NIOBRARA COUNTY MULTI-HAZARD MITIGATION PLAN

Town of Lusk, Town of Manville, Town of VanTassell, Niobrara County

Niobrara River Flood, Lusk, June 2015

Prepared by Niobrara County

with assistance from

Beck Consulting, AMEC Foster Wheeler

DRAFT

June 2015

Table of Contents

Table of Tables

Table of Figures

Table of Appendices

EXECUTIVE SUMMARY

Niobrara County, Wyoming, and the municipalities of Lusk, Manville, and Van Tassell developed and adopted a Multi-Hazard Mitigation Plan (MHMP) in 2003. The plan was updated and revised in 2009. This plan is a subsequent revision to ensure these four local jurisdictions remain disaster-resistant.

This revision was prepared by Niobrara County with the assistance of contractor, Beck Consulting, and subcontractor, AMECFW. The content of the plan relies on the advice and guidance of the Local Emergency Planning Committee (LEPC) and elected officials. The LEPC met to review and develop goals and projects, and to prioritize the projects. A subgroup of the LEPC consisting of the county commissioners, county clerk, and emergency manager met with the contractor to assist with the other steps.

Information was available about the project through coverage by the Lusk Herald and the county's website. The draft plan was made available at town and county offices, the public library, and online, for a four-week period starting in late June 2015.

A total of 14 hazards, 12 natural and two human-caused, were identified and profiled for the county. These hazards included; dam failure, drought, earthquakes, extreme temperatures, floods, hail, hazardous materials, landslides, lightning, terrorism, tornadoes, wildland fire, wind and wind-blown deposits, and winter storms and blizzards.

The goals and action items in this MHMP revision were developed after consideration of:

- the projects identified in the 2009 MHMP,
- the history of disasters in the county,
- the risks and vulnerabilities, and
- available resources and capacities.

Hazard Mitigation Goals

Four goals (rewritten to address each local jurisdiction's needs individually) with a total of 38 projects were either carried over and/or developed during this revision process. Projects that had not been accomplished from the 2009 plan, that were still appropriate and meaningful were incorporated into the revision.

Goal One: *Mitigate natural hazards to reduce potential injury and loss of life, and property damage in the Town of Lusk.*

Goal Two*: Mitigate natural hazards to reduce potential injury and loss of life, and property damage in the Town of Manville.*

Goal Three: *Mitigate natural hazards to reduce potential injury and loss of life, and property damage in the Town of VanTassell.*

Goal Four: *Mitigate natural hazards to reduce potential injury and loss of life, and property damage in Niobrara County.*

1. INTRODUCTION

Specific Jurisdictions Represented in the Plan

The jurisdictions represented in this plan are Niobrara County, and the towns of Lusk, Manville, and Van Tassell, Wyoming. These are the same four jurisdictions that participated in and adopted the original MHMP in 2003 and the 2009 update. There are no new or non-participating jurisdictions for the plan.

How the Jurisdictions Participated in the Plan Update

The four local jurisdictions participated in the planning process. Participation occurred in the following ways:

- By providing key staff to participate in the LEPC meetings,
- By identifying actions taken on projects from the 2009 plan,
- By providing existing plans and documents,
- By providing facilities to host meetings,
- By meeting with the contractor one-on-one as requested,
- By providing feedback on draft goals,
- By providing specific project ideas,
- By reviewing and commenting on the draft plan, and
- By adopting the updated plan.

Opportunity for Involvement by Other Interests

The Wyoming Office of Homeland Security (WOHS) and all Wyoming counties, including the neighboring counties of Westin, Converse, Platte, and Goshen were notified that Niobrara County was undertaking a revision to the MHMP and invited to provide input, comments, and review the draft plan. This notification came through the WOHS via the state-wide coordinator's web page.

There is no higher education facility located in the county. Local non-profits, businesses, and other organizations had opportunity to learn about and become involved in the process through articles and community calendar postings in the Lusk Herald, by invitation to the LEPC meetings, and on the county's website.

Process Followed to Update the Plan

Niobrara County retained hazard mitigation planner, Beck Consulting, of Red Lodge, Montana. The contract with the consultant was signed in March 2015 and the project kicked off in early April 2015.

Beck subcontracted the hazard assessment research and writing to AMEC Foster Wheeler (AMEC) in Boulder, CO. To kick-off the project, the contractor met with the County Commissioners and the LEPC on April 21, 2015. The LEPC was designated as the local planning team. Contractor Beck provided a briefing for the commissioners and developed a Briefing

Paper to be used for general information about the project. The Briefing Paper was posted on the county's website.

AMEC researched and updated the hazard profiles using the list of hazards from the original plan and the first update--after having that list validated by the county commissioners at the April kick-off meeting. Standard data bases and sources were consulted in the preparation of the hazard profiles. The sources are cited in the appropriate sections.

In April 2015, the contractor met with the county commissioners and emergency manager and held public meetings in Manville and Lusk. During these meetings, the contractor provided an explanation of the reasons for and benefits of updating the plan, outlined the schedule and process, covered the roles of all involved, provided contact information, and worked with the local officials to update the status of the projects in the 2009 plan.

The LEPC met with the contractor on two occasions (and reviewed draft documents between these meetings—communicating via e-mail) and performed the functions listed under the subsequent section describing their involvement. Following the LEPC meetings, the contractor documented the meetings and re-drafted products such as the introduction, development trends, and goals and projects as per the LEPC and county commissioners' guidance.

In May 2015, the contractor met again with the county commissioners and emergency manager, and met with and briefed the mayors and council members of the Lusk and VanTassell town councils. All of these meetings were publicly-noticed and open to the public.

In June 2015, the contractor met again with the county commissioners and the LEPC. The LEPC went through the draft list of mitigation projects and validated the priorities given to the projects by the county commissioners, emergency manager, and contractor. The following day, June 3, Lusk, Manville, and the county experienced a disastrous flash flood of the Niobrara River—causing significant property and infrastructure damage.

The release of the draft plan was announce on schedule at a county commissioner meeting, June 16, for a 30-day public review period. The draft plan was posted on the county's website and its availability announced in the Lusk Herald. Hard copies of the draft plan were made available at the three town halls, county courthouse, and public library in Lusk. The public comment period was open from late-June through late-July 2015. To expedite the process of finalizing the plan, the plan was reviewed by the Wyoming Office of Homeland Security simultaneously with the public comment period.

Comments received from WYOS and the public on the draft plan were reviewed by the Emergency Management Coordinator and forwarded to the contractor to be addressed in the final plan. The final plan was submitted to FEMA for review. Once FEMA deemed the plan "approvable" resolutions of adoption were provided to all of the local governing bodies for adoption.

The planning process is documented in Appendix A which include copies of meeting agendas, flyers, minutes, sign-in sheets, and news articles--provided in chronological order.

How the Planning Team Reviewed and Analyzed the Existing Plan

How each section of the plan was updated:

- Chapter I: Chapter I was re-written by the contractor with input from all of the local jurisdictions and the LEPC to describe the planning process, development trends, and address other FEMA requirements. How the planning team and public were involved in this update is described below.

- Chapter 2: This chapter was rewritten by contractor AMEC based on available data. The hazards did not change from 2009 to 2015.

- Chapters 3-15: These hazard history chapters were updated by the two contractors using existing data sources supplemented by information obtained at the public and LEPC meetings, and from the county commissioners.

- Chapter 16: The mitigation actions were based on the previous plan, problem statements and project ideas developed by the LEPC, and projects identified by the county commissioners, and the public. The draft goals and projects were refined by the LEPC and county commissioners.

- Chapter 17: The monitoring and maintenance chapter was updated by the contractor with the guidance of the county emergency manager.

- Appendices were updated by the contractor to document the planning process.

The list of mitigation actions (projects) in the 2009 MHMP was deemed one of the most important sections of the plan for close scrutiny. The contractor--assisted by the county commissioners and the new emergency manager updated the status of 2009 projects.

After receiving a briefing about the plan update, the LEPC spent much of their first meeting on April 21, 2015, discussing natural hazard problems and potential projects to address them. LEPC involvement following the first meeting involved review of draft project ideas and then prioritization of those projects.

The plan update was on an aggressive schedule after expiration of the previous plan, so there was unprecedented access to the elected officials. The elected officials made this update one of their top priorities. All three county commissioners (and all three mayors) were heavily involved. The county commissioners met numerous times with the contractor and attended every public meeting and every LEPC meeting—functioning in effect as a task group under the LEPC. Because the LEPC did not meet every month, the county commissioners--representing their constituents--helped to ensure the update truly met local needs by bringing their knowledge and expertise to the process through many meetings with the prime contractor.

The hazard history chapters were updated with information located by the contractors from sites such as the National Climate Data Center. Citations are provided in the text of those chapters. Information for updating Chapter I profiling the county was obtained by discussing

development trends, proposed developments, and the status of land use planning in the county with the county commissioners and at the public/elected official meetings.

How the Public Was Involved in the Update Process

Including the county commissioner and town council meetings, a total of nine public meetings were held in Lusk, Manville, and Van Tassell. Meeting agendas, notes, flyers, and sign-in sheets can be found in Appendix A. Input was solicited at each of the meetings. The Briefing Paper was posted on the county's website at the start of the process. The entire draft plan was posted once it was completed. The Lusk Herald published several articles during the process and a legal ad and article in the Herald announced the four-week public comment period. Public comments were addressed in the final plan.

Individuals/Groups Involved in the Plan Update Process

The following individuals and organizations were invited to participate in plan update and/or were members of the LEPC.

- County Commissioners
- Town mayors
- Town and Rural Fire Depts
- Emergency Medical Services
- Search and Rescue
- Law Enforcement/Coroner
- Emergency Management
- Women's Prison
- Niobrara Hospital
- Public Works
- Road and Levy (county)
- Weed and Pest (county)
- Chamber of Commerce
- WYDOT
- Senior Center
- Public school district
- Conservation District
- NRCS
- Union Pacific Railroad
- JP Oil

Figure 1-1: L to R, Commissioners Wade, Ladwig, and Stark, Emergency Manager Santistevan

Review and Incorporation of Existing Plans

Relevant county plans were identified for review. The Wyoming Multi-Hazard Mitigation Plan was also consulted to ensure consistency with this plan update.

Plan Name	Date	Jurisdiction	Comments
Niobrara Land Use Plan	1996	County	Plan is 20 years old. There are no concurrent accompanying regulations or ordinances.
Niobrara County Planning and Zoning Regulations	2004	County	Provides for five zones, one-family residential, multiple-family residential, commercial, industrial, and agricultural. Primarily identifies allowed uses for each zone. Does not address natural hazards related to future development.
2015-2010 Niobrara Conservation District Land and Resource Use Plan and Policy	2014	County	Very comprehensive plan. Emphasis on coordination in planning between all levels of government. MHMP related items include support for fire management, sharing of information, and adequate communications and related technology (broadband.)MHMP projects are consistent with this plan.
Niobrara County Community Wildfire Protection Plan	Undated	County	No plan could be produced by county staff. WY Division of Forestry had two maps with hand drawn areas delineated on file. There were no goals or projects. The map was used in the HIRA update.
Niobrara County EOP	2003	County	Out-dated. EOP will be updated after completion of the MHMP.
Wildland Fire Management Operating Plan	2015	County	Addresses cooperation, response, operations, and other issues. Contains prevention/education and mitigation sections.
Lusk Municipal Code	2004	Lusk	Adopts Uniform Building Codes, establishes building inspector and permit system, establishes subdivision requirements, contains "Flood Damage Prevention" chapter with requirements for construction in areas of special flood hazard, references 1986 FIRM.
Manville Municipal Code	Various	Manville	Under revision. Not available. As per mayor--no natural hazard references.

County Profile

Niobrara County was formed in 1912. The county encompasses approximately 2,626 square miles and is located in east central Wyoming. Agriculture is the dominant land use with open range in the nortern two-thirds of the county and open range with dry-land and irrigated farming in the southern third. There are 1,309,703 privately-owned acres in the county and 282,257 acres owned by the State and BLM. The total acreage in the county is 1,672,960. The county borders South Dakota and Nebraska on the east. Neighboring Wyoming counties include; Converse, Goshen, Platte, and Westin.

The following county profile information was compiled by Headwaters Economics using data from the U.S. Census and Bureau of Labor Statistics. It is found in the Economic Profile System, EPS-HD. (www.headwaterseconomics.org) Information has also been taken directly from the U.S. Census and the American Community Survey.

There are three incorporated communities in the county—the Towns of Lusk, Manville and Van Tassell. According to the most recent decennial U.S. Census, Lusk had a population of 1567, Manville had a population of 95, and VanTassell had a population of 15 in 2010.

According to the 2010 U.S. Census, the population for the whole county was 2,484. The estimated population for 2013 was 2,541 representing a 2.3% increase between 2010 and 2013. From 2000 to 2012 the population grew by 69 people or 3%. (Headwaters Economics EPS-HD) The population is just under 96% white only in race. There were 192 veterans in the county's population from 2009-2013. The population density based on the 2013 estimate is .9 people per square mile. The highest concentration of population is in the Town of Lusk, the county seat. (http://www.census.quickfacts)

The county had 1,331 housing units and 1,045 households in 2013. Households averaged 2.13 persons. Over 81% of residents one year and older had lived in the same house for the past year. The owner occupied housing rate from 2009-2013 was 62.2%. Over 90% of the population (25 years and over) were high school graduates or higher for 2009-2013. (http://www.census.quickfacts)

Median household income from 2009-2013 in 2013 dollars was $38,438. Per capita income for the same period was $26,797. 15.8% of the residents of the county were in poverty. (http://www.census.quickfacts)

From 1990 to 2013, the annual unemployment rate has ranged from a low of 2% in 1997 to a high of 5.6% in 2010. (Headwaters Economics EPS-HD) Total employment in the county in 2012 was 452 persons with a total annual payroll of $12,712,000.

According to data from the EPS-HD, Niobrara County is not generally impacted by national recessions. The primary industry is agriculture, supported by mineral exploration, light industry, small businesses, and government employment.

Figure 1-2: Niobrara County Baseline Map

Niobrara County is made up of gently rolling plains that slope down to the east. Elevation varies from over 5,000 feet in the southwest to 3,000 feet above sea level in the north. Lands drain into both the Cheyenne and Niobrara Rivers.

Surface water is scarce in the county. The surface is characterized by rolling hills, granite knobs, canyons, and breaks. Precipitation at Lusk is 15 inches annually with most of the precipitation coming between April and September. Underlying the surface are the Powder River and Denver-Julesberg Basins, both oil and gas producing basins. The county also contains limestone, silver, copper, and uranium. Air and water quality in the county are good.

The county is served by U.S. Route 85 bisecting the county from north to south and U.S. Route 18 and 20 which bisect the county from west to east. Route 18 turns north at Lusk joining Route 85. State highway 270 runs north and south of Manville. County roads access other more remote areas of the county. The Union Pacific (U.P.) Railroad has track that crosses the county and is used by both the U.P. and Burlington Northern.

Development Trends

Compared to other U.S. counties, Niobrara County population and land use is stable. According to documents filed with the County Clerk, two large rural subdivisions have been platted north of Lusk and west of Highway 85. Because the tracts are 35 acres or larger in size there is no review required under state law.

The "Frontier Reserve" development has 45 tracts 35 acres or larger. Access to this subdivision is by a rudimentary private road. This plat was recorded on August 29, 2005 by BWJ Limited.

The same firm also recorded the "Cedar Canyon" subdivision on November 13, 2007. Cedar Canyon has 43 tracts 35 acres or larger. This subdivision is located southwest of Lance Creek. A rudimentary private road accesses this development which has one resident family. With the existing access, landforms, and flashy fuels, wildland fire is a concern. There is no electricity in the development.

The county commissioners reported being aware that some of the lots in these two subdivisions have sold over the Internet. There have been a number of foreclosures on the lots. The commissioners have no indication that additional residences are planned or under construction at this time.

A small number of gas wells are in production in the northern end of the county. Niobrara has no coal production. Energy development and production will fluctuate with national and global energy markets.

The most capital intensive project in the county in recent years has been the upgrade of the railroad tracks by the Union Pacific Railroad. The U.P. transports large amounts of coal for electricity generation through Niobrara County from open pit coal mines located to the north, to various points south and east. The railroad has added a third track to the two existing tracks that run south to near Douglas, then turn east continuing into Nebraska. And the railroad is just completing the removal of wooden ties from the track bed, replacing them with concrete.

The Union Pacific continues to carry coal across the county. But, now the Burlington Northern Santa Fe is also carrying freight--including crude oil and anhydrous amonia--through the county on U.P. track. There is no passenger air or rail service.

The Town of Lusk has developed an industrial park on the south side of town. Several businesses (new and relocated) are now occupying the industrial park, including storage, taxidermy, the newspaper, an eye doctor, and a dollar store. There are still spaces available for additional businesses.

The women's correctional facility is a major employer in the county. A recent expansion of the facility added inmate birthing and child development space. Due to the difficulty of staffing at the prison, these new areas have not yet been utilized. The nature of corrections work, perceived desirability of Lusk as a place to live, lack of economic opportunity for spouses, and relatively high prices for rental housing have all discouraged the ability of the facility to staff adequately.

Despite relatively high rental prices there is little development of new housing. There is a very small amount of new residential construction, occurring primarily within the corporate limits of the Town of Lusk. Overall, continued stability and with no new significant scale development—residential, commercial, or industrial—appears likely in the near term.

2. HAZARDS IDENTIFICATION AND RISK ANALYSIS

In 2009, the Niobrara County Emergency Management Coordinator, along with the Wyoming State Geological Survey, identified 18 potential hazards that could affect Niobrara County, 12 of which were profiled in detail. Of those 15, six were considered significant and potentially life threatening. Definitions and explanations of all potential hazards are listed below.

Dam Failure: Dam failure is the uncontrolled release of impounded water resulting in downstream flooding, which can affect life and property. Flooding, earthquakes, blockages, landslides, lack of maintenance, improper operation, poor construction, vandalism, or terrorism can cause dam failures.

Drought: Drought is described as a protracted period of deficient precipitation resulting in extensive damage to vegetation, water table levels, and recreation.

Earthquake: A sudden motion or trembling that is caused by a release of strain accumulated within or along the edge of the earth's tectonic plates.

Expansive Soils: Expansive soils contain clays that have the potential to swell and shrink when they become wet or dry out. Expansive soils can have significant impact on roads, bridges and other transportation facilities, as well as on buildings. According to the Wyoming Geological Survey, there are not enough of these soils to present a significant problem in Niobrara County and so the hazard was not profiled further.

Extreme Temperatures: Extreme temperatures are unusually high or low temperatures that occur either out of season or for prolonged periods of time in-season. Niobrara County is vulnerable both to severe cold and severe heat incidents.

Flood / Flash Flood: A general and temporary condition of partial or complete inundation of normally dry land areas from (1) the overflow of inland or tidal waters, (2) the unusual and rapid accumulation or runoff of surface waters from any source, or (3) mudflows or the sudden collapse of shoreline land. Flash flood: a flood event occurring with little or no warning where water levels rise at an extremely fast rate.

Hail: Hail forms when raindrops freeze, begin to fall, and then are tossed back up into the colder parts of the cloud and refreeze. This process repeats and the hail grows until ultimately it falls from the clouds. Severe storms can drop enough hail to blanket the ground, flatten crops or clog storm sewers.

Hazardous Materials: A hazardous material is defined by the U.S. Department of Transportation (DOT) as one that poses an unreasonable risk to health and safety of operating or emergency personnel, the public, and/or the environment if not properly controlled during handling, storage, manufacture, processing, packaging, use, disposal, or transportation.

Landslide: A downward movement of a slope and materials under the force of gravity.

Land Subsidence: Land subsidence is a gradual settling or sudden sinking of the Earth's surface owing to subsurface movement of earth materials. In Wyoming this is often associated with

roof collapse of mined-out areas. There is little mining activity in Niobrara County so subsidence is not considered a significant hazard and is not profiled further.

Lightning: Lightning is a sudden electrical discharge released from the atmosphere that follows a course from cloud to ground, cloud to cloud, or cloud to surrounding air, with light illuminating its path. Lightning's unpredictable nature causes it to be one of the most feared and deadly weather elements.

Severe Winter Storm: A winter storm can range from a moderate snow over a few hours to blizzard conditions with blinding wind-driven snow that lasts several days.

Terrorism: Terrorism is the use of force or violence against persons or property in violation of the criminal laws of the United States for purposes of intimidation, coercion, or ransom.

Tornadoes: Tornadoes are violently rotating column of air extending from a thunderstorm to the ground.

Windstorms: Windstorms are the violent movement of air across the surf of the earth causing damage to assets. Damaging windstorms are not common in Niobrara County, but they have occurred.

Windblown deposits: Windblown deposits include areas of shifting silts and sands that can encroach on development, roads, and agricultural areas. Areas of windblown deposits are located in southern Niobrara County, but are not known to have caused problems. If these deposits are disturbed, they could potentially destabilize. A profile of the windblown deposits hazard is included with windstorms.

Wildfire: Any non-structure fire, other than prescribed fire, that occurs in the wildland.

Volcanism and Yellowstone Volcanic Explosion: Very large-scale explosive volcanic activity has occurred in the Yellowstone area within the past 2.5 million years, which, in geologic time, is very recent. Because of this, the Yellowstone volcanic area is considered a substantial threat across Wyoming and well beyond. The volume and extent of volcanic materials produced from past eruptions at Yellowstone were immense. It is possible that another eruption of similar magnitude will occur, but probably not within the next 20,000 years. In the event that another large-scale eruption did occur, the thickness of the volcanic material produced would be immense. For example, it is predicted that ash in Southeastern Wyoming would be over three feet deep. And, as stated in Smith and Siegel in Windows Into the Earth, 2000: "Devastation would be complete and incomprehensible at the caldera. Imagine Yellowstone National Park and everything in it destroyed. Nearby towns like West Yellowstone, Gardiner, and Cooke City, Montana, likely would be wiped out by ash, mudflows or pyroclastic flows. A Yellowstone caldera explosion today would dump ash over hundreds of thousands of square miles…"

The large-scale explosive events at Yellowstone occurred 640,000 years before present, 1,300,000 years before present, and 2,100,000 years before present. The recurrence intervals of these events range from 660,000 years (1,300,000 – 640,000) to 800,000 years (2,100,000 – 1,300,000). Only 640,000 years has elapsed since the last event, so 20,000 – 160,000 years may be left before a large event is expected. There are smaller events that occur more frequently.

These include several lava flows that were emplaced at approximately 150,000 years before present, 110,000 years before present, and 70,000 years before present. These events were localized within the Yellowstone area, not having the widespread effect of the previously described explosive events.

Because of the overly long expected occurrence of frequency (greater than 10,000 years) for explosive volcanism at Yellowstone, and the fact that a good response or mitigation plan is not possible for an event of this magnitude, the threats to Niobrara County were not analyzed in this document.

Methodology

The hazard profiles were developed based on the information provided by the State of Wyoming. The potential hazards profile list is derived from the FEMA Local Multi-Hazard Mitigation Planning Guidance issued in 2008. The preliminary assessment of the County, combined with the data provided by the State, resulted in the final hazards profile list. Information for the hazard profiles was derived by searching the National Climatic Database Center (NCDC) hosted by the National Weather Service, examining the existing multi-hazard mitigation plan and the emergency operations plan for Niobrara County and for Wyoming, hazard mitigation plans developed for neighboring Counties, and by examining archives and online historical resources where available. Population and demographic data is derived from the Census Bureau and the State of Wyoming. HAZUS and other FEMA resources provided definitions, reference maps, and other supplemental information to complete the profile.

Hazards Risk Analysis

Based on the histories and potential future occurrences of hazards that may cause significant impacts in Niobrara County, the planning team in 2009 selected the following hazards to be addressed in more detail in the hazard-specific chapters of this plan: dam failures, droughts, earthquakes, extreme temperatures, floods, hail, landslides, lightning, hazardous materials, tornadoes, wild-land fires, windstorms and windblown-deposits, and winter storms. The county commissioners validated this list of hazards for the 2015 plan update. Hazards that were not addressed further were those that were not likely to occur in the next 100 years, those that have no historical impact on property or life safety, or those whose low hazard rating is unlikely to change given current development trends for the County.

At the end of each of the following hazard-specific chapters there is an overall summary of the risk to people and property for each hazard. The probability of the hazard occurring is assessed as well. During the previous revision, Niobrara County Emergency Management generated a ranking of hazards to determine the most significant potential threats posed by natural and human-caused hazards. The following hazard analysis is based on a high, medium and low level of risk, as defined below, based on past history and the potential for future occurrence.

High: This ranking carries the highest threat. The potential of this hazard occurring in the assessment area is considered a matter of "when" it will occur, as opposed to "if" it will occur. The potential for damage is widespread. Hazards in this category may have already occurred in the past.

Medium: This ranking carries a moderate threat level to the general population. The potential of occurrence may be the same as the "high" ranking but the potential damage is more isolated and less costly than a more widespread disaster.

Low: The lowest ranking in the survey, the occurrence and potential cost of damage to life and property is minimal.

Jurisdiction(s) Affected: This indicates how widespread the hazard is within the County, and where the risk varies across the planning area. If the entire County is affected, a "County" designation is given.

Table 2-1: Risk Assessment for Each Jurisdiction

	Lusk	Manville	Van Tassell	Niobrara County
Dam Failure	Low	Low	Low	Low
Drought	High	High	High	High
Earthquake	Low	Low	Low	Low
Extreme Temperatures	Medium	Medium	Medium	Medium
Flooding	Low	Low	Low	Low
Hail	High	High	High	High
Landslides	Low	Low	Low	Low
Lightning	High	High	High	High
Hazardous Materials and Waste	Low	Low	Low	Low
Terrorism	Low	Low	Low	Low
Tornadoes	Medium	Medium	Medium	High
Wildland Fires	Medium	Medium	Medium	High
Wind and Wind Blown Deposits	Low	Low	Low	Low
Winter Storms and Blizzards	High	High	High	High

3. DAM FAILURES

Dams and reservoirs serve an important role for Wyoming residents and industry by providing additional water resources to farmers when natural precipitation is below normal levels, helping mitigate flooding dangers, and as a recreational resource. Occasionally, the dams fail, either completely or partially, and become a significant hazard downstream.

FEMA defines a dam as "An artificial barrier that has the ability to impound water, wastewater, or any liquid-borne material, for the purpose of storage or control of water."[1] FEMA further categorizes dams into 23 sub-categories of dam, dictated by either construction material or intent. A selected definition follows:

- Arch dam**.** A concrete, masonry, or timber dam with the alignment curved upstream so as to transmit the major part of the water load to the abutments.
- Buttress dam**.** A dam consisting of a watertight part supported at intervals on the downstream side by a series of buttresses. Buttress dams can take many forms, such as a flat slab or massive head buttress.
- Diversion dam**.** A dam built to divert water from a waterway or stream into a different watercourse.
- Earth dam. An embankment dam in which more than 50% of the total volume is formed of compacted earth layers are generally smaller than 3-inch size.
- Embankment dam. Any dam constructed of excavated natural materials, such as both earthfill and rockfill dams, or of industrial waste materials, such as a tailings dam.
- Gravity dam. A dam constructed of concrete and/or masonry, which relies on its weight and internal strength for stability.
- Hydraulic fill dam. An earth dam constructed of materials, often dredged, which are conveyed and placed by suspension in flowing water.
- Industrial waste dam. An embankment dam, usually built in stages, to create storage for the disposal of waste products from an industrial process. The waste products are conveyed as fine material suspended in water to the reservoir impounded by the embankment. The embankment may be built of conventional materials but sometimes incorporates suitable waste products.
- Masonry dam**.** Any dam constructed mainly of stone, brick, or concrete blocks pointed with mortar. A dam having only a masonry facing should not be referred to as a masonry dam.
- Regulating dam. A dam impounding a reservoir from which water is released to regulate the flow downstream.
- Rock-fill dam. An embankment dam in which more than 50% of the total volume is comprised of compacted or dumped cobbles, boulders, rock fragments, or quarried rock generally larger than 3-inch size.
- Saddle dam (or dike). A subsidiary dam of any type constructed across a saddle or low point on the perimeter of a reservoir.

[1] FEMA. Federal Guidelines for Dam Safety, "Glossary of Terms". Available online at http://www.fema.gov/media-library-data/20130726-1516-20490-9730/fema-148.pdf

A Dam Failure is defined as a "catastrophic type of failure characterized by the sudden, rapid, and uncontrolled release of impounded water or the likelihood of such an uncontrolled release. It is recognized that there are lesser degrees of failure and that any malfunction or abnormality outside the design assumptions and parameters that adversely affect a dam's primary function of impounding water is properly considered a failure. These lesser degrees of failure can progressively lead to or heighten the risk of a catastrophic failure. They are, however, normally amenable to corrective action."[2]

Dam failures are divided into four classifications: overtopping, foundation failure, structural failure, and other unforeseen failures. Overtopping of a dam is often a precursor of dam failure. National statistics show that overtopping due to inadequate spillway design, debris blockage of spillways, or settlement of the dam crest account for approximately 34% of all U.S. dam failures. Earthen dams and older dams are more susceptible to overtopping failure. Foundation defects, including deformation, settlement, and slope instability, cause about 30% of all dam failures. Another 20% of U.S. dam failures have been caused by piping (internal erosion caused by seepage). Seepage often occurs around hydraulic structures, such as pipes and spillways; through animal burrows; around roots of woody vegetation; and through cracks in dams, dam appurtenances, and dam foundations. Other causes of dam failures include structural failure of the materials used in dam construction, sabotage, earthquakes, and inadequate maintenance. (Source: http://www.damsafety.org)

In 1981, the U.S. Army Corps of Engineers completed an inspection program for Non-federal dams under the National Dam Inspection Act (P.L. 92-367). This was a four-year work effort and included compiling an inventory of about 50,000 dams and conducting a review of each State's capabilities, practices, and regulations regarding design, construction, operation, and maintenance of dams. Part of the inspection included evaluating the dams and assigning a hazard potential based on the downstream effects should one of the dams fail. The dams were rated (1) high, (2) significant, and (3) low hazard. The Corps of Engineers based the hazard potential designation on such items as acre-feet capacity of the dam, distance from nearest community downstream, population density of the community, and age of the dam. This classification is based on the consequences if a dam were to fail, not on the potential of failure, or the existing condition of the dam.

Dams assigned the low hazard potential classification are those where failure or mis-operation results in no probable loss of human life and low economic and/or environmental loss. Losses are principally limited to the owner's property. Dams assigned the significant hazard potential classification are those dams where failure or mis-operation results in no probable loss of human life but can cause economic loss, environmental damage, disruption of lifeline facilities, or can impact other concerns. Significant hazard potential classification dams are often located in predominantly rural or agricultural areas but could be located in areas with population and significant infrastructure. Dams assigned the high hazard potential classification are those where

[2] FEMA. Federal Guidelines for Dam Safety, "Glossary of Terms". Available online at http://www.fema.gov/media-library-data/20130726-1516-20490-9730/fema-148.pdf

failure or mis-operation will probably cause loss of human life. (http://www.fema.gov/media-library-data/20130726-1516-20490-7951/fema-333.pdf

Hazard Potential Classification	Loss of Human Life	Economic, Environmental, Lifeline Losses
Low	None expected	Low and generally limited to owner
Significant	None expected	Yes
High	Probable. One or more expected	Yes (but not necessary for this classification)

There were 1,458 dams in Wyoming that were reviewed by the Corps of Engineers. Of that total, 38 were rated high hazard, 56 were rated significant hazard, and the remaining 1,364 were rated low hazard.[3] There are currently 1,639 dams in Wyoming shown in the Corps of Engineers' National Inventory of Dams. (http://nid.usace.army.mil)

The Wyoming State Engineer's Office (WSEO) inspects dams over 20 feet high or with a storage capacity of 50 acre-feet or more, although smaller dams are also inspected in highly populated areas. As of 2012 there are 1,515 dams that are inspected by the State Engineer once every five years. Of those dams, 84 were rated high hazard, 106 were rated significant hazard, and 1,325 were rated low hazard. (http://www.damsafety.org/map/state.aspx?s=51)

There are 79 dams located in Niobrara County. They are all earthen dams, privately owned and primarily used for irrigation and stock/fish ponds. All are rated as low hazard according to the Corps of Engineers' National Inventory of Dams database. (http://nid.usace.army.mil/cm_apex/f?p=838:12) However, the Niobrara County Emergency Operations Plan rates the following dams as significant: Deuel Reservoir on Cow Creek, Fields Reservoir on Cottonwood Draw and Pfister No. 2 Reservoir on Oat Creek. Figure 3.1 shows the locations of dams located in Niobrara County.

History

There have been a number of dam failures in Wyoming, some of which have caused the loss of life and damage to property. Based on monthly Storm Data reports generated and released by the National Oceanic and Atmospheric Administration's National Climate Center, Niobrara County has not experienced a major dam failure. The Wyoming Multi-Hazard Mitigation Plan describes several dam failures. In August, 1955, a very heavy rain occurred in the County about 4 miles north of the old Whitman Post office. This caused some dams to break. One ranch lost 21 head of cattle in a local flood. Dam failures in adjacent Platte and Weston Counties both impacted Niobrara County. In July of 1969 a dambreak in Platte County resulted in a wall of water 50 feet high. Crops were damaged, livestock was killed and families were forced to evacuate. There was over $1 million worth of damage. In July of 1973, in Niobrara and Weston Counties, torrential rains accompanied by hail caused flash flooding in the area creeks and

[3] Wyoming Office of Homeland Security. Wyoming Multi-Hazard Mitigation Plan, "Chapter 4: Dam Failures". Available online at http://wyohomelandsecurity.state.wy.us/Library/mit_plan/4_Dam_Failure.pdf

rivers. Several earthen dams went out. Crop and property damage was estimated at $275,000. There is not sufficient information to detail what dams, streams, or specific areas in each County were affected.[4]

[4] Wyoming Office of Homeland Security. Wyoming Multi-Hazard Mitigation Plan, "Chapter 4: Dam Failures". Available online at http://wyohomelandsecurity.state.wy.us/Library/mit_plan/4_Dam_Failure.pdf

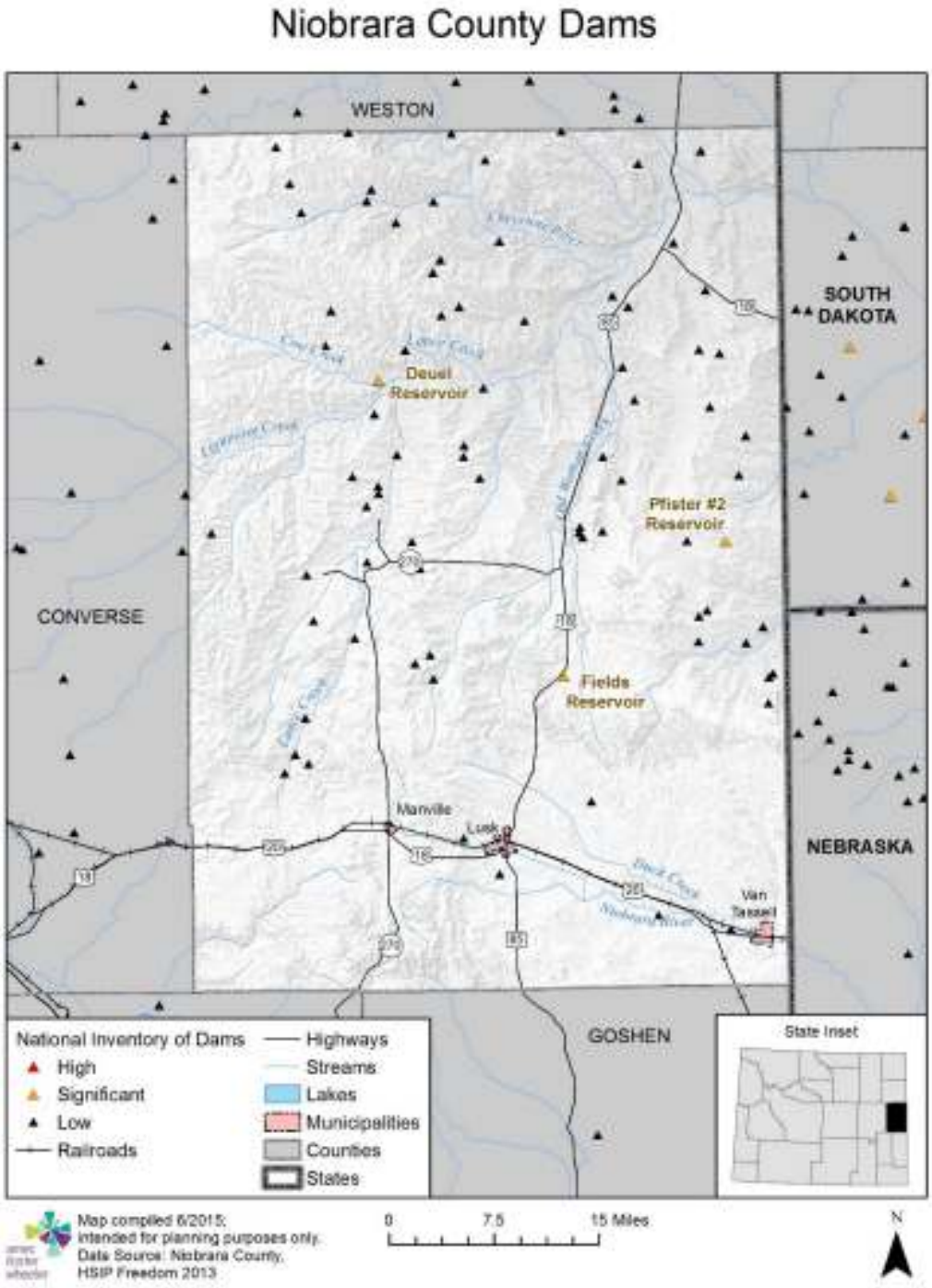


Figure 3-1: Dams in Niobrara County

Impacts

Estimates for the financial and property impacts of dam failures in Niobrara County are not available based on the data collected here. Based on the hazard rating of dams in Niobrara County, impacts for dam failures may be considered low.

Future Impacts

The probability of a dam failure for the County is low, as Niobrara's dams are all rated low hazard. In addition, the population density of Niobrara is sufficiently small that the failure of a low hazard dam in the County would result in minimal loss of life and structural property. Agricultural and grazing lands would be the most impacted. However, Niobrara is potentially impacted by dam failures in neighboring counties (particularly Platte and Weston Counties) which may result in overflow into rural Niobrara County. Since most of the streams and rivers in the County flow out of the County into larger water sources, where larger dams are located, there is minimal risk of upstream flooding due to dam failure. Other risks due to flooding are discussed in greater detail in Chapter 7 – Floods.

Summary

PROPERTY AFFECTED: Low

POPULATION AFFECTED: Low

PROBABILITY: Low

JURISDICTION AFFECTED: County

4. DROUGHT

Of all the natural weather-related disasters, drought is by far the most costly to our society. It indirectly kills more people and animals than the combined effects of hurricanes, floods, tornadoes, blizzards, and wildfires. And, unlike other disasters that quickly come and go, drought's long-term unrelenting destruction has been responsible in the past for mass migrations and lost civilizations. The 1980 and 1988 droughts in the U.S. resulted in approximately 17,500 heat-related deaths and an economic cost of over $100 billion. Drought occurs in four stages and is defined as a function of its magnitude (dryness), duration, and regional extent. Severity, the most commonly used term for measuring drought, is a combination of magnitude and duration.

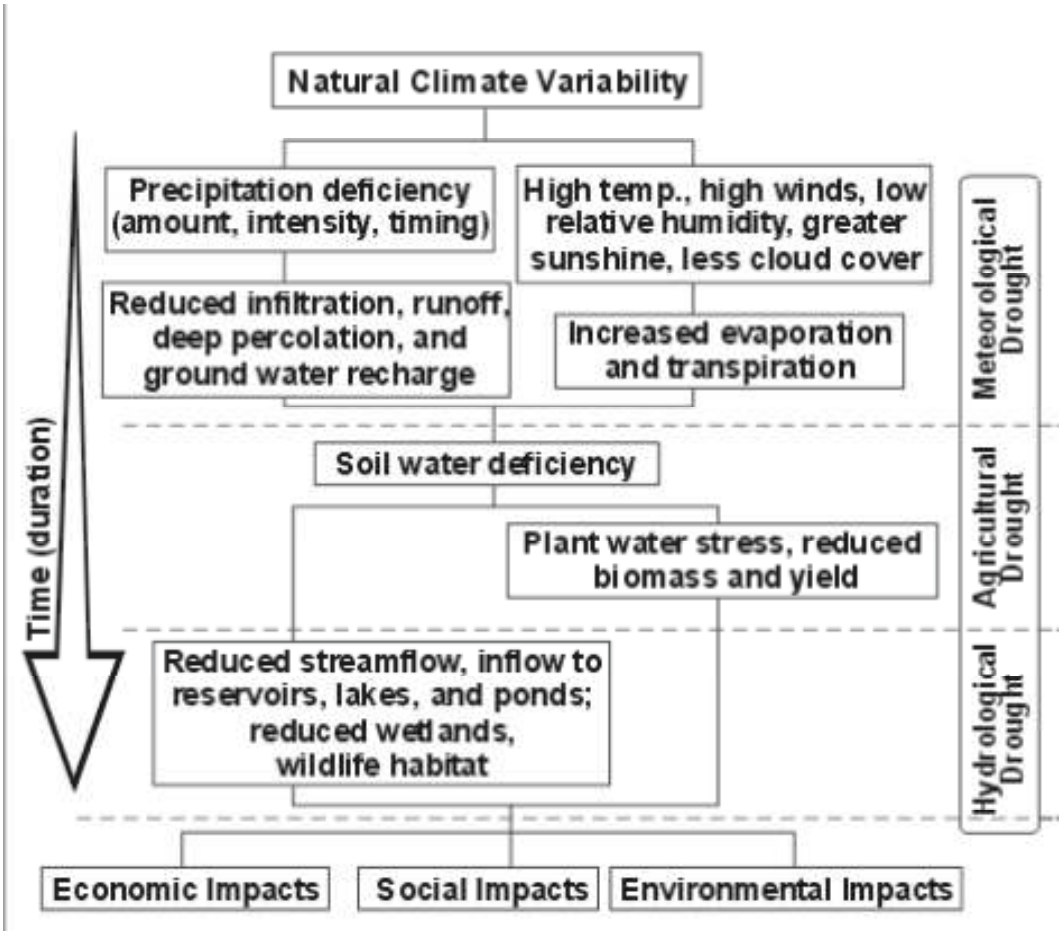


Figure 4-1: Drought Flow Chart

The first stage of drought is known as a meteorological drought which results from precipitation shortfalls over a period of time, typically at least three months or longer. In the mountain west much of the water supply comes from snowpack, so shortfalls in winter precipitation and low snowpack can be one of the first indicators of drought. The second stage is known as agricultural drought. Soil moisture is deficient to the point where plants are stressed and biomass (yield) is reduced. The third stage is the hydrological drought. Reduced stream flow (inflow) to reservoirs and lakes is the most obvious sign that a serious drought is in progress. The fourth stage is the socioeconomic drought. This final stage refers

to the situation that occurs when physical water shortage begins to affect people—such as the current drought in California.

As these stages evolve over time, the impacts to the economy, society, and environment converge into an emergency situation. Without reservoir water to irrigate farms, food supplies are in jeopardy. Without spring rains for the prairie grasslands, open range grazing is compromised. Without groundwater for municipalities, the hardships to communities result in increases in mental and physical stress as well as conflicts over the use of whatever limited water is available. Without water, wetlands disappear. The quality of any remaining water decreases due to its higher salinity concentration. There is also an increased risk of fires, and air quality degrades as a result of increased soil erosion in strong winds (blowing dust).

The U.S. Drought Monitor (USDM) provides a general summary of current drought conditions. The U.S. Department of Agriculture (USDA), the National Oceanic and Atmospheric Administration (NOAA), and the National Drought Mitigation Center (University of Nebraska-Lincoln) collaborate on this weekly product, which is released each Thursday. Multiple drought indicators, including various indices, outlooks, field reports, and news accounts are reviewed and synthesized. In addition, numerous experts from other agencies and offices across the country are consulted. The result is the consensus assessment presented on the USDM map. The image is color-coded for four levels of drought intensity. An additional category, "Abnormally Dry," is used to show areas that might be moving into a drought, as well as those that have recently come out of one. The dominant type of drought is also indicated (i.e. agricultural and/or hydrological). Source: http://droughtmonitor.unl.edu/

As of June 2, 2015, Niobrara County was considered within normal precipitation parameters, though western Wyoming is considered to be "abnormally dry," and severe southwest Wyoming is considered in a "moderate drought." Figure 4.2 shows the state drought map from the U.S. Drought Monitor.

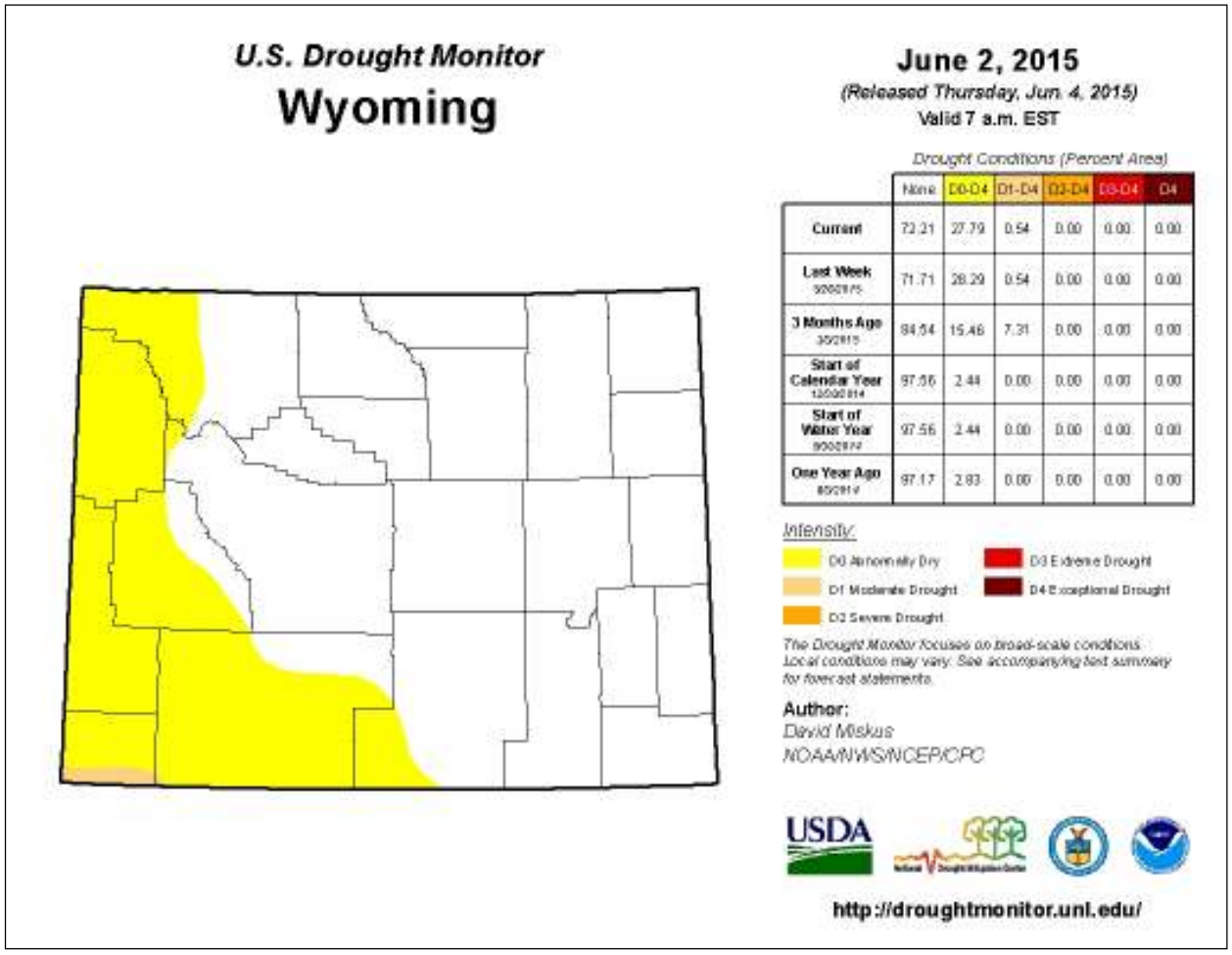


Figure 4-2: Wyoming Drought Map

History

Niobrara County's last multi-year drought was from 1999-2004, but 2012-2013 was also a relatively short but intense period of drought in Wyoming; as of June 2015, western and southwestern Wyoming is considered to be "abnormally dry," though the rest of the state has regained normal amounts of precipitation. The drought started in 1999 and began seriously impacting Wyoming residents in the spring of 2000, although some portions of the State indicate drought conditions began as early as 1995. It is considered by many to be the most severe drought in Wyoming in collective memory. Long-time residents indicated that streams also dried up in the 1930s and again in the 1950s. According to instrument records, since 1895 there have been only seven multi-year (three years or longer) statewide droughts. Based on deficit precipitation totals (negative departures from the long term average), they are ranked statewide. The data for the current drought is only available and compiled through 2006, so the numbers are higher than actually reflected, but further data is not yet available. Refer to Table 4.1 on the following page.

Table 4-1: Wyoming's Recent Worst Multi-Year, Statewide Droughts

Period	Drought Deficit (departure from annual precipitation)
1952-1956	94%
1999-2006	82%
1958-1964	77%
1900-1903	72%
1931-1936	61%
1987-1990	61%
1974-1977	41%

The most significant droughts in the last century, in terms of precipitation deficit, were from 1952-1956 and 1999-2004. Other notable periods include 1958-1964 and 1900-1903. Niobrara County–specific data from this dataset is unavailable. However, since drought is a regional phenomenon, it is reasonable to assume that Niobrara, geographically located on the dryer plains region, will experience drought conditions at the same time, or shortly after, statewide water data reflects a drought. Based on the statewide historical occurrences, then, drought is considered a likely hazard for Niobrara County.

Although Niobrara County-specific precipitation records for the past century are not available, precipitation records for the Cheyenne and Niobrara region are available from the Wyoming State Climate Office. Figure 4.1 displays the average, 5-year running average, and actual precipitation values for this region of Wyoming since 1895. The figure depicts regional periods of drought (more than three consecutive years) in the late 1890s, the late 1940s, and the early 2000s.

Instrumentation Record

As a whole, Wyoming's precipitation record from 1895-2012 reveals that, for the first half of the 20th century (except for the Dust Bowl years of the 1930s), there was generally a surplus of moisture. During the second half of the century there was an increasing trend of increased periods of drought (Figure 4.3).

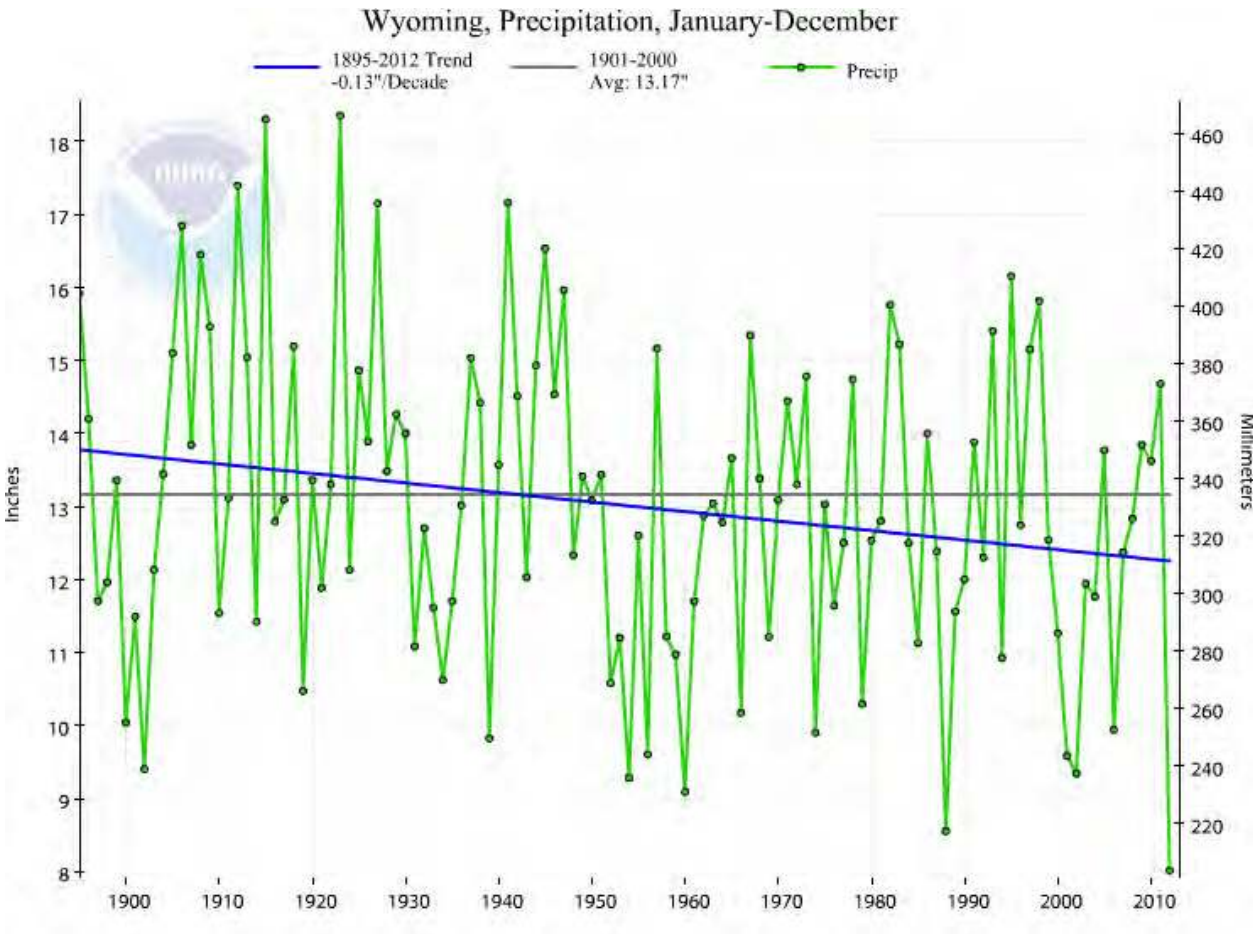


Figure 4-3: Wyoming Annual Precipitation (1895-2012)

Figure 4.4 illustrates the Wyoming weekly drought severity from 2000-22015. While there have been some above average years of precipitation from 2008 through 2011, below average rainfall returned in 2012 and 2013, resulting in the 5-year running average to fall. A U.S. Department of Agriculture (USDA) drought disaster declaration occurred in 2012 for most Wyoming counties, including Niobrara County. Niobrara County was also included in a USDA drought disaster declaration in 2013 as a primary county.

At the peak of the 2012 drought a little over 10% of Wyoming fell in the "D4 – Exceptional" drought category, and 100% of Wyoming experienced at least "D0 – Abnormally Dry" conditions. The U.S. Drought Monitor data are not aggregated by county, so it is not possible to repeat this analysis for Niobrara County specifically.

Figure 4.5 shows the regional precipitation data that includes Niobrara County.

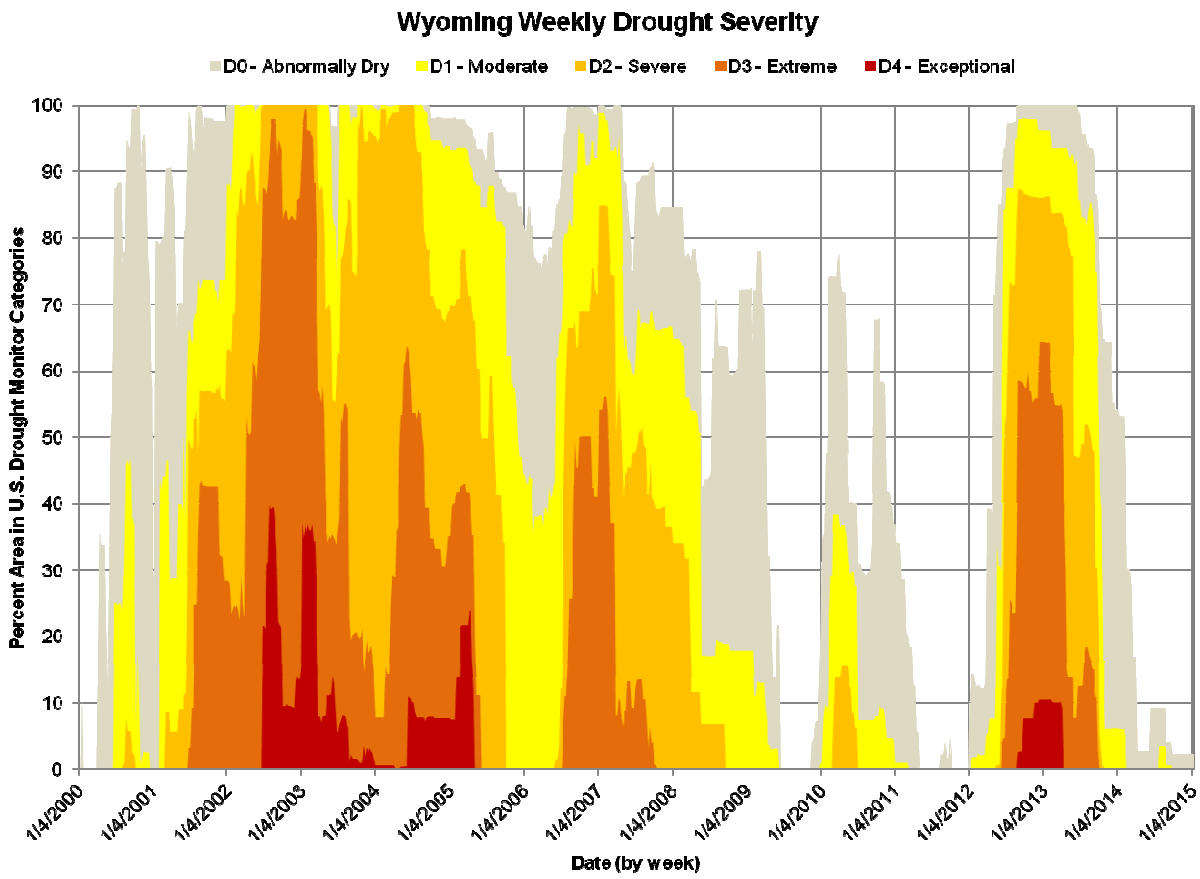


Figure 4-4: Wyoming Weekly Drought Severity (2000-2015)[1]

Source: United States Drought Monitor, http://droughtmonitor.unl.edu/MapsAndData/DataTables.aspx

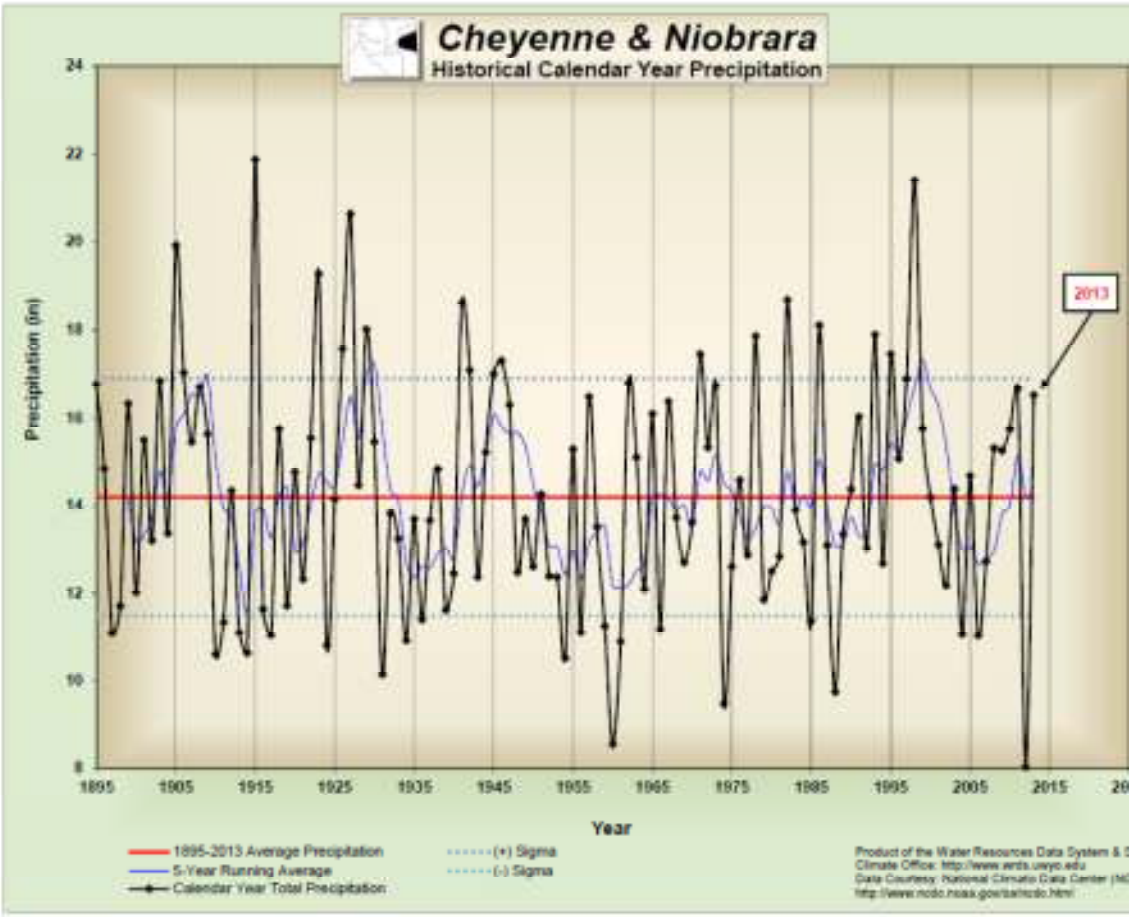


Figure 4-5: Cheyenne and Niobrara Region Total Calendar Year Precipitation (1895-2013)

Impacts

Based on Table 4.1 and Figure 4.1, the drought of 1999-2004 is as significant, if not more so, than any other drought in the last 100 years. Although water levels in Niobrara County did not drop to record lows during this time, they also declined steadily instead of being sandwiched between periods of above-average precipitation. For the purposes of profiling Niobrara County, the years from 2000 to 2006 are examined, instead of beginning in 1999. This is because, despite the statewide trend, the Niobrara region experienced significantly above-average precipitation during the 1999 calendar year. Also important to note is that, despite a spike in precipitation levels in 2005, the region continues to trend downwards on both the five-year average and total annual precipitation measurements. Likely, then, the effects of this drought will continue to ripple into the measurements and statistics for the next several years.

Table 4.2 depicts drought impacts to the Niobrara County agricultural community from 2000 to 2004. Wheat production fell 18% and the number of sheep and lambs in the County fell by nearly 50%. Corn for silage suffered the most serious losses, dropping more than 50%. However, oats, hay, and cattle all showed an increase in production despite the drought. This information was collected using the "National Agricultural Statistics Service" from the U.S. Department of Agriculture.

Table 4-2: Peak Commodity Production Changes from Pre-Drought (1994-1998) to Drought (2000-2004) for Niobrara County

Commodity	5-Year Pre-Drought Production Average (1994-1998)	5-Year Drought Production Averages (2000-2004)	Lowest Production During Drought (2000-2004)	Year of Lowest Production	Percent Change from 5-Year Periods
Winter Wheat (bushels)	154,075	125,400	73,500	2002	- 18.6%
Spring Wheat (bushels)	50,125	*	*	*	*
Corn for Silage (tons)	2,800	1,300	1,300	2004	- 53.6%
Corn for Grain (bushels)	*	39,100	21,200	2004	*
Barley (bushels)	15,434	*	*	*	*
Oats (bushels)	69,560	77,425	37,700	2002	+ 11.3 %
All hay (tons)	51,580	53,880	45,500	2002	+ 4.6 %
Sheep & Lambs (head)	16,000	9.320	6,600	2004	- 41.75 %
All Cattle (head)	60,200	64,800	60,000	2004	+ 7.6%

*There is no recorded data for these crops during the specified timeline. The Corn for Silage decreases is in spite of a 50-acre increase in overall planting.

Future Potential Impacts

The 1999-2004 drought is one of historic record. During this time, Niobrara County saw a serious decrease in winter wheat and corn crop yields and in the number of breeding sheep and lambs. Though other significant agricultural sectors posted increases, the gains are minimal and may be attributed to inflation rather than yield. Figure 4.2 demonstrates that, while spikes of production are present, overall the County experienced a decline in production values for the significant crops and livestock categories identified in Table 4.2. Figure 4.2 also illustrates the data gaps, helping to balance out the impact the gaps create in statistical calculations.

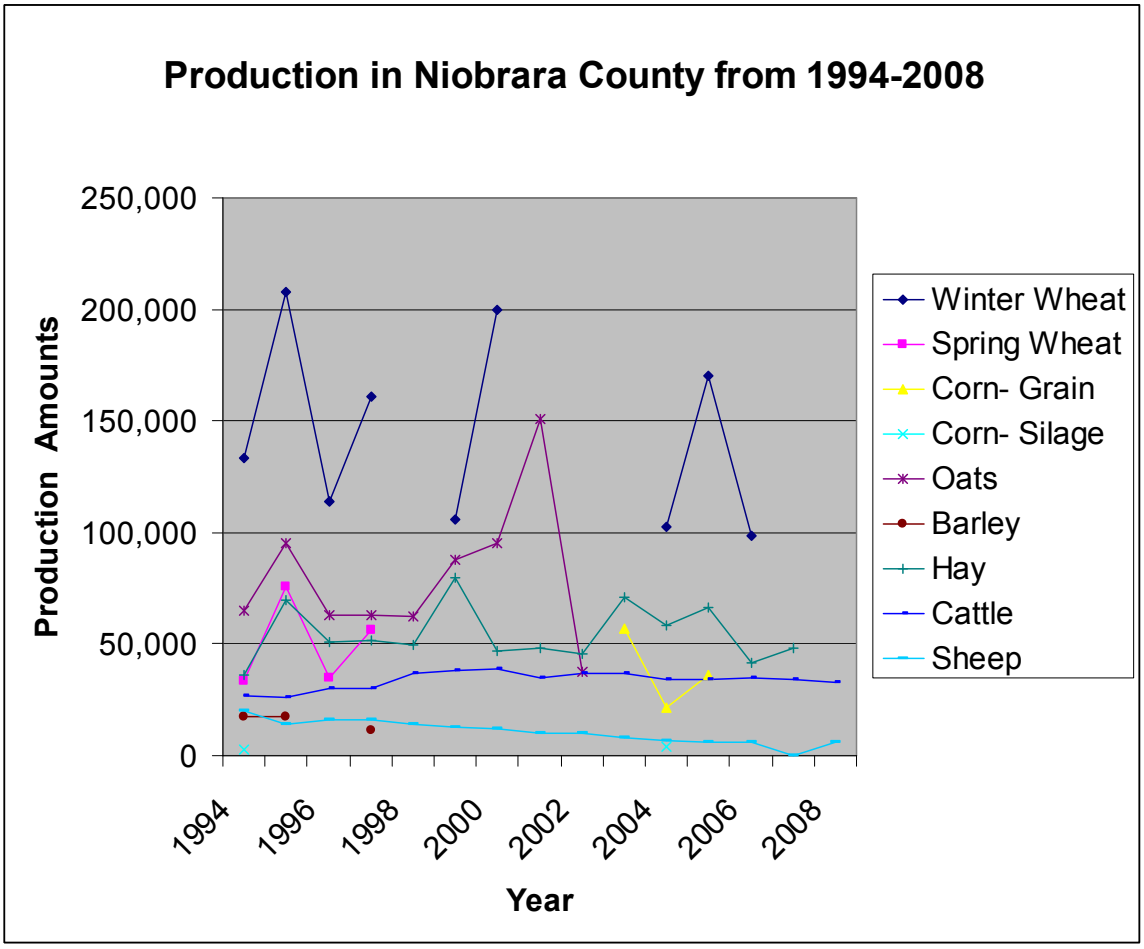


Figure 4-6: Change in Production Amounts in Niobrara County from 1994-2007

Because the agricultural production for Niobrara County is sporadic for all crops except hay, it is difficult to create an accurate financial impact prediction. Therefore, Table 4.3 looks at the statewide production of crops and livestock for the same categories as identified in Table 4.2, and summarizes the five-year averages for the years prior to the drought (1994-1998) and the five-year averages during the drought (2000-2004). Then, using the corresponding average value of each commodity over the period (as identified by the U.S. Department of Agriculture), a rough dollar cost is created. These dollar amounts help predict quantifiable losses when establishing potential future costs for the hazard.

Drought has minimal potential to affect existing and future structures, unless the damage is caused by secondary hazards such as wildfire.

Table 4-3: Financial Impacts of Drought for Wyoming, Comparing 1994-1998 and 2000-2004

Commodity	5-Year Pre-Drought Production Average (1994-1998)	Units	5-Year Drought Production Average (2000-2004)	Average Value Before Drought	Average Value After Drought	Change in Value between Periods (in thousands USD)
Winter Wheat	6,029	1,000 bu.	3,352	$ 3.55	$ 3.14	-$10,878
Spring Wheat	648	1,000 bu.	183	$ 3.53	$ 3.18	-$1,706
Barley	8,383	1,000 bu.	6,712	$ 3.05	$ 3.30	-$3,419
Oats	1,648	1,000 bu.	1,096	$ 1.79	$ 1.75	-$1,032
Corn (silage)	589	1,000 tons	733	*	*	*
Corn (grain)	6,328	1,000 bu.	6,239	$ 2.75	$ 2.38	-$2,553
Other Hay	2,399	1,000 tons	2,007	$ 78.70	$ 91.20	-$5,763
Cattle/Calves Inventory	1,660	1,000 head	1,464	*	*	*
Sheep/Lambs	708	1,000 head	494	*	*	*
Wool	6,159	Pounds	3,910	$ 0.93	$ 0.80	-$2,600
TOTAL						-$27,950

* Data not available

Production consistently devalues from the pre-drought to drought period. Averaged out, the 1999-2004 drought, from the years of 2000 to 2004, cost the State of Wyoming $27.9 million. Niobrara County is 2.7% of the State of Wyoming in land area. Assuming equal distribution of drought-driven economic loss, the potential drought impact in Niobrara County for this period was approximately $800,000. This does not include estimated losses for cattle and sheep/lambs that are not for wool production, as those numbers are not currently available. This equates to $912,200 in 2008.

Other data, derived from the local FSA office, indicates that payments for drought damages associated with stock, crop, and water facilities between the years of 1995 and 2006 totaled more than $2,979,687. The worst year, in 2002, totaled at$1,904,849. These payments were made to a range of 6 to 120 producers, depending on the year.

Summary

PROPERTY AFFECTED: High

POPULATION AFFECTED: High

PROBABILITY: High

JURISDICTION AFFECTED: County

5. EARTHQUAKES

An earthquake is generally defined as a sudden motion or trembling in the Earth caused by the abrupt release of slowly accumulated strain. The most common types of earthquakes are caused by movements along faults and by volcanic forces, although they can also result from explosions, cavern collapse, and other minor causes not related to slowly accumulated strains. Historically, earthquakes have occurred in every County in Wyoming (Figure 5.1).

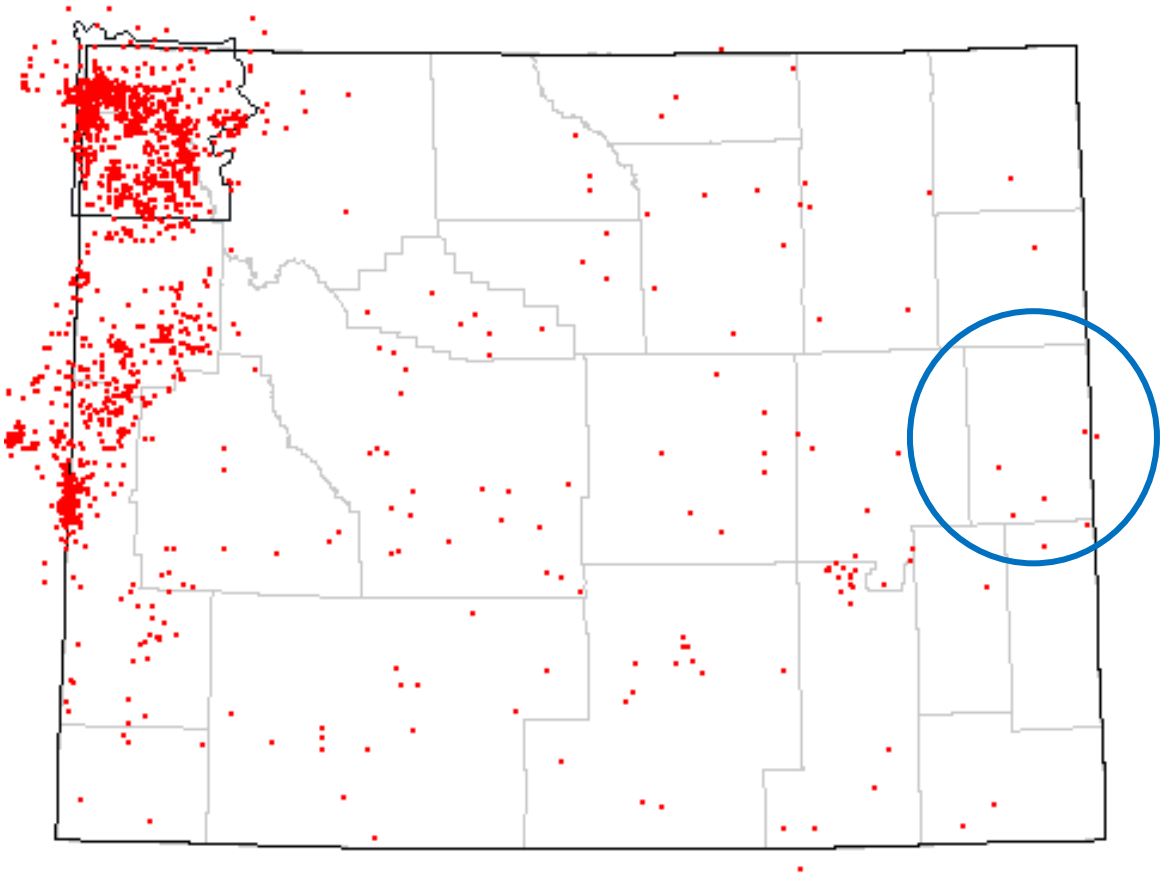


Figure 5-1: Historical Earthquakes in Wyoming, 1871-2014
(Niobrara County circled in blue)

Source: http://www.wrds.uwyo.edu/wrds/wsgs/hazards/quakes/quake.html

History

Seven 3.0 and greater earthquakes have been recorded in Niobrara County. Those earthquakes, one from a neighboring county, and one from western Nebraska are discussed below.

The earliest recorded earthquake in Niobrara County occurred on October 8, 1889. The event was felt in Lusk, Manville, and Muskrat Canyon and traveled in a northeasterly direction (Case, 1993).

Two earthquakes occurred in the Lusk area in the mid-1900s. On February 25, 1942, an intensity V earthquake, with an epicenter approximately 18 miles south of Lusk, caused no damage

(Casper Tribune-Herald, February 27, 1942). On October 3, 1954, an intensity IV earthquake was reported near Guernsey, approximately 38 miles south-southwest of Lusk. Although the event was felt from Douglas to Wheatland, no damage was reported. Train traffic between Douglas and Wheatland was temporarily halted until it was determined that the tracks had not been damaged (Laramie Republican-Boomerang, October 4, 1954).

In the 1960s, there were two earthquakes in the Lusk area. On March 28, 1964, there was an intensity V earthquake with an epicenter approximately 21 miles southeast of Lusk. No significant damage was reported (Casper Star-Tribune, March 29, 1964). On August 22, 1964, there was a magnitude 4.5, intensity V earthquake recorded with an epicenter approximately 17 miles northwest of Lusk. Much of the town was attending a concert in the town's new high school building. When the attendees felt the tremor, they thought that the furnace had blown up (Wyoming State Tribune, August 23, 1964). Fortunately, no significant damage was reported.

In the 1990s, there were a few earthquakes in the Lusk area. On November 1, 1992, a magnitude 3.0, intensity V earthquake occurred just a few miles southeast of Lusk. Although the earthquake was felt throughout Lusk, little damage was reported (Casper Star-Tribune, November 4, 1992). In 1996, there were two earthquakes in the Lusk area. The first occurred on April 8, 1996. It was a magnitude 3.7, intensity III event, and was located approximately 26 miles northeast of Lusk. Although the earthquake was felt in Lusk, no damage was reported. Another earthquake occurred on May 3, 1996. This earthquake, which was located in southwestern corner of South Dakota, had a magnitude of 3.1. No damage was reported.

Three events were reported in the 2000s, though none of the earthquakes caused damaged. A magnitude 3.1 earthquake was reported 19 miles outside of Lance Creek on August 22, 2008. County commissioners reported that an earthquake was felt in December of 2008 in Lusk and much of the County, but no damages were reported. Most recently, a magnitude 2.9 earthquake occurred 13 miles away from Van Tassell on March 10, 2011.

Deterministic Analysis of Regional Active Faults with a Surficial Expression

There are no known exposed active faults with a surficial expression in Niobrara County. As a result, no fault-specific analysis can be generated for Niobrara County. There are faults that have been recurrently active over the last 20 million years, but none have yet shown to be active in the last 2 million years in Niobrara County.

Floating or Random Earthquake Sources

Many federal regulations require an analysis of the earthquake potential in areas where active faults are not exposed, and where earthquakes are tied to buried faults with no surface expression. Regions with a uniform potential for the occurrence of such earthquakes are called tectonic provinces. Within a tectonic province, earthquakes associated with buried faults are assumed to occur randomly, and as a result can theoretically occur anywhere within that area of uniform earthquake potential. In reality, that random distribution may not be the case, as all earthquakes are associated with specific faults. If all buried faults have not been identified, however, the distribution has to be considered random. "Floating earthquakes" are earthquakes that are considered to occur randomly in a tectonic province.

It is difficult to accurately define tectonic provinces when there is a limited historic earthquake record. When there are no nearby seismic stations that can detect small-magnitude earthquakes, which occur more frequently than larger events, the problem is compounded.

Under these conditions, it is common to delineate larger, rather than smaller, tectonic provinces.

The U.S. Geological Survey identified tectonic provinces in a report titled "Probabilistic Estimates of Maximum Acceleration and Velocity in Rock in the Contiguous United States" (Algermissen and others, 1982). In that report, Niobrara County was classified as being in a tectonic province with a "floating earthquake" maximum magnitude of 6.1. Geomatrix (1988b) suggested using a more extensive regional tectonic province, called the "Wyoming Foreland Structural Province", which is approximately defined by the Idaho-Wyoming Thrust Belt on the west, 104° West longitude on the east, 40° North latitude on the south, and 45° North latitude on the north. Geomatrix (1988b) estimated that the largest "floating" earthquake in the "Wyoming Foreland Structural Province" would have a magnitude in the 6.0 – 6.5 range, with an average value of magnitude 6.25.

Federal or State regulations usually specify if a "floating earthquake" or tectonic province analysis is required for a facility. Usually, those regulations also specify at what distance a floating earthquake is to be placed from a facility. For example, for uranium mill tailings sites, the Nuclear Regulatory Commission requires that a floating earthquake be placed 15 kilometers from the site. That earthquake is then used to determine what horizontal accelerations may occur at the site. A magnitude 6.25 "floating" earthquake, placed 15 kilometers from any structure in Niobrara County, would generate horizontal accelerations of approximately 15%g at the site. That acceleration would be adequate for designing a uranium mill tailings site, but may be too large for less critical sites, such as a landfill. Critical facilities, such as dams, usually require a more detailed probabilistic analysis of random earthquakes. Based upon probabilistic analyses of random earthquakes in an area distant from exposed active faults (Geomatrix, 1988b), however, placing a magnitude 6.25 earthquake at 15 kilometers from a site will provide a fairly conservative estimate of design ground accelerations.

Probabilistic Seismic Hazard Analyses

The U.S. Geological Survey (USGS) publishes probabilistic acceleration maps for 500-, 1000-, and 2,500-year time frames. The maps show what accelerations may be met or exceeded in those time frames by expressing the probability that the accelerations will be met or exceeded in a shorter time frame. For example, a 10% probability that acceleration may be met or exceeded in 50 years is roughly equivalent to a 100% probability of exceedance in 500 years.

The USGS has recently generated a new probabilistic acceleration map for the United States (Petersen et al., 2014), but updated state-level maps are not available. A copy of the 2% probability of exceedence in 50 years map of PGA for the U.S. is shown in Figure 5.4. Until recently, the 500-year map was often used for planning purposes for average structures, and was the basis of the most current Uniform Building Code. The new International Building Code, however, uses a 2,500-year map as the basis for building design. The maps reflect current perceptions on seismicity in Wyoming. In many areas of Wyoming, ground accelerations shown on the USGS maps can be increased due to local soil conditions. For example, if fairly soft, saturated sediments are present at the surface, and seismic waves are passed through them, surface ground accelerations will usually be greater than would be experienced if only bedrock was present. In this case, the ground accelerations shown on the USGS maps would underestimate the local hazard, as they are based upon accelerations that would be expected if firm soil or rock were present at the surface. Intensity values can be found in Table 5.1.

Based on Figure 5.4, there is a 2% probability of exceedance in 50 years of PGA ranging from 0.1g to 0.14g in Niobrara County. Based upon the 500-year map (10% probability of exceedance in 50 years) (Figure 5.5), the estimated peak horizontal acceleration in Niobrara County ranges from 3%g in the eastern portion of the County to approximately 4%g in the western portion of the County. These accelerations are roughly comparable to intensity IV earthquakes (1.4%g - 3.9%g) to intensity V earthquakes (3.9%g - 9.2%g). These accelerations are comparable to the low end of accelerations to be expected in Seismic Zone 1 of the Uniform Building Code. Intensity IV earthquakes cause little damage. Intensity V earthquakes may result in cracked plaster and broken dishes. Lusk would be subjected to an acceleration of approximately 3%g or intensity IV.

Based upon the 1000-year map (5% probability of exceedance in 50 years) (Figure 5.6), the estimated peak horizontal acceleration in Niobrara County ranges from 5%g in the eastern part of the County to 8%g in the southwestern corner of the County. Those accelerations are roughly comparable to intensity V earthquakes (3.9%g - 9.2%g). Intensity V earthquakes can result in cracked plaster and broken dishes. Lusk would be subjected to an acceleration of approximately 6%g or intensity V.

Based upon the 2500-year map (2% probability of exceedance in 50 years) (Figure 5.7), the estimated peak horizontal acceleration in Niobrara County ranges from 9%g in the eastern half of the County to approximately 16%g in the southwestern corner of the County. Those accelerations are roughly comparable to intensity VI earthquakes (9.2%g – 18.0%g). Intensity VI earthquakes can result in fallen plaster and damaged chimneys. Lusk would be subjected to an acceleration of approximately 11%g or intensity VI.

As the historic record is limited, it is nearly impossible to determine when a 2,500-year event last occurred in the County. Because of the uncertainty involved, and based upon the fact that the new International Building Code utilizes 2,500-year events for building design, it is suggested that the 2,500-year probabilistic maps be used for Niobrara County analyses. This conservative approach is in the interest of public safety.

Table 5-1: Modified Mercalli Intensity and Peak Ground Acceleration

Modified Mercalli Intensity	Acceleration (%g) (PGA)	Perceived Shaking	Potential Damage
I	<0.17	Not felt	None
II	0.17 – 1.4	Weak	None
III	0.17 – 1.4	Weak	None
IV	1.4 – 3.9	Light	None
V	3.9 – 9.2	Moderate	Very Light
VI	9.2 – 18	Strong	Light
VII	18 – 34	Very Strong	Moderate
VIII	34 – 65	Severe	Moderate to Heavy
IX	65 – 124	Violent	Heavy
X	>124	Extreme	Very Heavy
XI	>124	Extreme	Very Heavy
XII	>124	Extreme	Very Heavy

Source: Wald, et al., 1999

Abridged Modified Mercalli Intensity Scale

Intensity value and description:

I Not felt except by a very few under especially favorable circumstances.

II Felt only by a few persons at rest, especially on upper floors of buildings. Delicately suspended objects may swing.

III Felt quite noticeably indoors, especially on upper floors of buildings, but many people do not recognize it as an earthquake. Standing automobiles may rock slightly. Vibration like passing of truck. Duration estimated.

IV During the day felt indoors by many, outdoors by few. At night some awakened. Dishes, windows, doors disturbed; walls make creaking sound. Sensation like heavy truck striking building. Standing automobiles rocked noticeably.

V Felt by nearly everyone, many awakened. Some dishes, windows, and so on broken; cracked plaster in a few places; unstable objects overturned. Disturbances of trees, poles, and other tall objects sometimes noticed. Pendulum clocks may stop.

VI Felt by all, many frightened and run outdoors. Some heavy furniture moved; a few instances of fallen plaster and damaged chimneys. Damage slight.

VII Everybody runs outdoors. Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable in poorly built or badly designed structures; some chimneys broken. Noticed by persons driving cars.

VIII Damage slight in specially designed structures; considerable in ordinary substantial buildings with partial collapse; great in poorly built structures. Panel walls thrown out of frame structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned. Sand and mud ejected in small amounts. Changes in well water. Persons driving cars disturbed.

IX Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb; great in substantial buildings, with partial collapse. Buildings shifted off foundations. Ground cracked conspicuously. Underground pipes broken.

X Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations; ground badly cracked. Rails bent. Landslides considerable from river banks and steep slopes. Shifted sand and mud. Water splashed, slopped over banks.

XI Few, if any, (masonry) structures remain standing. Bridges destroyed. Broad fissures in ground. Underground pipelines completely out of service. Earth slumps and land slips in soft ground. Rails bent greatly.

XII Damage total. Waves seen on ground surface. Lines of sight and level distorted. Objects thrown into the air.

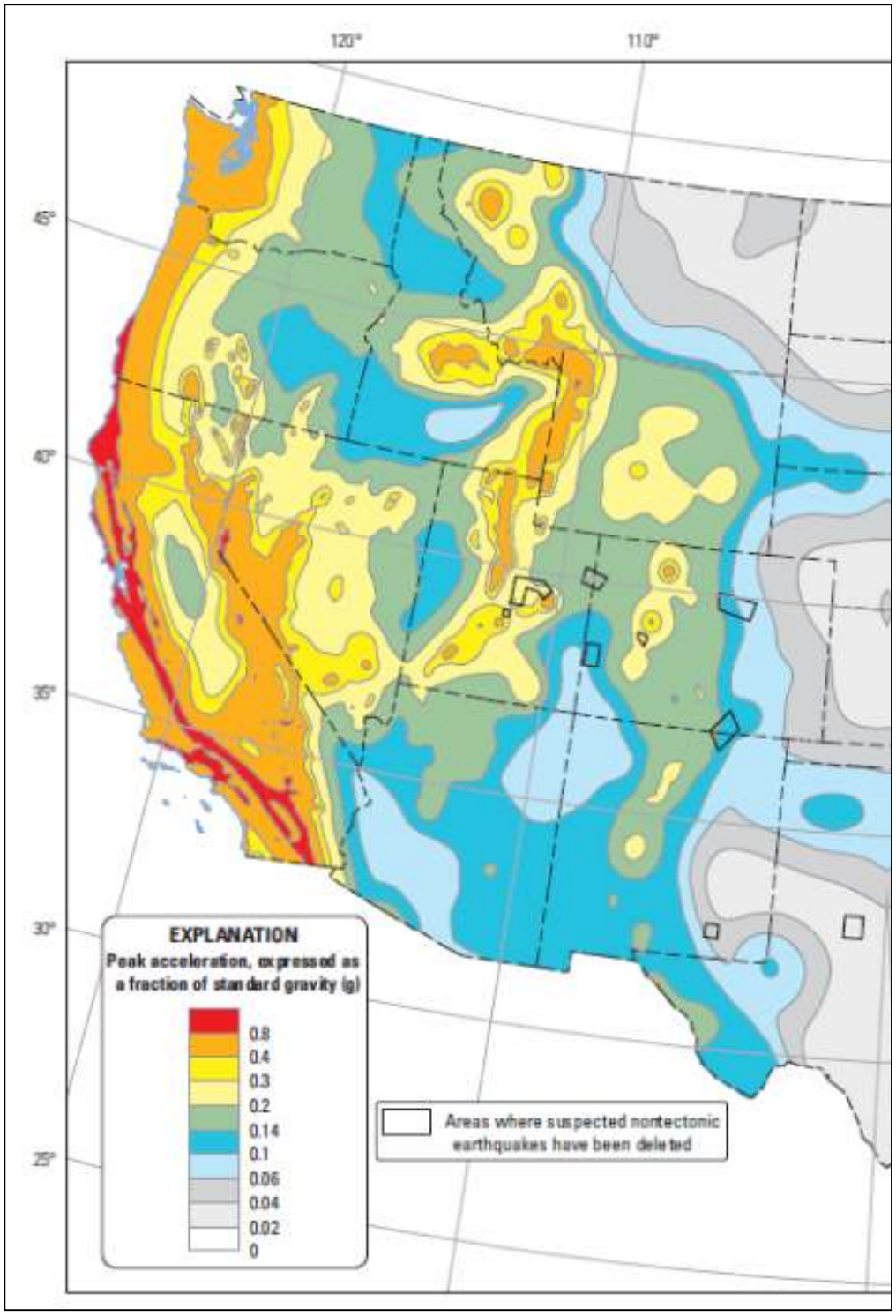


Figure 5-2: Two percent probability of exceedance in 50 years map of peak ground acceleration, Western United States

(Niobrara County area circled in black)

Source: Petersen et al., 2014

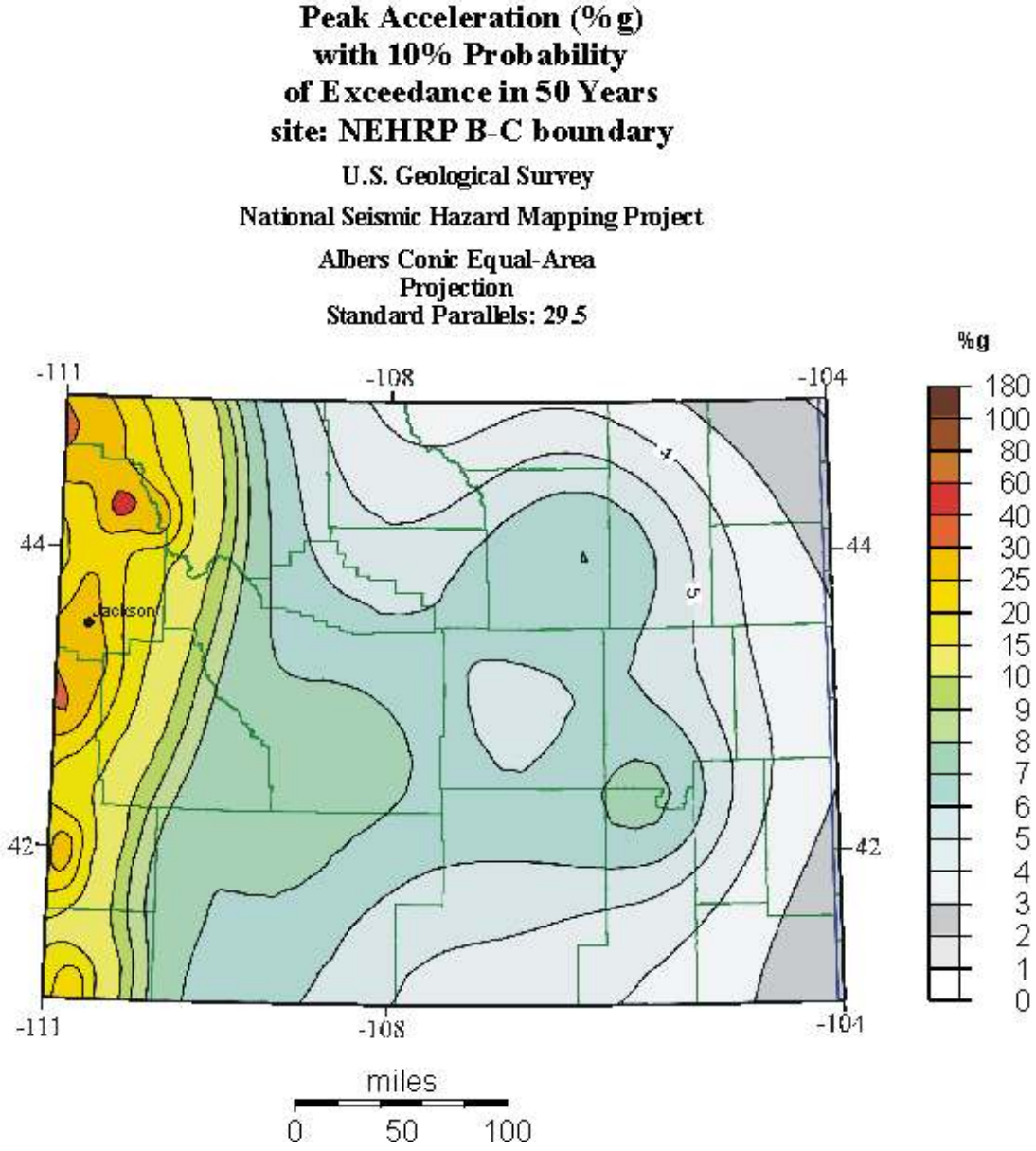


Figure 5-3: 500-year probabilistic acceleration map (10% probability of exceedance in 50 years).

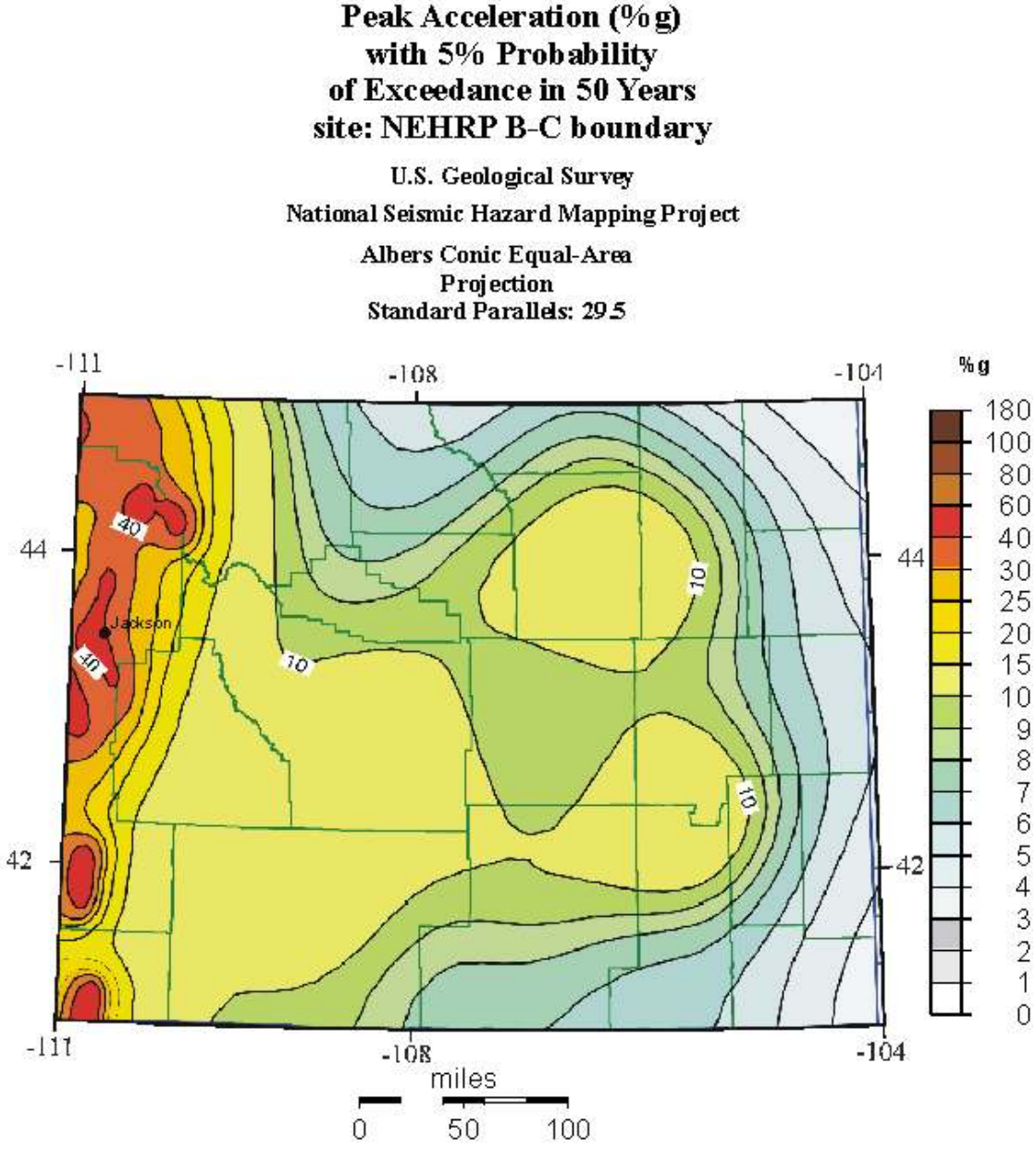


Figure 5-4: 1,000-year probabilistic acceleration map (5% probability of exceedance in 50 years).

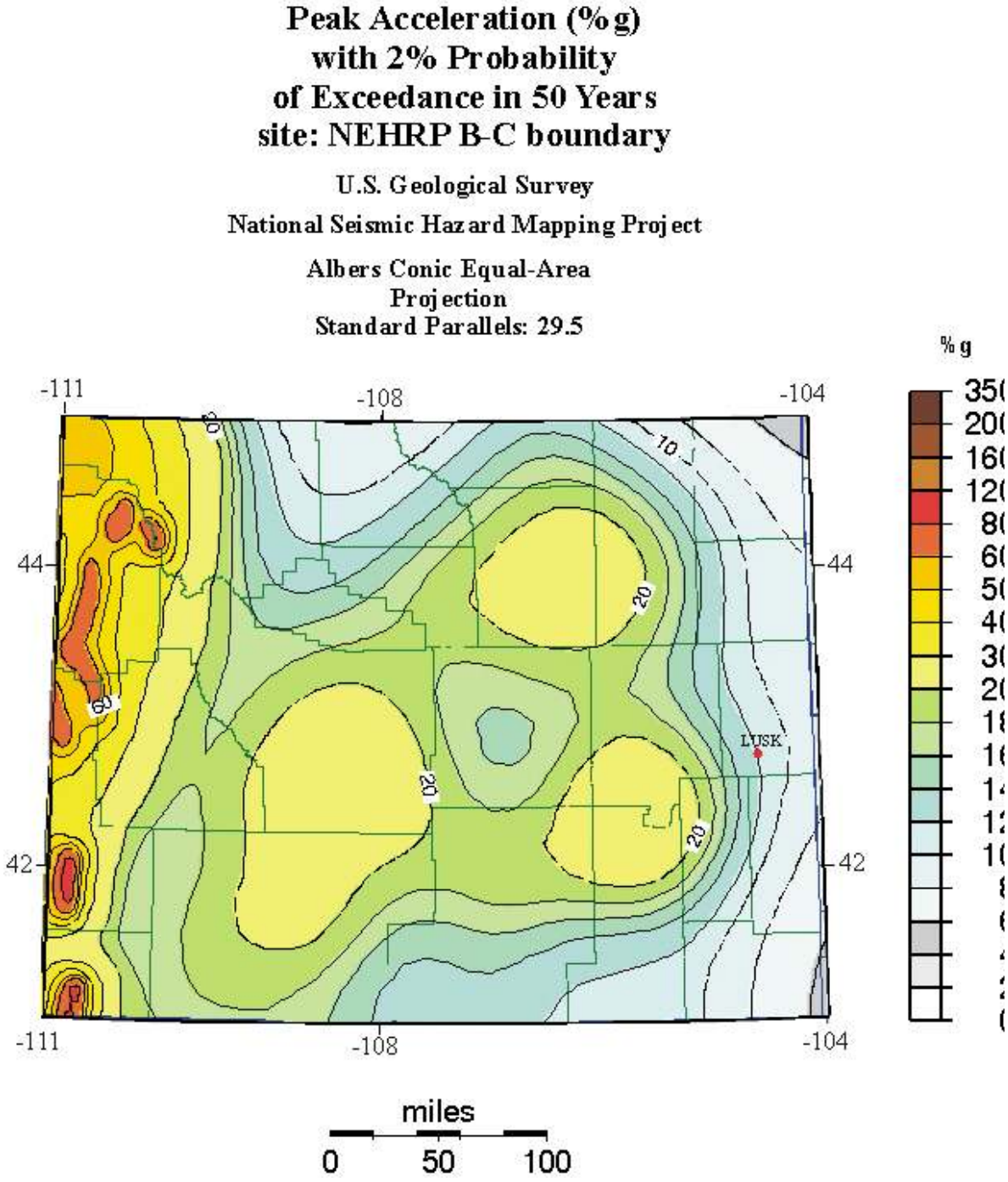


Figure 5-5: 2500-year probabilistic acceleration map

(2% probability of exceedance in 50 years).

Impacts

Seven historic earthquakes with magnitudes greater than 3.0 were recorded in or near Niobrara County. Because of the limited historic record, it is possible to underestimate the seismic hazard in Niobrara County if historic earthquakes are used as the sole basis for analysis. Earthquake and ground motion probability maps give a more reasonable estimate of damage potential in areas without exposed active faults at the surface, such as Niobrara County.

Current earthquake probability maps that are used in the newest building codes suggest a scenario that would result in moderate damage to buildings and their contents, with damage increasing from the northeast to the southwest. More specifically, the probability-based worst-case scenario could result in the following damage at points throughout the County:

Intensity VI Earthquake Areas

Lance Creek

Lusk

Node

Van Tassell

Mule Creek

Redbird

Manville

Keeline

In intensity VI earthquakes, some heavy furniture can be moved. There may be some instances of fallen plaster and damaged chimneys.

Potential Future Impacts

In 2011, the Wyoming State Geological Survey (WSGS) conducted an earthquake study involving 16 scenarios around the State using HAZUS. Twelve HAZUS scenarios were based on fault systems across Wyoming suspected of having potential to produce earthquakes. The remaining four studies were based on historic earthquake events, including the 1882 Estes Park earthquake. The authors of the study point out that the odds of an earthquake occurring in the exact same location are very low. However, areas that have experienced seismicity in the past are identified as a potential source of future earthquakes.

Of the 16 studies, only the historic Laramie Peak scenario impacted Niobrara County. The Laramie Peak Historic Earthquake scenario had a magnitude of 6.0 with an epicenter in northern Albany County. The study estimated that the southwestern corner of Niobrara County could experience Intensity V shaking, but no damages to buildings or infrastructure would occur.

Other HAZUS Studies

HAZUS (Hazards U.S.) is a nationally standardized, GIS-based, risk assessment and loss estimation computer program that was originally designed in 1997 to provide the user with an estimate of the type, extent, and cost of damages and losses that may occur during and

following an earthquake. It was developed for the FEMA by the National Institute of Building Sciences (NIBS). There have been a number of versions of HAZUS generated by FEMA, with HAZUS-MH (HAZUS – Multi-Hazard) being the most recent release. HAZUS-MH incorporates a flood and wind module with the previously existing earthquake module. Hazus-99 (1999 version) was previously used by the Wyoming State Geological Survey (WSGS).

HAZUS was originally designed to generate damage assessments and associated ground motions based largely upon analysis at the census-tract level. Census tracts average 4,000 inhabitants, with the tract boundaries usually representing visible features. HAZUS-99 calculated a ground motion value for the centroid of a census tract, and applied that value to the entire tract. The calculations are based on United States Geological Survey National Seismic Hazard Maps. In many of the western states, census tracts are very large, and parts of the tracts may be subjected to ground shaking that is considerably different than the value at the centroid. FEMA Region VIII and their subcontractor on HAZUS, PBS&J from Atlanta, have worked closely with the Wyoming State Geological Survey (WSGS) to develop a census-block-based analysis for HAZUS-MH in Wyoming. In fact, Wyoming is the national pilot project for the census-block-based analysis. The block-level analysis is a significant improvement. Census blocks are a subdivision of census tracts. Many blocks correspond to individual city blocks bounded by streets, but blocks – especially in rural areas – may include many square miles and may have some boundaries that are not streets. Ground motion values for Wyoming are now calculated at the centroid of census blocks.

As part of the development of the 2014 State of Wyoming Multi-Hazard Mitigation Plan a HAZUS probabilistic scenario was run for every Wyoming county. The scenario used a 2,500-year return period, and uses the USGS ground shaking data represented in figure 5.4. The probability of such an event is 2% in 50 years. Niobrara County used a driving Magnitude of 6.5 associated with the scenario. The results are presented in Tables 5.2 through 5.4

There are two methods to rank the counties to determine where earthquake impacts may be the greatest. Either the loss ratios (Table 5.3) or total damage (Table 5.4) figures can be used. The loss ratio is determined by dividing the sum of the structural and non-structural damage by the total building value for the County. The loss ratio is a better measure of impact for a County as it gives an indication of the percent of damage to buildings. The total damage figure by itself does not reflect the percentage of building damage. If a County has a number of valuable buildings, small damage to valuable buildings may result in a higher total damage figure than may be found in a County with fewer, less expensive buildings, that experience a higher percentage of damage.

Table 5.2 Losses in Thousands of Dollars by Wyoming County										
County	**Capital Stock Losses (Thousands of Dollars)**				**Loss Ratio (%)**	**Income Losses (Thousands of Dollars)**				**Total Loss (Thousands of Dollars)**
	Structural	Non-structural	Contents	Inventory		Relocation	Capital-Related	Wages	Rental	Loss
Albany	9,714	36,865	13,946	151	2.32	276	2,717	3,198	4,210	71,078
Big Horn	3,470	12,203	4,647	65	2.43	84	533	694	963	22,660
Campbell	5,116	20,093	9,419	282	1.37	144	1,484	2,013	1,592	40,144
Carbon	7,140	26,320	10,480	170	3.08	190	2,120	2,700	1,810	50,920
Converse	6,054	24,172	9,787	185	4.15	152	984	1,303	1,845	44,482
Crook	836	2,640	896	17	1.04	21	107	139	211	4,867
Fremont	14,890	61,030	24,640	460	3.75	380	2,920	3,940	3,190	111,450
Goshen	2,168	6,982	2,543	69	1.13	57	392	528	623	13,364
Hot Springs	3,038	10,871	4,176	52	4.20	82	799	1,149	969	21,136
Johnson	3,293	13,062	5,514	94	3.40	86	557	648	1,066	24,320
Laramie	13,605	47,839	17,577	233	1.25	406	3,926	4,402	4,976	92,963
Lincoln	65,670	225,594	64,429	2,538	31.08	1,211	8,579	10,359	15,347	391,727
Natrona	36,764	137,379	57,269	1,149	3.99	981	9,890	13,033	12,245	268,911

Niobrara	423	1,585	617	12	1.20	12	72	83	132	2,935
Park	11,430	42,694	15,289	429	2.98	285	5,173	6,217	4,487	86,004
Platte	1,875	6,894	2,697	36	1.60	51	326	418	554	12,850
Sheridan	7,830	29,154	12,057	233	2.09	213	1,898	2,402	2,636	56,423
Sublette	9,654	30,667	9,436	222	8.24	206	2,438	3,052	2,665	58,340
Sweetwater	12,782	50,213	20,753	542	2.84	313	2,180	2,514	3,719	93,017
Teton	92,477	359,169	110,323	2,402	24.72	1,821	37,784	43,975	34,030	681,981
Uinta	39,912	135,111	38,841	1,007	15.84	782	5,888	8,741	11,004	241,284
Washakie	4,115	13,761	5,656	134	3.54	99	904	1,019	1,236	26,925
Weston	897	3,016	1,085	21	0.96	26	147	266	302	5,760

Table 5.3 County Impacts Rated by Loss Ratio		
County	**Loss Ratio**	**Total Loss (Thousands of Dollars)**
Lincoln	31.08	391,727
Teton	24.72	681,981
Uinta	15.84	241,284
Sublette	8.24	58,340
Hot Springs	4.20	21,136
Converse	4.15	44,482
Natrona	3.99	268,911
Fremont	3.75	53,860
Washakie	3.54	26,925
Johnson	3.40	24,320
Carbon	3.08	37,762
Park	2.98	86,004
Sweetwater	2.84	93,017
Big Horn	2.43	22,660
Albany	2.32	71,078
Sheridan	2.09	56,423
Platte	1.60	12,850
Campbell	1.37	40,144
Laramie	1.25	92,963
Niobrara	1.20	2,935
Goshen	1.13	13,364
Crook	1.04	4,867
Weston	0.96	5,760

Table 5.4 County Impacts Rated by Dollar Loss		
County	**Total Loss (Thousands of Dollars)**	**Loss Ratio**
Teton	681,981	24.72
Lincoln	391,727	31.08
Natrona	268,911	3.99
Uinta	241,284	15.84
Sweetwater	93,017	2.84
Laramie	92,963	1.25
Park	86,004	2.98
Albany	71,078	2.32
Sublette	58,340	8.24
Sheridan	56,423	2.09
Fremont	53,860	3.75
Converse	44,482	4.15
Campbell	40,144	1.37
Carbon	37,762	3.08
Washakie	26,925	3.54
Johnson	24,320	3.4
Big Horn	22,660	2.43
Hot Springs	21,136	4.2
Goshen	13,364	1.13
Platte	12,850	1.6
Weston	5,760	0.96
Crook	4,867	1.04
Niobrara	2,935	1.2

The estimated worst case event in Niobrara County could cause$2,935,000 in building related damage. HAZUS estimates that 56 buildings (5.3% of the total in the County), would be at least moderately damaged. The probability of such an event is 2% in 50 years. A total economic loss estimate suggests the County would suffer $4 million in damages. The biggest potential impact would be economic, resulting from damage to rail tracks and disruption of rail service with all of the coal that crosses the county. This would have a multi-million dollar impact in areas receiving the coal and could ripple into power generation problems elsewhere. New construction of public buildings in the state take into consideration earthquake risk. In comparison with other Wyoming counties, Niobrara's earthquake risk is low.

Summary

PROPERTY AFFECTED:	Low
POPULATION AFFECTED:	Medium
PROBABILITY:	Low
JURISDICTION AFFECTED:	County

6. EXTREME TEMPERATURES

Niobrara County's location along the eastern border of Wyoming is one of the warmest temperature zones for the State. In the wintertime it is characteristic to have rapid and frequent changes between mild and cold spells. Usually there are less than 10 cold waves during a winter, and frequently less than half that number for most of the State. The majority of cold waves in Wyoming move southward on the east side of the Divide Sometimes only the northeast part of the State is affected by the cold air as it slides eastward over the plains. Many of the cold waves are not accompanied by enough snow to cause severe conditions.

Both severe cold and severe heat are profiled in this section. When temperatures drop significantly below normal winter lows, the cold is considered severe and begins to impact the daily operations of Niobrara County. Severe cold impacts inanimate objects, plants, animals and water supplies, and is identified by two levels of severity:

For the purposes of this plan, "extreme cold" is defined as a period of time (at least 24 hours) in which temperatures/wind-chills are well below normal, resulting in deaths due to exposure (not including auto deaths).

"Excessive cold" is a 24-hour or longer period of time that has temperatures and wind-chills which are significantly lower than normal for that time of the year, resulting in at least one cold-related death (cold as the primary or secondary cause of death), and/or a 24-hour or longer period of time in which winds chills drop below -20 for 24 hours, even if there were no exposure deaths.[5]

Conversely, summers on the open prairie are often hot and dry. Heat is expected for Niobrara County. However, when temperatures consistently exceed normal ranges and being to impact daily life, including agricultural and recreational operations, the heat is considered severe. Similar to severe cold, severe heat is divided into two categories:

"Extreme heat" is defined as a range of temperature 10 degrees or more above the average high temperature, lasting for several weeks.

"Excessive heat" is defined as a 24-hour or longer period of time with temperature and humidity significantly higher than normal for that time of the year and meets one of the following conditions:

1. The heat results in at least one heat-related death (heat was the primary or secondary cause of death), or;
2. There is 24-hour or longer period of time in which heat index values reached 105º F or higher for 3 hours or more during the daylight hours and remained above 75º F at night, whether there is a heat-related death or not.

[5] NOAA

Table 6.1 shows the average temperatures for each month in Niobrara County between 1931 and 2010.

Table 6-1: Niobrara County Average Temperatures by Month 1931-2010

Month	Average High	Average Low
January	36.4	1.6
February	39.8	2.4
March	44.6	19.9
April	53.4	34.9
May	63.4	45.7
June	73.9	54
July	79.6	62.4
August	78.5	62.6
September	68.7	47.6
October	57	36.7
November	44.4	16
December	35.6	3.3
Source: NOAA		

History

According to the National Climate Center Database (NCDC), Niobrara County has had no recorded instances of extreme temperature that meet NCDC criteria, probably because of the lack of fatalities. Figure 6.2 charts the average high and low temperatures per month in Niobrara County, and then the warmest temperature and coldest temperature on record for each month between 1931 and 2010.

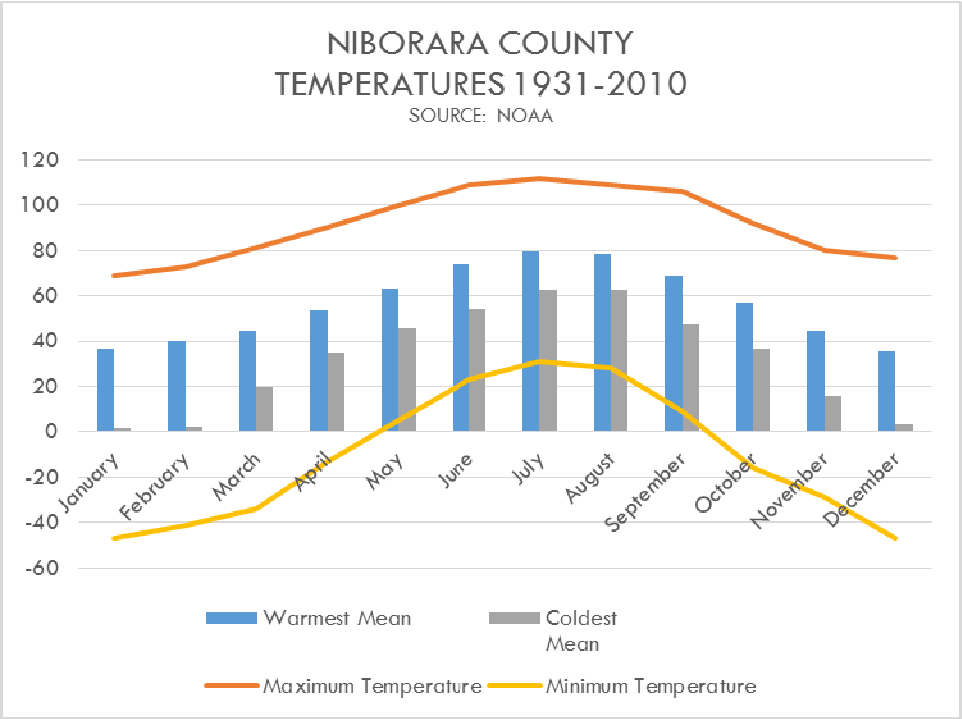


Figure 6-1: Niobrara County Temperatures 1931 - 2010

The majority of the State of Wyoming experiences very few days above 90ºF. In Niobrara County, the number of days ranges from 15 to 50, with fewer days spanning across the southern third of the County and the most numerous days occupying the northern third. Only Goshen County, directly south of Niobrara, has a more uniform distribution of a high number of hot days. This indicates that, compared to the rest of the State, Niobrara as a County has a higher potential for extreme heat.

Very little of the State experiences long periods of time with minimum temperatures below freezing. This is a mixed statistic, more useful when calculating the impacts of frozen ground and frost on crops than on the human population. Generally, 'extreme cold' events are documented as those which cause serious or permanent injury or death to humans exposed to the event. Cold temperatures above 0ºF and without wind-chill data are not usually considered 'extreme.' Generally, Niobrara experiences moderate cold temperatures and, even during the most extreme cold events documented in the County, is still moderate compared to the rest of the State. Therefore, the extreme cold risk rating in Niobrara is medium.

Impacts

Extreme temperatures impact human and livestock populations, crops, and in some cases cause property damage when frozen pipes burst, heating units cause structure fires, or unusually high demands on electricity cause power outages. Generally, the associated impacts are recorded with subsequent or concurrent hazards with better documentation records, such as winter storms or droughts. However, in the case of Niobrara County, extreme temperatures (both

severe cold and severe heat) could damage the rail tracks that cross the County and disrupt rail service for the delivery of coal. This would have a multi-million dollar impact on the areas receiving coal and could ripple into power generation problems elsewhere, in addition to the increased strains on power due to increased demands driven by heating or cooling needs of residents and businesses.

Future Impacts

It is difficult to predict quantifiable future impacts, because no existing data is available from which to draw comparisons. Using the general assessments of climate and temperature risks, the impacts identified in the previous section will still apply in the future. The relative risk of extreme cold remains medium, and the relative risk for extreme heat remains high. The population density of the County inherently increases the danger of these hazards due to the isolated nature of most of the County, and from the potential isolation of population centers such as Lusk from larger supply and resource centers.

At the public meetings held in the County for the previous revision, participants felt strongly that the number of severe cold events captured in the data significantly under-represented the actual number of events that have occurred in the County. Extreme temperatures have minimal potential to affect buildings--with the exception of frozen pipes. Impacts could be felt across all jurisdictions.

Summary

PROPERTY AFFECTED:	Medium
POPULATION AFFECTED:	Medium
PROBABILITY:	Medium
JURISDICTION AFFECTED:	All

7. FLOODS

A flood, as defined by the National Flood Insurance Program, is a general and temporary condition of partial or complete inundation of two or more acres of normally dry land area or of two or more properties from: overflow of waters; unusual and rapid accumulation or runoff of surface waters from any source; or a mudflow. Floods can be slow or fast rising, but generally develop over a period of many hours or days.

Floods can also occur with little or no warning and can reach full peak in only a few minutes. Such floods are called flash floods. A flash flood usually results from intense storms dropping large amounts of rain within a brief period. Floods can occur due to precipitation or rapidly melting snow. They can also occur because of ice jams.

According to the National Flood Insurance Program Community Status Book Niobrara County has not been mapped as of June 2015. The only participating community is the town of Lusk, which has a current effective Flood Insurance Rate Map (FIRM) dated March 18, 1986. The map shows only approximate Zone A and Zone C. No detailed elevations of the 100-year floodplain are provided. Other communities in the County include Manville and Van Tassell, however, neither community has a mapped floodplain.

According to FEMA records, as of March 31, 2015 there are no floodplain insurance policies in place in the County. There is also no history of flood claims from January 1, 1978 through March 31, 2015. (http://www.fema.gov/policy-claim-statistics-flood-insurance/policy-claim-statistics-flood-insurance/policy-claim-13)

The major sources of flooding in Niobrara County include the Niobrara River in the south and the Cheyenne River in the north. The main source of flooding in Lusk is the Niobrara River. Numerous creeks and streams feed into these rivers, including the Bergreen Creek, which drains into the Niobrara River, and Lance Creek, Lightning Creek, Twenty Mile Creek, and Black Thunder Creek, which all drain into the Cheyenne River. Muddy Creek, located in the southwest corner of the County, drains into Glendo Reservoir, located in neighboring Platte County.

History

The documented flood history for Niobrara County extends back to 1935. The abbreviated flood history in Table 6.1 below was in large part derived from the monthly Storm Data reports generated and released by the National Oceanic and Atmospheric Administration's National Climate Center. Other sources are unpublished reports from the Wyoming Office of Homeland Security, newspaper accounts, and periodicals from public libraries. The table represents floods that have caused damage, injuries, or loss of life. A damaging flood occurs in the County about every five years on average, based upon the historical data presented in Table 7.1.

On June 4, 2015, flash flooding damaged homes, businesses and a highway bridge in Lusk and surrounding areas. Heavy rain of 6 inches over XX hours sent the Niobrara River over its banks about 2:30 a.m. Thursday and down the main street. Niobrara County Emergency Management Coordinator reported the water covered about four city blocks and knocked out the town's drinking water system resulting in a boil order from the Environmental Protection Agency (EPA).

The flooding closed all major roads in and out of Lusk, including about 130 miles of U.S. 85 from Lingle to Newcastle and U.S. 18-20 from Orin Junction to the Nebraska line. A culvert was washed out at MP 31 on US 18/20. Flood damage caused the U.S 85 bridge to collapse where it crosses the railroad tracks in Lusk. The town lost power at 3:24a.m., when the Western Area Power Association's (WAPA) substation was submerged in at least 4-feet of water. The Red Cross opened a shelter at the fairgrounds, anticipating 50-100 evacuees. Estimated damages are $XXX.

Figure 7-1: Flood damage to a business in Lusk, WY

(Source: Niobrara County Emergency Management)

Figure 7-2: Flood damage to US 85 bridge over railroad tracks in Lusk, WY

(Source: Niobrara County Emergency Management)

Table 7-1: Niobrara County Historic Flood Data

County	Location	Start Date	Deaths	Injuries	Property Damage	Crop Damage	Total Damage	Information
Niobrara	Town of Lusk	11-June-1960	0	0	0	0	0	Flood damaged buildings, roads, small livestock and poultry.
Niobrara	County-wide	July 1973	0	0	$0	$0	$0	Torrential rains caused damage to roads and bridges; several earthen dams failed.
Niobrara	Niobrara + 11 other counties	May 1978	0	0	$0	$0	$15.5 million	Wet snow and record rain caused extensive damage to property, crops, livestock, homes, bridges, and roads.
Niobrara	Town of Lusk	June 1962	0	0	0	0	0	Flood damaged buildings, roads, small livestock and poultry.
Niobrara	County-wide	June 1962	0	0	0	0	0	Heavy thundershowers and a flash flood impacted the County across widespread areas.
Niobrara	Town of Lusk	July 1980	0	0	$0	$0	$0	One of the most vicious storms to hit the area brought heavy rain. Several basements were flooded, and pasture was lost.
Niobrara	Niobrara River	Spring 1990	0	0	$0	$0	$0	Seasonal flooding exceeded the Niobrara River's basins and washed out bridges and roads, and damaged other structures.
Niobrara	Niobrara River	Spring 1991	0	0	$0	$0	$0	The flood originated in Manville at the headwaters of Niobrara River and extended all the way to the northeastern State line. People were evacuated and homes suffered damage.

County	Location	Start Date	Deaths	Injuries	Property Damage	Crop Damage	Total Damage	Information
Niobrara	County-wide	May 1995	0	0	$0	$0	$0	Moderate to heavy rain fell in these counties during the evening hours. Rainfall between one and one-half and three inches occurred in these areas on top of already saturated soils. This produced flooding of creeks and streams in the three counties. In Niobrara County, three bridges were washed out on County roads. Some flooding of farmland was also reported.
Niobrara	Redbird	August 2006	0	0	$40K	$0	$40 K	Heavy rainfall produced flash flooding along Dogie, Spring and Lance creeks, washing out a bridge and road.
Niobrara	County-wide	Spring 2008	0	0	0	$0	$0	Three floods washed out County roads and a private bridge in the northern part of the County.
Niobrara	Keeline Lusk	29-Septemer-2014	0	0	0	0	0	An intense low pressure system moved northeast from northern Colorado into western South Dakota and produced widespread showers and thunderstorms with heavy rainfall. During a 24 hour period, one to three inches fell over southeast Wyoming. An observer northwest of Keeline measured 2.2 inches of rain. An observer in Lusk measured 2.12 inches of rain.

County	Location	Start Date	Deaths	Injuries	Property Damage	Crop Damage	Total Damage	Information
Niobrara	Lusk	4-June-2015	0	0	?	?	?	Six inches of heavy rain sent the Niobrara River over its banks and down the mainstreet about 2:30 a.m. in the Town of Lusk. Water covered about four city blocks and knocked out the town's drinking water system. The flooding closed all major roads in and out of Lusk, including about 130 miles of U.S. 85 from Lingle to Newcastle and U.S. 18/20 from Orin Junction to the Nebraska line. A culvert washout occurred at MP 31 on US 18/20. Flood damage caused the U.S 85 bridge to collapse where it crosses the railroad tracks. The town lost power when the Western Area Power Association's (WAPA) substation was submerged in at least 4-feet of water.

Figure 7-3: Flooding in Town of Manville March 5, 2014; no damages were reported

Impacts

The available flood history indicates that damaging floods occur infrequently in Niobrara County. On average, a damaging flood occurs around every five years. Loss of life for Niobrara is not well documented and current data indicates no injuries or deaths associated with flooding. While this is probably a reflection of poor data collection, the risk of injury or death associated with flooding remains low.

Flood of Record for Future Impacts

At the time of this writing, the May 1978 flood was the most damaging event recorded and may be considered the flood of record for Niobrara County. Damages have not yet been totaled, however, and the June 2015 flood may become the new flood of record. The 1978 loss inflicted damages of roughly $15.5 million spread over 12 counties. Assuming an even distribution of loss, Niobrara faced about $1.2 million in damages from that event. Of course, the damage estimates are not equally distributed in actual counties, but since a County-specific breakdown is unavailable, a measurement factor was utilized.

Niobrara is situated primarily in the Cheyenne River Basin, with the southeast corner making up the primary content of the Niobrara River Basin. The relatively small stream density (compared to the rest of the State) combined with the extremely rural nature of the County (which averages less than 1 person per square mile) makes the dangers of flooding in the County very low. The Town of Lusk, which lies along the Niobrara River, accounts for the entire mapped flood risk in the County, however other communities such as Manville and Van Tassell are subject to potential flood damage.

Flood Analysis

Planning level flood loss estimates were made available for every county in Wyoming with the 2009 update to the Wyoming Hazard Mitigation Plan. FEMA used HAZUS-MH MR2 to model the 100-year floodplain and perform associated building and population risk assessments. HAZUS-MH is FEMA's GIS-based natural hazard loss estimation software. The HAZUS-MH flood model results include analysis for Niobrara County, modeling streams draining a 10 square mile minimum drainage area, using 30 meter (1 arc second) Digital Elevation Models (DEM). Hydrology and hydraulic processes utilize the DEMs, along with flows from USGS regional regression equations and stream gauge data, to determine reach discharges and to model the floodplain. Losses are then calculated using HAZUS-MH national baseline inventories (buildings and population) at the census block level.

HAZUS-MH produces a flood polygon and flood-depth grid that represents the 100-year floodplain. The 100-year floodplain represents a flood that has a 1% chance of being equaled or exceeded in any single year. While not as accurate as official flood maps, these floodplain boundaries are available for use in GIS and could be valuable to communities that have not been mapped by the National Flood Insurance Program. HAZUS-MH generated damage estimates are directly related to depth of flooding and are based on FEMA's depth-damage functions. For example, a two-foot flood generally results in about 20% damage to the structure (which translates to 20% of the structure's replacement value). The HAZUS-MH flood analysis results provide the number of buildings impacted, estimates of the building repair costs, and the associated loss of building contents and business inventory. Building damage can cause additional losses to a community as a whole by restricting the building's ability to function properly. Income loss data accounts for losses such as business interruption and rental income losses as well as the resources associated with damage repair and job and housing losses.

Potential losses derived from HAZUS-MH used default national databases and may contain inaccuracies; loss estimates should be used for planning level applications only. The damaged building counts generated are susceptible to rounding errors and are likely the weakest output of the model due to the use of census blocks for analysis. In rural Wyoming, census blocks are large and often sparsely populated or developed; this may contribute to inaccurate loss estimates. HAZUS-MH assumes population and building inventory to be evenly distributed over a census block; flooding may occur in a small section of the census block where there are not actually any buildings or people, but the model assumes that there is damage to that block. There could also be errors and inadequacies associated with the hydrologic and hydraulic modeling of the HAZUS-MH model. In addition, excessive flood depths may occur due to problems with a DEM or with modeling lake flooding. Errors in the extent and depth of the floodplain may also be present from the use of 30 meter digital elevation models. HAZUS Level II analyses based on local building inventory, higher resolution terrain models, and DFIRMs could be used in the future to refine and improve the accuracy of the results.

Maps and Results

A series of maps and analysis results were compiled for Niobrara County and the communities of Lusk, Manville and Van Tassell. Tables 7.2 and 7.3 below contain the results of the HAZUS loss estimation. Building and contents value loss estimates, income-related loss estimates, and displaced population and shelter needs estimates are included in Table 7.2: Flood Loss by Municipality. These loss estimates have been grouped by municipality to demonstrate how the risk varies across the County. Per Capita Loss was calculated using total building loss and Census 2009 estimates to the municipal and county –level

population. Percent Building Loss and Percent Contents Loss were calculated using building and contents loss estimates, and HAZUS building and contents exposure data. Table 7.3: HAZUS Loss Estimation Additional Analysis shows these estimates, also grouped by municipality.

Three maps are provided at the county scale and for each municipality: 1) the Flood Hazards map shows the HAZUS floodplain boundary, 2) the Flood Depth map shows HAZUS flood depth data, and the 3) Building Loss map shows total building loss, in dollars, by census block. It is important to note that the highest flood depth in the municipality maps indicates the maximum depth for the county and is not representative of the highest depth in that municipality. Figures 7.1 through 7.12 reflect the maps for the County and each community.

According to the HAZUS model output, Niobrara County would suffer a total of $3,848,000 in total direct economic loss to buildings and 223 people would be displaced in the event of a countywide 100-year flood. There would be a total of six damaged buildings, none of which would be substantially damaged (>50% damaged). Lightning Creek flows east across the County and drains into the Cheyenne River in the northern area of the County. The Niobrara River meanders east through Manville, Lusk, and Van Tassell. The Town of Lusk would suffer the most damage in the County, with a total direct economic loss for buildings of $2,059,000 and 153 displaced people. The Town of Van Tassell has the greatest Percent Building Loss (3.0%), Percent Contents Loss (3.3%), and Per Capita Loss ($2,167) of the jurisdictions in the County. The total county, incorporated and unincorporated, would suffer 1.2% Building Loss, 1.8% Contents Loss, and $1,626 Per Capita Loss

Table 7-2: HAZUS Loss Estimation

Municipality	Building Loss ($K)	Contents Loss ($K)	Inventory Loss ($K)	Relocation Loss ($K)	Capital Related Loss ($K)	Wages Loss ($K)	Rental Income Loss ($K)	Total Loss ($K)	# of Displaced People	# of People Needing Short Term Shelter
Lusk	784	1,221	40	-	4	10	-	2,059	153	97
Manville	20	11	-	-	-	-	-	31	4	-
Van Tassell	25	14	-	-	-	-	-	39	2	-
Unincorporated	988	710	13	-	-	8	-	1,719	64	-
TOTAL	**1,817**	**1,956**	**53**	**-**	**4**	**18**	**-**	**3,848**	**223**	**97**

.

Table 7-3: HAZUS Loss Estimation Additional Analysis

Municipality	2009 Population*	Total Exposure ($K)	Building Loss ($K)	Building Exposure ($K)	% Building Loss	Contents Loss ($K)	Contents Exposure ($K)	% Contents Loss	Total Loss ($K)	Per Capita Loss ($)
Lusk	1,429	165,385	784	95,767	0.8%	1,221	69,618	1.8%	2,059	1,441
Manville	101	6,642	20	4,348	0.5%	11	2,294	0.5%	31	307
Van Tassell	18	1,263	25	841	3.0%	14	422	3.3%	39	2,167
Unincorporated	818	85,733	988	51,972	1.9%	710	33,761	2.1%	1,719	2,101
TOTAL	**2,366**	**259,023**	**1,817**	**152,928**	**1.2%**	**1,956**	**106,095**	**1.8%**	**3,848**	**1,626**

* U.S. Census Bureau

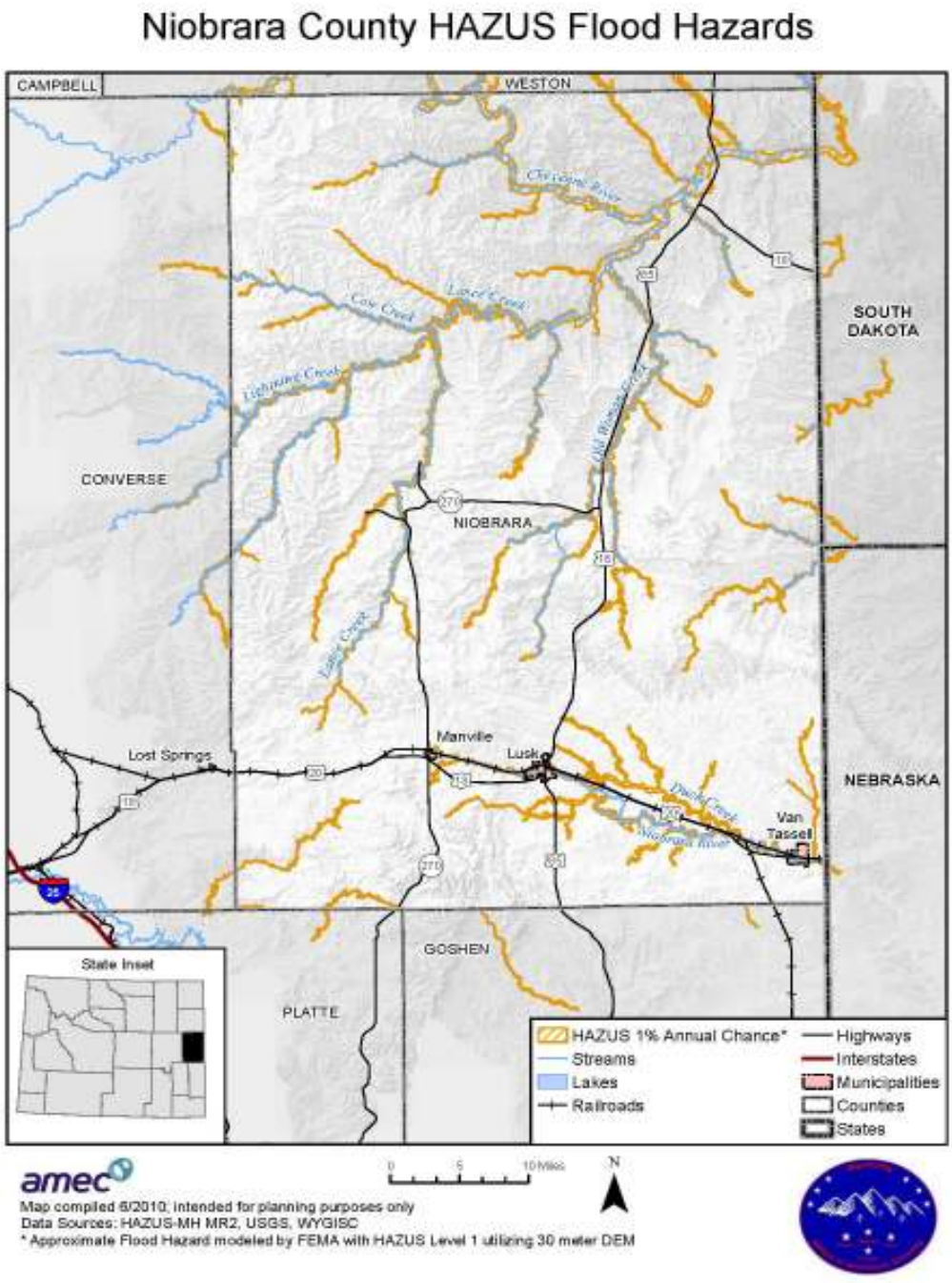


Figure 7-4: Niobrara County HAZUS Flood Hazards

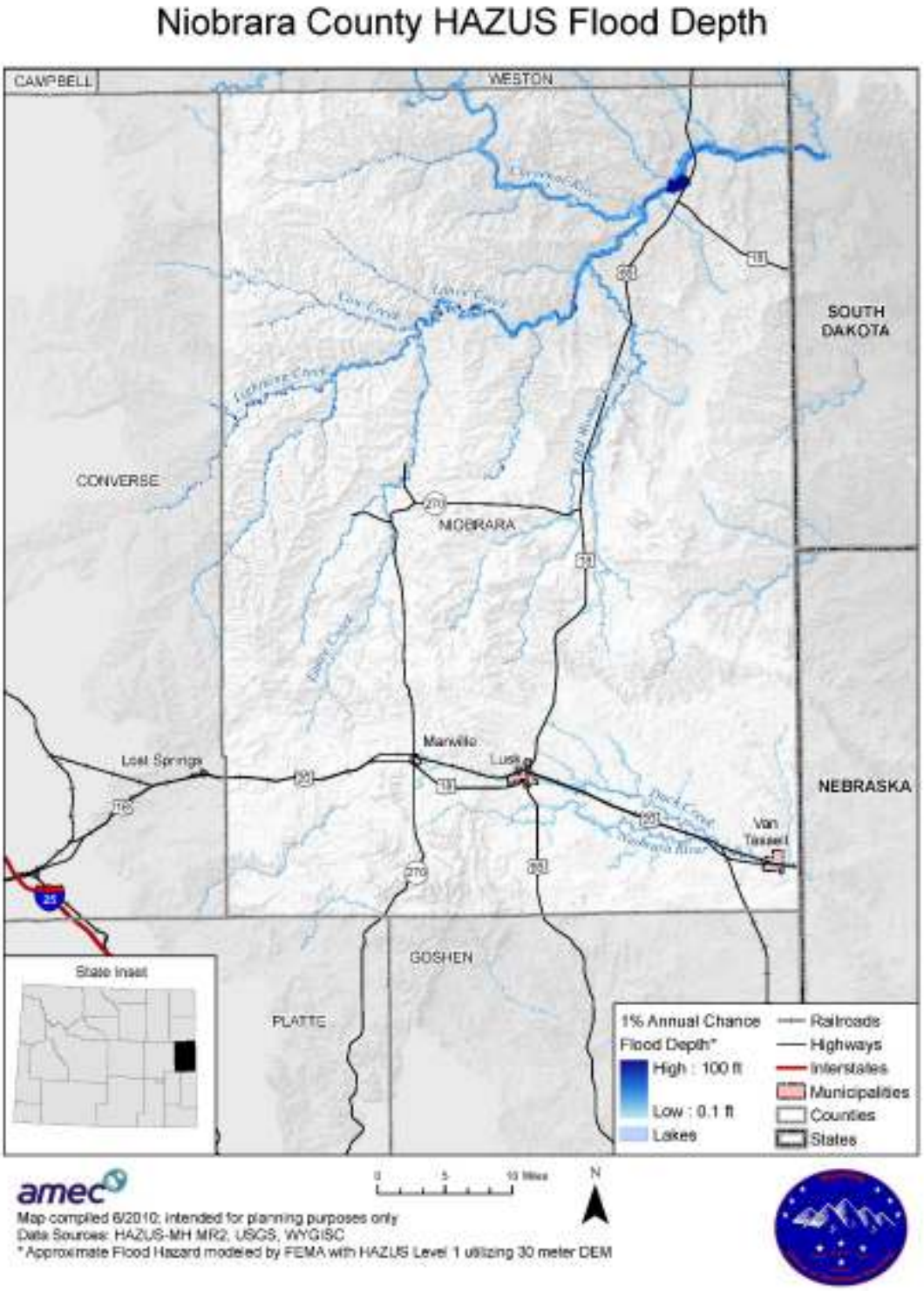


Figure 7-5: Niobrara County HAZUS Flood Depth

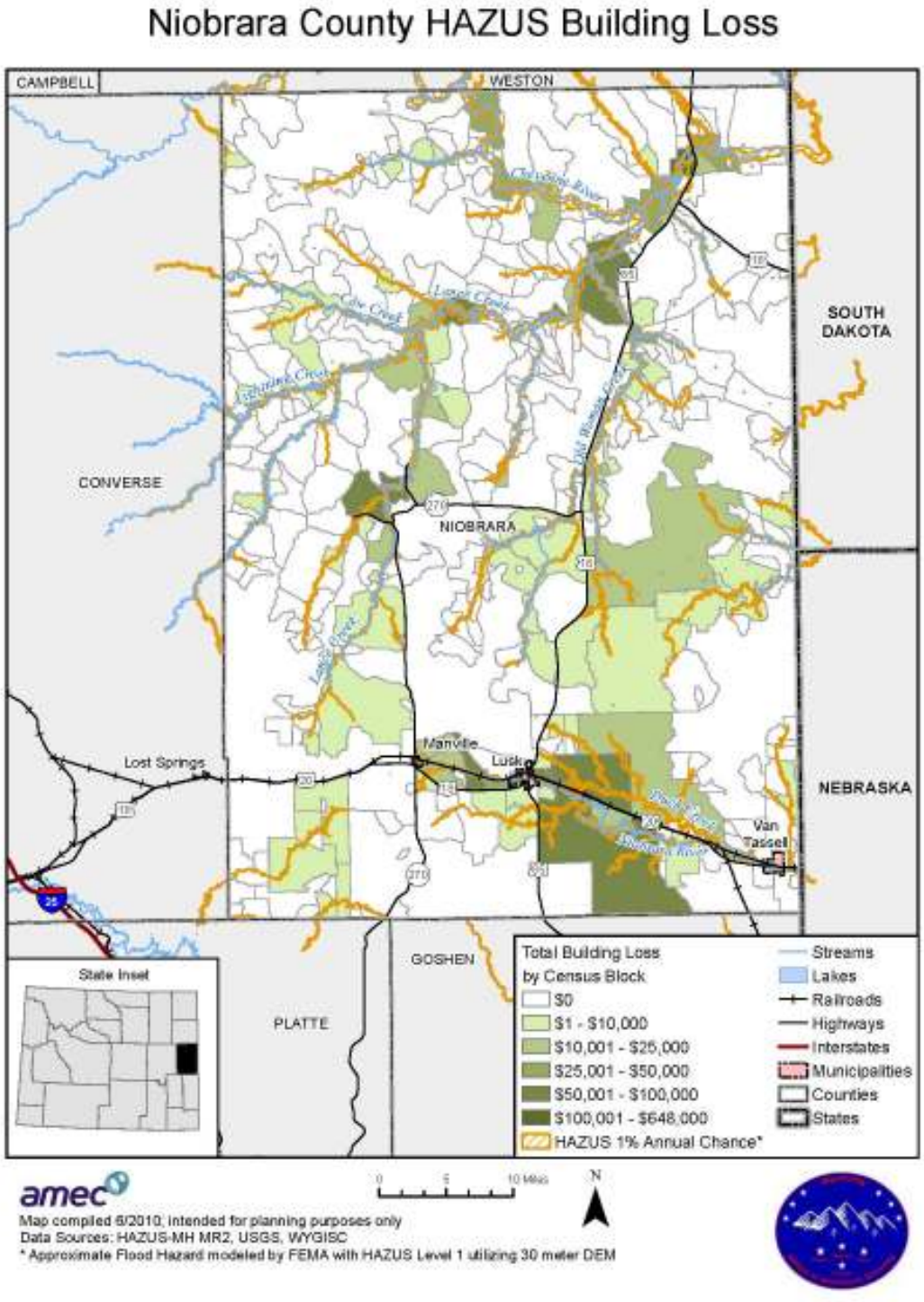


Figure 7-6: Niobrara County HAZUS Building Loss

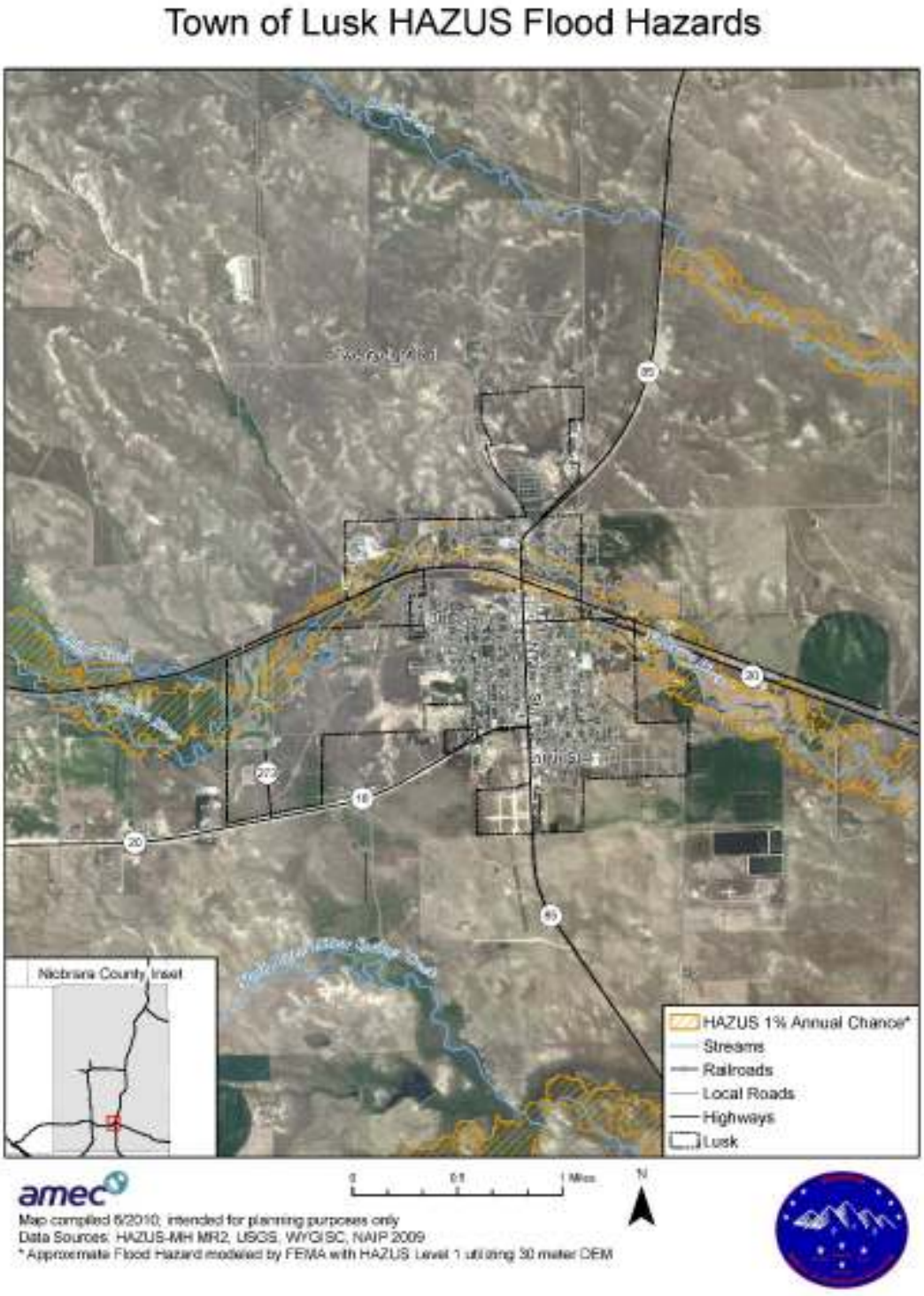


Figure 7-7: Town of Lusk HAZUS Flood Hazards

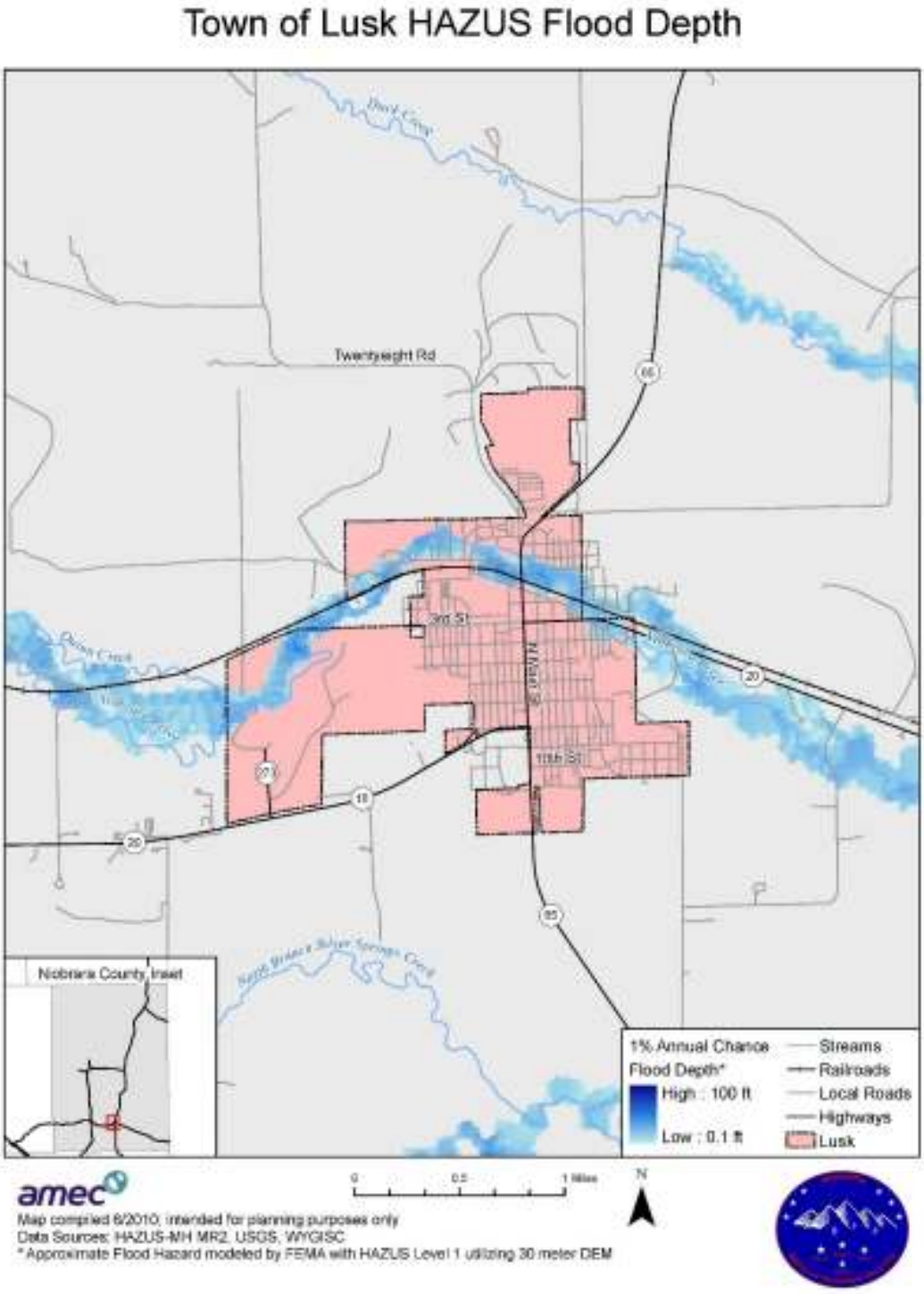


Figure 7-8: Town of Lusk HAZUS Flood Depths

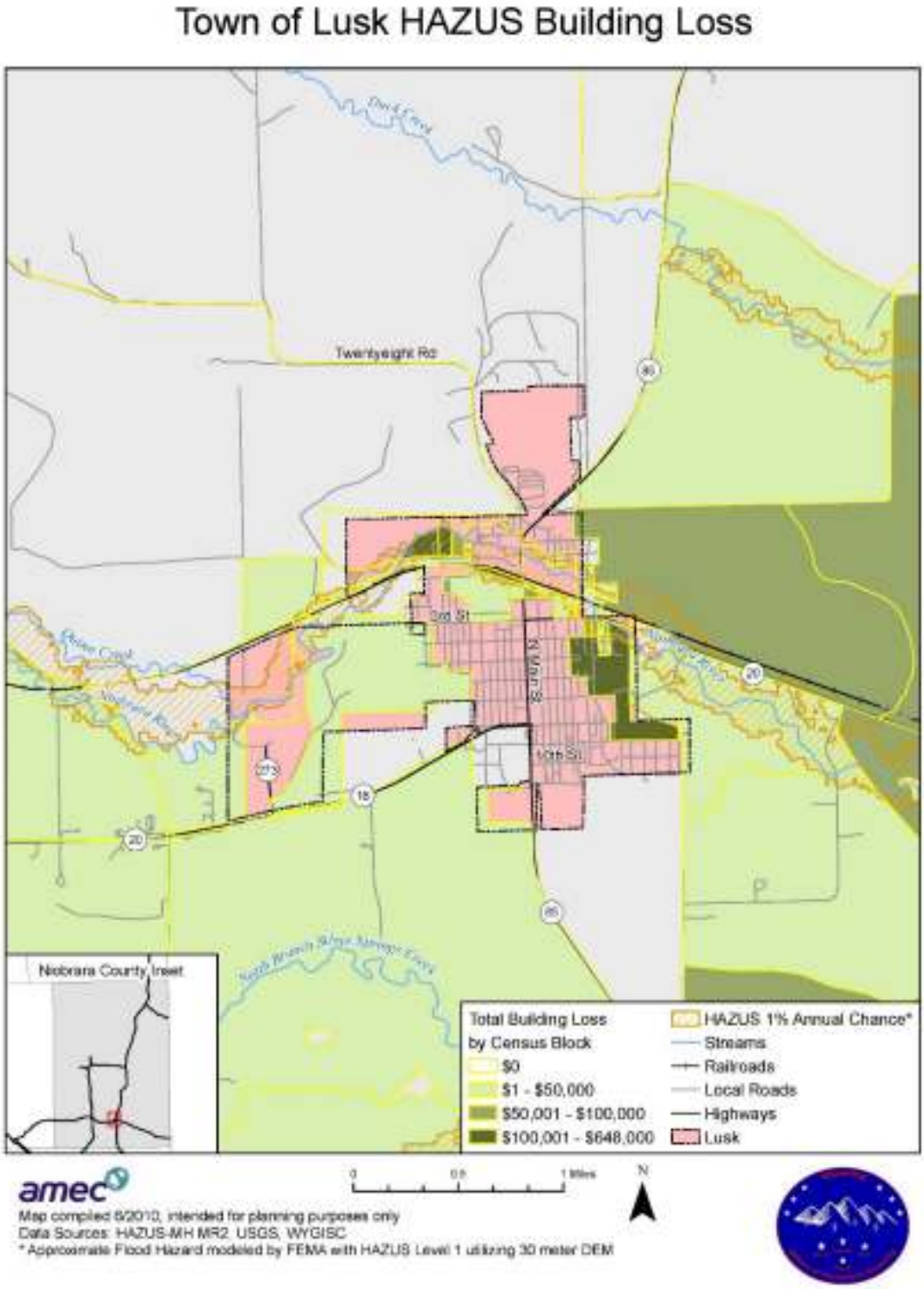


Figure 7-9: Town of Lusk HAZUS Building Loss

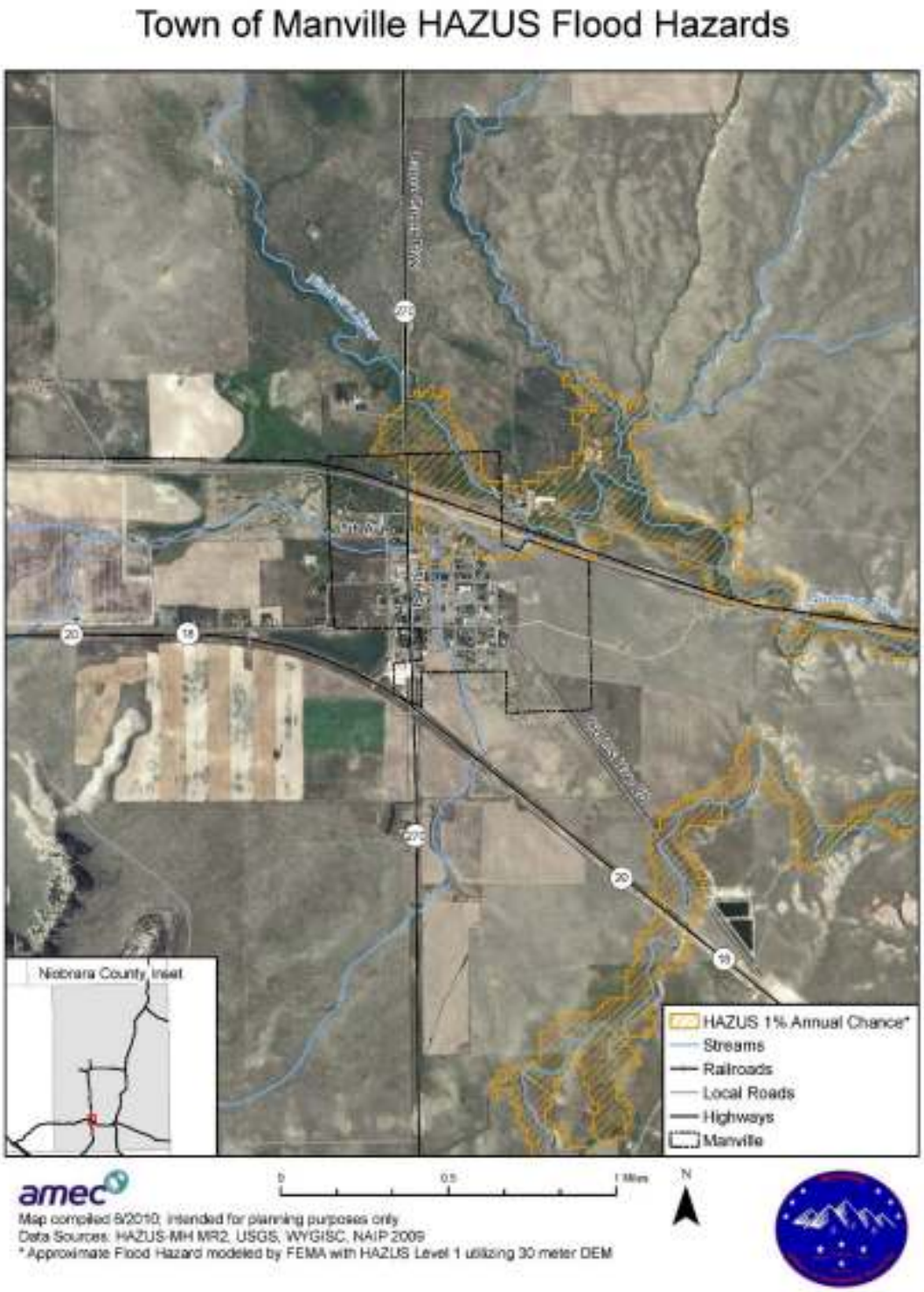


Figure 7-10: Town of Manville HAZUS Flood Hazards

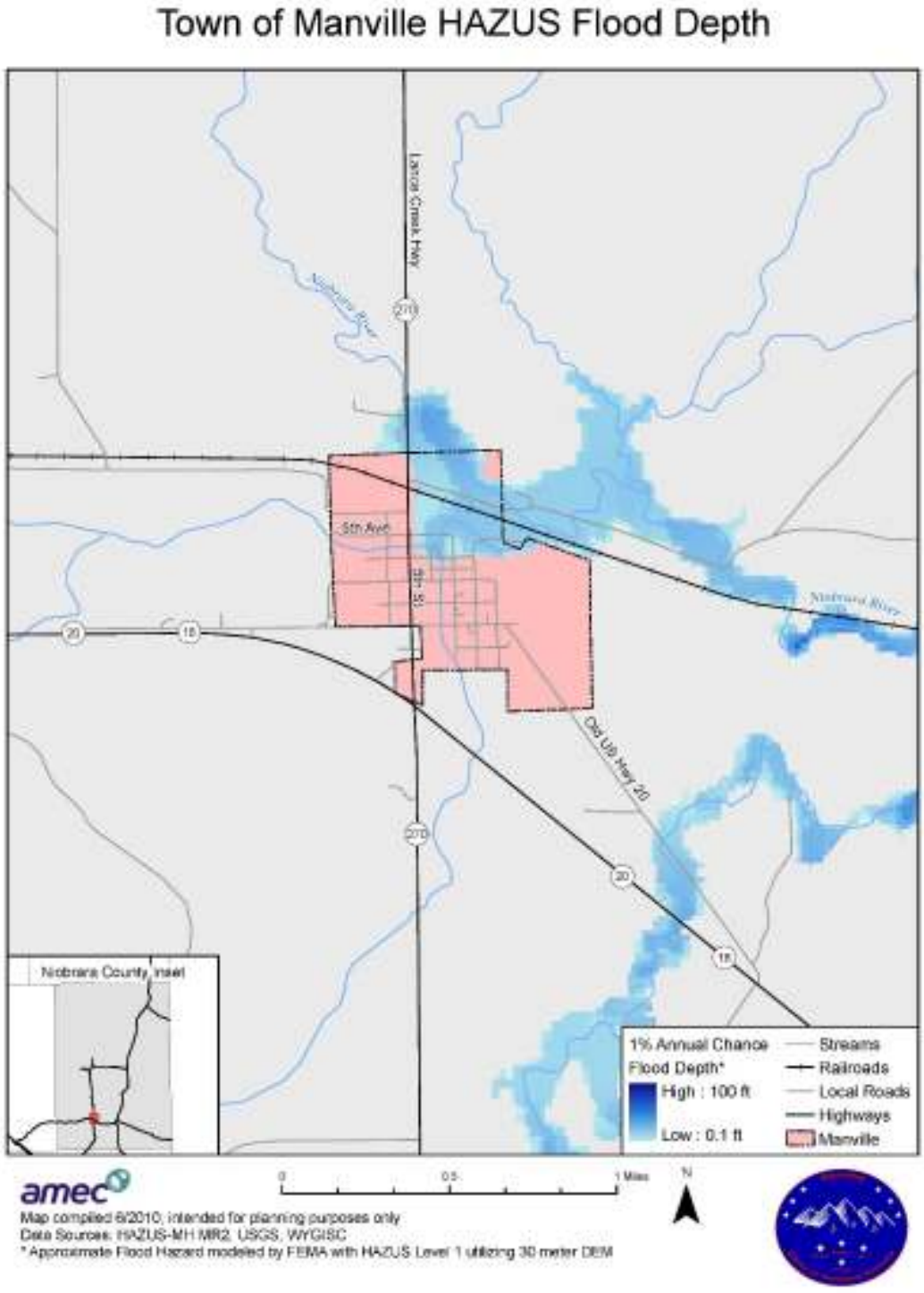


Figure 7-11: Town of Manville HAZUS Flood Depth

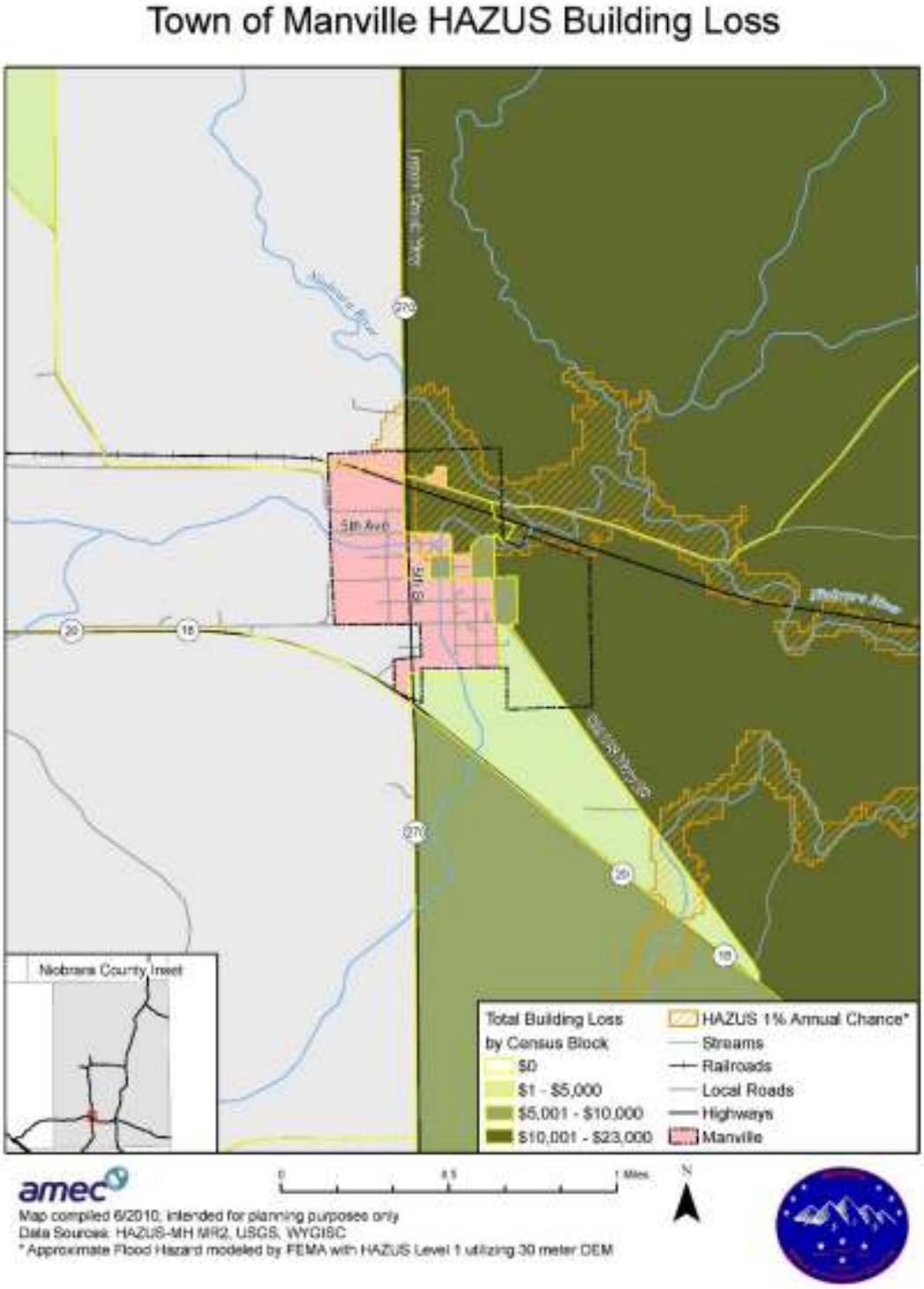


Figure 7-12: Town of Manville HAZUS Building Loss

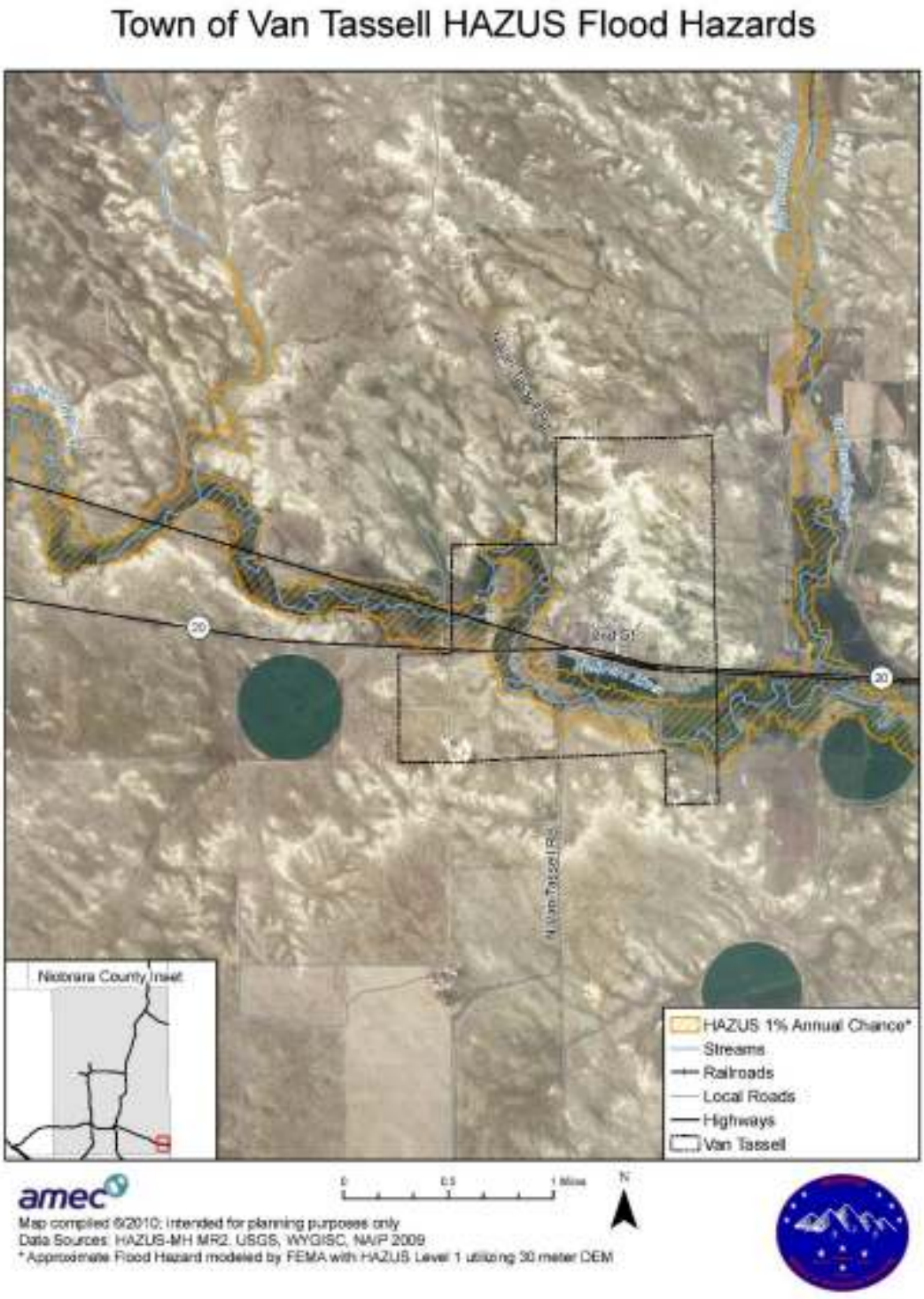


Figure 7-13: Town of Van Tassell HAZUS Flood Hazards

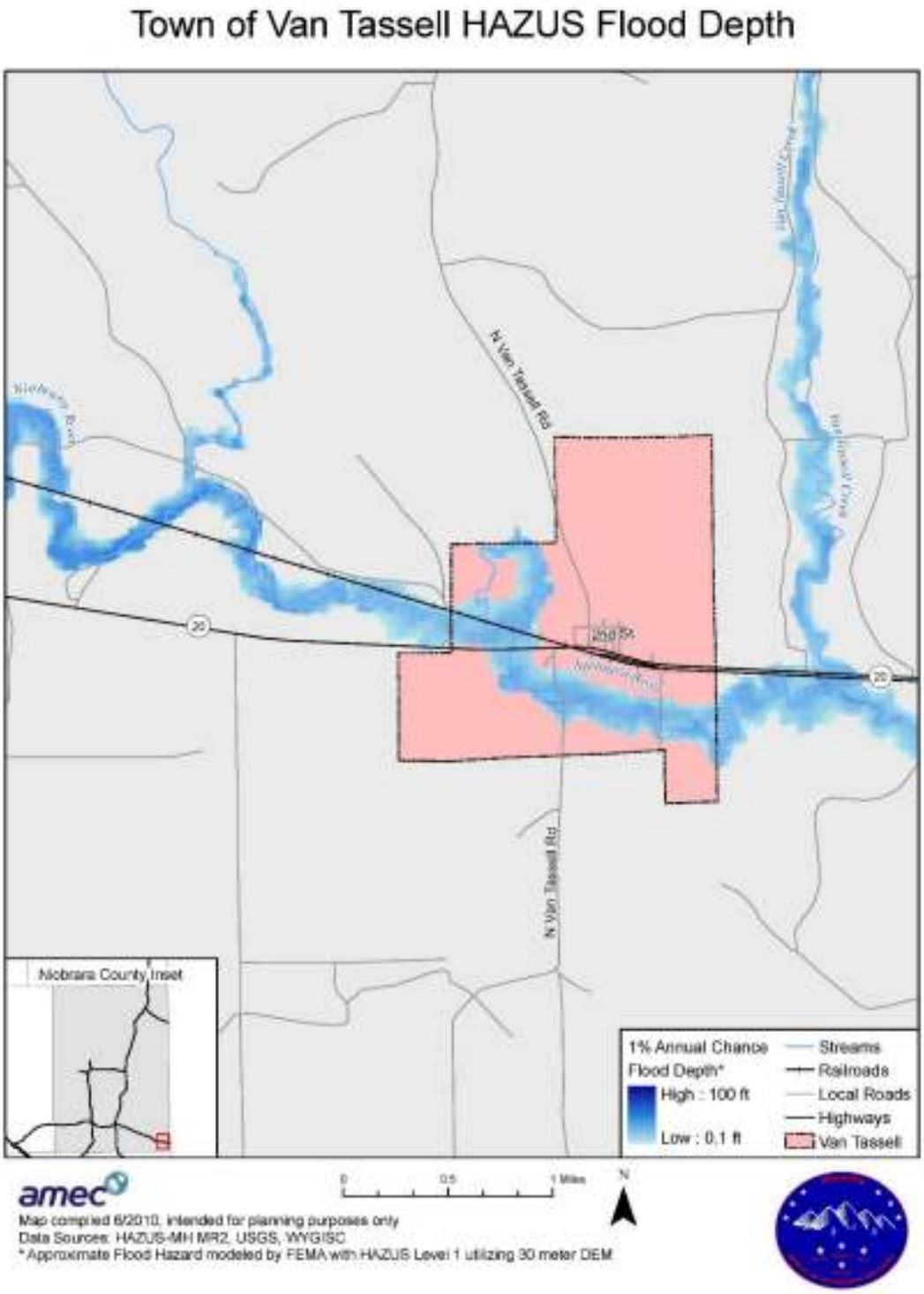


Figure 7-14: Town of Van Tassell HAZUS Flood Depth

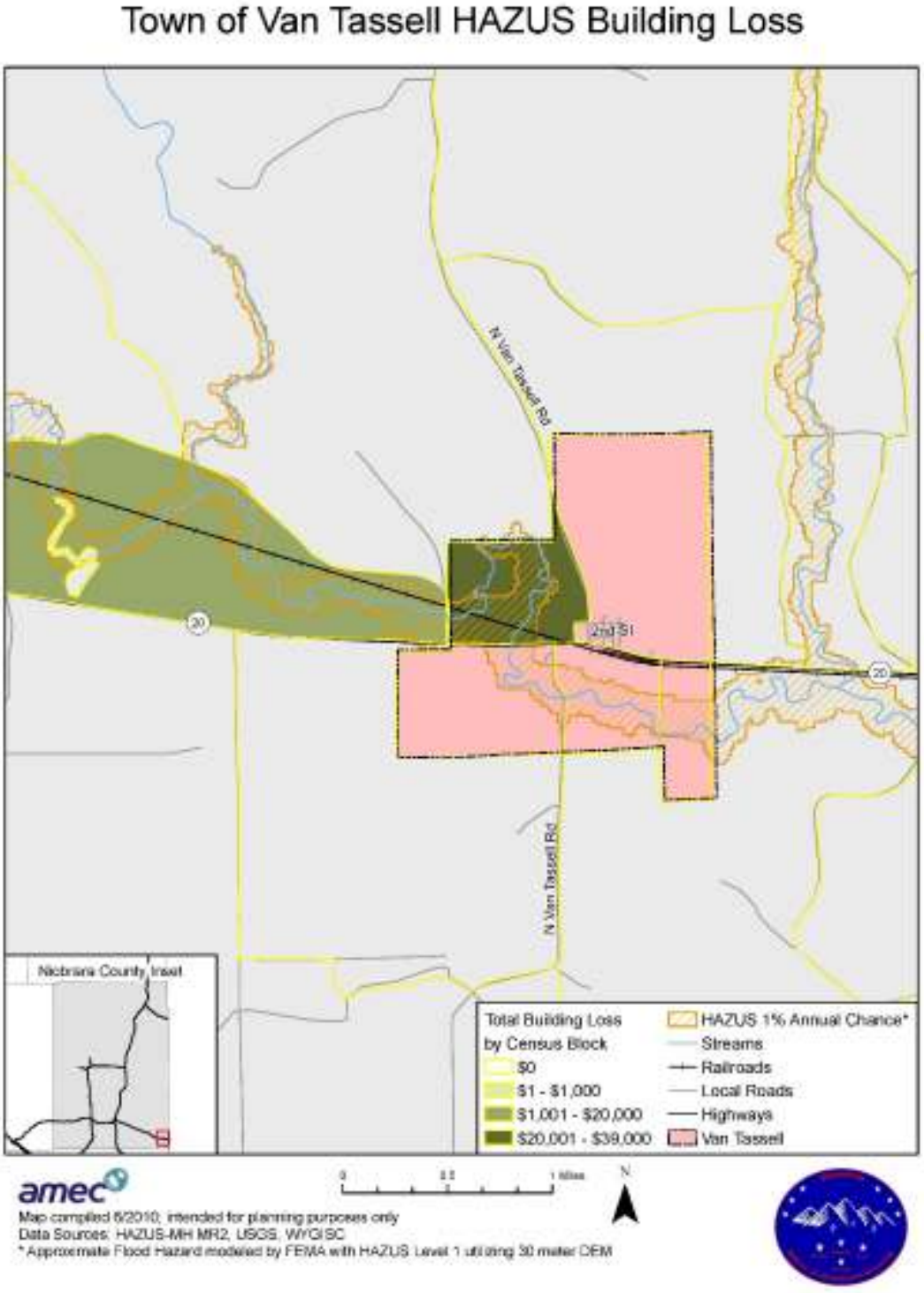


Figure 7-15: Town of Van Tassell HAZUS Building Loss

Future Potential Impacts

Floods occasionally occur in Niobrara County. Based on the flood history, damaging events occur about every five years. The HAZUS analysis summarizes the values at risk in the floodplain. Based on this analysis, Niobrara County has over $2.6 million in building value that could be exposed to flooding. Though flooding is generally a widespread event within a city or municipality, the inherent geography and population distribution in Niobrara alters this assumption. Outside of Lusk, flooding will impact fewer people and properties.

Potential losses from flooding are related to a variety of factors including flood depth, flood velocity, building type and construction. Based on Flood Insurance Administration (FIA) flood Depth-Damage curves, the percent of damage is directly related to the flood depth. Additional losses can include inventory loss, relocation costs, wage loss and rental income loss. Based on the assumptions used in the HAZUS analysis, expected 100- year flood damages would be over $3.8 million in the County. A large percentage of this estimated loss, $2.1 million, would occur in the Town of Lusk. There is a 1% chance of these damages occurring in any given year.

With little new construction planned in the County in the foreseeable future there do not appear to be future buildings that would be at risk from flooding during this planning period. However the lack of officially mapped flood hazards in the county outside of the Town of Lusk make it difficult to know the extent and depth of flood hazards. The Town of Lusk, heavily damaged in the flood of 2015, will see significant rebuilding or repair of structures in the floodplain. Future damages can be reduced by constructing new buildings per the floodplain regulations of the community.

Summary

PROPERTY AFFECTED:	Medium
POPULATION AFFECTED:	Low
PROBABILITY:	Medium
JURISDICTION AFFECTED:	Lusk, County

8. HAIL

Hail causes more than a billion dollars of property damage nationally each year, mostly to crops. The southeast corner of Wyoming lies within the Nation's "Hail Alley". Together with adjacent portions of Colorado and Nebraska, this region of Wyoming is battered by more hailstorms than any other part of the United States. Climatological data shows this area of Wyoming averaging five to nine days annually when hail is reported. Niobrara County is adjacent to "Hail Alley", and frequent damaging hail storms have occurred.

Hail falls from thunderstorm clouds that extend miles high into extremely cold air. Updrafts bring raindrops from the bottom to the top of the cloud where they freeze into ice pellets. The pellets then fall only to be blown back up where another coating of rain freezes to the hailstone and it grows larger, layer by layer. This layering effect increases the size of hailstones, sometimes to the size of baseballs or grapefruits. Typically the stronger the updraft, the more times a hailstone repeats this cycle and consequently, the larger it grows. Once hailstones reach a weight sufficient enough to overcome the updrafts, they fall to the ground. Since the stone is not in the warm air below the thunderstorm long enough to melt before reaching the ground, it falls as ice.

Hail falls in swaths ranging from 20-115 miles long and 5-30 miles wide, and typically one-half mile wide and five miles long. The swath is rarely a large, continuous bombardment, but generally consists of a series of hail strikes that are produced by individual thunderstorm clouds traversing the same general area. A single storm will produce several series of hail storms as it moves. The swaths may partially overlap but often leave completely undamaged gaps between them.

History

The National Climatic Data Center (NCDC) keeps a record of all hail events with hail ¾ inch or greater in diameter, or that cause property damage, crop damage, injuries, or fatalities. According to NCDC's Storm Events Database, there have been 79 separate damaging hail storms in Niobrara County since 1960. Since 1960, Niobrara County has seen a slight upward trend in the amount of recorded hailstorms per year, with 10 recorded in 2013, though it is important to note that this may correlate with improved storm detection technology. Hail diameter has remained relatively constant during these events, with most recorded hail having a diameter between 1 and 2 inches. The largest hail ever recorded in Niobrara County occurred on August 28, 1996 over Redbird, and reached a maximum of 3.5 inches in diameter.

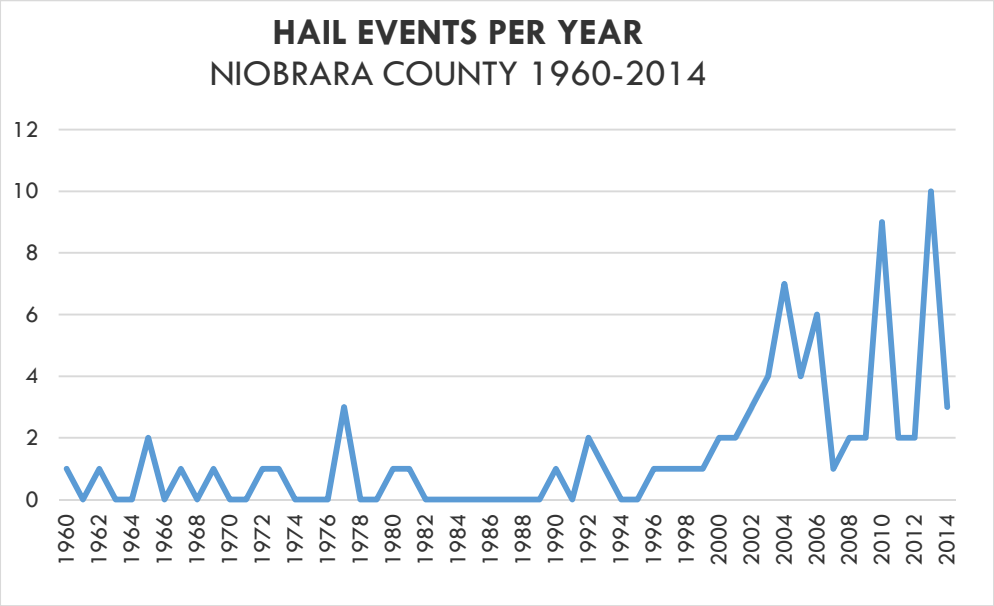


Figure 8-1: Hail Events per Year Niobrara County 1960 – 2014

Source: NCDC

Table 8.1 presents a history of documented, damaging hail storms, based on data derived from the monthly Storm Data reports generated and released NCDC. Other sources are unpublished reports from the Wyoming Office of Homeland Security, newspaper accounts, and periodicals from public libraries. Table 8.1 summarizes hail storms that have caused damage, injuries, or loss of life since 1960. To date, hail events have caused $6,579,027 (2015 USD) in damage to property and $200,936 (2015 USD) in damage to crops. There have been no documented injuries or loss of life from hail in Niobrara County.

Table 8-1: Niobrara County Damaging Hail Storms: 1960-2014

Year	Deaths	Injured	Estimated Damage- Property	Estimated Damage-Crops
1960	0	0	$21,981	$21,981
1962	0	0	$215,446	$0
1965	0	0	$413109	$0
1967	0	0	$0	$1,948
1969	0	0	$0	$177,288
1972	0	0	$15,566	$0
1973	0	0	$1,465,422	$0
1977	0	0	$4,396,265	$0
1981	0	0	$7,158	$0

Year	Deaths	Injured	Estimated Damage- Property	Estimated Damage-Crops
1990	0	0	$497	$0
1992	0	0	$30,250	$0
1996	0	0	$7,539	$0
1998	0	0	$5,794	$0
Total	**0**	**0**	**$6,579,027**	**$200,926**

Source: NCDC/Previous Plan

Impacts

Depending on the storm, size of the stone and the frequency that it is falling, hail can cause extensive damage to people, structures, unprotected property, livestock and crops. The total documented hail damage for Niobrara County is $6,779,953, which includes $6,579,027 in damage to property, and $200,936 in damage to crops. Most of the accumulated damage was to windows, vehicles, roofs and agricultural assets. The range of damages from a hailstorm can vary greatly, as table 8.1 shows; the highest recorded property damage total in 2015 dollars was almost $4.4 million, and the highest recorded crop damage total was $177,288.

Future Impacts

Niobrara County is in a hail prone region of Wyoming and will continue to experience damaging events, likely on an annual basis. Based on past documented storm damages averaged over the last 43 years, the potential damage to crops and property can be up to $1.4 million per storm. Future hail storms will impact private and public property such as cars, roofs, equipment, buildings, crops and livestock, and can occur on a county-wide basis. While Niobrara County has not had any documented injuries or fatalities caused by hail, Wyoming has suffered 14 injuries caused by hail between 1960 and 2014, so the threat is there. Due to the population density of Niobrara County, hailstorms occurring over Lusk will inflict more personal property damage and injuries than storms occurring over rural areas. There is no way to predict where hail will fall outside of a regional generalization.

Summary

PROPERTY AFFECTED: Medium

POPULATION AFFECTED: Medium

PROBABILITY: High

JURISDICTION AFFECTED: Lusk, County

9. LANDSLIDES

Landslides are one of the most common geologic hazards in Wyoming, with some of the highest landslide densities in the country found in the State. The figure below shows mapped landslides in Wyoming. Niobrara County is circled in blue.

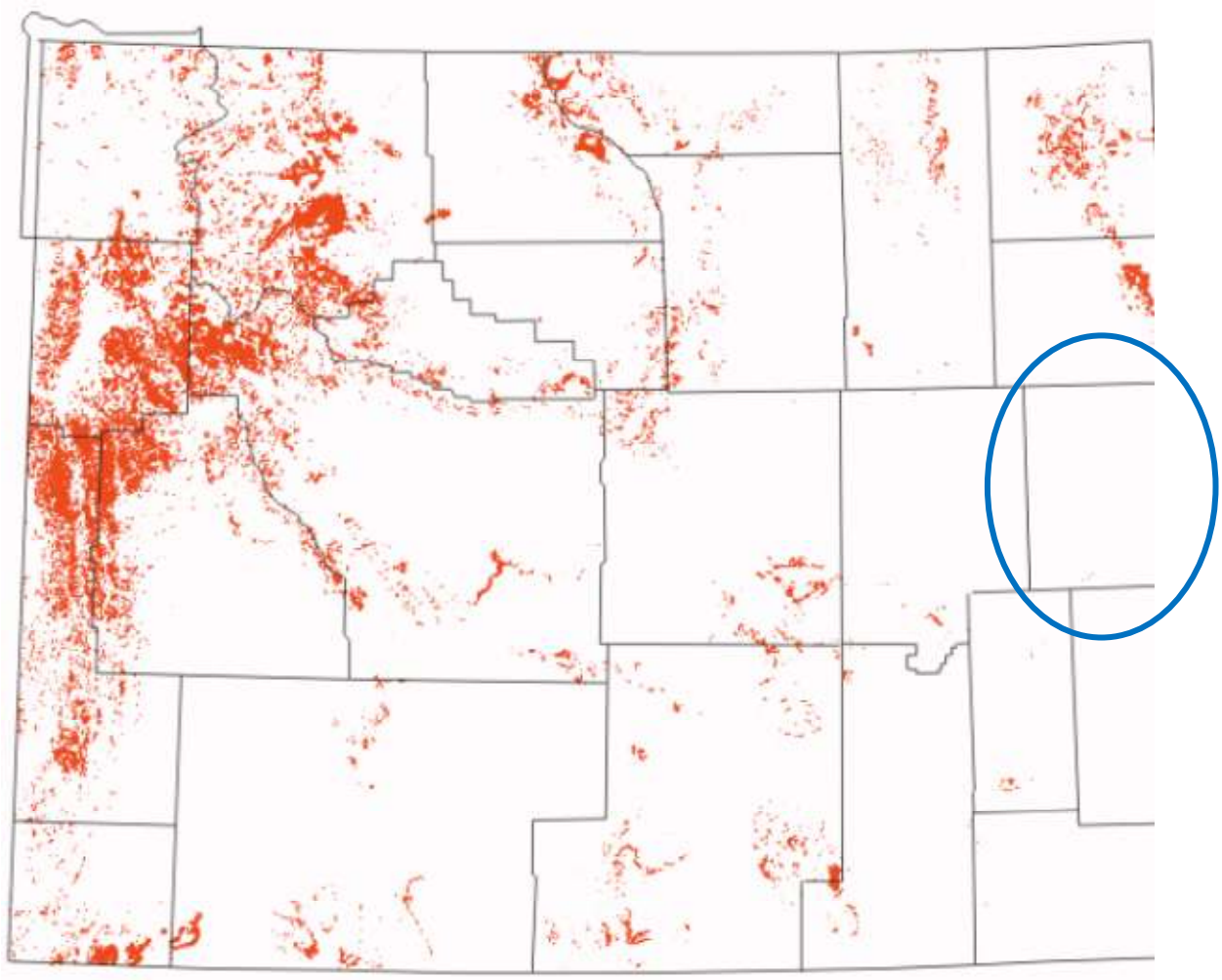


Figure 9-1: Mapped Landslides in Wyoming

There are many types of landslides present in Wyoming. In order to properly describe landslide type, the Geologic Hazards Section developed a landslide classification modified from Varnes (1978) and Campbell (1985). As can be seen in Figure 9.2 there are five basic types of landslides that occur in three types of material. Falls, topples, slides, lateral spreads, and flows can occur in bedrock, debris, or earth. While individual landslide types can occur in nature, most landslides are complex, or composed of combinations of basic types of landslides.

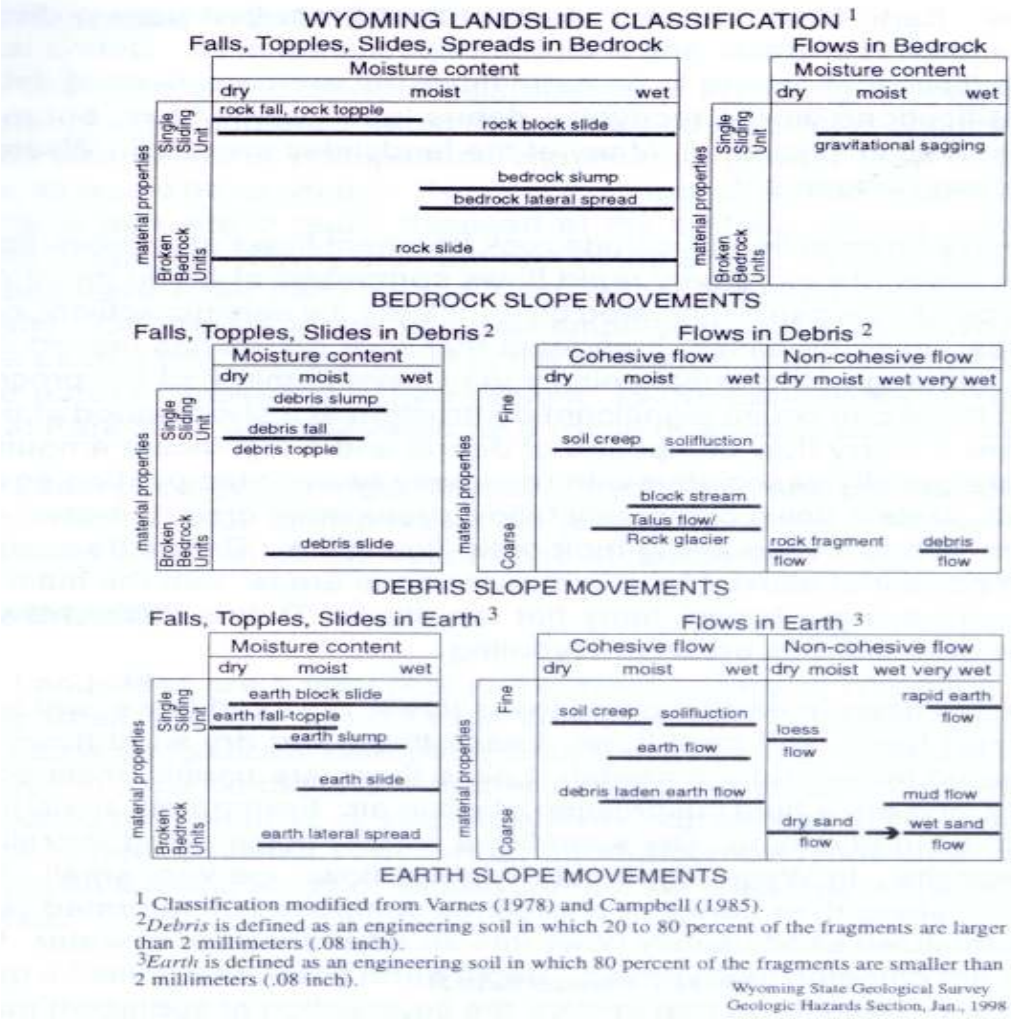


Figure 9-2: Wyoming Landslide Classification

History

A small landslide hazard area is present in the southern part of Niobrara County. Specifically landslides are present on the following Quadrangle:

Silver Springs

Landslides on the Silver Springs Quadrangle were examined by the Wyoming State Geological Survey and Niobrara County Emergency Management. A blockslide is present in Section 34, T32N, R64W. Rockfall/talus complexes are present in Sections 5 and 6, T 31N, R64W, and a small blockslide is present in Section 4, T31N, R64W.

None of the landslides are near or could have a significant effect on any cultural or historic landmarks, properties, or resources in the County. Mapped landslides for Niobrara County are shown on the figure below.

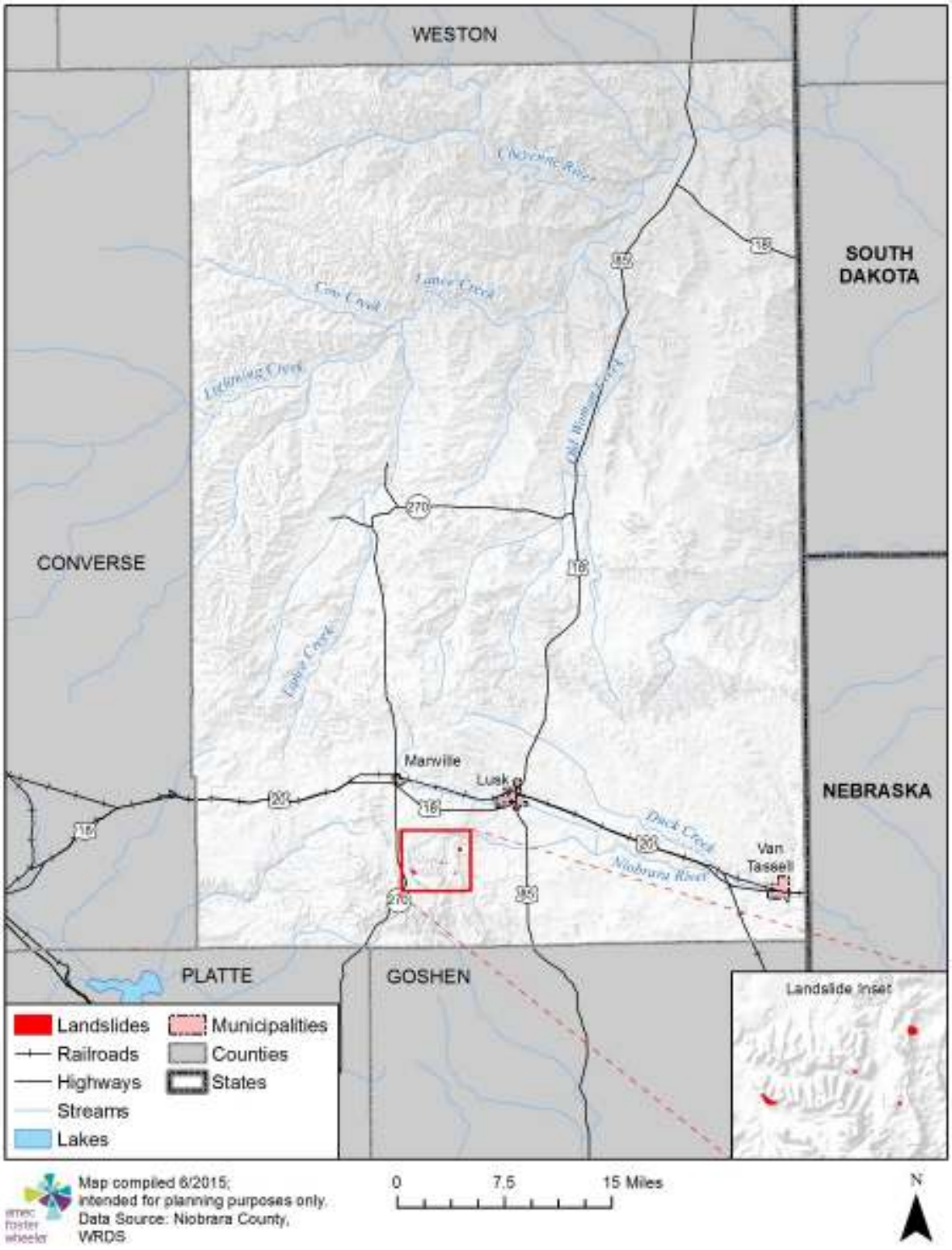


Figure 9-3: Mapped Landslides in Niobrara County

Future Impacts

There are three measures of future landslide impacts – historic dollar damages, estimated yearly damages, and building exposure values. There are not enough current data to estimate historic or yearly dollar damages. Landslides could also impact and damage railroad tracks, roads, pipelines for energy and resource delivery (including gas and water), and energy delivery.

The WSGS has calculated the building exposure value for buildings that may occur within 100 feet of a landslide. All landslides mapped in Wyoming have been digitized. The landslides then had a 100-foot buffer digitally added to the outside of the landslides. The modified landslides were then digitally crossed with Census block building values. In some cases, a landslide boundary will dissect a census block. In that case the proportional value of buildings in the census block will be assigned to the landslide. If a census block is within a landslide, then the values of all the buildings in the census block is assigned. The values derived by County are shown in Figure 9.4 below. Table 9.1 shows the ranking of counties based upon landslide building exposure values.

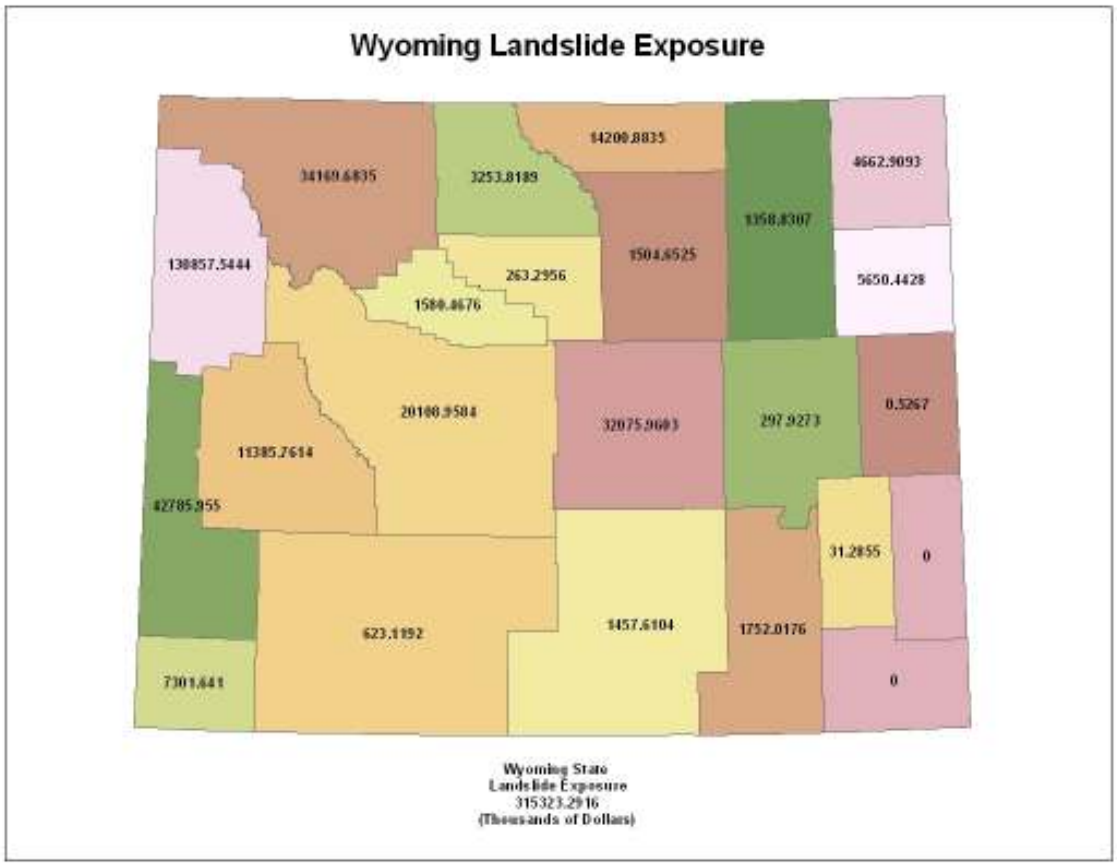


Figure 9-4: Wyoming Landslide Exposure by County

As outlined in Figure 9.4, there is approximately $5,650 in building value that is built on or near landslides. More detail for the County is provided in Figure 9.

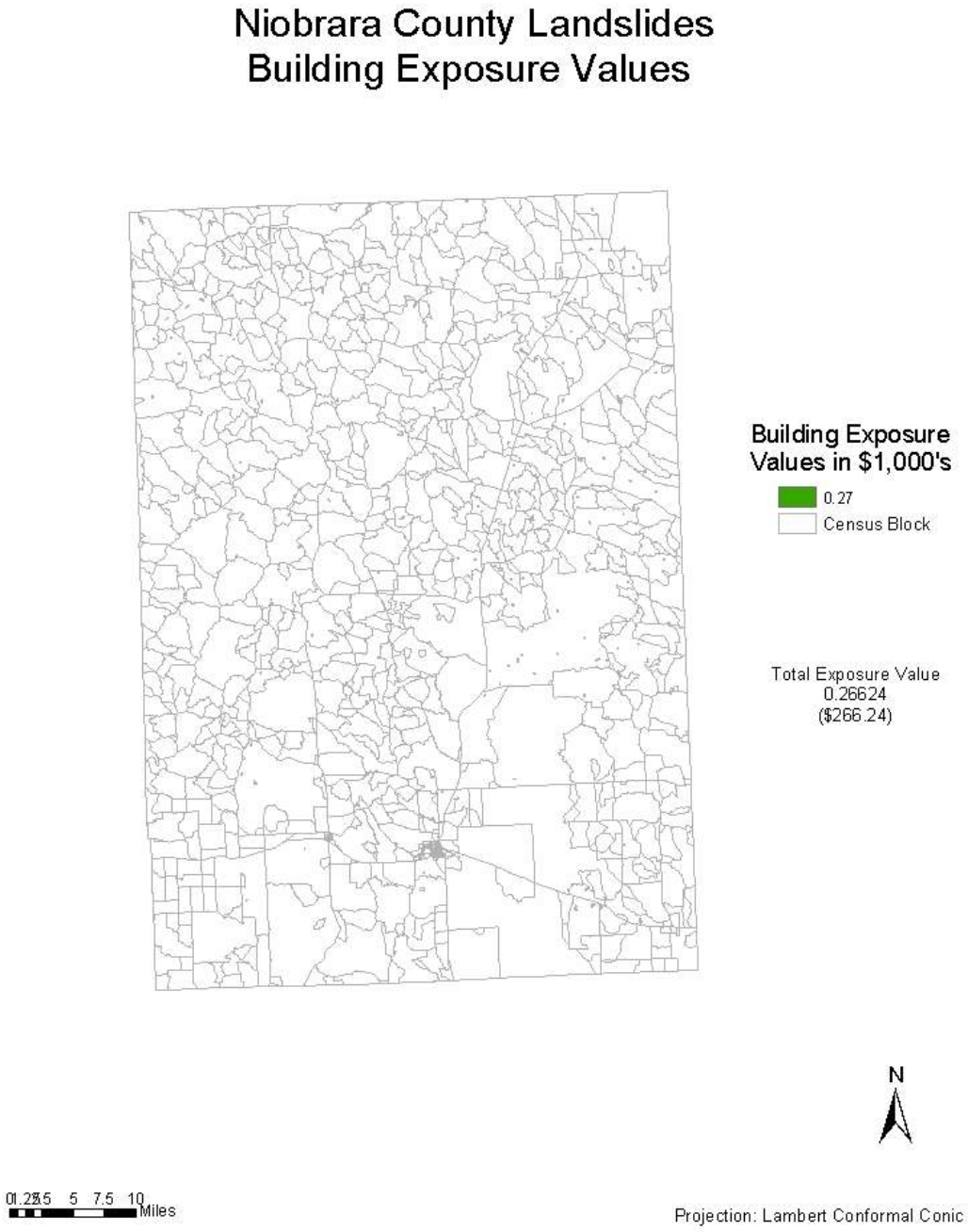


Figure 9-5: Wyoming Landslide Exposure in Niobrara County

Table 9-1: Building Exposure Values for Landslides

County	Landslide Building Exposure Value (USD)
Teton	130,857,545
Lincoln	42,785,955
Park	34,169,685
Natrona	32,075,960
Fremont	20,108,960
Sheridan	14,200,885
Sublette	11,385,760
Uinta	7,301,640
Weston	5,650,450
Crook	4,662,910
Big Horn	3,253,820
Albany	1,752,020
Hot Springs	1,580,470
Johnson	1,504,650
Carbon	1,457,610
Campbell	1,358,830
Sweetwater	623,120
Converse	297,930
Washakie	263,295
Platte	31,285
Niobrara	525
Goshen	0
Laramie	0

The probability of a landslide causing damage in Niobrara County is very low due to the limited presence of the hazard in the county. A recurrence interval is difficult to determine because of the poor historic data. The vulnerability of property and people potentially affected is one of the smallest in the State, however, with only Goshen and Laramie counties ranking lower.

Summary

PROPERTY AFFECTED:	Low
POPULATION AFFECTED:	Low
PROBABILITY:	Low
JURISDICTION AFFECTED:	Scattered, isolated areas across the County

10. LIGHTNING

Lightning is a sudden electrical discharge released from the atmosphere that follows a course from cloud to ground, cloud to cloud, or cloud to surrounding air, with light illuminating its path. Lightning's unpredictable nature causes it to be one of the most feared weather elements.

Anyone caught in an exposed area during a thunderstorm could be at risk to a lightning strike. In Wyoming, outdoor enthusiasts venturing to high and exposed areas should be especially cautious because rapid thunderstorm development with associated lightning can place even the most experienced climbers in jeopardy without warning.

History

Nationwide lightning strikes are routinely monitored by Vaisala, Inc. with accuracies to within a 0.625-mile (1 kilometer) resolution. Statewide, Vaisala's National Lightning Detection Network recorded an annual average of 291,409 lightning flashes between 1997 and 2012 in the State of Wyoming, with 148,754 flashes occurring in 2012.

Clearly the eastern plains have more than three times the cloud to ground lightning strikes as does the western half of the State. Parts of Niobrara County, along with Platte, Weston, Crook, Campbell, and Laramie counties, are the most active in the State.

The National Climatic Data Center (NCDC) defines a recordable lighting event as a sudden electrical discharge from a thunderstorm, resulting in a fatality, injury, and/or damage. In Niobrara County, there have been two lightning events between 1950 and 2014 that meet the NCDC's criteria. These events have resulted in zero fatalities, zero injuries, and over $11,000 in property and crop damage (2015 dollars).

It is important to note that dollar damage estimates may include damage from associated severe weather, including precipitation and wildland fire.

Table 10.1 includes NCDC-recorded lightning events that have caused deaths, injuries, and damage in Niobrara County.

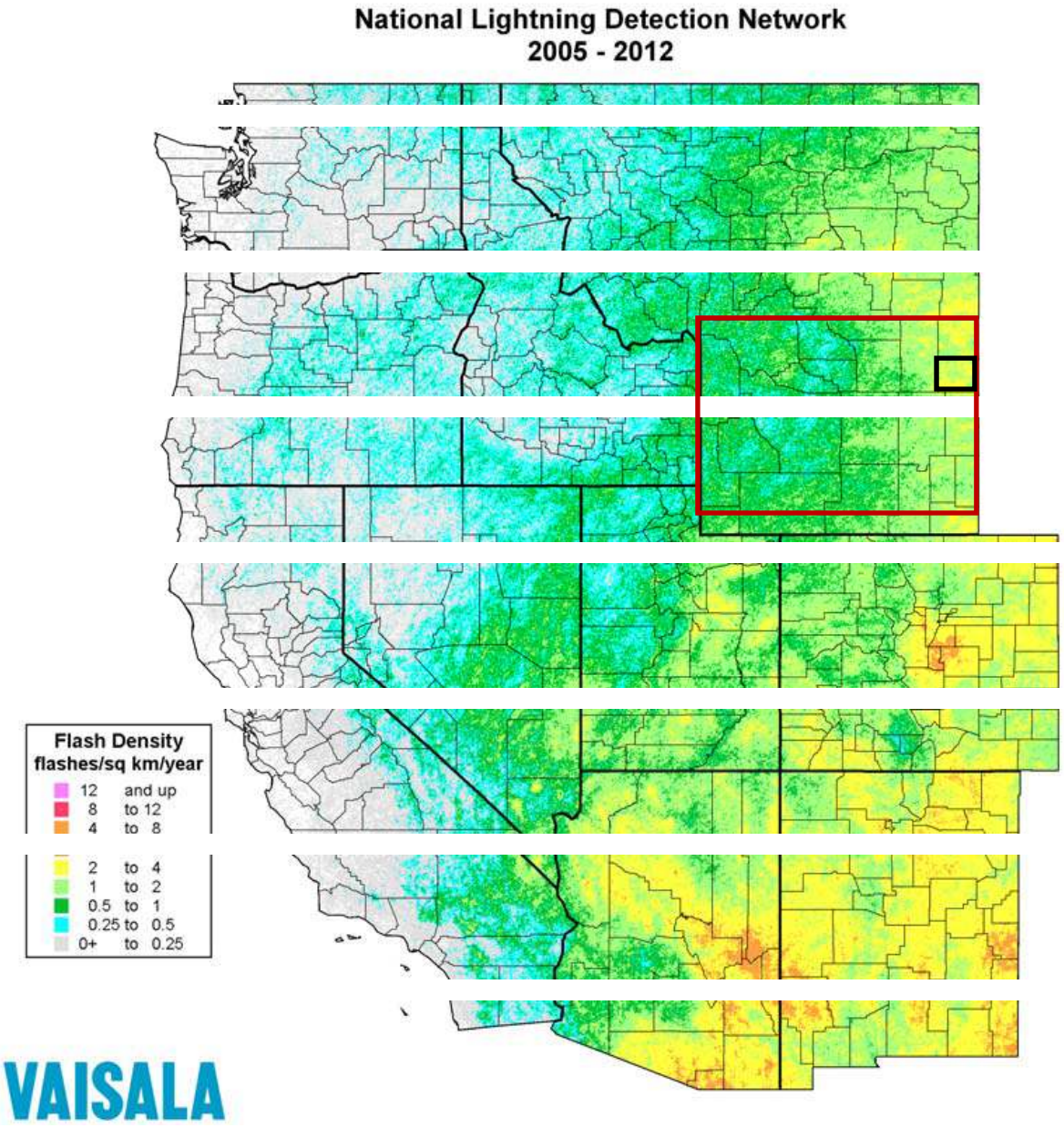


Figure 10-1: Average annual lightning flash density for 2005-2012 over Western U.S.

Illustration courtesy of Vaisala Inc.

Table 10-1: Recorded NCDC Lightning Events (1950-2014)

Location	Date	Fatalities	Injuries	Estimated Property Damage	Estimated Crop Damage	Total Estimated Damage	Storm Information
Northern Niobrara County	24 July 1997	0	0	$7,371	$4,422	$11,793	Ignited large-scale wild fire
Lance Creek	11 Sept 1997	0	0	$0	$0	$0	Ignited several brush fires
TOTAL		**0**	**0**	**$7,371**	**$4,422**	**$11,793**	

Impacts

Lightning strikes can be fatal to people who are exposed during a lightning storm, especially sportsmen and outdoor enthusiasts. Being outdoors at any time during a lightning storm is dangerous. Lightning strikes are not always fatal, and can cause devastating injuries to struck persons rather than killing them. Lightning can also strike livestock.

One of the biggest risks associated with lightning strikes is their ability to ignite fires, whether in a structure or in the wild. Northern Niobrara County had a large-scale grass/forest fire ignited by lightning in 1996. The fire burned for two days, and required 50,000-60,000 gallons of water before it was extinguished. Depending on what is struck, lightning can also short out electric systems and utilities disrupting commerce and every day activities.

Future Impacts

Future impacts from lightning are difficult to determine because of the erratic nature of storms. Because of Niobrara County's location in the eastern plains of Wyoming, it will remain susceptible to lightning strikes. Damaging lightning events can occur year-round, though they are most common in the spring and summer months. Impacts to persons and property are likely to remain isolated. It is fair to say that lighting causing injuries and/or fatalities to people and damage to property is an ever-present risk. Outdoor workers, outdoor enthusiasts and livestock will remain susceptible to lightning strikes. With the right conditions, lightning-caused wildland fires may cause extensive damage.

Summary

PROPERTY AFFECTED: Low

POPULATION AFFECTED: Low

PROBABILITY: High

JURISDICTION AFFECTED: County

11. HAZARDOUS MATERIALS AND WASTE

The general definition of a hazardous material is a substance or combination of substances which because of its quantity, concentration, or physical, chemical or infectious characteristics, may either (1) cause, or significantly contribute to, an increase in mortality or an increase in serious, irreversible, or incapacitating reversible, illness; or (2) pose a substantial present or potential hazard to human health or environment when improperly treated, stored, transported, disposed of or otherwise managed.

The U.S. Department of Transportation, U.S. Environmental Protection Agency, and the Occupational Safety and Health Administration all have responsibilities in regards to hazardous materials and waste. Presented below are the various definitions and general responsibilities of each of the agencies.

The U.S. Department of Transportation, which has control over transported hazardous materials, uses the following definition: Hazardous material means a substance or material that the Secretary of Transportation has determined is capable of posing an unreasonable risk to health, safety, and property when transported in commerce, and has designated as hazardous under section 5103 of Federal hazardous materials transportation law (49 U.S.C. 5103). The term includes hazardous substances, hazardous wastes, marine pollutants, elevated temperature materials, materials designated as hazardous in the Hazardous Materials Table (see 49 CFR 172.101), and materials that meet the defining criteria for hazard classes and divisions in part 173 of subchapter C of this chapter. The U.S. DOT has nine classes of hazardous material:

1. Explosives
2. Compressed Gasses: Flammable Gasses; Non-Flammable Compressed Gasses; Poisonous Gasses
3. Flammable Liquids: Flammable (Flash Point Below 141 degrees); Combustible (Flash Point 141 degrees – 200 degrees)
4. Flammable Solids: Flammable Solids; Spontaneously Combustible; Dangerous When Wet
5. Oxidizers and Organic Peroxides: Oxidizer; Organic Peroxide
6. Toxic Materials: Material that is Poisonous; Infectious Agents
7. Radioactive Material
8. Corrosive Material: Destruction of Human Skin; Corrode Steel at a Rate of 0.25 Inches Per Year
9. Miscellaneous

The U.S. Environmental Protection Agency also has responsibility for hazardous materials, chemicals, and wastes that have the potential to be released into the environment through stationary facilities. The Environmental Protection Agency (EPA) addresses through the Resource Conservation and Recovery Act (RCRA), the need for facilities with hazardous waste substances to store containers in some kind of containment system. Stationary containers, such as tanks, as well as portable storage containers, such as 55-gallon drums, are required to have a system that will protect the environment from this waste if a leak were to occur. Hazardous waste regulations appear in Title 40 of the Code of Federal Regulations. Portable container containment is addressed under Subpart I, Use and Management of Containers (EPA 40 CFR 264.175). Facilities dealing with the storage of hazardous materials may also be required to have containment if they are to meet the Uniform Fire Code (UFC) standards. Within the UFC standards, Section 80, Division III refers to Hazardous Materials Storage Requirements pertaining to containers and tanks and Division IV refers to Spill Containment with regard to hazardous materials.

The Emergency Planning and Community Right-to-Know Act (EPCRA) requires certain regulated entities to report information about hazardous chemicals and substances at their facilities to Federal, State, and local authorities. The objective is to improve the facilities', or government agencies' ability to plan for and respond to chemical emergencies, and to give citizens information about chemicals present in their communities. The President issued Executive Orders to Federal agencies that mandate their compliance with certain EPCRA requirements. Part of EPA's mission is to ensure that Federal facilities comply with these requirements. Sections 301 and 303 of EPCRA mandate the creation of two organizations; The State Emergency Response Commission (SERC) and the Local Emergency Planning Committee (LEPC). Sections 311-312 of EPCRA require facilities to submit material safety data sheets or Tier II forms (lists of hazardous chemicals on-site (above threshold quantities)) to SERC's, LEPC's, and local fire departments.

In addition to EPCRA, there is a Risk Management Program. When Congress passed the Clean Air Act Amendments of 1990, it required EPA to publish regulations and guidance for chemical accident prevention at facilities using extremely hazardous substances. The Risk Management Program Rule (RMP Rule) was written to implement Section 112(r) of these amendments. The rule, which built upon existing industry codes and standards, requires companies of all sizes that use certain flammable and toxic substances to develop a Risk Management Program, which includes a(n):

- Hazard assessment that details the potential effects of an accidental release, an accident history of the last five years, and an evaluation of worst-case and alternative accidental releases;
- Prevention program that includes safety precautions and maintenance, monitoring, and employee training measures; and
- Emergency response program that spells out emergency health care, employee training measures and procedures for informing the public and response agencies (e.g. the fire department) should an accident occur.

By June 21, 1999, a summary of the facility's risk management program (known as a "Risk Management Plan" or "RMP") was to be submitted to EPA, which will make the information publicly available. The plans must be revised and resubmitted every five years.

The Risk Management Program is about reducing chemical risk at the local level. This information helps local fire, police, and emergency response personnel (who must prepare for and respond to chemical accidents), and is useful to citizens in understanding the chemical hazards in communities. EPA anticipates that making the RMPs available to the public stimulates communication between industry and the public to improve accident prevention and emergency response practices at the local level.

The Occupational Safety and Health Administration (OSHA), established under the Department of Labor by the OSHA Act of 1970, regulates the storage and use of toxic and hazardous substances as they relate to worker health and safety. OSHA regulations are found in Title 29 of the Code of Federal Regulations (CFR), Part 1910, Subpart H.

History

According to the "Wyoming State Emergency Response Commission 2003 Annual Report", there was only one hazardous material spill reported in Niobrara County in 2003. In 1996, a gas pipeline ruptured in the northern part of the County. Comparing the "Wyoming State Emergency Response Commission 2003 Annual Report" with the 2004 annual report, the number of facilities statewide reporting

hazardous materials decreased from 53 in 2003 to 31 in 2004. The majority of the spills statewide in both years were related to petroleum production.

Between 2010 and 2015, Niobrara County has had two hazardous materials incidents, which both occurred on the highway north of Manville. Both incidents involved hot oil tankers overturning and spilling on the highway north of Manville, one in spring 2014, and one in spring 2015. In both cases, the County cleaned up the mess and there was no need for assistance from the regional response team.

Impacts

Depending on the chemical spilled and the specifics of the incident, hazardous material's incidents can have many impacts, including roadway closures, evacuations/shelter in place orders, injuries, fatalities and long-term health impacts, environmental—air, soil, and water damage, damage to buildings, homes and other property. Data on clean-up costs is not readily available, although the costs of cleaning up a serious spill could be many tens of thousands of dollars.

Future Impacts

Hazardous material spills will continue in Wyoming and the rest of the nation. There are some facilities, however, that contain extremely hazardous substances. Those are the facilities that are required to generate Risk Management Plans. An accident resulting in the release of chemicals from those facilities could pose a significant problem to local jurisdictions and the State of Wyoming. Life safety is a concern related to transportation incidents that may occur on major roadways or railways in the County. US Route 18, US Route 85, US Route 20, the Union Pacific Railroad, and the Lusk Municipal Airport are all potential sources of hazardous materials exposures.

Existing and future buildings are at low risk for hazardous material incidents in the County.

There are no Risk Management Plan facilities present in Niobrara County. No additional information is available for this report because of Homeland Security concerns.

Summary

PROPERTY AFFECTED:	Low
POPULATION AFFECTED:	Low
PROBABILITY:	Low
JURISDICTION AFFECTED:	Lusk, County

12. TORNADOES

Wyoming, lying just west of "Tornado Alley," is fortunate to experience less frequent and intense tornadoes than neighboring states to the east. However, tornadoes remain a significant hazard in the State. Tornadoes are the most intense storm on earth, having been recorded at velocities exceeding 315 mph. The phenomenon results in a destructive rotating column of air ranging in diameter from a few yards to greater than a mile, usually associated with a downward extension of a cumulonimbus cloud. Tornadoes are classified by their intensity by using the Fujita (F) Scale, with F0 being the least intense and F5 being the most intense. In 2007, the Enhanced Fujita Scale was released (Table 12.1).

Table 12-1: Fujita Scale of Tornado Intensity

Fujita Scale	Wind Speed (mph)	Typical Damage
F0	40-72	Light
F1	73-112	Moderate
F2	113-157	Considerable
F3	158-206	Severe
F4	207-260	Devastating
F5	261-318	Incredible

Enhanced Fujita (EF) Scale	
EF Scale	**Wind Speed (mph)**
EF0	65-85
EF1	86-110
EF2	111-135
EF3	136-165
EF4	166-200
EF5	Over 200

According to the Wyoming Climate Atlas, the State of Wyoming ranks 25th in the number of annual tornadoes (10), 33rd in fatalities (six deaths per million people), 37th in injuries, and 36th in property damage ($49,339,505) in the US from 1950-1994.[6]

[6] Jan Curtis and Kate Grimes, *Wyoming Climate Atlas* "Chapter 7.4 Tornadoes" . Available online at http://www-wwrc.uwyo.edu/sco/climateatlas/severe_weather.html#74 last accessed January 26, 2009.

Tornado statistics, especially prior to the 1970s, is viewed as incomplete since many storms must have occurred without being reported or witnessed. Wyoming's open rangelands experience little if any damage from these storms so many go unreported. In the 1990s, the Internet and Doppler radar increased the public's awareness of tornadoes and offered the potential that more tornadoes could be observed and reported. The trend in annual tornadoes has decreased since 1976 and appears to have coincided with a major hemispheric weather pattern shift, despite the increased reporting based on Doppler radar vortex (circulation) signatures.[7]

History

According to the National Oceanic and Atmospheric Administration's (NOAA) National Climatic Data Center (NCDC), 30 separate tornadoes have been recorded in Niobrara County since 1950. Of these, 13 tornadoes were classified as "damaging". Damage is defined by those events that resulted in loss of property or life. A damaging tornado occurs in Niobrara County every 4.9 years on average, based upon the compiled data; it is important to note that the County has not had a damaging tornado since 1984. Tornadoes have been responsible for 0 deaths and 5 injuries in Niobrara County, according to available data.

On June 13th, 1984, Niobrara had a small outbreak of F0, F1 and F2 tornadoes. The storms caused property damage in several areas across the County, and injured one person.

Most of the tornadoes that have occurred in Niobrara County since 1950 have been F0 or F1. The County has had three F2s, and no tornadoes rated higher than an F2 on the Fujita Scale. According to NCDC data, the County has not had a tornado rated higher than F0 since 1985.

Since 1950, the majority of tornadoes in Niobrara County occurred in the month of June. Historically, all

Niobrara County tornadoes recorded by the NCDC since 1950 have occurred between April and September, though there is a risk of tornadoes in other months. Tornadoes are most likely to occur in late afternoon or evening. Most historical recorded tornadoes in Niobrara County occurred between 2 p.m. and 10 p.m., although there is risk at any time of day or night for a tornado to form.

[7] Ibid.

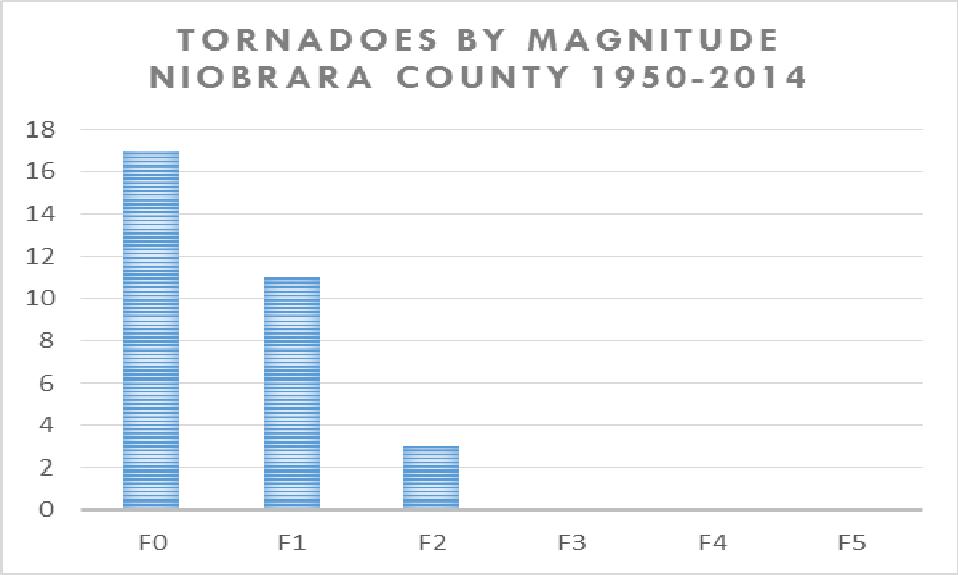


Figure 12-1: Tornadoes by Magnitude Niobrara County 1950- 2014

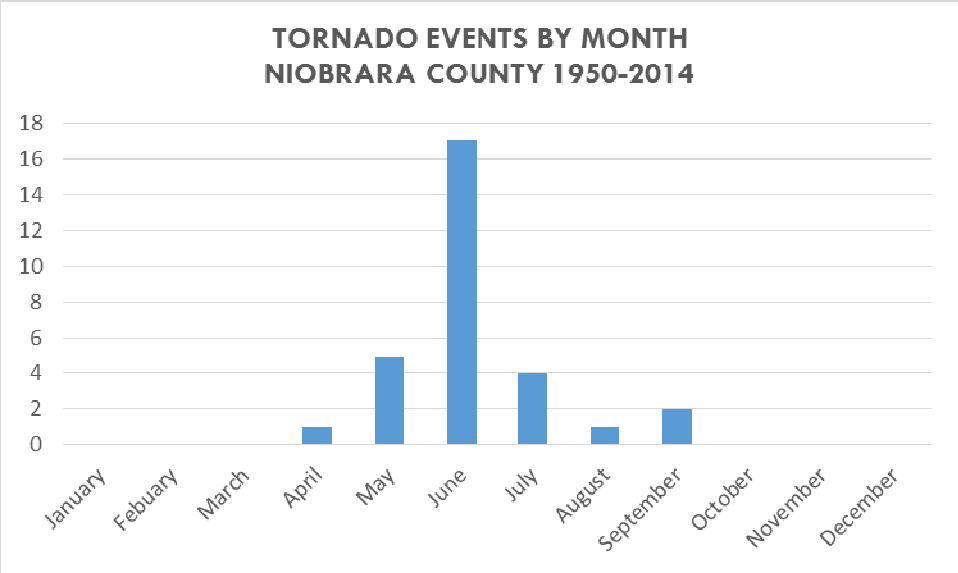


Figure 12-2: Tornado Events by Month Niobrara County 1950 - 2014

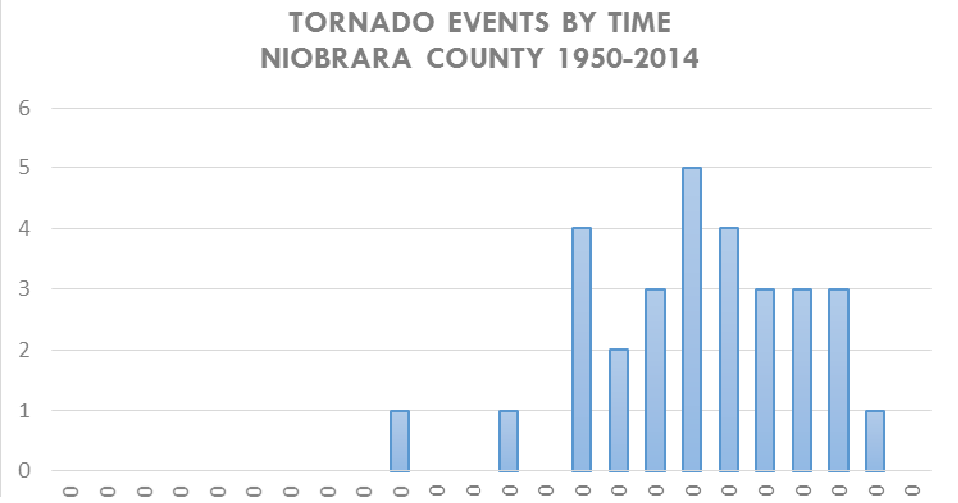


Figure 12-3: Tornado Events by Time Niobrara County 1950 - 2014

Table 12-2: TORNADOES IN NIOBRARA COUNTY, WYOMING, 1950-2014

LOCATION	COUNTY/ZONE	DATE	TIME	MAGNITUDE	INJURIES	FATALITIES	PROPERTY DAMAGE (2015 USD)	CROP DAMAGE (2015 USD)
Niobrara	Niobrara	06/07/1950	15:30	F1	0	0	$2,939	$0
Niobrara	Niobrara	05/08/1952	12:30	F1	0	0	$2,673	$0
Niobrara	Niobrara	06/11/1953	16:00	F1	0	0	$22,109	$0
Niobrara	Niobrara	05/24/1960	15:30	F1	1	0	$199,425	$0
Niobrara	Niobrara	06/26/1960	21:00	F1	0	0	$19,942	$0
Niobrara	Niobrara	06/14/1962	17:45	F0	0	0	$0	$0
Niobrara	Niobrara	07/17/1962	22:00	F1	0	0	$195,463	$0
Niobrara	Niobrara	04/12/1976	19:10	F1	0	0	$103,743	$0
Niobrara	Niobrara	09/21/1977	21:45	F0	0	0	$0	$0
Niobrara	Niobrara	07/28/1978	19:00	F2	0	0	$905,364	$0
Niobrara	Niobrara	08/01/1979	21:00	F0	0	0	$81,308	$0
Niobrara	Niobrara	06/14/1980	16:15	F0	0	0	$0	$0
Niobrara	Niobrara	06/05/1982	20:30	F2	3	0	$611,707	$0
Niobrara	Niobrara	06/20/1983	18:40	F1	0	0	$711	$0
Niobrara	Niobrara	06/13/1984	17:00	F1	0	0	$56,814	$0
Niobrara	Niobrara	06/13/1984	17:00	F1	0	0	$56,814	$0
Niobrara	Niobrara	06/13/1984	17:00	F1	0	0	$56,814	$0
Niobrara	Niobrara	06/13/1984	19:00	F2	1	0	$568,140	$0
Niobrara	Niobrara	07/26/1985	20:40	F0	0	0	$5,486	$0

LOCATION	COUNTY/ZONE	DATE	TIME	MAGNITUDE	INJURIES	FATALITIES	PROPERTY DAMAGE (2015 USD)	CROP DAMAGE (2015 USD)
Niobrara	Niobrara	07/26/1985	20:41	F0	0	0	$5,486	$0
Niobrara	Niobrara	05/13/1990	16:25	F0	0	0	$4,516	$0
Niobrara	Niobrara	09/19/1990	17:32	F0	0	0	$0	$0
Niobrara	Niobrara	06/26/1991	18:17	F0	0	0	$0	$0
Niobrara	Niobrara	06/29/1991	18:17	F0	0	0	$0	$0
Niobrara	Niobrara	08/07/1991	18:45	F0	0	0	$0	$0
Niobrara	Lusk	05/20/1998	14:25	F0	0	0	$0	$0
Niobrara	Van Tassell	05/21/1998	09:35	F0	0	0	$0	$0
Niobrara	Lusk	06/27/1999	14:28	F0	0	0	$0	$0
Niobrara	Lance Creek	06/12/2001	14:05	F0	0	0	$0	$0
Niobrara	Redbird	06/12/2011	13:58	F0	0	0	$0	$0
Niobrara	Redbird	06/12/2011	14:30	F0	0	0	$0	$0
				TOTALS	**5**	**0**	**$2,899,454**	**$0**

Future Impacts

Tornadoes remain a significant threat for Niobrara County. While the County has not seen a damaging tornado since 1990, this can partly be attributed to the County's vast areas of undeveloped land. A tornado is still a threat to form anywhere at any time. Niobrara County's 18 historical damaging tornadoes have averaged $161,000 in property damage (2015 dollars), with the most destructive causing $905,364 in property damage (2015 dollars) in 1978. Most of the damage occurred on ranches, and homes and buildings remain vulnerable to these powerful storms. Because of the random nature of tornadoes, it is difficult to predict where the next one will hit, what will be affected, or how damaging it will be.

Based upon the historic record between 1950 and 2014, a damaging tornado will occur approximately every three years, although there have been longer gaps of times between occurrences since 1990.

At the public meetings held in Niobrara County during the previous revision, participants felt strongly that the number of tornadoes captured in the data significantly under-represented the actual number of tornadoes that have occurred in the County.

Summary

PROPERTY AFFECTED:	High
POPULATION AFFECTED:	Medium
PROBABILITY:	High
JURISDICTION AFFECTED:	County

13. WILDLAND FIRES

Niobrara County, because of its semi-arid climate, available fuels and rural character, is vulnerable to catastrophic wildland fires in some locations. Of all the fires in Wyoming, over 50% involve wildland areas. As defined by the National Interagency Fire Center (NIFC), a "wildland fire is any non-structure fire, other than prescribed fire, that occurs in an area in which development is essentially non-existent, except for roads, railroads, power lines, and similar transportation facilities." Before discussing wildland fire hazard in Niobrara County, some key terms should be identified. The term "wildland/urban interface" or WUI is widely used within the wildland fire management community to describe any area where buildings are constructed close to or within a boundary of natural terrain and fuel, where high potential for wildland fires exists. "Aspect" refers to the direction in which a slope faces. "Fuel" consists of combustible material, including vegetation, such as grass, leaves, ground litter, plants, shrubs, and trees that feed a fire.

As the population and the wildland/urban interface in Wyoming increases, the more significant the risk of wildland fire hazard. The past 100 years of wildland fire suppression has led to heavy vegetation growth and thus has greatly increased the potential fuel-load for a wildfire to burn. As the wildland/urban interface has grown into these densely packed forests, the potential for catastrophic wildland fires has increased as well.

Wyoming wildland fires are managed and supported to varying extents through cooperative efforts by the:

1. Bureau of Land Management (BLM) Wyoming Fire Program
2. Geospatial Multi-Agency Coordination (GeoMAC) Wildland Fire Support Maps
3. Wyoming Fire Academy
4. Wyoming Wildland Fire Plan Action Team
5. National Park Service (NPS) Fire Management Program
6. US Fish and Wildlife Service (FWS) Fire Management Branch
7. National Interagency Fire Center (NIFC)
8. Bureau of Indian Affairs (BIA) Fire and Aviation Management – NIFC
9. USDA Forest Service (USFS) Fire and Aviation Management
10. Wyoming State Forestry Division

Currently, the principal action plan for the State is the Wyoming Wildland Urban Interface Hazard Assessment produced by a joint venture of the Wyoming State Forestry Division, USFS, BLM, NPS, and other interested parties, with the BLM hosting the data. The Assessment maps fire hazard incorporating population density against slope, aspect, and fuels. With the mapping analysis evaluating areas of varying wildfire vulnerability, the final output will result in a Risk, Hazard, and Value (RHV) map displaying areas of concern (Redzones) for catastrophic wildland fires. The Wyoming Wildland Urban Interface Hazard Assessment builds on the work of earlier hazard methodologies and provides new and updated data to further enhance accuracy and scale.

Niobrara County develops an annual operating plan between the Bureau of Land Management, Wyoming State Forestry Division, and the County. The document outlines the details of the Wyoming interagency cooperative agreements for the County by outlining the specific fire zones that Niobrara supports, either primarily or as a secondary responder. This effort supports statewide fire mitigation and response plans.

History

The wildland fire history for the State of Wyoming has been compiled in the Wyoming Multi-Hazard Mitigation Plan from various State and federal sources. Unfortunately the data does not provide detail to the County level. Wyoming's damaging fire seasons often coincide with times of drought, which indicates that the risk assessments for drought and wildfire are tied together. One of the worst fire seasons occurred during 1988, when fifty fires started in Yellowstone National Park. These fires, along with other natural and human-caused fires that began outside the Park boundaries eventually burned more than a third of the Park, nearly 800,000 acres. Another 700,000 acres outside the Park also burned. Approximately 25,000 firefighters worked to put out the fires. The costs exceeded $120 million.

Table 13.1 summarizes recent wildland fire incidents including lightning-caused fires listed in a National Weather Service severe weather database. Figure 13.1 depicts the location of historical wildfires in the County between 1980 and 2013.

Table 13-1: Number of Wildland Fires and Acres Burned in Wyoming, 1960-2012

Year	Intensity type	Amount		
		Federal land	State & private land	Total
1960	Number of fires	159	39	198
	Number of acres burned	2,533	840	3,373
1961	Number of fires	147	57	204
	Number of acres burned	1,193	16	1,209
1962	Number of fires	116	20	136
	Number of acres burned	241	44	285
1963	Number of fires	141	31	172
	Number of acres burned	1,367	764	2,131
1964	Number of fires	143	24	167
	Number of acres burned	3,650	393	4,043
1965	Number of fires	68	15	83
	Number of acres burned	228	94	322

Year	Intensity type	Amount		
		Federal land	State & private land	Total
1966	Number of fires	261	243	504
	Number of acres burned	2,391	4,908	7,299
1967	Number of fires	135	156	291
	Number of acres burned	325	4,490	4,815
1968	Number of fires	163	132	295
	Number of acres burned	2,551	12,122	14,673
1969	Number of fires	231	396	627
	Number of acres burned	2,980	25,981	28,961
1970	Number of fires	241	413	654
	Number of acres burned	7,984	11,378	19,362
1971	Number of fires	209	433	642
	Number of acres burned	3,406	67,567	70,973
1972	Number of fires	183	438	621
	Number of acres burned	1,362	24,078	25,440
1973	Number of fires	200	444	644
	Number of acres burned	2,911	10,047	12,958
1974	Number of fires	301	772	1,073
	Number of acres burned	5,000	27,847	32,847
1975	Number of fires	205	513	718
	Number of acres burned	6,101	15,177	21,278
1976	Number of fires	349	589	938
	Number of acres burned	7,019	14,795	21,814
1977	Number of fires	369	612	981
	Number of acres burned	6,045	16,885	22,930
1978	Number of fires	301	559	860
	Number of acres burned	3,392	5,220	9,152

Year	Intensity type	Amount		
		Federal land	State & private land	Total
1979	Number of fires	366	598	964
	Number of acres burned	12,100	16,294	28,394
1980	Number of fires	333	603	936
	Number of acres burned	2,426	15,665	18,091
1981	Number of fires	406	677	1,083
	Number of acres burned	30,326	6,757	37,083
1982	Number of fires	205	555	760
	Number of acres burned	1,779	16,026	17,805
1983	Number of fires	177	734	911
	Number of acres burned	2,294	25,136	27,430
1984	Number of fires	169	607	776
	Number of acres burned	658	13,305	13,963
1985	Number of fires	352	1,252	1,604
	Number of acres burned	11,227	56,185	67,412
1986	Number of fires	202	546	748
	Number of acres burned	6,385	15,325	21,710
1987	Number of fires	201	816	1,017
	Number of acres burned	7,872	21,123	28,995
1988	Number of fires	504	1,456	1,960
	Number of acres burned	1,413,175	124,127	1,537,302
1989	Number of fires	278	738	1,016
	Number of acres burned	4,331	25,088	29,419
1990	Number of fires	353	492	845
	Number of acres burned	2,221	31,499	33,720
1991	Number of fires	379	836	1,215
	Number of acres burned	16,106	61,944	78,050
1992	Number of fires	407	872	1,279

Year	Intensity type	Amount		
		Federal land	State & private land	Total
	Number of acres burned	6,750	33,727	40,477
1993	Number of fires	163	303	466
	Number of acres burned	4,283	4,628	8,911
1994	Number of fires	584	1,027	1,611
	Number of acres burned	44,207	58,480	102,687
1995	Number of fires	250	597	847
	Number of acres burned	2,846	12,697	15,525
1996	Number of fires	516	1,506	2,022
	Number of acres burned	105,687	417,310	522,997
1997	Number of fires	171	738	909
	Number of acres burned	8,420	20,016	28,436
1998	Number of fires	1127	4466	5585
	Number of acres burned	17,5697	5,3736	22,9425
1999	Number of fires	1587	5746	7325
	Number of acres burned	37,2047	47,0976	84,3015
2000	Number of fires	339	909	1,248
	Number of acres burned	261,967	358,697	620,664
2001	Number of fires	4867	2196	7058
	Number of acres burned	138,6967	18,4146	157,1108
2002	Number of fires	303	815	1,118
	Number of acres burned	60,007	163,227	223,234
2003	Number of fires	283	727	1,010
	Number of acres burned	44,797	22,888	67,685
2004	Number of fires	185	655	850
	Number of acres burned	2,665	23,909	26,574
2005	Number of fires	190	697	887
	Number of acres burned	8,695	17,104	25,779

Year	Intensity type	Amount		
		Federal land	State & private land	Total
2006	Number of fires	289	1,008	1,297
	Number of acres burned	57,893	262,151	320,044
2007	Number of fires	254	816	1070
	Number of acres burned	50,878	52,304	107,505
2008	Number of fires	211	533	744
	Number of acres burned	88,908	51,456	140,364
2009	Number of fires	248	422	670
	Number of acres burned	939	5,778	6,717
2010 (Estimate)	Number of fires	321	541	562
	Number of acres burned	23,926	67,062	90,988
2011	Number of fires	643	355	998
	Number of acres burned	130,129	92,948	223,077
2012	Number of fires	802	547	1,349
	Number of acres burned	334,948	427,559	762,507

Source: Wyoming Multi-Hazard Mitigation Plan Comprehensive Update, June 2014

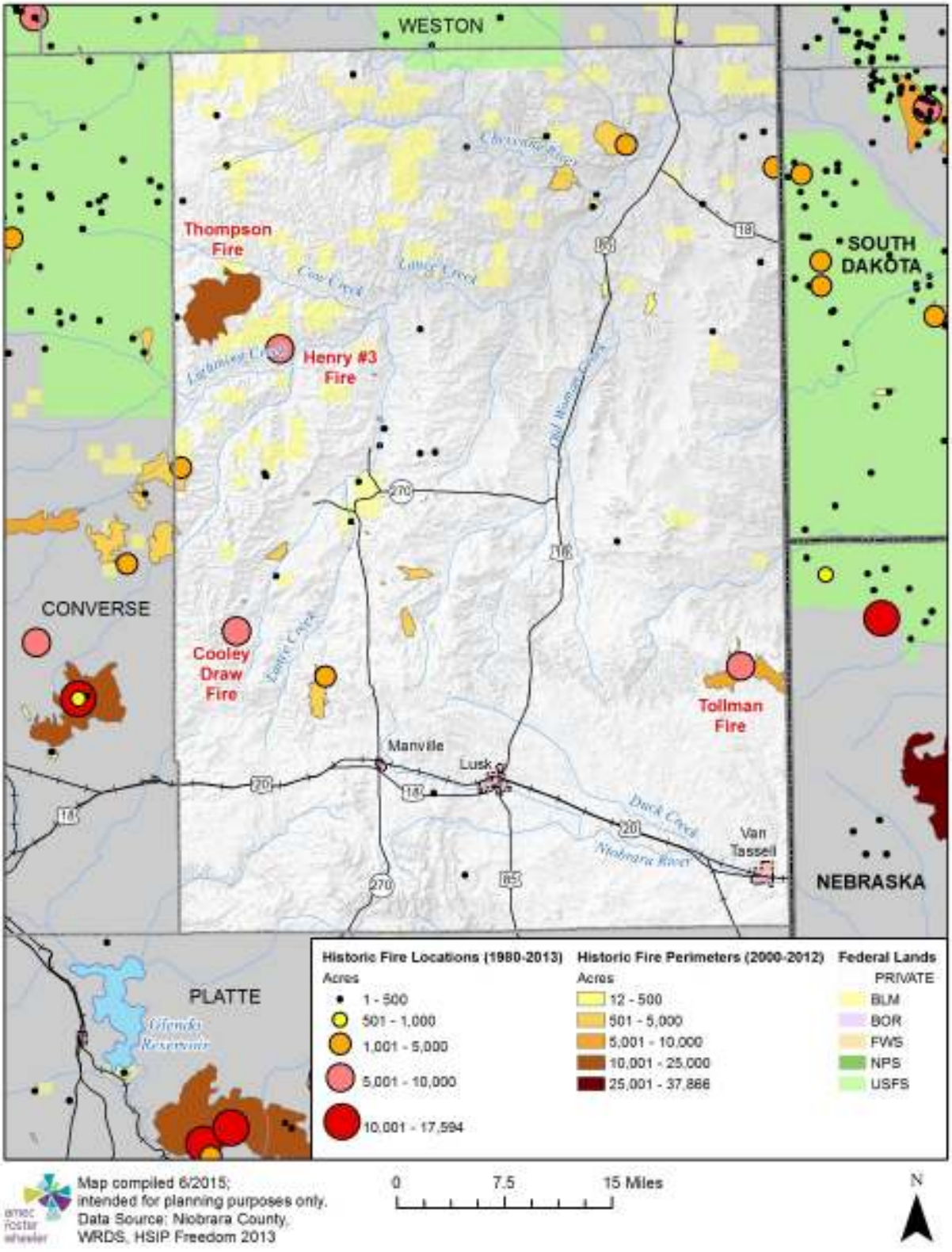


Figure 13-1: Niobraba County Wildland Fire Occurrences: 1980-2013

Impacts

GIS is a tool that is used to compare, capture, input, output, store, manipulate, analyze, model, and display spatial data. In the case of the Wildland Urban Interface Hazard Assessment, wildfire hazard vulnerability is determined by comparing values such as slope, vegetation, housing density, and aspect. The following is from the Wyoming Wildland Urban Interface Hazard Assessment Methodology—a report written by the Wyoming State Forestry Division:

The Wildland Urban Interface Hazard Assessment uses three main layers to determine fire danger—Risk, Hazard, and Values. The following lists include the data used to create each of the three layers.

- Risk – Probability of Ignition
- Lightning Strike density
- Road density
- Historic fire density
- Hazard – Vegetative and topological features affecting intensity and rate of spread
- Slope
- Aspect
- Fuels – Interpreted from GAP Vegetation information.
- Values – Natural or man-made components of the ecosystem on which a value can be placed.
- Housing Density – Life and property
- Non-flammable areas Mask – a mask was created to aid in the analysis for areas that will not carry fire such as water and rock areas. These areas show in the final assessment as a zero value for hazard.

The statewide Wildland Urban Interface Hazard Assessment and its resultant outputs serve two primary purposes: assisting in prioritizing and planning mitigation projects and creating a communications tool to which agencies can relate to common information and data. With the mapping analysis evaluating areas of varying wildfire vulnerability, the final output will result in a Risk, Hazard, and Value (RHV) map displaying areas of concern (Redzones) for catastrophic wildland fires. The Redzone map for Niobrara County follows. The Town of Lusk is in close proximity to the Redzone.

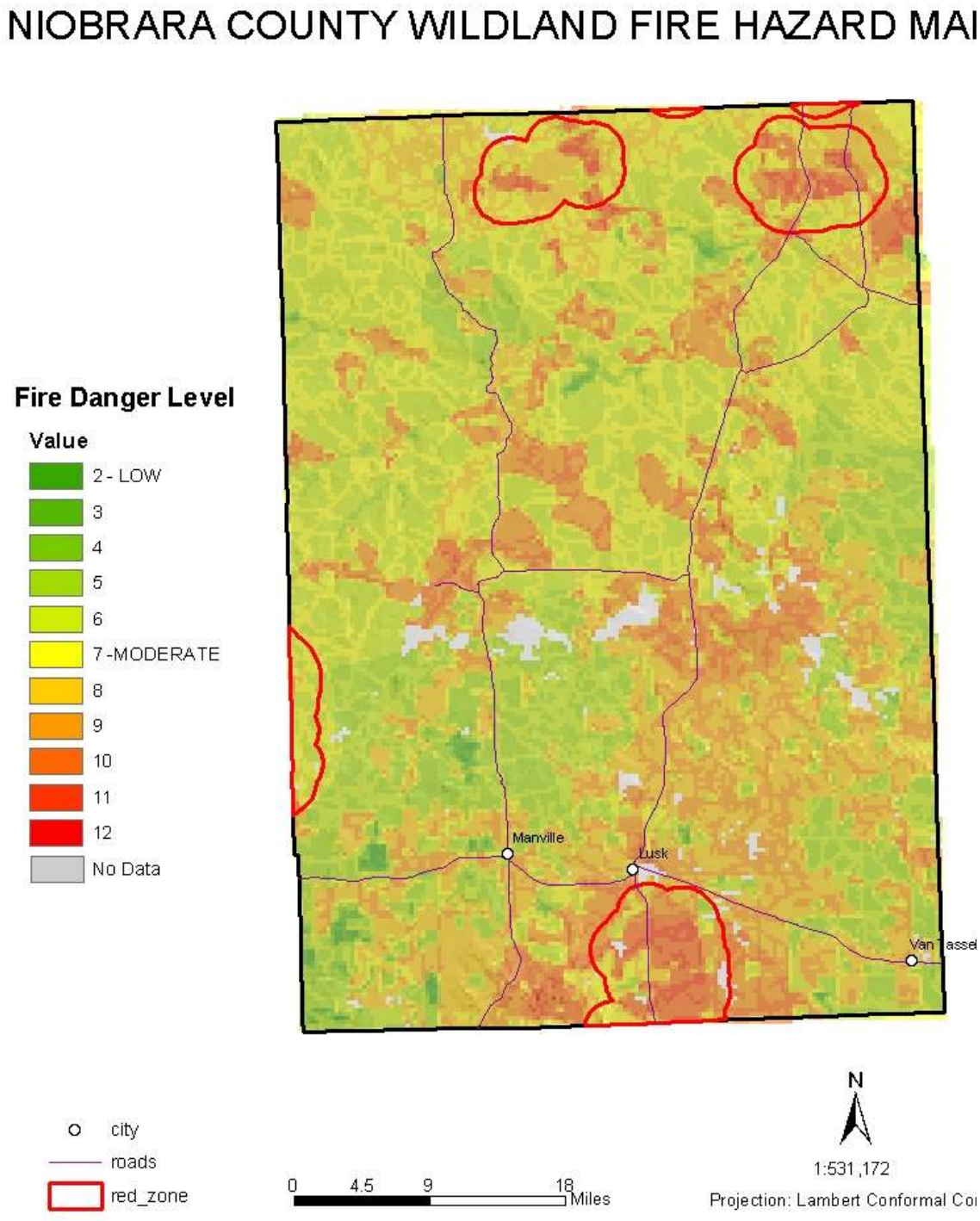


Figure 13-2: Niobrara County Wildland Fire Base Map with Redzones

Table 13-2: Wildland fire building exposure values by County (USD)

County	Amount of damage
Big Horn	1,090,772
Niobrara	4,852,748
Washakie	11,368,310
Platte	18,264,504
Hot Springs	25,587,017
Goshen	37,962,569
Carbon	83,931,249
Sublette	95,442,304
Uinta	105,943,675
Converse	132,529,212
Lincoln	171,746,619
Crook	184,102,247
Park	194,432,223
Albany	261,395,171
Sweetwater	279,772,342
Weston	311,602,160
Fremont	322,353,040
Johnson	451,817,404
Campbell	741,143,167
Natrona	894,951,685
Laramie	1,107,754,091
Sheridan	1,544,049,533
Teton	1,546,011,448
TOTAL	**$8,528,103,488**

Niobrara County is ranked second to last in terms of building exposure values to wildfire in the State (Table 13.2). This is due in part because of the relatively low wildfire risk compared to the rest of the State, and in part because of the building and population density of Niobrara, which is very low.

Figure 13.3 uses the Redzone data from the State Wildland Urban Interface Hazard Assessment Methodology. It demonstrates that the vast majority of the County has a low to moderate fire assessment, with six Redzones present in the County. Of these, only two are entirely contained in Niobrara County. One large Redzone comes dangerously close to the Town of Lusk, which may potentially increase the risk of the majority of population and property value (due to the unusually high concentration of housing and population in the Town relative to the rest of the County).

Another method of estimating potential future impact is to determine the value of structures that are located within Redzones, or wildland fire building exposure values. Wildland fire building exposure value is the value of buildings that can be potentially damaged by wildland fire in an area. Building exposure values are based on Census Block level data from HAZUS. The methodology utilized is similar to that used to model flood exposure described in Chapter 7 Floods. In Figure 13.3, the assessment parallels the Redzones identified in the previous figure. As expected, the greatest exposed property falls inside the zones most at-risk for wildfire. Unfortunately, a model of Lusk specifically is unavailable at this time, so the calculations are skewed and do not include the potential damage estimates if a wildfire expanded into the settled community. The expansion of wildfires into urban areas is rare, but not without precedent, as established during the wildfires in California during 2007. Therefore, this data gap should be addressed to allow for accurate mitigation and preparedness planning for Lusk prior to a Redzone-scale event.

In addition to the dangers directly associated with the fire, wildfires create dangerous atmospheric conditions by filling the air with smoke. The effects of wildfire smoke can be felt for miles, depending on the winds. Smoke may impact air quality, forcing vulnerable populations such as children, those with asthma, or those requiring additional oxygen support, to remain indoors. Livestock are also impacted by poor air quality. Smoke may cloud visibility on roads and create dangerous transportation conditions, as well.

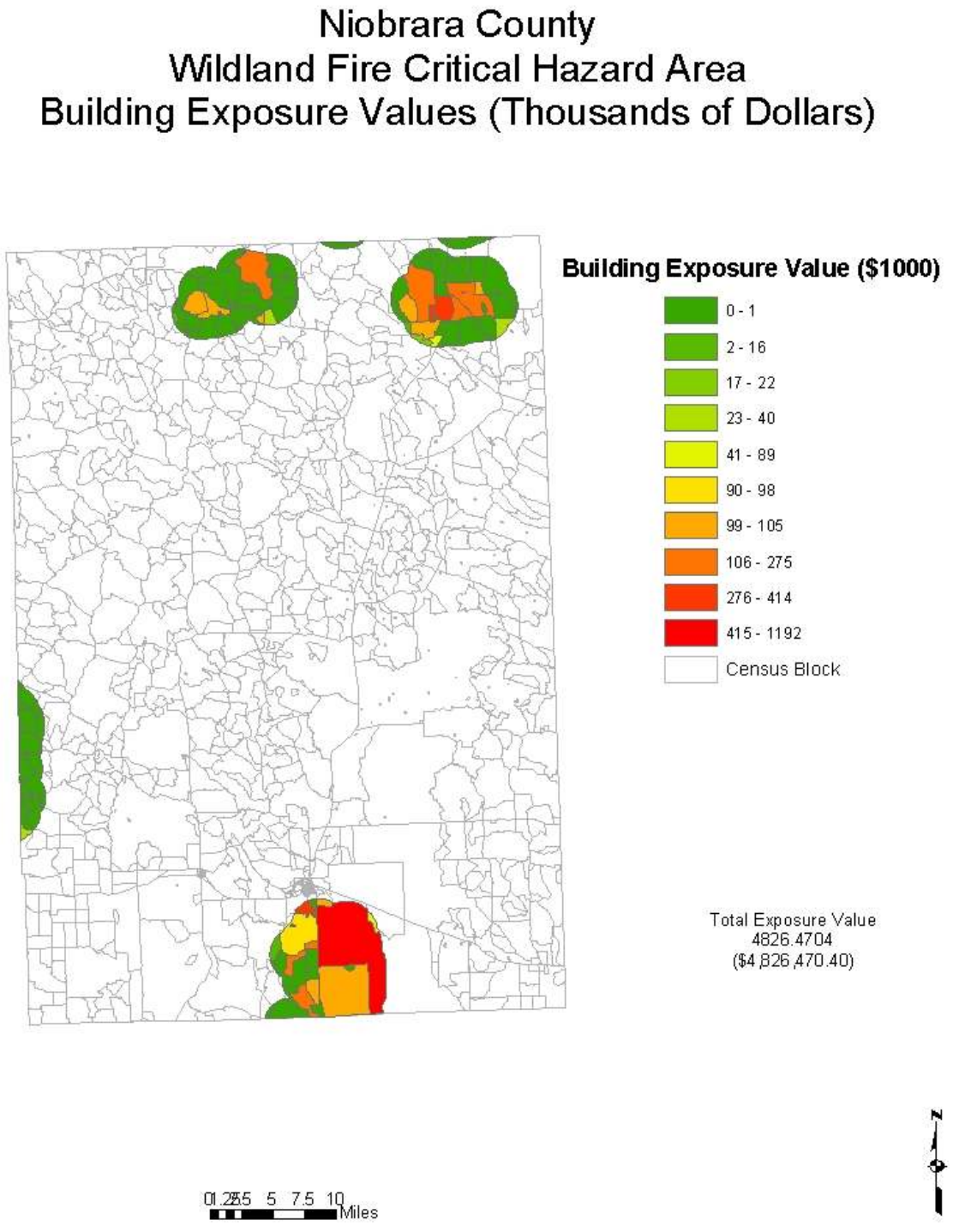


Figure 13-3: Wildland Fire Building Exposure Map for Niobrara County

Future Impacts

Wildfires occur somewhere within the County on generally an annual basis. Based on GIS analysis performed by the State of Wyoming, Niobrara County has about $4.8 million in building value potentially at risk to wildland fires. This data is slightly inaccurate because the model does not include the direct impacts of a fire on Lusk, the only major population center in the County. It is unlikely that all identified risk areas will simultaneously face a completely destructive event as modeled, so this final number is also just a total damage estimate. The two deficiencies of the data may balance one another out for estimation and prediction purposes, however. Future wildfires could damage crops and watersheds within the County, and contribute to soil erosion and deposition problems. With little new construction planned, there appears to be little to no risk for impacts from wildland fire to future buildings—during the planning period.

Summary

PROPERTY AFFECTED:	High
POPULATION AFFECTED:	Low
PROBABILITY:	High
JURISDICTION AFFECTED:	Unincorporated areas, mostly in the north and south of the County. Closest potentially affected urban area: Lusk

14. WINDSTORMS AND WINDBLOWN DEPOSITS

Wind is the movement of air from areas of high pressure to areas of low pressure, or can be the result of microbursts associated with temperature variations in the atmosphere, usually associated with thunderstorms or dry thunderstorms. Windblown deposits are fine-grained materials such as sands and silts that are mobilized by wind. Wyoming has some of the most significant windblown deposits in the U.S. Strong winds can mobilize and significantly move sand or silt grains in much of Wyoming. Many of the mapped deposits in Wyoming are somewhat stabilized, but a significant number are still active.

Niobrara County has moderate amounts of windblown deposits in the lower southeast corner of the County, as well as isolated deposits concentrated in the southwest corner of the County, scattered across the plains, and approaching the Nebraska border, as shown in Figures 14.1 and 14.2.

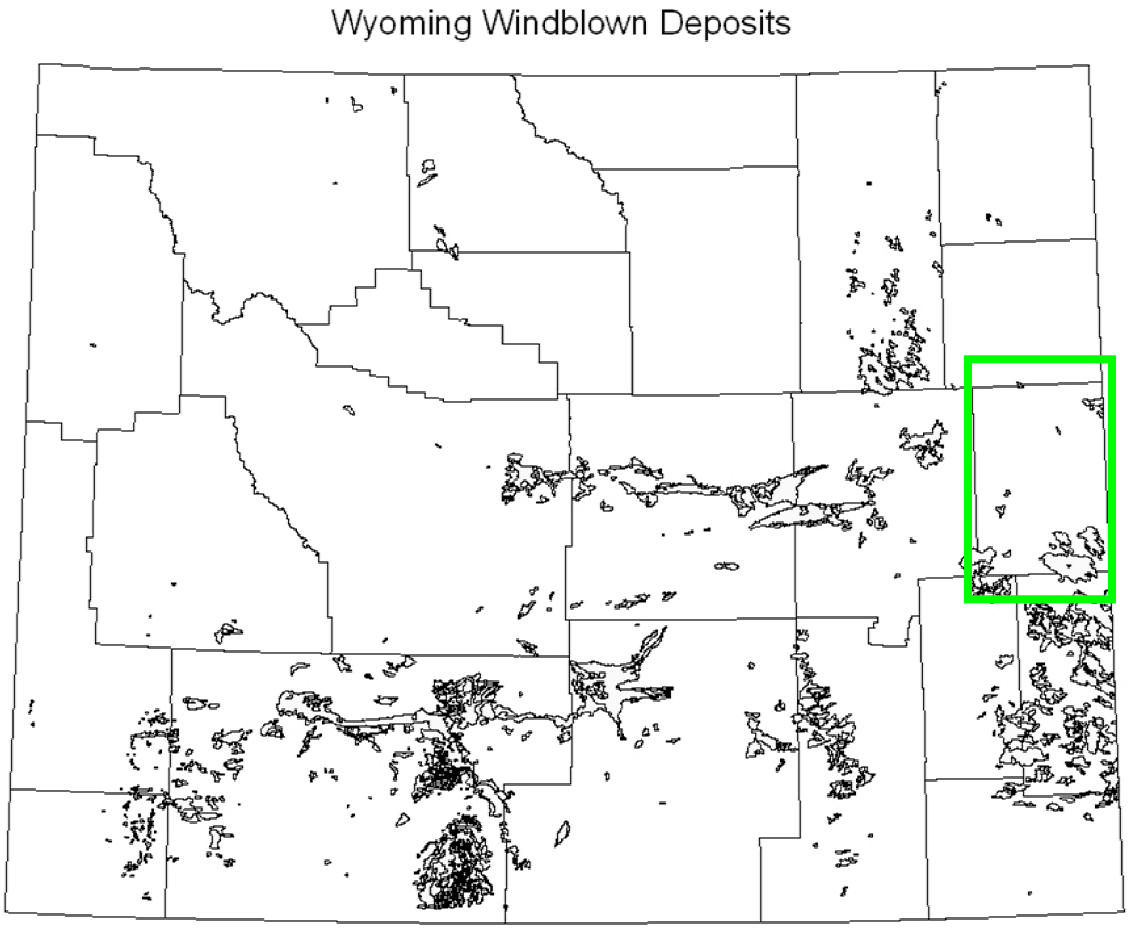


Figure 14-1: Wyoming Windblown Deposits

Niobrara County is Highlighted

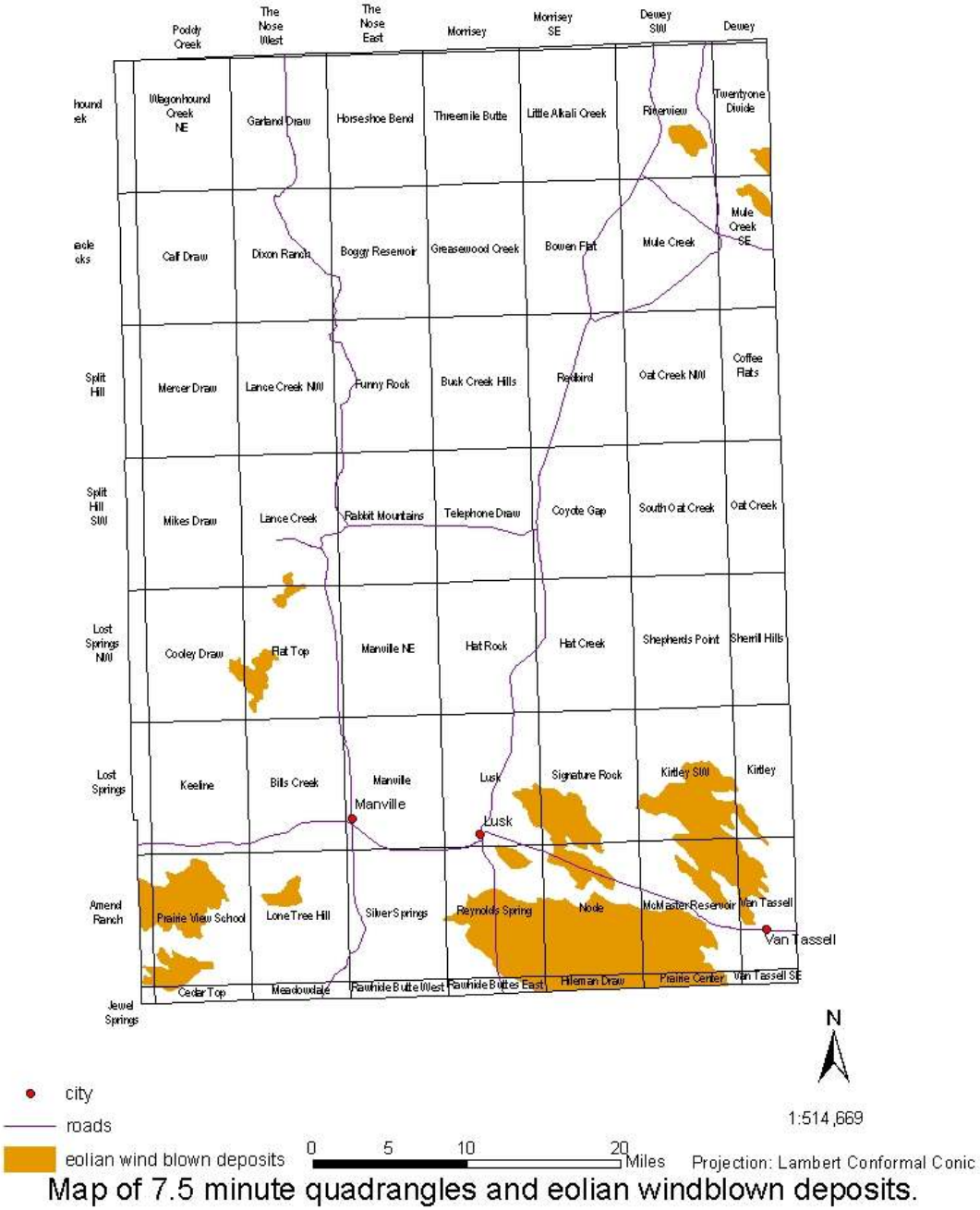


Figure 14-2: Niobrara County Windblown Deposits

There are numerous Quadrangles with windblown deposits mapped. The Riverview and Twentyone Divide Quadrangles are in the northeast corner of Niobrara County, the Prairie View School and Lone Tree Quadrangles are in the southwestern corner of Niobrara County, and the Reynolds Spring, Node, McMaster Reservoir, Kirtley SW, Lusk, and Signature Rock Quadrangles are in the south-central and southeastern part of the County. A summary of the windblown deposits is presented below. Re-vegetation is recommended for all areas that could destabilize upon disturbance.

Northeastern Niobrara County

Riverview and Twentyone Divide Quadrangles: There is a series of windblown deposits in Sections 22, 23, 25, 26, 27, 35, 36, T40N, R61W and in Sections 21, 22, 27, and 28, T40N, R60W. If the deposits are disturbed, they could potentially destabilize.

Southwestern Niobrara County

Prairie View Quadrangle: There are large windblown deposits in Sections 16, 17, 19, 20, 21, 28, 29, 30, 31, 32, T32N, R66W; Sections 22, 23, 24, 25, 26, 27, 34, 35, 36, T 32N, R67W; Sections 6 and 7, T31N, R66W, and Sections 1 ,2, 3, and 11, T31N, R67W. In addition there is a windblown deposit in Sections 19, 29, and 30, T 31N, R66W; Sections 23, 24, 25, 26, and 27, T31N, R67W. If the deposits are disturbed, they could potentially destabilize.

Lone Tree Quadrangle: There are windblown deposits in Sections 35 and 36, T32N, R66W; Sections 30, 31, and 32, T32N, R65W; and Sections 1, 2, 11, and 12, T31N, R66W. If the deposits are disturbed, they could potentially destabilize.

South-Central and Southeastern Niobrara County

Lusk: Sections 14 and 15, T32N, R63W.

Reynolds Spring Quadrangle: Sections 14, 15, 22, 23, and 24, T32N, R63W; Sections 31, 32, 33, 34, 35, T32N, R63W; Sections 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 20, 21, 22, 23, 24, 25, 26, 27, 28, T31N, R63W; Sections 1 and 12, T31N, R64W. If the deposits are disturbed, they could potentially destabilize.

Node Quadrangle: Sections 1, 12, 13, 24, 25, T31N, R63W; Sections 1-36, T31N, R62E; Sections 21, 22, 27, 28, 31, 32, 33, 34, and 35, T32N, R62W. If the deposits are disturbed, they could potentially destabilize.

Signature Rock Quadrangle: Sections 4, 5, 6, 7, 8, 9, 15, 16, 17, 18, T32N, R63W; Sections 1 and 2, T33N, R63W; Sections 25 and 36, T33N, R63W. If the deposits are disturbed, they could potentially destabilize

Kirtley SW Quadrangle: Sections 25, 26, 27, 34, 35, 36, T33N, R61W; Sections 1, 2, 11, 12, 13, 14, 15, 16, T32N, R61W. If the deposits are disturbed, they could potentially destabilize.

Mc Master Reservoir Quadrangle: Sections 13, 14, 15, 16, 21, 22, 23, 24, 24, 26, 27, 28, 33, 34, 35, and 36, T32N, R61W; Sections 1, 2, 3, 7, 8, 9, 10, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 26, 27, 28, 29, 30, 32, 32, 33, 34, 35, T31N, R61W; Sections 1, 12, 13, 24, 25, T31N, R62W. If the deposits are disturbed, they could potentially destabilize.

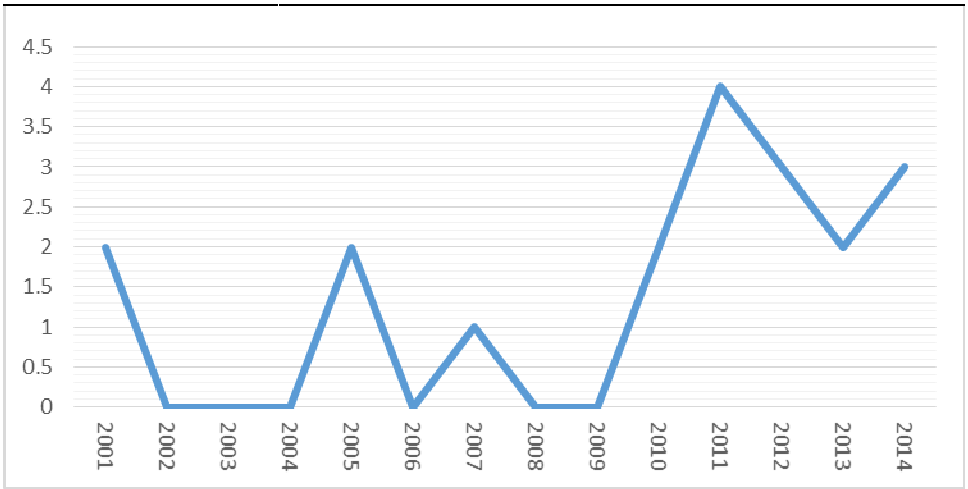
History

Located in Wyoming's "wind zone", Niobrara County is in a gap in the Rocky Mountains that acts as a funnel that concentrates westerly winds as low pressure and storm fronts pass through. Short-lived but strong wind gusts associated with thunderstorms and dry microbursts tend to cause damage in the County. The National Climatic Data Center's online database lists 30 high wind events in the County between 1950 and 2014. Eight of these events had recorded damage and are described in Table 14.1. While the County experiences high wind events every couple years, a damaging wind event hasn't occurred in-county since 2001. Table 14.2 graphs total wind events from 2001-2014.

Table 14-1: Damaging Wind Events 1995-2014

Date and Time	Damage	Description
7/12/1995 at 10:05 PM	$4K	Strong thunderstorm winds destroyed a garage just west of Lusk. Lightning caused a power outage for an hour in Lusk.
8/29/1996 at 5:35 PM	$10K	Strong thunderstorm winds knocked down a shed.
7/1/1997 at 7:00 AM	$20K	Power lines, light poles and tree branches downed in Torrington; Visibilities reduced due to blowing dust and sand; minor damage to corn and bean crops.
2/2/1999 at 4:30 AM	$148K	West winds were sustained at 35 to 45 mph across all of southeast Wyoming with gusts as high as 85 mph. Dozens of trailers were blown over on Interstate 25 north of Cheyenne, and on Interstate 80 west of Laramie. A record wind gust for the month of February was reported at the National Weather Service Office in Cheyenne. Many billboards, power lines, trees and awnings were blown down around the city. A gas station canopy was also ripped off by the winds. In Wheatland, trees were blown down and a barn was destroyed by the winds. In Converse County, the winds damaged house siding, roof shingles and vehicle windows. A semi-trailer was overturned on Interstate 25 between Douglas and Glenrock. Winds in this area were sustained at 35 to 50 mph, with gusts to 60 mph.
4/8/1999 at 4:30 AM	$10K	High winds were reported across much of southeastern Wyoming. Wind speeds of 40 to 60 mph were common, with gusts to 69 mph reported in Cheyenne, and gusts to 74 mph at Buford, in the foothills west of Cheyenne.
5/6/1999 at 6:30 AM	$6K	High winds were reported over extreme southeastern Wyoming for much of the day. Winds of 35 to 45 mph were common, with gusts to 62 mph reported at Pine Bluffs, WY.
7/6/2001 at 5:50 PM	$10K	Strong wind gusts damaged corrals and sheds as well as removed some roof shingles.
7/6/2001 at 6:20 PM	$1K	Thunderstorm wind took roof off storage shed.

Table 14-2: High Wind Events Niobrara County 2001 - 2014



Impacts

There is not a well-documented history of problems associated with windblown deposits in Niobrara County and Wyoming. If stabilizing vegetation has been stripped from the surface because of some form of development, or extended drought, previously stable dunes may mobilize and encroach on human development. There are accounts of such problems in the Casper area. Dunes have moved onto subdivision properties, temporarily closed roads, and impinged on homes. The problems were easily fixed, and no significant dollar losses have been associated with windblown deposits.

High winds impact structures and vehicles primarily. Very high winds can blow cars off of roads, causing vehicle accidents, and even force high-profile vehicles to topple or roll. They can also topple weak structures and damage homes, barns, sheds, and other sturdier buildings. In areas where loose soil is present, high winds can create dust storms, which reduce visibility, damage finishes on structures and vehicles, clog air filters, and pollute standing water. The historical records of these events indicate that the likelihood is fairly low, and the damage potential is fairly high.

Future Impacts

Gusty thunderstorm or microburst winds will likely continue to occur in Niobrara County and will possibly result in isolated property damage in developed areas. If development occurs in parts of the County that have stabilized dunes, this could lead to nuisance problems with the windblown deposits. Windblown deposits can inhibit transportation, affect agricultural lands and contribute to dust storms.

These winds also potentially impact the property in Niobrara County directly, by damaging structures and vegetation, creating unsafe driving conditions, or altering perceived

temperatures (wind chill). Combined with other events, winds may increase the severity of a hazard, such as the combination of snow or sand and high winds.

Since 1995, Niobrara County has suffered eightdamaging wind events, with a general average of $8,700 damage per event. However, the potential for damage is much greater, as the event in February 1999 caused massive infrastructure impact and $148,000 in damages to the county.

Summary

PROPERTY AFFECTED:	Medium
POPULATION AFFECTED:	Low
PROBABILITY:	High (wind) Medium (deposits)
JURISDICTION AFFECTED:	County

15. TERRORISM

Terrorism is the use of force or violence against persons or property in violation of the criminal laws of the United States for purposes of intimidation, coercion, or ransom. Terrorists often use threats to create fear among the public, try to convince citizens that their government is powerless to prevent terrorism, and to get immediate publicity for their cause. Terrorism has been used throughout history to intimidate, coerce, and bring harm to populations. Terrorism can be propagated by foreigners, and also U.S. citizens hostile towards the government or other entities.

There are many different types of terrorism, and the United States has had many incidents of terrorism over the past century. Most terrorist attacks include a CBRNE component - chemical, biological, radiological, nuclear and/or explosives. Armed attacks are also a concern, and a growing mechanism for terrorism is cyberterrorism – the use of hacking to attack computer networks and systems.

History

New York's World Trade Center was targeted twice and the Federal Building in Oklahoma City once. Both of these attacks resulted in a large number of fatalities. Americans have also been killed in other terrorist aircraft incidents. A number of attempts have been stopped. In addition to these high profile cases, domestic terrorists have targeted entities such as laboratories, resort development, and auto dealerships--making statements in favor of environmental protection. There is no history of terrorism or terrorist acts in Niobrara County.

Impacts

Niobrara County has certain assets and infrastructure critical to the daily life of County residents; the targeting or loss of one or more of these assets could have severe consequences, depending on the specifics of an attack. Impacts of a terrorist attack in Niobrara County could include fear and panic, civil unrest, property loss and damage, damage or destruction of infrastructure, loss of life, loss of services, and interruption of communications, business and/or general commerce.

There is no history upon which to develop a dollar loss estimate for Niobrara County. Losses would depend on the type, location and severity of the terrorist action.

Future Impacts

Because of the varied nature and impacts of terrorist attacks, future impacts are difficult to project. Future impacts would be dependent on the type of attack and target, but most impacts from terrorist attacks include injuries, fatalities, economic disruption, environmental concerns, and fear. The attack may also have a cascading effect - if a dam was targeted for example, flooding could also occur.

Summary

PROPERTY AFFECTED:	Low
POPULATION AFFECTED:	Low
PROBABILITY:	Low
JURISDICTION AFFECTED:	All

16. WINTER STORMS AND BLIZZARDS

Niobrara County has historically experienced severe winter storms. Severe weather events experienced in the County from 1886 to the present are included in the table below.

The snow, ice, and extended periods of cold associated with winter storms such as these could potentially affect Niobrara County's infrastructure. For example, heavy snow and ice precipitation could shut down County transportation systems. Blocked roads and railroads could result in isolation from needed amenities including: food, water, fuel, medical supplies, and emergency services. County power and communication systems could also be compromised due to winter storms. Power and phone lines could freeze or be knocked down. Lack of electricity and communication with the outside world could further hinder residents' ability to sustain themselves throughout a storm. Stranded motorists and people unexpectedly caught outside in winter storms risk hypothermia, starvation, and even death without adequate shelter, food, and water supplies. Search and rescue teams and emergency medical services could be strained by attempts to rescue such people.

Niobrara County has large ranching communities and wildlife populations that may also be impacted by severe winter storms. Freezing streams make water supplies scarce for both livestock and wildlife. Heavy snowfall could hinder both the animals' ability to find food and ranchers' attempts to bring food to their livestock. Finally, without adequate shelter, prolonged exposure to cold and wet conditions could ultimately result in loss of life. Winter storms could also cause structural damage to County buildings and residences. Heavy snow loads can collapse roofs and break branches, and extreme cold temperatures can freeze water pipes. Finally, flood events may result from winter storms if warm temperatures cause large snow packs to melt quickly.

History

The winter storm history in Niobrara County extends from 1886 to present. Niobrara County has a winter storm of significance about once every two years, based on 58 events during a 122 year period. There have been a few winter storms in the County that have caused great damage, economic impact, and brought about change in livestock practices. Data in Table 16.1. were derived from the monthly Storm Data reports from National Oceanic and Atmospheric Administration's (NOAA) National Climatic Data Center (NCDC). Other sources are unpublished reports from the Wyoming Office of Homeland Security, newspaper accounts, and periodicals from public libraries. One of the most significant statewide storms occurred in 1949 and resulted in $9 million in damages across Niobrara and nine other Counties.

Table 16-1: Damaging Winter Storms in Niobrara County

Location	Start Date	End Date	Fatalities	Injuries	Est. Property Damage (2015)	Est. Crop Damage (2015)	Storm Character	Information
County	11/16/77	11/19/77	1	0	$1.7 mil	$0	Heavy snow/high winds	Statewide storm; fatality was pedestrian on interstate; numerous people stranded until roads reopened
County	01/25/80	01/27/80	4	5	?	$0		
County	12/20/83	12/25/83	0	?	$6.5 mil	$0	Subzero cold	
County	03/06/96	03/07/96	0	19	$94,350	$0	Snow	Injuries related to roadside incidents/automobile accidents
County	10/04/98	10/05/98	0	0	$326,594	$0	Snow, ice, wind	
County	02/16/00	02/17/00	0	12	$137,398	$0	Heavy snow	
County	02/25/00	02/25/00	0	15	$137,398	$0	Snow	
County	04/21/01	04/21/01	0	0	$233,672	$0	Snow	
County	03/13/02	03/14/02	0	0	$13,152	$0	Snow	
TOTAL			**5**	**51**	**$9,142,564**	**$0**		

Impacts

The historic dollar impact of winter storms in Niobrara County in 2015 dollars is $9,142,564, which annualizes out to $1,589,400. The actual impacts are much greater because of the effects on transportation and because of loss of life and injuries. The impacts from loss of livestock can carry over for many years.

Whether citizens of the county or travelers, people can be greatly impacted by severe winter storms. Most storms last a number of days, and people can be stranded in their homes by closed roadways or other transportation routes. Most injuries and fatalities occur because of exposure or traffic accidents. Vulnerable populations can be especially susceptible to the effects of severe cold.

Accumulated snow can also have a devastating effect on critical infrastructure. Snow and ice can accumulate on above-ground power lines, bringing them down and causing large areas to be without power until it is restored. Snowpack, icy roads, and blowing and drifting snow can close roadways, and in some instances these roadways can be critical transportation routes for people and goods. Because of the wide-scale nature of severe winter storms, it is conceivable that all routes to a location may be blocked, effectively cutting it off until a route is cleared.

Future Impacts

Based on the history of winter storms, Niobrara County will continue to experience damaging winter storms about once every two years. Based on the worst case regional event that involved Niobrara County (1949) the dollar impacts could be in excess of $6.7 million (assuming an equal distribution of the total losses of $67 million, across the 10 counties involved), enough power lines could be toppled that emergency intervention could be required, significant property damage could occur, and the livestock industry could lose 15%-20% of its inventory. Impacts to buildings from severe winter storms is only a fraction of the total dollar impact that can occur, but can include roof damage and damage to plumbing. With little new construction at present, no specific impacts to future buildings are certain.

Life safety will continue to be a concern for motorists, outdoor enthusiasts, or ranchers stranded by winter storms. Injuries and deaths will likely occur during storm-related vehicle accidents. The rural nature and low population density of Niobrara County increases the risks of storm-related death and injury to rural residents, and to a lesser extent includes Lusk, which could be isolated from larger supply and resource depots located further west in Wyoming or in Nebraska and South Dakota.

Summary

PROPERTY AFFECTED:	Medium
POPULATION AFFECTED:	High
PROBABILITY:	High
JURISDICTION AFFECTED:	County

17. HAZARD MITIGATION GOALS AND PROJECTS

How the goals and projects were developed

This plan contains four goals to help protect people and property in Niobrara County from natural hazards and hazmat incidents. Each of the three incorporated communities and the county have their own individual goal. Projects to address a range of hazards are listed under each of the goal statements. The county commissioners and LEPC agreed with the contractor's recommendation to organize the goals by jurisdiction rather than by hazard. This allows each jurisdiction and the public to easily see and track the projects that will protect their citizens and property, and for which the jurisdiction will take the lead.

A total of 35 mitigation projects were identified as follows;

- Projects from the 2009 plan were reviewed for status and carried forward as appropriate,
- The LEPC identified hazards to which the jurisdictions were vulnerable and then identified projects for those jurisdictions to address the specific hazard vulnerabilities,
- The contractor reviewed other local plans and brought forward needs and projects in those plans that related to hazard mitigation,
- The contractor met with elected officials from each local jurisdiction about their specific projects, and
- The public was queried for project ideas.

Once a draft list of projects was compiled, the contractor and the Emergency Manager prioritized those projects. The draft projects were presented to both the Niobrara County Commissioners and the LEPC for validation. The project list was finalized and incorporated into the draft plan, and then made available for public comment.

Project Costs

Costs for mitigation actions will to fall within three ranges low, medium, or high.

- Low Cost Projects: from $0 to $5,000
- Medium Cost Projects: from $5,001 to $50,000
- High Cost Projects: Over $50,000

Project Priorities

Priority rankings of High, Medium, or Low were also assigned. Generally, the jurisdictions will initiate and depending on the complexity, try to accomplish the High priority projects within two years, the time frame for Medium priority projects will be three to four years, and Low priority projects will be accomplished by the five-year anniversary of this plan if feasible. All projects were initially ranked by the coordinator and contractor based on the following criteria. The LEPC then validated the rankings.

- Perceived cost effectiveness and feasibility of obtaining funding,
- Level of risk to life and property posed by hazard which project addresses,
- Reasonableness of project and extent to which it provides a long-term solution,
- Potential consequences of not implementing,
- Support from the public and elected officials, and

- Compatibility with other plans and policies.

The county commissioners, the mayors and elected bodies have the ability to adopt additional plans, policies, ordinances and regulations as needed within state statutes.

There is no professional planning staff in the county, or on retainer to the county or its communities. The county has a very general land use plan that is no longer current. The county recognizes this, but has neither expertise nor resources to update the plan.

The Niobrara County Conservation District periodically prepares a strategic plan. The 2004 plan was recently updated and was reviewed for consistency with this MHMP update.

The only other planning activity contemplated will be an update to the county's Emergency Operations Plan (EOP.) That effort may get underway once the MHMP has been completed and adopted. There are no other known planning efforts during the 5-year horizon of this MHMP.

Project Types

A range of types of mitigation actions or projects were identified by the participants in the planning process. Examples of a range of types of projects from other counties were provided. This was done to assist the elected officials, LEPC, and other participants in understanding the types of projects that could logically fall under a hazard mitigation plan.

Table 17-1: Project Types by Jurisdiction

Goal	Project Types
Goal One—Lusk	Emergency Services, Prevention, Property Protection, Structural
Goal Two—Manville	Education and Awareness, Emergency Services, Prevention, Property Protection
Goal Three—VanTassel	Education and Awareness, Emergency Services
Goal Four—Niobrara County	Education and Awareness, Emergency Services, Natural Resource Protection, Prevention, Property Protection

Figure 17-1: U.P. coal train along Hwy 18/20

Goal One: Mitigate natural hazards to reduce potential injury and loss of life, and property damage in the Town of Lusk.

Hazards	Mitigation Project	Project Rank	Responsible Agency	Estimated Project Cost	Sources of Funding	Benefit/Comments
All	Test warning siren. Post information on what the tones mean.	M	County EM	L	County	Reduce confusion. Provide advance warning. Help residents respond appropriately.
All	Review and update basic plan for continuity of town government.	L	Town, County EM	L	Town	Allow town government to continue to function in event of disaster.
Flood	Investigate engineering solutions to flooding of Niobrara Creek in Lusk.	H	Tow, County EM	M	Town, County EM, WOHS, FEMA	Reduce property loss and interruption of commerce and transportation from flooding. Protect lives.
Flood	Encourage property owners along creek to purchase flood insurance. Link to WYDOT site.	M	Town	L	Town	Recoup damages after flooding.
Flood	Monitor water levels in creek. Notify low-lying land owners of flood potential.	M	County EM	L	Town	Provide for preparation from low land flooding.
Hazmat	Develop an evacuation plan for Lusk.	L	Town, County EM	M	Town	Be prepared for hazmat spill or release from mobile source. Reduce potential loss of life.

Figure 17-2: Drainage culverts in the Town of Manville

Goal Two: Mitigate natural hazards to reduce potential injury and loss of life, and property damage in the Town of Manville.

Hazards	Mitigation Project	Project Rank	Responsible Agency	Estimated Project Cost	Sources of Funding	Benefit/Comments
All	Test warning siren. Post information on what the tones mean.	M	County EM	L	County	Reduce confusion. Provide advance warning. Help residents respond appropriately.
All	Establish small cache of sheltering materials, supplies.	L	Town, County EM, Red Cross	L	Town, County EM, Red Cross	Be prepared to shelter small number of people for short-term.
All	Use a basic template to plan for continuity of government.	L	Town, County EM	L	Town	Allow town government to continue to function in event of disaster.
Flood	Replace remaining culverts to reduce flooding.	H	Town	M	Town	Complete ongoing project to replace culverts. Reduce future flood damage to property.
Wildland Fire	Print message on July water bill about taking responsibility for reducing fire danger on private property. (Annually)	H	Town	L	Town	Increase awareness of risk and reduce risk to property and lives from wildland fire.

Figure 17-3: Town Hall, Van Tassell, Wyoming

Goal Three: Mitigate natural hazards to reduce potential injury and loss of life, and property damage in the Town of VanTassell.

Hazards	Mitigation Project	Project Rank	Responsible Agency	Estimated Project Cost	Sources of Funding	Benefit/Comments
All	Maintain small cache of sheltering materials, supplies.	M	Town, County EM, Red Cross	L	Town, County EM, Red Cross	Be prepared to shelter small number of people for short-term.
Hazmat	Educate residents on how to respond to hazmat incident with annual mailing	H	Town, County EM	L	Town	Residents know what to do, not do in event of spill. Protect lives.

Goal Four: Mitigate natural hazards to reduce potential injury and loss of life, and property damage in Niobrara County.

Hazards	Mitigation Project	Project Rank	Responsible Agency	Estimated Project Cost	Sources of Funding	Benefit/Comments
All	Educate residents about need to sign up for Code Red notification system.	H	County EM, LEPC	L	County	Provide warning before impact to allow preparation. Reduce loss of life and property damage.
All	Participate in Converse-Niobrara broadband feasibility study	H	County	L	County, various	Determine needs to increase capacity/redundancy of broadband service
All	Integrate emergency comm systems. Boost WYOLink.	H	County EM	M	County, State	Ensure reliable communications during incidents.
All	Encourage Niobrara Electric to continue to harden power lines and create redundancy.	H	County	High	Niobrara Electric	Reduced risk of power loss and related situations during all types of incidents. Quicker recovery.
All	Update 2003 EOP	M	County EM	L	County	More effective response.
All	Maintain capacity to shelter small numbers for short time.	M	County EM	M	County EM, Red Cross	Be prepared to assist in all types of emergencies and disasters.
All	Obtain a command vehicle for emergency management.	M	County	H	County, WOHS	Improve ability to respond to disasters of all types.
All	First responders and elected officials develop personal disaster plans.	L	County	L	N/A	Key individuals have plans in place. Elected officials and responders serve as example.
All	Coordinate evacuation, transportation, and sheltering with Women's Prison.	L	County EM, Sheriff	L	County, State Corrections	Be prepared to safely evacuate prison and provide shelter to inmates if necessary.
All	Have all first responders complete ICS 100 and 200.	M	County EM	M	County	Increase effectiveness of response to all large incidents.
All	Host ICS 300 and 400 class in the	M	County EM	L	County, WOHS	Increase effectiveness of

Hazards	Mitigation Project	Project Rank	Responsible Agency	Estimated Project Cost	Sources of Funding	Benefit/Comments
	county.					response to all large incidents.
All	Design and conduct an exercise using ICS (power and communications outage)	M	County EM, LEPC	M	Participating entities	Increase familiarity with ICS. Better preparation for real incident.
All	Use a basic template to plan for continuity of county government.	M	County EM, County Elected Officials	L	County	Allow county government to continue to function in event of disaster.
Drought	Aggressively control grasshoppers during drought.	M	County Weed and Pest	H	County	Reduce damage to crops and other vegetation.
Flood	Install erosion control on county road at Twenty-mile Creek	M	County	H	County, State, FEMA	Save critical infrastructure (road) from washout. Prevent more costly rebuild in future.
Flood	Install erosion control to protect against loss of Cow Creek Road	M	County	H	County, State, FEMA	Save critical infrastructure (road) from washout. Prevent more costly rebuild in future.
Flood	Construct permanent bridge at Lance Creek to replace temporary seasonal bridge	M	County	H	County, State, FEMA	Address temporary solution. Provide needed access for residential, oil field traffic.
Flood	Drain and fill road section at Big Muddy Creek Crossing	L	County	H	County, State, FEMA	Save critical infrastructure (road) from washout. Prevent more costly rebuild in future.
Hazmat	Host annual awareness level hazmat course for fire, medical and law personnel.	M	County EM	L	County	Increase effectiveness of response. Improve safety of responders.
Hazmat	Work with UPRR to sponsor oil rail transport training	H	County, EM	L	County	Increase skill for response to oil tanker rail incident.
Hazmat	Continue education on response to pipeline incidents (host pipeline company provided training)	M	County EM, LEPC	L	Participating entities	Increase effectiveness of response. Improve safety of responders. Protect people and natural resources.

Hazards	Mitigation Project	Project Rank	Responsible Agency	Estimated Project Cost	Sources of Funding	Benefit/Comments
Hazmat	Provide ongoing training in use of PPE. Include medical personnel as appropriate.	H	County	M	County Fire	Effective fire and hazmat response. Prevent accidents and injuries to firefighters.
Wildland Fire	Document and provide ongoing fire training (hazmat and other.)	H	County	M	County Fire	Effective fire and hazmat response. Prevent accidents and injuries to firefighters.
Winter Storms	Encourage continued construction of wooden and living snow fences along roadways	M	County	M	UP Railroad, WYDOT, Conservation District	Prevent winter vehicle accidents from blowing and drifting snow. Save lives. Reduce property damage.
Other	Participate and assist public health in preparation of Isolation and Quarantine plan	H	County	L	Public Health, Lusk, County	Prepare for infectious disease incident. Protect medical personnel, public. Save lives.

Action Plan

The above projects will be worked on pending adequate resources (personnel and funding.) Some of the projects are ongoing or already underway—for example testing sirens and education about the different tones. Other projects will be selected based on priority, availability of resources, timeliness, and the opportunity to complete. The initial priorities assigned with this update are expected to shift somewhat over the course of the five-year planning period based on the needs of the individual jurisdictions and resources available to them and perhaps in response to the Niobrara River flood of June 2015.

For projects not requiring outside expertise or funding (most of the projects in this plan) and located exclusively within one local jurisdiction, the Town of Manville, for example, the Town may select and proceed with projects they wish to complete. During the previous 5-year planning cycle, Manville did just this--by replacing some of the drainage structures identified in the projects to prevent future flooding.

As described in Chapter 19, the County Emergency Management Coordinator will place the MHMP on the LEPC agenda once annually. Each incorporated community has the opportunity—and does have--representation on the LEPC. The Coordinator and LEPC will discuss the list of projects in the plan to see if any changes in overall priorities are desired. The discussion will include any direction or emphases from the local governing bodies, WOHS, or FEMA; incidents which have occurred during the previous year that could affect mitigation project priorities; and local resources and funding available to accomplish projects. The County Commissioners may direct, or the LEPC may hold a vote, if and when they wish to pursue grant funds for work on mitigation projects.

Use of Cost-Benefit Analysis

In cases where grants are being sought, the Coordinator will complete a cost/benefit analysis before submitting any funding requests.

The county can also make available information regarding the STAPLEE method for evaluating and prioritizing mitigation actions. The method looks at social, technical, administrative, political, legal, economic, and environmental aspects of projects to weigh pros and cons of implementing specific projects. Information on this analysis method can be found in FEMA's *Developing the Mitigation Plan* (FEMA 386-3).

The jurisdictions applying for funds will need to consider compatibility with goals and objectives in the state's plan, compatibility with goals in this plan, impacts of the project on other jurisdictions, costs and benefits, funding priorities, and compatibility with other plans and programs when selecting projects to implement.

Existing Authorities, Policies, Programs and Resources for Implementation

The county has very little in the way of existing plans and regulatory mechanisms for implementation. The county has an outdated land use plan and Lusk has a municipal code dated 2004. The two remaining communities are small in population, have no land use or other plans, no planning staff, and no dedicated resources available to implement projects. In the case of VanTassell, population 15, there is no paid staff of any kind.

Generally projects will be accomplished under county leadership either by the Emergency Management Coordinator, volunteers (firefighters, emergency medical personnel, and elected officials) or through contractors funded by grants.

Communities in Wyoming do have statutory authority to engage in planning. While the authority exists, local governments in Wyoming have consistently shown a preference towards minimizing government regulations especially related to the use and development of private property. The natural resource land use plan prepared by the Niobrara County Conservation District reinforces this general philosophy and the county commissioners confirmed at a meeting that this is their position at the present time.

18. PLAN MONITORING, MAINTENANCE, REVISION AND COORDINATION

Responsible Parties

The Niobrara County Commissioners in cooperation with the mayors of the three participating incorporated towns are responsible for ensuring that the MHMP is kept current. With adoption of the plan, the commissioners designate the Coordinator, Niobrara County Emergency Management—with the assistance of the Local Emergency Planning Committee—as the lead in accomplishing the on-going responsibilities.

Plan Monitoring and Evaluation

There are two types of plan monitoring and evaluation; effectiveness and implementation. Effectiveness monitoring looks at whether the plan has addressed needed items. Implementation monitoring looks at whether projects in the plan are being undertaken and completed. The county's Emergency Management Coordinator with the help of the LEPC will ask the following questions to evaluate the effectiveness and implementation of the plan.

- Have any potential hazards developed that were not addressed in the plan?
- Have any natural disasters occurred that were not addressed in the plan?
- Has any unanticipated development occurred that is vulnerable to hazards?
- Are there any additional mitigation ideas that need to be incorporated?
- Have projects been initiated and/or completed?
- What are the barriers to completing projects identified in the plan?

Each fall following the year of adoption of this plan, the LEPC will meet to ask and answer the questions listed above. The discussion will be documented so that when the plan is revised, the findings of the monitoring can be incorporated into the revision. The Niobrara County Emergency Management Coordinator will convene the LEPC for this purpose.

Plan Update Review Triggers

Any of the following three situations could trigger a review and update of the plan.

- Occurrence of a major natural disaster in or near Niobrara County,
- Passage of five years, or
- Change in state or federal regulations which must be complied with.

Revision Procedures

Should a major natural disaster occur in Niobrara County, the LEPC shall meet following the disaster to determine whether a review of the MHMP is warranted. In the absence of a major natural disaster, the five-year review will take place during the six-month period preceding the FEMA approval anniversary date. Because the plan is just being completed in the wake of the Niobrara River flood of 2015, this can be considered at the present time and would not trigger a review.

Following proper notice in the paper of record, the Niobrara County Emergency Management Coordinator will convene the LEPC and with their assistance and/or the assistance of the WOHS or a contractor as determined necessary, carry out the following tasks;

1. Review the Hazard Mitigation Plan Review Tool comments from WOHS and FEMA during their most recent review of the plan (2015.)

2. Examine and revise the risk assessment data as needed to ensure it is current.

3. Update the mitigation strategies to incorporate completion of actions and add any needed strategies or projects.

4. Identify problems that may be hindering or affecting implementation of the plan, and recommend actions for resolving those problems.

5. Recommend any necessary revisions to the MHMP.

6. Comply with all applicable regulations and statutes.

So that the public will have an opportunity to become involved in and comment on the revision, one public meeting will be scheduled in Lusk. This meeting may occur as a regularly-scheduled county commissioner meeting. The meeting will be publicized in the Lusk Herald.

Forty-five days prior to the five-year anniversary date, a final draft of the revised plan will be submitted to the WOHS.

An annual review will be conducted by the Niobrara County Emergency Management Director for the purpose of summarizing the status and effectiveness of the plan mitigation goals or strategies.

Incorporation into Other Plans

In the event Niobrara County moves forward to update their comprehensive land use plan in the next five years, the contents of this plan will be considered. The Niobrara County Emergency Manager will offer input to the process as appropriate—encouraging consideration of ways in which future development could occur to minimize the vulnerability to natural hazards.

The Emergency Management Coordinator will be the person updating the Niobrara County EOP and is familiar with the contents of this plan. Update of the EOP is a project identified in this plan. This plan will be considered when updating the EOP.

The towns in the county have no planners on staff and no intent to prepare any land use plans. These communities would likely contract planning assistance if/when a major development is proposed. The Emergency Management Coordinator could work with any contracted planners to make them aware of natural hazards in the county, and the MHMP.

Opportunity for Continued Public Involvement

In addition to the procedures for including the public in the five-year updates described above, to ensure the public will have the opportunity to remain involved in the implementation and annual updates of the plan, the following will take place.

1) The Niobrara County Emergency Management Coordinator will provide a brief annual summary report to the three governing bodies on what has been accomplished during the previous year and to receive guidance from the elected officials on their priorities for the coming year.

2) Each year following a fall LEPC meeting called for the purpose of reviewing the status of the plan, the county will provide information to the newspapers to notify the public of the accomplishments of the previous year and allow comment for any revisions.