storms (includes thunderstorms, tornados, hail, and high wind events)**
- **Flooding**
- **Drought**
- **Wildfire**

The planning team acknowledges that additional hazards could have been addressed in this plan. High wind events, for instance, are not considered separate from winter storms and summer storms. Following is a list of other hazards the team considered including in this plan, but chose not to, with a justification for their omission from this plan:

- Geologic Hazards – these hazards, which include earthquakes and landslides, are given a limited level of planning analysis in the South Dakota Hazard Mitigation Plan, but the state is not particularly vulnerable to such events. For example, the plan states that earthquakes have never caused significant damage in South Dakota. A map generated through the U.S. Geological Service Earthquake Hazards Program website indicates that there is only about a two percent chance that a quake of at least magnitude 5 will occur in Charles Mix County in any 100 year period, and virtually no chance of a magnitude 6 or greater earthquake [4]. No significant earthquake has ever been recorded in Charles Mix County, although minor quakes ranging in magnitude from 3.8 to 4.4 have been recorded in adjacent counties. Regarding landslides, a review of the United States Geological

[4] A magnitude 5 earthquake is considered moderate, potentially causing varying amounts of damage to poorly constructed buildings, but significant damage would be unlikely to occur. A magnitude 6 quake is strong, with the potential to cause damage to well-built structures.

Survey's Landslide Incidence and Susceptibility Map indicates the potential of a landslide occurring in Charles Mix County along the Missouri River, but any such event likely would be localized, minor in scale, and located far from any populated areas.

- Agricultural pests and diseases - this hazard is given a moderate level of planning analysis in the South Dakota Hazard Mitigation Plan. However, the planning team considered the subject matter to be outside the intended focus of this plan.
- Hazardous materials - this hazard is given a moderate level of planning analysis in the South Dakota Hazard Mitigation Plan. But again, the planning team considered the subject matter to be outside the scope of this plan, as they wanted to focus on natural hazards.
- Infectious diseases – the Coronavirus pandemic of 2020 hit just as this plan was being updated. The team considered the possibility of addressing the Coronavirus and other types of infectious diseases, but decided the subject matter was outside the focus of this plan.

Hazard Profiles

In this section, each of the hazards the planning team chose to focus on is described in terms of the hazard's ***location*** within Charles Mix County, its ***extent***, the ***history*** of the hazard's occurrence in the county, the ***probability*** of future events, and the local ***resources and capabilities*** available to mitigate against the hazard. In addition, a background description of each hazard is presented at the beginning of each hazard's profile.

- ***Location*** is the geographic areas within the county that are affected by each of the hazards. Some of the hazards - winter storms, summer storms, and drought - do not have a geographic definition at this level of analysis, since they impact all areas of the county equally. Flooding and wildfires, however, do impact specific areas of the county more than others. The maps presented at the end of this chapter show locations vulnerable to flooding within each jurisdiction. A map showing areas most vulnerable to fires is presented on page 47.
- ***Extent*** is the strength or magnitude of the hazard, which is described in a variety of ways depending on the type of hazard. For example, tornado strength is measured on the Fujita Scale, high wind events are measured by speed, fire is measured in terms of acres affected, and certain hazards are measured in terms of the duration of the event.
- A brief section on the ***history*** of each hazard's occurrence in the county is presented, with a description of some of the most significant events. More information about the hazard events that have impacted the county is presented in **Appendix C**, including a comprehensive list of weather-related hazard events recorded in the county since 1960, and records of hazard events that resulted in a major disaster declaration in the county.
- ***Probability*** of occurrence of a hazard impacting an area is the likelihood that such an event will occur. In this plan, a hazard with a "high" probability is one that is

expected to occur at least five times over a ten year period, a "moderate" probability hazard is expected to occur from two to five times in any given ten year period, and a "low" probability hazard would be expected to occur no more than twice per ten year period. Determination as to the probability of hazard events occurring in the future was based largely on an analysis of the frequency of past hazard events in Charles Mix County and through discussions with members of the planning team.

- Information about the existing ***resources and capabilities*** to mitigate against each hazard is included. This includes plans and regulatory mechanisms, administrative and technical resources, financial resources, and education and outreach.

Winter Storms

Description

Winter storms historically occur from late fall to the middle of spring, varying in intensity from mild to severe. Winter storms have a major impact in South Dakota, regularly destroying property and killing livestock. Such storms are generally classified into four categories - freezing rain, sleet, snow, and blizzard - with some taking the characteristics of different categories during distinct phases of the storm.

Freezing rain coats objects with ice, creating dangerous conditions. Sleet does not generally cling to objects like freezing rain, but it does make the ground very slippery, increasing the number of traffic accidents and personal injuries due to falls. Heavy snow can make travel difficult, and can collapse roofs.

Blizzards occur when snow is combined with high wind, producing blowing snow that results in low visibility. When such conditions arise, blizzard warnings are issued. These warnings take effect when wind conditions are at least 35 mph and temperatures of 20 degrees Fahrenheit or less over an extended period of time are expected. Severe blizzard conditions exist when heavy snow is accompanied by winds of at least 45 mph and temperatures of 10 degrees Fahrenheit or lower. Early blizzards in South Dakota were so devastating that the state once had the dubious distinction of being called the Blizzard State.

Winter storms can have a big impact on the power lines operated by rural electric providers, especially when they are accompanied by high winds or freezing rain. They can knock down power lines, which tend to be the most vulnerable elements of the electrical grid, and can even snap the poles.

Location

The topography of South Dakota is such that no part of the state is immune from the effects of winter storms. Farmland and grassland, which covers most of the state (including Charles Mix County) offers little resistance to high winds and drifting snow, and there are no large bodies of water or mountain ranges to mitigate against temperature extremes. All areas of the county are equally likely to be impacted.

Extent

The extent of winter storms in Charles Mix County can be quite substantial. In terms of snowfall, many winter storms in the county have dropped more than 10 inches of snow. In terms of duration, some winter storms in the county have resulted in power outages of over a week in some locations, although typical outages last for no more than a few hours. Regarding wind speed, **Table C.2** in **Appendix C** shows numerous records of high wind events occurring during the winter months with wind speeds in excess of 50 miles per hour.

History

Table C.2 in **Appendix C** lists many significant winter storms that have impacted the county. As **Table C.1** in **Appendix C** shows, winter storms resulting in a major disaster declaration have occurred in Charles Mix County in 1996, 1997, 2005, and 2019.

One of the most serious winter storms to occur in the state happened between October 22 and 24, 1995, resulting in FEMA Disaster Declaration 1075, which was declared in January 1996. As the storm moved eastward across South Dakota, ice and five to 15 inches of wet snow formed on electric lines, poles, and trees. Winds associated with the storm caused lines to slap together and poles to snap, producing widespread power outages to large portions of rural South Dakota, including Charles Mix County. The damage included broken poles, broken wires, and substation failures due to transmission line damage. The storm also forced major transportation delays because of snow accumulation on roadways and poor visibility. The combination of power outages and travel difficulty resulted in numerous cancellations and delays in school openings.

Statewide, the electric cooperatives lost nearly 9,500 poles and 170 transmission lines in this storm, resulting in damage estimated at $10 million to $10.3 million. Total statewide damage from the event was estimated at over $13 million, and approximately 30,290 households were affected by the power outages. Some cooperatives did not get power restored to all households until November 5. The power outages led to several rural water system pumping stations to go off-line, causing a loss of water service to members of rural water systems. The National Guard was utilized to provide generators to power these pumping stations, thereby restoring water service. Crews from electric cooperatives in neighboring states assisted local cooperatives with line repairs.

Another very serious winter storm to impact Charles Mix County occurred in late November 2005 when heavy freezing rain coated roads and power lines with ice up to three inches thick throughout much of southeast South Dakota. The storm resulted in FEMA Disaster Declaration 1620. In the affected area, a total of 9,400 power poles were damaged, leaving approximately 56,000 people without electricity for varying amounts of time. The Charles Mix Electric Association lost 1,100 poles in the county due to the storm; their total damages were over $1.5 million. Many roads were shut down for extended periods, and most schools and businesses were forced to close. The southeast part of Charles Mix County suffered the most damage from this storm, with some households out of power for up to a week as power lines were being repaired.

A very unusual late-season winter storm struck much of eastern South Dakota in mid-April 2013, resulting in FEMA Disaster Declaration 4115. Although Charles Mix was not one of the designated counties in this disaster, the county did not escape from the effects of the storm, which featured heavy, wet snow and icing that brought down power lines and trees in various locations.

Another late-season winter storm struck South Dakota in March 2019, resulting in FEMA Disaster Declaration 4440. The storm resulted in approximately $330,000 of public assistance funds allocated in Charles Mix County.

Probability

Table C.2 shows numerous records of significant winter storm events in Charles Mix County since the mid-1990s, an average of about three and a half per year. Therefore, based on the historic evidence, the probability of a significant winter storm affecting Charles Mix County in a given year is high. The probability of a winter storm causing substantial damage (e.g. power lines blown down) in any given year is at least moderate.

Resources and Capabilities

Following is a description of the local resources and capabilities available for dealing with winter storm events.

- The county and each of the towns has equipment for dealing with winter storms. A list of the equipment can be found in the Charles Mix County Local Emergency Operations Plan, which is updated regularly.
- Facilities are available in each community that can be used to provide short term shelter during an extended power outage or other emergency situation. The following table provides information about the facilities.

Table 3.1 – Shelter Facilities

Community	Facility	Generator	Kitchen/Feeding Capacity	Med Supplies	Cots, Blankets
Dante	Community Dance Hall		100		25
Lake Andes	Community Center		21 to 50		10 to 30
Lake Andes	Andes Central School		30		50 to 100
Pickstown	Community Center		100 to 199		30 to 70
Platte	Platte School		21 to 50	Yes	20 to 50
Platte	Platte Health Center	250 kW	100 to 199	Yes	20 to 50
Wagner	Fire Dept		40 to 50		
Wagner	Good Samaritan Center	85 kW	100 to 199	Yes	70 to 120
Wagner	National Guard Armory		40 to 50	Yes	70 to 150

- The Charles Mix Electric Association maintains a list of priority projects in its work plan. The Association is a party to the South Dakota Electric Cooperatives Mutual Aid Plan, which commits participating cooperatives to come to the aid of other cooperatives in times of emergency.

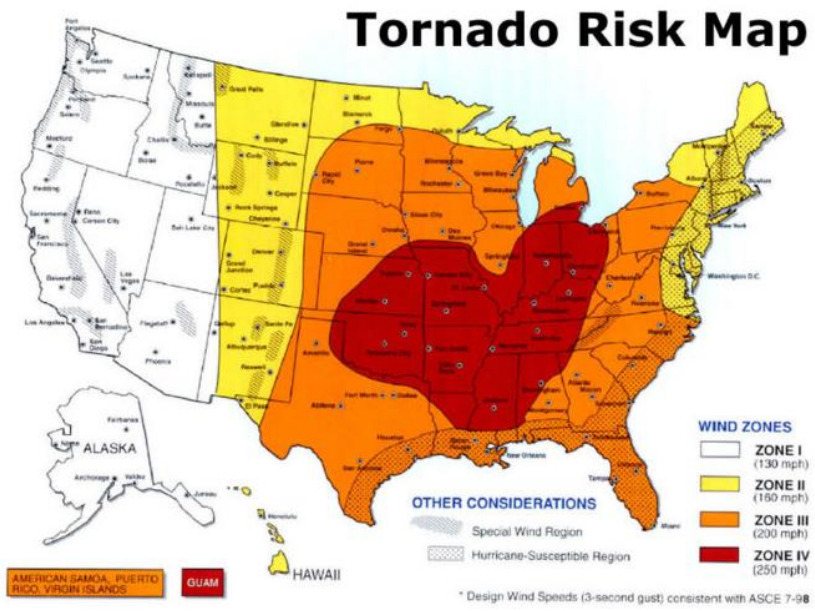
- The county participates actively in public awareness campaigns in conjunction with the State Office of Emergency Management and the National Weather Service, as well as sponsoring local awareness activities.
- The county LEPC plans for winter operations annually, which helps ensure a safe and efficient response for people in need of emergency assistance.

Summer storms

Description

Summer storms can include heavy rainfall, hail, tornadoes, and thunderstorm activity. These events usually are associated with unstable weather conditions. In Charles Mix County, most damage from summer storms occurs because of high wind events and/or hail. Hail is always closely connected with thunderstorms. Hailstones can be pea-sized, up to the size of baseballs. Large hailstones are dangerous to people and animals, but most hail damage is typically suffered by crops or structures. Almost every year someone in Charles Mix County reports some kind of hail damage to crops or property.

Tornadoes are the most dramatic type of summer storm experienced in Charles Mix County, and are a special source of concern. They are one of nature's most violent storms, capable of tremendous destruction with wind speeds of 250 mph or more. Damage paths can be a mile wide and can extend for more than 50 miles. Tornadoes mostly occur in South Dakota during the months of May, June, and July. The greatest period of tornado activity is between 4 PM and 6 PM. Tornadoes present a difficult mitigation challenge, since few structures can withstand the violent winds of a twister.



South Dakota is located near the northwest edge of the core area of tornado activity in the United States, as shown in this image. Often referred to as "tornado alley", this part of the country is particularly susceptible to tornadoes in part because the terrain is relatively flat, which allows warm, humid air from the Gulf of Mexico and cool, dry air from Canada to crash into each other, creating large super cells. According to the National Oceanic and Atmospheric Administration's Storm Prediction Center, South Dakota ranked eighth in the nation in the frequency of tornadoes from 1950 to 1994, with a total of 1,139 tornadoes reported in the state (an average of 25.3 per year). During this period, there were 11 deaths

in the state attributed to tornadoes, and 243 injuries. South Dakota ranked 27th in the nation in tornado damage, with average annual losses of $3.8 million.

Location

Summer storms are equally likely to occur in all parts of the county.

Extent

The extent of summer storms can be measured in many ways. In terms of wind speed, **Table C.2** in **Appendix C** shows numerous records of thunderstorms that produced wind speeds over 60 miles per hour, as well as many high wind events in the warmer months with wind speeds over 60 miles per hour. **Table C.2** also shows many events with hail over one inch in diameter. In terms of onset, summer storms typically develop with a long warning time, although certain hazards associated with such storms, such as hail or tornadoes, can develop more suddenly.

Regarding tornadoes, **Table C.2** shows three records of a tornado with a magnitude greater than F1. The following table lists the entire range of tornado strength according to the enhanced Fujita scale.

Table 3.2 – Enhanced Fujita Scale

Scale	Wind Speed (MPH)	Potential Damage
EFO	65 to 85	Minor damage. Peels surface off some roofs; some damage to gutters or siding; branches broken off trees; shallow-rooted trees pushed over.
EF1	86 to 110	Moderate damage. Roofs severely stripped; mobile homes overturned or badly damaged; loss of exterior doors; windows and other glass broken.
EF2	111 to 135	Considerable damage. Roofs torn off well-constructed houses; foundations of frame homes shifted; mobile homes completely destroyed; large trees snapped or uprooted; light-object missiles generated; cars lifted off ground.
EF3	136 to 165	Severe damage. Entire stories of well-constructed houses destroyed; severe damage to large buildings; trains overturned; trees debarked; heavy cars lifted off ground and thrown; structures with weak foundations badly damaged.
EF4	166 to 200	Devasting damage. Well-constructed and whole-frame houses completely leveled; some frame homes may by swept away; cars and other large objects thrown and small missiles generated.
EF5	Over 200	Incredible damage. Well-built frame houses destroyed with foundations swept clean of debris; steel-reinforced concrete structures critically damaged; tall buildings collapse or have severe structural deformations; cars, trucks, and trains can be thrown approximately 1 mile.

https://en.wikipedia.org/wiki/Enhanced_Fujita_scale

History

Charles Mix County has experienced many summer storms that have caused significant damage. **Table C.1** in **Appendix C** shows that several of these storms resulted in a Presidential disaster declaration, and **Table C.2** in **Appendix C** lists many other significant summer storms

that have occurred in the county, including many storms that were accompanied by tornadoes.

One of the more significant summer storms in Charles Mix County occurred in June 2003 when a storm accompanied by large hail caused severe crop damage in a 15 mile-wide area over southern and eastern parts of the county. About 60,000 acres of crops were damaged or destroyed as hail accumulated to a depth of several inches in places, with drifts as high as four feet in the Wagner area. The hail cracked windows and damaged siding in the Wagner area.

In August 2007 a storm accompanied by hail impacted the Dante and Wagner areas. A state record size hailstone certified at almost 7" in diameter occurred at Dante.

Although there are no records of a truly devastating tornado event in Charles Mix County, several tornadoes have caused significant damage. In 1962, several houses in Lake Andes were damaged by a tornado, in 1971 a tornado damaged some homes in Platte, and in 2000 a tornado damaged three homes in Wagner.

Probability

Table C.2 shows that numerous significant summer storm events have occurred in Charles Mix County, well over one per year on average. Therefore, based on the historical evidence, the probability of a summer storm occurring somewhere in the county in a given year is high. However, the probability of a storm causing significant damage (e.g. damaging hail or a tornado) in the county in a given year is low to moderate.

Regarding tornadoes, **Table C.2** shows 27 days in which a tornado was recorded in Charles Mix County since 1960, an average of almost one every other year. It is likely that other tornadoes occurred in the county during this period, but were unnoticed or unreported.

Resources and Capabilities

Following is a description of the local resources and capabilities available for dealing with summer storms.

- Outdoor warning sirens are located in each community, and at some of the recreation areas along the Missouri River. Each siren is tested regularly, and all but the Marty siren can be activated from the 911 dispatch center in Lake Andes.
- The basement of the county courthouse in Lake Andes is a public facility that can provide shelter during a tornado or other emergency situation. Some of the recreation areas also have a storm shelter available.
- As described above under the Winter Storm profile section, the Charles Mix Electric Association maintains a list of priority projects in its four-year work plan, and the Association is a party to the South Dakota Electric Cooperatives Mutual Aid Plan.
- Weather spotters are in place throughout the county.

- The county participates actively in public awareness campaigns in conjunction with the State Office of Emergency Management and the National Weather Service, as well as sponsoring local awareness activities.

Flooding

Description

Floods are among the most serious and costly disaster events. In South Dakota, there are two main climatologic causes of flooding: runoff from rainfall and runoff from melting snow. The water from rainfall or melting snow flows overland until it reaches a nearby river or lake. If the river or lake cannot hold all of the water that is entering it, some of the water will begin to overflow, causing flooding. The size of the flood is influenced by such factors as the intensity or length of the rainfall, melting rate of the snow, and the infiltration of the water into the ground.

Following is a description of the four types of flooding that have the potential of impacting Charles Mix County, based on information in the South Dakota Hazard Mitigation Plan:

- Flash flooding, which results from several inches or more of rain falling in a very short period of time. This high intensity rainfall is commonly caused by powerful thunderstorms that cover a small geographic area. The flood that occurs as a result of this runoff happens very rapidly, and is generally very destructive, although usually only a small area is affected.
- Long-rain flooding, which results after several days or even weeks of fairly low-intensity rainfall over a widespread area. This is the most common cause of major flooding. The ground becomes "water logged," and the water can no longer infiltrate into the ground. The flooding that results is often widespread, covering hundreds of square miles, and can last for several days or many weeks.
- Flooding resulting from melting snow in the spring. This type has characteristics of both flash floods and long-rain floods. The area covered is generally not as large as that covered by the long-rain flood, but is typically larger than that covered by the flash flood. Generally, the flood lasts for several days, occurring when large amounts of snow melt rapidly due to warm temperatures. The flooding can be made worse if the ground remains frozen while the snow is melting, causing the melt water to run off to nearby rivers and lakes rather than infiltrating into the ground. Some of the largest floods in South Dakota have been the result of melting snow and ice.
- Dam failure, resulting from natural or man-made causes. Charles Mix County is vulnerable to this type of flood primarily because of the Fort Randall Dam, which impounds the Missouri River and is considered to be a high hazard dam.

Location

In the past, the greatest flooding threat in Charles Mix County was along the Missouri River, which flows south/southeastward across South Dakota in a deep, wide channel, draining almost the entire state. Flooding along the river used to be an annual threat until a series of

huge dams along the river, including Fort Randall, was constructed in the 1950s. Now, most of the Missouri River within South Dakota consists of a chain of reservoirs impounded by the dams. From north to south, these dams are Oahe, Big Bend, Fort Randall, and Gavins Point, which were built for flood control, to provide water for irrigation, and for the generation of hydroelectricity. The Fort Randall Dam is located near Pickstown and it impounds Lake Francis Case (see **Figure 2.1**).

Because of the dams, the threat of flooding from the Missouri River has been greatly reduced, although it has not been entirely eliminated. In 2011, significant flooding along the river did occur, with substantial damage. The primary cause of the flooding was very heavy snowmelt at the river's source in the Rocky Mountains, along with extremely high spring rains throughout much of the river's drainage basin. The complicated politics concerning river management also played a role in the disaster that unfolded over the next few months.

In addition to land adjacent to the Missouri River, flood hazard zones are located along some of the river's tributary streams, along Choteau Creek, along an unnamed drainage in Wagner, and in the community of Marty (see maps at end of this chapter). Other low-lying areas of the county also are vulnerable to flooding, whether or not they are located in a designated flood zone. For instance, the small community of Ravinia was impacted by severe flooding in 2008 (see *History* section).

Extent

The extent of flooding in Charles Mix County has rarely been truly significant. Minor, localized flooding typically occurs in the county after very heavy rain events, especially in the spring following snowy winters. Floodwater depth is usually not significant. In terms of duration, flooding can cause road closures lasting from less than a day to several weeks or longer.

The most serious flooding the county has experienced was during the historic 2011 Missouri River flood when the river reached a record 8.8 feet above flood stage near Greenwood, inundating land along the river. The flooding that occurred in Charles Mix County in 2019 was notable both for its severity and its widespread impact throughout the county. Many areas of the county experienced water over county and township roads, with some roads closed for many months.

History

Many flooding events have impacted the county. **Table C.2** in **Appendix C** shows those that resulted in a Presidential disaster declaration, while **Table C.1** shows several other flood events that have impacted the county. Following is a summary of some of the more significant floods the county has experienced.

Serious flooding in 1984 resulted in FEMA Disaster Declaration 717, which caused almost $4.5 million of damage in the affected counties.

Flooding in 1995 resulted in FEMA Disaster Declaration 1052. All of South Dakota had above normal precipitation from January through May, with many weather stations in the central

and eastern portions of the state experiencing their all-time wettest Spring. Damage was caused by ground saturation and flooding due to very high residual groundwater tables from 1994, heavy winter snow and spring rain, and rapid snowmelt. Many roads were under water due to high groundwater saturation, causing interruption of emergency services. Damage also included power transmission and distribution facilities owned by rural electric cooperatives. In the area impacted by the flood, surveys identified over 3,000 homes with some type of damage, the majority caused by groundwater seepage of one to three inches into basements. In many areas the water table rose almost to the surface, saturating septic drain fields and preventing proper treatment of wastewater. The total damage estimate in the affected counties was over $35 million, which included $9.3 million in damage to public infrastructure.

Flooding in 1997 resulted in FEMA Disaster Declaration 1173, which was declared for all counties in South Dakota. At the time, the event was considered one of the top ten natural disasters ranked by FEMA relief costs. From November 1996 through February 1997 the weather across the eastern part of the state was cold and very wet, with record snowfall in many places. The persistent cold greatly limited snowmelt between storms, which caused snow to pile up from 10 to 24 inches deep. An early April blizzard added to the snow pack, and heavy rain later in the month combined to further saturate the ground. Prairie potholes turned into lakes, causing many people to be evacuated from their homes and farms, and preventing farmers from planting thousands of acres of land. The flood caused over $87 million in damage statewide, and took the lives of two people. In Charles Mix County, many township roads were damaged and culverts in various places were destroyed.

Flooding in 2008 resulted in FEMA Disaster Declaration 1774, which particularly affected the southeast part of the county. The community of Ravinia was especially impacted, with many of the town's roads under water for a period of about ten days. The high water caused the town's sewage lift station to fail, which left residents without sewer service for several weeks, and some houses suffered water damage. Big pumping equipment, including some provided by the U.S. Army Corps of Engineers, had to be brought in to deal with the situation.

Flooding in the spring and summer of 2010 resulted in FEMA Disaster Declaration 1915. Heavy rainfall of up to six inches caused widespread flash flooding of many county and township roads, residences, and fields. Some residences were damaged by the floodwater, and some temporary evacuations were necessary. The former Yankton Sioux tribal administration building in Marty, which had suffered previous flood damage in 2007 and 2008, had to be abandoned. See **Appendix C** for details about this event.

The Missouri River flood of 2011 may have been the most notable flooding event ever to occur in the recorded history of South Dakota, resulting in FEMA Disaster Declaration 1984. Although Charles Mix County did not suffer as much damage as some other parts of the state, the county did feel the impact of the event. The flood began to develop in May and increased throughout the month as runoff from excessive upstream snowmelt and rain reached the area. Lowland areas along the river began to flood, impacting recreational facilities and some roads. By the end of June the river reached a record 8.8 feet above flood stage near

Greenwood, where two households were evacuated and one house was lost to floodwaters. A newly built cabin located near the river a few miles east of the North Wheeler Recreation Area also suffered some flood damage. Many roads in the southeastern part of the county in the vicinity of the Missouri were damaged, and a great deal of farmland along the river was flooded. A slow drop in the river began in July and by late September flooding finally ended.

Flooding in 2019 had a major impact throughout the year in Charles Mix County, starting in March when heavy rainfall fell on frozen ground, which led to considerable overland flooding of agricultural lands and inundation of numerous roads. This event resulted in FEMA Disaster Declaration 4440. Flooding continued during the summer, and became even more severe in September after a six inch rainfall event. The heavy rainfall caused the Platte Dam to breach, temporarily washing out SD Hwy 44 until repairs could be made. South Dakota Highway 50 at Lake Andes, which had just reopened in late August after the spring flooding, was flooded out again, as were many other county and township roads. This event resulted in FEMA Disaster Declaration 4469.

Probability

Based on the historic evidence, the probability of minor flooding occurring somewhere in the county in a given year is moderate, but the probability of flooding resulting in significant damage is low. It is a certainty that flooding will continue to impact the county to some degree, no matter what mitigation actions are pursued.

Resources and Capabilities

An important resource available to mitigate against damage from flooding is managing development in floodplains and other areas prone to flooding. Charles Mix County and most of the municipalities in the county participate in the National Flood Insurance Program (NFIP) and have passed an ordinance to reduce future flood risk. In addition to mandating that all construction must have the lowest floor elevated to at least one foot above the base flood elevation, most of the ordinances also have requirements regarding anchoring, types of construction materials that may be used, and utility systems. The Wagner ordinance mandates that subdivision proposals must be consistent with the need to minimize flood damage. The following table provides information on NFIP participation in the county.

Table 3.3 – National Flood Insurance Program Participation

Jurisdiction	NFIP Participation Status	FIRM Effective Date	Insurance Policies in Force	Amount of Coverage	Number of Claims	Total Claims Paid
Charles Mix Co	Yes	6/02/2004	1	$50,000		
Dante	Yes	6/02/2004				
Geddes	No					
Lake Andes	Yes	(NSFHA)				
Pickstown	Yes	6/02/2004				
Platte	Yes	(NSFHA)	5	$1,448,000	3	$186,300
Ravinia	No					
Wagner	Yes	6/02/2004	2	$117,500		

Sources: www.fema.gov/policy-claim-statistics-flood-insurance; Marc Macy, SD NFIP Coordinator

Following is a description of other local resources and capabilities available for mitigating damage from flooding.

- The county passed a drainage ordinance in 2013. The ordinance is enforced by a drainage board consisting of the county commission, which meets as needed.
- Some of the communities within the county are continuing to implement drainage improvement projects. Wagner and Dante have completed projects within the last several years with the use of FEMA hazard mitigation funds.
- The U.S. Army Corps of Engineers has an emergency preparedness plan in place for the Fort Randall Dam. The Corps also has jurisdictional control over construction activity below the 1,365 foot elevation mark around Lake Francis Case, which is considered the ordinary high water (OHW) level. Any work below this elevation requires regulatory review and permitting, and in no case would the Corps issue a permit for a habitable structure.
- Inspection and maintenance of dams, culverts, and other drainage structures is performed regularly in the county.

Drought

Description

Drought is a deficiency in precipitation over an extended period of time, usually a season or more, resulting in a water shortage causing adverse impacts on vegetation, animals, and/or people. It is a normal, recurrent feature of climate that occurs in virtually all climate zones. Human factors, such as water demand and water management, can exacerbate the impact that drought has on a region.

Droughts can occur at any time of the year, but the consequences are worse during the summer growing season, especially after winters with below normal precipitation. A small departure in normal precipitation during the months of June through August can have a significantly negative impact on crop production. The demand for water for multiple uses also impacts water availability. Rural water systems that were originally designed to supply water for people are now also being used for cattle and to fight wildfires, taxing the limits of the systems.

Drought in South Dakota is often accompanied by periods of extreme heat. According to the National Weather Service, among natural hazards, only the cold of winter—not lightning, hurricanes, tornadoes, floods, or earthquakes—takes a greater toll on human life. Between 1936 and 1975, nearly 20,000 people were killed in the United States by the effects of heat and solar radiation, and in the heat wave of 1980, more than 1,250 people died. Elderly people, small children, those with chronic illnesses, and those on certain medications are particularly susceptible to heat stress.

Location

All areas of the county are equally likely to be impacted by drought.

Extent

Drought severity, the most commonly used term for measuring drought, is a combination of the magnitude and duration of the drought. In terms of magnitude, Charles Mix County has experienced many years of annual precipitation less than two thirds its average amount. In terms of duration, it is not unusual for Charles Mix County to experience periods of below normal precipitation that last for several months. During the 1930s, drought conditions persisted for multiple years. In an area that is so highly dependent on agriculture, the impact of a major drought can be significant. Although most agricultural producers now have crop insurance and agricultural practices today are more advanced, the impacts of drought can still be serious.

History

Charles Mix County has experienced many significant droughts. The drought of 1976 was one of the most severe in memory, resulting in South Dakota's only drought emergency declaration to date. Drought in 1980 and 1981 affected the entire state of South Dakota, and was rated as a 10 to 25 year event. Drought in 2012 was so devastating that the State of South Dakota activated a Drought Task Force.

The most significant drought in the area's history occurred in the 1930s, the so called dust bowl years. The drought came in three waves, 1934, 1936, and 1939-1940, but some parts of the Great Plains experienced drought conditions for as many as eight consecutive years. The soil, depleted of moisture, was lifted by the wind into great clouds of dust and sand which were so thick they concealed the sun for several days at a time. The "black blizzards" were caused by sustained drought conditions, compounded by years of land management practices that left topsoil susceptible to the forces of the wind.

Probability

Table C.2 in **Appendix C** shows at least one drought record in Charles Mix County in five of the years since 1999. Based on this, the probability of a significant drought occurring in the county in any given year is moderate. The probability of a truly severe drought impacting the county, such as occurred in 2012, is low, expected to occur no more than twice per ten years.

At the statewide level, the developers of the South Dakota Hazard Mitigation Plan cite tree ring research spanning a period of about 400 years indicating that multi-year droughts as significant as the 1930s drought occur on average every 57 years in South Dakota. Based on historical records, notable droughts have occurred somewhere in the state on average about every 12 years.

Resources and Capabilities

Resources at the local level in Charles Mix County to mitigate the impacts of drought are available. The Randall Community Water District has restrictions on the amount of water that it will distribute within its service area, and could take such action during extreme

drought conditions. The cities served by the water district could then enact regulations restricting non-essential water use, such as for watering lawns and washing cars.

In the agricultural sector, most farmers in Charles Mix County have crop insurance, which helps lessen the financial impact of drought. Furthermore, modern agricultural practices are more advanced (such as no-till farming and the development of more drought-tolerant crops), so farmers can better withstand years of below average rainfall.

Resources available at the state or regional level include the State Drought Task Force, which was activated during the severe drought of 2012. The goal of the task force is to monitor drought conditions by gathering the most current data available and to make sure that South Dakotans have access to that information as quickly as possible. The group coordinates the exchange of drought information among government agencies and agriculture groups, fire managers, and water-supply organizations. Another resource is the Natural Resource Conservation Service, which has information available about how to deal with droughts.

Wildfire

Description

Wildfires are uncontrolled conflagrations that spread freely through the environment. Such fires that occur near populated areas pose threats not only to natural resources, but also to human life and personal property. Wildfires are not as serious a concern in Charles Mix County as they are in more forested parts of the country, but the opinion of the planning team is that the hazard does warrant some attention in this plan.

Location

Wildfires in Charles Mix County are most likely to occur in large areas of extensive brush or unmanaged vegetation, including pastures and other types of grassland, dried out wetlands, and wildlife production areas. This includes the hills and draws along the Missouri River, which contain a significant amount of cedar trees and thick brush. Another concern is controlled burns that get out of control, which can occur almost anywhere in the county.

Extent

Each of the fire departments in the county submits reports to the South Dakota Division of Wildland Fire about the fires they fight. The division compiles the reports and produces a comprehensive database of all the records, which the planning team was able to obtain for fires occurring in the county from 2000 through 2019. The following table summarizes this information in terms of the size of the fires that have been fought. It shows that most of the fires have been fairly small, most impacting no more than a few acres.

Table 3.4 – Wildfires in Charles Mix County (2000 – 2019)

1 to 10 Acres	10 to 49 Acres	50 to 99 Acres	100 to 249 Acres	250 + Acres
246	84	19	17	4

Source: South Dakota Division of Wildland Fire (based on reports from the local fire departments)

According to the database, the most common specific cause of wildfires in Charles Mix County since 2000 has been from debris that caught fire, followed closely by equipment that ignited vegetation. Human-caused fires, such as fireworks, also have been fairly common. Lightning only accounted for about three percent of all fires reported.

History

Many notable wildfires have occurred in Charles Mix County, but nothing on a truly destructive scale. The largest known fire to occur in the county was the Chalk Rock Fire of 1985, which consumed 1,800 acres. In October 2011, several wildfires broke out in Charles Mix County during a four day period, the largest of which burned about 400 large hay bales, plus grassland (see **Appendix C**). There have been no fire-related Presidential disaster declarations involving Charles Mix County.

Probability

Wildfires affecting less than ten acres are likely to occur somewhere in Charles Mix County most years, but larger wildfires are much less common. **Table 3.4** shows only four wildfires over 250 acres in size from 2000 to 2019. Based on this period of analysis, the probability of a significant wildfire is low. The probability of a wildfire causing serious damage also is low.

Resources and Capabilities

Several fire departments are based in the county. Each department has volunteer firefighters who have had training in fighting wildfires; the level of training varies from basic to advanced. The departments also have adequate equipment and protective gear for their volunteers to handle most of the wildfires they are likely to encounter. Various mutual aid agreements also are in place which helps ensure that assistance is available during particularly serious wildfires and other emergency events. A summary of the capabilities of each fire department is presented in the following table.

Table 3.5 - Fire Department Resources and Capabilities

Dept	Vols	Vehicles	HazMat Capability
Dante	16	1 pumper, 2 brush trucks	No
Geddes	25	1 pumper, 3 tankers, 3 brush trucks	No
L Andes	35	1 pumper, 1 tanker, 3 brush trucks, 1 rescue	Yes
Platte	35	2 pumpers, 2 tankers, 5 brush trucks, 2 other	Yes
Ravinia	15	1 pumper, 3 brush trucks	No
Wagner	25	2 pumpers, 2 tankers, 4 brush trucks, 1 rescue	Yes

Following is a summary of the other local resources and capabilities available for dealing with wildfires.

- The county has a fire management plan, which was developed in 2005 with the assistance of the South Dakota Dept of Agriculture. The plan is focused on response, but it also includes sections on fire prevention and preparedness.

- The county adopted a burn ban ordinance during the extreme drought of 2012, which prohibits open burning when the National Weather Service's Grassland Fire Danger Index is at the Very High or Extreme level.
- A requirement is in place that those wanting to start controlled burns must first contact the E-911 dispatch center in Lake Andes.

Community Assets

Hazards can affect all parts of the community, but their impact on certain community assets is particularly important to consider. In this section, the most important community assets and facilities in the county are identified. The section begins by identifying those assets and facilities that would play a critical role in helping the community respond to a hazard event. Following this, certain other important community assets are identified, and the section ends with a brief discussion of some of the most vulnerable populations in the county.

Hazard Preparedness and Response

Government Offices

- Charles Mix County Courthouse, Lake Andes
- City offices in Dante, Geddes, Lake Andes, Pickstown, Platte, and Wagner
- Yankton Sioux Tribal Office, Wagner

Emergency Response

- Charles Mix County Emergency Management Office
- Charles Mix County Sheriff's Office, Lake Andes
- Police departments in Platte and Wagner.
- Fire departments in Dante, Geddes, Lake Andes, Pickstown, Platte, and Wagner
- Charles Mix County Highway Department, Lake Andes

Medical facilities

- Platte Health Center
- Wagner Community Memorial Hospital
- Indian Health Service Center, Wagner

Shelters

- Disaster relief shelters are located in each community (see page 21).
- Public emergency storm shelters are located at some of the recreation areas along the Missouri River.

Notification

- Warning sirens are located in each community, and at some of the recreation areas along the Missouri River.

Other Important Assets

Included in this category are assets and facilities that are important to the basic everyday functioning of communities, including educational facilities, major businesses, and other facilities. These assets generally would not have a direct role in the local response to a disaster event, although they could play a part. The schools, for example, could be used to shelter people during long-term power outages, whether or not they are officially designated as a shelter.

Educational Facilities

- Andes Central School, Lake Andes (K-12)
- Platte Community School (K-12)
- Wagner Community School (K-12)
- Marty Indian School (K-12)
- Ihanktonwan Community College, Marty

Important Businesses

- Dakota Manufacturing Company, Platte
- Dante Feed & Grain elevator
- Farmer's Cooperative Association elevator, Wagner
- Farmer's Elevator Company of Platte
- Fort Randall Casino (located between Pickstown and Wagner)
- Fousek Grain elevator, Wagner
- Geddes Farmer's Cooperative elevator
- Lake Andes Farmer's Cooperative elevator
- Meyerink Farm Service, Platte
- Platte Livestock Market
- Wagner Building Supply

Other Important Facilities

- U.S. Army Corps of Engineers, Pickstown
- Charles Mix Electric Association, Lake Andes
- Randall Community Water District, Lake Andes

Vulnerable Populations

The issue of vulnerable populations is important to consider, because such populations may be particularly vulnerable to disaster events. Vulnerable populations include the very young, the elderly, those with physical or mental disabilities, and the very poor. They can also include populations that tend to be isolated in some way from the rest of the community, such as those who are not fluent in English.

The South Dakota Hazard Mitigation Plan includes a section on social vulnerability, using the Social Vulnerability Index for the United States. This index, compiled by the University of South Carolina Hazards and Vulnerability Research Institute, measures the social vulnerability of all counties in the nation to environmental hazards. The index synthesizes 30 socioeconomic variables, which research suggests contribute to reduction in a community's ability to prepare for, respond to, and recover from hazards. The primary variables are race and class, wealth, percentage of elderly residents, Hispanic ethnicity, special needs individuals, Native American ethnicity, and service industry employment. According to the index, Charles Mix County is in the top 20% of counties in the nation most socially vulnerable to environmental hazards.

In the context of this plan, a specific population of concern is the aged, who tend to be more vulnerable to the effects of hazard events because of their physical or mental condition, or other factors. Many of the aged live in nursing homes and assisted living facilities. There are three such facilities in the county - the Lake Andes Nursing Home, the Platte Nursing Home, and the Wagner Good Samaritan Home.

Vulnerability and Loss Potential

This section assesses the vulnerability of Charles Mix County and the participating jurisdictions to the hazards profiled earlier in this chapter. Vulnerability is defined as the extent to which people and property are exposed to harm or damages created by a hazard. The method of determining vulnerability varies by the type of hazard and the availability of data, but each methodology is based on either potential for loss or actual losses. Following is a description of each specific methodology used.

Potential Loss Methodologies

- FEMA digital Flood Insurance Rate Maps were used to identify 100-year flood zones in the county. Using GIS, these flood zones were overlaid on parcel layer data to provide estimates of loss potential at the community level.
- FEMA's HAZUS loss estimation software was used to estimate potential flood losses in each community. HAZUS produces a flood polygon and flood-depth grid representing the 100-year floodplain, with losses calculated using national baseline inventories (buildings and population) at the census block level. The maps generated by HAZUS are not as accurate as FEMA's Flood Insurance Rate Maps, nor is the resulting data, but HAZUS is a helpful planning tool for areas that have not been mapped by the National Flood Insurance Program [5].

[5] A limitation of HAZUS is the inadequacies associated with the hydrologic and hydraulic modeling of the HAZUS model, especially in sparsely populated areas where census blocks - the basis of the loss calculations - are large. The software assumes the population and building inventory to be evenly distributed over the census blocks, whereas in reality flooding may occur only in a small part of the block where there are few buildings or people. Also, HAZUS uses default national databases that may not be applicable at the local level.

- Data on the population living in wildfire threat zones was used to estimate potential wildfire losses.
- The value of buildings within the county was used to estimate potential losses due to winter storms and summer storms (building exposure).
- Population density within the county was used to estimate potential losses due to winter storms and summer storms.

Actual Loss Methodologies

- The National Climatic Data Center's Storm Events Database was consulted for historical information regarding weather-related events (see **Table C.2** in **Appendix C**).
- Records from FEMA were consulted for federal assistance provided to Charles Mix County following major disaster declarations through FEMA's Public Assistance program (see **Table C.1** in **Appendix C**).
- Data from the U.S. Dept of Agriculture Risk Management Agency was used to assess crop loss due to a variety of natural hazards.
- Information from the National Drought Mitigation Center's Drought Impact Reporter was used to assess the local impact of droughts.
- Data from the South Dakota Division of Wildland Fire was used to assess the historical impact of wildfires in the county.

At the conclusion of the vulnerability assessment for each hazard, development trends are considered to determine whether the county's vulnerability to the hazard might increase in the future. Information on development trends in the county was obtained by analyzing population trends and projections, and through discussion with local officials about where housing development and other growth may be likely to occur. Other factors, including the possible impact of climate change, also are considered.

At the end of the chapter, the county's vulnerability to each hazard is summarized. Vulnerability is characterized as either "low", "moderate", or "high", based on the results of the risk analysis. Following the summary, maps are presented showing the community assets discussed in the previous section, and areas of known risk.

Winter Storms

All areas of South Dakota are vulnerable to winter storms, and the consequences of such storms can be great. They can disrupt the power supply when electrical lines are brought down by high winds, falling trees, or extreme ice buildup. Everyday activities can be significantly disrupted when road conditions deteriorate because of snow cover or precipitation that freezes on road pavement. In extreme situations, roads can be closed because of accumulated snow for days or even weeks. Winter storms also can kill or injure livestock, and can cause significant crop losses when they occur early in the growing season.

The rural areas of the county may be somewhat more vulnerable to winter storms than the towns. For example, transmission of electricity in rural areas is dependent on many miles of power lines located in open country that is highly susceptible to high wind events, especially when combined with freezing rain (high winds can snap power poles, and freezing rain and sleet forms ice on the lines, making them heavy and more susceptible to being blown down). The rural elderly are at particular risk at these times, because they are more likely to depend upon certain in-home health care systems that require electricity to operate.

Isolation also increases the vulnerability of people living in the rural areas of the county. For instance, if rural roads are blocked by snow for extended periods of time, people cannot travel into town for groceries, medical supplies, or other important items.

To assess the county's vulnerability to winter storms, the methodology that was used in the South Dakota Hazard Mitigation Plan was essentially followed for this plan. The following factors were considered:

- The number of prior winter storm events in the county
- Past damage amounts
- The county's building exposure
- Population density

Prior Events:

Table C.2 in **Appendix C** shows that numerous winter storms have occurred in Charles Mix County, including blizzards, ice storms, heavy snows, and extreme cold events. The authors of the South Dakota Hazard Mitigation Plan found that there were 83 total winter storm events in the National Climatic Data Center's Storm Events Database between January 1993 and August 2016 for Charles Mix County, ranking the county tied for 10th among the state's counties.

Past Damage Amounts:

Winter storms have the potential to cause significant amounts of damage. The ice storm that occurred in November 2005 caused an estimated $1 million dollars of property damage in Charles Mix County, and many other winter weather events have caused significant amounts of damage in the county, as shown in **Appendix C**.

Given Charles Mix County's agriculturally-based economy, another method to determine vulnerability is to look at the impact of winter storms on the county's agricultural producers. Farmers typically protect themselves from the impacts of adverse weather and other natural hazards by insuring their crops against losses through multi-peril crop insurance, which is underwritten by the Risk Management Agency, a part of the U.S. Dept of Agriculture. Data on indemnity payouts for crop loss in Charles Mix County due to various types of winter weather events between 2000 and 2017 was obtained from the Risk Management Agency, and is presented in the following table. During this period of analysis, winter weather-related payouts represented approximately 7% of all indemnity payouts in Charles Mix County.

Table 3.6 – Crop Loss Due to Winter Weather

Year	Frost	Freeze	Cold Winter	Cold Wet Weather
2000	$0	$0	$39,746	$0
2001	$0	$0	$2,153,449	$69,357
2002	$9,043	$6,871	$49,019	$4,429
2003	$0	$0	$318	$0
2004	$46,546	$37,281	$11,405	$1,438
2005	$9,643	$557	$7,339	$0
2006	$0	$572	$1,744	$0
2007	$14,625	$2,612	$113,639	$33,727
2008	$0	$0	$70,469	$7,695
2009	$0	$0	$490,004	$12,636
2010	$0	$0	$1,904	$66,952
2011	$0	$12,901	$15,099	$242,264
2012	$5,694	$0	$0	$5,008
2013	$0	$29,734	$2,877,250	$57,147
2014	$0	$16,284	$1,321,878	$22,777
2015	$12,947	$17,473	$1,660,250	$9,388
2016	$0	$0	$0	$7,501
2017	$0	$124,215	$91,920	$57,132

Source: USDA Risk Management Agency (http://www.rma.usda.gov/data/cause.html)

Building Exposure:

The total value of buildings in Charles Mix County is approximately $979,078,000, according to the South Dakota Hazard Mitigation Plan, which ranks the county 19th among the state's 66 counties. The median figure for South Dakota counties is approximately $605,000,000. The county's building exposure can be considered moderate.

Population Density:

Charles Mix County is sparsely populated, with an average of only 8.3 people per square mile, less than the state figure of 10.7 people per square mile. Given that South Dakota is itself considered to be very rural, Charles Mix County would have to be rated low in terms of population density.

Development Trends

Looking ahead, the slight population growth expected in the county is probably not enough to significantly increase the county's vulnerability to winter storms or other hazards. One area of concern, however, is the development that is occurring at the campground/ recreation areas scattered throughout the county, including the North Point and Platte Creek Recreation Areas. Much of the development occurring at North Point and Platte Creek consists of modest homes and trailers that are only occupied during the summer, but the North Cottage Bay and Svatos Addition developments at North Point and the subdivisions at Platte Creek have several homes valued at $500,000 or more. People living in these areas are somewhat

more vulnerable to winter storms than those living in the cities and towns, where more services and infrastructure are available.

Climate change also may have an impact on local vulnerability to winter storms. According to the South Dakota Hazard Mitigation Plan, the winter season is warming at a faster rate than any other season in South Dakota, but winter storms and blizzards will continue to be a severe weather hazard in the state. Warmer winter temperatures could mean more ice and freezing rain events, which would impact electrical utilities and communication systems, the transportation system, and livestock. An increase in the frequency of large snowfall events also is being experienced in the northern U.S. There remains some uncertainty in projections for the coming decades, but the rising trend of extreme precipitation events is something that needs to be considered.

Summer Storms

All areas of Charles Mix County are vulnerable to summer storms, especially those that are accompanied by tornadoes, lightning, or large hail. Typical damage from summer storms includes blown down power lines, crop damage from hail and high wind, and flooding as the result of heavy rain. Like the rest of the Great Plains, Charles Mix County is especially vulnerable to summer storms accompanied by high wind. This is because the landscape is open and there is little topographic relief to block the wind. Infrastructure and facilities located at higher elevations, such as the bluffs along the Missouri River, may be particularly vulnerable to high wind events.

Vulnerable populations include the elderly, the sick, those with a mobility limitation, and people who happen to be outside during a storm event. People living in mobile homes are also vulnerable, since such structures can be overturned by winds of 60 to 70 miles per hour if they are not anchored properly.

As with winter storms, the methodology that was used in the South Dakota Hazard Mitigation Plan to assess vulnerability to summer storms was followed for this plan. The following factors were considered:

- The number of prior summer storm events in the county
- Past damage amounts
- The county's building exposure
- Population density

Prior events:

Table C.2 in **Appendix C** shows many significant summer storm events that have been recorded in Charles Mix County, including hailstorms, thunderstorms, lightning, and tornadoes. The table shows 37 recorded tornadoes. The authors of the South Dakota Hazard Mitigation Plan assigned a rating of 5 (out of 10 maximum) to Charles Mix County in terms of the frequency of tornadoes recorded between 1950 and 2016, and assigned a rating of 9 for tornadoes of magnitude F1 or greater.

Past Damage Amounts:

Summer storms have the potential to cause significant amounts of damage. A summer storm in July 1998 that was accompanied by hail caused an estimated $1 million dollars of property damage in Charles Mix County, and $2.2 million dollars of crop damage. A hail storm in August 1996 caused an estimated $500,000 of crop damage. As shown in **Appendix C**, many other summer storm events have caused lesser amounts of property and/or crop damage in the county.

As with winter storms, another method to determine the county's vulnerability to summer storms is to look at the impact of such storms on the county's agricultural producers. Summer storms can cause a lot of damage to cropland, especially when they are accompanied by hail. Data on indemnity payouts for crop loss in Charles Mix County due to hail as well as high wind events between 2000 and 2017 was obtained from the Risk Management Agency, and is presented in the table below. During this period of analysis, summer storm-related payouts represented about 3% of all indemnity payouts in Charles Mix County.

Table 3.7 – Crop Loss Due to Severe Summer Weather

Year	Hail	High Wind		Year	Hail	High Wind
2000	$413,489	$214		**2009**	$35,303	$3,066
2001	$375,561	$16		**2010**	$87,868	$10,940
2002	$64,077	$0		**2011**	$42,087	$4,093
2003	$226,745	$0		**2012**	$0	$138,964
2004	$3,200	$13,485		**2013**	$0	$484,012
2005	$111,209	$3,481		**2014**	$31,102	$82,230
2006	$14,582	$6,572		**2015**	$62,879	$4,171
2007	$80,854	$89,411		**2016**	$35,411	$4,629
2008	$62,213	$27,452		**2017**	$1,887,521	$42,386

Source: USDA Risk Management Agency (http://www.rma.usda.gov/data/cause.html)

Building Exposure:

The total value of buildings in Charles Mix County is approximately $979,078,000, according to the South Dakota Hazard Mitigation Plan, which ranks the county 19th of the state's 66 counties. The median figure for South Dakota counties is approximately $605,000,000. The county's building exposure can be considered moderate.

Population Density:

Charles Mix County is sparsely populated, with an average of only 8.3 people per square mile, even less than the state figure of 10.7 people. Given that South Dakota is itself very rural, Charles Mix County can be rated low in terms of population density.

Development Trends

The small rate of population increase projected is not expected to significantly increase the county's vulnerability to summer storms. However, the development occurring at the North

Point and Platte Creek recreation areas is of some concern regarding summer storms, as is the expansion occurring at many of the other campground/recreation areas scattered throughout the county. These recreational areas are particularly busy during the summer months with visitors and people living in their summer homes, many of which are nothing more than modified trailers offering little protection from tornadoes and other violent summer weather. Three injuries occurred during a thunderstorm at the Snake Creek Campground in July 2019.

Regarding the impact of climate change, the South Dakota Hazard Mitigation Plan cites the Climate Science Special Report from 2017, which states that damages from convective weather hazards, such as severe thunderstorms and tornadoes, have undergone the greatest increase relative to other extreme weather since 1980. The plan states that the tornado season is getting longer, and that an increase in potential days for severe thunderstorms is projected for the mid to late 21st century, although the largest increases are projected for neighboring regions of the Midwest and the southern plains. There is some uncertainty in these projections, but severe thunderstorms and tornadoes will remain a hazard in South Dakota.

Flooding

Like all counties in South Dakota, Charles Mix is vulnerable to flooding. Given the specific nature of flooding, the county's vulnerability to flooding will be analyzed first on a general county-level basis, and then specifically for each community. Given the degree to which flooding is geographically-based, this approach made the most sense to the planning team.

General Flood Vulnerability

According to the HAZUS analysis that was run for the South Dakota Hazard Mitigation Plan (see Table 3-45 of that plan), the potential building damage loss from flooding in Charles Mix County is $4,020,000. The median figure for all South Dakota counties is approximately $2,800,000. Overall, Charles Mix ranks 23rd out of the state's 66 counties in this measure of vulnerability. The potential displaced population in the county was determined to be 232 people, compared to the median for South Dakota counties of 255.

Currently, there are a total of eight National Flood Insurance Program policies in Charles Mix County, with three claims having been paid since 1978 totaling $186,300. There is one repetitive loss property in Charles Mix County, the former Yankton Sioux tribal administration building in Marty. Claims were made on this property following flood events in 2007, 2008, and 2010. Damage was so severe in 2010 that the building was abandoned, and it sits vacant today.

In addition to impacting buildings and other structures, a good deal of public infrastructure throughout the county is vulnerable to flooding. Flood damage frequently involves washed out or damaged roads and drainage culverts, often occurring in the spring, especially following winters with heavy snow. Roads and infrastructure in the vicinity of Choteau Creek, Mosquito Creek, and Platte Creek typically experience the most damage. Choteau Creek,

which passes near Dante and Wagner, has historically caused the most trouble. Over the years it has become almost completely silted in to the point where now even a small amount of rain causes it to overrun its banks. There are no longer any houses or other structures located near the creek, so vulnerability is limited primarily to roads and public infrastructure.

Flooding also has a major impact on agriculture. Spring flooding can delay farmers getting into their fields to plant, and later in the growing season it can damage crops. Data on indemnity payouts for crop loss in Charles Mix County due to flooding, as well as excess moisture/precipitation, between 2000 and 2017 was obtained from the Risk Management Agency, and is presented in the following table. During this period of analysis, flood-related payouts represented about 10% of all indemnity payouts in Charles Mix County, second only to drought.

Table 3.8 – Crop Loss Due to Flooding

Year	Flooding	Excess Moisture/ Precipitation		Year	Flooding	Excess Moisture/ Precipitation
2000	$0	$82,550		**2009**	$3,201	$239,729
2001	$5,245	$974,871		**2010**	$38,809	$2,372,014
2002	$0	$73,376		**2011**	$793,062	$2,641,241
2003	$2,569	$51,353		**2012**	$0	$64,080
2004	$6,865	$33,176		**2013**	$0	$59,443
2005	$0	$199,489		**2014**	$0	$61,456
2006	$0	$33,175		**2015**	$0	$168,686
2007	$602	$825,566		**2016**	$0	$3,950,870
2008	$48,996	$2,187,792		**2017**	$3,519	$271,776

Source: USDA Risk Management Agency (http://www.rma.usda.gov/data/cause.html)

2019 was probably the worst year ever in terms of flooding's impact on South Dakota's agricultural producers. The state ranked first in the nation with almost 4 million acres of farmland prevented from being planted due to flooding, more than double the next nearest state. Charles Mix County ranked 4th in the state with a total of approximately 162,000 acres not planted.

Charles Mix County also is vulnerable to flooding due to dam failure, primarily because of the Fort Randall Dam and the other dams on the Missouri River. As mentioned earlier, it had once been thought that the system of dams on the Missouri River had essentially eliminated the threat of flooding along the river. However, flooding did occur along the Missouri in 2011, due to heavy snowmelt at the river's source in the Rocky Mountains and extremely high rainfall throughout the river's drainage basin in the spring of 2011. Mismanagement of dam releases - which can be considered a type of dam failure - exacerbated the situation. Most of the flooded area in Charles Mix County was pasture or cropland, but infrastructure and some property also was impacted, as described earlier.

There is also some flooding vulnerability associated with several smaller dams within Charles Mix County, including the Platte Dam, which is located two miles west of Platte, and the Lake

Wagner Dam, which is located on the northwest edge of Wagner. As discussed earlier, the Platte Dam did fail in 2019, causing extensive damage to SD Highway 44. The Lake Wagner Dam, originally built in 1938, also could cause extensive economic loss if it failed.

Local Flood Vulnerability

At the community level, flood vulnerability was determined by using FEMA's HAZUS loss estimation software to estimate potential losses from flooding, and by using GIS software to determine the value of property at risk of being flooded. The following table summarizes the results of the HAZUS analysis, showing that Wagner is much more vulnerable to flooding than any of the other communities. It should be noted that the HAZUS runs may have included some land outside the cities' incorporated limits. For instance, the flood prone areas identified by the software in Lake Andes, Pickstown, and Ravinia are actually located outside each town's city limits.

Table 3.9 – HAZUS Base Flood Loss Estimation Results

Community	Building Structural Damage	Debris Generated	Households Displaced	People Needing Shelter
Dante	$17,160	17 tons	3	0
Geddes	*HAZUS FAILED TO RUN*			
Lake Andes	$92,400	72 tons	19	3
Marty	$63,360	40 tons	6	0
Pickstown	$1,320	1 ton	0	0
Platte	*HAZUS FAILED TO RUN*			
Ravinia	$1,320	1 ton	1	0
Wagner	$1,164,240	745 tons	262	216

Source: FEMA HAZUS loss estimation software

The following table shows the amount and value of property at risk of flooding. The analysis was done by using GIS software to overlay areas of known flood risk (either the 100 year floodplain or the area identified by HAZUS as flood prone) on parcel data supplied by the county. Note that the figures reflect only those parcels on which the structure itself - not just part of the parcel - is located within the floodplain. The table shows that Wagner has the most amount of property vulnerable to flooding, although the property loss ratio (amount of property at risk compared to the total building inventory) is higher in Dante. No analysis was done for Marty, since all property at risk there is tax exempt.

Table 3.10 – Property in Flood Prone Areas

	Assessed Value (Residential)	Assessed Value (Commercial)	Property Loss Ratio
Dante	$225,800	$10,500	12.3%
Wagner	$2,126,500	$1,191,400	7.6%

Sources: FEMA Flood Insurance Rate Maps; FEMA HAZUS loss estimation software; Charles Mix County GIS Administrator; Charles Mix County Director of Equalization

Development Trends

Looking ahead, the small rate of population increase projected is not expected to significantly increase the county's vulnerability to flooding. However, the development that has been occurring at the recreation areas along Lake Francis Case may somewhat increase vulnerability. Fortunately, there are regulations governing work activity below the lake's ordinary high water (OHW) level of 1,365 feet, as described earlier. During the flood of 2011, the lake reached an elevation of 1,374 feet, within one foot of the top of the flood control pool, which is the highest water level the lake can hold without going over the spillway gates. As mentioned earlier, a cabin located about seven miles southwest of Geddes suffered flood damage, and water got within 20 feet of some homes in the North Cottage Bay development at the North Point Recreation Area.

A factor likely to increase the county's vulnerability to flooding is the continuing conversion of wetlands and other marginal land to agricultural production. Farming these marginal lands is increasing the probability and severity of flooding in certain areas as the land's natural capacity to absorb excess surface water is decreased. The primary impact is on rural roads and infrastructure. Precise statistics on the amount of road damage that flooding has caused over the years in Charles Mix County are not available, but there appears to be little doubt that county and township roads are suffering more flood-related damage than they used to. Future updates to this plan could explore this trend in more depth.

The nature and frequency of flooding also could be altered by climate change. There is no comprehensive assessment of how climate change might affect flooding in South Dakota, but regional trends for the northern Great Plains show a trend toward less frequent, but more intense, rain events. Climate projections indicate that 1-day, 20-year return events may increase in frequency by 8% to 16% in the coming decades. In the northern Great Plains region, this is compounded by an overall wetter trend of about 15% increase when comparing the years 1986-2015 to 1901-1960. The additional moisture overall can add to the increase in precipitation per extreme event.

Drought

Without question, Charles Mix County is vulnerable to drought. As shown in **Appendix C**, there are 19 drought records for the county in the Storm Events Database just since 1999, with many more droughts known to have occurred before then. The biggest impact of drought in Charles Mix County is in the agricultural sector, which is not surprising, given the county's heavy reliance on farming. Non-irrigated cropland is most susceptible to drought, and yield reductions due to moisture shortages can be aggravated by wind-induced soil erosion.

Data on indemnity payouts for crop loss in Charles Mix County due to drought and heat between 2000 and 2017 was obtained from the Risk Management Agency, and is presented in the table below. During this period of analysis, drought-related payouts accounted for 80% of all indemnity payouts in Charles Mix County, far higher than any other type of payout. It is

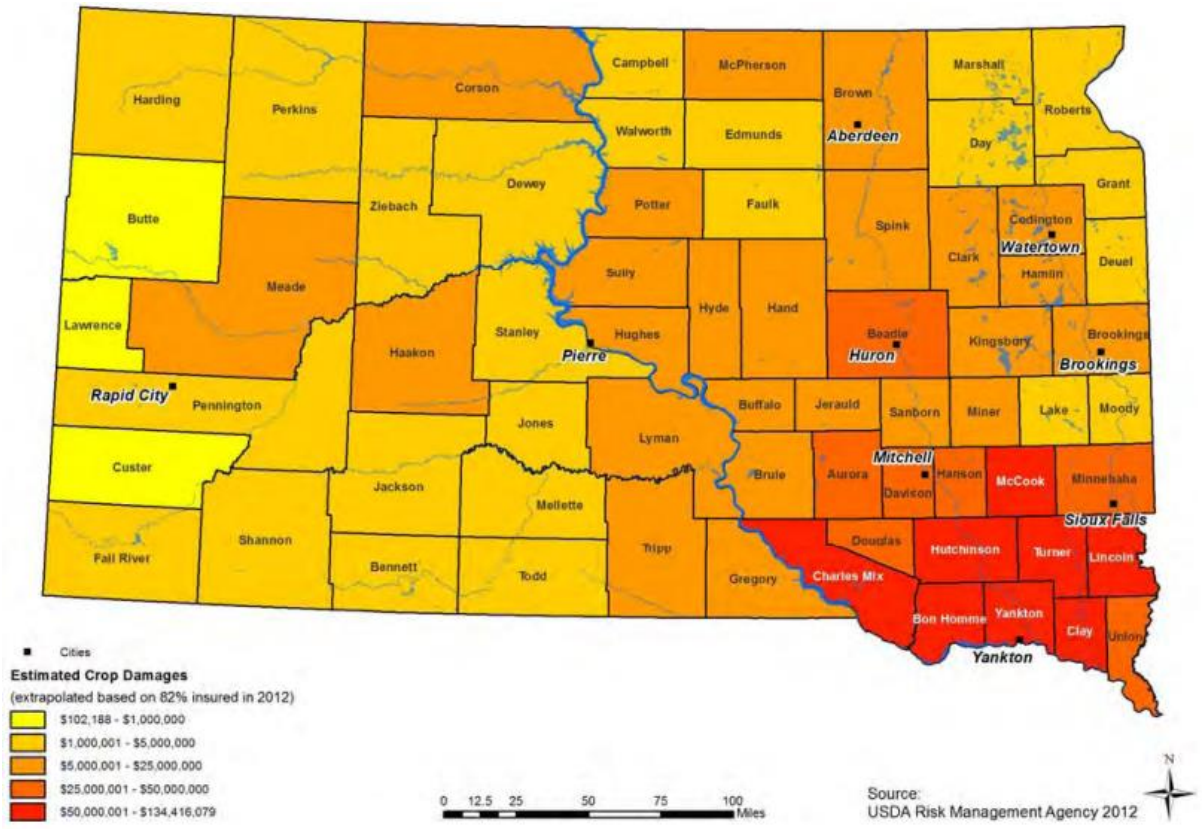
safe to say that drought is one of the costliest natural hazards facing Charles Mix County farmers [6].

Table 3.11 – Crop Loss Due to Drought and Heat

Year	Drought	Heat		Year	Drought	Heat
2000	$3,975,006	$172,324		**2009**	$114,384	$12,252
2001	$1,025,123	$40,178		**2010**	$177,754	$0
2002	$14,953,511	$275,651		**2011**	$27,809	$104,207
2003	$5,502,026	$485,110		**2012**	$57,689,233	$1,513,245
2004	$6,066,001	$69,579		**2013**	$4,499,216	$123,371
2005	$3,845,588	$498,974		**2014**	$3,164,076	$0
2006	$6,728,369	$499,665		**2015**	$2,626,064	$1,460
2007	$264,170	$122,117		**2016**	$674,150	$16,510
2008	$713,654	$10,413		**2017**	$4,767,970	$67,171

Source: USDA Risk Management Agency (http://www.rma.usda.gov/data/cause.html)

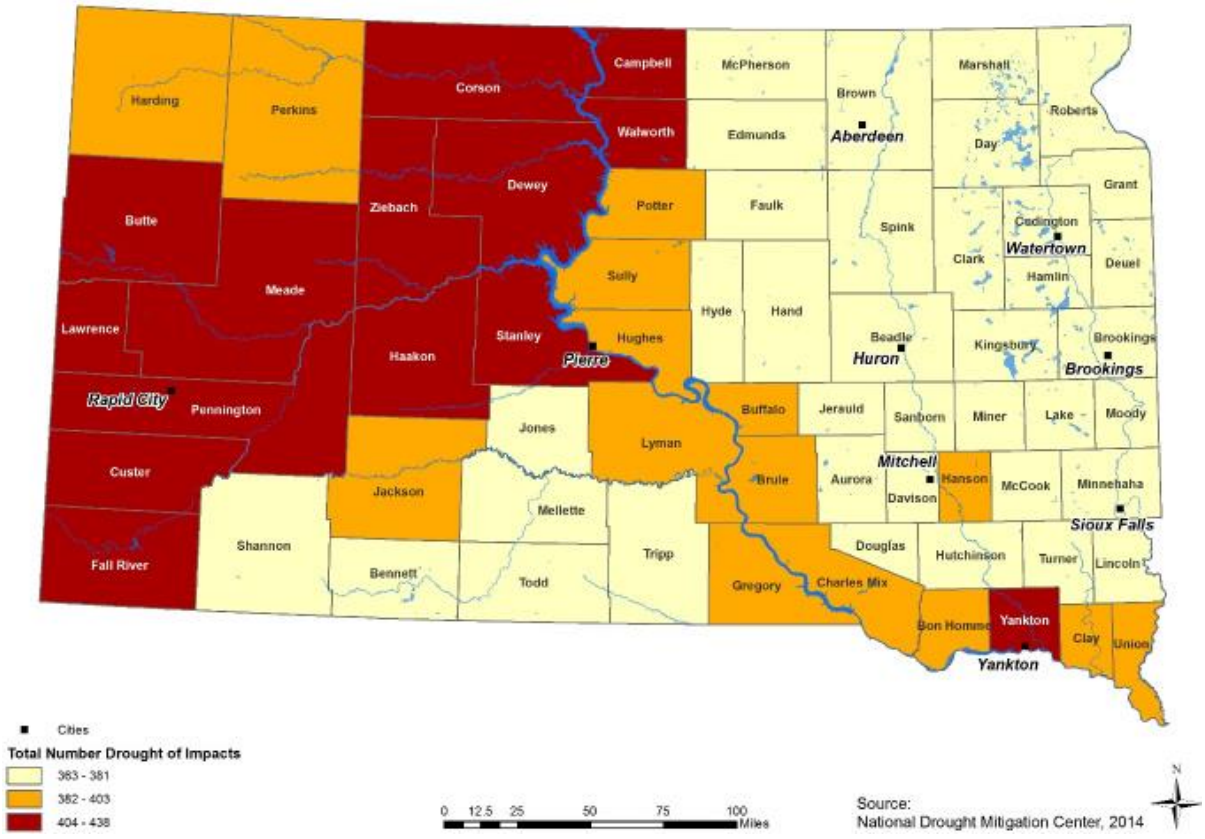
As the table shows, the 2012 drought had by far the biggest impact on the county's agricultural production. In fact, only three other counties in South Dakota suffered more loss than did Charles Mix County. The figure below, as reproduced from the South Dakota Drought Mitigation Plan, shows the 2012 drought's impact statewide.



[6] Drought also appears to be the costliest natural hazard statewide for South Dakota farmers. From 2000 through 2017, drought payouts accounted for approximately 50% of all indemnity payouts in the state.

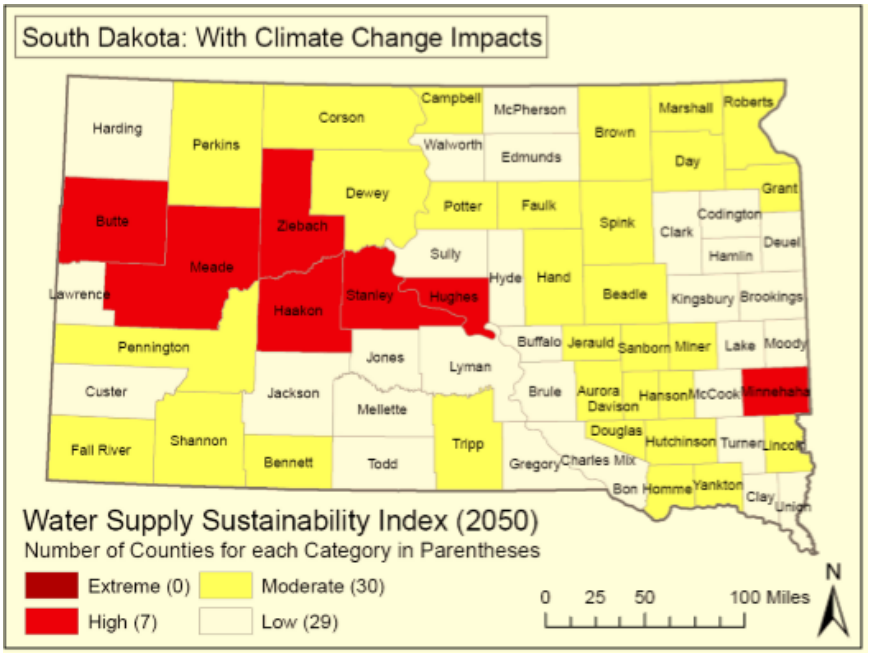
To determine which areas of the state are most vulnerable to the agricultural impacts of drought, the authors of the South Dakota Drought Mitigation Plan analyzed crop losses in each county compared to the total value of the county's crops. Crop value was taken from the 2012 Census of Agriculture, while crop loss was based on the Risk Management Agency's crop indemnity data for the period 2000 to 2014. The resulting loss ratio is the average annual loss divided by total crop value; the higher the ratio the higher the vulnerability. Charles Mix County's average annual loss from drought for the 2000 – 2014 period was $8,133,112, compared to a total crop value of $102,917,000, resulting in a loss ratio of 7.9%. In comparison, the average loss ratio figure for South Dakota counties was 3.1%. The authors of the South Dakota Drought Mitigation Plan assigned a "High" vulnerability rating for Charles Mix County for this measure of drought vulnerability.

Vulnerability also was assessed by reviewing the South Dakota Drought Mitigation Plan's section on the National Drought Mitigation Center's Drought Impact Reporter. The Drought Impact Reporter analyzes drought impact information from a broad range of areas, including the social, economic, and environmental realms. As shown in the figure below from the South Dakota Drought Mitigation Plan, Charles Mix County is in the middle range of counties in terms of number of drought impacts.



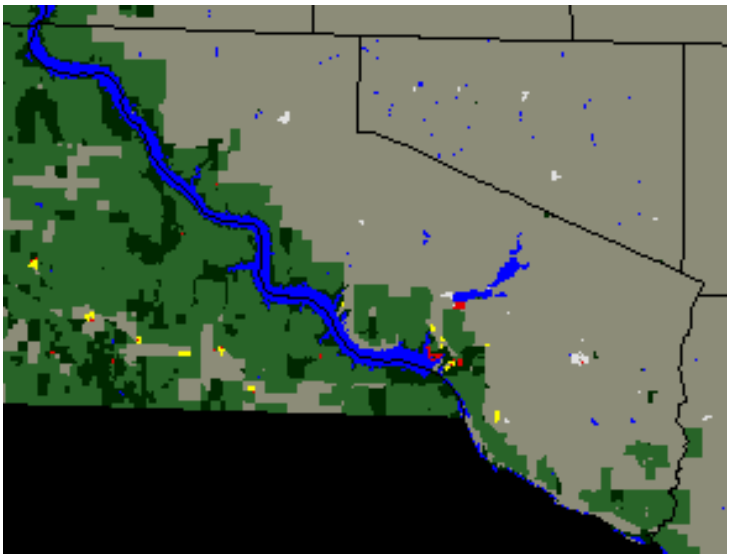
Development Trends

Vulnerability to drought may increase in coming years if current land use trends continue and more marginal land in the county is brought into agricultural production. Climate change also may increase the frequency and severity of droughts in the future, according to many climate prediction models. As described in the South Dakota Drought Mitigation Plan, an analysis performed for the Natural Resources Defense Council examined the effects of climate change on water supply and demand in the United States. The study found that more than 1,100 counties may face higher risks of water shortages by mid-century as a result of climate change. In South Dakota, more than half of the state's counties could face higher risks of water shortages by mid-century as a result of increasing potential for drought due to climate change impacts. The figure shown here from the Natural Resources Defense Council as reproduced in the South Dakota Drought Mitigation Plan shows that Charles Mix County is not one of the counties expected to experience water shortages in the future due to climate change.



Wildfire

Wildfire risk in Charles Mix County can be determined by analyzing historical records of actual wildfire losses in the county, or by estimating potential wildfire losses. Regarding actual losses, **Table 3.4** provided information about the size and frequency of wildfires that have occurred in the county in the recent past.



To analyze potential wildfire loss in Charles Mix County, information from the SILVIS Lab at the University of Wisconsin was used. The SILVIS webpage displays areas of Wildfire Interface and Wildfire Intermix, which are locations that have a combination of fairly dense

housing and vegetation. Such areas are considered to be vulnerable to wildfires. The figure on the previous page shows the Wildfire Interface (yellow) and Wildfire Intermix (red) areas in Charles Mix County. Only a very small area of the county is in the High (red) or Moderate (yellow) risk zones. The total population and number of housing units in Charles Mix County at risk is summarized in the table below, which is based on 2010 Census Block data.

Table 3.12 – Population in Wildfire Risk Zones in Charles Mix County

Housing Units	Total Population	Median Home Value	Total Home Value
199	376	$67,700	$13,472,300

Source: State of South Dakota Hazard Mitigation Plan, based on data from the SILVIS Lab at the University of Wisconsin–Madison

The population of 376 living in a High or Moderate Risk threat zone ranks Charles Mix County 42nd among South Dakota counties, and it represents about four percent of the county's total population. Putting things in perspective, in South Dakota as a whole approximately 25% of the population lives in a wildfire threat zone.

This is not to say that there is no threat. Even in areas of the county without much woody vegetation, wildfires are possible. They can occur in pastures and other types of grassland, wetlands (many of which dry out in the summer), and wildlife production areas. The loss potential from these fires is generally slight, although occasional damage has been reported. Wildfire impacts on the county's agricultural producers are insignificant; data on indemnity payouts show no payouts for crop loss due to wildfire in Charles Mix County between 2000 and 2017.

Development Trends

The modest population growth expected to occur in the county probably will not significantly increase the degree of wildfire risk. One factor that could increase wildfire vulnerability is the continued spread of cedar trees in Charles Mix County. These trees are spreading quickly in the area, especially in the hilly terrain along the Missouri River, and the fuel load they represent could turn an otherwise routine brush fire into a very serious situation. Efforts to control their spread have met with only limited success.

The development that is occurring at the recreation areas along Lake Francis Case is of some concern regarding wildfire vulnerability, as is the expansion of the campgrounds. The biggest concern is that there is no water supply on hand at any of the developments, so water would have to be trucked in to fight a fire. Another issue is that some of the homes are being built in areas prone to wildfires. For instance, Sand Dollar Cove at the North Point Recreation Area borders a field that is usually planted in wheat every other year (wheat stubble is quite prone to igniting), while other development is occurring in wooded, brushy areas. Another problem is that much of the seasonal housing is being built in very close proximity. Sand Dollar Cove exemplifies this trend - if one of the homes or garages there caught fire, it could rapidly spread to neighboring structures.

Climate change also may increase local wildfire vulnerability. The South Dakota Hazard Mitigation Plan cites a U.S. Forest Service study that indicates the potential for an increase in future lightning activity and a higher frequency of weather patterns conducive to surface drying. These factors, together with higher summer temperatures, will likely increase the annual window of high fire risk by 10 to 30%. The plan states that predictions past 2040 are largely speculative, but there will be an increase in the potential for drought and the number of days in any given year with flammable fuels, which may extend the fire season.

Risk Assessment Summary

In this section, the vulnerability of Charles Mix County to each of the hazards profiled is summarized. Maps are presented at the end of the section to augment the analysis, showing areas vulnerable to flooding. The graphic on page 47 showed areas most vulnerable to wildfire. Vulnerability to winter storms, summer storms, and drought is not mapped, as those hazards are likely to impact all areas of the county more or less equally.

- **Winter Storms**

Charles Mix County's vulnerability to winter storms can be considered high. All areas of the county are vulnerable to winter storms. Major winter storms accompanied by heavy snow or freezing rain contribute to the vulnerability of county residents by making roads dangerous for travel. The isolation of residents living outside the county's major communities puts them at increased risk. Some of these residents are more than 15 miles from the nearest place with groceries, medical service and supplies, or other important items. If roads are blocked by snow for an extended period of time, some rural residents, particularly the elderly, may be at risk. Winter storms accompanied by high winds have the potential to damage residential and commercial property in the county, as well as infrastructure. A major concern is the vulnerability of rural electric power infrastructure. When winter storms are accompanied by high winds and freezing precipitation, ice can build up on powerlines, which can cause the lines and poles to come down. It is a certainty that the county will remain vulnerable to winter storms no matter what mitigation actions are taken.

- **Summer Storms**

Charles Mix County's vulnerability to summer storms can be considered moderate. All areas of the county are vulnerable to summer storms, and are highly vulnerable to summer storms that are accompanied by tornadoes or hail. Although the county's population density is low and infrastructure development is not extensive, a large amount of cropland in the county is vulnerable to the effects of hail and other violent summer weather. Vulnerability may be somewhat higher in Geddes and Ravinia, where about 17% and 40% of the housing stock respectively consists of mobile homes, compared to 10% statewide. The lack of building codes in most of the county impacts vulnerability to summer storms accompanied by high winds.

- **Flooding**

The overall vulnerability of Charles Mix County to flooding can be described as moderate. Much of the impact is to cropland and to rural county and township roads. Following is a summary of vulnerability to flooding in each of the communities:

Dante: **Table 3.9** and **Table 3.10** show that the town is vulnerable to flooding. In fact, flooding has been a persistent problem in the community, which was built on low-lying ground near Choteau Creek. Much of the farmland surrounding Dante has been stripped of its vegetation, which once helped slow runoff. Without the vegetation, rainwater now rushes south toward 300th Street (aka Warren Avenue), where it overwhelms the ditches and spreads onto adjacent property. Heavy rain events can cause significant damage as water overtops 300th Street and gets into basements. Drainage improvements were made along 300th Street in 2016 with the assistance of HMGP funding.

Geddes: There does not appear to be much vulnerability here, and no significant flooding has ever occurred in the community. Small scale flooding in 2007 did cause very minor damage to a county garage located on the south side of town.

Lake Andes: No significant flood damage has been known to occur within Lake Andes itself, but there is vulnerability just outside the city. Flooding in 2019 had a major impact on the community when Lake Andes (the lake) overflowed and spilled across U.S. Highway 18 in March, closing the road for months and damaging several homes in the South Indian Housing complex. The highway finally reopened in late August, only to be flooded again after another very heavy rain event in September.

Marty: This community, situated in a low-lying area, is especially vulnerable to flooding. In 2010, a period of very heavy rain caused damage to several structures, including the Yankton Sioux Tribe's central administration building. Damage to the building was so extensive that Tribal leaders determined that repairing it would be too expensive, and it now sits vacant.

Pickstown: Located at the top of a ridge overlooking the Missouri River, there is very little flood risk here, and no history of any significant flood damage.

Platte: There is some vulnerability to small-scale flooding in Platte, especially in the northeast and northwest parts of the community, where sandbagging occasionally has been necessarily to prevent more extensive flooding. The situation is better than it used to be after a large diameter storm sewer pipe was installed in the early 2000s under a natural drainageway that runs through the community. Further drainage improvements were made following minor flooding in Platte in 2011. Flooding in 2019 had a significant impact in the community, including widespread road damage and basement flooding.

Ravinia: Standing water after heavy rain events is a problem in Ravinia, because of the town's flat topography and lack of drainage infrastructure. Several homes here have been impacted by flooding, as has the town's utility infrastructure. Flooding in 2019 had a significant impact here, with several homes reporting damage.

Wagner: **Table 3.9** and **Table 3.10** show that Wagner is definitely vulnerable to flooding. The most vulnerable area is the south side of town, where several houses

are located in the flood zone. In 2014, the city completed a project using HMGP funding to install larger culverts under Front Avenue to improve drainage and reduce flooding in the area. Flooding in 2019 had a significant impact in the community, including widespread road damage and basement flooding.

- **Drought**

Charles Mix County's vulnerability to drought can be considered high, and is certain to continue for the foreseeable future. All areas of the county are vulnerable to drought. The impact is primarily to the agricultural sector, where serious losses have occurred. Residential and commercial impacts of drought are minor. The water supply through the Randall Community Water District is secure.

- **Wildfire**

The overall vulnerability to wildfire in Charles Mix County can be considered low, although it may be somewhat higher in the wooded draws along the Missouri River. Only 4% of the county's population is considered to be living in a High or Moderate Risk wildfire threat zone, well below the statewide figure of 25%, and no truly destructive wildfire has ever been recorded in the county.

Figure 3.1 - Charles Mix County

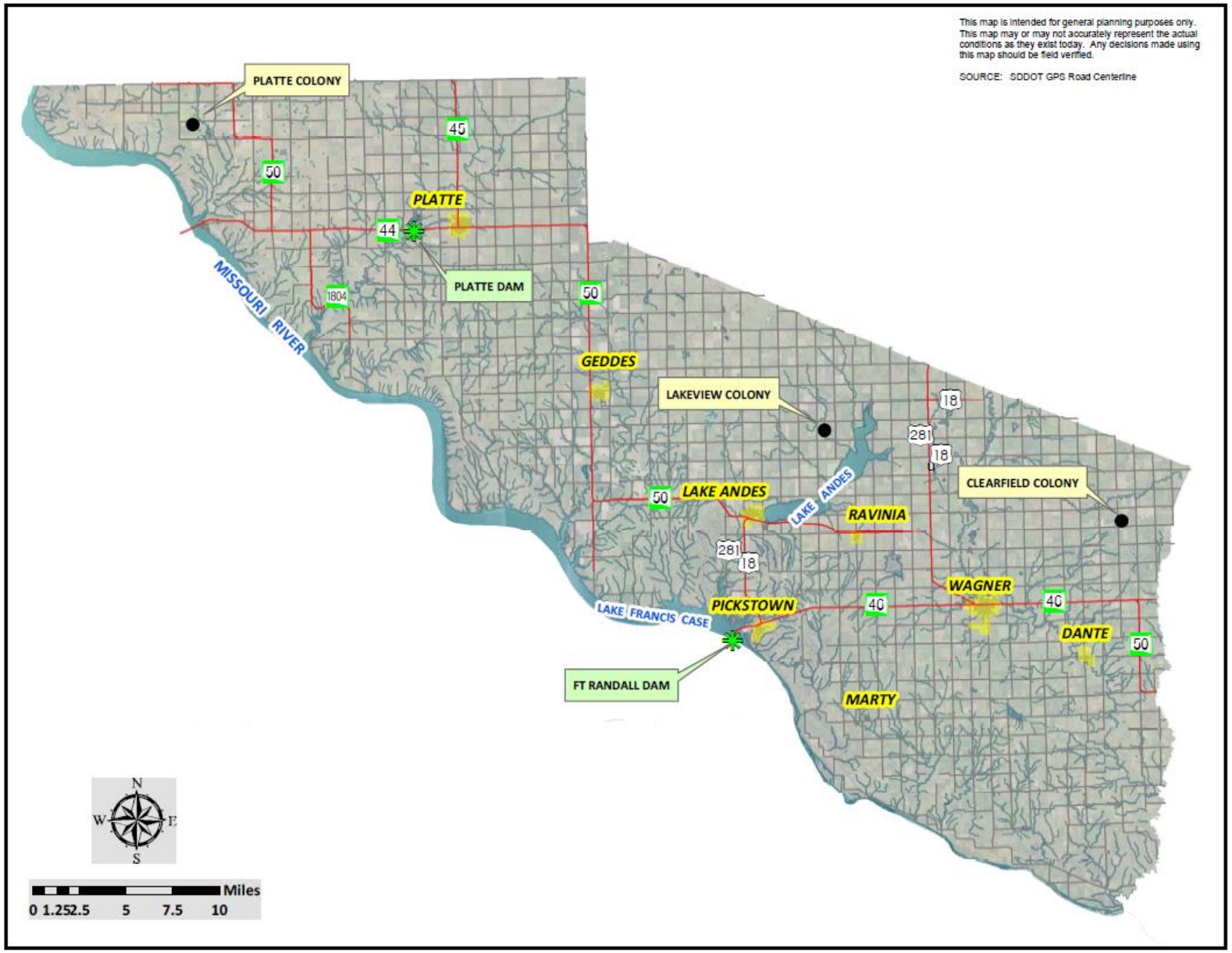


Figure 3.2 – Dante

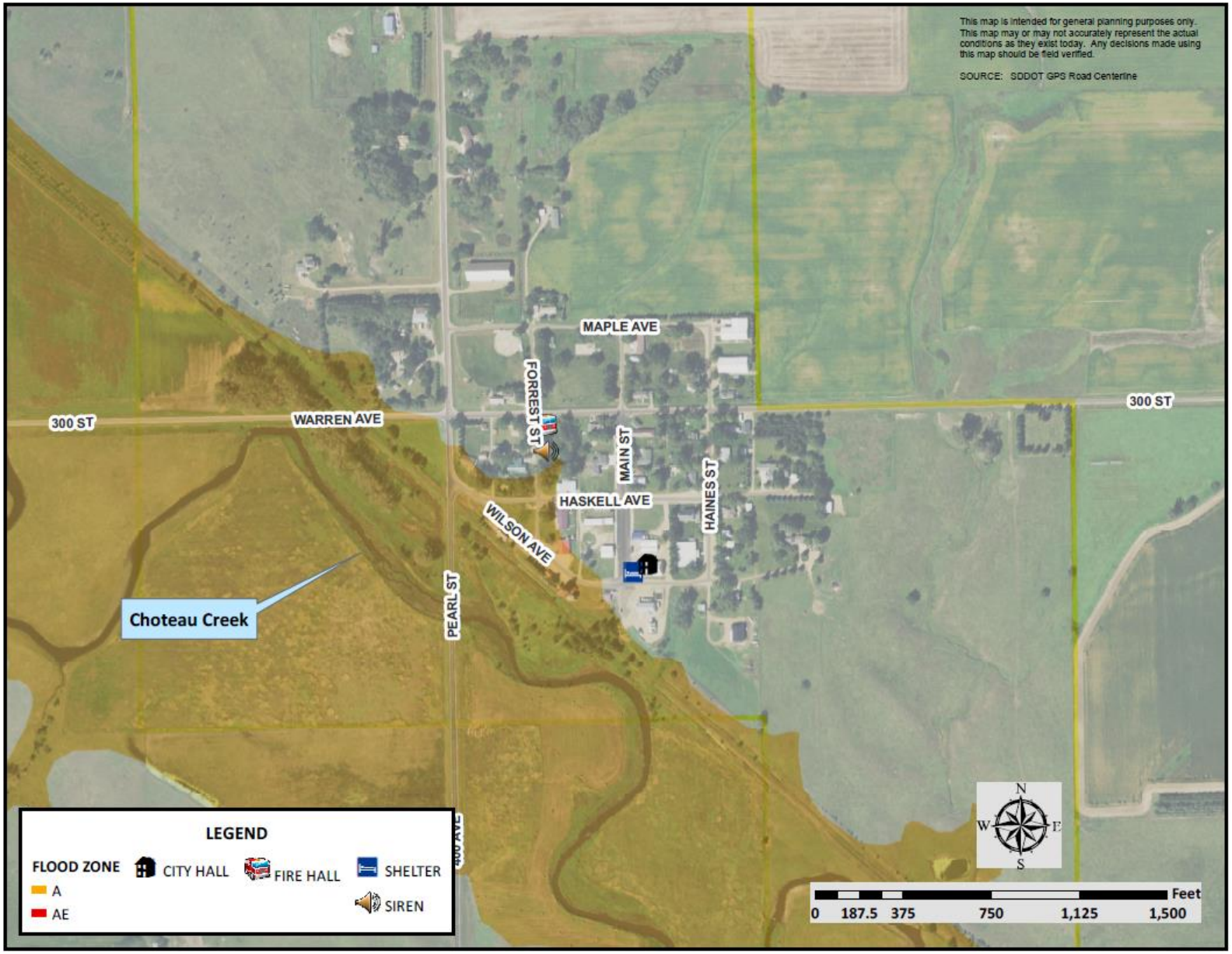


Figure 3.3 – Geddes

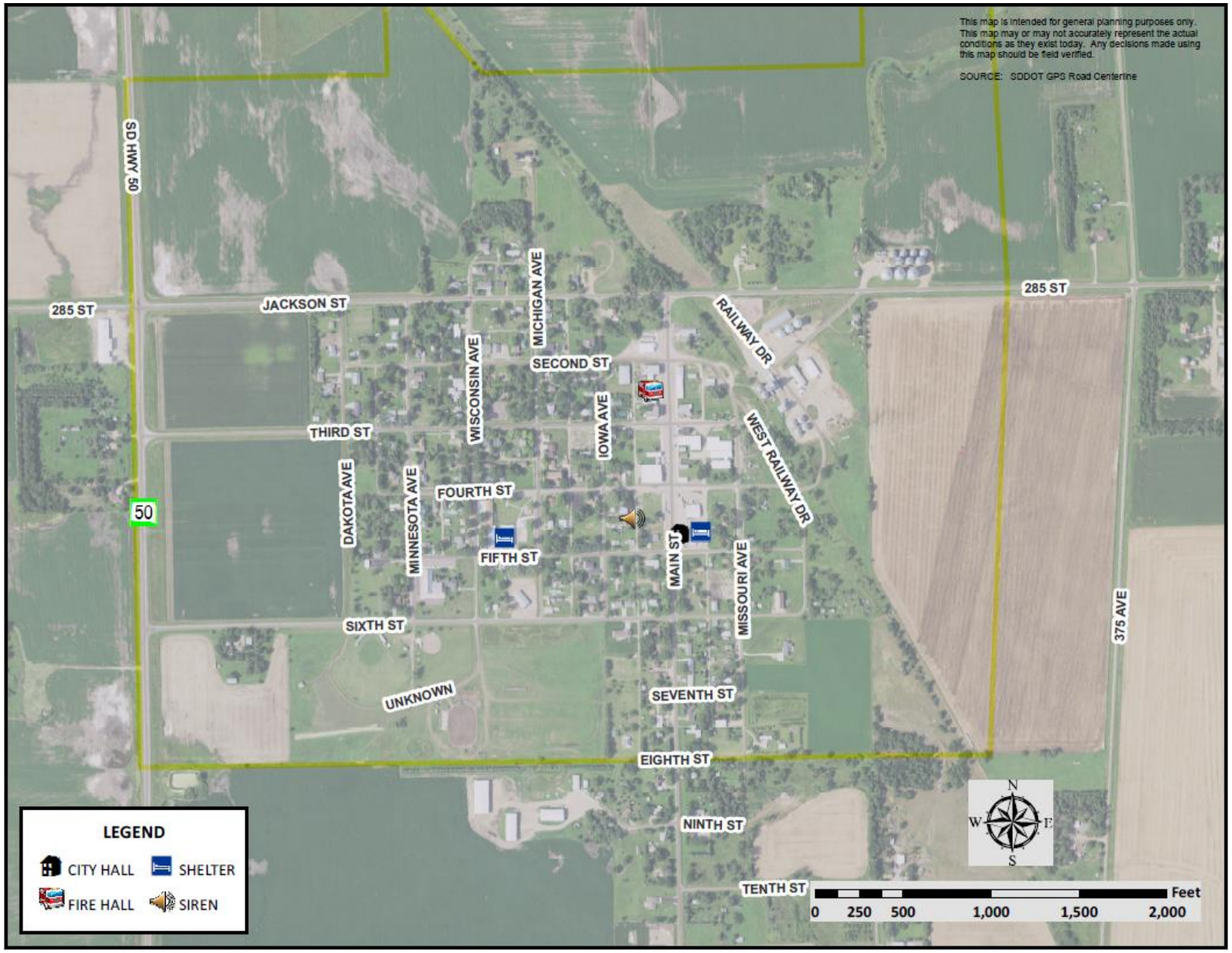


Figure 3.4 - Lake Andes

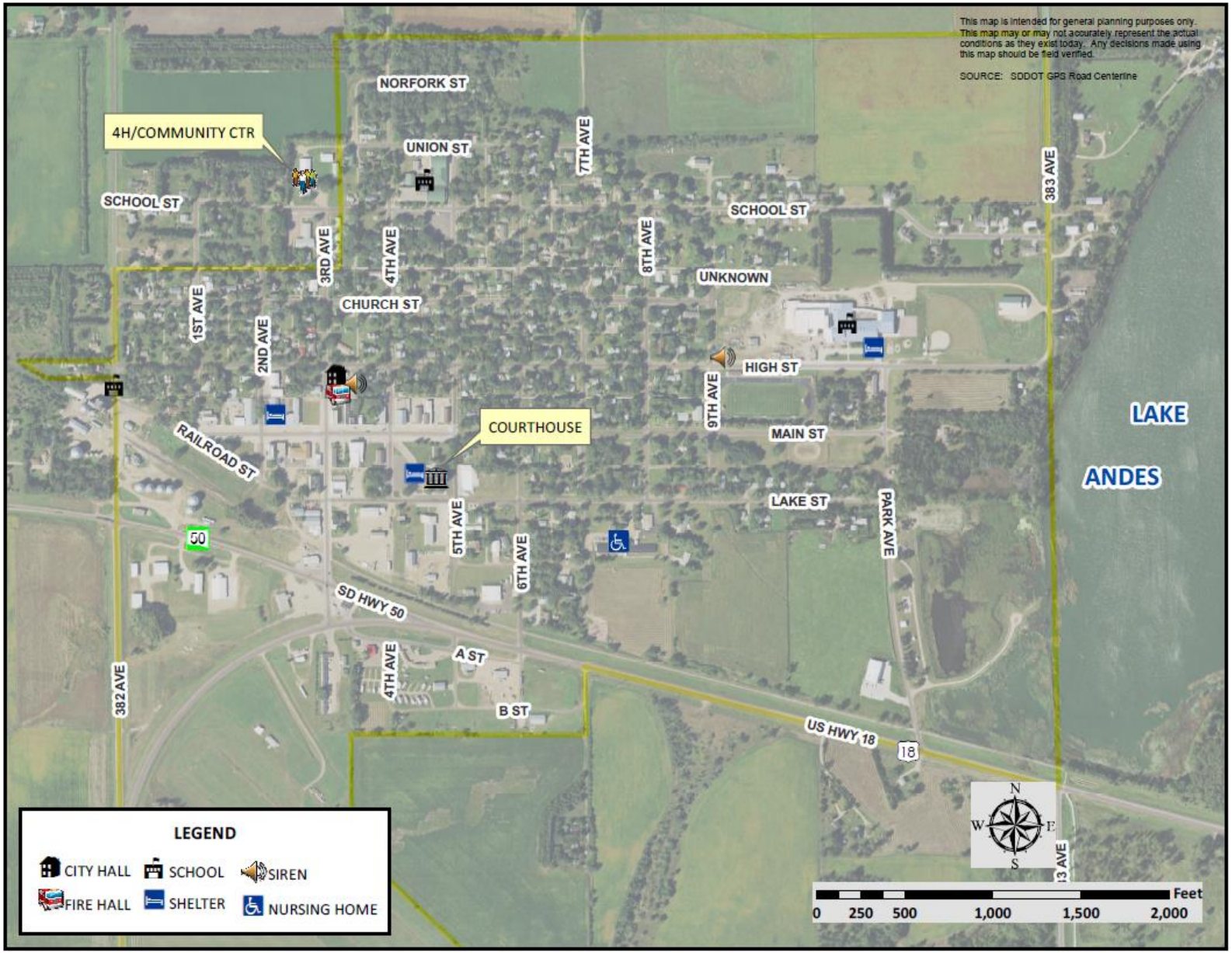


Figure 3.5 – Marty

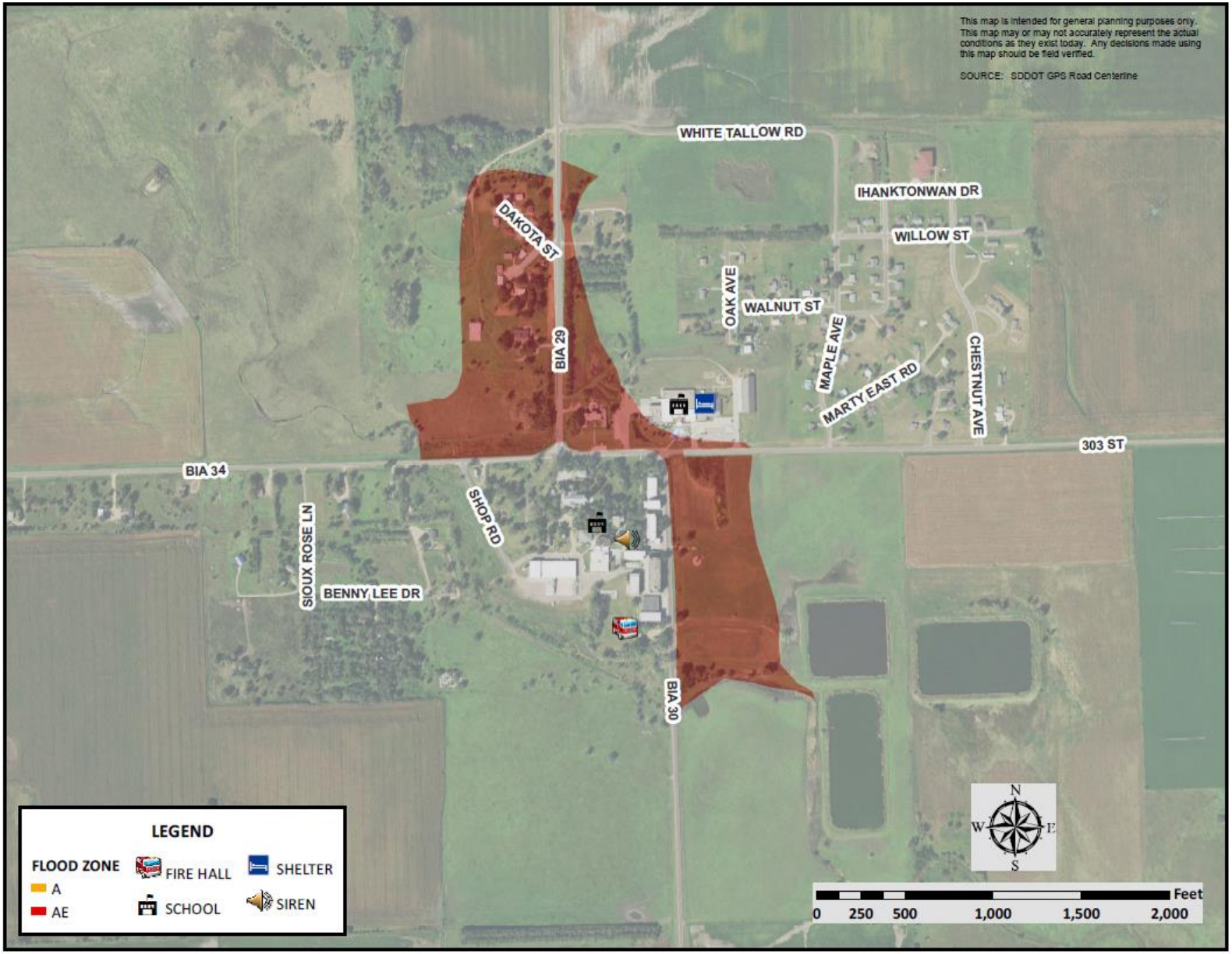


Figure 3.6 – Pickstown

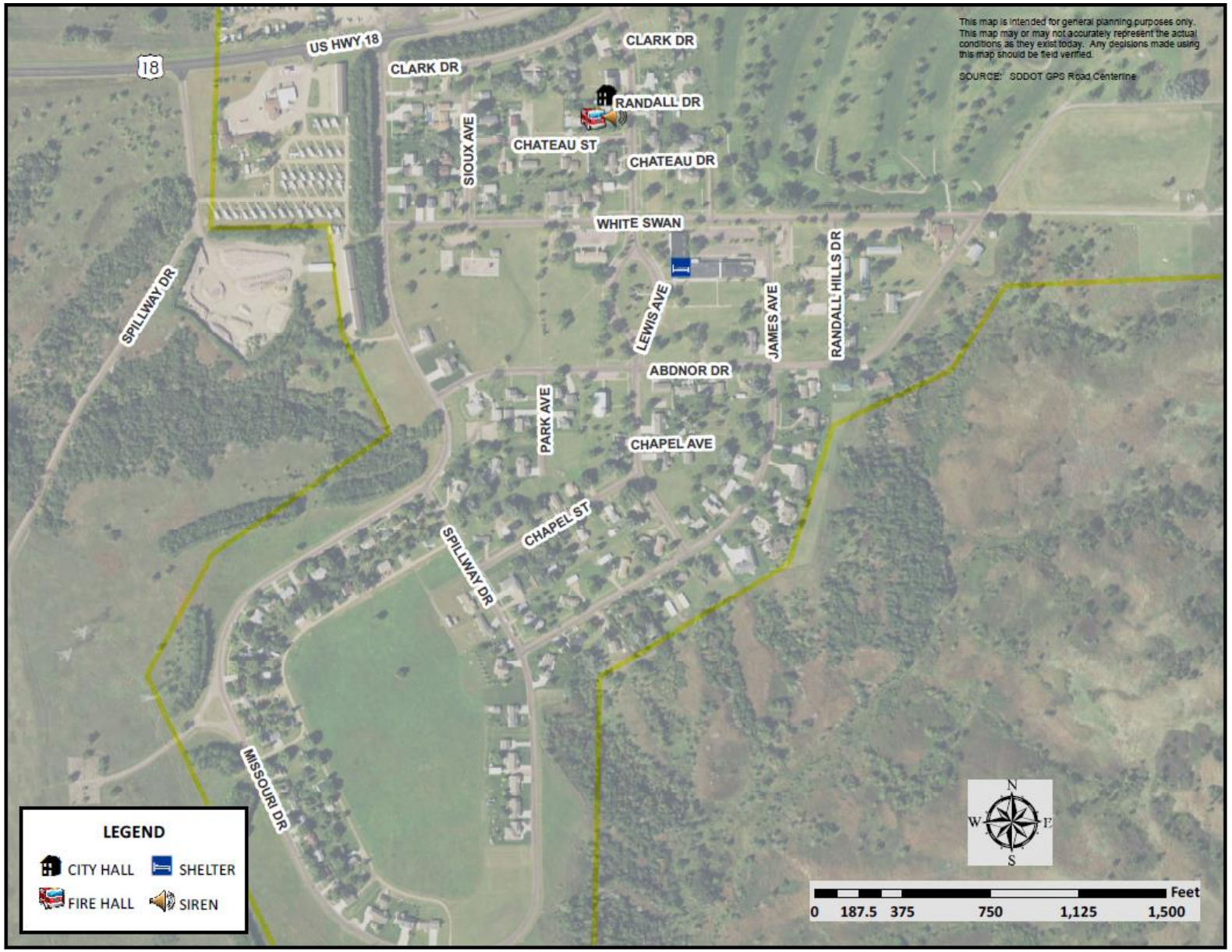


Figure 3.7 – Platte

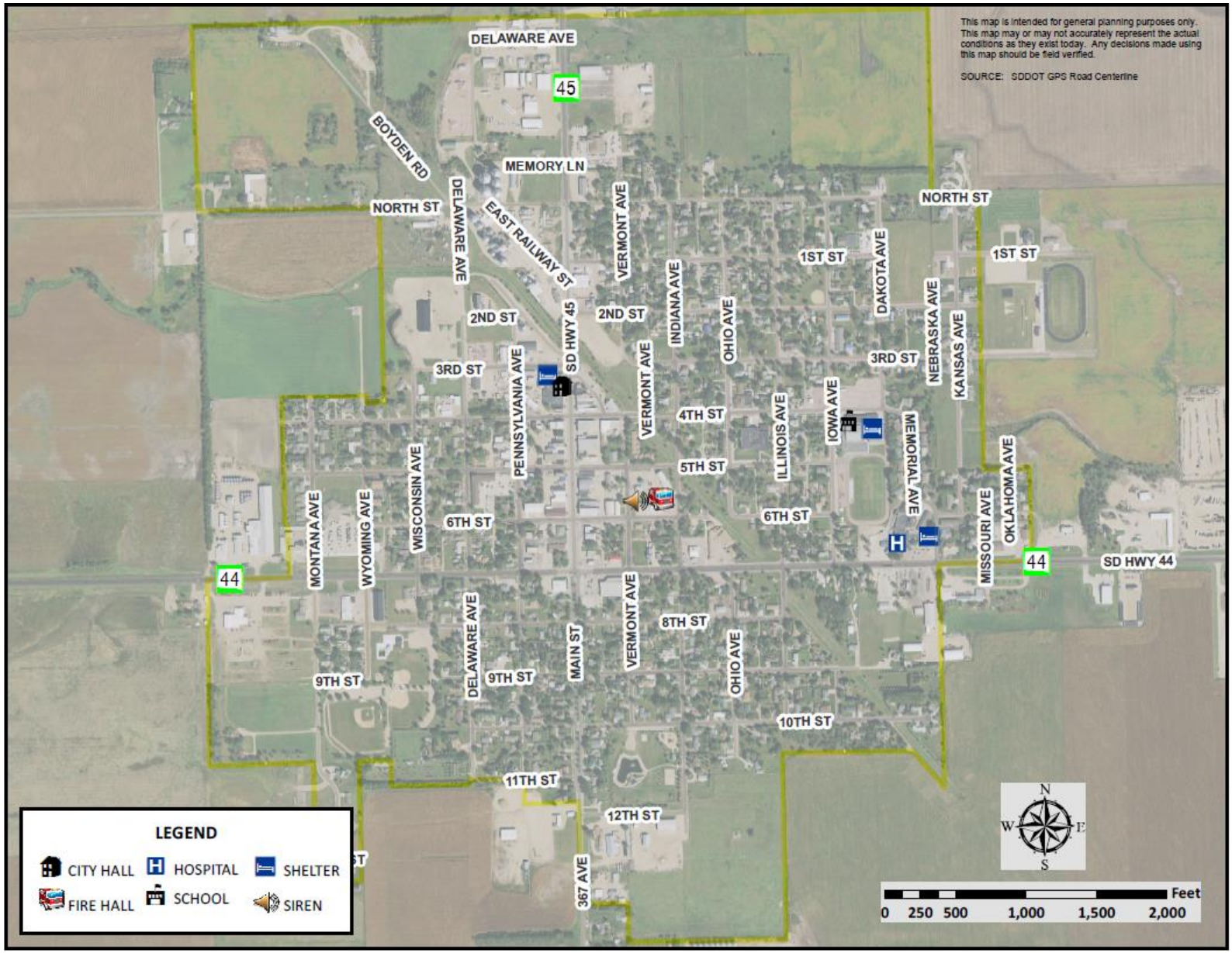


Figure 3.8 – Ravinia

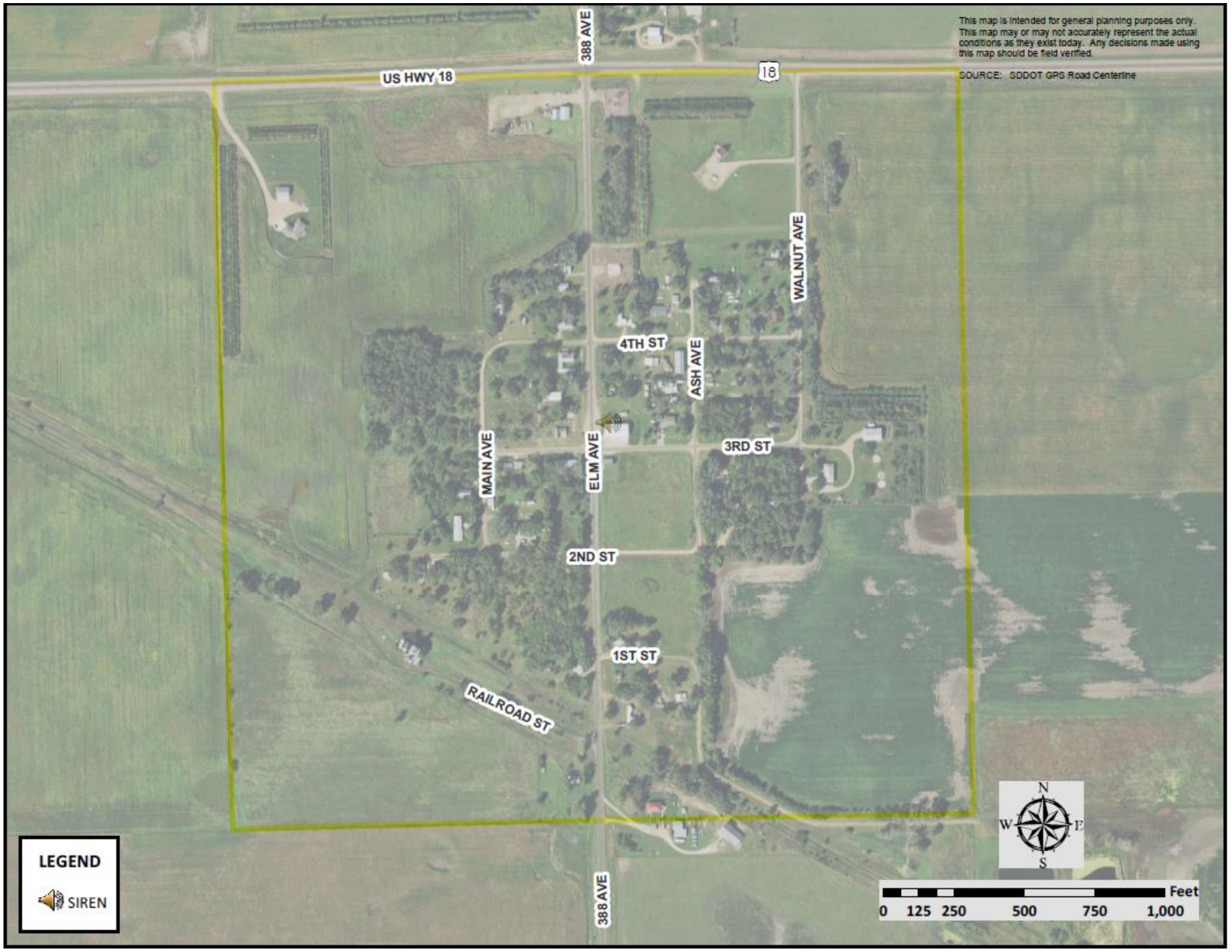
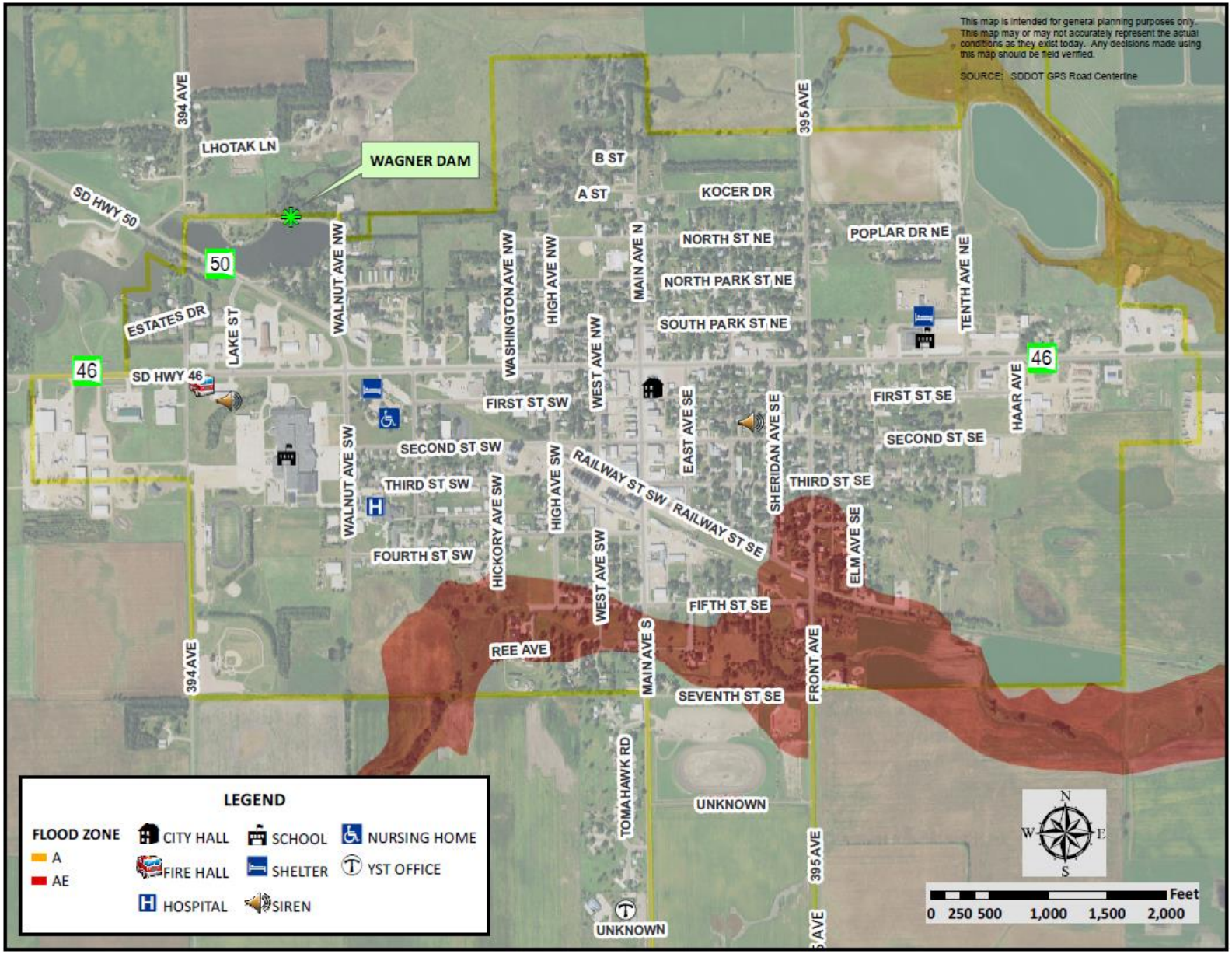


Figure 3.9 – Wagner



CHAPTER IV
RISK MITIGATION STRATEGY

Background

The previous chapter described the types of hazards most likely to impact Charles Mix County, and discussed the county's vulnerability to each of the hazards. This chapter identifies the hazard mitigation goals and objectives that the planning team decided upon, and then focuses on a presentation of the mitigation actions proposed to achieve the goals and objectives. A table showing all of the proposed actions is included. The chapter concludes with a discussion about how the proposed actions were prioritized.

Mitigation Goals and Objectives

After the risk assessment was completed, the planning team began to identify the goals and objectives it wanted to achieve. The team began by reviewing the goals listed in the county's current plan. The team also wanted to ensure that its goals were consistent with and supported the priorities of the other planning documents that were reviewed as this plan was being developed. In the end, the team decided upon the following general goals:

- Minimize loss of life and injuries from hazards.
- Minimize damage to existing and future structures within hazard areas.
- Reduce losses to critical facilities, utilities, and infrastructure from hazards.
- Reduce impacts to the economy and the environment from hazards.

After the team had settled on the goals, they began to focus more narrowly on each hazard by reviewing the results of the risk assessment and analyzing each jurisdiction's vulnerability to the hazards, and the severity of the threat posed by the hazards. Much of the discussion focused on damage caused by past hazard events, and what could be done to lessen or eliminate damage from future events. The planning team also considered how future development might affect the jurisdictions' vulnerability to each of the hazards faced.

Following are the specific mitigation objectives for each of the hazards:

Winter storm

- Reduce property losses due to winter storms.
- Ensure that people are adequately protected from the effects of winter storms.
- Minimize disruptions to the power distribution system.

Summer storm

- Reduce property losses due to summer storms.

- Ensure that people are adequately protected from the effects of summer storms.
- Ensure that people have adequate warning when violent weather threatens.

Flooding

- Reduce property and infrastructure losses due to flooding.
- Minimize development in areas that are prone to flooding.
- Maintain the natural and man-made systems that protect people and property from floods.

Drought

- Reduce economic and environmental impacts due to drought.

Wildfire

- Reduce property losses due to wildfires.

Mitigation Actions

With the goals and objectives identified by the planning team, the participating jurisdictions began the process of identifying mitigation actions that could be taken to accomplish the goals. The jurisdictions began by reviewing the actions listed in the county's current disaster mitigation plan and discussing the progress that had been made to implement the actions. A list of the actions and a summary of the implementation status of each action is shown in the following table.

Table 4.1 – Progress on Implementing Previously Proposed Actions

Mitigation Action	Hazard	Current Status
CHARLES MIX COUNTY		
Ensure continued NFIP compliance and implement policies that reduce risk exposure to flooding.	Flooding	Continuing
Improve county/township roads to mitigate against damage from flooding.	Flooding	The County plans to study flood prone roads in Jackson Township and elsewhere.
Generator acquisition for County Emergency Operations Center.	Winter storm	Completed
Formalize mutual aid agreements among local fire departments.	Wildfire	No progress, informal agreements are still in place.
Continue to enforce burn bans when conditions warrant.	Wildfire	Continuing
Consider enrolling in a public safety notification system.	All hazards	No progress on County level; Wagner uses Code Red system.
Clean out Choteau Creek to improve water flow.	Flooding	No progress
Erect a warning siren at the Platte Colony.	Summer storm	No progress
Construct a storm shelter at the Platte Colony.	Summer storm	No progress

Mitigation Action	Hazard	Current Status
Construct a storm shelter at the recreation areas.	Summer storm	Some of the recreation areas now have a shelter.
Begin participating in StormReady Community Program.	Summer storm	Completed
Consider adopting a comprehensive drought response plan.	Drought	No longer a priority
Gather data to create a more precise loss estimate for wildfire.	Wildfire	No longer a priority
TOWN OF DANTE		
Ensure continued NFIP compliance and implement policies that reduce risk exposure to flooding.	Flooding	Continuing
Reshape the ditches and install new culverts along 300th Street (aka Warren Ave).	Flooding	Completed with HMGP funds.
CITY OF LAKE ANDES		
Ensure continued NFIP compliance and implement policies that reduce risk exposure to flooding.	Flooding	Continuing
Conduct a stormwater drainage study for the community.	Flooding	No progress
Replace warning siren.	Summer storm	Completed
Generator acquisition for important community facilities, including 4-H building, pumphouse, and siren.	Winter storm	No progress
TOWN OF PICKSTOWN		
Ensure continued NFIP compliance and implement policies that reduce risk exposure to flooding.	Flooding	Continuing
Using snow fences or living snow fences to limit blowing and drifting of snow over critical road segments.	Winter storm	No longer a priority
Install transfer switch in Rainbow Room Community Center.	Winter storm	No progress
Acquire battery backup for warning siren.	Summer storm	No progress
CITY OF PLATTE		
Ensure continued NFIP compliance and implement policies that reduce risk exposure to flooding.	Flooding	Continuing
Generator acquisition for fire hall.	Winter storm	No longer a priority
Upgrade or replace warning siren.	Summer storm	No progress
Make drainage improvements on the west side of town.	Flooding	No progress
CITY OF WAGNER		
Ensure continued NFIP compliance and implement policies that reduce risk exposure to flooding.	Flooding	Continuing
Generator acquisition for new city shop building.	Winter storm	No longer a priority
Clean out creek on south side of town for better water flow.	Flooding	No progress
Generator acquisition for fire hall.	Winter storm	Completed
Relocate east side siren farther north; acquire new siren to serve south side of community.	Summer storm	No progress

Following this review, a list of potential mitigation actions based on FEMA's guidance document *Mitigation Ideas: A Resource for Reducing Risk to Natural Hazards* was reviewed. The actions on the list can be grouped into the following general categories:

- Prevention: Government administrative or regulatory actions or processes that influence building and development. Examples include:
  - Adopting zoning regulations.
  - Preserving open space.
  - Reviewing and strengthening local flood ordinances.
  - Adopting stormwater management regulations.
  - Adopting National Building Code standards.
  - Enacting measures to restrict non-essential water usage.

- Education and Outreach: Actions to inform and educate elected officials, stakeholders, property owners, and the general public about potential risks from hazards and potential ways to mitigate them. Examples include:
  - Developing a disaster mitigation public awareness program.
  - Participating in the StormReady program.
  - Participating in the Firewise Communities program.
  - Making presentations to school groups or neighborhood organizations.
  - Mailings to residents in hazard-prone areas.
  - Encouraging people to take various water-saving measures.

- Property Protection: Actions that modify existing buildings or infrastructure to protect them from a hazard or remove them from the hazard area. Examples include:
  - Property acquisition, elevation, or relocation, including elevating roads in flood-prone areas.
  - Making structural retrofits to facilities.
  - Replacing overhead utility lines with underground lines.

- Natural Resource Protection: Actions that, in addition to minimizing hazard losses, also preserve or restore the functions of natural systems. Examples include:
  - Using low-lying areas as natural water retention ponds.
  - Restoring and preserving wetlands.
  - Restoring stream corridors.
  - Forest and vegetation management.
  - Providing incentives for xeriscaping.

- Structural Projects: Actions that involve the construction of new structures to reduce the impact of a hazard. Examples include:
  - Upgrading stormwater infrastructure, such as culverts and storm sewer piping.
  - Building floodwalls.
  - Building tornado safe rooms.

It was explained that hazard mitigation is defined as *sustained action* taken to reduce or eliminate the long-term risk to people and property from hazards, as opposed to preparedness planning. Still, some actions to enhance disaster preparedness were discussed. Actions considered in this category included installing warning sirens in areas currently not well served and acquiring emergency power generators for critical facilities.

The final list of mitigation actions identified by the jurisdictions is shown in **Table 4.2**, which contains the following information for each action:

- The local priority rating – either High or Medium.
- The individual (party) primarily responsible for implementing the action.
- The estimated time frame needed to accomplish the action. Short term actions are those that can be completed within a few years, while Long term actions may take several years or more to accomplish due to cost or other factors.
- The estimated cost to implement the action.
- Resources that may be available to help fund the action.

Prioritizing the actions is important because it is unlikely that all of them can be pursued simultaneously, especially when costly projects are being considered. Those actions providing the most overall benefit in terms of cost are likely to be pursued first, while some lower priority actions may never be implemented. The prioritization process was informal and somewhat subjective, but a methodology did help guide the process. This framework, which was suggested by the Planning & Development District III office, is based on the following criteria:

- Overall benefit - how many lives or how much property will be protected, and how much disruption will be prevented? Are there any critical facilities or important public infrastructure that will be protected?
- Financial feasibility - how expensive will the action be? Could the action qualify for grant or loan funding?
- Political feasibility – will the public support the action? Are there any groups or interests that may be opposed to the action and thus prevent it from being implemented?
- Technical feasibility – does the technology exist for the action to be implemented? Is the action likely to function as intended?
- Environmental feasibility - does the action have the potential to have an adverse impact on the environment?
- Legal feasibility – are there any legal issues that might prevent the action from being implemented?

Guesswork was kept to a minimum during the prioritization process. For instance, in determining the potential benefit of a given action, the amount of property that would be protected by the action could in some cases be estimated with a fair amount of certainty. Assessing the proposed actions in relation to the other criteria was sometimes more difficult. Determining the political feasibility of the actions may have been the most subjective part of

the process, but the jurisdiction representatives generally had a good idea of how the public and vested interests would support the actions.

Funding considerations also are critical, because neither Charles Mix County nor any of the other participating jurisdictions have much discretionary money available to fund mitigation activities. Given this reality, it is unlikely that any mitigation action requiring substantial financial resources could be implemented locally without grant assistance. Following are potential sources of outside funding to help the jurisdictions accomplish mitigation projects:

FEMA grant programs

- Hazard Mitigation Grant Program (HMGP)
- Pre-Disaster Mitigation (PDM)
- Flood Mitigation Assistance (FMA)
- Rehabilitation of High Hazard Potential Dams (HHPD)

FEMA hazard mitigation funds have been awarded for mitigation projects within the county. Some of these projects include improvements that were done in 2012 to alleviate flooding along 290th Street south of Geddes, drainage improvements along Wagner's Front Avenue in 2014, and reshaping 300th Street in Dante in 2016 to reduce flooding.

Other grant and loan programs/sources

- US Economic Development Administration
- US Department of Agriculture Rural Development grant/loan program
- US Indian Community Development Block Grant program
- South Dakota Community Development Block Grant program
- South Dakota State Homeland Security Program
- South Dakota Dept. of Environment and Natural Resources
- South Central Water Development District
- South Dakota Dept. of Transportation
- Western States Wildland Urban Interface Grant Program

Table 4.2 - Proposed Mitigation Actions

CHARLES MIX COUNTY ACTIONS	PRIORITY	RESPONSIBLE PARTY	TIME	COST	RESOURCES
Update NFIP floodplain mapping after 2019 flooding	HIGH	Floodplain Admin	MID	N/A	N/A
Replace bridge on 301 St at Bon Homme County Line - 43.029766 / -98.103744 (Lone Tree Township)	HIGH	Highway Dept	MID	$250,000	DOT
Improve county/township roads to mitigate against damage from flooding.	HIGH	Highway Dept	MID	$50,000 to $100,000	FEMA/DOT
Replace bridge on 396th Ave - 43.444617 / -98.805924 (Carrol Township)	HIGH	Highway Dept	MID	$250,000	DOT
Water drainage project south of Platte between City and 277th St to improve water drainage near county shop.	HIGH	County Drainage Board / Platte	SHORT	Unknown	FEMA
Lake Andes Lake Drainage - discharge	HIGH	OEM/GFP/EM/YST/ LA/USACE	SHORT	Unknown	FEMA
Generator acquisition for County admin building / EOC	HIGH	EM	SHORT	$40,000	FEMA
Clean out Choteau Creek from Wagner to Dante to create channel and improve flow.	MED	County Drainage Board	LONG	Unknown	FEMA
Formalize mutual aid agreements between fire departments	MED	EM	MID	N/A	N/A
Partner with 211 Helpline Center	MED	EM	SHORT	N/A	N/A
Improve Repeat Tower Rd on 379th Ave - 43.152768 / -98.605682	MED	Highway Dept / EM	MID	~$50,000	FEMA
GEDDES ACTIONS	**PRIORITY**	**RESPONSIBLE PARTY**	**TIME**	**COST**	**RESOURCES**
Implement drainage improvements.	HIGH	Public works dept	LONG	Unknown	FEMA; DENR; USDA
Acquire generator for multi-purpose community center.	HIGH	Public works dept	MID	$30,000	FEMA
Acquire additional warning siren.	HIGH	Public works dept	MID	$20,000	FEMA
LAKE ANDES ACTIONS	**PRIORITY**	**RESPONSIBLE PARTY**	**TIME**	**COST**	**RESOURCES**
Ensure continued NFIP compliance and implement policies that reduce risk exposure to flooding.	HIGH	City Finance Officer	SHORT	N/A	N/A
Raise the East Sewage Lift Station.	HIGH	Public works dept	MID	$50,000	FEMA; SRF
Replace warning siren on east side of town.	HIGH	Public works dept	SHORT	$20,000	FEMA
Install generator on North Sewage Lift Station	HIGH	Public works dept	MID	$30,000	FEMA; SCWDD
Upgrade the storm water drainage system.	HIGH	Public works dept	LONG	Unknown	CDBG; DENR; USDA

PICKSTOWN ACTIONS	PRIORITY	RESPONSIBLE PARTY	TIME	COST	RESOURCES
Ensure continued NFIP compliance and implement policies that reduce risk exposure to flooding.	HIGH	City Finance Officer	SHORT	N/A	N/A
Upgrade warning siren.	HIGH	Public works dept	SHORT	$15,000	FEMA
Install generator and transfer switch for Rainbow Room Community Center.	MED	Public works dept	MID	$30,000	FEMA
Bury overhead power lines from substation.	MED	Public works dept	MID	≈$100,000	FEMA
Complete drainage study for area west of Missouri Drive	MED	Public works dept	MID	$75,000	FEMA; SCWDD
PLATTE ACTIONS	**PRIORITY**	**RESPONSIBLE PARTY**	**TIME**	**COST**	**RESOURCES**
Ensure continued NFIP compliance and implement policies that reduce risk exposure to flooding.	HIGH	City Finance Officer	SHORT	N/A	N/A
Hydrology study for the east and south sides of town.	HIGH	Public works dept	SHORT	$50,000	FEMA
Acquire backup generators for city hall.	HIGH	City Finance Officer	SHORT	$30,000	FEMA
Acquire backup generators for pumphouse.	HIGH	Public works dept	SHORT	$30,000	FEMA
Storm sewer system improvements, including drainage ditch through town.	HIGH	Public works dept	LONG	Unknown	CDBG; DENR; USDA
Upgrade city's warning siren system.	MED	Fire department	MED	$50,000	FEMA
WAGNER ACTIONS	**PRIORITY**	**RESPONSIBLE PARTY**	**TIME**	**COST**	**RESOURCES**
Ensure continued NFIP compliance and implement policies that reduce risk exposure to flooding.	HIGH	City finance officer	ONGOING	N/A	N/A
Generator acquisition for city hall/police department.	HIGH	City finance officer	SHORT	45,000	FEMA
Clean out creek on south side of town for better water flow.	HIGH	Public works dept	MID	$2 MIL	FEMA; SCWDD
Relocate east side siren farther north; acquire new siren to serve south side of community.	MED	Public works dept	MID	$30,000	FEMA

Potential Resources for Funding Assistance:

FEMA FEMA Hazard Mitigation Assistance Programs
DENR South Dakota Dept. of Environment and Natural Resources
USDA US Department of Agriculture Rural Development
CDBG Community Development Block Grant
SCWDD South Central Water Development District
DOT South Dakota Dept of Transportation

Mitigation Action Plan

The Charles Mix County Hazard Mitigation Plan is the backbone for disaster mitigation planning within the county. To remain useful, the plan cannot exist in a vacuum – it is designed to work with other local planning and development tools and mechanisms, and local officials and policy makers need to be familiar with it. This section first describes how the mitigation plan will be incorporated into existing planning mechanisms, and concludes by describing how the mitigation strategy will be implemented.

Plan Incorporation

It is important that the goals and actions included in this plan be integrated with the other plans and policies within the county that may affect land use and development. Neither this plan nor any of the others will work effectively if they contain contrary goals or policy recommendations. The following table shows the planning-related technical documents that currently exist within the county, each of which was reviewed as this plan was being developed. Looking ahead, future updates of this plan should not be made without reviewing these planning tools.

Table 4.3 – Local Planning Mechanisms

	Capital Improvement Plan	Comprehensive Land Use Plan	Zoning ordinance	Building codes	Electrical Construction Plan	Housing Plan	Flood damage prevention ordinance	Drainage ordinance	Five Year Highway Improvement Plan	Fire Management Plan
Charles Mix Co.		X					X		X	X
Dante		X	X				X			
Geddes										
Lake Andes		X	X				X			
Pickstown		X	X	X			X			
Platte		X	X				X			
Ravinia										
Wagner		X	X	X		X	X			

Hazard mitigation concepts should be incorporated where appropriate into the policy documents listed in the table. It is also important that major development projects within the jurisdictions be undertaken based on sound hazard mitigation planning.

Hazard mitigation also is discussed in the 2019 Comprehensive Economic Development Strategy (CEDS) for the Planning & Development District III region, which includes Charles Mix County. The CEDS, which is updated every five years for the Economic Development Administration, analyzes development issues, opportunities, and challenges from a regional

perspective. One chapter of the document focuses on economic resiliency, including the role that hazard mitigation can play in helping communities maintain their economic wellbeing.

Plan Implementation

The Charles Mix County Emergency Management Director is ultimately responsible for ensuring that the plan's mitigation strategy is implemented effectively. The director will work under the authority of the county commission to implement the strategy, and will coordinate his/her activities with other county departments and other agencies as needed. Each jurisdiction participating in this plan also will play a critical role in carrying out the action plan by identifying and prioritizing the actions they want to pursue, allocating resources for their implementation, and applying for funding assistance as needed. If and when they are able to secure funding, they will move forward with implementing their actions.

The availability of funding is critical to the success of this plan, and therefore the mitigation actions listed in **Table 4.2** should be considered when the jurisdictions begin the process of working on their annual budgets. In this way, the plan will not become a mere "wish list" of ideas for which there is no practical funding mechanism. For those jurisdictions that lack any other planning tools and mechanisms, this may be the only practical way for the plan to be implemented. To help ensure that this happens, the Emergency Management Director will contact each community early in the year prior to the budgeting process to remind them to consider their proposed mitigation actions, and also to remind them of the possibility of obtaining funding for their projects through FEMA or other sources.

If FEMA mitigation funds are awarded for a project, grant administration will be the responsibility of the local jurisdiction, which will appoint an individual who will be responsible for ensuring that the project is completed as proposed and that all grant award conditions and requirements are followed. A resource that can help the jurisdictions meet the FEMA grant requirements (and help develop the grant applications) is the Planning & Development District III office. District III staff have decades of experience working on various planning and community development activities within Charles Mix County, and over a decade of experience working with the county's emergency management office.

CHAPTER V
PLAN MAINTENANCE

Background

Plan maintenance is a continuous process, which involves monitoring, evaluating, and updating the plan. It provides the foundation for an ongoing mitigation program and helps ensure that the plan remains relevant and effective. This chapter addresses how Charles Mix County officials intend to ensure that the plan will remain a dynamic, useful tool for mitigating against the impact of future disaster events.

Plan Monitoring and Evaluation

Ultimate responsibility for monitoring the plan and evaluating its effectiveness lies with the Charles Mix County Emergency Management Director. The director will work with the support of the Charles Mix County Local Emergency Planning Committee (LEPC), which meets quarterly and includes representation from each jurisdiction participating in this plan.

The LEPC will review the plan annually. Major points of discussion will include whether the risk assessment remains valid, whether the mitigation goals and objectives identified in the plan remain sound, and whether progress is being made on implementing the mitigation actions identified in the plan. An opportunity also will be provided to add additional mitigation actions to the plan as needed, and to discuss whether development or other factors are affecting vulnerability to any hazards.

After the LEPC's plan review meeting, the Emergency Management Director will meet with the Charles Mix County commission and the other participating jurisdictions to discuss the progress being made to implement the plan. At this time, a determination will be made about whether the implementation strategy needs to be revised or the plan itself needs to be updated.

Plan evaluation must be an ongoing process. This will help ensure that the plan remains relevant and able to meet local conditions and priorities, which can change. Following are some of the factors that can have a major impact on mitigation planning:

- Occurrence of a significant disaster event – Serious events can reveal flaws in local jurisdictions' disaster preparedness plans. The 9/11 terrorist strikes are a dramatic example of this type of event. The Missouri River flooding that occurred in 2011 is another example of an event significant enough to necessitate a reexamination of local mitigation strategies.
- Change in the nature or magnitude of risks – Changing environmental conditions, increased development in sensitive areas, and other factors can be significant

enough to cause localities to rethink their mitigation strategies. As discussed earlier, climate change may increase the county's vulnerability to drought, and possibly other hazards.

- Change in funding availability – The availability of money often determines whether an action can be implemented. For example, local budget cuts can delay, or prevent altogether, a mitigation project's implementation. On the other hand, grant opportunities for specific types of mitigation actions may argue for their implementation.
- Change in local priorities – Local priorities regarding mitigation projects can change for a number of reasons. Regular meetings between the Charles Mix County commission and the local township boards are one way in which the county stays current on the townships' needs regarding their roads, bridges, and other infrastructure.
- Legal factors – Laws and regulatory requirements may change, which may make certain mitigation actions more or less feasible or desirable.
- Technological change – Advances in technology may make it possible in the future to address certain types of hazards more effectively or at lower cost.
- Other factors – There are many other factors that can have an impact on local disaster mitigation priorities and strategies. For example, a detailed engineering analysis may indicate that a proposed mitigation action may be much costlier than first estimated, which could make the action unpractical to pursue.

Updating the Plan

Updating the plan may occur at any time in response to the factors identified above. Otherwise, it is expected that the County will begin the process of updating the plan approximately two years prior to the plan's expiration date. Plan updates will reflect changes in growth and development, changing mitigation priorities, and progress in implementing the plan. Led by the Emergency Management Director, the process will consist of the following general steps:

- Obtain funding assistance
- Hire contractor to write the plan
- Organize planning team
- Begin soliciting public participation and input
- Hold meetings of planning team to develop the plan
- Make draft of the plan available for public review and comment
- Submit plan for State review
- Revise plan as needed based on reviewer comments
- Plan submitted by State to FEMA
- Revise plan as needed based on reviewer comments
- Jurisdictional adoption of approved plan

Public Involvement

Throughout the development of this plan update, a sustained effort was made to involve the general public in the plan. Outreach included press releases that were posted on community websites, as well as social media. Looking forward, the outreach strategy will evolve over time as different methods are used to get greater public participation in the mitigation planning process. Once approved, the plan will be available for the public to see at the county courthouse and in each city office. It also will be made available on the community websites. Other outreach activities may include:

- Community visits by the Emergency Management Director to discuss the plan (local schools, civic meetings, etc.)
- Press releases and articles about the plan published in the local newspapers.
- Information about the plan included with utility billing statements.

Another way for the public to participate in the mitigation planning process will be through the mitigation plan review meeting of the Charles Mix County LEPC. The meeting will be made known to the public through a public notice or press release in the local newspapers stating that the plan will be reviewed at the meeting and that comments from the public are encouraged.

All comments and suggestions received from the public through any of the forums described above will be included in a public comment section in the plan's appendix.

APPENDICES

APPENDIX A: Outreach Effort

This section documents the outreach effort that was used to solicit input into the plan.

Meeting #1 - Email to Planning Team:

From: Mike Kotab mkotab@charlesmixcounty.org

Sent: Thursday, May 14, 2020 11:47 AM

To: ANN RYSAVY <radrys@yahoo.com>; Becky Work <cywagner@hcinet.net>; City of Pickstown <pickstown@hcinet.net>; Wade Wright <wadewright_21@hotmail.com>; cityhall@cme.coop; City of Geddes <geddescity@midstatesd.net>; Shauna Meyerink <platte@midstatesd.net>; Bryan Slaba <Bryan.Slaba@avera.org>; Jim Duba <Jim.Duba@avera.org>; Cody Wilson <Cody.Wilson@usace.army.mil>; Chad Loeffler (Work) <loeffler@cme.coop>; dangel@cme.coop; Scott Pick <Scott.Pick@rcwd.org>; Danielle Davenport <ddavenport@charlesmixcounty.org>; Denise Weber <dweber@charlesmixcounty.org>; Karen Krcil <kkrcil@charlesmixcounty.org>
Cc: John Clem John.Clem@districtiii.org

Subject: Upcoming Pre Disaster Mitigation (PDM) Plan Meeting

I would like to extend an invitation to each of you and/or your communities/entities to attend a conference call on Wednesday, May 20th at 7pm (number to call and access code is in the attachment). I ask that at least one representative of your community/entity call in and attend the meeting. If you are unable, that is fine as it is not mandatory but a replacement representative is welcomed and encouraged. I have attached an agenda/press release and I ask that the municipalities post on their website or social media or however else you would like to post it.

I have also attached a copy of the current PDM plan which we will discuss during the meeting. We are setting aside 2 hours for this call but I do not anticipate it will take that long as we are only updating and not recreating.

For our records we will also be asking for names of individuals and the entity they are representing.

Respectfully,

Mike Kotab
Emergency Management
Charles Mix County
605.491.3134
mkotab@charlesmixcounty.org

Meeting #1 - Email to Other Emergency Management Directors:

From: Mike Kotab mkotab@charlesmixcounty.org

Sent: Thursday, May 14, 2020 11:56 AM

To: Harrington, Pat <douglascountyem@yahoo.com>; 'David Baker' <aurcoemmgr@goldenwest.net>; BH Emergency Management <bhcem@hcinet.net>; gregfire@gwtc.net; Kolstad, Brent Brent.Kolstad@state.sd.us

Cc: John Clem John.Clem@districtiii.org

Subject: PDM Plan Update - EM Notification

Good afternoon fellow EMs and Brent:

Just to let you know, Charles Mix County in the process of updating our PDM plan. Our first meeting will be next Wednesday, May 20th at 7pm via phone conference. I have attached a copy of the agenda which includes the phone number / access code if any of you would like to listen in.

Respectfully,

Mike Kotab
Emergency Management
Charles Mix County
605.491.3134
mkotab@charlesmixcounty.org

Meeting #1 Press Release:

DISASTER MITIGATION MEETING

Blizzards, tornadoes, and floods are a few of the natural hazards that strike this part of the country. Events like this have the potential of causing thousands of dollars annually in damage to property. To lessen the impact of these disasters in the future, Charles Mix County is beginning the process of updating its current Disaster Mitigation Plan.

A series of meetings will be held to obtain input as the plan is developed. These meetings are open to everyone. If you have an idea about what can be done to prepare for future disaster events occurring in Charles Mix County, you are urged to attend the meetings.

The first meeting will be held via phone conference call on May 20 at 7:00 PM. Dial **1 800 567-5900**, and use access code **2044505**. Agenda items for the initial meeting include a review of the county's current disaster mitigation plan, and identifying and profiling the hazards that impact the county.

Additional information about the meeting can be obtained by contacting the Charles Mix County Emergency Management Office at 605-491-3134 or by email at mkotab@charlesmixcounty.org. You can also contact John Clem at 800-952-3562 or by email at John.Clem@districtiii.org.

APPENDIX B: Planning Meeting Items

This section consists of items from the planning team meetings and jurisdictional meetings that were held as the plan was being developed, including agendas and meeting minutes.

APPENDIX C: History of Previous Hazard Occurrences

This appendix provides details about hazard events that have impacted Charles Mix County in the past. **Table C.1** below lists all of the events since 1970 that resulted in a major disaster declaration in which Charles Mix County was part of the designated area. Records from FEMA were consulted for federal assistance provided following each disaster through FEMA's Public Assistance program.

Table C.1 – Major Disaster Declarations Affecting Charles Mix County

Dec #	Declaration Date	Type	Primary Damage Impact	Public Assistance To County
717	Jul 1984	Severe Storms and Flooding		
999	Jul 1993	Severe Storms, Tornadoes		
1052	May 1995	Severe Storms, Flooding		
1075	Jan1996	Severe Winter Storm		
1156	Jan 1997	Severe Winter Storm		
1173	Apr 1997	Severe Flooding		
1620	Dec 2005	Severe Winter Storm		
1774	Jul 2008	Severe Storms and Flooding	Roads, bridges	
1915	May 2010	Flooding	Roads, bridges	≈$335,000
1984	May 2011	Severe Storms and Flooding	Roads	≈$500,000
4440	Jun 2019	Severe Winter Storm; Flooding	Roads, bridges	≈$330,000
4469	Nov 2019	Severe Storm; Tornado; Flooding	Roads, bridges	≈$300,000

Sources: www.fema.gov/disasters/grid/state-tribal-government/72; www.fema.gov/data-feeds/openfema-dataset-public-assistance-funded-projects-summaries-v1

Table C.2 is a comprehensive list of the most significant hazard events reported for Charles Mix County from 1960 through 2019, as recorded in the National Climatic Data Center's Storm Events Database. The National Climatic Data Center receives storm data from the National Weather Service, which gets its information from a variety of sources, including county, state and federal emergency management officials, local law enforcement officials, National Weather Service damage surveys, the insurance industry, and the general public.

The Storm Events Database is useful, but it does have limitations. One problem is that records for certain hazard events, including winter storms and blizzards, only go back to the 1990s. Another issue is that damage amounts in most cases are estimates, especially for events that impacted multiple counties. Also note that the database contains a preponderance of records from recent times. This is due to an inconsistency in data reporting over the years, and does not indicate an increase in the frequency of events affecting the county.

The table includes the following information about the events:

- Date - multiple events may be shown for a single day because a storm system may contain many specific storm events affecting different locations.
- Type of event.

- Descriptive information - details are provided for some of the more noteworthy events back to the 1990s.
- Magnitude - the magnitude of tornadoes, hail, thunderstorm winds, and high wind events is given. For events occurring since 2000 the speed is represented by either the highest measured wind gust (M) or the highest estimated wind gust (E). Note that speeds are shown in knots - multiply figure by 1.15 to get approximate speed in miles per hour.
- Property and crop damage - the National Weather Service uses all available data from the sources identified above in compiling the damage amounts, but the figures should be considered as broad estimates. In many cases, damage amounts are unknown.

Table C.2 – History of Significant Hazard Events in Charles Mix County

DATE	EVENT TYPE	DESCRIPTION	MAG	PROP DAMAGE ($1,000s)	CROP DAMAGE ($1,000s)
7/17/1961	Hail		2.00 in.		
5/14/1962	Tornado		F3		
5/14/1962	Tornado		F1		
5/16/1962	Tornado		F3		
5/21/1962	Tornado		F3		
7/18/1963	Thunderstorm Wind		0 kts.		
8/15/1963	Hail		0.75 in.		
6/22/1964	Tornado		F1		
6/1/1965	Tornado		F0		
6/1/1965	Tornado		F0		
8/17/1967	Hail		3.50 in.		
6/20/1968	Thunderstorm Wind		56 kts.		
6/20/1968	Tornado		F2		
6/15/1970	Tornado		F1		
9/6/1970	Thunderstorm Wind		0 kts.		
6/4/1971	Tornado		F2	25	
6/4/1971	Tornado		F1	2.5	
6/5/1971	Tornado		F0		
6/18/1972	Thunderstorm Wind		50 kts.		
6/17/1973	Hail		0.75 in.		
6/17/1973	Thunderstorm Wind		0 kts.		
6/24/1973	Tornado		F2	25	
7/1/1973	Thunderstorm Wind		0 kts.		
7/9/1973	Thunderstorm Wind		0 kts.		
6/3/1975	Tornado		F1		

DATE	EVENT TYPE	DESCRIPTION	MAG	PROP DAMAGE ($1,000s)	CROP DAMAGE ($1,000s)
6/3/1975	Tornado		F1		
6/3/1975	Tornado		F1		
6/19/1975	Thunderstorm Wind		0 kts.		
6/20/1975	Thunderstorm Wind		0 kts.		
8/20/1975	Hail		1.25 in.		
8/20/1975	Thunderstorm Wind		0 kts.		
8/9/1976	Hail		1.75 in.		
8/9/1976	Hail		0.75 in.		
8/2/1977	Thunderstorm Wind		52 kts.		
9/1/1977	Thunderstorm Wind		0 kts.		
4/8/1978	Hail		0.75 in.		
7/17/1978	Thunderstorm Wind		0 kts.		
7/17/1978	Thunderstorm Wind		0 kts.		
7/25/1978	Hail		1.75 in.		
7/25/1978	Hail		2.00 in.		
6/19/1979	Tornado		F1	2.5	
7/29/1979	Thunderstorm Wind		0 kts.		
5/26/1980	Hail		1.75 in.		
5/26/1980	Thunderstorm Wind		0 kts.		
6/6/1980	Hail		1.75 in.		
6/6/1980	Hail		1.75 in.		
6/6/1980	Thunderstorm Wind		50 kts.		
6/26/1980	Thunderstorm Wind		70 kts.		
6/1/1981	Hail		1.00 in.		
7/19/1981	Thunderstorm Wind		0 kts.		
7/19/1981	Tornado		F1		
5/8/1982	Hail		1.75 in.		
7/18/1982	Hail		0.75 in.		
7/18/1982	Thunderstorm Wind		0 kts.		
7/18/1982	Thunderstorm Wind		0 kts.		
7/18/1982	Tornado		F0		
7/18/1982	Tornado		F0		
7/21/1982	Thunderstorm Wind		0 kts.		
10/5/1982	Hail		1.00 in.		
6/12/1983	Tornado		F0		
6/26/1983	Tornado		F1	2.5	
6/5/1984	Thunderstorm Wind		61 kts.		

DATE	EVENT TYPE	DESCRIPTION	MAG	PROP DAMAGE ($1,000s)	CROP DAMAGE ($1,000s)
4/19/1985	Thunderstorm Wind		0 kts.		
5/11/1985	Tornado		F0		
5/11/1985	Tornado		F0		
5/30/1985	Thunderstorm Wind		0 kts.		
9/2/1985	Hail		1.75 in.		
4/26/1986	Hail		2.75 in.		
9/24/1986	Thunderstorm Wind		56 kts.		
7/11/1987	Thunderstorm Wind		70 kts.		
8/15/1987	Hail		2.00 in.		
8/15/1987	Hail		3.00 in.		
9/4/1987	Hail		1.75 in.		
9/18/1988	Hail		2.00 in.		
7/17/1989	Hail		1.75 in.		
5/22/1990	Hail		1.75 in.		
5/22/1990	Thunderstorm Wind		60 kts.		
8/25/1990	Thunderstorm Wind		0 kts.		
4/26/1991	Hail		0.75 in.		
5/12/1991	Tornado		F0		
5/28/1991	Thunderstorm Wind		52 kts.		
5/28/1991	Thunderstorm Wind		80 kts.		
7/20/1991	Hail		1.75 in.		
7/30/1991	Thunderstorm Wind		52 kts.		
5/15/1992	Hail		3.00 in.		
5/15/1992	Hail		0.75 in.		
5/15/1992	Hail		1.00 in.		
6/16/1992	Hail		0.75 in.		
6/16/1992	Thunderstorm Wind		52 kts.		
6/16/1992	Tornado		F0		
7/7/1992	Thunderstorm Wind		50 kts.		
7/21/1992	Thunderstorm Wind		65 kts.		
7/21/1992	Thunderstorm Wind		65 kts.		
5/7/1993	Hail		2.50 in.	50	
6/24/1994	Hail		2.75 in.	500	500
7/4/1994	Hail		1.75 in.		
7/15/1994	Thunderstorm Wind		0 kts.		
8/18/1994	Hail		2.75 in.	100	800
8/21/1995	Hail		0.75 in.		

DATE	EVENT TYPE	DESCRIPTION	MAG	PROP DAMAGE ($1,000s)	CROP DAMAGE ($1,000s)
1/17/1996	Blizzard			20	
1/29/1996	Cold/wind Chill				
2/10/1996	High Wind		58 kts.	60	
3/24/1996	Blizzard			10	
4/12/1996	Heavy Snow				
4/25/1996	High Wind		62 kts.	10	
6/19/1996	Hail		1.75 in.		
6/19/1996	Hail		0.75 in.		
6/19/1996	Hail		2.00 in.		
6/19/1996	Hail		2.75 in.		
7/7/1996	Hail		1.75 in.		
7/7/1996	Hail		2.50 in.		
7/7/1996	Hail		0.75 in.		
8/4/1996	Hail		0.88 in.		
8/6/1996	Hail	Hail damaged crops with the heaviest damage occurring in a strip 2 miles wide and 6 miles long southeast of Wagner.	1.75 in.		500
10/29/1996	High Wind		57 kts.	50	
11/14/1996	Ice Storm			20	
12/16/1996	Blizzard				
12/25/1996	Heavy Snow				
1/4/1997	Blizzard				
1/9/1997	Blizzard				
1/15/1997	Cold/wind Chill				
2/3/1997	Heavy Snow				
3/12/1997	Flood	Widespread snowmelt flooding began in March and continued through the end of the month. Widespread flooding of farmland and other lowlands occurred, both near and away from major river basins. Many roads, farm buildings, and some homes and businesses were flooded. Many basements were flooded just from groundwater seepage.			
4/1/1997	Flood				
4/6/1997	High Wind		63 kts.	10	
4/9/1997	Heavy Snow				
6/11/1997	Flash Flood	Rainfall of 3 to 6 inches flooded roads, basements, and some vehicles and homes. The flooding resulted from overflow of drainage ditches, sewer systems, at least one creek, and simple ponding of water in low areas.		30	
6/20/1997	Thunderstorm Wind		61 kts.	50	
7/27/1997	Hail		0.75 in.		
8/29/1997	Thunderstorm Wind		52 kts.		
3/31/1998	Heavy Snow			10	

DATE	EVENT TYPE	DESCRIPTION	MAG	PROP DAMAGE ($1,000s)	CROP DAMAGE ($1,000s)
5/14/1998	Hail		0.88 in.		
7/5/1998	Hail		0.75 in.		
7/5/1998	Thunderstorm Wind		52 kts.		
7/6/1998	Hail		1.75 in.	100	500
7/6/1998	Hail	Large hail destroyed or damaged crops, broke windows, and damaged vehicles and many farm buildings. The hail covered the ground in places and was accompanied by strong winds and heavy rain.	1.75 in.	1000	2200
7/6/1998	Hail		0.75 in.		
7/6/1998	Hail		1.00 in.		
7/6/1998	Thunderstorm Wind		52 kts.	5	
7/6/1998	Thunderstorm Wind		52 kts.		
7/6/1998	Thunderstorm Wind		61 kts.		
8/19/1998	Hail		1.75 in.		
8/19/1998	Hail		0.75 in.		
8/19/1998	Thunderstorm Wind		52 kts.		
11/10/1998	Blizzard			21	
5/3/1999	Hail		0.75 in.		
5/3/1999	Thunderstorm Wind		61 kts.	2	
5/3/1999	Tornado		F0		
5/10/1999	Hail		0.75 in.		
5/10/1999	Hail		1.00 in.		
5/10/1999	Hail		0.75 in.		
5/22/1999	Hail		0.75 in.		
6/4/1999	Hail		0.75 in.		
6/4/1999	Hail		0.75 in.		
6/4/1999	Hail		1.50 in.		
6/7/1999	Hail		0.75 in.		
6/7/1999	Hail		1.75 in.		
6/22/1999	Hail		0.75 in.		
6/22/1999	Hail		0.75 in.		
7/2/1999	Thunderstorm Wind	Thunderstorm winds caused widespread tree damage, destroyed an unoccupied trailer home south of Platte, damaged calf shelters and other farm structures. The winds also blew off a 30 foot section of a metal roof at a pork plant near Academy, and overturned campers.	60 kts.	100	
7/2/1999	Thunderstorm Wind		70 kts.	10	
7/2/1999	Thunderstorm Wind		61 kts.	10	
11/1/1999	Drought	Generally dry weather that began in August continued through November. Dry surface and soil conditions became quite pronounced in November. Water levels fell, especially in small streams and lakes. Damage to winter wheat crops was feared.			

DATE	EVENT TYPE	DESCRIPTION	MAG	PROP DAMAGE ($1,000s)	CROP DAMAGE ($1,000s)
		The area experienced the third driest fall (September through November) period on record. Unusually warm weather during the month contributed to the drying. The most noticeable manifestation of the dry conditions was the large number of grass fires across the area. While damage was mainly limited to the grasslands, considerable manpower and expense was needed to fight the fires.			
12/1/1999	Drought	Dry weather that began in August continued through December. Grass fires continued to be a problem. Agricultural concern was mostly for the future start of the growing season, but there were some effects on winter wheat.			
1/10/2000	High Wind		43 kts. E		
2/1/2000	Drought	Dry weather that prevailed during the fall continued in February, Dry surface and soil conditions remained quite pronounced. Water levels continued to fall slowly. especially in wetlands, small streams, and lakes. Above normal temperatures contributed to further drying. Grass fires were again a problem in some areas.			
3/1/2000	Drought				
4/1/2000	Drought	Dry weather continued, allowing dry surface and soil conditions to continue. Rainfall in the middle and later parts of the month alleviated the short term dryness somewhat, but soil moisture was still inadequate for the long term. Water levels remained low, especially in some small lakes.			
4/5/2000	High Wind		56 kts. E	17	
5/11/2000	Thunderstorm Wind		57 kts. M		
6/19/2000	Hail		0.75 in.		
8/7/2000	Hail		0.75 in.		200
8/7/2000	Hail		0.88 in.		
8/7/2000	Hail		1.75 in.		
8/7/2000	Hail		1.00 in.		
8/7/2000	Hail		1.75 in.		
8/7/2000	Tornado	An F1 tornado damaged three homes, and damaged cropland.	F1	100	
8/16/2000	Hail		0.75 in.		
11/11/2000	Winter Storm				
12/16/2000	Blizzard				
12/28/2000	High Wind		52 kts. E		
1/29/2001	Blizzard				
2/7/2001	Winter Storm				
2/24/2001	Winter Storm				
6/9/2001	Thunderstorm Wind	Thunderstorm winds up to 70 mph blew over two grain bins, moving one of them a half mile. A calf shelter also was destroyed, a livestock trailer was overturned, and there was tree damage.	61 kts. E	20	
7/7/2001	Lightning			1	
7/21/2001	Thunderstorm Wind	Thunderstorm winds up to 70 mph destroyed part of a large cattle shed near Dante.	61 kts. E	100	

DATE	EVENT TYPE	DESCRIPTION	MAG	PROP DAMAGE ($1,000s)	CROP DAMAGE ($1,000s)
7/30/2001	Thunderstorm Wind	Thunderstorm winds up to 85 mph blew off a door and part of the roof at the Wagner airport, blew down trees and power poles, and blew two farm wagons across a highway. The temperature rose over 20 degrees in a few minutes, briefly reaching 99 degrees.	75 kts. M	50	
7/30/2001	Thunderstorm Wind		61 kts. E	50	
7/31/2001	Thunderstorm Wind		57 kts. E		
8/29/2001	Hail	Thunderstorm winds up to 70 mph damaged trees and power lines, with many power poles reported down. Farm machinery and roofs were damaged, including a roof blown off a home. Large hail fell in an area from near Marty east to Dante, including the town of Wagner. Damage was reported to vehicles and crops, but the amount of damage was not known.	0.75 in.		
8/29/2001	Hail		0.75 in.		
8/29/2001	Hail		0.75 in.		
8/29/2001	Hail		2.75 in.		
8/29/2001	Thunderstorm Wind		61 kts. E	100	
10/9/2001	Hail		0.75 in.		
10/9/2001	Hail		1.50 in.		
10/9/2001	Hail		1.50 in.		
11/26/2001	Heavy Snow				
2/11/2002	High Wind		50 kts. E		
3/14/2002	Winter Storm				
5/5/2002	Hail		1.00 in.		
5/7/2002	Hail		0.88 in.		
7/9/2002	Hail		1.50 in.		
7/9/2002	Hail		0.75 in.		
7/9/2002	Hail		0.88 in.		
7/9/2002	Hail		0.75 in.		
7/9/2002	Hail		0.88 in.		
7/24/2002	Hail		0.88 in.		
7/24/2002	Hail		0.75 in.		
7/24/2002	Hail		0.75 in.		
7/24/2002	Hail		0.75 in.		
7/24/2002	Hail		1.75 in.		
7/24/2002	Hail		0.75 in.		
7/24/2002	Hail		0.75 in.		
8/9/2002	Hail		0.75 in.		
8/9/2002	Hail		1.00 in.		
8/9/2002	Hail		0.88 in.		
8/9/2002	Thunderstorm Wind		61 kts. E	100	

DATE	EVENT TYPE	DESCRIPTION	MAG	PROP DAMAGE ($1,000s)	CROP DAMAGE ($1,000s)
8/9/2002	Thunderstorm Wind		52 kts. E		
8/9/2002	Thunderstorm Wind		52 kts. E		
8/11/2002	Hail		0.88 in.		
8/16/2002	Hail		0.88 in.		
1/15/2003	Heavy Snow				
2/14/2003	Winter Weather				
3/3/2003	Winter Weather				
4/6/2003	Heavy Snow				
6/5/2003	Hail		1.75 in.	10	
6/5/2003	Hail	Large hail covered the ground and caused severe crop damage in a 15 mile-wide area over southern and eastern Charles Mix County. About 60,000 acres of crops were damaged or destroyed, but the amount of loss was not available due to the complications of figuring damages in the case of replanted crops. The hail accumulated to a depth of several inches in places, with drifts as high as four feet in the Wagner area. The hail cracked windows and damaged siding in the Wagner area.	1.75 in.		
6/5/2003	Hail		0.88 in.		
6/5/2003	Hail		0.75 in.		
6/5/2003	Hail		1.00 in.		
6/5/2003	Hail		0.88 in.		
6/5/2003	Thunderstorm Wind		52 kts. EG		
6/24/2003	Hail		0.75 in.		
6/24/2003	Tornado	An F1 tornado damaged or destroyed several buildings at an abandoned farm near Lake Andes, and also caused tree damage.	F1	50	
6/24/2003	Tornado		F0		
6/24/2003	Tornado		F1		
7/3/2003	Thunderstorm Wind	Thunderstorm winds up to 55 mph blew down at least four large trees in Geddes. One tree damaged a car when it fell.	52 kts. EG	2	
7/5/2003	Thunderstorm Wind		52 kts. EG		
8/19/2003	Thunderstorm Wind		52 kts. EG		
11/22/2003	Winter Storm				
12/8/2003	Winter Storm				
2/11/2004	Winter Weather				
3/15/2004	Heavy Snow				
4/18/2004	Hail		0.88 in.		
5/16/2004	Hail		0.88 in.		
5/16/2004	Hail		0.75 in.		
5/29/2004	Hail	Large hail damaged vehicles and cracked windows in Marty. Crop damage was suspected. The amount of property and crop damage was not known.	1.75 in.		
5/29/2004	Hail		1.75 in.		

DATE	EVENT TYPE	DESCRIPTION	MAG	PROP DAMAGE ($1,000s)	CROP DAMAGE ($1,000s)
7/12/2004	Hail		0.88 in.		
7/12/2004	Hail		1.00 in.		
7/12/2004	Hail		2.50 in.		
7/12/2004	Hail		0.75 in.		
7/15/2004	Hail		0.75 in.		
7/15/2004	Thunderstorm Wind		69 kts. EG	10	
7/15/2004	Tornado	A tornado moved from northwest to southeast over open country through Charles Mix County on a ten mile track. The tornado damaged crops, but did not cause any property damage. The tornado was observed to be about a quarter mile wide early in its life, then steadily narrowed before dissipating.	F0		5
10/29/2004	High Wind		53 kts. MG		
1/4/2005	Heavy Snow				
3/10/2005	High Wind		52 kts. EG	10	
5/7/2005	Hail		0.75 in.		
6/7/2005	Thunderstorm Wind		52 kts. EG		
6/20/2005	Thunderstorm Wind		61 kts. EG		
6/21/2005	Flash Flood	Heavy rain caused flooding of numerous roads and several small streams. SD Hwy 50 was closed because of flooding between L. Andes and Ravinia. In Wagner, water up to 3 feet deep flooded roads near a stream.			
7/6/2005	Hail		0.50 in.		10
8/3/2005	Hail		0.75 in.		
8/25/2005	Hail		1.00 in.		
9/12/2005	Hail		1.00 in.		
9/18/2005	Hail		0.75 in.		
9/18/2005	Hail		1.00 in.		
11/8/2005	High Wind		52 kts. EG	20	
11/27/2005	Ice Storm	Heavy freezing rain coated roads, and power lines with ice up to 3 inches thick throughout SE South Dakota. Many roads were shut down for extended periods. Most schools and businesses were forced to close. Many miles of power lines and thousands of poles were brought down, resulting in power outages to thousands of households. In some rural areas, power was out for more than two weeks. Many people took shelter wherever they could. Damage to power poles and lines was so great that repairs required assistance from crews from eight states.		1000	
11/28/2005	Blizzard			100	
11/30/2005	Winter Weather				
12/2/2005	Winter Weather				
2/16/2006	Winter Weather				
3/12/2006	Winter Weather				
3/19/2006	Winter Storm				
6/16/2006	Thunderstorm Wind		57 kts. EG		

DATE	EVENT TYPE	DESCRIPTION	MAG	PROP DAMAGE ($1,000s)	CROP DAMAGE ($1,000s)
7/18/2006	Drought				
8/1/2006	Drought				
9/16/2006	Hail		0.75 in.		
9/16/2006	Hail		0.75 in.		
9/16/2006	Hail		1.75 in.		
9/16/2006	Hail		1.75 in.		
12/20/2006	Winter Storm			40	
12/29/2006	Winter Storm				
2/12/2007	Winter Weather				
2/24/2007	Winter Storm				
2/28/2007	Heavy Snow				
3/1/2007	Blizzard				
4/21/2007	Hail		2.50 in.		
4/21/2007	Hail		0.88 in.		
4/21/2007	Hail		1.00 in.		
4/21/2007	Hail		0.88 in.		
5/4/2007	Hail		0.88 in.		
5/5/2007	Hail		1.00 in.		
5/5/2007	Hail		1.00 in.		
5/5/2007	Hail		1.75 in.		
5/5/2007	Hail		1.75 in.		
5/5/2007	Hail		1.75 in.		
5/5/2007	Hail		1.00 in.		
5/5/2007	Thunderstorm Wind		52 kts. EG		
5/5/2007	Thunderstorm Wind		52 kts. EG		
5/5/2007	Tornado		EF0		
5/22/2007	Flash Flood				
6/6/2007	Thunderstorm Wind		57 kts. EG		
6/21/2007	Flash Flood	Thunderstorm winds caused tree and power line damage, with resulting power outages. Large hail was accompanied by very heavy rain. Flash flooding occurred near Pickstown.			
6/21/2007	Hail		0.75 in.		
6/21/2007	Hail		0.75 in.		
6/21/2007	Thunderstorm Wind		61 kts. EG		
6/21/2007	Thunderstorm Wind		61 kts. EG		
7/17/2007	Hail		1.00 in.		
7/18/2007	Hail		1.00 in.		
8/3/2007	Thunderstorm Wind	Thunderstorm winds blew the roof off a hog confinement building and scattered debris over a field.	61 kts. EG		5

DATE	EVENT TYPE	DESCRIPTION	MAG	PROP DAMAGE ($1,000s)	CROP DAMAGE ($1,000s)
8/9/2007	Hail	Winds estimated at 60 mph occurred. Large hail whitened the ground at Lake Andes. Thunderstorm winds caused significant tree damage in Platte.	0.88 in.		
8/9/2007	Thunderstorm Wind		52 kts. EG		
8/10/2007	Hail		1.00 in.		
8/10/2007	Hail		0.75 in.		
8/10/2007	Hail		1.00 in.		
8/10/2007	Hail		1.00 in.		
8/10/2007	Hail		1.00 in.		
8/10/2007	Thunderstorm Wind		57 kts. EG	5	
8/10/2007	Thunderstorm Wind		52 kts. EG		
8/10/2007	Thunderstorm Wind		57 kts. MG		
8/10/2007	Thunderstorm Wind		57 kts. EG		
8/10/2007	Thunderstorm Wind		61 kts. EG		
8/21/2007	Hail		0.88 in.		
8/21/2007	Hail		0.88 in.		
8/21/2007	Hail	Hail occurred in a wide area, with particularly large hail in the Dante and Wagner areas. A state record size hailstone certified at almost 7" in diameter occurred at Dante.	1.00 in.		
8/21/2007	Hail		1.75 in.		
8/21/2007	Hail		6.13 in.		
8/21/2007	Hail		6.88 in.		
8/21/2007	Hail		1.00 in.		
8/21/2007	Hail		0.88 in.		
9/29/2007	Hail		0.75 in.		
9/29/2007	High Wind		61 kts. EG	10	
12/1/2007	Winter Weather				
12/25/2007	Winter Weather				
1/20/2008	Winter Weather				
1/23/2008	Winter Weather				
2/11/2008	Winter Weather				
3/16/2008	Winter Weather				
3/31/2008	Heavy Snow				
4/10/2008	Blizzard				
4/25/2008	Heavy Snow				
5/6/2008	Hail		0.88 in.		
5/30/2008	Hail		0.75 in.		
6/2/2008	Hail		1.75 in.	200	
6/2/2008	Hail		1.00 in.		

DATE	EVENT TYPE	DESCRIPTION	MAG	PROP DAMAGE ($1,000s)	CROP DAMAGE ($1,000s)
6/2/2008	Hail		0.88 in.		
6/2/2008	Thunderstorm Wind		61 kts. EG	10	
6/3/2008	Hail		1.00 in.		
6/3/2008	Hail		1.75 in.		
6/4/2008	Flash Flood	Heavy rain caused flash flooding of roads in and near Dante.			
6/5/2008	Flash Flood				
6/5/2008	Hail		1.00 in.		
6/5/2008	Hail		1.75 in.		
6/5/2008	Hail		1.00 in.		
6/5/2008	Thunderstorm Wind		61 kts. EG	10	
6/5/2008	Thunderstorm Wind		61 kts. EG	50	
6/5/2008	Thunderstorm Wind		52 kts. EG		
6/5/2008	Tornado	The storm produced an EF1 tornado near Marty and caused flash flooding in Wagner. 1.75 in. hail recorded.	EF1	100	
6/17/2008	Hail		0.88 in.		
6/19/2008	Hail		0.88 in.		
7/28/2008	Hail		1.00 in.		
7/28/2008	Thunderstorm Wind		52 kts. EG		
8/14/2008	Hail		0.75 in.		
8/14/2008	Hail		0.88 in.		
10/26/2008	High Wind		39 kts. ES		
11/6/2008	Blizzard				
11/7/2008	Winter Weather				
12/14/2008	Blizzard				
12/20/2008	Winter Weather				
2/26/2009	Winter Weather				
3/23/2009	Thunderstorm Wind		52 kts. EG		
3/30/2009	Blizzard				
4/4/2009	Blizzard				
6/23/2009	Hail		0.75 in.		
6/25/2009	Thunderstorm Wind		52 kts. EG		
6/26/2009	Thunderstorm Wind		52 kts. EG	5	
6/29/2009	Hail		0.75 in.		
8/8/2009	Hail		1.00 in.	1	
8/8/2009	Hail		1.75 in.		
8/8/2009	Hail		2.00 in.		
8/8/2009	Hail		1.75 in.		

DATE	EVENT TYPE	DESCRIPTION	MAG	PROP DAMAGE ($1,000s)	CROP DAMAGE ($1,000s)
8/12/2009	Thunderstorm Wind		52 kts. EG		
8/12/2009	Thunderstorm Wind		52 kts. EG		
9/2/2009	Thunderstorm Wind		61 kts. EG	5	
12/8/2009	Winter Weather				
12/23/2009	Blizzard				
1/6/2010	Blizzard	Snowfall of 3 to 6 inches and winds gusting over 40 mph produced widespread blizzard conditions, with visibilities less than a quarter mile. New snowfall included 6 inches at Pickstown. Schools and businesses were closed, and travel became impossible in much of the area. The wind combined with cold temperatures to produce wind chills colder than 35 below zero.			
1/7/2010	Extreme Cold				
1/25/2010	Winter Weather	Northwest winds gusting to over 50 mph, along with existing loose snow cover, caused blowing snow with visibilities of a quarter mile or less in areas.			
5/24/2010	Thunderstorm Wind	Heavy winds up to 65 mph blew down power poles and caused tree damage in Platte. The wind also destroyed a small shed and damaged equipment on a farm southwest of Platte.	56 kts. EG	5	
6/1/2010	Hail		0.88 in.		
6/12/2010	Flash Flood	Heavy rainfall of up to 6 inches caused widespread flash flooding of many roads, residences, and fields, causing damage to and forcing evacuation of numerous residences. The Yankton Sioux reservation was especially hard hit, with the tribal headquarters made unusable, and 63 families displaced from their homes. Estimated damage was $1 million.		1000	
7/6/2010	Hail		1.00 in.		
7/10/2010	Flash Flood				
7/10/2010	Hail		1.00 in.		
7/23/2010	Hail		1.00 in.		
7/23/2010	Thunderstorm Wind		56 kts. EG		
8/8/2010	Thunderstorm Wind		52 kts. EG		
8/10/2010	Thunderstorm Wind		56 kts. EG	5	
8/19/2010	Thunderstorm Wind		56 kts. EG	5	
8/19/2010	Thunderstorm Wind		56 kts. EG		
8/30/2010	Thunderstorm Wind		61 kts. EG	1	
8/30/2010	Thunderstorm Wind		56 kts. EG	5	
8/30/2010	Thunderstorm Wind		52 kts. EG		
8/30/2010	Thunderstorm Wind		56 kts. EG		
9/22/2010	Flash Flood				
10/26/2010	High Wind		52 kts. EG		
12/10/2010	Winter Weather	Snowfall ranging from 2 to 8 inches was accompanied by sustained winds reaching 40 mph at times, with gusts as high as 55 mph. The snowfall, strong winds, and existing snow cover resulted in widespread blizzard conditions. Travel was impossible in much of the area, and businesses and schools were forced to close.			

DATE	EVENT TYPE	DESCRIPTION	MAG	PROP DAMAGE ($1,000s)	CROP DAMAGE ($1,000s)
12/31/2010	Blizzard	Snowfall of 6 to 10 inches and winds gusting to over 40 mph produced widespread blizzard conditions. Roads were closed and many businesses were forced to close as travel became difficult to impossible.			
1/1/2011	Blizzard				
1/9/2011	Heavy Snow	Heavy snow occurred in the area, including 9 inches in Pickstown.			
1/22/2011	Winter Weather				
2/1/2011	Extreme Cold				
2/20/2011	Heavy Snow	Heavy snowfall, including 7 inches at Platte, severely limited travel and commerce over the northwest part of the county, with some roads becoming blocked. Winds averaging 20 to 30 mph contributed to the problems by causing drifting snow and areas of reduced visibilities in blowing snow. The snow was preceded by freezing rain and sleet, causing icing of travel surfaces. In the southeast part of the county, the precipitation was mainly freezing rain and sleet, with some ice accumulation on trees and power lines.			
3/7/2011	Winter Weather				
3/20/2011	Hail		0.75 in.		
4/9/2011	Hail		1.00 in.		
4/15/2011	Heavy Snow				
5/20/2011	Flood	Flooding along the Missouri River developed in May, increasing throughout the month as runoff from excessive upstream snowmelt and rain reached the area. Lowland areas along the river began to flood, impacting recreational facilities and some roads. The river reached 3.2 feet above flood stage near Greenwood at the end of the month.			
5/29/2011	Hail		0.88 in.		
5/30/2011	Hail		1.00 in.		
5/30/2011	Hail		0.75 in.		
5/30/2011	Hail		1.75 in.		
5/30/2011	Hail		1.25 in.		
5/30/2011	Hail		1.00 in.		
5/30/2011	Thunderstorm Wind		52 kts. EG		
5/30/2011	Thunderstorm Wind		70 kts. EG		
5/30/2011	Tornado		EF0		
6/1/2011	Flood	Flooding along the Missouri River from upstream spring snowmelt and heavy rain worsened in June. Lowland areas along the river, including many roads and recreational areas and a few homes, were flooded. The river reached a record 8.8 feet above flood stage near Greenwood at the end of the month.			
6/20/2011	Flash Flood	Runoff from heavy rain caused record flooding of Platte Creek, with several roads under water. The creek reached 2.1 feet above flood stage near Platte at the end of June.			
6/20/2011	Flood				
7/1/2011	Flood	Runoff from heavy rain caused continued record flooding of Platte Creek, with several roads under water. The creek crested at a record 2.7 feet above flood stage near Platte on July 8th.			

DATE	EVENT TYPE	DESCRIPTION	MAG	PROP DAMAGE ($1,000s)	CROP DAMAGE ($1,000s)
7/1/2011	Flood	Record Missouri River flooding continued in July. Populated areas evacuated before the month remained evacuated, with a few additional evacuations made. Damage continued to many homes, businesses, recreation areas, and low lying areas. A very slow drop in the river began before the end of the month.			
7/15/2011	Excessive Heat				
8/1/2011	Flood	Major impacts from Missouri River flooding continued into August, with flooding varying from minor to major, and evacuated areas remaining evacuated. Water levels receded very slowly during the month, and effects of the flooding slowly began to abate, but in many places the extent of damage to homes, businesses, and lowlands was beginning to become evident.			
8/5/2011	Flash Flood				
8/7/2011	Thunderstorm Wind		52 kts. EG		
8/18/2011	Thunderstorm Wind		52 kts. EG		
9/1/2011	Flood				
10/4/2011	Wildfire	Several wildfires broke out in Gregory and Charles Mix Counties during a four day period. Warm and dry weather, strong winds, and dry vegetation contributed to the fires starting and spreading. The fires affected grassland and cropland, including baled hay. Several wildfires damaged grassland and crops. The largest fire started just south of Lake Andes and burned about 400 large round hay bales, plus grassland. One firefighter suffered smoke inhalation, and firefighters were called to the same site the next day as flames sparked up again. The amount of crop damage was not known.			
2/13/2012	Winter Weather				
4/15/2012	High Wind		53 kts. MG		
5/5/2012	Hail		1.50 in.		
5/5/2012	Hail		0.75 in.		
6/1/2012	Drought	Drought conditions began in the late spring and persisted throughout the year. Crop loss was very substantial. Extreme heat made the drought even worse.			
6/13/2012	Hail		1.75 in.		
6/13/2012	Hail		1.00 in.		
6/26/2012	Excessive Heat				
7/1/2012	Drought				
7/2/2012	Excessive Heat				
7/15/2012	Excessive Heat				
7/18/2012	Excessive Heat				
8/1/2012	Drought				
8/1/2012	Excessive Heat				
8/1/2012	Thunderstorm Wind		52 kts. EG		
8/3/2012	Hail		1.00 in.		
9/1/2012	Drought				
10/1/2012	Drought				

DATE	EVENT TYPE	DESCRIPTION	MAG	PROP DAMAGE ($1,000s)	CROP DAMAGE ($1,000s)
10/17/2012	High Wind		57 kts. MG		
11/1/2012	Drought				
12/1/2012	Drought				
12/9/2012	Blizzard	Northwest winds gusting to 50 mph and loose snow cover combined to lower visibilities to near zero with blowing snow over much of the area. Travel was brought to a standstill and businesses were closed.			
12/27/2012	Winter Weather				
1/1/2013	Drought				
2/1/2013	Drought				
2/10/2013	Blizzard	Snowfall of 2 to 4 inches was accompanied by northwest winds gusting to 45 mph, producing blizzard conditions with widespread visibilities below a quarter mile. The low visibilities and drifting snow closed roads and some businesses, and forced school closings.			
3/1/2013	Drought				
3/9/2013	Winter Weather				
4/1/2013	Drought				
4/9/2013	Winter Storm	An extended period of precipitation began with freezing rain and freezing drizzle producing light ice accumulations, then changing to sleet and then snow, with sleet and snow accumulations reaching 9.5 inches at Platte. The winter precipitation made travel very difficult, resulting in schools and businesses being forced to close.			
4/22/2013	Winter Weather	A late season blizzard dumped a substantial amount of snow in the area. The storm resulted in FEMA Disaster Declaration DR-4115.			
5/1/2013	Drought				
6/21/2013	Hail		1.00 in.		
7/7/2013	Flash Flood				
7/7/2013	Thunderstorm Wind		52 kts. EG	10	
7/7/2013	Thunderstorm Wind		61 kts. MG	2	
7/7/2013	Thunderstorm Wind		52 kts. EG		
12/3/2013	Winter Storm				
1/16/2014	High Wind		53 kts. MG		
1/26/2014	High Wind		55 kts. MG		
2/4/2014	Winter Weather				
3/18/2014	Heavy Snow				
3/27/2014	Winter Weather				
6/3/2014	Hail		1.00 in.		
8/2/2014	Hail		3.00 in.		
11/15/2014	Winter Weather				
12/15/2014	Winter Storm				
12/26/2014	Winter Weather				

DATE	EVENT TYPE	DESCRIPTION	MAG	PROP DAMAGE ($1,000s)	CROP DAMAGE ($1,000s)
1/3/2015	Winter Weather				
1/31/2015	Winter Storm				
3/3/2015	Winter Weather				
5/10/2015	Tornado	A tornado formed and moved over fields, damaging some trees, before crossing into Douglas County.	EF0		
5/25/2015	Hail		1.75 in.		
6/6/2015	Hail		1.50 in.		
6/20/2015	Thunderstorm Wind		52 kts. EG		
6/22/2015	High Wind		59 kts. MG		
7/5/2015	Thunderstorm Wind		51 kts. MG		
7/25/2015	Thunderstorm Wind		52 kts. EG		
9/7/2015	Hail		1.25 in.		
9/22/2015	Heavy Rain				
11/20/2015	Heavy Snow				
11/30/2015	Winter Storm				
12/15/2015	Winter Weather				
12/25/2015	Winter Storm				
2/2/2016	Winter Weather				
2/19/2016	High Wind		60 kts. MG		
3/23/2016	Winter Storm				
4/24/2016	Thunderstorm Wind	Thunderstorm winds blew the roof off a trailer house.	52 kts. EG	2	
5/22/2016	Hail		1.00 in.		
5/23/2016	Flash Flood				
5/25/2016	Hail		1.75 in.		
5/30/2016	Flash Flood				
5/30/2016	Hail		1.00 in.		
6/10/2016	Excessive Heat				
7/6/2016	Thunderstorm Wind		52 kts. EG		
7/19/2016	Excessive Heat				
11/17/2016	Winter Storm				
12/17/2016	Cold/wind Chill				
12/25/2016	High Wind		54 kts. MG		
1/24/2017	Winter Storm				
2/23/2017	Winter Storm				
6/13/2017	Hail		1.25 in.		
6/29/2017	Hail		1.25 in.		
7/5/2017	Thunderstorm Wind		52 kts. EG		

DATE	EVENT TYPE	DESCRIPTION	MAG	PROP DAMAGE ($1,000s)	CROP DAMAGE ($1,000s)
7/9/2017	Hail		1.00 in.		
8/13/2017	Hail		1.25 in.		
12/21/2017	Winter Weather				
12/26/2017	Extreme Cold				
12/31/2017	Extreme Cold	Record low high temperature of -9 near Academy.			
1/10/2018	Winter Weather				
1/15/2018	Cold/wind Chill				
1/21/2018	Winter Storm				
2/5/2018	Winter Weather				
2/8/2018	Winter Weather				
2/10/2018	Cold/wind Chill				
2/19/2018	Winter Weather				
2/22/2018	Winter Storm				
2/24/2018	Winter Weather				
3/5/2018	Blizzard				
3/16/2018	Winter Weather				
4/2/2018	Winter Weather				
4/13/2018	Blizzard	Life threatening conditions developed, as a mix of rain, sleet and snow changed to all snow. Brutal winds gusting over 50 mph whipped visibility to less than a quarter mile at times. Businesses and schools were closed. Travel was not recommended for a two day period. Total snowfall of 12 inches was measured at Platte and 15 inches at Wagner.			
4/18/2018	Winter Storm				
4/30/2018	Hail		1.00 in.		
5/24/2018	Hail		1.25 in.		
6/1/2018	Thunderstorm Wind		70 kts. EG		
7/3/2018	Heat				
7/8/2018	Heat				
7/11/2018	Heat				
7/12/2018	Flood				
7/18/2018	Hail		1.75 in.		
7/21/2018	Flood				
8/1/2018	Flood				
8/28/2018	Hail		1.00 in.		
9/1/2018	Flood				
9/20/2018	Flash Flood				
1/1/2019	Extreme Cold				
3/3/2019	Extreme Cold				

DATE	EVENT TYPE	DESCRIPTION	MAG	PROP DAMAGE ($1,000s)	CROP DAMAGE ($1,000s)
3/9/2019	Winter Weather				
3/14/2019	Blizzard				
4/11/2019	Blizzard				
6/28/2019	Heat				
6/29/2019	Extreme Heat				
6/30/2019	Heat				
3/13/2019	Flood	Rainfall of one to three inches on frozen ground and into a snow pack with between 2 and 5 inches of liquid water equivalent resulted in considerable overland flooding. SD Hwy 46 was closed both east and west of Wagner due to water flowing over the roadway.			
5/29/2019	Flood				
6/1/2019	Flood				
6/30/2019	Hail		1.00 in.		
7/1/2019	Flood				
7/5/2019	Flood				
7/17/2019	Thunderstorm Wind	Significant tree damage occurred at the Snake Creek Campground. Injuries occurred when tree branches fell on tents. Several campers rolled by high winds.	100 kts. MG		
7/28/2019	Thunderstorm Wind		56 kts. EG		
7/28/2019	Tornado		EFU		
8/1/2019	Flood			50	
8/6/2019	Flash Flood			10	
8/6/2019	Lightning				5
8/9/2019	Thunderstorm Wind		52 kts. MG		
8/9/2019	Thunderstorm Wind		52 kts. MG		
8/9/2019	Flood			10	
8/17/2019	Hail		2.00 in.		
8/31/2019	Flood			25	
9/1/2019	Flood				
9/1/2019	Flood				
9/10/2019	Thunderstorm Wind		62 kts. MG		
9/10/2019	Hail		1.00 in.		
9/12/2019	Flood	Widespread areal flooding resulted after excessive rainfall from September 10-12, which brought over 6 inches to Platte and Academy. Numerous county and township roads were damaged by floodwater.		150	
9/18/2019	Flood			10	
9/30/2019	Hail		1.00 in.		
10/1/2019	Flood			5	
11/1/2019	Flood				

DATE	EVENT TYPE	DESCRIPTION	MAG	PROP DAMAGE ($1,000s)	CROP DAMAGE ($1,000s)
11/26/2019	Winter Weather				
11/29/2019	Winter Storm				
12/1/2019	Flood				
12/1/2019	Winter Storm				
12/28/2019	Blizzard	**Light mixed precipitation resulted in a minor glaze of ice accumulation, then heavy snowfall (up to 16 inches in the sourthern areas of the county) and high wind resulted in white out conditions. Snow drifts to several feet were common.**			

Source: National Climatic Data Center's Storm Events Database

APPENDIX D: References

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