CHAPTER I
PLANNING PROCESS

Background

This plan is an update of the Lyman County Pre-Disaster Mitigation Plan, which was authored by Northern Tier Consulting, LLC under the direction of the Lyman County Emergency Management Office, and was approved by FEMA in September 2015. The purpose of the plan is to prevent or reduce losses to people and property that may result from future hazard events in Lyman County. The plan identifies and analyzes hazards relevant to the area, 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 to help mitigate against future disaster events.

This is a multi-jurisdictional plan. Following is the list of jurisdictions that participated in the plan's development by having a representative attend the planning meetings and by providing input into the plan:

- Lyman County
- Town of Kennebec
- Town of Oacoma
- City of Presho
- Town of Reliance

Production of the plan was the ultimate responsibility of the Lyman 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 organized by the Lyman County Emergency Management Director and whose members are listed in **Table 1.1** on pages 3 and 4.

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.

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**).

Figure 1.1 – Lyman County

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 Lyman 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:

- Lyman County (commissioners, planning/zoning staff, floodplain administrator, auditor, director of equalization, highway superintendent, etc.)
- Municipalities (city council members, finance officer, public works staff, fire department members, etc.)
- Other entities, including the Lyman County School District, the West Central Electric Cooperative, the West River/Lyman-Jones Rural Water System, and the Stanley-Jones Clinic in Presho.

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 Lyman County.
- 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 06/15/20	Mtg 2 08/25/20
Margo Mitchell	Lyman County	Emergency Manager	X	X
John Clem	Planning District III	Plan author	X	X
Deb Halverson	Lyman County	Auditor	X	X
Stacie Gran	Lyman County	Dept of Equalization	X	
Misty Ramser	Lyman County	Highway Dept	X	X
Rod Bower	Town of Kennebec	City council	X	X

Name	Representing	Position	Meeting Attendance	
			Mtg 1 06/15/20	Mtg 2 08/25/20
Sarah Caslin	Town of Kennebec	Finance Officer	X	X
Gary Dominiack	Town of Oacoma	Mayor	X	
Valerie Moore	Town of Oacoma	Finance Officer	X	X
Del Rae Diedrich	City of Presho	Finance Officer	X	X
Ryan Husman	City of Presho	Fire department		X
Shane Reis	Town of Reliance	City council	X	
Renelle Uthe	Lyman County School District	Staff	X	

Outreach Effort

Throughout the plan's development, efforts were made to obtain involvement in the plan beyond just the planning team. Emails were distributed, information was posted on the county website, 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. 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 Lyman 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. Some of the members had participated when the current plan was developed, but none of the members from Lyman County were involved in developing the current plan.

[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.

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 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 summarizing 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, and the plan was posted on the county website. After a short review period, 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 Lyman 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 Margo Mitchell 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

Lyman County is located in central South Dakota. It covers approximately 1,640 square miles in area, and its population at the time of the 2010 Census was 3,755. Municipalities within the county are Presho (pop 497), Oacoma (pop 451), Kennebec (pop 240), and Reliance (pop 191). Unincorporated communities include Lower Brule (pop 613), Vivian (pop 119) and Iona (pop 81). Kennebec is the Lyman County seat of government. **Figure 2.1** shows the county's communities and highway network.

Physical Characteristics

The area covered by this plan is very lightly settled, with most of the land devoted to livestock grazing, although crops are grown where the terrain and local conditions are favorable. These crops grown include corn, wheat, alfalfa, sorghum, and sunflowers. Most of the land is fairly level to gently rolling, but there are some rugged areas, especially along the Missouri and White Rivers. Away from the rivers, there are some isolated buttes that rise prominently from the landscape.

Figure 2.1 – Lyman County

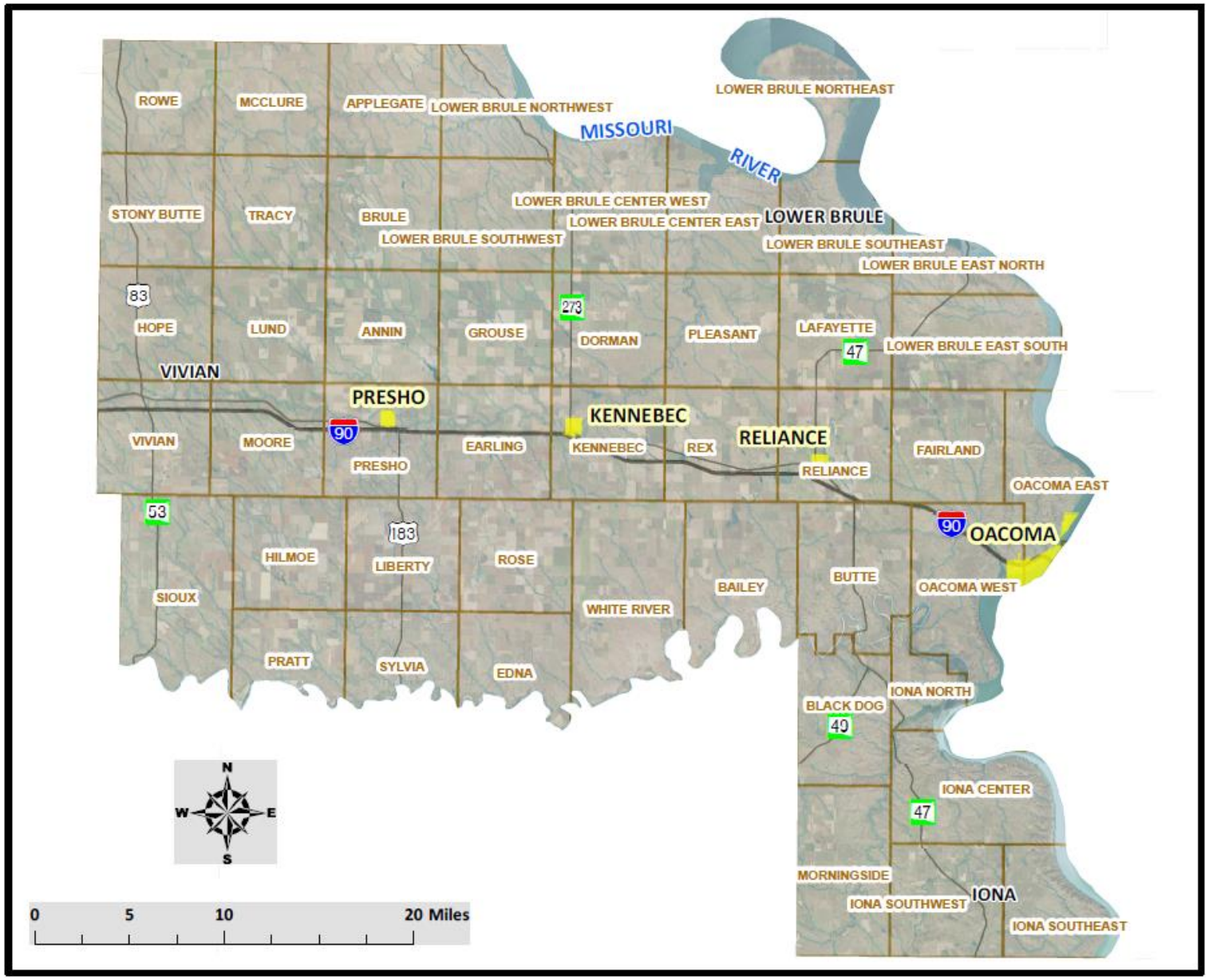


Table 2.1 provides a breakdown of the land cover in Lyman County. The table is based off satellite imagery from the United States Geological Service's National Land Cover Database, processed using ArcGIS computer mapping software. As the table shows, most of Lyman County's land cover is grassland; developed land makes up only a very small fraction of the land area. **Figure 2.2** is a graphic representation of Lyman County's land cover.

Table 2.1 - Vegetative Land Cover

Cover Type	Square Miles	% of Total Area
Grassland	1,172	71.8
Cultivated crops	328	20.1
Pasture land	60	3.6
Developed land (open space)	35	2.2
Wetlands	20	1.2
Forested land	10	0.6
Developed land (low to high intensity)	7	0.4

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

As in most of South Dakota, Lyman County's climate is characterized as sub-humid and continental, which means that summers are often hot and winters are usually quite 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 [2], while winter lows can drop below -20 degrees. Precipitation averages about 23 inches per year, most of which occurs as rain during the spring and early summer; winter snow is not especially 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 Chamberlain weather station in adjacent Brule County.

Table 2.2 - Monthly Climate Conditions at Chamberlain, SD Weather Station (1896 – 1978)

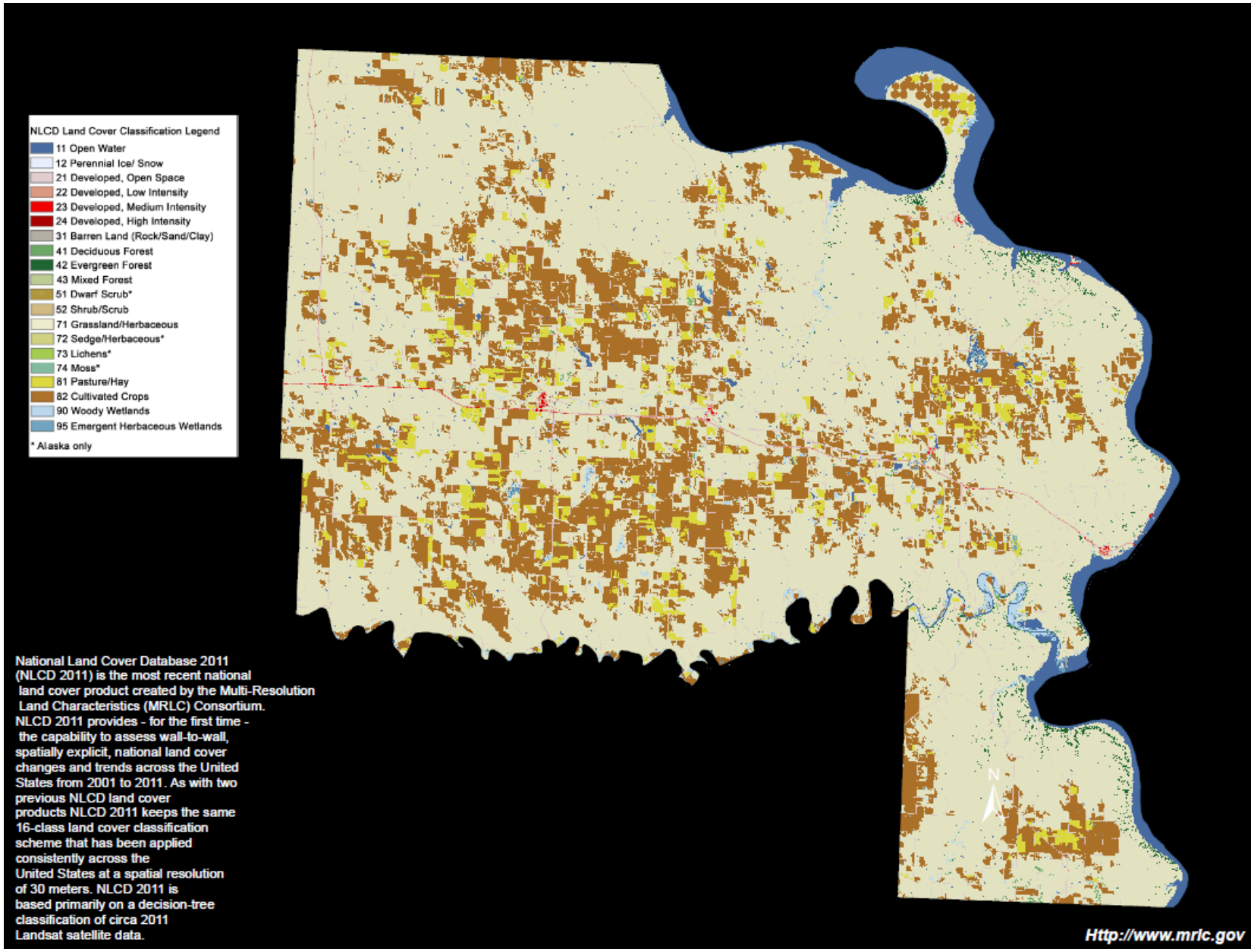
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ave
Ave High	28.9	33.5	46.6	62.5	73.4	82.4	89.7	88.0	78.5	66.2	48.2	34.3	61.0
Ave Low	5.9	10.2	22.0	35.9	46.5	56.4	62.7	60.2	50.4	38.1	24.1	12.1	35.4
Ave Precipitation	0.4	0.6	0.9	2.1	2.9	3.3	2.5	2.2	1.7	1.2	0.6	0.5	23.6
Ave Snowfall	5.0	5.1	4.7	1.3	0.0	0.0	0.0	0.0	0.0	0.2	2.3	4.6	31.5

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

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

[2] 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 2.2 – Lyman 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

Lyman County is very lightly settled. The population density in the county is only about 2.3 people per square mile, whereas the State of South Dakota has a population density of about 10.5 people per square mile and the national figure is 89.5. As **Table 2.3** shows, Lyman County's current population is lower now than it was at the middle of the 20th Century, but the population has stabilized in recent decades. Much of the growth that has occurred has been on the Lower Brule Indian Reservation.

Table 2.3 - Lyman County Population Change

Pop 1950	Pop 1960	Pop 1970	Pop 1980	Pop 1990	Pop 2000	Pop 2010	Pop 2017 Estimate	Pop 2030 Projected
4,572	4,428	4,060	3,864	3,638	3,895	3,755	3,882	3,816

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

Table 2.4 provides basic demographic information for Lyman County. The table shows that a relatively large percentage of the county's population is composed of American Indians, most of whom live on the Lower Brule Indian Reservation. The table also shows that the population base in the county is relatively young, which indicates a potential for some future population growth, depending on levels of future out-migration.

Table 2.4 - Racial and Age Characteristics (2010)

Entity	White Population	Black Population	American Indian Pop	Asian Populatio	Other Races	Population Under 20	Population 65 & Over	Median Age
Lyman Co.	58.3%	0.1%	38.2%	0.3%	3.1%	31.9%	14.6%	36.1
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)

Lyman County's economy is dependent to a large extent upon agriculture, mostly cattle grazing. Government, education, and health care are important employment sectors on the Lower Brule Indian Reservation, and another important revenue generator on the reservation is the Golden Buffalo Casino. Industry and manufacturing are essentially nonexistent in Lyman County. In part because of the lack of high wage occupations, income levels in the county are well below state and national figures, as shown in **Table 2.5**.

Table 2.5 – Socioeconomic Characteristics (2010)

Entity	Median Family Income	Family Poverty Rate	High School Grad or Higher	Bachelor's Degree or Higher
Lyman Co.	$56,302	14.8%	68.0%	7.3%
South Dakota	$62,967	8.7%	90.1%	26.0%
United States	$64,585	10.9%	85.7%	28.5%

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

Infrastructure and Utilities

Transportation

Lyman County's main transportation route is Interstate 90, which connects every community in the county, except for Lower Brule and Iona. Other important highways include S.D. Highway 47, which runs north to Lower Brule and south to Iona; U.S. Highway 83 on the western edge of the county, which runs north to the state capital of Pierre; and U.S. Highway 183, which runs south from Presho to the town of Winner in Tripp County.

Regarding other modes of transportation, a rail line operated by the Mitchell-Rapid City (MRC) Regional Railroad Authority runs parallel to Interstate 90. The line had been out of service for many years, but rehabilitation of the line from the eastern border of the county to Presho was completed in 2013. Eventually the line may be rehabilitated all the way east to Rapid City. Presho has a public airport, and there are private airports in Kennebec and Vivian; all of these airports have a gravel landing surface.

Utilities

Most residents of Lyman County are served by the Lyman-Jones Rural Water System. The Mni Wiconi Water System serves the eastern part of the county, including the Lower Brule Indian Reservation, and the Tripp County Water Users District serves households in the

southeast part of the county, including Iona. Regarding sewage disposal, each community in the county has a wastewater collection and treatment system. Rural residents use individual septic tanks and drainfields.

Solid waste service is provided by the Tri-County Landfill, which operates a landfill located in adjacent Brule County. Designated rubble sites are located outside each community.

Electric power is provided to most county residents by the West Central Electric Cooperative. The Rosebud Electric Cooperative serves the Iona area. There is no natural gas service available anywhere in Lyman County.

Telephone and Internet service in Lyman County is provided by a variety of companies, including Golden West Communications, MidState Communications, and the Kennebec Telephone Company. Cellular phone service is available throughout much of the county, but there are still some areas where signals are weak or non-existent.

Services

Medical Services

The medical service system in Lyman County includes the Kennebec Clinic Avera, the Stanley-Jones Memorial Clinic in Presho, and the Indian Health Service clinic in Lower Brule. The nearest hospital for most county residents is in Chamberlain, although people in the northwest part of the county have closer access to medical treatment in Pierre. People needing serious medical attention can be transported to trauma center hospitals in Pierre, Rapid City, or Sioux Falls.

Fire and Emergency Response

Fire departments in Lyman County are located in Kennebec, Presho, Reliance, and Vivian. Oacoma is served by the Chamberlain Fire Department, which is located just east of Oacoma in Brule County. All of these departments respond to both structural and wildland fires, and they also respond to accidents and other emergency events.

The Missouri Valley Ambulance Service, based in Chamberlain, serves the eastern portion of Lyman County. The Lyman County Ambulance Service covers the west side of the county.

Education

The only high schools in the county are located in Presho and Lower Brule. Middle schools are located in Presho and Lower Brule, and elementary schools are located in Kennebec and Lower Brule. The only post-secondary education available in the county is the Lower Brule Community College in Lower Brule.

CHAPTER III
RISK ASSESSMENT

Background

The risk assessment provides the foundation for the rest of the mitigation planning process. It sets the stage for identifying mitigation goals and actions to help Lyman County become more resilient to disasters, and it answers the following questions: What are the hazards that could affect Lyman 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 planning area, 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.

For this plan update, the planning team decided to make some significant changes to the risk assessment. The most important of the changes are as follows:

- The risk assessment has been reorganized to follow more closely the structure of the South Dakota Hazard Mitigation Plan. Notably, the loss estimation/

vulnerability assessment section for each hazard has been separated from the hazard profile section. The planning team felt that this separation was a more logical and clearer way to present the information.

- Data deficiencies for some of the hazards analyzed in the current plan have been addressed by providing more detailed information regarding the risk they pose to the jurisdictions. For example, flooding has been given more attention, in part because of the historic and unprecedented flooding that occurred along the Missouri River in 2011.
- More informative hazard vulnerability maps have been developed.
- The hazard profiles were updated with recent hazard events since the current plan was completed. These events also are shown in **Table C.2** in **Appendix C**.

Identifying Hazards

The planning team began the risk assessment by reviewing the South Dakota Hazard Mitigation Plan, focusing on the hazards identified in the state plan. The team also reviewed the risk assessment section of Lyman County's current hazard mitigation plan.

Following this, the planning participants reviewed historical records of hazard events that have occurred in Lyman County, which were obtained from the National Climatic Data Center's Storm Events Database. See **Table C.2** in **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 Lyman 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**

All of these hazards are analyzed in the county's current mitigation plan. 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 but chose not to include in this plan, with a justification for their omission:

- 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 no more than a two percent chance that

a quake of at least magnitude 5 will occur in Lyman County in any 100 year period, and virtually no chance of a magnitude 6 or greater earthquake [3]. The largest earthquake known to have occurred in Lyman County was a 4.4 magnitude quake in 1967 that had an epicenter in the southern tip of the county. Regarding landslides, a review of the United States Geological Survey's Landslide Incidence and Susceptibility Map does indicate the potential of a landslide occurring in the area along the Missouri River, but any such event likely would be localized and minor in scale.

- 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 addressed in Lyman County's current mitigation plan, but the planning team considered the subject matter to be outside the focus of this plan. This plan can serve as a complement to Lyman County's existing hazardous materials plan.
- 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.
- Transportation incidents - this hazard is addressed in Lyman County's current mitigation plan, but the planning team considered the subject matter to be outside the focus of this plan.

Power failure and Communication outage, both addressed in the current plan, can result from various types of hazard events, but are not hazards in and of themselves. Dam failure, also addressed by itself in the current plan, is included in this plan's flooding section.

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***, its ***extent***, the ***history*** of the hazard's occurrence, 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 area within Lyman County that is 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 occur in all areas of the planning area more or less with equal frequency. Flooding and wildfires, however, do impact specific areas more than others. The maps

[3] 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.

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 42.

- ***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 can be 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 events 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 fewer 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 Lyman 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. There is a long warning time associated with most winter storms, giving people time to prepare, but they still 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, 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 planning area are equally likely to be impacted by winter storms.

Extent

The extent of winter storms in Lyman County can be quite substantial. In terms of snowfall, many winter storms in the county have dropped more than 10 inches of snow. **Table C.2** in **Appendix C** describes a blizzard in November 2005 that dumped 21 inches at Kennebec. 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** shows numerous records of high wind events occurring during the winter months with wind speeds in excess of 50 miles per hour, and some events with wind speeds over 60 mph.

History

Table C.2 in **Appendix C** lists many significant winter storms that have impacted Lyman County. As **Table C.1** in **Appendix C** shows, winter storms resulting in a major disaster declaration occurred in Lyman County in 1995, 1997, 2010, and 2019.

A serious winter storm with ice hit Lyman County in January 1995, resulting in FEMA Disaster Declaration 1045. Unusual foggy January weather resulted in a heavy crust of ice forming on many of the power lines in central South Dakota, including Lyman County. The addition of high winds caused power poles to snap. Deep drifts of snow made it difficult for power company repairers to gain access to the damaged power lines, and in many areas county snow removal equipment was required to provide access. In the affected counties, at least 13,435 households were without electric power for varying periods of time, with some homes without power for 12 days. Statewide, more than 1,700 power poles had to be replaced, and the damage estimate was over $3.8 million.

A winter storm in 1997 resulted in FEMA Disaster Declaration 1156. Statewide in the affected counties the event caused over $19,000,000 in reported damage.

Another very serious winter storm to impact Lyman 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 central and eastern South Dakota. The storm resulted in FEMA Disaster Declaration 1620. Although Lyman County was not part of the disaster declaration, the event had a major impact on the county. Heavy snow, combined with winds gusting to 70 miles per hour, caused blizzard conditions in the county. Many roads, including Interstate 90, were closed due to treacherous travel conditions, and several accidents were reported. Snowfall amounts included 11 inches near Presho and 21 inches at Kennebec.

An unusual late-season winter storm struck South Dakota in March 2019, resulting in FEMA Disaster Declaration 4440. The storm resulted in approximately $25,000 of public assistance funds allocated in Lyman County.

Probability

Table C.2 shows numerous significant winter storm events in Lyman County since the mid-1990s, an average of over three per year. Therefore, based on the historic evidence, the probability of a significant winter storm affecting Lyman 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. It is a certainty that winter storms will continue to affect the county.

Resources and Capabilities

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

- Lyman County and each of the participating jurisdictions have equipment for dealing with winter storms. A list of the equipment can be found in the Lyman County Local Emergency Operations Plan.
- Several primary reception and care centers are located within Lyman County. These are places that can provide shelter to people during a power outage or other emergency situation. The following table lists each of the facilities.

Table 3.1 – Relief Shelter Facilities

Facility	Capacity	Special Needs	Generator	Feeding Capacity
Kennebec Elementary School Gym	90	Yes	No	100 - 199
Kennebec Fire Hall	35	Yes	Yes	51 - 99
Oacoma Community Center	200	Yes	No	200 - 299
Lyman High School Gym (Presho)	300	Yes	Yes	100 - 199
Presho Fire Hall	25	Yes	No	21 – 50
Reliance Fire Hall	20	Yes	No	1 – 20
Reliance Legion Hall	125	No	No	50 – 75
Vivian Fire Hall	40	Yes	No	1 - 20
Vivian Community Center	150	No	No	100 - 199

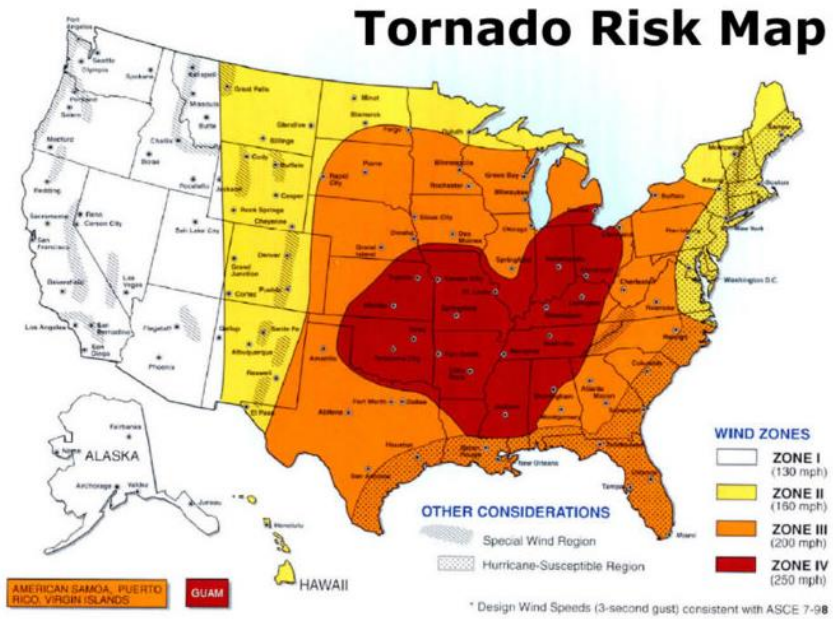
- The West Central Electric Cooperative and the Rosebud Electric Cooperative maintain a list of priority projects in their work plans. Both are a party to the South Dakota Electric Cooperatives Mutual Aid Plan, which commits participating cooperatives to come to the aid of other cooperatives in times of emergency.
- The Lyman County Local Emergency Planning Committee (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 are a common occurrence in Lyman County, as they are in most parts of the United States. They usually are associated with unstable weather conditions, and are often very large in size, traveling across wide areas and through multiple jurisdictions within a region. In Lyman County, summer storms usually occur during the spring and summer, most often in the late afternoon or evening. Summer storms can include heavy rainfall, hail, lightning, and high winds, and they can produce tornadoes under the right conditions. In Lyman 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 Lyman County reports some kind of hail damage to crops or property.

Tornadoes are the most dramatic type of summer storm experienced in Lyman County. They are capable of tremendous destruction, with wind speeds of 250 mph or more and damage paths that 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 they can occur with little advanced warning and because 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 several records of thunderstorms that produced wind speeds over 60 miles per hour, as well as several other summer high wind events with wind speeds over 60 miles per hour. **Table C.2** also shows over 50 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 four 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

As shown in **Table C.2** in **Appendix C,** Lyman County has experienced many summer storms that have caused significant damage, including many storms that were accompanied by a tornado. **Table C.1** In **Appendix C** shows that several of these storms resulted in a major disaster declaration.

A thunderstorm that struck near Vivian in July 2010 resulted in the largest known hailstone ever recorded in the United States. Details about the storm are shown in **Table C.2** in **Appendix C**.

A notable summer storm occurred in June 2015, causing substantial property damage and resulting in FEMA Disaster Declaration 4233. Winds estimated at 100 miles per hour caused severe damage to several buildings in Lower Brule, damaged the roof of the Lyman County courthouse, downed many trees, and caused other damage. The Red Cross set up shelter for displaced people. As shown in **Table C.1**, public assistance costs to Lyman County as a result of this storm were approximately $260,000.

Probability

Table C.2 shows that numerous significant summer storm events have occurred in Lyman 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 20 days in which a tornado was recorded in Lyman County since 1960, an average of one every three years. It is likely that other tornadoes occurred in the county during this period and 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. Each siren is tested regularly, each has a backup source of power, and some can be activated remotely.
- Public facilities that can provide shelter from tornadoes in Lyman County include the basement of the courthouse in Kennebec and the local fire stations.
- Weather spotters are in place throughout the county.
- The Lyman County Emergency Management office actively participates in severe weather public awareness campaigns in conjunction with the State Office of Emergency Management and the National Weather Service. The office communicates regularly with local officials regarding severe weather awareness and training opportunities.

- As described earlier in the Winter Storm profile section, the electric cooperatives serving the area maintain a list of priority projects in their work plans, and each is a party to the South Dakota Electric Cooperatives Mutual Aid Plan.

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 Lyman 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. Flooding can be made worse if the ground remains frozen while the snow melts, causing melt water to run off 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. Lyman County is vulnerable to this type of flood primarily because of the dams that impound the Missouri River, including the Big Bend Dam, which is considered to be a high hazard dam [4].

[4] A high hazard dam is one whose loss would cause major economic loss, and in which there are anywhere from a few to hundreds of inhabited structures located in the predicted area of inundation.

Location

Most flooding in Lyman County occurs along the Missouri River and its tributaries, usually in the spring due to the combination of melting snow and the frozen ground, or after especially heavy rainfall. Flooding along the White River sometimes involves ice jams, which occur during the spring thaw and block the flow of water. These ice jams have caused water to flow onto the road surface of the U.S. Highway 183 bridge, but the highway has never actually been closed due to flooding. Medicine Creek, which flows past Kennebec and Presho, also has caused trouble over the years.

In the past, the greatest flooding threat in South Dakota was along the Missouri River, which flows south/southeastward across the state in a deep, wide channel. Flooding along the river used to be an annual threat until a series of huge dams along the river, including Big Bend, 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. The dams were built for flood control, to provide water for irrigation, and for the generation of hydroelectricity.

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. 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.

Extent

The extent of flooding in Lyman 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 9.6 feet above flood stage at Oacoma. The flooding that occurred in Lyman 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.

History

As shown in **Table C.1** in **Appendix C**, several flood events have resulted in a major disaster declaration in Lyman County. **Table C.2** in **Appendix C** shows many other flooding events that have impacted the county. Following is a summary of some of the more significant floods the county has experienced.

In the 1980s, Grouse Creek overflowed into Byre Lake, which at the time supplied water to Kennebec, and caused considerable damage. In the mid-1990s, Medicine Creek overflowed and caused considerable damage to county roads between Vivian and Kennebec.

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 much of the state was cold and very wet, with record setting 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.

Flooding in 2008 resulted in FEMA Disaster Declaration 1774. Total public assistance costs from the flood in Lyman County were approximately $90,000.

Flooding in the spring and summer of 2010 was the worst in a decade, resulting in FEMA Disaster Declaration 1915. The event caused about $120,000 of public assistance costs throughout the county, primarily due to flooding of county and township roads.

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. The flood resulted in approximately $280,000 of public assistance costs in Lyman County, plus over $95,000 of public assistance to the West Central Electric Cooperative. Extensive bank erosion occurred along the Missouri River in the Oacoma area, which particularly affected the Cedar Shores Resort. The Missouri River at Oacoma reached a record 9.6 feet above flood stage on June 30th, and many people along the river, especially in Oacoma, had to build levees to hold back the rising water, with some locations being flooded.

Flooding in 2019 had a major impact throughout the year in Lyman 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. Ice jams caused flooding along the White River throughout southern Lyman County. Additional flooding in the summer resulted in FEMA Disaster Declaration 4463. The total public assistance allocated to Lyman County due to flooding in 2019 was over $1.5 million.

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

Lyman County, the Town of Kennebec, and the City of Presho participate in the National Flood Insurance Program (NFIP). Each entity is in good standing with the program, and each has a flood ordinance designed to reduce flood risk. The following table provides information on NFIP participation in the county.

Table 3.3 – National Flood Insurance Program Information

Jurisdiction	NFIP Participation Status	FIRM Effective Date	Insurance Policies in Force	Amount of Coverage
Lyman Co	Yes	6/08/98	1	$350,000
Kennebec	Yes	8/05/86	5	$289,300
Oacoma	No			
Presho	Yes	(NSFHA)		
Reliance	No			

Sources: www.fema.gov/policy-claim-statistics-flood-insurance

Following is a description of other local capabilities for mitigating damage from flooding, as well as projects recently undertaken or planned to address flooding.

- Presho upgraded storm sewer infrastructure along Main Street in 2019. Reliance plans to have a hydraulics and hydrology study done in the near future.
- The U.S. Army Corps of Engineers has an emergency action plan in place for the Big Bend Dam. The Corps also has jurisdictional control over construction activity in the area surrounding Lake Sharpe, which is the body of water impounded by the dam. Any work in this area requires regulatory review and permitting. Major repairs were made to the dam following the 2011 flood, including additional riprap and repairs to the spillway, which are ongoing.
- Inspection and maintenance of dams, culverts, and other drainage structures is performed regularly in Lyman 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 little precipitation. A small departure in normal precipitation from May 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 Lyman 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, Lyman County has experienced many years of annual precipitation less than two thirds its average amount. In terms of duration, it is not unusual for Lyman 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

Lyman 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. Only 12 inches of rain was recorded for the year at the Chamberlain weather station in Brule County. 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 Lyman County in six 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 to mitigate the impacts of drought are available. The rural water systems serving the area – Lyman-Jones Rural Water System, Mni Wiconi, and the Tripp County Water Users District – have restrictions on the amount of water they will distribute within their service areas, and could take such action during extreme drought conditions. Likewise, the communities served by the water systems could enact regulations restricting non-essential water use, such as for watering lawns and washing cars.

In the agricultural sector, most farmers in Lyman 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 Lyman County as they are in more forested parts of the country, but the opinion of the planning team is that the hazard does warrant attention in this plan.

Location

Wildfires are most likely to occur in large areas of extensive brush or unmanaged vegetation, including grassland, which makes up over 70 percent of Lyman County's land base. Grassland fires are considered to be quite dangerous because they tend to spread faster than forest fires and are thus difficult to attack. A secondary area of concern is the hills and draws along the Missouri River, which contain a significant - and increasing - amount of cedar trees and thick brush. Fires there are difficult to fight because of the uneven terrain. 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.

Table 3.4 – Wildfires in Lyman County (2000 - 2019)

1 to 10 Acres	10 to 49 Acres	50 to 99 Acres	100 to 249 Acres	250 to 999 Acres	1,000 Acres and Up
130	60	24	20	19	14

Source: South Dakota Division of Wildland Fire

Information on the cause of many of the fires is lacking, but equipment igniting vegetation was the most frequently reported cause, followed by human-related causes (including fireworks and smoking), lightning, and burning debris. One home was lost due to the fires, three other structures were destroyed, and three injuries to firefighters were reported. No information is available regarding the dollar amount of damages.

History

Some notable wildfires have occurred in Lyman County since 2000. Three of the largest fires occurred in 2000, including one that burned 6,000 acres.

Probability

Wildfires affecting less than ten acres are likely to occur somewhere in Lyman County most years, but large scale wildfires are less common. **Table 3.4** shows a total of 33 wildfires of at least 250 acres in size between 2000 and 2019. Based on this period of analysis, the

probability of a significant wildfire can be considered high, although the probability of a wildfire causing serious damage is low to moderate.

Resources and Capabilities

Each fire department based in the county 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 are in place which helps ensure that assistance is available during particularly serious wildfires and other emergency events. A summary of the capabilities of the departments is presented in the following table.

Table 3.5 - Fire Department/Ambulance Service Resources and Capabilities

Department	Members	Vehicles
Kennebec	30	8
Presho	17	8
Reliance	19	7
Vivian	19	5

The county has a burn ban ordinance, which prohibits open burning during very dry conditions. The ordinance requires people wanting to start a controlled fire to contact the Sheriff's office for permission.

Community Assets

Hazards can affect all parts of the community, but their impact on certain community assets and facilities is particularly important to consider. This includes assets and facilities that would play a critical role in helping the community prepare for and respond to a hazard event. The section also includes a brief discussion of vulnerable populations in the county.

Government Offices

- Lyman County Courthouse, Kennebec
- Municipal Finance Offices in Kennebec, Oacoma, Presho, and Reliance
- Lower Brule Tribal administration building

Emergency Response

- Lyman County Emergency Management Office, Kennebec
- Lower Brule Emergency Management Office
- Lyman County Sheriff's Office, Kennebec
- Bureau of Indian Affairs Police, Lower Brule
- Fire departments in Kennebec, Lower Brule, Presho, Reliance, and Vivian
- Lyman County Ambulance Service, Presho
- Missouri Valley Ambulance Service, Chamberlain

- Lower Brule Ambulance Service
- Lyman County Highway Department

Medical facilities

- Avera Clinic, Kennebec
- Stanley-Jones Memorial Clinic, Presho
- Indian Health Service clinic, Lower Brule

Educational Facilities

- Lower Brule Community College, Lower Brule
- Lyman High School, Presho
- Lower Brule Tribal School, Lower Brule
- Lyman Middle School, Presho
- Lyman Elementary School, Kennebec

Shelters

- Disaster relief shelters are located in each community (see page 19).
- Public facilities that can provide emergency shelter from a tornado or other severe storm include the basement of the courthouse in Kennebec and the local fire stations.

Notification

- A warning siren is located in each community.

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 counties to environmental hazards. The index synthesizes 30 socioeconomic variables that may contribute to reducing 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, Lyman 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. The only such facility in Lyman County is located in Presho.

Vulnerability and Loss Potential

This section assesses the vulnerability of Lyman 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 losses from flooding. HAZUS produces a flood polygon and flood-depth grid that represents 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 still a helpful planning tool, especially for communities that have not been mapped by the National Flood Insurance Program [5].
- Data on the population living in wildfire threat zones was used to estimate potential wildfire losses.
- The value of buildings within Lyman County was used to estimate potential losses due to winter storms and summer storms (building exposure).
- Population density within Lyman 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 events (see **Table C.2** in **Appendix C**).
- Records from FEMA were consulted for federal assistance provided to Lyman County following major disaster declarations through FEMA's Public Assistance program (see **Table C.1** in **Appendix C**).

[5] A limitation of HAZUS is the inadequacies associated with its hydrologic and hydraulic modeling, 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 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.

Rural areas of the county may be 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 very susceptible to high winds, 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). Rural residents also are vulnerable if roads are blocked by snow for an extended period of time and they cannot travel into town for groceries, medical supplies, or other important items.

To assess the county's vulnerability to winter storms, the methodology used in the South Dakota Hazard Mitigation Plan was followed for this plan, using these factors:

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

Prior Events:

Table C.2 in **Appendix C** shows numerous winter storm events for Lyman County, including blizzards, ice storms, heavy snows, and extreme cold events. The authors of the South Dakota Hazard Mitigation Plan found that there were 57 total winter storm events in the National Climatic Data Center's Storm Events Database between January 1993 and August 2016 for Lyman County, ranking the county tied for 50th among the state's 66 counties.

Past Damage Amounts:

Winter storms have the potential to cause significant amounts of damage. Substantial damages following major disasters have been recorded for the West Central Electric Cooperative's infrastructure located within Lyman County, and many other winter weather events have caused significant damage in the county (see **Table C.2**).

Given Lyman 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 Lyman County due to various types of winter weather events between 2000 and 2017 is presented in the following table. During this period of analysis, winter weather-related payouts represented approximately 12% of all indemnity payouts in Lyman County.

Table 3.6 – Crop Loss Due to Winter Weather

Year	Frost	Freeze	Cold Winter	Cold Wet Weather
2000	$0	$0	$155,822	$0
2001	$0	$0	$4,202,998	$28,013
2002	$10,574	$211,722	$89,626	$111,771
2003	$25,565	$21,562	$3,111	$2,750
2004	$7,937	$60,425	$79,665	$23,805
2005	$14,243	$71,608	$10,937	$655
2006	$37,602	$14,487	$38,011	$0
2007	$694	$18,010	$322,766	$0
2008	$0	$8,187	$448,281	$21,634
2009	$88,810	$241,960	$969,580	$260,055
2010	$7,313	$0	$153,578	$19,572
2011	$13,988	$201,400	$368,693	$210,327
2012	$2,592	$0	$53	$0
2013	$23,093	$0	$1,360,444	$30,889
2014	$44,840	$90,927	$287,656	$289,503
2015	$31,743	$18,931	$3,071,086	$16,198
2016	$7,415	$10,873	$50,847	$28,547
2017	$0	$99,193	$415,683	$119,354

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

Building Exposure:

The total value of buildings in Lyman County is approximately $388,000,000, according to the South Dakota Hazard Mitigation Plan, which ranks the county 44th 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 low.

Population Density:

Lyman County is very sparsely populated. The county has an average of only 2.3 people per square mile, well below the state figure of 10.5 people per square mile and the national figure of 89.5. Lyman 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. However, climate change may have an impact on 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 Lyman 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, property damage if a populated area is struck, and flooding as the result of heavy rain. Like the rest of the Great Plains, Lyman County is especially vulnerable to summer storms accompanied by high wind 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 used in the South Dakota Hazard Mitigation Plan to assess vulnerability to summer storms was followed for this plan, using these factors:

- 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 storms that have been recorded in Lyman County, including hailstorms, thunderstorms, lightning, and tornadoes. The table shows 20 recorded tornadoes, including an F3 magnitude event that occurred in 1971. The authors of the South Dakota Hazard Mitigation Plan assigned a rating of 4 (out of 10 maximum) to Lyman County in terms of the frequency of tornadoes recorded between 1950 and 2016, and assigned a rating of 6 for tornadoes of magnitude F1 or greater.

Past Damage Amounts:

Summer storms have the potential to cause significant amounts of damage, especially when accompanied by tornadoes or hail. Many summer storm events that have caused significant property and/or crop damage in Lyman County are shown in **Table C.2**.

As with winter storms, another method to determine vulnerability to summer storms is to look at the impact of such storms on 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 Lyman County due to hail and high wind events between 2000 and 2017, obtained from the USDA Risk Management Agency, is presented in the table below. During this period of analysis, summer storm-related payouts represented about 6% of all indemnity payouts in Lyman County.

Table 3.7 – Crop Loss Due to Severe Summer Weather

Year	Hail	High Wind		Year	Hail	High Wind
2000	$4,658	$74,606		**2009**	$65,968	$0
2001	$94,795	$0		**2010**	$636,000	$29,337
2002	$21,204	$17,150		**2011**	$235,658	$61,046
2003	$101,866	$4,716		**2012**	$1,291,954	$43,176
2004	$0	$211,065		**2013**	$443,754	$1,140,402
2005	$2,904	$35,601		**2014**	$108,312	$818
2006	$153	$138,695		**2015**	$277,683	$28,888
2007	$0	$56,760		**2016**	$138,409	$391,781
2008	$144,564	$208,958		**2017**	$1,464,948	$62,249

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

Building Exposure:

The total value of buildings in Lyman County is approximately $388,000,000, according to the South Dakota Hazard Mitigation Plan, which ranks the county 44th 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 low.

Population Density:

Lyman County is very sparsely populated. The county has an average of only 2.3 people per square mile, well below the state figure of 10.5 people per square mile, and far below the national figure of 89.5. Lyman County would have to be rated low in terms of population density.

Development Trends

Looking ahead, the expected population growth in the county is not likely to significantly increase the county's vulnerability to summer storms. However, climate change could have an impact on vulnerability. 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 uncertainty in these projections, but severe thunderstorms and tornadoes will remain a hazard in the state.

Flooding

Like all counties in South Dakota, Lyman is vulnerable to flooding. Because of the specific nature of flooding, vulnerability is 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 Lyman County is $3,267,000. The median figure for all South Dakota counties is approximately $2,800,000; Lyman ranks 29th among the state's 66 counties in this measure of vulnerability. The potential displaced population was determined to be 145 people, compared to the state median of 255 per county.

Currently, there are a total of six National Flood Insurance Program policies in Lyman County, with three losses having occurred since 1978 totaling $117,254 in payments. There are no repetitive loss properties in Lyman County.

In addition to impacting buildings and other structures, a good deal of public infrastructure throughout the county is vulnerable to flooding. Damage often involves washed out or damaged roads and drainage culverts, often occurring in the spring, especially following winters with heavy snow.

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 Lyman County due to flooding and excess moisture/precipitation between 2000 and 2017, obtained from the USDA Risk Management

Agency, is presented in the following table. During this period of analysis, flood-related payouts represented about 14% of all indemnity payouts in Lyman 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	$128,380		**2009**	$0	$1,361,315
2001	$0	$814,871		**2010**	$12,273	$4,346,664
2002	$0	$5,215		**2011**	$0	$4,044,267
2003	$0	$153,797		**2012**	$0	$264,482
2004	$0	$237,488		**2013**	$0	$363,277
2005	$17,736	$812,872		**2014**	$0	$1,384,723
2006	$0	$0		**2015**	$0	$104,084
2007	$0	$585,301		**2016**	$0	$79,776
2008	$0	$1,345,816		**2017**	$0	$7,185

Source: USDA Risk Management Agency (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. Lyman County ranked 38th in the state with a total of approximately 38,000 acres not planted.

Lyman County also is vulnerable to flooding due to dam failure, primarily because of the Big Bend 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. In the unlikely event that the Big Bend Dam completely failed, water would inundate farmland along the river, as well as property in Oacoma, but the rise in water would be gradual enough that everyone could escape, especially since floodwater would be very unlikely to reach Interstate 90, which would serve as the primary escape route [6]. There also is flooding vulnerability associated with several smaller dams located within Lyman County that could cause economic loss if they failed (see **Figure 3.1**).

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

[6] The predicted inundation level is shown in the U.S. Army Corps of Engineers Big Bend Dam Inundation Study, but it is not available for reproduction in this plan.

the results of the HAZUS analysis. It should be noted that the HAZUS runs may have included some land outside the cities' incorporated limits..

Table 3.9 – HAZUS Base Flood Loss Estimation Results

Community	Building Structural Damage	Debris Generated	Households Displaced	People Needing Shelter
Kennebec	$68,000	49 tons	44	0
Oacoma	$6,000	7 tons	1	0
Presho	$21,000	11 tons	1	0
Vivian	$10,000	5 tons	3	0

Source: FEMA HAZUS loss estimation software (July 2020)

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.

Table 3.10 – Property in Flood Prone Areas

Community	Number of Housing Units	Assessed Value (Residential)	Assessed Value (Commercial)

Sources: FEMA Flood Insurance Rate Maps; FEMA HAZUS loss estimation software; Lyman County Director of Equalization

Development Trends

Looking ahead, Lyman County's population is projected to increase slightly, but growth is not likely to increase the local vulnerability to flooding, as development is not occurring in areas prone to flooding. Although population growth is not expected to increase the county's vulnerability to flooding, a factor that is likely to increase vulnerability 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 Lyman 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

There is no question that Lyman County is vulnerable to drought. As shown in **Appendix C**, there are 25 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 local impact of drought is in the agricultural sector, which is not surprising, given the area'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 Lyman County due to drought and heat between 2000 and 2017, obtained from the USDA Risk Management Agency, is presented in the following table. During this period of analysis, drought-related payouts accounted for almost 60% of all indemnity payouts in Lyman County, far higher than any other type of payout. It is safe to say that drought is one of the costliest natural hazards facing Lyman County farmers, as it is for most farmers in South Dakota [7].

Table 3.11 – Crop Loss Due to Drought and Heat

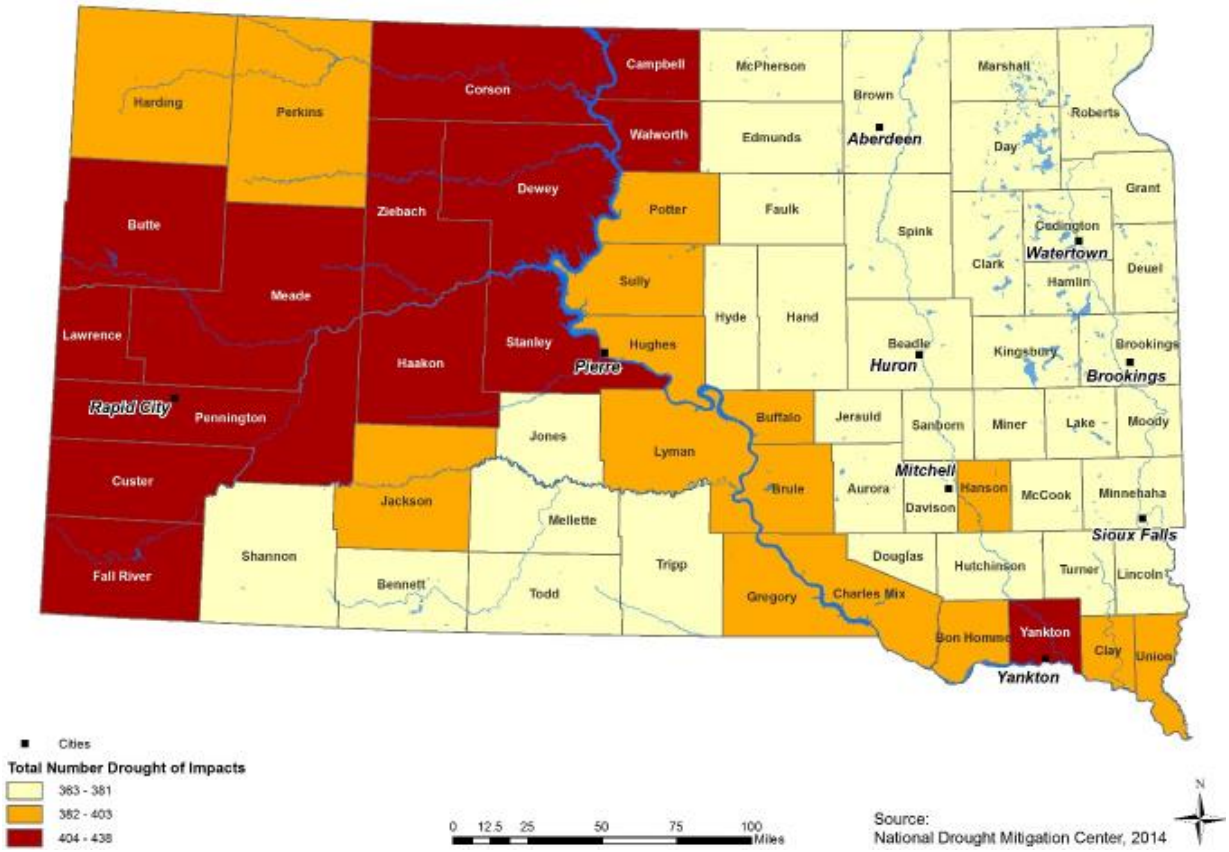
Year	Drought	Heat		Year	Drought	Heat
2000	$1,039,736	$11,235		**2009**	$764,616	$2,723
2001	$546,896	$22,804		**2010**	$72,347	$2,368
2002	$9,304,102	$48,958		**2011**	$2,587	$108,851
2003	$2,211,763	$77,051		**2012**	$11,881,713	$103,514
2004	$3,261,774	$708		**2013**	$13,358,337	$16,131
2005	$1,354,239	$287,778		**2014**	$802,473	$0
2006	$7,739,684	$15,024		**2015**	$5,287,472	$142
2007	$1,393,804	$460,002		**2016**	$840,552	$299,122
2008	$619,977	$11,405		**2017**	$8,207,636	$67,875

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

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 conducted an analysis comparing crop losses in each county 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. Lyman County's average annual loss from drought for the 2000 – 2014 period was $4,326,512, compared to a total crop value of $95,031,000, resulting in a loss ratio of 4.6%. In comparison, the average loss ratio figure for South Dakota counties was 3.1%, with four counties having a loss ratio over 10%. The authors of the South Dakota Drought Mitigation Plan assigned a "Moderate" vulnerability rating for Lyman County for this measure of drought vulnerability.

[7] From 2000 through 2013, drought payouts accounted for just under 50% of all indemnity payouts in the state. The next highest type of payout was from excess moisture/precipitation, representing about 30% of payouts.

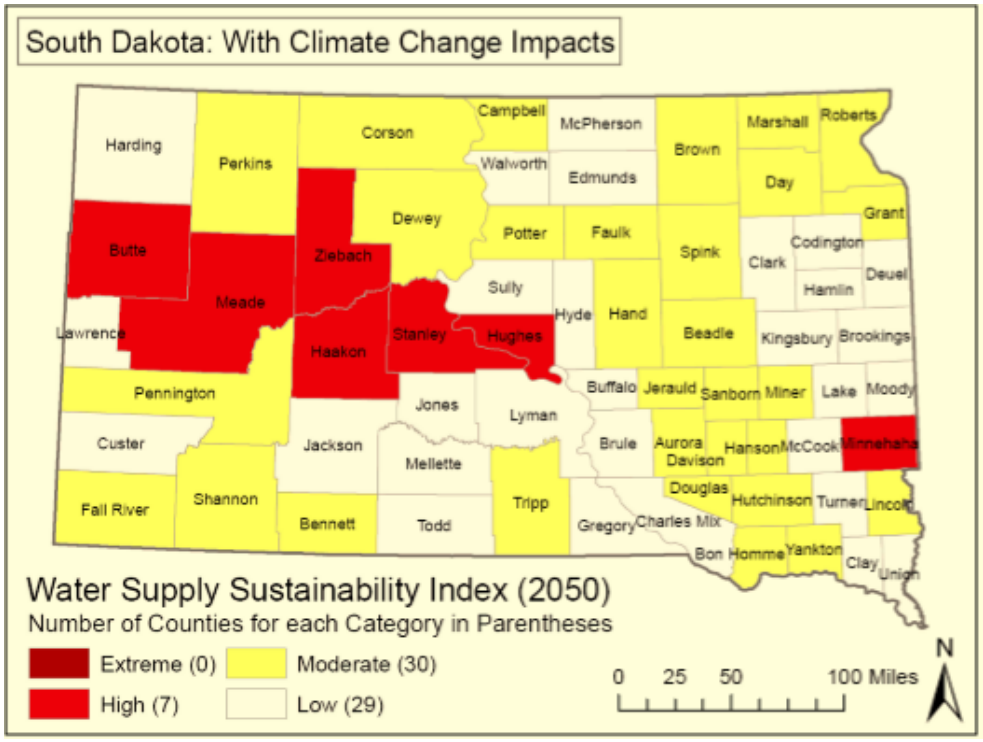
Vulnerability also was assessed by reviewing the South Dakota Drought Mitigation Plan's section on the National Drought Mitigation Center's Drought Impact Reporter. The Drought Impact Reporter analyzes drought impact information from a broad range of areas, including the social, economic, and environmental realms. As shown in the figure below, which was reproduced from the South Dakota Drought Mitigation Plan, Lyman 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 found that more than 1,100 counties may face higher risks of water shortages by mid-century as a result of climate change. Two of the reasons for this are expected shifts in precipitation and potential evapotranspiration (PET). In South Dakota, study results indicate that 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. However, the figure below from the Natural Resources Defense Council, as reproduced from the South Dakota Drought Mitigation Plan,

shows that Lyman County is not one of the counties expected to experience water shortages in the future due to climate change.



Wildfire

Wildfire risk in Lyman County can be determined by analyzing historical records of actual wildfire losses in the county (see **Table 3.4**), or by estimating potential wildfire losses. To analyze potential wildfire loss in the 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. This map shows the Wildfire Interface (yellow) and Wildfire Intermix (orange) areas in Lyman County. The total population in Lyman County at risk to wildfires is summarized in the following table.

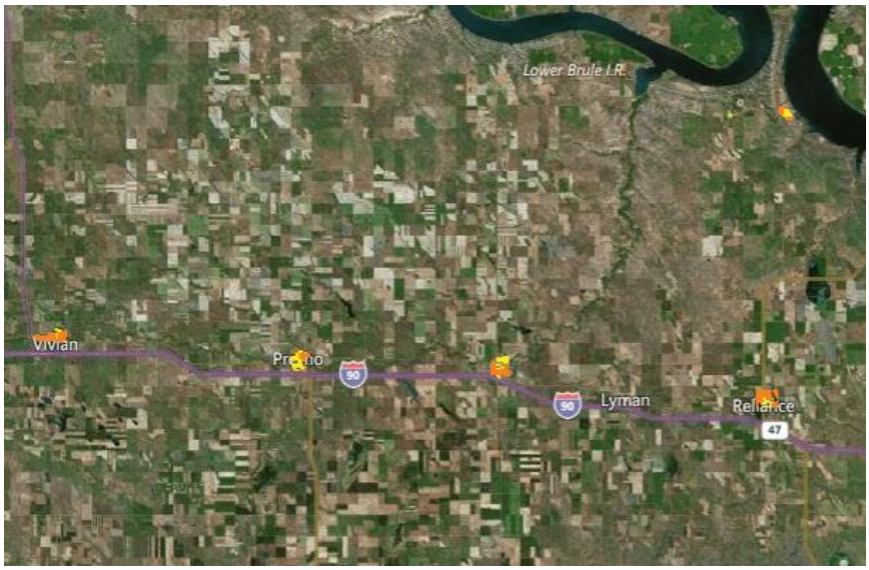


Table 3.12 – Population in Wildfire Risk Zones in Lyman County

Housing Units	Total Population	Median Home Value	Total Home Value
1,034	2,280	$64,900	$67,106,600

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

The population of 2,280 living in a High or Moderate Risk threat zone represents almost 61% of Lyman County's total population, 14th highest among South Dakota counties. Putting things in perspective, in South Dakota as a whole approximately 25% of the population lives in a wildfire threat zone.

Development Trends

The modest population growth expected to occur in the county probably will not significantly increase wildfire risk. One factor that could increase vulnerability is the continued spread of cedar trees in Lyman 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.

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 Lyman County to each of the hazards profiled is summarized. Maps are presented at the end of the section to augment the analysis, showing areas within each community where vulnerability to flooding exists. The graphic on page 42 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**

Lyman 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 25 miles from the nearest place with groceries, medical 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**

Lyman County's overall 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 and pastureland in the county is vulnerable to the effects of hail and other violent summer weather. Vulnerability may be somewhat higher in Oacoma and Reliance, where over 20% and 35% of the housing stock respectively consists of mobile homes, compared to 10% statewide. Residents of the Lower Brule community are also vulnerable, since most of the housing stock there lacks a basement. The lack of building codes in most areas of the county (see **Table 4.3** on p.59) impacts vulnerability to summer storms accompanied by high winds.

- **Flooding**

The overall vulnerability of Lyman County to flooding can be described as moderate. Most of the vulnerability is to cropland and to rural county roads. Vulnerability also exists along the White River. Flood damage to households and businesses generally is not a major concern, with the exception of the Missouri River flood in 2011. Flooding in 2019 caused substantial road damage throughout the county, including two road segments along the White River that were lost to erosion, and two large culverts in Iona Township that were destroyed. Following is a summary of vulnerability to flooding in each of the communities:

Kennebec: There is considerable vulnerability to flooding here, as shown in **Table 3.9** and **Table 3.10**. The only mapped flood zone in Lyman County is located along Medicine Creek in Kennebec. Flooding in 2019 caused considerable damage to the KOA Campground, flooded several homes, and flooded SD Hwy 273 at the Medicine Creek crossing, forcing the road to be closed for a day.

Lower Brule: There is some vulnerability to flooding here. If the Big Bend Dam completely failed, water might inundate some residences just outside the community.

Oacoma: There is some vulnerability to flooding here, as shown in **Table 3.9** and **Table 3.10**. The Missouri River flood of 2011 flooded some roads, inundated the city park, and would have caused substantial public and private damage except for a sandbagging effort that saved several residential properties and two sewage lift stations. Flooding in 2019 caused a minor amount of damage to a few residential properties, one of which experienced sewage backup.

Presho: There is some vulnerability to flooding in Presho, as shown in **Table 3.9** and **Table 3.10**. Flooding in 2019 caused major damage to several residential properties,

the municipal airport, and the golf course, and caused some damage at the sewage lagoon.

Reliance: There is some vulnerability to flooding in Reliance, despite the fact that the HAZUS software did not find any flood prone areas. There is some risk associated with Reliance Lake, which has overflown into the Reliance sewage lagoon during periods of very high rain. Failure of the dam at Reliance Lake would inundate the lagoon, as well as farmland below the dam. Flooding in 2019 had some impact on the community, but not nearly as much as it did in Kennebec and Presho.

Vivian: There is some vulnerability to flooding in Vivian, as shown in **Table 3.9** and **Table 3.10**. Flooding in 2019 caused a minor amount of damage to a couple of residential properties.

- **Drought**

Lyman 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. None of the water systems serving county residents has ever had difficulty delivering enough water to their customers.

- **Wildfire**

The overall vulnerability to wildfire in Lyman County can be considered moderate. Although no truly destructive wildfires have ever been recorded in the county, almost 61% of the county's population is considered to be living in a High or Moderate Risk wildfire threat zone, well above the statewide figure of 25%. The continued spread of cedar trees is a factor that could increase the county's vulnerability to wildfire in some areas, especially in the rugged terrain along the Missouri River.

Figure 3.1 - Lyman County

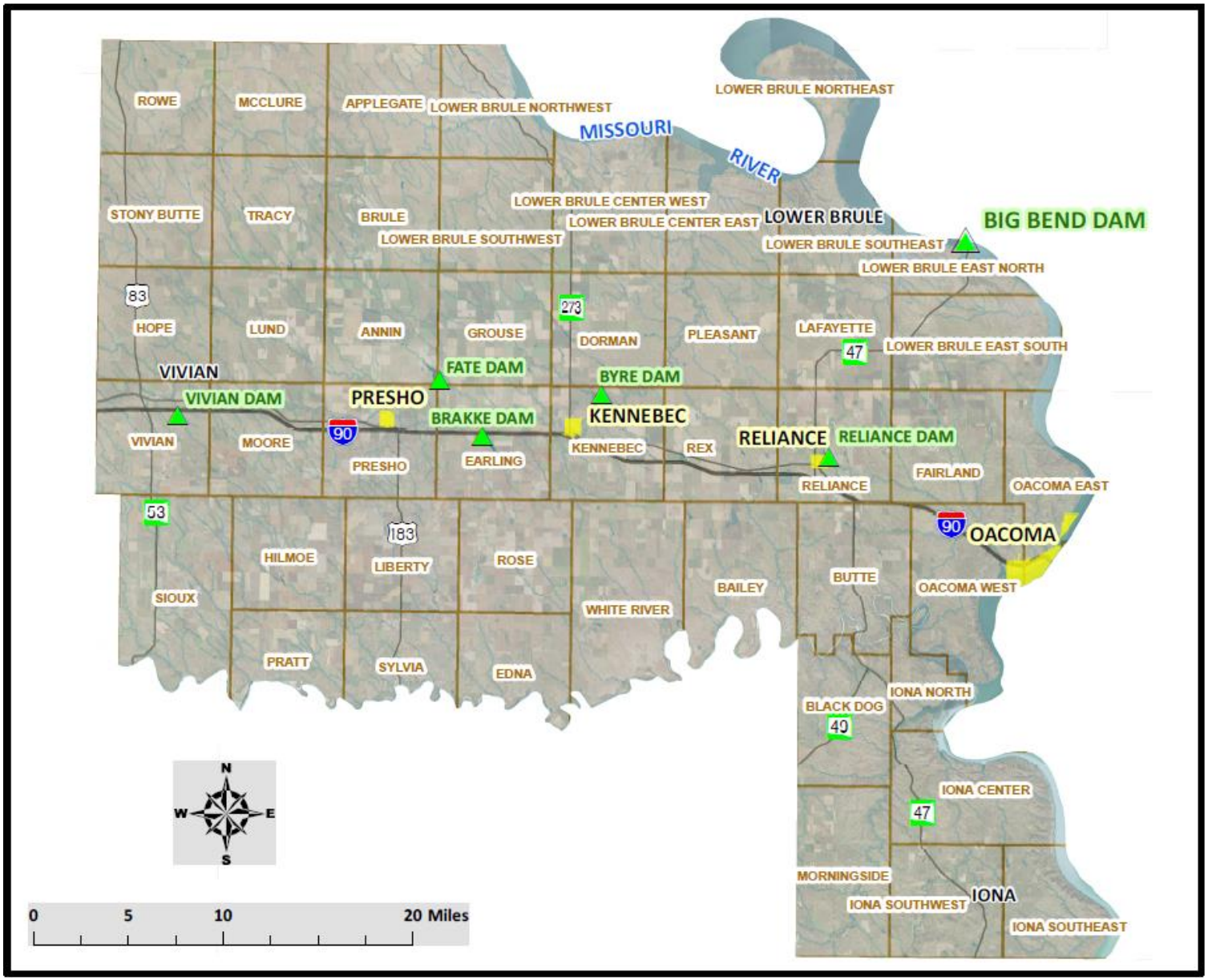


Figure 3.2 – Kennebec

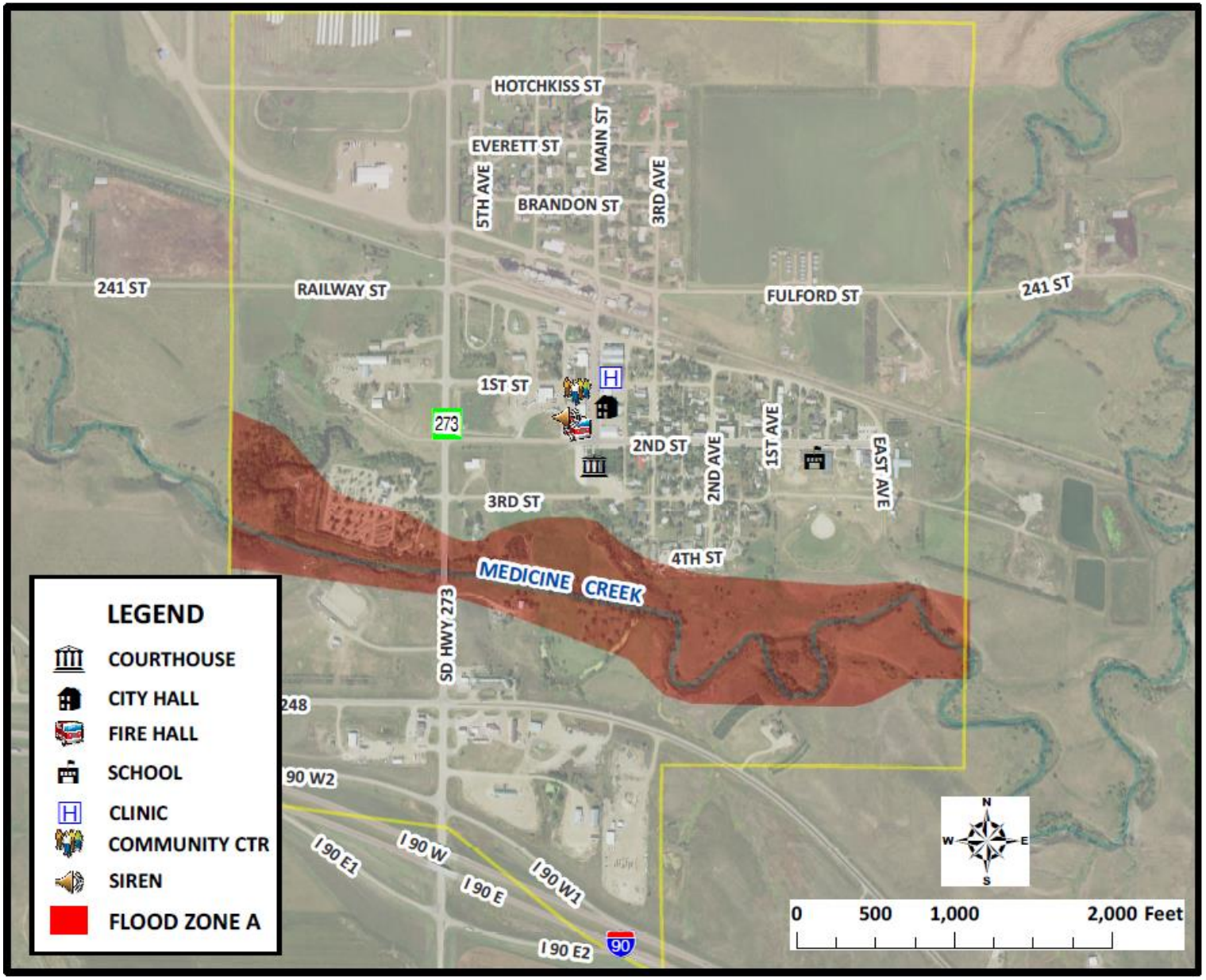


Figure 3.4 – Oacoma

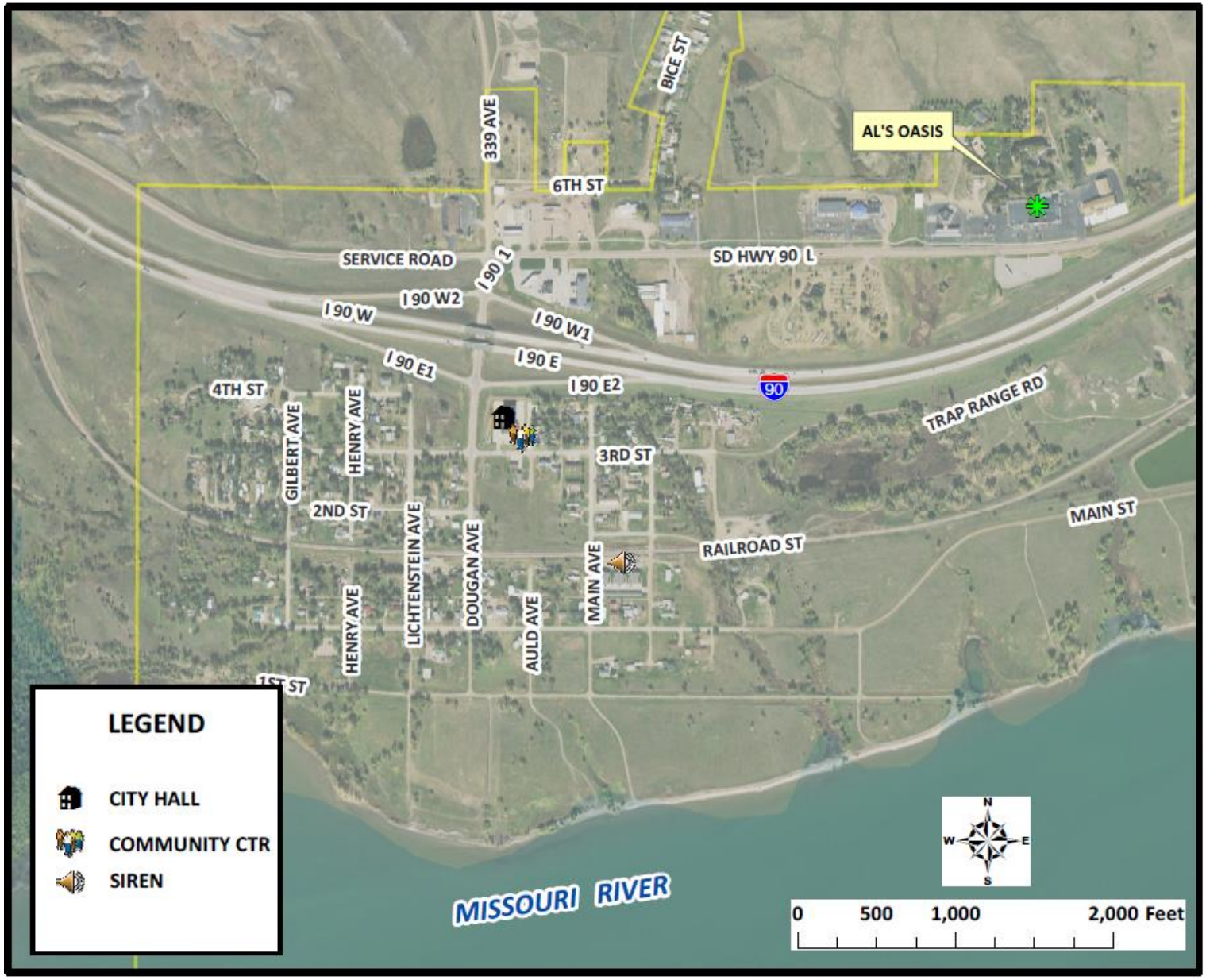


Figure 3.5 – Presho

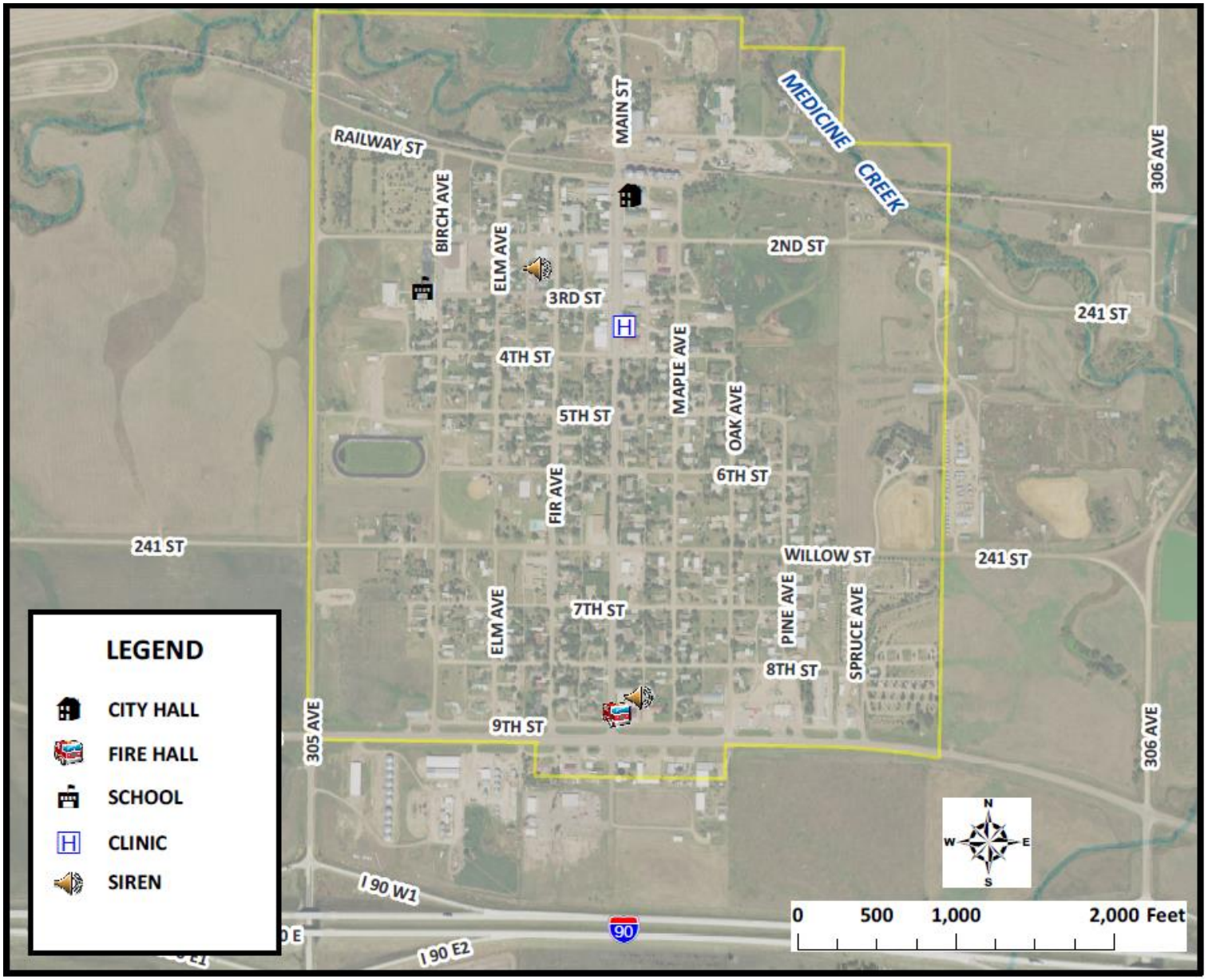
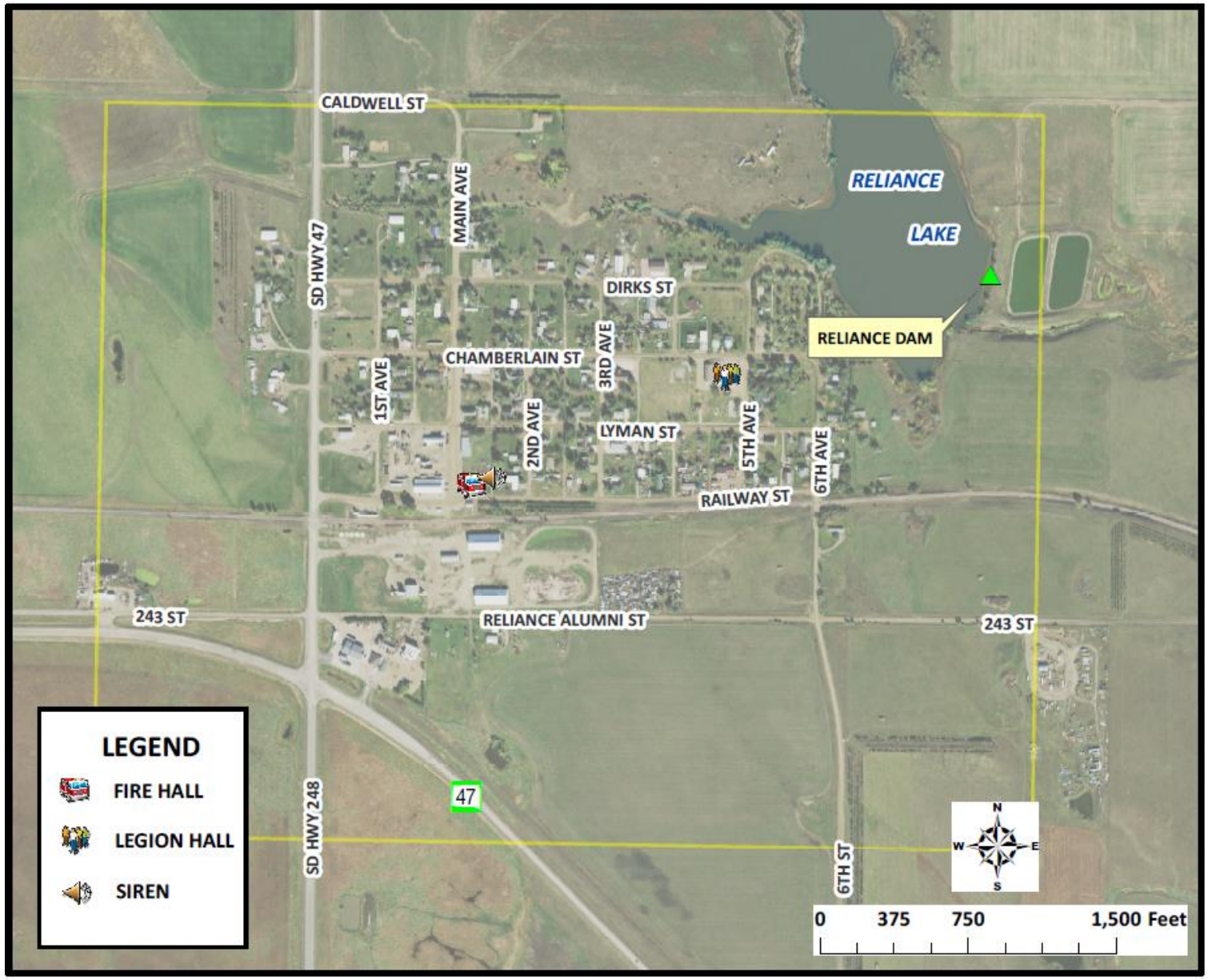


Figure 3.6 – Reliance



CHAPTER IV
RISK MITIGATION STRATEGY

Background

The previous chapter described the types of hazards most likely to impact Lyman 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 identified the goals and objectives it wanted to achieve. The team began by reviewing the goals listed in Lyman 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 these goals, they began to focus more narrowly on each hazard by reviewing the results of the risk assessment and then analyzing 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 vulnerability to each of the hazards faced.

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

Winter storm

- Reduce property and infrastructure 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 and infrastructure losses due to summer storms.

- Ensure that people are adequately protected from 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 and infrastructure 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
LYMAN COUNTY [8]		
Prairie dog prevention and response	Infectious Disease	No longer a priority for inclusion in plan
Snow traps for County Road 6 and County Road 13	Winter storm	No known progress
Invest in weather radios	All hazards	No known progress
Improvements to various county roads	All hazards	Some progress is being made
TOWN OF KENNEBEC		
Develop new culvert for Fulford Street	Flooding	No progress
Add larger line to fire hydrant on south side of town	Fire	Completed
Purchase emergency radios	All hazards	No progress
Upgrade warning siren	All hazards	No progress
Acquire snow removal equipment	Winter storm	No progress

[8] None of the Lyman County staff participating in this plan update were employed by the County five years ago when the current plan was developed, and there is some uncertainty about the status of the County projects.

Mitigation Action	Hazard	Current Status
Purchase generator for clinic	All hazards	No progress
Purchase generator for courthouse	All hazards	No progress
Purchase generator for fire hall	All hazards	No progress
Purchase generator for school	All hazards	No progress
TOWN OF OACOMA		
Purchase generator for community center/shelter	All hazards	No progress
Acquire siren for north end of town	All hazards	No progress
Develop new culverts in community to assist with drainage	Flooding	No progress
Procure a drainage study for area	Flooding	No progress
Upgrade warning siren	All hazards	Completed
CITY OF PRESHO		
Purchase new generator for fire station	All hazards	No progress
Clean out Medicine Creek from Presho to Kennebec	Flooding	No progress
Stabilize Medicine Creek stream bank on east edge of town	Flooding	No progress
TOWN OF RELIANCE		
Purchase new generator for community shelter	All hazards	No progress
Purchase new generator for fire station	All hazards	No progress
Enhance communication systems (pager and repeater)	All hazards	No progress
Upgrade equipment for fire station	Fire	No progress
Upgrade warning siren	All hazards	Completed
Acquire snow removal equipment	Winter storm	No progress
Portable water tank and pump for fire department	Fire/Drought	Completed
Purchase phone upgrade to setup a fire bar	Fire	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 a 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 storm water systems, such as culverts and storm sewer piping.
  - Building floodwalls.
  - Building or installing 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**. Some of the actions in the current plan are kept for this plan. Many of the actions that have been dropped are those oriented more toward preparedness than mitigation, while a few have already been accomplished. **Table 4.2** contains the following information for each action:

- The local priority rating – either High or Medium.
- The party (group or individual) mainly 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 finish 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 Lyman 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:

<u>FEMA grant programs</u>

- Hazard Mitigation Grant Program (HMGP)
- Pre-Disaster Mitigation (PDM)
- Flood Mitigation Assistance (FMA)

- Rehabilitation of High Hazard Potential Dams (HHPD)

Other grant and loan programs/sources

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

Table 4.2 - Proposed Mitigation Actions

LYMAN COUNTY	PRIORITY	RESPONSIBLE PARTY	TIME	COST	RESOURCES
Powerline burial.	HIGH	Rural Electric Coops	ONGOING	Unknown	FEMA
Improvements to various county roads.	HIGH	Hwy Superintendent	LONG	Unknown	FEMA
Remove vegetation from Medicine Creek to allow better flow.	HIGH	County Commission	LONG	Unknown	NCRCD; FEMA
Improve or move roads along White River.	HIGH	Hwy Superintendent	MID	Unknown	FEMA; DOT
Fix slide area on County Road 6 southwest of Oacoma.	HIGH	Hwy Superintendent	LONG	$300,000	DOT
Purchase generator for courthouse.	HIGH	County Commission	SHORT	$50,000	FEMA
Construct satellite fire station in Iona.	MED	County Commission	MID	$250,000	CDBG; WUIG
TOWN OF KENNEBEC	**PRIORITY**	**RESPONSIBLE PARTY**	**TIME**	**COST**	**RESOURCES**
Remove vegetation from Medicine Creek to allow better flow.	HIGH	Public Works Dept	LONG	Unknown	NCRCD; FEMA
Address drainage problems throughout town, including new culverts along Fulford Street.	HIGH	Public Works Dept	LONG	Unknown	FEMA; DENR; USDA
Upgrade warning siren.	HIGH	City Council; EMD	SHORT	$10,000	FEMA
Purchase generators for school and clinic.	HIGH	Lyman School Super; Clinic Director	MID	$30,000 each	FEMA
Acquire snow removal equipment.	HIGH	City Council	MID	≈$100,000	Unknown
Purchase emergency radios for residents.	MED	City Council; EMD	MID	≈$25,000	Unknown
TOWN OF OACOMA	**PRIORITY**	**RESPONSIBLE PARTY**	**TIME**	**COST**	**RESOURCES**
Drainage study for the town.	HIGH	Town Board	SHORT	≈$25,000	FEMA
Relocate water supply intakes.	HIGH	Public Works Dept	MID	Unknown	Unknown
Install additional culverts to improve drainage.	HIGH	Public Works Dept	MID	Unknown	DENR; USDA; NCRCD
Purchase generator for community center.	MED	Town Board	SHORT	≈$30,000	FEMA
Acquire warning siren for north side of town.	MED	Town Board	MID	≈$20,000	FEMA
CITY OF PRESHO	**PRIORITY**	**RESPONSIBLE PARTY**	**TIME**	**COST**	**RESOURCES**
Generator for fire station.	HIGH	Fire Dept	MID	$50,000	FEMA
Clean out Medicine Creek streambed within city limits.	HIGH	Public Works Dept	LONG	$100,000	NCRCD

Rubble site flood prevention.	MED	City Council	MID	$20,000	FEMA
Raise east end of airport runway to prevent flooding.	MED	City Council	MID	$100,000	Unknown
Water diversion away from lagoon.	MED	Public Works Dept	MID	$30,000	DENR; USDA

Potential Resources for Funding Assistance:

FEMA FEMA Hazard Mitigation Assistance Programs
DOT South Dakota Department of Transportation
NCRCD North Central Resource Conservation District
DENR South Dakota Dept. of Environment and Natural Resources
USDA US Department of Agriculture Rural Development
WUIG Western States Wildland Urban Interface Grant

Mitigation Action Plan

This plan is intended to serve as the backbone for disaster mitigation planning within Lyman County. To remain useful, the plan cannot exist in a vacuum – it is designed to work with other county and local planning and development tools and mechanisms. 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
Lyman County							X		X	
Kennebec				X			X			
Oacoma		X	X							
Presho				X			X			
Reliance		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 Lyman 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 Lyman 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 meet with representatives from each jurisdiction annually to discuss hazard mitigation, including the possibility of obtaining funds through FEMA or other sources for the projects they have identified.

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 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 Lyman County, and many years 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 Lyman 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 Lyman County Emergency Management Director. The director will work with the support of the Lyman County Commission to review the plan at least annually, or as the need arises. Appropriate staff from the participating jurisdictions will be brought into the review process also.

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. 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. For example, climate change is a factor that could increase local vulnerability to drought and 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.
- 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 project 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 and within jurisdictions 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 information that was posted on the county

webiste, as well as social media posts. 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 Lyman County Commission. The review will be an official agenda item, and therefore the public will have an opportunity to provide input into the plan.

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 Emergency Management Directors in Other Counties:

From: John Clem
Sent: Wednesday, June 10, 2020 11:43 AM
To: Poppen, Jim <Jim.Poppen@state.sd.us>; Brent.Kolstad@state.sd.us; Katheryn <brbufem@midstatesd.net>; Jon Burdette <jburdette@trippcounty.us>; Brad Christensen <gregfire@gwtc.net>
Cc: Margo Mitchell <margo.mitchell@lymancoso.org>
Subject: Lyman County PDM Plan Update

Hello folks –

This is just an FYI that **Lyman County** is beginning the process of updating its current Pre-Disaster Mitigation Plan. The first meeting will take place on **Monday, June 15 at 10:00 AM**. It will be conducted through a phone conference call, and I can forward call-in information if any of you would like to participate in the call. Let me know if there are any questions.

John Clem
Planning & Development District III
PO Box 687
Yankton, SD 57078
800 952-3562
John.Clem@districtiii.org

Meeting #2 - Email to Emergency Management Directors in Other Counties:

From: John Clem
Sent: Tuesday, August 18, 2020 11:07 AM
To: Poppen, Jim <Jim.Poppen@state.sd.us>; Christopherson, Martin <Martin.Christopherson@state.sd.us>; Brent.Kolstad@state.sd.us; Jon Burdette <jburdette@trippcounty.us>; Katheryn <brbufem@midstatesd.net>; Brad Christensen <gregfire@gwtc.net>
Cc: Margo Mitchell <margo.mitchell@lymancoso.org>
Subject: Lyman County PDM Plan

Good morning,

This is just an FYI that **Lyman County** will be holding its final meeting to update the county's current Pre-Disaster Mitigation Plan. The meeting will take place on **Tuesday, August 25 at 10:00 AM**. It will be conducted via phone conference call, and you are invited to participate if you are bored and have nothing better to do. The number to call is 1 800 567-5900 and the access code is 2044505. We anticipate submitting the plan to SD Emergency Management in September. Let me know if there are any questions.

John Clem
Planning & Development District III
PO Box 687
Yankton, SD 57078
800 952-3562
John.Clem@districtiii.org

APPENDIX B: History of Previous Hazard Occurrences

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

Table C.1 – Major Disaster Declarations Affecting Lyman County

Dec #	Date Disaster Declared	Type	Primary Damage Impact	Public Assistance To County
3015	Jun 1976	Drought		
764	May 1986	Severe Storms, Flooding		
1045	Mar 1995	Severe Winter Storm		
1052	May 1995	Flooding		
1156	Feb 1997	Severe Winter Storm		
1173	Apr 1997	Severe Flooding		
1596	Jul 2005	Severe Storm		
1774	Jul 2008	Severe Storms, Flooding	Roads, bridges	≈$90,000
1886	Mar 2010	Severe Winter Storm	Emergency Protection	≈$35,000
1915	May 2010	Flooding	Roads, bridges	≈$120,000
1984	May 2011	Flooding	Roads	≈$280,000
4137	Aug 2013	Severe Storms, Tornadoes	Utilities	
4233	Jul 2015	Severe Storms, Tornadoes	Utilities	≈$260,000
4440	Jun 2019	Severe Winter Storm	Roads, bridges	≈$25,000
4463	Sep 2019	Severe Storms, Flooding	Roads, bridges	≈$1,665,000

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 Lyman County from 1960 through 2019. The list is taken from the National Climatic Data Center's Storm Events Database, which is based off storm data from the National Weather Service, which in turn 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 – Significant Hazard Events in Lyman County

DATE	EVENT TYPE	DESCRIPTION	MAG	PROP DAMAGE ($1,000s)	CROP DAMAGE ($1,000s)
6/26/1960	Tornado		F1	2.5	
7/25/1960	Tornado		F2	25	
6/21/1962	Tornado		F1		
9/3/1963	Hail		3.00 in.		
7/21/1967	Hail		1.75 in.		
5/25/1969	Hail		1.75 in.		
7/10/1969	Tornado		F1		
5/30/1970	Hail		1.75 in.		
6/4/1971	Tornado		F2		
6/6/1971	Tornado		F0		
7/9/1971	Hail		2.75 in.		
7/9/1971	Tornado	Two tornadoes reported	F3		
7/30/1972	Tornado		F0		
7/1/1973	Hail		1.00 in.		
5/19/1974	Thunderstorm Wind		0 kts.		
5/20/1974	Hail		4.50 in.		
7/2/1974	Thunderstorm Wind		52 kts.		
6/19/1975	Hail		1.75 in.		
4/13/1976	Thunderstorm Wind		61 kts.		
5/18/1977	Thunderstorm Wind		71 kts.		
9/8/1977	Thunderstorm Wind		0 kts.		
7/9/1979	Hail		1.00 in.		

DATE	EVENT TYPE	DESCRIPTION	MAG	PROP DAMAGE ($1,000s)	CROP DAMAGE ($1,000s)
7/14/1979	Thunderstorm Wind		0 kts.		
6/26/1980	Thunderstorm Wind		52 kts.		
7/3/1980	Thunderstorm Wind		65 kts.		
8/13/1980	Thunderstorm Wind		52 kts.		
8/20/1980	Thunderstorm Wind		0 kts.		
6/23/1981	Hail		1.00 in.		
7/20/1982	Tornado	Four tornadoes reported	F0		
8/23/1982	Hail		0.75 in.		
7/18/1983	Thunderstorm Wind		65 kts.		
8/18/1983	Thunderstorm Wind		56 kts.		
8/26/1983	Thunderstorm Wind		54 kts.		
7/25/1984	Thunderstorm Wind		70 kts.		
5/28/1985	Tornado		F0		
7/16/1985	Thunderstorm w/hail		1.75 in.		
7/17/1985	Thunderstorm Wind		69 kts.		
9/2/1985	Thunderstorm Wind		52 kts.		
5/8/1986	Tornado		F0		
6/6/1986	Thunderstorm Wind		56 kts.		
8/6/1986	Thunderstorm w/hail		2.50 in.		
7/6/1987	Tornado	Nine tornadoes reported	F1	2.5	
7/9/1987	Tornado		F1	2.5	
7/20/1987	Hail		1.50 in.		
8/2/1987	Thunderstorm Wind		54 kts.		
8/5/1987	Tornado	Five tornadoes reported	F2	250	
5/25/1988	Hail		1.75 in.		
6/12/1988	Thunderstorm Wind		0 kts.		
6/11/1990	Thunderstorm Wind		52 kts.		
6/16/1990	Hail		1.75 in.		
8/2/1991	Hail		1.00 in.		
6/16/1992	Thunderstorm Wind		61 kts.		
6/4/1994	Thunderstorm Wind	Winds destroyed a tin shed and overturned a camper, injuring an occupant. Numerous tree branches were broken.	61 kts.	50	
1/17/1996	Blizzard				
1/24/1996	Heavy Snow				
1/28/1996	Extreme Cold				
2/1/1996	Extreme Cold				
2/10/1996	High Wind		57 kts.		

DATE	EVENT TYPE	DESCRIPTION	MAG	PROP DAMAGE ($1,000s)	CROP DAMAGE ($1,000s)
2/26/1996	Heavy Snow				
3/24/1996	Blizzard				
4/17/1996	Thunderstorm Wind		52 kts.		
4/24/1996	High Wind		70 kts.		
4/25/1996	High Wind		60 kts.		
5/18/1996	Hail		1.75 in.		
7/5/1996	Thunderstorm w/hail		1.00 in.		
7/7/1996	Hail		1.00 in.		
7/20/1996	Thunderstorm w/hail		0.75 in.		
7/28/1996	Hail		0.88 in.		
8/1/1996	Hail		1.75 in.		
10/29/1996	High Wind		58 kts.		
11/16/1996	Heavy Snow				
11/19/1996	Winter Storm				
12/14/1996	Heavy Snow				
12/16/1996	Blizzard				
1/3/1997	Winter Storm				
1/9/1997	Blizzard				
1/15/1997	Blizzard				
2/3/1997	Winter Storm				
3/21/1997	Flood				
4/1/1997	Flood				
4/4/1997	Blizzard				
5/1/1997	Flood				
6/3/1997	Flood				
6/19/1997	Hail		0.75 in.		
6/20/1997	Thunderstorm w/hail	Several supercell thunderstorms moved southeast along a strong warm front across southern Stanley, Jones, Hughes, Lyman, and Buffalo counties. Hail up to the size of baseballs and winds gusting to 80mph damaged and destroyed thousands of acres of crops, and caused substantial property damage. The most extensive damage occurred in the areas of Draper, Vivian, Presho, and Kennebec where there was a 20 mile long and 4 mile wide path of destruction.	2.75 in.		
6/20/1997	Thunderstorm Wind		61 kts.		
11/2/1997	High Wind		50 kts.		
3/6/1998	Heavy Snow				
6/10/1998	Hail		0.75 in.		
6/17/1998	Hail		0.88 in.		
7/2/1998	Hail		1.75 in.		

DATE	EVENT TYPE	DESCRIPTION	MAG	PROP DAMAGE ($1,000s)	CROP DAMAGE ($1,000s)
11/9/1998	Blizzard				
3/26/1999	High Wind				
5/6/1999	High Wind		50 kts.		
5/9/1999	Tornado		F0		
6/7/1999	Hail		1.50 in.		
7/15/1999	Hail		0.75 in.		
7/18/1999	Thunderstorm w/hail		1.25 in.		
7/22/1999	Hail		0.75 in.		
7/29/1999	Hail		0.88 in.		
11/1/1999	High Wind		47 kts.		
1/10/2000	High Wind		38 kts. M		
2/19/2000	Wildfire	Due to extremely dry and windy conditions, a fire burned about 40 square miles of grassland between Kennebec and Lower Brule. The fire threatened a ranch but changed directions before anyone had to be evacuated.			
2/25/2000	Hail		0.88 in.		
3/7/2000	Hail		0.75 in.		
4/5/2000	High Wind		55 kts. M		
4/19/2000	High Wind		56 kts. M		
6/1/2000	Hail		0.75 in.		
6/14/2000	High Wind		56 kts. M		
7/9/2000	Hail		1.75 in.		
7/21/2000	Hail		0.75 in.		
7/24/2000	Hail		0.88 in.		
9/3/2000	Hail		1.75 in.		
11/7/2000	Blizzard				
11/11/2000	Winter Storm				
11/28/2000	High Wind		44 kts. M		
12/10/2000	Heavy Snow				
12/16/2000	Blizzard				
12/28/2000	High Wind		51 kts. M		
1/29/2001	Winter Storm				
2/7/2001	Winter Storm				
2/24/2001	Winter Storm				
4/22/2001	Winter Storm				
6/9/2001	Thunderstorm Wind		52 kts. E		
6/18/2001	Hail		1.25 in.		
11/26/2001	Winter Storm				

DATE	EVENT TYPE	DESCRIPTION	MAG	PROP DAMAGE ($1,000s)	CROP DAMAGE ($1,000s)
2/11/2002	High Wind		53 kts. M		
3/14/2002	Winter Storm				
4/23/2002	High Wind		50 kts. M		
6/1/2002	Drought				
6/20/2002	Hail		2.00 in.		
6/24/2002	Thunderstorm w/hail		0.75 in.		
7/7/2002	Thunderstorm Wind		52 kts. E		
7/24/2002	Tornado		F0		
7/26/2002	Thunderstorm Wind		52 kts. E		
8/11/2002	Hail		1.75 in.		
8/17/2002	High Wind		49 kts. M		
8/21/2002	Hail		1.75 in.		
11/29/2002	High Wind		50 kts. E		
1/15/2003	Heavy Snow				
5/4/2003	Hail		0.75 in.		
6/9/2003	Hail		1.75 in.		
6/11/2003	Thunderstorm w/hail	Three tornadoes also reported	4.50 in.		
6/24/2003	Thunderstorm w/hail		0.75 in.		
7/1/2003	Hail; Flash Flood		1.75 in.		
7/4/2003	Thunderstorm Wind		52 kts. EG		
7/5/2003	Thunderstorm w/hail		0.75 in.		
7/8/2003	Thunderstorm Wind		52 kts. EG		
11/3/2003	Heavy Snow				
11/12/2003	High Wind		50 kts. EG		
11/22/2003	Heavy Snow				
2/29/2004	Heavy Snow				
3/1/2004	Heavy Snow				
3/10/2004	High Wind		51 kts. MG		
5/11/2004	Thunderstorm w/hail		0.88 in.		
7/10/2004	Thunderstorm w/hail		0.75 in.		
7/27/2004	Thunderstorm w/hail		0.88 in.		
8/1/2004	Thunderstorm w/hail		1.25 in.		
8/7/2004	Thunderstorm Wind		52 kts. EG		
8/15/2004	Thunderstorm Wind		52 kts. EG		
8/30/2004	Hail		1.00 in.		
10/29/2004	High Wind		50 kts. MG		
1/4/2005	Heavy Snow				

DATE	EVENT TYPE	DESCRIPTION	MAG	PROP DAMAGE ($1,000s)	CROP DAMAGE ($1,000s)
1/21/2005	High Wind		35 kts. MS		
3/10/2005	High Wind		58 kts. MG		
5/13/2005	Flood				
5/17/2005	Thunderstorm Wind		52 kts. EG		
6/7/2005	Thunderstorm Wind		59 kts. MG		
9/12/2005	Hail		0.88 in.		
9/18/2005	Hail		0.75 in.		
11/8/2005	High Wind		57 kts. MG		
11/27/2005	Blizzard	Snow began across most of central and north central South Dakota in the late afternoon and early evening hours of the 27th with significant snowfall accumulations occurring by the time the snow ended later in the day on the 28th. Strong northwest winds with gusts to 70 mph caused widespread blizzard conditions. Many roads, including Interstate-90, were closed due to the treacherous travel conditions, and several accidents were reported. Snowfall amounts included 11 inches near Presho and 21 inches at Kennebec.			
3/12/2006	Winter Storm				
3/20/2006	Winter Storm				
5/28/2006	Thunderstorm w/hail		67 kts. MG		
6/1/2006	Drought				
6/14/2006	Thunderstorm Wind		61 kts. EG		
7/1/2006	Drought				
7/15/2006	Excessive Heat	A record high of 112 degrees was set at Kennebec.			
7/28/2006	Excessive Heat				
8/1/2006	Drought				
8/4/2006	Hail		1.25 in.		
8/9/2006	Thunderstorm w/hail		61 kts. EG		
8/20/2006	Hail		1.75 in.		
9/1/2006	Drought				
10/1/2006	Drought				
11/1/2006	Drought				
12/1/2006	Drought				
12/29/2006	Heavy Snow				
1/1/2007	Drought				
1/8/2007	High Wind		50 kts. EG		
2/1/2007	Drought				
2/24/2007	Winter Storm				
3/2/2007	Blizzard				
4/3/2007	Extreme Cold				

DATE	EVENT TYPE	DESCRIPTION	MAG	PROP DAMAGE ($1,000s)	CROP DAMAGE ($1,000s)
6/6/2007	Thunderstorm Wind		52 kts. MG		
6/12/2007	Flash Flood	Heavy rains of 4 inches flooded a road and much of the property around a home.			
7/17/2007	Thunderstorm Wind		52 kts. EG		
7/27/2007	Wildfire	A grassland fire was sparked by haying equipment 5 miles SE of Presho. With strong winds and low humidity, the fire spread quickly and burned nearly 100 acres of hay and prairie grass.			
8/6/2007	Thunderstorm w/hail		61 kts. EG		
8/13/2007	Hail		0.75 in.		
1/29/2008	Extreme Cold				
4/10/2008	Blizzard				
5/24/2008	Hail		0.88 in.		
6/5/2008	Hail		0.88 in.		
7/16/2008	Thunderstorm w/hail		2.75 in.		
7/28/2008	Hail		1.75 in.		
7/30/2008	Hail		2.00 in.		
8/4/2008	High Wind		50 kts. MG		
8/11/2008	Hail		0.75 in.		
8/13/2008	Hail		1.50 in.		
10/26/2008	High Wind		56 kts. MG		
11/6/2008	Blizzard				
12/13/2008	Blizzard				
12/14/2008	Extreme Cold				
12/21/2008	Extreme Cold				
2/11/2009	Flood	The White River rose above flood stage of 15 feet near Oacoma on February 11th. The river crested at 17.6 feet on February 13th before it fell below flood stage on the 15th.		5	
2/25/2009	Winter Storm				
2/27/2009	Heavy Snow				
3/30/2009	Blizzard				
4/4/2009	Winter Storm				
6/23/2009	Thunderstorm Wind		56 kts. MG		
6/26/2009	Thunderstorm Wind		56 kts. MG		
8/3/2009	Thunderstorm w/hail		52 kts. EG		
8/12/2009	Hail		1.50 in.		
12/23/2009	Blizzard				
1/6/2010	Blizzard				
1/7/2010	Extreme Cold				
1/22/2010	Winter Storm				

DATE	EVENT TYPE	DESCRIPTION	MAG	PROP DAMAGE ($1,000s)	CROP DAMAGE ($1,000s)
3/8/2010	Flood				
4/13/2010	High Wind		58 kts. MG		
5/24/2010	Thunderstorm w/hail		1.00 in.		
5/29/2010	Hail		0.88 in.		
6/22/2010	Thunderstorm Wind		70 kts. EG		
7/3/2010	Thunderstorm Wind		70 kts. EG		
7/6/2010	Hail		1.25 in.		
7/10/2010	Hail; Flash Flood		1.00 in.		
7/21/2010	Thunderstorm Wind		52 kts. EG		
7/23/2010	Thunderstorm w/tornado	A U.S. record hailstone fell near Vivian, measuring 8 inches in diameter and weighing 1.9 pounds. Along with the very large hail, damaging winds in excess of 70 mph along with an isolated tornado occurred. The large hail and high winds caused extensive damage to property as it moved across the region. Some of the hail went completely through car windshields, roofs, garages, and campers. The hail caused five minor injuries to motorists on Interstate-90, including a minor who was severely injured when the windshield in the vehicle he was traveling in was shattered.	8.00 in.		
8/3/2010	Thunderstorm Wind		54 kts. MG		
9/14/2010	Hail		1.75 in.		
9/22/2010	Hail		1.00 in.		
10/26/2010	High Wind		54 kts. MG		
12/30/2010	Blizzard				
12/31/2010	Blizzard	10 inches of snow recorded at Kennebec.			
1/1/2011	Blizzard				
2/2/2011	Extreme Cold				
2/16/2011	Flood	The White River fluctuated above and below flood stage for several days causing minor flooding to occur. The river gage southwest of Oacoma along Highway 47 crested at 21.4 feet or 6.4 feet above flood stage. Flooding of agricultural land occurred.			
2/20/2011	Blizzard				
3/2/2011	Flood	Minor flooding occurred along the White River. The river gage southwest of Oacoma along Highway 47 crested at 16.9 feet or 1.9 feet above flood stage. Flooding of agricultural land occurred.			
4/14/2011	Winter Storm				
4/30/2011	High Wind		35 kts. MS		
5/8/2011	Thunderstorm w/tornado		EF0		
6/6/2011	Thunderstorm Wind		61 kts. EG		
6/12/2011	Flood	Record snow melt along with much above normal May and June precipitation in the upper Missouri River basin resulted in record high releases on the Oahe Dam upstream. Due to the high releases, the Missouri River at Oacoma and Chamberlain rose to above the flood stage of 65 feet on June 12th, reaching a record of 74.6 feet on June 30th. Many			

DATE	EVENT TYPE	DESCRIPTION	MAG	PROP DAMAGE ($1,000s)	CROP DAMAGE ($1,000s)
		people along the river, especially in Oacoma, had to build levees to hold back the rising water, and some locations were flooded. The flooding continued into July.			
6/16/2011	Hail		0.88 in.		
6/20/2011	Flash Flood	Heavy rainfall of 5 to 7 inches brought flash flooding to eastern Lyman county. Many roads were flooded with some washed out. Two women died in two separate vehicles after driving into a washed out portion of a road. The accidents happened 9 miles north of Reliance on BIA 10 just north of the intersection with Highway 47.			
6/22/2011	Flood				
6/30/2011	Thunderstorm Wind		58 kts. MG		
7/1/2011	Flood				
7/9/2011	Hail		1.75 in.		
7/15/2011	Excessive Heat				
7/21/2011	Thunderstorm Wind		61 kts. EG		
7/27/2011	Thunderstorm Wind		61 kts. EG		
8/1/2011	Flood				
8/2/2011	Thunderstorm Wind		52 kts. EG		
8/11/2011	Thunderstorm Wind	80 mph winds downed several grain bins, and knocked a few semis off of Interstate-90. The winds also downed some power lines and poles.	70 kts. EG		
9/20/2011	High Wind		54 kts. MG		
10/7/2011	High Wind		51 kts. MG		
2/28/2012	Blizzard				
4/15/2012	High Wind		67 kts. MG		
5/5/2012	Hail		1.50 in.		
5/10/2012	High Wind		55 kts. MG		
6/7/2012	Thunderstorm Wind		50 kts. MG		
6/13/2012	Hail		1.75 in.		
7/17/2012	Hail		1.00 in.		
7/19/2012	Thunderstorm Wind		52 kts. EG		
7/20/2012	Thunderstorm w/hail		0.88 in.		
7/24/2012	Drought	A persistent upper level ridge of high pressure over the central U.S. allowed hot and dry air to hold its grip across the region. By July, severe drought conditions had expanded northward into South Dakota. Crops began to show stress, and cattle sell-offs occurred across the region. Range and pasture conditions were poor to very poor, with fire danger remaining a big issue. The severe drought continued into August.			
8/1/2012	Thunderstorm Wind		59 kts. MG		
9/1/2012	Drought				
10/1/2012	Drought				
10/17/2012	High Wind		67 kts. MG		

DATE	EVENT TYPE	DESCRIPTION	MAG	PROP DAMAGE ($1,000s)	CROP DAMAGE ($1,000s)
10/18/2012	High Wind		61 kts. MG		
11/1/2012	Drought				
12/1/2012	Drought				
12/9/2012	Blizzard				
1/1/2013	Drought				
2/1/2013	Drought				
2/10/2013	Blizzard				
3/1/2013	Drought				
4/1/2013	Drought				
4/8/2013	Winter Storm	14 inches of snow recorded at Kennebec.			
5/1/2013	Drought				
5/27/2013	Thunderstorm w/hail		71 kts. MG		
6/12/2013	Thunderstorm Wind		50 kts. MG		
6/21/2013	Thunderstorm Wind		65 kts. MG		
6/22/2013	Thunderstorm Wind		56 kts. MG		
7/7/2013	Thunderstorm Wind		53 kts. MG		
7/20/2013	Thunderstorm Wind		58 kts. MG		
8/7/2013	Thunderstorm w/hail		1.25 in.		
10/11/2013	High Wind		35 kts. MS		
12/3/2013	Winter Storm				
12/7/2013	Extreme Cold				
1/5/2014	Extreme Cold				
1/16/2014	High Wind		53 kts. MG		
1/20/2014	High Wind		52 kts. MG		
1/26/2014	High Wind		61 kts. MG		
3/31/2014	Blizzard				
4/28/2014	Flood	Heavy rains of 3 to 4 inches fell across parts of southern Lyman County, resulting in the flooding of several roads between Interstate 90 and the White River south of Kennebec. No travel was advised on a road two miles south of Kennebec.			
6/16/2014	Hail		1.00 in.		
6/21/2014	Thunderstorm Wind		61 kts. EG		
3/3/2015	Blizzard				
3/29/2015	High Wind		51 kts. MG		
5/28/2015	Hail		1.00 in.		
6/9/2015	Thunderstorm w/hail		52 kts. EG		
6/19/2015	Thunderstorm Wind		90 kts. MG		

DATE	EVENT TYPE	DESCRIPTION	MAG	PROP DAMAGE ($1,000s)	CROP DAMAGE ($1,000s)
6/20/2015	Thunderstorm Wind	100 mph winds or higher caused severe damage to several buildings in Lower Brule and downed many trees. The roof of the courthouse sustained damage, and light poles at the football field were bent over. The Red Cross set up shelter for displaced people.	87 kts. EG		
6/22/2015	Thunderstorm Wind		61 kts. EG		
7/2/2015	Thunderstorm Wind		70 kts. EG		
7/12/2015	Thunderstorm Wind		50 kts. MG		
7/25/2015	Thunderstorm Wind		52 kts. EG		
7/27/2015	Thunderstorm Wind		52 kts. EG		
8/22/2015	High Wind		51 kts. MG		
9/7/2015	Thunderstorm w/hail		63 kts. MG		
9/16/2015	Thunderstorm Wind		52 kts. MG		
10/11/2015	High Wind		63 kts. MG		
11/18/2015	High Wind		62 kts. MG		
11/30/2015	Heavy Snow				
12/1/2015	Heavy Snow				
12/15/2015	Winter Storm				
2/7/2016	High Wind		58 kts. MG		
2/19/2016	High Wind		56 kts. MG		
5/24/2016	Thunderstorm Wind		53 kts. MG		
5/26/2016	Hail		1.00 in.		
6/14/2016	Funnel Cloud				
6/22/2016	Hail		1.75 in.		
7/6/2016	Thunderstorm Wind		73 kts. MG		
7/19/2016	Excessive Heat				
7/26/2016	Hail; Flash Flood	Heavy rain of 4 inches caused flash flooding of secondary roads and standing water in fields northeast of Presho.	1.75 in.		
8/10/2016	Thunderstorm Wind		56 kts. EG		
8/14/2016	Thunderstorm Wind		56 kts. EG		
9/4/2016	Thunderstorm Wind		52 kts. EG		
9/8/2016	Hail		1.25 in.		
11/5/2016	Wildfire	Very warm, dry, and breezy conditions contributed to a wildfire five miles northeast of Reliance that burned 750 acres. Fifty firefighters from seven fire departments helped extinguish the fire. Some structures were threatened, and the fire forced the closure of a three-mile stretch of SD Hwy 47 for over five hours.			
12/16/2016	Heavy Snow				
12/18/2016	Extreme Cold				
12/25/2016	High Wind		63 kts. MG		
1/24/2017	Heavy Snow	Seven inches of snow recorded at Kennebec.			

DATE	EVENT TYPE	DESCRIPTION	MAG	PROP DAMAGE ($1,000s)	CROP DAMAGE ($1,000s)
6/6/2017	Drought	An extremely dry May caused a severe drought by June. The South Dakota Drought Task force was activated, and CRP lands were opened up for grazing and haying.			
6/11/2017	Hail		2.50 in.		
7/1/2017	Drought	Hot and dry conditions throughout July led to the continuation and expansion of drought across central and northeast South Dakota. By the end of July, extreme drought developed across parts of Lyman County. July was a hot month, accelerating the deteriorating conditions. Average monthly temperatures were from 3 to 5 degrees above normal, with a high of 107 degrees recorded at Kennebec.			
7/5/2017	Thunderstorm Wind		66 kts. MG		
7/17/2017	Thunderstorm Wind		63 kts. MG		
8/1/2017	Drought				
8/12/2017	Hail		1.50 in.		
8/21/2017	Thunderstorm; Hail		1.50 in.		
9/1/2017	Drought				
10/1/2017	Drought				
12/4/2017	Blizzard				
12/26/2017	Extreme Cold				
12/31/2017	Extreme Cold				
1/21/2018	Heavy Snow				
2/8/2018	Heavy Snow				
2/18/2018	Heavy Snow				
3/5/2018	Blizzard				
3/16/2018	Winter Storm				
4/13/2018	Blizzard	Life threatening conditions developed during this rare mid-April blizzard. Businesses and schools were closed, and I-90 was closed. Livestock losses were substantial as the storm hit during calving season. Total snowfall of 17 inches was measured at Kennebec and 12 inches at Presho.			
5/17/2018	Thunderstorm Wind		57 kts. MG		
5/24/2018	Hail		1.00 in.		
6/5/2018	High Wind		56 kts. EG		
6/8/2018	Thunderstorm Wind		61 kts. MG		
6/11/2018	Thunderstorm Wind		52 kts. EG		
6/21/2018	Flood	Heavy rain in southwest South Dakota from June 17 thru 20 caused flooding along the White River from Kadoka to the confluence of the Missouri River. The river rose about half a foot above flood stage at Oacoma for a short time on June 21st. Minor flooding of agricultural land occurred.			
6/27/2018	Flash Flood	Flash flooding from heavy rains occurred near Oacoma, with parts of roads underwater.			
6/27/2018	Hail		1.75 in.		
7/18/2018	Hail		1.75 in.		

DATE	EVENT TYPE	DESCRIPTION	MAG	PROP DAMAGE ($1,000s)	CROP DAMAGE ($1,000s)
8/4/2018	Hail		1.00 in.		
8/6/2018	Hail		1.75 in.		
8/23/2018	Thunderstorm Wind		54 kts. MG		
8/25/2018	Thunderstorm Wind		57 kts. MG		
8/27/2018	Hail		3.50 in.		
10/3/2018	High Wind		54 kts. MG		
1/18/2019	Heavy Snow				
1/27/2019	High Wind		63 kts. MG		
2/16/2019	Heavy Snow				
3/2/2019	Extreme Cold				
3/13/2019	Blizzard				
4/11/2019	Blizzard				
3/14/2019	Flood				
3/26/2019	Flood				
4/1/2019	Flood				
5/22/2019	Flood				
5/22/2019	Flood				
5/26/2019	Flood				
6/30/2019	Hail		1.00 in.		
7/3/2019	Hail		1.00 in.		
7/3/2019	Hail		1.00 in.		
7/3/2019	Hail		1.75 in.		
7/3/2019	Hail		1.75 in.		
7/5/2019	Thunderstorm Wind		52 kts. MG		
7/20/2019	Thunderstorm Wind		53 kts. MG		
7/20/2019	Thunderstorm Wind		56 kts. MG		
8/2/2019	Flash Flood				
8/6/2019	Hail		2.00 in.		
8/6/2019	Hail		2.75 in.		
8/6/2019	Hail		2.75 in.		
8/6/2019	Thunderstorm Wind		52 kts. EG		
8/6/2019	Thunderstorm Wind		56 kts. MG		
8/6/2019	Thunderstorm Wind		70 kts. EG		
8/9/2019	Thunderstorm Wind		61 kts. EG		
8/9/2019	Tornado		EF0		
8/15/2019	Hail		1.50 in.		
8/15/2019	Thunderstorm Wind		52 kts. MG		

DATE	EVENT TYPE	DESCRIPTION	MAG	PROP DAMAGE ($1,000s)	CROP DAMAGE ($1,000s)
8/17/2019	Hail		1.75 in.		
8/17/2019	Thunderstorm Wind		61 kts. EG		
9/10/2019	Hail		1.00 in.		
11/29/2019	Winter Storm				
12/1/2019	Winter Storm				

Source: National Climatic Data Center's Storm Events Database

APPENDIX C: References

PRINT REFERENCES

- Lyman County Pre-Disaster Mitigation Plan. Northern Tier Consulting. 2015.
- Lyman County Hazardous Materials Plan. Planning & Development District III. 2003.
- Oacoma Comprehensive Plan. Planning & Development District III. 2004.
- Reliance Comprehensive Plan. Planning & Development District III. 2003.
- West Central Electric Cooperative Construction Work Plan.
- Big Bend Dam Emergency Action Plan, Fort Thompson, South Dakota. U.S. Army Corps of Engineers, Omaha District. 2010.
- Big Bend Dam Inundation Study. U.S. Army Corps of Engineers, Omaha District. Jan 2015.
- Flood Repairs at Missouri River Mainstem Dam Projects & Bank Stabilization along the Missouri River. U.S. Army Corps of Engineers. Sept 2013.
- Electrical Transmission and Distribution Mitigation: Loss Avoidance Study Nebraska and Kansas FEMA-1674-DR-KS and FEMA-1675-DR-NE. Federal Emergency Management Agency. 2008.
- Local Mitigation Planning Handbook. FEMA. March 2013.
- Mitigation Ideas: A Resource for Reducing Risk to Natural Hazards. FEMA. January 2013.
- State of South Dakota Hazard Mitigation Plan April 2019. South Dakota Office of Emergency Management/Wood. 2019.
- South Dakota Drought Mitigation Plan. South Dakota Drought Task Force/South Dakota Office of Emergency Management. 2015.
- South Dakota's Five-Year Floodplain Management Work Plan. South Dakota Office of Emergency Management. 2005.
- South Dakota Electric Cooperatives Mutual Aid Plan. South Dakota Rural Electric Association. 2008.

ELECTRONIC REFERENCES

- Census data: factfinder2.census.gov/faces/nav/jsf/pages/index.xhtml
- Population data: census.gov/population/www/censusdata/cencounts/files/sd190090.txt
- Land cover information: www.mrlc.gov/index.php
- Climate extremes: www.weather.gov/fsd/climatearchive
- Major disaster declarations and emergency declarations in South Dakota: www.fema.gov/disasters/grid/state-tribal-government/
- Public assistance amounts following declared disasters: www.fema.gov/data-feeds/openfema-dataset-public-assistance-funded-projects-summaries-v1
- Storm event records: www.ncdc.noaa.gov/stormevents/choosedates.jsp?statefips=46, SOUTHDAKOTA
- Crop loss records: www.rma.usda.gov/data/cause.html
- Flood insurance information: www.fema.gov/policy-claim-statistics-flood-insurance
- National Flood Insurance Program participation: www.fema.gov/cis/SD.html
- 2019 flooding impact: fb.org/market-intel/prevent-plantings-set-record-in-2019-at-20-million-acres
- Drought impact: droughtreporter.unl.edu/map/
- Wildfire vulnerability: silvis.forest.wisc.edu/data/wui-change/
- Earthquake history in South Dakota: www.sdgs.usd.edu/publications/maps/earthquakes/earthquakes.htm
- Earthquake magnitude: en.wikipedia.org/wiki/Richter_magnitude_scale
- Landslide information: landslides.usgs.gov/hazards/nationalmap/
- Social vulnerability: artsandsciences.sc.edu/geog/hvri/sovi%C2%AE-0