Perkins, Chase, and Dundy Counties
Multi-Jurisdictional

Hazard Mitigation Plan 2020

Plan developed by
JEO Consulting Group

HAZARD MITIGATION PLANNING TEAM

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**Served as an advisory or consultant role*

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LIST OF ACRONYMS

ACS – American Community Survey
BCA – Benefit Cost Analysis
BRIC – Building Resilient Infrastructure and Communities
CFR – Code of Federal Regulations
CIKR – Critical Infrastructure and Key Resources
CRS – Community Rating System
DHS – Department of Homeland Security
DMA 2000 – Disaster Mitigation Act of 2000
EAP – Emergency Action Plan
ELAP – Emergency Assistance for Livestock, Honeybees, and Farm-Raised Fish Program
EPA – Environmental Protection Agency
EPZ – Emergency Planning Zone
ESL – English as Second Language
FBI – Federal Bureau of Investigation
FEMA – Federal Emergency Management Agency
FIRM – Flood Insurance Rate Map
FMA – Flood Mitigation Assistance Program
FRA – Federal Railroad Administration
FR – FEMA's Final Rule
GIS – Geographic Information Systems
HMA – Hazard Mitigation Assistance
HMGP – Hazard Mitigation Grant Program
HMP – Hazard Mitigation Plan
HPRCC – High Plains Regional Climate Center
IP – Office of Infrastructure Protection
JEO – JEO Consulting Group, Inc.
LEOP – Local Emergency Operations Plan
LFD – Livestock Forage Disaster Assistance Program
LIP – Livestock Indemnity Program
NCEI – National Centers for Environmental Information
NDA – Nebraska Department of Agriculture
NDEE – Nebraska Department of Environment and Energy
NDOT – Nebraska Department of Transportation
NDMC – National Drought Mitigation Center
NeDNR – Nebraska Department of Natural Resources
NEMA – Nebraska Emergency Management Agency
NFIP – National Flood Insurance Program
NFS – Nebraska Forest Service
NIPP – National Infrastructure Protection Plan
NOAA – National Oceanic and Atmospheric Administration
NRC – National Response Center
NTAS – National Terrorism Advisory System
NTSB – National Transportation Safety Board
NWS – National Weather Service
PCD – Perkins, Chase, and Dundy Counties
PDSI – Palmer Drought Severity Index
PHMSA – U.S. Pipeline and Hazardous Material Safety Administration
P.L. – Public Law
RMA – Risk Management Agency
SBA – Small Business Administration
SFHA – Special Flood Hazard Area
SPIA – Sperry-Piltz Ice Accumulation Index
SSA – Sector-Specific Agency
START – National Consortium for the Study of Terrorism and Responses to Terrorism
SURE – Supplemental Revenue Assistance Payments
TAP – Tree Assistance Program
TORRO – Tornado and Storm Research Organization
USACE – U.S. Army Corps of Engineers
USDA – United States Department of Agriculture
WUI – Wildland Urban Interface

EXECUTIVE SUMMARY

Introduction

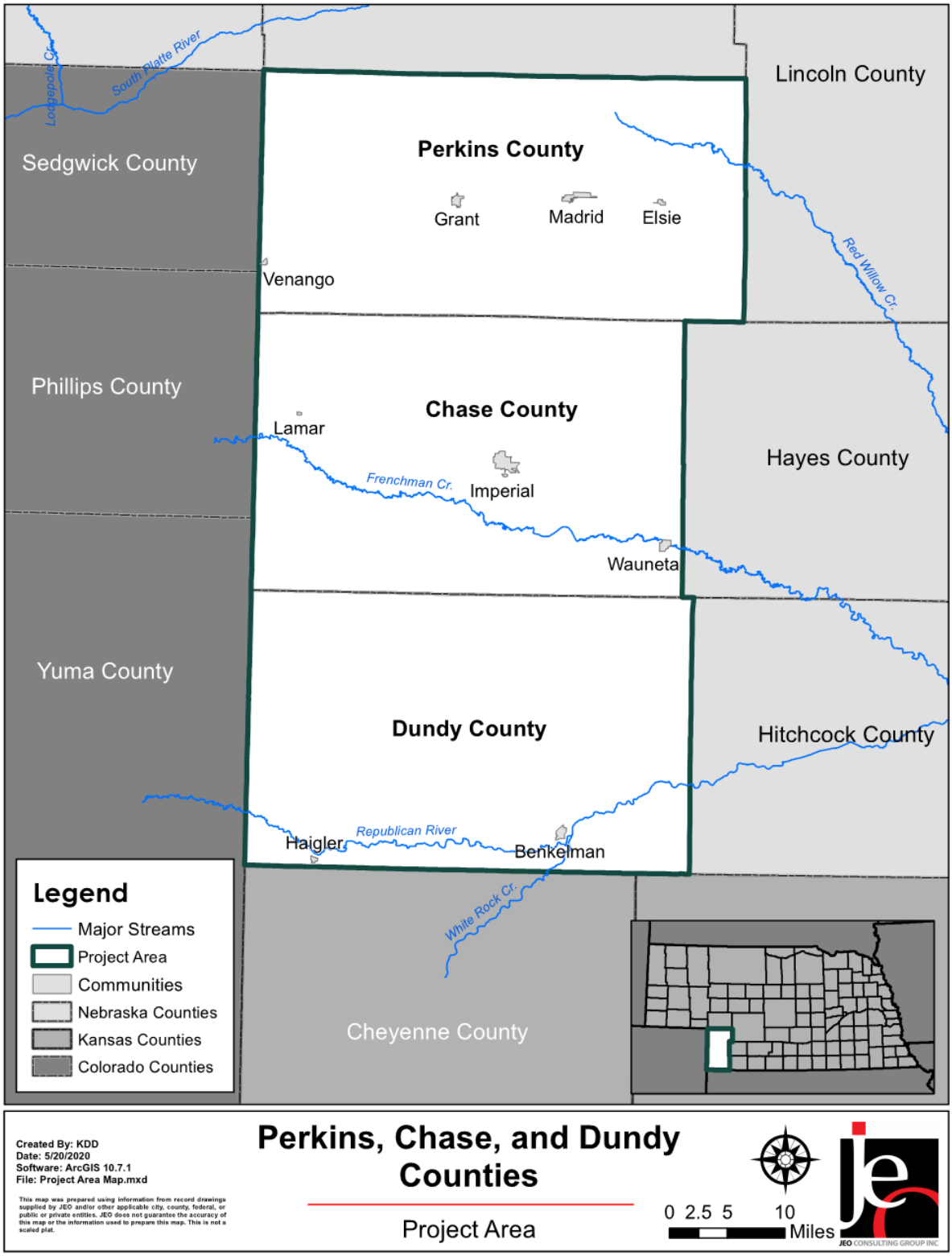
This plan is an update to the Perkins, Chase, and Dundy Counties (PCD) Multi-Jurisdictional Hazard Mitigation Plan (HMP) approved in 2015. The plan update was developed in compliance with the requirements of the Disaster Mitigation Act of 2000 (DMA 2000).

Hazard mitigation planning is a process in which hazards are identified and profiled; people and facilities at-risk are identified and assessed for threats and potential vulnerabilities; and strategies and mitigation measures are identified. Hazard mitigation planning increases the ability of communities to effectively function in the face of natural and human-caused disasters. The goal of the process is to reduce risk and vulnerability, in order to lessen impacts to life, the economy, and infrastructure. Plan participants are listed in the following table and illustrated in the following planning area map.

Table 1: Participating Jurisdictions

Participating Jurisdictions	
Chase County	**Perkins County**
City of Imperial	City of Grant
Imperial Rural Fire District	Village of Elsie
Village of Wauneta	Village of Madrid
Dundy County	Village of Venango
City of Benkelman	Madrid Fire Protection District
Benkelman Fire District	Venango Volunteer Fire Department
Village of Haigler	**Upper Republican NRD**

Figure 1: Map of Planning Area



Goals and Objectives

The potential for disaster losses and the probability of occurrence of natural and human-caused hazards present a significant concern for the communities participating in this plan update. The driving motivation behind the update of this hazard mitigation plan is to reduce vulnerability and the likelihood of impacts to the health, safety, and welfare of all citizens in the planning area. To this end, the Planning Team reviewed and approved goals which helped guide the process of identifying both broad-based and community-specific mitigation strategies and projects that will, if implemented, reduce their vulnerability and help build stronger, more resilient communities.

Goals from the 2015 HMP were reviewed, and the Planning Team agreed that they are still relevant and applicable for this plan update. Jurisdictions that participated in this plan update agreed that the goals identified in 2015 would be carried forward and utilized for the 2020 plan. The goals for this plan update are as follows:

Goal 1: Protect Health and Safety of Residents

Objective 1.1: Reduce or prevent damage to property or prevent loss of life or serious injury (overall intent of the plan).

Goal 2: Reduce Future Losses from Hazard Events

Objective 2.1: Provide protection for existing structures, future development, critical facilities, services, utilities, and trees to the extent possible.

Objective 2.2: Develop hazard-specific plans, conduct studies or assessments, and retrofit jurisdictions to mitigate for hazards and minimize their impact.

Objective 2.3: Minimize and control the impact of hazard events through enacting or updating ordinances, permits, laws, or regulations.

Goal 3: Increase Public Awareness and Educate on the Vulnerability to Hazards

Objective 3.1: Develop and provide information to residents and businesses about the types of hazards they are exposed to, what the effects may be, where they occur, and what they can do to be better prepared.

Goal 4: Improve Emergency Management Capabilities

Objective 4.1: Develop or improve Emergency Response Plan and procedures and abilities.

Objective 4.2: Develop or improve Evacuation Plan and procedures.

Objective 4.3: Improve warning systems and ability to communicate to residents and businesses during and following a disaster or emergency.

Goal 5: Pursue Multi-Objective Opportunities (whenever possible)

Objective 5.1: When possible, use existing resources, agencies, and programs to implement the projects.

Objective 5.2: When possible, implement projects that achieve several goals.

Goal 6: Enhance Overall Resilience and Promote Sustainability

Objective 6.1: Incorporate hazard mitigation and adaptation into updating other existing planning endeavors (e.g., comprehensive plans, zoning ordinance, subdivision regulation, etc.)

Summary of Changes

The hazard mitigation planning process undergoes several changes during each plan update to best accommodate the planning area and specific conditions. Changes from the 2015 Hazard Mitigation Plan and planning process in this update included: greater efforts to reach and include stakeholder groups, effort to include all taxing authorities as participants; a more specific hazard risk assessment applicable to the planning area; and the inclusion of additional mitigation strategies. This update also works to unify the various planning mechanisms in place throughout the participating communities (i.e. comprehensive plans, local emergency operation plans, zoning ordinances, building codes, etc.) to ensure that the goals and objectives identified in those planning mechanisms are consistent with the strategies and projects included in this plan. Other changes as identified in the 2015 PCD HMP are described in the table below.

Comment/Revision from 2015 Review Tool	Location of Revision	Summary of Change
The process narrative mentioned the use of surveys. What was surveyed? How many people participated? What comments were collected and how were they brought into the plan?	N/A	Surveys were not used in this HMP update.
Indicate the location of the planning area in statewide and national maps.	Figure 1	The location of the planning area relative to the State of Nebraska is indicated.
Indicate the presence of any dams or levees outside the planning area whose failure could impact jurisdictions within the planning area.	Section 4	Any dams or levees outside the planning area that may impact local jurisdictions are discussed.
For jurisdictions with comprehensive plans, consider incorporate their existing and future land use maps into the community profiles.	Community Profiles	Future Land Use maps were included for jurisdictions that had one.

It should be noted as well that due to the COVID-19 outbreak, numerous changes were made during the planning process to plan meeting dates and requirements. To best protect residents and staff members in the planning area, Round 2 meetings were held via an online and phone format rather than in-person public workshop meetings. Additional changes are described in Section Two.

Plan Implementation

Various communities across the planning area have implemented hazard mitigation projects following the 2015 Hazard Mitigation Plan. A few examples of completed projects include adopting a No Adverse Impact to floodplain management, installing reverse osmosis systems, updating warning sirens, installing backup generators, and others. In order to build upon these prior successes and to continue implementing mitigation projects, despite limited resources, communities and local jurisdictions will need to continue relying upon multi-agency coordination as a means of leveraging resources.

Hazard Profiles

The hazard mitigation plan includes a description of the hazards considered, including a risk and vulnerability assessment. Data considered during the risk assessment process include: historic occurrences and recurrence intervals; historic losses (physical and monetary); impacts to the built environment (including privately-owned structures as well as critical facilities); and the local risk assessment. The following tables provide an overview of the risk assessment for each hazard and the losses associated with each hazard.

Table 2: Hazard Occurrences

Hazard	Previous Occurrence Events/Years	Approximate Annual Probability	Likely Extent	
Agricultural Disease	Animal: 16/6 Plant: 71/20	100%	~2 animals per event Crop damage or loss	
Dam Failure	4/109	4%	Some inundation of structures (<1% of structures) and roads	
Drought	434/1,489 months of drought	29%	D1-D2	
Extreme Heat	Avg 9 days per year >100°F	100%	>100°F	
Flooding	28/28	100%	Some inundation of structures (<1% of structures) and roads near streams. Some evacuations of people may be necessary (<1% of population)	
Hazardous Materials Release	11/48	23%	Avg Liquid Spill	i.e. 1,353 gal
			Avg Gas Spill	i.e. 1,305 gal
Severe Thunderstorms	1,002/23	100%	≥1” rainfall Avg 57 mph winds; Hail range 0.75-4.5” (H2-H4); average 1.26”	
Severe Winter Storms	151/23	100%	0.25” – 0.5” Ice 5°-40° below zero (wind chill) 2-15” snow 15-70 mph winds	
Terrorism	0/47	<1%	Varies by event	
Tornadoes & High Winds	146/23	100%	Avg: EF0 Range EF0-EF2 Avg 49 mph; Range 35-82 Estimated Gust	
Transportation Incidents	Auto: 1,407/12	100%	Damages incurred to vehicles involved and traffic delays; substantial damages to aircrafts involved with some aircrafts destroyed	
	Aviation: 12/57	21%		
	Highway Rail: 39/43	91%		
Wildfire	270/18	100%	Avg 42 acres Some homes and structures threatened or at risk	

The following table provides loss estimates for hazards with sufficient data. Description of major events are included in *Section Seven: Community Profiles.*

Table 3: Hazard Loss History

HAZARD TYPE		Count	Property	Crop[2]
Agricultural Disease	Animal Disease[1]	16	28 animals	N/A
	Plant Disease[2]	71	N/A	$1,417,165
Dam Failure[5,6]		4	N/A	N/A
Drought[7,9]		434/1,498 months	$11,000,000	$106,706,707
Extreme Heat[8]		Avg 9 days per year	$0	$18,459,537
Flooding[9]	Flash Flood	27	$1,890,000	$684,052
	Flood	1	$100,000	
Hazardous Materials Release	Fixed Site[3]	4	$0	N/A
	Transportation[4]	7	$2,697	
Severe Thunderstorms[9]	Hail	735	$4,274,750	$179,161,001
	Heavy Rain	3	$0	
	Lightning	3	$102,000	
	Thunderstorm Wind	258	$1,975,000	
Severe Winter Storms[9]	Blizzard	33	$160,000	$12,055,749
	Extreme Cold/Wind Chill	13	$0	
	Heavy Snow	24	$0	
	Ice Storm	2	$0	
	Winter Storm	74	$56,000	
	Winter Weather	5	$6,000	
Terrorism[10]		0	$0	N/A
Tornadoes and High Winds[9] *1 injury*	High Winds	114	$348,000	$5,047,616
	Tornadoes	42	$3,109,000	
Transportation Incidents *461 injuries 28 fatalities*	Auto[11]	1,407	N/A	N/A
	Aviation[12]	12	N/A	
	Highway Rail[13]	39	$254,050	
Wildfire[14] *9 injuries 2 fatalities*		703	21,647 acres	$283,485
Total		**3,586**	**$23,277,497**	**$323,815,312**

N/A: Data not available
1 NDA (2014-2019)
2 USDA RMA (2000-2019)
3 NRC (1990-2019)
4 PHSMA (1971-2019)
5 Stanford NPDP (1911-2019)
6 DNR Dam Inventory
7 NOAA (1895-2019)
8 NOAA (1897-2019)
9 NCEI (1996-2019)
10 University of Maryland (1970 - 2018)
11 NDOT (2006-2018)
12 NTSB (1962-2019)
13 FRA (1975-2018)
14 NFS (2000-2018)

Events like agricultural disease, extreme heat, wildfires, severe thunderstorms, and severe winter storms will occur annually. Other hazards like drought, dam failure, and hazardous materials release will occur less often. The scope of events and how they will manifest themselves locally is not known regarding hazard occurrences. Historically, drought, severe thunderstorms, severe winter storms, and tornadoes and high winds have resulted in the most significant damages within the planning area. These hazards are summarized below.

Drought

Drought is a regular and reoccurring phenomenon in the planning area and the State of Nebraska. Historical data shows that drought has occurred with regularity across the planning area and recent research indicates that trend will continue and potentially intensify. The most common impacts of drought affect the agricultural sector. Over $106 million in total crop loss was reported for the planning area since 2000.

Prolonged drought events can have a profound effect on the planning area and individual communities within it. Expected impacts from prolonged drought events include but are not limited to: economic loss in the agricultural sector; loss of employment in the agricultural sector; and limited water supplies (drinking and fire suppression).

Severe Thunderstorms

Thunderstorms differ from many other hazards in that they are generally large in magnitude, have a long duration, and travel across large areas and through multiple jurisdictions within a single region. Additionally, thunderstorms often occur in a series, with one area potentially impacted multiple times in one day. Severe thunderstorms are most likely to occur between the months of May and August with the highest number of events occurring in June. The National Centers for Environmental Information (NCEI) recorded 999 severe thunderstorm events in 22 years. These events caused over $6 million in property damages and over $179 million in crop losses. Typical impacts resulting from severe thunderstorms include but are not limited to: loss of power; obstruction of transportation routes; grass/wildfires starting from lightning strikes; localized flooding; and damages from hail and high winds.

Vulnerable populations related to severe thunderstorms include: residents of mobile homes (three percent of housing units); citizens with decreased mobility; and those caught outside during storm events. Most residents within the planning area are familiar with severe thunderstorms and know how to appropriately prepare and respond to events.

Severe Winter Storms

Severe winter storms occur regularly across the entire State of Nebraska and in the planning area. Winter storms can bring extreme cold temperatures, freezing rain and ice, and heavy or drifting snow. Blizzards are particularly dangerous and can have significant impacts for residents, the local economy, transportation corridors, and infrastructure. Severe winter storms typically occur between November and March. The NCEI reported 151 severe winter storm events in the last 22 years that caused over $222,000 in property damages and USDA data shows over $12 million in crop damage since 2000. Impacts resulting from severe winter storms include but are not limited to: hypothermia and frost bite; closure of transportation routes; downed power lines and power outages; collapsed roofs from heavy snow loads; crop damage; and injury or death to cattle. The most vulnerable citizens within the planning area are children, the elderly, individuals and families below the poverty line, and those new to the area. Residents in this planning area may also be more at risk to severe winter storms due to occupations which require them to be outside despite hazardous weather conditions.

Tornadoes and High Winds

Tornadoes and high winds are an annual occurrence for the planning area. Tornadoes are known for high winds and a spinning vortex of air. Tornadoes and high winds typically occur between May and July. The NCEI reported 146 tornado and high wind events that caused over $3 million in property damages in 22 years. Impacts resulting from tornadoes and high winds include but are not limited to: closure of transportation routes; downed power lines and power outages; collapsed roofs; and closure of critical facilities.

The most vulnerable citizens within the planning area are the elderly, individuals without basements or shelters, residents of mobile homes, citizens with decreased mobility, and those caught outside during storm events.

Mitigation Strategies

There are a wide variety of strategies that can be used to reduce the impacts of hazards for the built environment and planning area residents. *Section Five: Mitigation Strategy* shows the mitigation actions chosen by the participating jurisdictions to prevent future losses.

SECTION ONE: INTRODUCTION

Hazard Mitigation Planning

Severe weather and hazardous events are occurring more frequently in our daily lives. Pursuing mitigation strategies reduces risk and is socially and economically responsible to prevent long-term risks from natural and human-caused hazard events.

FEMA definition of Hazard Mitigation

"Any sustained action taken to reduce or eliminate the long-term risk to human life and property from [natural] hazards."

Natural hazards, such as severe winter storms, high winds and tornadoes, severe thunderstorms, flooding, extreme heat, drought, agriculture diseases, and wildfires are part of the world around us. Human-caused hazards are a product of the society and can occur with significant impacts to communities. Human-caused hazards can include dam failure, hazardous materials release, transportation incidents, and terrorism. These hazard events can occur as a part of normal operation or as a result of human error. All jurisdictions participating in this planning process are vulnerable to a wide range of natural and human-caused hazards that threaten the safety of residents, and have the potential to damage or destroy both public and private property, cause environmental degradation, or disrupt the local economy and overall quality of life.

Perkins, Chase, and Dundy Counties have prepared this multi-jurisdictional hazard mitigation plan in an effort to reduce impacts from natural and human-caused hazards and to better protect the people and property of the region from the effects of these hazards. This plan demonstrates a regional commitment to reducing risks from hazards and serves as a tool to help decision makers establish mitigation activities and resources. Further, this plan was developed to make the counties and participating jurisdictions eligible for federal pre-disaster funding programs and to accomplish the following objectives:

- Minimize the disruption to each jurisdiction following a disaster.
- Establish actions to reduce or eliminate future damages in order to efficiently recover from disasters.
- Investigate, review, and implement activities or actions to ensure disaster related hazards are addressed by the most efficient and appropriate solution.
- Educate citizens about potential hazards.
- Facilitate development and implementation of hazard mitigation management activities to ensure a sustainable community.

Disaster Mitigation Act of 2000

The U.S. Congress passed the Disaster Mitigation Act 2000 to amend the Robert T. Stafford Disaster Relief and Emergency Assistance Act[1]. Section 322 of the DMA 2000 requires that state and local governments develop, adopt, and routinely update a hazard mitigation plan to remain

1 Federal Emergency Management Agency, Public Law 106-390. 2000. "Disaster Mitigation Act of 2000." Last modified September 26, 2013. https://www.fema.gov/media-library/assets/documents/4596.

eligible for pre- and post-disaster mitigation funding.[2] These funds include the Hazard Mitigation Grant Program (HMGP)[3], Building Resilient Infrastructure and Communities (BRIC)[4], and the Flood Mitigation Assistance Program (FMA)[5]. The Federal Emergency Management Agency (FEMA) administers these programs under the Department of Homeland Security (DHS).[6]

This plan was developed in accordance with current state and federal rules and regulations governing local hazard mitigation plans. The plan shall be monitored and updated on a routine basis to maintain compliance with the legislation – Section 322, Mitigation Planning, of the Robert T. Stafford Disaster Relief and Emergency Assistance Act, as enacted by Section 104 of the DMA 2000 (P.L. 106-390)[7] and by FEMA's Final Rule (FR)[8] published in the Federal Register on November 30, 2007, at 44 Code of Federal Regulations (CFR) Part 201.

Hazard Mitigation Assistance

On June 1, 2009, FEMA initiated the Hazard Mitigation Assistance (HMA) program integration, which aligned certain policies and timelines of the various mitigation programs. These HMA programs present a critical opportunity to minimize the risk to individuals and property from hazards while simultaneously reducing the reliance on federal disaster funds.[9]

Each HMA program was authorized by separate legislative actions, and as such, each program differs slightly in scope and intent.

Mitigation is the cornerstone of emergency management. Mitigation focuses on breaking the cycle of disaster damage, reconstruction, and repeated damage. Mitigation lessens the impact disasters have on people's lives and property through damage prevention, appropriate development standards, and affordable flood insurance. Through measures such as avoiding building in damage-prone areas, stringent building codes, and floodplain management regulations, the impact on lives and communities is lessened.

- FEMA Mitigation Directorate

- HMGP: To qualify for post-disaster mitigation funds, local jurisdictions must have adopted a mitigation plan that is approved by FEMA. HMGP provides funds to states, territories, Indian tribal governments, local governments, and eligible private non-profits following a presidential disaster declaration. The DMA 2000 authorizes up to seven percent of HMGP funds available to a state after a disaster to be used for the development of state, tribal, and local mitigation plans.

- FMA: To qualify to receive grant funds to implement projects such as acquisition or elevation of flood-prone homes, local jurisdictions must prepare a mitigation plan. Furthermore, local jurisdictions must be participating communities in the National Flood Insurance Program (NFIP). The goal of FMA is to reduce or eliminate claims under the NFIP.

2 Federal Emergency Management Agency. June 2007. "Robert T. Stafford Disaster Relief and Emergency Assistance Act, as amended, and Related Authorities." Federal Emergency Management Agency 592: 22. Sec. 322. Mitigation Planning (42 U.S.C. 5165). https://www.fema.gov/media-library/assets/documents/15271

3 Federal Emergency Management Agency. "Hazard Mitigation Grant Program." Last modified July 8, 2017. https://www.fema.gov/hazard-mitigation-grant-program.

4 Federal Emergency Management Agency. "Building Resilient Infrastructure and Communities." Last modified July 10, 2020. https://fema.gov/bric.

5 Federal Emergency Management Agency. "Flood Mitigation Assistance Grant Program." Last modified July 11, 2017. https://www.fema.gov/flood-mitigation-assistance-grant-program.

6 Federal Emergency Management Agency. "Hazard Mitigation Assistance." Last modified March 29, 2017. https://www.fema.gov/hazard-mitigation-assistance.

7 Federal Emergency Management Agency: Federal Register. 2002. "Section 104 of Disaster Mitigation Act 2000: 44 CFR Parts 201 and 206: Hazard Mitigation Planning and Hazard Mitigation Grant Programs; Interim Final Rule." https://www.fema.gov/pdf/help/fr02-4321.pdf.

8 Federal Emergency Management Agency: Federal Register. 2002 "44 CFR Parts 201 and 206: Hazard Mitigation Planning and Hazard Mitigation Grant Programs; Interim Final Rule." https://www.fema.gov/pdf/help/fr02-4321.pdf.

- BRIC: To qualify for funds, local jurisdictions must adopt a mitigation plan that is approved by FEMA. BRIC assists states, territories, Indian tribal governments, and local governments in implementing a sustained pre-disaster hazard mitigation program.

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SECTION TWO: PLANNING PROCESS

Introduction

The process utilized to develop a hazard mitigation plan is often as important as the final planning document. For this planning process, PCD adapted the four-step hazard mitigation planning process outlined by FEMA to fit the needs of the participating jurisdictions. The following pages will outline how the Regional Planning Team was established; the function of the Regional Planning Team; critical project meetings and community representatives; outreach efforts to the general public; key stakeholders and neighboring jurisdictions; general information relative to the risk assessment process; general information relative to local/regional capabilities; plan review and adoption; and ongoing plan maintenance.

Requirement §201.6(b): Planning process. An open public involvement process is essential to the development of an effective plan. In order to develop a more comprehensive approach to reducing the effects of natural disasters, the planning process shall include:
(1) An opportunity for the public to comment on the plan during the drafting stage and prior to plan approval;
(2) An opportunity for neighboring communities, local and regional agencies involved in hazard mitigation activities, and agencies that have the authority to regulate development, as well as businesses, academia and other private and non-profit interests to be involved in the planning process; and
(3) Review and incorporation, if appropriate, of existing plans, studies, reports, and technical information.
Requirement §201.6(c)(1): The plan shall document] the planning process used to develop the plan, including how it was prepared, who was involved in the process, and how the public was involved.

Multi-Jurisdictional Approach

According to FEMA, "A multi-jurisdictional hazard mitigation plan is a plan jointly prepared by more than one jurisdiction." The term 'jurisdiction' means 'local government.' Title 44 Part 201, Mitigation Planning in the CFR, defines a 'local government' as "any county, municipality, city, town, township, public authority, school district, special district, intrastate district, council of governments, regional or interstate government entity, or agency or instrumentality of a local government; any Indian tribe or authorized tribal organization, any rural community, unincorporated town or village, or other public entity." For the purposes of this plan, a 'taxing authority' was utilized as the qualifier for jurisdictional participation. FEMA recommends the multi-jurisdictional approach under the DMA 2000 for the following reasons:

- It provides a comprehensive approach to the mitigation of hazards that affect multiple jurisdictions;
- It allows economies of scale by leveraging individual capabilities and sharing cost and resources;
- It avoids duplication of efforts; and
- It imposes an external discipline on the process.

Both FEMA and the Nebraska Emergency Management Agency (NEMA) recommend this multi-jurisdictional approach through the cooperation of counties, regional emergency management, and natural resources districts. PCD utilized the multi-jurisdiction planning process recommended

by FEMA (Local Mitigation Plan Review Guide[10], Local Mitigation Planning Handbook[11], and Mitigation Ideas: A Resource for Reducing Risk to Natural Hazards[12]) to develop this plan.

Hazard Mitigation Planning Process

The hazard mitigation planning process as outlined by FEMA has four general steps which are detailed in the figure below. The mitigation planning process is rarely a linear process. It's common that ideas developed during the initial risk assessment may need revision later in the process, or that additional information may be identified while developing the mitigation plan or during plan implementation that results in new goals or additional risk assessments.

Organization of Resources

- Focus on the resources needed for a successful mitigation planning process. Essential steps include: Organizing interested community members; and Identifying technical expertise needed.

Assessment of Risk

- Identify the characteristics and potential consequences of the hazard. Identify how much of the jurisdiction can be affected by specific hazards and the potential impacts on local assets.

Mitigation Plan Development

- Determine priorities and identify possible solutions to avoid or minimize the undesired effects. The result is the hazard mitigation plan and strategy for implementation.

Plan Implementation and Progress Monitoring

- Bring the plan to life by implementing specific mitigation projects and changing day-to-day operations. It is critical that the plan remains relevant to succeed. Thus, it is important to conduct periodic evaluations and revisions, as needed.

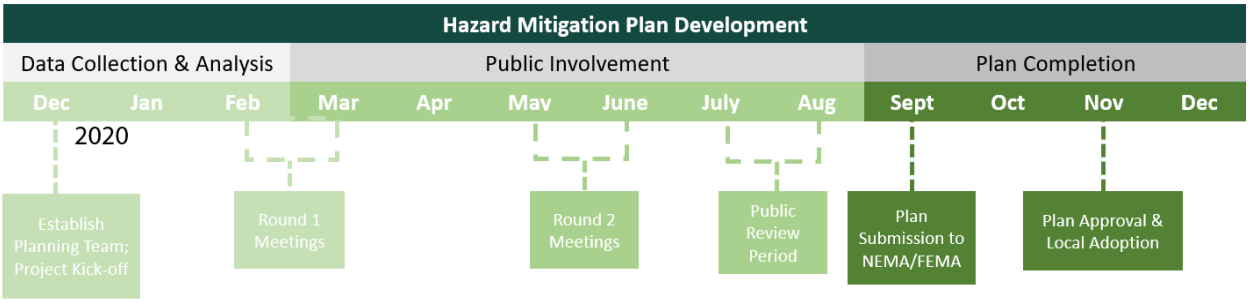
Organization of Resources

Plan Update Process

PCD applied for PDM funding for their multi-jurisdictional hazard mitigation plan (HMP) in fiscal year 2018. JEO Consulting Group, INC. (JEO) was contracted in November 2018 to guide and facilitate the planning process and assemble the multi-jurisdictional hazard mitigation plan. For the planning area, James Brueggeman (Perkins County Emergency Manager) led the development of the plan and served as the primary point of contact throughout the project. A clear timeline of this plan update process is provided in Figure 2.

10 Federal Emergency Management Agency. 2011. "Local Mitigation Plan Review Guide." https://www.fema.gov/media-library/assets/documents/23194.
11 Federal Emergency Management Agency. 2013. "Local Mitigation Planning Handbook." https://www.fema.gov/media-library/assets/documents/31598.
12 Federal Emergency Management Agency. 2013. "Mitigation Ideas: A Resource for Reducing Risk to Natural Hazards." https://www.fema.gov/media-library-data/20130726-1904-25045-0186/fema_mitigation_ideas_final508.pdf.

Figure 2: Project Timeline



Planning Team

At the beginning of the planning process, PCD and JEO staff identified who would be the regional Hazard Mitigation Planning Team. This Planning Team was established to guide the planning process, review the existing plan, and serve as a liaison to plan participants throughout the planning area. A list of Planning Team members can be found in Table 4. Additional technical support was provided to the Planning Team by staff from NEMA and the Nebraska Department of Natural Resources (NeDNR).

Table 4: Hazard Mitigation Planning Team

Name	Title	Jurisdiction
Brandon Myers	Emergency Manager	Dundy County
Duane Dreiling	Emergency Manager	Chase County
James Brueggeman	Emergency Manager	Perkins County
*Joe Green	Recovery Planning Specialist	NEMA
*Karl Dietrich	Planner	JEO Consulting Group
*Phil Luebbert	Project Coordinator	JEO Consulting Group

**Served as a consultant or advisory role*

A kick-off meeting was held on December 9, 2019, to discuss an overview of the planning process between JEO staff and the Planning Team. Preliminary discussion was held over hazards to be included in this plan, changes to be incorporated since the last plan, goals and objectives, identification of key stakeholders to include in the planning process, and a general schedule for the plan update. This meeting also assisted in clarifying the role and responsibilities of the Planning Team and strategies for public engagement throughout the planning process. Table 5 shows kick-off meeting attendees.

Table 5: Kick-off Meeting Attendees

Name	Title	Jurisdiction
Brandon Myers	Emergency Manager	Dundy County
Duane Dreiling	Emergency Manager	Chase County
James Brueggeman	Emergency Manager	Perkins County
Karon Harris	Sheriff's Secretary	Perkins County
Karl Dietrich	Planner	JEO Consulting Group
Phil Luebbert	Project Coordinator	JEO Consulting Group
Joe Green	Recovery Planning Specialist	NEMA

Table 6 shows the date, location, and agenda items of for the kick-off meeting.

Table 6: Kick-off Meeting Location and Time

Location and Time	Agenda Items
Grant, NE December 9, 2019 1:00pm	-Consultant and Planning Team responsibilities -Overview of plan update process and changes from 2015 HMP -Review and adoption of goals and objectives -Dates/Locations for meetings -Plan goals/objectives -Identification of regional hazards to discuss in the HMP

Public Involvement and Outreach

To notify and engage the public in the planning process, a wide range of stakeholder groups were contacted and encouraged to participate. There were 13 stakeholder groups or entities that were identified and sent letters to participate. The following stakeholders attended meetings Perkins County FSA, Imperial Manor Parkview Heights, Chase County Community Hospital, Sarah Ann Hester memorial Home, and the Southwest Nebraska Public Health Department. These stakeholders provided input which was incorporated into the appropriate community profiles (see *Section Seven*).

Table 7: Notified Stakeholder Groups

Organizations		
Chase County Community Hospital	Imperial Manor Parkview Heights	Southwest Nebraska Public Health Department
Chase/Dundy County FSA	Perkins County FSA	Southwest Nebraska RC&D
Dundy County Chamber of Commerce	Perkins County Health Services	Wauneta Care and Therapy Center
Dundy County Hospital	Sarah Ann Hester Memorial Home	
Golden Ours Convalescent Home	South Platte United Chambers of Commerce	

Neighboring Jurisdictions

Neighboring jurisdictions were notified and invited to participate in the planning process. The following table indicates which neighboring communities or entities were notified of the planning process. Invitation and informational letters were sent to county clerks, county and regional emergency managers, Regional Emergency Management Agencies, and NRDs. The Sedgwick County Emergency Manager attended the first Round 1 meeting.

Table 8: Notified Neighboring Jurisdictions

Notified Neighboring Jurisdictions	
Cheyenne County, KS	Sedgwick County, CO
Hayes County, NE	Phillips County, CO
Keith County, NE	Yuma County, CO
Middle Republican NRD	Cheyenne County, KS

Participant Involvement

Participants play a key role in identifying hazards, providing a record of historical disaster occurrences and localized impacts, identifying and prioritizing potential mitigation projects and strategies, and the developing annual review procedures.

To be a participant in the development of this plan update, jurisdictions were required to have, at a minimum, one representative present at the Round 1 or Round 2 meeting or attend a follow-up meeting with a JEO staff member. Some jurisdictions sent multiple representatives to meetings.

For jurisdictions who had only one representative, they were encouraged to bring meeting materials back to their governing bodies, to collect diverse input on their jurisdiction's meeting documents. Sign-in sheets from the Round 1 meetings can be found in *Appendix A*. Sign-in sheets are not available for Round 2 meetings as they were held virtually, however, attendance was recorded. Jurisdictions that were unable to attend the scheduled public meetings were able to request a meeting with JEO staff to satisfy the meeting attendance requirement. This effort enabled jurisdictions which could not attend a scheduled public meeting to participate in the planning process.

Outreach to eligible jurisdictions included notification prior to all public meetings, phone calls and email reminders of upcoming meetings, and reminders to complete worksheets required for the planning process. Individuals and departments invited to attend included, but were not limited to:

- Local Agencies (Clerks, Treasurers, City Administrators, Mayors, Village Board Members, Council Presidents, Utility Superintendents, Floodplain Administrators, Planning Commissioners, Fire Chiefs, School Superintendents),
- Regional Agencies (NRD General Manager, Emergency Managers, Highway Superintendents, County Commissioners, Clerks, Planning Manager),
- and State Agencies (Nebraska Emergency Management Agency, Nebraska Department of Natural Resources).

Table 9 provides a summary of outreach activities utilized in this process.

Table 9: Outreach Activity Summary

Action	Intent
Project Website	Informed the public and local/planning team members of past, current, and future activities (https://jeo.com/perkins-chase-and-dundy-county-hazard-mitigation-plan)
Project Announcement	Project announcement shared with local media outlets and participating jurisdictions to be posted on social media
Round 1 Meeting Letters and Emails (30-day notification)	Sent to participants, stakeholders, and neighboring jurisdictions to discuss the agenda/dates/times/ locations of the first round of public meetings
Round 2 Meeting Letters and Emails (30-day notification)	Sent to participants to discuss the agenda/dates/times/locations of the second round of public meetings
Press Release	Sent to local newspapers to announce the plan and describe the purpose of the plan
Notification Phone Calls	Called potential participants to remind them about upcoming meetings
Follow-up Emails and Phone Calls	Correspondence was provided to remind and assist participating jurisdictions with the collection and submission of required local data
Project Flyer	Flyers were posted about the PCD HMP and how to get involved. Flyers were shared with all Hazard Mitigation Planning team members
Word-of-Mouth	Staff discussed the plan with jurisdictions throughout the planning process

Assessment of Risk

Round 1 Meetings: Hazard Identification

At the Round 1 meetings, jurisdictional representatives (i.e. the local planning teams) reviewed the regional hazards identified at the kick-off meeting and conducted risk and vulnerability assessments based on these hazards' previous occurrence and the communities' exposure. (For a complete list and regional overview of regional hazards reviewed, see *Section Four: Risk Assessment.)*.

Table 10 shows the date and location of meetings held for the Round 1 meeting phase of the project.

Table 10: Round 1 Meeting Dates and Locations

Agenda Items	
General overview of the HMP update process, discuss participation requirements, begin the process of risk assessment and impact reporting, update critical facilities, capabilities assessment, and status update on current mitigation projects	
Location and Time	**Date**
Perkins County Courthouse 200 Lincoln Avenue Grant NE, 2:00PM	Wednesday, March 4, 2020
EMS Building 1215 Grant Street Imperial NE, 6:00PM	Wednesday, March 4, 2020
EMS Building 1305 A Street Benkelman NE, 7:00PM	Thursday, March 5, 2020

The intent of these meetings was to familiarize local planning team members with the plan update process, expected actions for the coming months, the responsibilities of being a participant, and to collect preliminary information to update the HMP. Data collected at these meetings included: updates to mitigation actions from the 2015 PCD HMP; review, confirm, or update hazards of top concerns from each jurisdiction; and to begin reviewing and updating community profiles for demographics and capabilities. Information/data reviewed include but was not limited to: local hazard prioritization results; identified critical facilities and their location within the community; future development areas; and expected growth trends (refer to *Appendix B*).

The following tables show the attendees for each jurisdiction who attended a Round 1 meeting or had a one-on-one discussion for Round 1 information with JEO staff.

Table 11: Round 1 Meeting Attendees

Name	Title	Jurisdiction
Imperial – Wednesday, March 4, 2020		
Abigail Cyboron	Interim CEO	Chase County Community Hospital
Billie Hayes	E.S Manager	Imperial Manor Parkview Heights
Doug Mitchell	Fire Chief	Imperial Volunteer Fire Department
Duane Dreiling	Emergency Manager	Chase County
Evelyn Skelton	Clerk/Treasurer	Village of Wauneta
Julia Strand	Water Program Specialist	Upper Republican NRD
Kathie Skeen	Emergency Planning Coordinator	Southwest Nebraska Public Health Department
Pat Davison	Director of Public Works	City of Imperial
Relgene Zimbelman	Fire Chief	Benkelman Rural Fire Department
Vince Turpin	EMS Captain	Benkelman Rural Fire Department
Wade Turner	Water Operator	Village of Elsie
Karl Dietrich	Planner	JEO Consulting Group
Phil Luebbert	Project Coordinator	JEO Consulting Group
Grant – Wednesday, March 4, 2020		
Andrea Brueggeman	President of Council	City of Grant
David Steinwart	Utility Superintendent/Floodplain Manager/Village Emergency Manager	Village of Madrid
James Brueggeman	Emergency Manager/Sheriff	Perkins County
Jessie Faber	Clerk/Treasurer	City of Grant
Karon Harris	Sheriff's Secretary	Perkins County
Lisa Schmitt	Mayor	City of Grant
Michael Dolezal	Highway Superintendent/Assistant Chief	Perkins County/Venango Volunteer Fire Department
Rob Crowder	Emergency Manager	Sedgwick County
Teri Moss	County Executive Director	Perkins County FSA
Troy Grothman	Clerk, Fireman	Village of Venango, Venango Volunteer Fire Department
Karl Dietrich	Planner	JEO Consulting Group
Phil Luebbert	Project Coordinator	JEO Consulting Group
Benkelman – Thursday, March 5, 2020		
Brandon Myers	Emergency Manager	Dundy County
James Summers	Utility Superintendent	City of Benkelman
Janice Edwards	Administrator	Sarah Ann Hester Memorial Home
Keith Haskell	Board Chairperson	Village of Haigler
Richard Bartholomew	County Commissioner	Dundy County
Shawna Turpin	Emergency and Safety	Sarah Ann Hester Memorial Home
Tim Smith	Street Superintendent	City of Benkelman
Karl Dietrich	Planner	JEO Consulting Group
Phil Luebbert	Project Coordinator	JEO Consulting Group

Figure 3: Round 1 Meeting in Imperial, NE

Table 12: Round 1 One-on-One Meeting Attendees

Name	Title	Jurisdiction
Thursday, March 26, 2020		
Mike Lee	Fire Chief	Madrid Fire Protection District
Trent Harger	Assistant Chief	Madrid Fire Protection District
Karl Dietrich	Planner	JEO Consulting Group

Mitigation Plan Development

Round 2 Meetings: Mitigation Strategies

The identification and prioritization of mitigation measures is an essential component in developing effective hazard mitigation plans. At the Round 2 meetings, participating jurisdictions identified new mitigation actions in addition to the mitigation actions continued from the 2015 HMP. Participating jurisdictions were also asked to review the information collected from the Round 1 meeting related to their community through this planning process and to complete a plan integration worksheet.

Round 2 meetings also included a brief discussion about the planning process, when the plan would be available for public review and comment, and the grant application process once the plan was approved. Table 13 shows the date and location of meetings held for Round 2 Meetings. Meeting attendees are identified in Table 14.

Due to the COVID-19 outbreak, Round 2 meetings were held via an online and phone format rather than in-person public workshop meeting. This was done to protect the health of residents and staff members in the planning area and to help reduce the spread of the virus.

Table 13: Round 2 Meeting Dates and Locations

Agenda Items	
Identify new mitigation actions, review of local data and community profile, discuss review process, complete plan integration worksheet.	
Location and Time	**Date**
Online Zoom Meeting: 2:00PM MT	Wednesday, June 3, 2020
Online Zoom Meeting: 7:00PM MT	Thursday, June 4, 2020

Table 14: Round 2 Meeting Attendees

Name	Title	Jurisdiction
Zoom Meeting – Wednesday, June 3, 2020		
Brandon Myers	Emergency Manager	Dundy County
James Brueggeman	Emergency Manger/Sheriff	Perkins County
Jessie Faber	Clerk/Treasurer	City of Grant
Julia Strand	Water Program Specialist	Upper Republican NRD
Karon Harris	Sheriff's Secretary	Perkins County
Richard Bartholomew	County Commissioner	Dundy County
Troy Grothman	Clerk, Fireman	Village of Venango, Venango Volunteer Fire Department
Karl Dietrich	Planner	JEO Consulting Group
Phil Luebbert	Project Manager	JEO Consulting Group
Mary Baker	Resilience Strategist	JEO Consulting Group
Zoom Meeting – Thursday, June 4, 2020		
Andrea Brueggeman	President of Council	City of Grant
Evelyn Skelton	Clerk/Treasurer	Village of Wauneta
Doug Mitchell	Fire Chief	Imperial Volunteer Fire Department
James Summers	Utility Superintendent	City of Benkelman
Keith Haskell	Board Chairperson	Village of Haigler
Lisa Schmitt	Mayor	City of Grant
Mike Lee	Fire Chief	Madrid Fire Protection District
Pat Davison	Director of Public Works	City of Imperial
Wade Turner	Water Operator	Village of Elsie
Karl Dietrich	Planner	JEO Consulting Group
Phil Luebbert	Project Manager	JEO Consulting Group
Mary Baker	Resilience Strategist	JEO Consulting Group
Round 2 One-on-One Meeting Attendees		
Duane Dreiling	Emergency Manager	Chase County
David Steinwart	Utility Superintendent/Floodplain Manager/Village Emergency Manager	Village of Madrid
Relgene Zimbelman	Fire Chief	Benkelman Rural Fire Department
Karl Dietrich	Planner	JEO Consulting Group
Phil Luebbert	Project Manager	JEO Consulting Group

Data Sources and Information

Effective hazard mitigation planning requires the review and inclusion of a wide range of data, documents, plans, and studies. The following table identifies many of the sources utilized during this planning process. Individual examples of plan integration are identified in *Section Seven: Community Profiles.*

Table 15: General Plans, Documents, and Information

Documents	
Disaster Mitigation Act of 2000 DMA https://www.fema.gov/media-library-data/20130726-1524-20490-1678/dma2000.txt	National Flood Insurance Program Community Status Book (2020) https://www.fema.gov/national-flood-insurance-program-community-status-book
Final Rule (2015) https://www.fema.gov/emergency-managers/risk/hazard-mitigation/regulations-guidance/archive	National Response Framework (2019) https://www.fema.gov/media-library/assets/documents/117791
Hazard Mitigation Assistance Unified Guidance (2015) https://www.fema.gov/media-library/assets/documents/103279	Robert T. Stafford Disaster Relief and Emergency Assistance Act (2019) https://www.fema.gov/media-library/assets/documents/15271
Local Mitigation Plan Review Guide (2011) https://www.fema.gov/sites/default/files/2020-06/fema-local-mitigation-plan-review-guide_09_30_2011.pdf	The Census of Agriculture (2012) https://www.agcensus.usda.gov/Publications/2012/Full_Report/Census_by_State/Nebraska/
Local Mitigation Planning Handbook (2013) https://www.fema.gov/sites/default/files/2020-06/fema-local-mitigation-planning-handbook_03-2013.pdf	What is a Benefit: Guidance on Benefit-Cost Analysis on Hazard Mitigation Projects http://www.fema.gov/benefit-cost-analysis
Mitigation Ideas: A Resource for Reducing Risk to Natural Hazards (2013) https://www.fema.gov/sites/default/files/2020-06/fema-mitigation-ideas_02-13-2013.pdf	
Plans and Studies	
Perkins, Chase, and Dundy Counties Hazard Mitigation Plan (2015) https://jeo.com/perkins-chase-and-dundy-county-hazard-mitigation-plan	Nebraska Drought Mitigation and Response Plan (2000) http://carc.nebraska.gov/docs/NebraskaDrought.pdf
Flood Insurance Studies https://www.fema.gov/flood-insurance	State of Nebraska Hazard Mitigation Plan (2014) https://nema.nebraska.gov/sites/nema.nebraska.gov/files/doc/hazmitplan.pdf
Fourth National Climate Assessment (2018) https://nca2018.globalchange.gov/	State of Nebraska Flood Hazard Mitigation Plan (2013) https://nema.nebraska.gov/sites/nema.nebraska.gov/files/doc/flood-hazmit-plan.pdf
National Climate Assessment (2014) https://nca2014.globalchange.gov/	
Data Sources/Technical Resources	
Arbor Day Foundation – Tree City Designation https://www.arborday.org/	Nebraska Department of Natural Resource – Geographic Information Systems (GIS) https://dnr.nebraska.gov/data
Environmental Protection Agency - Chemical Storage Sites https://myrtk.epa.gov/info/search.jsp	Nebraska Department of Natural Resources http://www.dnr.ne.gov

Federal Emergency Management Agency http://www.fema.gov	Nebraska Department of Natural Resources – Dam Inventory http://prodmaps2.ne.gov/html5DNR/?viewer=daminventory
FEMA Flood Map Service Center https://msc.fema.gov/portal/advanceSearch	Nebraska Department of Revenue – Property Assessment Division www.revenue.ne.gov/PAD
High Plains Regional Climate Center http://climod.unl.edu/	Nebraska Department of Transportation http://dot.nebraska.gov/
National Agricultural Statistics Service http://www.nass.usda.gov/	Nebraska Emergency Management Agency http://www.nema.ne.gov
National Centers for Environmental Information https://www.ncei.noaa.gov/	Nebraska Forest Service – Wildland Fire Protection Program http://nfs.unl.edu/fire
National Consortium for the Study of Terrorism and Responses to Terrorism (START) http://www.start.umd.edu/gtd/	Nebraska Forest Service (NFS) http://www.nfs.unl.edu/
National Drought Mitigation Center – Drought Impact Reporter http://droughtreporter.unl.edu/map/	Nebraska Public Power District https://www.nppd.com/
National Drought Mitigation Center – Drought Monitor http://droughtmonitor.unl.edu/	Nebraska State Historical Society http://www.nebraskahistory.org/histpres/index.shtml
National Environmental Satellite, Data, and Information Service http://www.nesdis.noaa.gov/	Stanford University - National Performance of Dams Program https://npdp.stanford.edu/
National Fire Protection Association https://www.nfpa.org/	Storm Prediction Center Statistics http://www.spc.noaa.gov
National Flood Insurance Program https://www.fema.gov/national-flood-insurance-program	United States Army Corps of Engineers – National Levee Database https://levees.sec.usace.army.mil/#/
National Flood Insurance Program https://dnr.nebraska.gov/floodplain/flood-insurance	United States Census Bureau http://www.census.gov
National Historic Registry https://www.nps.gov/subjects/nationalregister/index.htm	United States Census Bureau https://data.census.gov/cedsci/
National Oceanic Atmospheric Administration (NOAA) http://www.noaa.gov/	United States Department of Agriculture http://www.usda.gov
National Weather Service http://www.weather.gov/	United States Department of Agriculture – Risk Assessment Agency http://www.rma.usda.gov
Natural Resources Conservation Service www.ne.nrcs.usda.gov	United States Department of Agriculture – Web Soil Survey https://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx
Nebraska Association of Resources Districts http://www.nrdnet.org	United States Department of Commerce http://www.commerce.gov/
Nebraska Climate Assessment Response Committee http://carc.agr.ne.gov	United States Department of Transportation – Pipeline and Hazardous Materials Safety Administration https://www.phmsa.dot.gov/

Nebraska Department of Education http://nep.education.ne.gov/	United States Geological Survey http://www.usgs.gov/
Nebraska Department of Education Directory http://educdirsrc.education.ne.gov/	United States Coast Guard National Response Center https://nrc.uscg.mil/
Nebraska Department of Environment and Energy http://www.deq.state.ne.us/	United States Small Business Administration http://www.sba.gov
Nebraska Department of Health and Human Services http://dhhs.ne.gov/Pages/default.aspx	UNL – College of Agricultural Sciences and Natural Resources – Schools of Natural Resources http://casnr.unl.edu

Public Review

Once the draft of the HMP was completed, a public review period was opened to allow for participants and community members at large to review the plan, provide comments, and request changes. The public review period was open from August 3, 2020 through August 17, 2020. Participating jurisdictions were mailed a letter notifying them of this public review period. The HMP was also made available on the project website (https://jeo.com/perkins-chase-and-dundy-county-hazard-mitigation-plan) to download the document. The Hazard Mitigation Planning Team received comments from the Upper Republican NRD, Perkins County, and the Imperial Rural Fire District local planning teams. Comments were limited to grammatical changes, updates on governance, critical facility additions, regional hazard updates, and hazard prioritization changes. The plan was also reviewed by NeDNR, specifically regarding the drought, flooding, and dam failure sections. All received comments were incorporated into the HMP.

Plan Adoption

Based on FEMA requirements, this multi-jurisdictional hazard mitigation plan must be formally adopted by each participant through approval of a resolution. This approval will create individual ownership of the plan by each participant. Formal adoption provides evidence of a participant's full commitment to implement the plan's goals, objectives, and action items. A copy of the resolution draft submitted to participating jurisdictions is located in *Appendix A*. Copies of adoption resolutions may be requested from the State Hazard Mitigation Officer.

Requirement §201.6(c)(5): For multi-jurisdictional plans, each jurisdiction requesting approval of the plan must document that it has been formally adopted.

Once adopted, participants are responsible for implementing the plan and updating it every five years. Those who participated directly in the planning process would be logical champions for updating the plan. In addition, the plan will need to be reviewed and updated annually or when a hazard event occurs that significantly affects the area or individual participants.

Plan Implementation and Progress Monitoring

Hazard mitigation plans need to be living documents. To ensure this, the plan must be reviewed annually, and must be monitored, evaluated, and updated on a five-year or less cycle. This includes incorporating the mitigation plan into county and local comprehensive or capital improvement plans as they stand or are developed. *Section Six* describes the system that jurisdictions participating in the PCD HMP have established to monitor the plan; provides a description of how, when, and by whom the HMP process and mitigation actions will be evaluated; presents the criteria used to evaluate the plan; and explains how the plan will be maintained and updated.

SECTION THREE: PLANNING AREA PROFILE

Introduction

To identify jurisdictional vulnerabilities, it is vitally important to understand the people and built environment of the planning area. The following section is meant to provide an overall profile description of the characteristics of the planning area. Many characteristics are covered in each jurisdiction's community profile, including demographics, transportation routes, and structural inventory. Redundant information will not be covered in this section. Therefore, this section will highlight at-risk populations and characteristics of the built environment that add to regional vulnerabilities.

Planning Area Geographic Summary

PCD's planning area includes the southwestern corner of Nebraska and spans 2,702 square miles. For the purpose of this plan update, the planning area includes all of Chase, Dundy, and Perkins counties. The planning area has a diverse range of topographic regions including dissected plains, sandhills, plains, and large reservoirs (Figure 4). Descriptions of these topographic regions are below.

- **Dissected plains**: Hilly land with moderate to steep slopes and sharp ridge crests.
- **Large reservoirs**: Constructed for purposes such as water storage for irrigation, generation of electricity, flood control or recreation.
- **Plains**: Flat-lying land that lies above the valley. The materials of the plains are sandstone or stream-deposited silt, clay, sand and gravel overlain by wind-deposited silt (called *loess*).
- **Sandhills**: Hilly land composed of low to high dunes of sand stabilized by grass cover.[13]

The region resides in the Republican Watershed. Main waterways in the planning area include the Republican River and Frenchman Creek. The Republican River flows into Kansas where it joins with the Missouri River. PCD in located in the Upper Republican Natural Resources District.

Demographics and At-Risk Populations

As noted above, the planning area includes all of Perkins, Chase, and Dundy counties. The overall planning area population served is 8,724. This population includes a range of demographics and persons at risk to natural and human-made disasters.

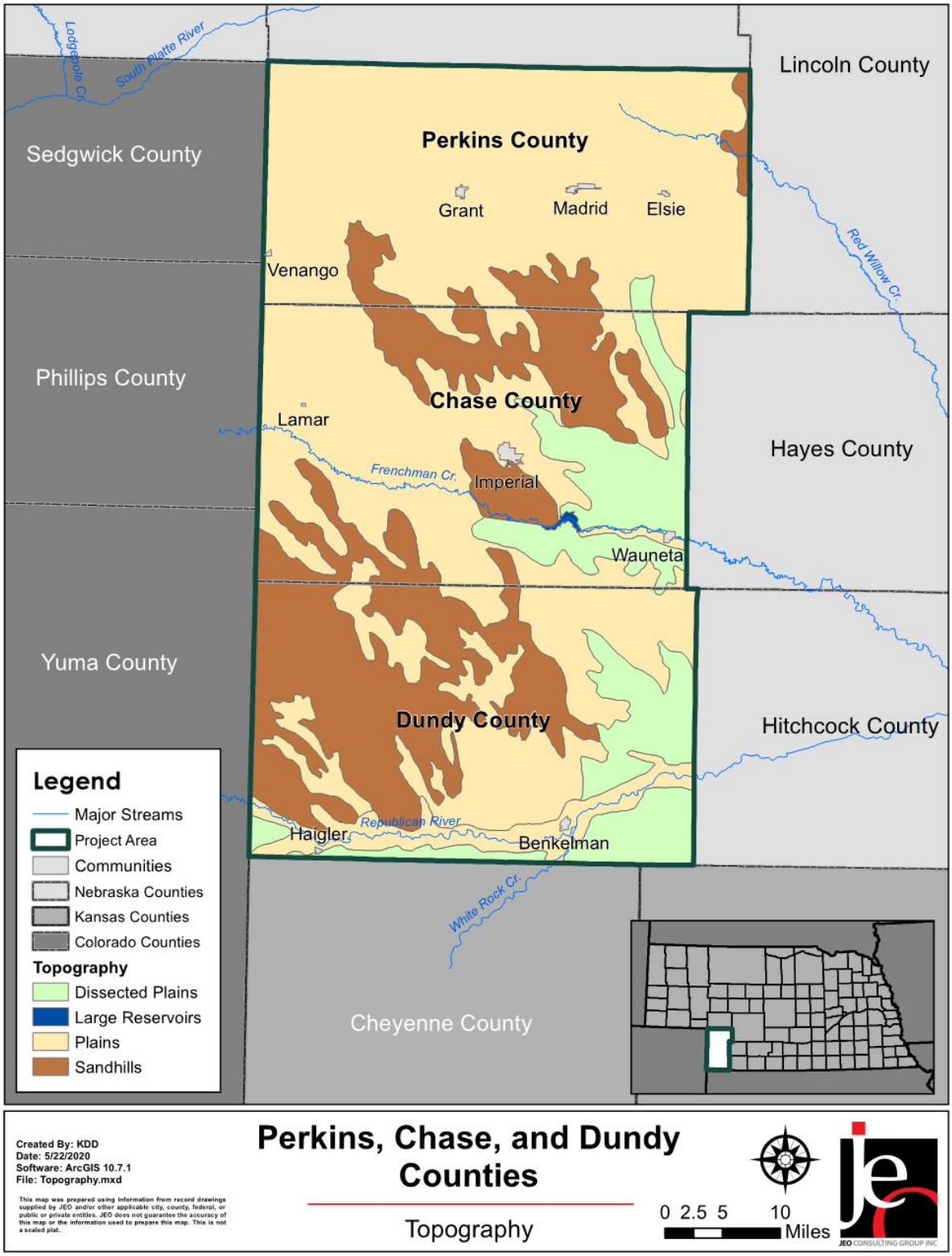
Table 16: Estimated Population for Planning Area

Age	Planning Area	State of Nebraska
<5	5.4%	6.9%
5-19	19.8%	20.7%
20-64	53.3%	57.6%
>64	21.5%	14.8%
Median	43.8	36.3

Source: U.S. Census Bureau

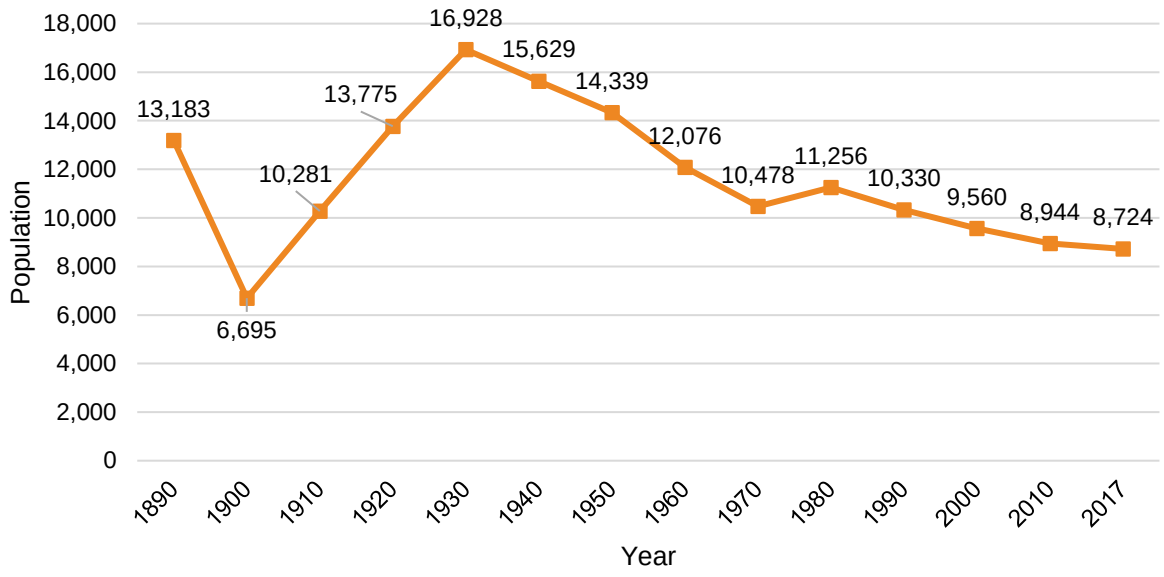
13 Conservation and Survey Division/Institute of Agriculture and Natural Resources. 2001. "Topographic regions map of Nebraska." https://digitalcommons.unl.edu/caripubs/62.

Figure 4: Topography



Community and regional vulnerability are impacted by growing or declining populations. Communities growing quickly may lack resources to provide services for all members of the community in a reasonable timeframe including snow removal, emergency storm shelters, repairs to damaged infrastructure, or even tracking the location of vulnerable populations. Communities experiencing population decline may be more vulnerable to hazards as a result of vacant and/or dilapidated structures, an inability to properly maintain critical facilities and/or infrastructure, and higher levels of unemployment and populations living in poverty. It is important for communities to monitor their population changes and ensure that those issues be incorporated into hazard mitigation plans, as well as other planning mechanisms within the community. Communities with decreasing population are located primarily in rural areas, away from larger city centers and major transportation corridors.

Figure 5: Planning Area Population, 1890-2017



Source: U.S. Census Bureau[14]

The planning area has displayed an overall decline in total population since the 1980s. While the U.S. Census Bureau conducts a formal census every ten years, the estimated population of the three-county planning area in 2017 was 8,724. Subsequent updates to this HMP should include updated census data from the 2020 census to determine if the trend is continuing.

At-risk Populations

In general, at-risk populations may have difficulty with medical issues, poverty, extremes in age, and communication due to language barriers. Several outliers may be considered when discussing potentially at-risk populations, including:

- Not all people who are considered “at-risk” are at-risk;
- Outward appearance does not necessarily mark a person as at-risk;
- A hazard event will, in many cases, impact at-risk populations in different ways.

14 United States Census Bureau. “2017 American Fact Finder: S0101: Age and Sex.” [database file]. https://data.census.gov/cedsci/.

The National Response Framework defines at-risk populations as "…populations whose members may have additional needs before, during, and after an incident in functional areas, including but not limited to: maintaining independence, communication, transportation, supervision, and medical care."[15]

Dependent children under 19 years old are one of the most vulnerable populations to disasters.[16] The majority of people in this age group lack practical knowledge necessary to respond appropriately during a disaster. Despite this vulnerability, children are generally overlooked in disaster planning because the presence of a caretaker is assumed. With nearly 19.8% of the planning area's population younger than 19, children are a key vulnerable group to address in the planning process.

Schools house a high number of children and adults within the planning area during the daytime hours of weekdays, as well as during special events on evenings and weekends. The following table identifies the various school districts located within the planning area, and Figure 6 is a map of the school district boundaries.

Table 17: School Inventory

School District	Total Enrollment (2018-2019)	Total Teachers
Chase County Schools	625	51
Dundy County Stratton Public Schools	318	36
Perkins County Schools	414	38
Wauneta-Palisade Public Schools	239	19

Source: Nebraska Department of Education[17]

Like minors, seniors (age 65 and greater) are often more significantly impacted by hazards and temperature extremes. During prolonged heat waves or periods of extreme cold, seniors may lack resources to effectively address hazard conditions and as a result may incur injury or potentially death. Prolonged power outages (either standalone events or as the result of other contributing factors) can have significant impacts on any citizen relying on medical devices. One study conducted by the Center for Injury Research and Policy found that increases in vulnerability related to severe winter storms (with significant snow accumulations) begin at age 55.[18] The study found that on average there are 11,500 injuries and 100 deaths annually related to snow removal. Men over the age of 55 are 4.25 times more likely to experience cardiac events during snow removal.

While the previously identified populations live throughout the planning area, there is the potential that they will be located in higher concentrations at care facilities. Table 18 identifies the number and capacity of care facilities throughout the planning area.

15 United States Department of Homeland Security. October 2019. "National Response Framework Third Edition." https://www.fema.gov/media-library/assets/documents/117791.

16 Flanagan, Gregory, Hallisey, Heitgerd, & Lewis. 2011. "A Social Vulnerability Index for Disaster Management." Journal of Homeland Security and Emergency Management, 8(11): Article 3.

17 Nebraska Department of Education. 2019. "Nebraska Education Profile." Accessed June 2020. http://nep.education.ne.gov/.

18 Center for Injury Research and Policy. January 2011. "Snow Shoveling Safety." Accessed July 2017. http://www.nationwidechildrens.org/cirp-snow-shoveling.

Figure 6: Regional School Districts

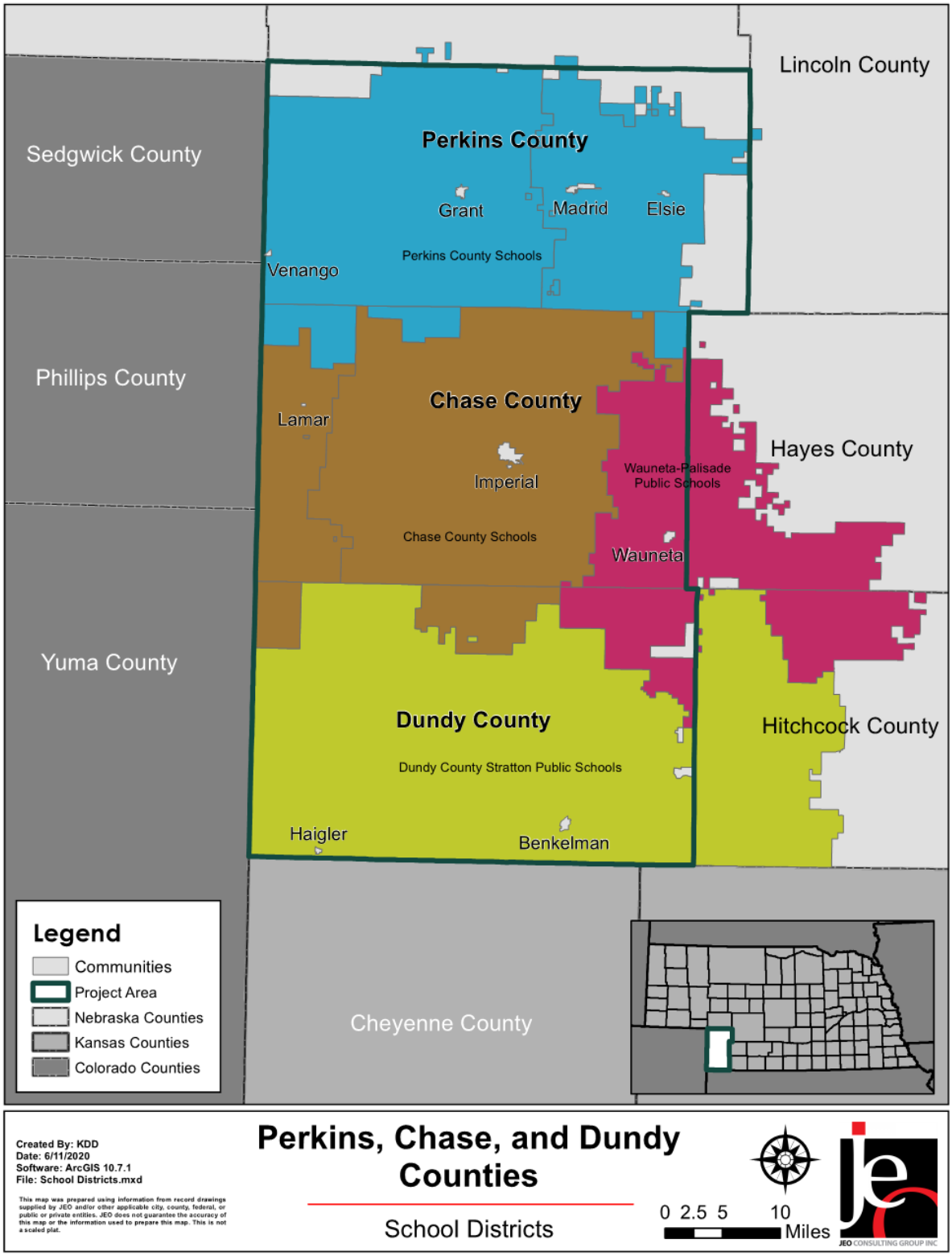


Table 18: Inventory of Care Facilities

Jurisdiction	Hospitals	Hospital Beds	Health Clinics	Adult Care Homes	Adult Care Beds	Assisted Living Homes	Assisted Living Beds
Chase	1	20	2	2	94	1	49
Dundy	1	12	1	1	56	0	0
Perkins	1	20	1	1	50	1	17

Source: Nebraska Department of Health and Human Services[19,20,21,22]

In addition to residents being classified as at-risk by age, there are other specific groups within the planning area that experience vulnerabilities related to their ability to communicate or their economic status. Table 19 provide statistics per county regarding households with English as a second language (ESL) and population reported as in poverty within the past 12 months.

Table 19: ESL and Poverty At-Risk Populations

County	Percent That Speaks English as Second Language	Families Below Poverty Level
Chase	12.1%	5.1%
Dundy	16.3%	6.0%
Perkins	5.4%	2.7%

Source: U.S. Census Bureau[23,24]

Residents below the poverty line may lack resources to prepare for, respond to, or recover from hazard events. Residents with limited economic resources might struggle to prioritize the implementation of mitigation measures over more immediate needs. Further, residents with limited economic resources are more likely to live in older, more vulnerable structures. These structures could be mobile homes; located in the floodplain; located near know hazard sites (i.e. chemical storage areas); or older poorly maintained structures. Residents below the poverty line will be more vulnerable to all hazards within the planning area.

Residents who speak English as a second language may struggle with a range of issues before, during, and after hazard events. General vulnerabilities revolve around what could be an inability to effectively communicate with others or an inability to comprehend materials aimed at notification and/or education. When presented with a hazardous situation it is important that all community members be able to receive, decipher, and act on relevant information. An inability to understand warnings and notifications may prevent non-native English speakers from reacting in a timely manner. Further, educational materials related to regional hazards are most often developed in the dominant language for the area, for the planning area that would be English. Residents who struggle with English in the written form may not have sufficient information related to local concerns to effectively mitigate potential impacts. Residents with limited English proficiency would be at an increased vulnerability to all hazards within the planning area.

19 Department of Health and Human Services. June 2020. "Assisted Living Facilities." http://dhhs.ne.gov/licensure/Documents/ALF%20Roster.pdf.
20 Department of Health and Human Services. June 2020. "Hospitals." http://dhhs.ne.gov/licensure/Documents/Hospital%20Roster.pdf#search=hospital%20roster.
21 Department of Health and Human Services. June 2020. "Long Term Care Facilities." http://dhhs.ne.gov/licensure/Documents/LTCRoster.pdf#search=long%20term%20care%20facilities%20roster
22 Department of Health and Human Services. June 2020. "Rural Health Clinic." http://dhhs.ne.gov/licensure/Documents/RHC_Roster.pdf#search=hospital%20roster.
23 U.S. Census Bureau. 2020. "Language Spoken at Home: 2017 American Community Survey (ACS) 5-year estimates." https://data.census.gov/cedsci/.
24 U.S. Census Bureau. 2020. "Selected Economic Characteristics: 2017 ACS 5-year estimate." https://data.census.gov/cedsci/.

Similar to residents below the poverty line, racial minorities tend to have less systemic access to resources, financial and otherwise, that would enable them to implement hazard mitigation projects and to respond and recover from hazard events, including residence in standard housing and financial stability. The mostly homogenous racial profile of the planning area indicates that racial inequity will not significantly affect the community's vulnerability to hazards (Table 20).

Table 20: Racial Composition Trends

Race	2010		2017		% Change
	Number	% of Total	Number	% of Total	
White, Not Hispanic	8,639	97.4%	8,647	99.1%	1.7%
Black	0	0%	9	0.1%	0.1%
American Indian and Alaskan Native	16	0.2%	3	0.03%	-0.17%
Asian	6	0.1%	0	0%	-0.1%
Native Hawaiian and Other Pacific Islander	1	0.01%	0	0%	-0.01%
Other Races	140	1.6%	20	0.2%	(-1.4%)
Two or More Races	71	0.8%	45	0.5%	-0.3%
Total Population	**8,873**	**-**	**8,724**	**-**	**-**

Source: U.S. Census Bureau[25,26]

Built Environment and Structural Inventory

The US Census provides information related to housing units and potential areas of vulnerability as described in the following discussion.

Of the occupied housing units in the planning area, more than 23 percent are renter-occupied. Renter-occupied housing units often do not receive many of the updates and retrofits that are needed to make them resilient to disaster impacts. Communities may consider enacting landlord outreach programs aimed at educating property owners about the threats in their area and what they can do to help reduce the vulnerability of the tenants living in their housing units. It should be noted that Dundy County has the highest percentage of renter-occupied housing units in the planning area. The City of Grant, the second largest community in the planning area, has more than 32 percent of housing stock occupied by renters.

Unoccupied homes may not be maintained as well as occupied housing, thus adding to their vulnerability. During disaster events like high winds or tornadoes, these structures may fail and result in debris which can impact other structures as well as people, resulting in injuries or fatalities, as well as higher damage totals.

25 U.S. Census Bureau. 2020. "Race: 2010 ACS 5-year estimate." https://data.census.gov/cedsci/.
26 U.S. Census Bureau. 2020. "Race: 2017 ACS 5-year estimate." https://data.census.gov/cedsci/.

Table 21: Housing Characteristics

Jurisdiction	Total Housing Units				Occupied Housing Units			
	Occupied		Vacant		Owner		Renter	
	#	%	#	%	#	%	#	%
Chase County	1,671	86.2%	267	13.8%	1,345	80.5%	326	19.5%
Lamar	6	100%	0	0%	6	100%	0	0%
Imperial	833	89.4%	99	10.6%	678	81.4%	155	18.6%
Wauneta	314	85.8%	52	14.2%	261	83.1%	53	16.9%
Dundy County	875	76.4%	271	23.6%	595	68%	280	32%
Benkelman	464	77.5%	135	22.5%	323	69.6%	141	30.4%
Haigler	74	74%	26	26%	53	71.6%	21	28.4%
Perkins County	1247	86.2%	200	13.8%	983	78.8%	264	21.2%
Elsie	67	81.7%	15	18.3%	52	77.6%	15	22.4%
Grant	579	90.3%	62	9.7%	391	67.5%	188	32.5%
Madrid	104	77%	31	23%	84	80.8%	20	19.2%
Venango	78	83.9%	15	16.1%	56	71.8%	22	28.2%
Planning Area	**6,312**	**84.3%**	**1173**	**15.7%**	**4,827**	**76.5%**	**1,485**	**23.5%**

Source: U.S. Census Bureau[27]

The US Census provides information related to housing units and potential areas of vulnerability. The selected characteristics examined in Table 22 include lacking complete plumbing facilities; lacking complete kitchen facilities; no telephone service available; housing units that are mobile homes; and housing units with no vehicles.

Table 22: Selected Housing Characteristics

	Chase	Dundy	Perkins	Total
Occupied Housing Units	1,671 (86.2%)	875 (76.4%)	1,247 (86.2%)	3,793
Lacking Complete Plumbing Facilities	0.0%	0.9%	0.0%	(0.3%)
Lacking Complete Kitchen Facilities	0.0%	0.3%	1.4%	(0.6%)
No Telephone Service Available	0.8%	1.3%	1.8%	(1.3%)
Housing Unit with No Vehicles Available	4.1%	2.6%	3.5%	(3.4%)
Mobile Homes	10.9%	6.5%	3.0%	(6.8%)

Source: U.S. Census Bureau, 2019[28]

Approximately one percent of housing units lack access to landline telephone service. This does not necessarily indicate that there is not a phone in the housing unit, as cell phones are now the primary form of telephone service. However, this lack of access to landline telephone service does represent a population at increased risk to disaster impacts. Reverse 911 systems are designed to contact households via landline services and as a result, some homes in hazard

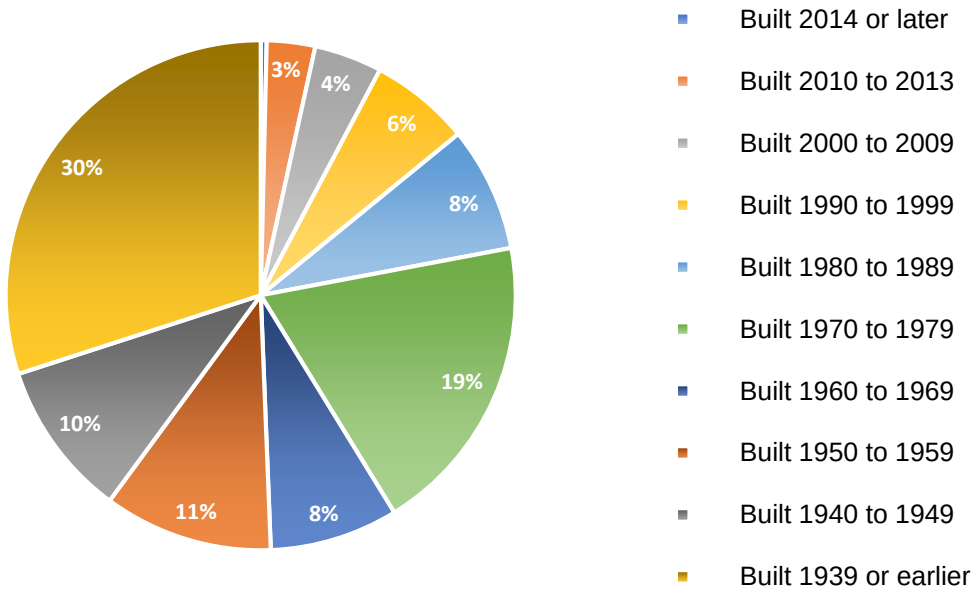
27 U.S. Census Bureau. 2020. "Selected Housing Characteristics: 2017 ACS 5-year estimate." https://data.census.gov/cedsci/.
28 U.S. Census Bureau. 2020. "Selected Housing Characteristics: 2017 ACS 5-year estimate." https://data.census.gov/cedsci/.

prone areas may not receive notification of potential impacts in time to take protective actions. Emergency managers should continue to promote the registration of cell phone numbers with Reverse 911 systems.

Approximately six percent of housing units in the planning area are mobile homes. Chase County has the highest rate of mobile homes in its housing stock at 10.9 percent. Mobile homes have a higher risk of sustaining damages during high wind events, tornadoes, severe thunderstorms, and severe winter storms. Mobile homes that are either not anchored or are anchored incorrectly can be overturned by 60 mph winds. A thunderstorm is classified as severe when wind speeds exceed 58 mph, placing improperly anchored mobile homes at risk. Furthermore, approximately three percent of all housing units in the planning area do not have a vehicle available. Households without vehicles may have difficulty evacuating during a hazardous event and a reduced ability to access resources in times of need.

The majority of homes within the planning area were built prior to 1980 (78%), with 30% of homes built prior to 1939 (Figure 7). Housing age can serve as an indicator of risk, as structures built prior to the development of state building codes may be more vulnerable. Residents living in these homes maybe at higher risk to the impacts of high winds, tornadoes, severe winter storms, and thunderstorms.

Figure 7: Housing Age in Planning Area



State and Federally Owned Properties

The following table provides an inventory of state and federally owned properties within the planning area by county.

Table 23: State and Federally Owned Facilities

Facility	Nearest Community
Perkins County	
Chase County	
Enders Reservoir Wildlife Management Area	Enders
Wanamaker Wildlife Management Area	Imperial
Dundy County	
Rock Creek State Recreation Area	Parks

Source: Nebraska Game & Parks,[29] U.S National Park Service[30]

Historical Sites

According to the National Register of Historic Places for Nebraska by the National Park Service (NPS), there are 11 historic sites located in the planning area.

Table 24: Historical Sites

Site Name	Date Listed	Nearest Community, County	In Floodplain?
Balcony House	7/5/2000	Imperial, Chase	No
Champion Mill	6/23/1988	Champion, Chase	Yes
Chase County Courthouse	1/10/1990	Imperial, Chase	No
Dundy County Courthouse	1/10/1990	Benkelman, Dundy	No
Grant City Park	2/16/1996	Grant, Perkins	No
Grant Commercial Historic District	2/16/1996	Grant, Perkins	No
Lovett Site	5/5/1972	Wauneta, Chase	Unknown (Restricted Address)
Perkins County Courthouse	7/5/1990	Grant, Perkins	No
Pinkie's Corner	12/7/2011	Imperial, Chase	No
Texas Trail Stone Corral	12/9/2002	Imperial, Chase	No
Wauneta Roller Mills	3/12/2008	Wauneta, Chase	No

Source: National Park Service[31]

29 Nebraska Game and Parks. 2020. "Public Access ATLAS." https://maps.outdoornebraska.gov/PublicAccessAtlas/.
30 U.S National Park Service. 2020. "Parks." https://www.nps.gov/state/ne/index.htm.
31 National Park Service. June 2020. "National Register of Historic Places NPGallery Database." https://npgallery.nps.gov/nrhp.

SECTION FOUR: RISK ASSESSMENT

Introduction

The ultimate purpose of this hazard mitigation plan is to minimize the loss of life and property across the planning area. The basis for the planning process is the regional and local risk assessment. This section contains a description of potential hazards, regional vulnerabilities and exposures, probability of future occurrences, and potential impacts and losses. By conducting a regional and local risk assessment, participating jurisdictions can develop specific strategies to address areas of concern identified through this process. The following table defines terms that will be used throughout this section of the plan.

Table 25: Term Definitions

Term	Definition
Hazard	A potential source of injury, death, or damages
Asset	People, structures, facilities, and systems that have value to the community
Risk	The potential for damages, loss, or other impacts created by the interaction of hazards and assets
Vulnerability	Susceptibility to injury, death, or damages to a specific hazard
Impact	The consequence or effect of a hazard on the community or assets
Historical Occurrence	The number of hazard events reported during a defined period of time
Extent	The strength or magnitude relative to a specific hazard
Probability	Likelihood of a hazard occurring in the future

Methodology

The risk assessment methodology utilized for this plan follows the risk assessment methodology outlined in the FEMA Local Mitigation Planning Handbook. This process consists of four primary steps: 1) Describe the hazard; 2) Identify vulnerable community assets; 3) Analyze risk; and 4) Summarize vulnerability.

When describing the hazard, this plan examines the following items: previous occurrences of the hazard within the planning area; locations where the hazard has occurred in the past or is likely to occur in the future; extent of past events and likely extent for future occurrences; and probability of future occurrences. While the identification of vulnerable assets was conducted across the entire planning area, *Section Seven* includes discussions of community-specific assets at risk for relevant hazards. Analysis for regional risk examines historic impacts and losses and potential impacts should the hazard occur in the future. Risk analysis includes both qualitative (i.e. description of historic or potential impacts) and quantitative data (i.e. assigning values and measurements for potential loss of assets). Finally, each hazard identified the plan provides a summary statement encapsulating the information provided during each of the previous steps of the risk assessment process.

For each of the hazards profiled the best and most appropriate data available was considered. Further discussion relative to each hazard is discussed in the hazard profile portion of this section.

Requirement §201.6(c)(2): Risk assessment. The plan shall include a risk assessment that provides the factual basis for activities proposed in the strategy to reduce losses from identified hazards. Local risk assessments must provide sufficient information to enable the jurisdiction to identify and prioritize appropriate mitigation actions to reduce losses from identified hazards.

Requirement §201.6(c)(2)(i): The risk assessment shall include a] description of the type … of all natural hazards that can affect the jurisdiction.

Requirement §201.6(c)(2)(i): The risk assessment shall include a] description of the … location and extent of all natural hazards that can affect the jurisdiction. The plan shall include information on previous occurrences of hazard events and on the probability of future hazard events.

Requirement §201.6(c)(2)(ii): The risk assessment shall include a] description of the jurisdiction's vulnerability to the hazards described in paragraph (c)(2)(i) of this section. This description shall include an overall summary of each hazard and its impact on the community.

Requirement §201.6(c)(2)(ii): The risk assessment] must also address National Flood Insurance Program (NFIP) insured structures that have been repetitively damaged floods.

Requirement §201.6(c)(2)(ii)(A): The plan should describe vulnerability in terms of the types and numbers of existing and future buildings, infrastructure, and critical facilities located in the identified hazard area.

Average Annual Damages and Frequency

FEMA *Requirement §201.6(c)(2)(ii) (B)* suggests that when the appropriate data is available, hazard mitigation plans should also provide an estimate of potential dollar losses for structures in vulnerable areas. This risk assessment methodology includes an overview of assets at risk and provides historic average annual dollar losses for all hazards for which historic event data is available. Additional loss estimates are provided separately for those hazards for which sufficient data is available. These estimates can be found within the relevant hazard profiles.

Average annual losses from historical occurrences can be calculated for those hazards which have a robust historic record and recorded monetary damages. There are three main pieces of data used throughout this formula.

- Total Damages in Dollars: This is the total dollar amount of all property damages and crop damages as recorded in federal, state, and local data sources. The limitation to these data sources is that dollar figures usually are estimates and often do not include all damages from every event, but only officially recorded damages from reported events.
- Total Years of Record: This is the span of years there is data available for recorded events.
- Number of Hazard Events: This shows how often an event occurs. The frequency of a hazard event will affect how a community responds. A thunderstorm may not cause much damage each time, but multiple storms can have an incremental effect on housing and utilities. In contrast, a rare tornado can have a widespread effect on a community.

An example of the Event Damage Estimate is found below:

$$\textbf{Annual Frequency}\ (\#) = \frac{Total\ Events\ Recorded\ (\#)}{Total\ Years\ of\ Record\ (\#)}$$

$$\textbf{Annual Damages}\ (\$) = \frac{Total\ Damages\ in\ Dollars\ (\$)}{Total\ Years\ Recorded\ (\#)}$$

Data for all the hazards are not always available, so only those with an available dataset are included in the loss estimation.

Hazard Identification

The identification of relevant hazards for the planning area began with a review of the 2019State of Nebraska Hazard Mitigation Plan. The Regional Planning Team and participating jurisdictions reviewed the list of hazards addressed in the state mitigation plan and determined which hazards were appropriate for discussion relative to the planning area. The hazards for which a risk assessment was completed are included in the following table.

Table 26: Hazards Addressed in the Plan

Hazards Addressed in the Plan		
Agricultural Disease	Flooding	Terrorism
Dam Failure	Hazardous Materials Release	Tornadoes and High Winds
Drought	Severe Thunderstorms	Transportation Incidents
Extreme Heat	Severe Winter Storms	Wildfires

Hazard Elimination

Given the location and history of the planning area, several hazards from the 2015 PCD HMP as well as the State HMP were eliminated from further review. These hazards are listed below with a brief explanation of why the hazards were eliminated.

- **Civil Disorder**: For the entire state, there have been a small number of civil disorder events reported; most date back to the 1960s, however, in 2020 civil disorder events occurred during Black Lives Matter Protests. Most events have occurred in the state's larger communities like Lincoln and Omaha. The absence of civil unrest in recent years does not necessarily indicate there will not be events in the future, but there are other planning mechanisms in place to address this concern. This approach is consistent with the 2019 Nebraska State Hazard Mitigation Plan.

- **Earthquakes**: The regional planning team indicated earthquakes are not a hazard of top concern. The planning area has experienced no earthquakes since 1900. Due to the low probability of events and associated impacts this hazard is not fully profiled in this HMP.

- **Landslides**: According to the data available related to landslides across the state, no landslides have occurred within the planning area. Landslides across the state have been highly localized and did not exceed local response capabilities. Further, landslides that have occurred (across the state) have not resulted in reported damages. The following table outlines the number of recorded landslide events that have occurred in the planning area. This approach is consistent with the 2019 Nebraska HMP.

Table 27: Known Landslides in the Planning Area by County

County	Number of Landslides	Total Estimated Damages
Chase	0	$0
Dundy	0	$0
Perkins	0	$0

Source: University of Nebraska-Lincoln, 2018[32]

- **Levee Failure**: According to the Army Corps of Engineers National Levee Database, there are no documented levees located in the planning area. Therefore, levee failure events are not expected to occur in the planning area. Any agricultural berm failure events which may produce localized flooding issues are discussed in more detail in Section Four: Flooding. Levees outside the planning area are also of minor concern as they would likely not impact local jurisdictions. Yuma County Colorado has three small levees in the town of Wray. The National Levee Database indicates if those were to fail, they would only impact Wray.

- **Public Health Emergency**: The list of hazards discussed in this plan were discussed and finalized during the kick-off meeting in December 2019. At that time, a public health emergency was not a concern as one had not impacted the planning area. Due to the Covid-19 pandemic in 2020, public health emergencies have now impacted the planning area, State of Nebraska, and United States as a whole. During the next plan update, impacts from the pandemic will be evaluated and further discussion of including this hazard into the HMP will take place. This approach is consistent with the 2019 Nebraska State Hazard Mitigation Plan.

- **Urban Fire:** Fire departments across the planning area have mutual aid agreements in place to address this threat, and typically this hazard is addressed through existing plans and resources. As such, urban fire will not be fully profiled for this plan. Discussion relative to fire will be focused on wildfire and the potential impacts wildfire could have on the built environment. This approach is consistent with the 2019 Nebraska State Hazard Mitigation Plan.

Hazard Identification Changes

Additionally, several hazards from the 2015 Chase, Dundy, and Perkins Counties Multi-Jurisdictional HMP have been modified and combined to provide a more robust and interconnected discussion. The following hazards from the previous HMP have combined hazard profiles in the following section:

- High Winds and Tornadoes
- Severe Thunderstorms and Hail

Hazard Assessment Summary Tables

The following table provides an overview of the data contained in the hazard profiles. Hazards listed in this table and throughout the section are in alphabetical order. This table is intended to be a quick reference for people using the plan and does not contain source information. Source information and full discussion of individual hazards are included later in this section.

32 University of Nebraska-Lincoln. 2018. "Database of Nebraska Landslides." http://snr.unl.edu/data/geologysoils/landslides/landslidedatabase.aspx.

Table 28: Regional Risk Assessment

Hazard	Previous Occurrence Events/Years	Approximate Annual Probability	Likely Extent	
Agricultural Disease	Animal: 16/6 Plant: 71/20	100%	~2 animals per event Crop damage or loss	
Dam Failure	4/109	4%	Some inundation of structures (<1% of structures) and roads	
Drought	434/1,489 months of drought	29%	D1-D2	
Extreme Heat	Avg 9 days per year >100°F	100%	>100°F	
Flooding	28/28	100%	Some inundation of structures (<1% of structures) and roads near streams. Some evacuations of people may be necessary (<1% of population)	
Hazardous Materials Release	11/48	23%	Avg Liquid Spill	i.e. 1,353 gal
			Avg Gas Spill	i.e. 1,305 gal
Severe Thunderstorms	1,002/23	100%	≥1” rainfall Avg 57 mph winds; Hail range 0.75-4.5” (H2-H4); average 1.26”	
Severe Winter Storms	151/23	100%	0.25” – 0.5” Ice 5°-40° below zero (wind chill) 2-15” snow 15-70 mph winds	
Terrorism	0/47	<1%	Varies by event	
Tornadoes & High Winds	146/23	100%	Avg: EF0 Range EF0-EF2 Avg 49 mph; Range 35-82 Estimated Gust	
Transportation Incidents	Auto: 1,407/12	100%	Damages incurred to vehicles involved and traffic delays; substantial damages to aircrafts involved with some aircrafts destroyed	
	Aviation: 12/57	21%		
	Highway Rail: 39/43	91%		
Wildfire	270/18	100%	Avg 42 acres Some homes and structures threatened or at risk	

The following table provides loss estimates for hazards with sufficient data. Detailed descriptions of major events are included in *Section Seven: Community Profiles.*

Table 29: Loss Estimation for the Planning Area

HAZARD TYPE		Count	Property	Crop[2]
Agricultural Disease	Animal Disease[1]	16	28 animals	N/A
	Plant Disease[2]	71	N/A	$1,417,165
Dam Failure[5,6]		4	N/A	N/A
Drought[7,9]		434/1,498 months	$11,000,000	$106,706,707
Extreme Heat[8]		Avg 9 days per year	$0	$18,459,537
Flooding[9]	Flash Flood	27	$1,890,000	$684,052
	Flood	1	$100,000	
Hazardous Materials Release	Fixed Site[3]	4	$0	N/A
	Transportation[4]	7	$2,697	
Severe Thunderstorms[9]	Hail	735	$4,274,750	$179,161,001
	Heavy Rain	3	$0	
	Lightning	3	$102,000	
	Thunderstorm Wind	258	$1,975,000	
Severe Winter Storms[9]	Blizzard	33	$160,000	$12,055,749
	Extreme Cold/Wind Chill	13	$0	
	Heavy Snow	24	$0	
	Ice Storm	2	$0	
	Winter Storm	74	$56,000	
	Winter Weather	5	$6,000	
Terrorism[10]		0	$0	N/A
Tornadoes and High Winds[9] *1 injury*	High Winds	114	$348,000	$5,047,616
	Tornadoes	42	$3,109,000	
Transportation Incidents *461 injuries 28 fatalities*	Auto[11]	1,407	N/A	N/A
	Aviation[12]	12	N/A	
	Highway Rail[13]	39	$254,050	
Wildfire[14] *9 injuries 2 fatalities*		703	21,647 acres	$283,485
Total		**3,586**	**$23,277,497**	**$323,815,312**

N/A: Data not available
1 NDA (2014-2019)
2 USDA RMA (2000-2019)
3 NRC (1990-2019)
4 PHSMA (1971-2019)
5 Stanford NPDP (1911-2019)
6 DNR Dam Inventory
7 NOAA (1895-2019)
8 NOAA (1897-2019)
9 NCEI (1996-2019)
10 University of Maryland (1970 - 2018)
11 NDOT (2006-2018)
12 NTSB (1962-2019)
13 FRA (1975-2018)
14 NFS (2000-2018)

Historical Disaster Declarations

The following tables show past disaster declarations that have been granted within the planning area.

Farm Service Agency Small Business Administration Disasters

The U.S. Small Business Administration (SBA) was created in 1953 as an independent agency of the federal government to aid, counsel, assist, and protect the interests of small business concerns, to preserve free competitive enterprise, and maintain and strengthen the overall economy of our nation. A program of the SBA includes disaster assistance for those affected by major natural disasters. There were no SBA disasters involving the planning area in the last decade.

Presidential Disaster Declarations

Presidential disaster declarations are available via FEMA from 1953 to 2019. Declarations prior to 1962 are not designated by county on the FEMA website and are not included below. The following table describes presidential disaster declarations within the planning area for the period of record. Note that while data is available from 1953 onward, the planning area has received 13 presidential disaster declarations since 1990.

Table 30: Presidential Disaster Declarations

Disaster Declaration Number	Declaration Date	Title	Affected Counties	Public Assistance
873	7/4/1990	Severe Storms, Tornadoes & Flooding	Chase	N/A
998	7/19/1993	Severe Storms &Flooding	Chase, Dundy	N/A
1373	5/16/2001	Severe Winter Storms, Flooding, & Tornadoes	Chase, Dundy, Perkins	$2,982,075.51
1480	7/21/2003	Severe Storms & Tornadoes	Perkins	$3,891,329.31
1627	1/26/2006	Severe Winter Storm	Dundy, Perkins	$5,444,137.27
1674	1/7/2007	Severe Winter Storm	Chase, Dundy, Perkins	$124,357,843.32
1721	8/29/2007	Severe Storms & Flooding	Chase, Dundy, Perkins	$1,315,541.44
1770	6/20/2008	Severe Storms, Tornadoes & Flooding	Chase, Dundy	$36,258,650.19
1853	7/31/2009	Severe Storms, Tornadoes & Flooding	Chase, Perkins	$4,491,366.48
1924	7/15/2010	Severe Storms & Flooding	Chase, Perkins	$49,926,354.50
3245	9/13/2005	Hurricane Katrina Evacuees	Chase, Dundy, Perkins	$393,813.27
4014	8/12/2011	Severe Storms, Tornadoes, Straight Line Winds & Flooding	Chase, Dundy	$3,362,468.45
4225	6/25/2015	Severe Storms, Tornadoes, Straight Line Winds & Flooding	Dundy	$14,492,814.44

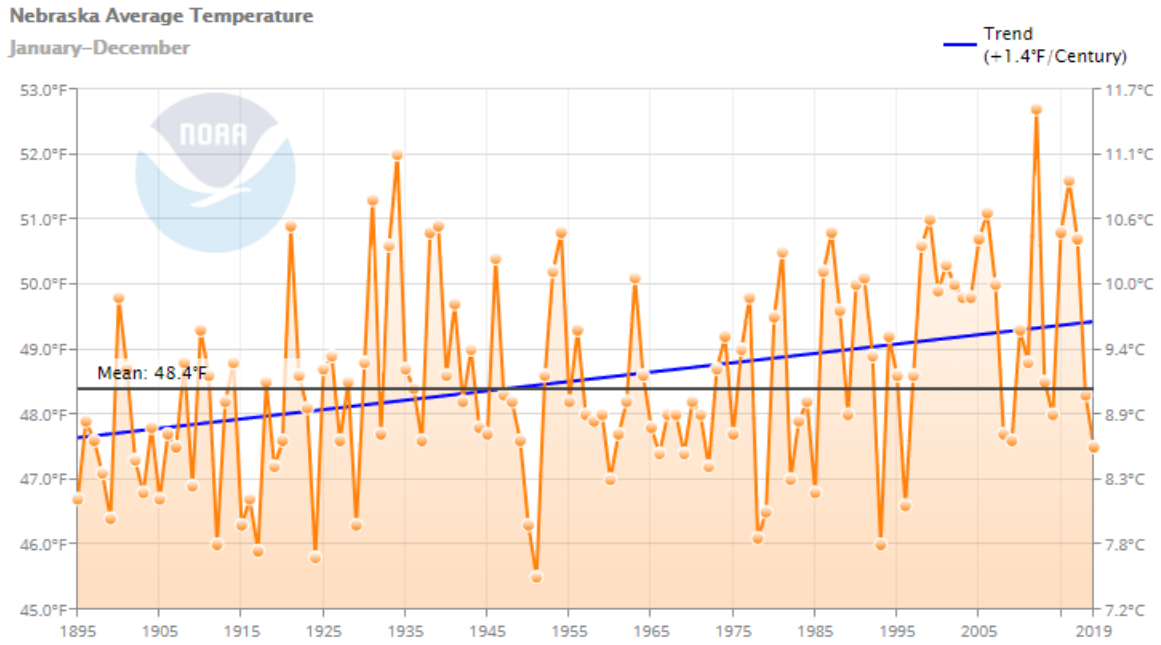
Source: Federal Emergency Management Agency, 1953-2019[33]

33 Federal Emergency Management Agency. 2019. "Disaster Declarations." Accessed June 2020. https://www.fema.gov/disasters.

Climate Adaptation

Long-term climate trends have increased and will continue to increase the vulnerability to hazards across the planning area. Since 1895, Nebraska's overall average temperature has increased by about 2°F (Figure 8). This trend will likely contribute to an increase in the frequency and intensity of hazardous events, which will cause significant economic, social, and environmental impacts on Nebraskans.

Figure 8: Average Temperature (1895-2019)



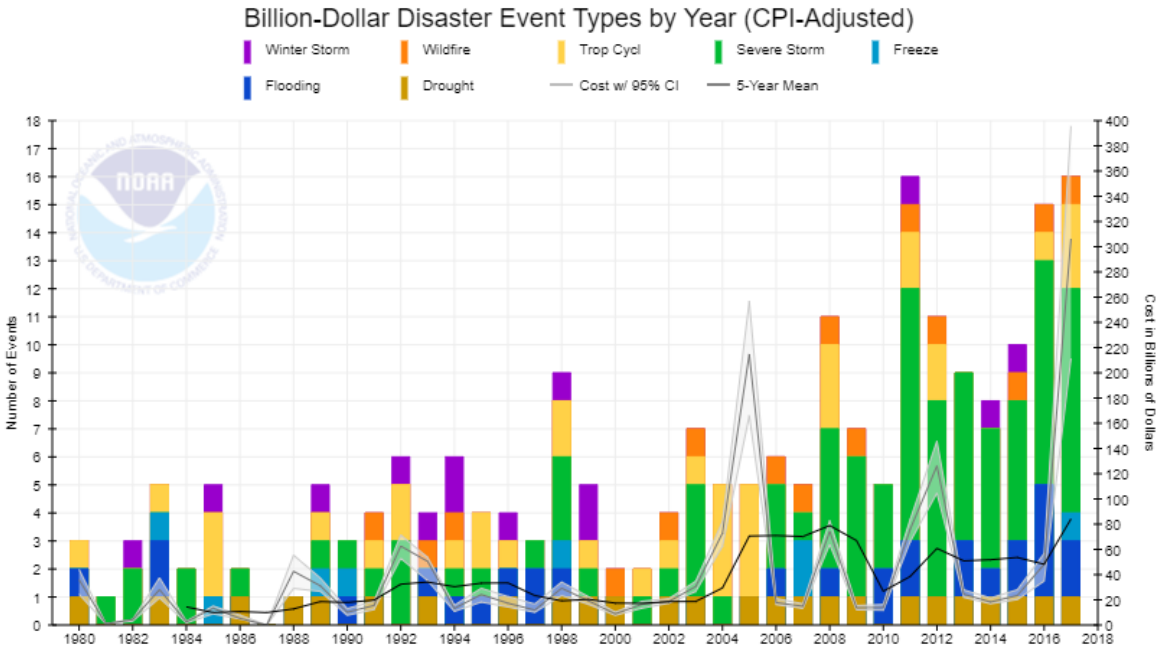
As seen in Figure 9 and Figure 10, the United States is experiencing an increase in the number of billion-dollar natural disasters. Regardless of whether this trend is due to a change in weather patterns or due to increased development, the trend exists.

According to a recent University of Nebraska report (*Understanding and Assessing Climate Change: Implications for Nebraska,* 2014),[34] Nebraskans can expect the following from the future climate:

- Increase in extreme heat events
- Decrease in soil moisture by 5-10%
- Increase in drought frequency and severity
- Increase in heavy rainfall events
- Increase in flood magnitude
- Decrease in water flow in the Missouri River from reduced snowpack in the Rocky Mountains
- Additional 30-40 days in the frost-free season

34 Rowe, C.M., Bathke, D.J., Wilhite, D.A., & Oglesby, R.J. 2014. "Understanding and Assessing Climate Change: Implications for Nebraska."

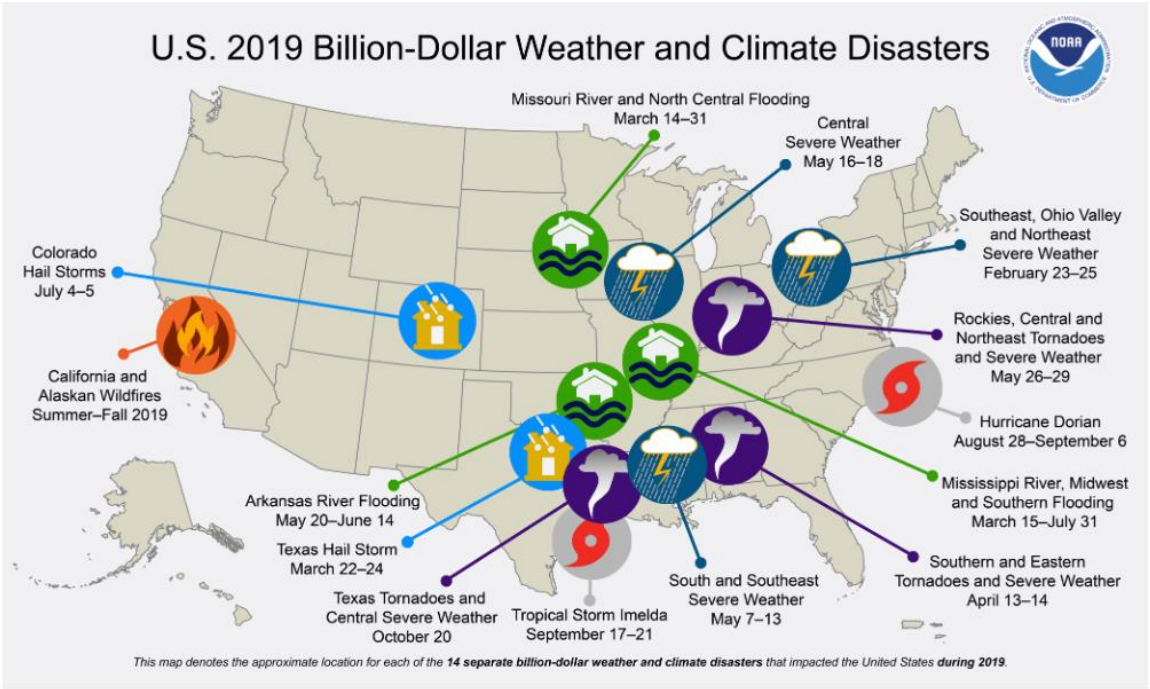
Figure 9: Billion Dollar Disasters



Source: NOAA, 2018

Figure 10: Billion Dollar Weather and Climate Disasters

In 2020 (as of April 8), there have been 2 weather and climate disaster events with losses exceeding $1 billion each across the United States. These events included 2 severe storm events. Overall, these events resulted in the deaths of 35 people and had significant economic effects on the areas impacted. The 1980–2019 annual average is 6.6 events (CPI-adjusted); the annual average for the most recent 5 years (2015–2019) is 13.8 events (CPI-adjusted).

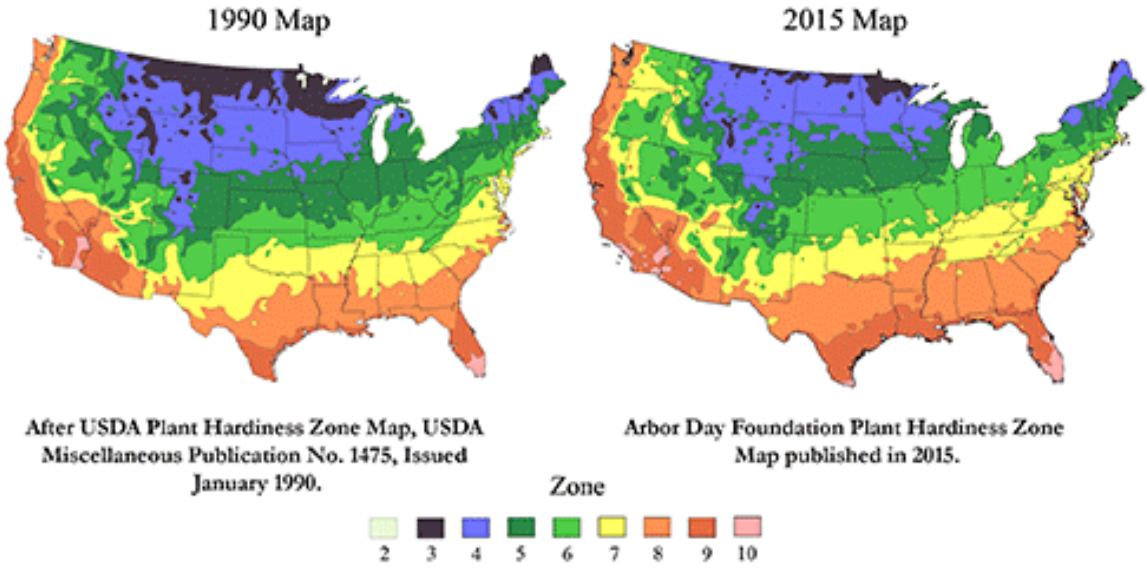


2019 is the fifth consecutive year (2015-2019) in which 10 or more billion-dollar weather and climate disaster events have impacted the United States. Over the last 40 years (1980-2019), the **years with 10 or more** separate billion-dollar disaster events include **1998, 2008, 2011-2012,** and **2015-2019**.

Source: NOAA, 2020

These trends will have a direct impact on water and energy demands. As the number of 100°F days increase, along with warming nights, the stress placed on the energy grid will likely increase and possibly lead to more power outages. Critical facilities and vulnerable populations that are not prepared to handle periods of power outages, particularly during heat waves, will be at risk. Furthermore, the agricultural sector will experience an increase in droughts, an increase in grass and wildfires, changes in the growth cycle as winters warm, and changes in the timing and magnitude of rainfall. These added stressors on agriculture could have devastating economic effects if new agricultural and livestock management practices are not adopted. Figure 11 shows the change in plant hardiness zones over a 25-year period.

Figure 11: Plant Hardiness Zone Change

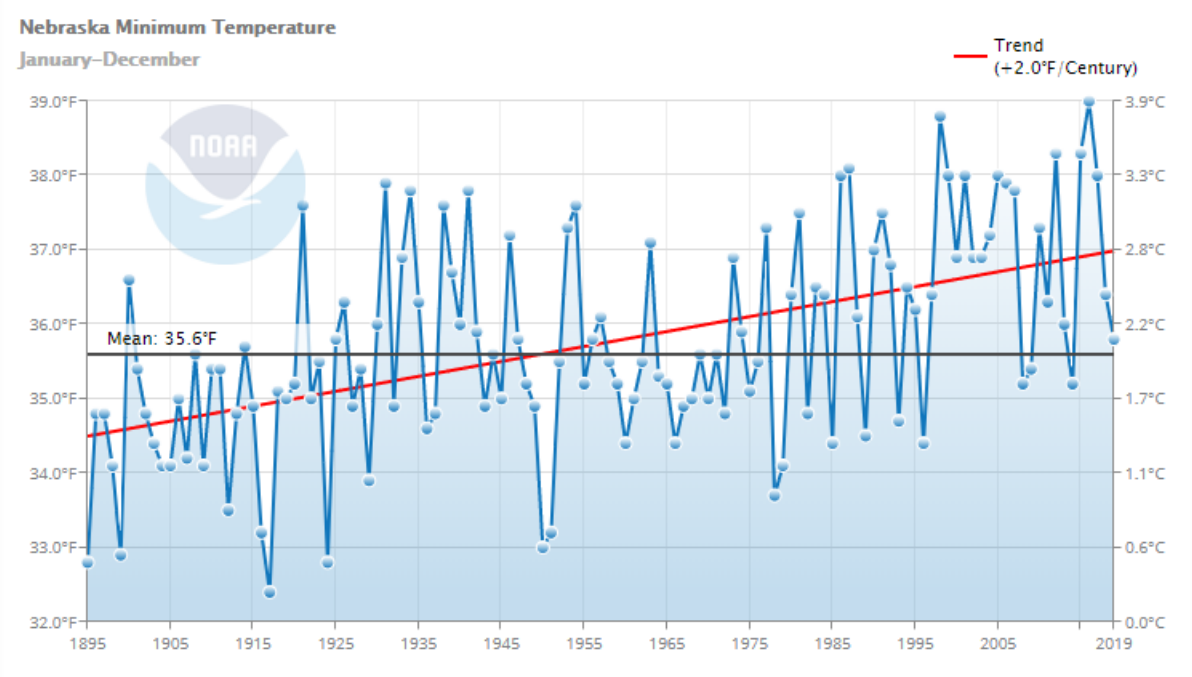


Source: Arbor Day Foundation, 2018[35]

Figure 12 shows a trend of increasing minimum temperatures in the state. High nighttime temperatures can reduce grain yields, increase stress on animals, and lead to an increase in heat-related deaths.

35 Arbor Day Foundation. 2018. "Hardiness Zones." https://www.arborday.org/media/map_change.cfm.

Figure 12: Minimum Temperature 1895 – 2018



Source: NOAA, 2020

The planning area will have to adapt to these changes or experience an increase in economic losses, loss of life, property damages, and agricultural damages. HMPs have typically been informed by past events in order to be more resilient to future events, and this HMP includes strategies for the planning area to address these changes and increase resilience. However, future updates to this plan should consider including adaptation as a core strategy to be better informed by future projections on the frequency, intensity, and distribution of hazards as well.

Hazard Profiles

Based on research and experiences of the participating jurisdictions, the hazards profiled were determined to either have a historical record of occurrence or the potential for occurrence in the future. As the planning area is generally uniform in climate, topography, building characteristics, and development trends, overall hazards and vulnerability do not vary greatly across the planning area. The following profiles will broadly examine the identified hazards across the region. Hazards of local concern or events which have deviated from the norm are discussed in greater detail in respective community profiles (see *Section Seven* of this plan). The following table identifies the top hazards of concern for participating jurisdictions.

Table 31: Top Hazards of Concern

Jurisdiction	Agricultural Disease	Dam Failure	Drought	Extreme Heat	Flooding	Hazardous Materials Release	Severe Thunderstorms	Severe Winter Storms	Terrorism	Tornadoes and High Winds	Transportation Incidents	Wildfires
Upper Republican NRD			X		X		X			X		
Chase County		X	X	X	X		X	X		X		X
City of Imperial			X	X	X	X	X	X		X		X
Village of Wauneta		X			X		X	X		X		
Dundy County		X	X		X	X	X	X		X		
City of Benkelman		X	X	X	X		X	X		X		
Village of Haigler			X	X	X		X	X		X		X
Perkins County			X	X	X	X	X	X		X		X
Village of Elsie						X					X	
City of Grant			X	X			X	X		X		
Village of Madrid			X	X	X		X	X		X		
Village of Venango			X				X	X				
Benkelman Fire District						X		X				X
Imperial Rural Fire District			X							X		X
Madrid Fire Protection District						X	X	X		X		X
Venango Volunteer Fire Department						X	X	X		X		

AGRICULTURAL ANIMAL AND PLANT DISEASE

Agriculture disease is any biological disease or infection that can reduce the quality or quantity of either livestock or vegetative crops. This section looks at both animal disease and plant disease, as both make up a significant portion of Nebraska's and the planning area's economy.

The State of Nebraska's economy is heavily invested in both livestock and crop sales. According to the Nebraska Department of Agriculture (NDA) in 2017, the market value of agricultural products sold was estimated at nearly $22 billion; this total is split between crops (estimated $9.31 billion) and livestock (estimated $12.67 billion). For the planning area, the market value of sold agricultural products exceeded $798 million.[36]

Table 32 shows the population of livestock within the planning area. This count does not include wild populations that are also at risk from animal diseases.

Table 32: Livestock Inventory

County	Market Value of 2017 Livestock Sales	Cattle and Calves	Hogs and Pigs	Poultry Egg Layers	Sheep and Lambs
Chase	$287,658,000	129,338	(D)	198	2
Dundy	$100,017,000	97,468	246	955	(D)
Perkins	$49,896,000	36,020	(D)	784	254
Total	**$437,571,000**	**262,826**	**246**	**1,937**	**256**

Source: U.S. Census of Agriculture, 2017
**(D) Withheld to avoid disclosing data for individual farms*

According to the NDA, the primary crops grown throughout the state include alfalfa, corn, sorghum, soybeans, and wheat. The following tables provide the value and acres of land in farms for the planning area.

Table 33: Land and Value of Farms in the Planning Area

County	Number of Farms	Land in Farms (acres)	Market Value of 2017 Crop Sales
Chase	325	568,622	$152,454,000
Dundy	268	540,172	$61,119,000
Perkins	418	556,062	$146,896,000
Total	**1,011**	**1,664,856**	**$360,469,000**

Source: U.S. Census of Agriculture, 2017

36 US Department of Agriculture, National Agricultural Statistics Server. 2020. "2017 Census of Agriculture – County Data." Accessed June 2020. https://www.nass.usda.gov/Publications/AgCensus/2017/Full_Report/Volume_1,_Chapter_2_County_Level/Nebraska/.

Table 34: Crop Values

County	Corn		Soybeans		Wheat	
	Acres Planted	Value (2017)	Acres Planted	Value (2017)	Acres Planted	Value (2017)
Chase	177,183	$103,208,000	18,737	$9,871,000	38,503	$7,706,000
Dundy	97,021	$40,841,000	5,016	$2,991,000	29,248	$7,535,000
Perkins	219,885	$103,942,000	29,316	$16,756,000	71,860	$12,983,000
Total	**494,089**	**$247,991,000**	**53,069**	**$29,618,000**	**139,611**	**$28,224,000**

Source: U.S. Census of Agriculture, 2012

Location

Given the strong agricultural presence in the planning area, animal and plant disease have the potential to occur across the planning area. If a major outbreak were to occur, the economy in the entire planning area would be affected, including urban areas.

The primary land uses where animal and plant disease will be observed include agricultural lands, range or pasture lands, and forests. It is possible that animal or plant disease will occur in domestic animals or crops in urban areas.

Historical Occurrences

Animal Disease

The NDA provides reports on diseases occurring in the planning area. There were 16 instances of animal disease reported between January 2014 and January 2019 by the NDA (Table 35). These outbreaks affected 28 animals.

Table 35: Livestock Diseases Reported in the Planning Area

Year	County	Disease	Population Impacted
2014	Chase	Porcine Reproductive and Respiratory Syndrome	3
2014	Chase	Leptospirosis	1
2016	Chase	Rabies	1
2017	Chase	Porcine Delta Coronavirus	2
2017	Chase	Porcine Epidemic Diarrhea	2
2017	Chase	Seneca Valley Virus	1
2017	Chase	Bovine Viral Diarrhea	1
2017	Chase	Leptospirosis	1
2018	Chase	Rabies	1
2018	Chase	Paratuberculosis	1
2018	Chase	Bovine Viral Diarrhea	1
2018	Dundy	Bovine Viral Diarrhea	8
2018	Perkins	Equine Influenza	1
2019	Chase	Infectious Bovine Rhinotracheitis/Infectious Pustule	1
2019	Dundy	Paratuberculosis	1
2019	Perkins	Paratuberculosis	2

Source: Nebraska Department of Agriculture, January 2014- November 2019[37]

37 Nebraska Department of Agriculture. 2019. "Livestock Disease Reporting." http://www.nda.nebraska.gov/animal/reporting/index.html.

Plant Disease

A variety of diseases can impact crops and often vary from year to year. The NDA provides information on some of the most common plant diseases, which are listed below.

Table 36: Common Crop Diseases in Nebraska by Crop Types

Crop Diseases		
Corn	Anthracnose	Southern Rust
	Bacterial Stalk Rot	Stewart's Wilt
	Common Rust	Common Smut
	Fusarium Stalk Rot	Gross's Wilt
	Fusarium Root Rot	Head Smut
	Gray Leaf Spot	Physoderma
	Maize Chlorotic Mottle Virus	
Soybeans	Anthracnose	Pod and Stem Blight
	Bacterial Blight	Purple Seed Stain
	Bean Pod Mottle	Rhizoctonia Root Rot
	Brown Spot	Sclerotinia Stem Rot
	Brown Stem Rot	Soybean Mosaic Virus
	Charcoal Rot	Soybean Rust
	Frogeye Leaf Spot	Stem Canker
	Phytophthora Root and Stem Rot	Sudden Death Syndrome
Wheat	Barley Yellow Dwarf	Leaf Rust
	Black Chaff	Tan Spot
	Crown and Root Rot	Wheat Soy-borne Mosaic
	Fusarium Head Blight	Wheat Streak Mosaic
Sorghum	Ergot	Zonate Leaf Spot
	Sooty Stripe	
Other Pests	Grasshoppers	Western Bean Cutworm
	European Corn Borer	Corn Rootworm
	Corn Nematodes	Bean Weevil
	Mexican Bean Beatle	Soybean Aphids
	Rootworm Beatles	Eastern Ash Borer

Average Annual Losses

According to the USDA RMA (2000-2019) there were 71 plant disease events in the planning area. While the RMA does not track losses for livestock, annual crop losses from plant disease can be estimated. Agricultural livestock disease losses are determined from the Nebraska Department of Agriculture.

Table 37: Agricultural Plant Disease Losses

Hazard Type	Number of Events	Events per Year	Total Crop Loss	Average Annual Crop Loss
Plant Disease	71	3.5	$1,417,165	$83,362.64

Source: RMA, 2000-2019

Table 38: Agricultural Livestock Disease Losses

Hazard Type	Number of Events	Events per Year	Total Animal Losses	Average Animal Losses per Event
Animal Disease	16	4.7	28	1.8

Source: NDA, 2014-2019

Extent

There is no standard for measuring the magnitude of agricultural disease. Historical events have impacted livestock ranging from a single individual to eight individuals. The planning area is heavily dependent on the agricultural economy. Any severe plant or animal disease outbreak which may impact this sector would negatively impact the entire planning area's economy.

Probability

Given the historic record of occurrence for animal disease (16 outbreaks reported in six years) and plant disease (71 outbreaks in 20 years), for the purposes of this plan, the annual probability of agricultural disease occurrence is 100 percent.

Regional Vulnerabilities

The following table provides information related to regional vulnerabilities; for jurisdictional-specific vulnerabilities, refer to *Section Seven: Community Profiles*.

Table 39: Regional Agricultural Disease Vulnerabilities

Sector	Vulnerability
People	-Those in direct contact with infected livestock -Potential food shortage during prolonged events -Residents in poverty if food prices increase
Economic	-Regional economy is reliant on the agricultural industry -Large scale or prolonged events may impact tax revenues and local capabilities -Land value may largely drive population changes within the planning area
Built Environment	None
Infrastructure	-Transportation routes can be closed during quarantine
Critical Facilities	None
Climate	-Exacerbate outbreaks, impacts, and/or recovery period -Changes in seasonal normals can promote spread of invasive species and agricultural disease

DAM FAILURE

According to the Nebraska Administrative Code, dams are "any artificial barrier, including appurtenant works, with the ability to impound water, wastewater, or liquid-borne materials and which is:

- twenty-five feet or more in height from the natural bed of the stream or watercourse measured at the downstream toe of the barrier, or from the lowest elevation of the outside limit of the barrier if it is not across a stream channel or watercourse, to the maximum storage elevation or
- has an impounding capacity at maximum storage elevation of fifty acre-feet or more, except that any barrier described in this subsection which is not in excess of six feet in height or which has an impounding capacity at maximum storage elevation of not greater than fifteen acre-feet shall be exempt, unless such barrier, due to its location or other physical characteristics, is classified as a high hazard potential dam.

Dams do not include:

- an obstruction in a canal used to raise or lower water;
- a fill or structure for highway or railroad use, but if such structure serves, either primarily or secondarily, additional purposes commonly associated with dams it shall be subject to review by the department;
- canals, including the diversion structure, and levees; or
- water storage or evaporation ponds regulated by the United States Nuclear Regulatory Commission."[38]

The NeDNR uses a classification system for dams throughout the state, including those areas participating in this plan. The classification system includes three classes, which are defined in the table below.

Table 40: Dam Size Classification

Size	Effective Height (feet) x Effective Storage (acre-feet)	Effective Height
Small	≤ 3,000 acre-feet	and ≤ 35 feet
Intermediate	> 3,000 acre-feet to < 30,000 acre-feet	or > 35 feet
Large	≥ 30,000 acre-feet	Regardless of Height

Source: NeDNR, 2013[39]

The effective height of a dam is defined as the difference in elevation in feet between the natural bed of the stream or watercourse measured at the downstream toe (or from the lowest elevation of the outside limit of the barrier if it is not across stream) to the auxiliary spillway crest. The effective storage is defined as the total storage volume in acre-feet in the reservoir below the elevation of the crest of the auxiliary spillway. If the dam does not have an auxiliary spillway, the effective height and effective storage should be measured at the top of dam elevation.

38 Nebraska Department of Natural Resources. "Department of Natural Resources Rules for Safety of Dam and Reservoirs." Nebraska Administrative Code, Title 458, Chapter 1, Part 001.09.

39 Nebraska Department of Natural Resources. 2013. "Classification of Dams: Dam Safety Section." https://dnr.nebraska.gov/sites/dnr.nebraska.gov/files/doc/dam-safety/resources/Classification-Dams.pdf.

Dam failure, as a hazard, is described as a structural failure of a water-impounding structure. Structural failure can occur during extreme conditions, which include, but are not limited to:

- Reservoir inflows in excess of design flows
- Flood pools higher than previously attained
- Unexpected drop in pool level
- Pool near maximum level and rising
- Excessive rainfall or snowmelt
- Large discharge through spillway
- Erosion, landslide, seepage, settlement, and cracks in the dam or area
- Earthquakes
- Vandalism
- Terrorism

The NeDNR, U.S. Army Corps of Engineers (USACE), and the Federal Energy Regulatory Commission all are involved in regulating dam safety in Nebraska. Dams are classified by the potential hazard each poses to human life and economic loss. The following are classifications and descriptions for each hazard class:

- **Low Hazard Potential**: Failure of the dam expected to result in no probable loss of human life and in low economic loss. Failure may damage storage buildings, agricultural land, and county roads.
- **Significant Hazard Potential**: Failure of the dam expected to result in no probable loss of human life but could result in major economic loss, environmental damage, or disruption of lifeline facilities. Failure may result in shallow flooding of homes and commercial buildings or damage to main highways, minor railroads, or important public utilities.
- **High Hazard Potential**: Failure of the dam expected to result in loss of human life is probable. Failure may cause serious damage to homes, industrial or commercial buildings, four-lane highways, or major railroads. Failure may cause shallow flooding of hospitals, nursing homes, or schools.

Location

According to USACE's National Institute of Dams, there are a total of 22 dams located within the planning area, with classifications ranging from low to high hazard.

Figure 13 maps the location of these dams in the planning area.

Table 41: Dams in the Planning Area

County	Low Hazard	Significant Hazard	High Hazard
Chase	9	1	2
Dundy	7	0	0
Perkins	3	0	0
Total	**20**	**0**	**2**

Source: USACE, 2020[40]

Dams classified with high hazard potential require the creation of an Emergency Action Plan (EAP). The EAP defines responsibilities and provides procedures designed to identify unusual

40 United States Army Corps of Engineers. June 2020. "National Inventory of Dams." https://nid.sec.usace.army.mil/ords/f?p=105:1:::::::.

and unlikely conditions which may endanger the structural integrity of the dam within sufficient time to take mitigating actions and to notify the appropriate emergency management officials of possible, impending, or actual failure of the dam. The EAP may also be used to provide notification when flood releases will create major flooding. An emergency situation can occur at any time; however, emergencies are more likely to happen when extreme conditions are present. There are two high hazard dams located within the planning area, both in Chase County. However, during discussions with local planning team members, both are located at the Enders Reservoir, so they are likely one structure. NeDNR does not identify Enders Dike as a dam in their statewide inventory.

Table 42: High Hazard Dams in the Planning Area

County	Dam Name	NID ID	Purpose	Dam Height	Max Storage (Acre Ft)	Last Inspection Date
Chase	Enders Dam	NE01070	Irrigation	103 ft	98,960	7/24/2017
Chase	Enders Dike	NEO1070	Flood Control	28 ft	44,480	-

Source: USACE, 2020[41]

Upstream Dams Outside the Planning Area

Additionally, there is one high hazard dam located upstream of the planning area which, if it was to fail, would likely impact the region. The Chase County Local Emergency Operations Plan (LEOP) identifies the upstream Bonny Dam as a dam which could affect the planning area.[42,43,44]

Table 43: High Hazard Dams Outside the Planning Area

County, State	Dam Name	NID ID	Purpose	Dam Height	Max Storage (Acre Ft)	Last Inspection Date
Yuma, CO	Bonny Dam	CO01300	Flood Control	158 ft	348,390	10/20/2016

Source: USACE, 2020

Historical Occurrences

According to the Stanford University National Performance of Dams Program and local resources, there have been no dam failure events within the planning area from 1911 to 2018.[45] According to the NeDNR Dam Inventory, there are four dams that have failed within the planning area and have not been repaired.[46] The table below shows information regarding the failed dams.

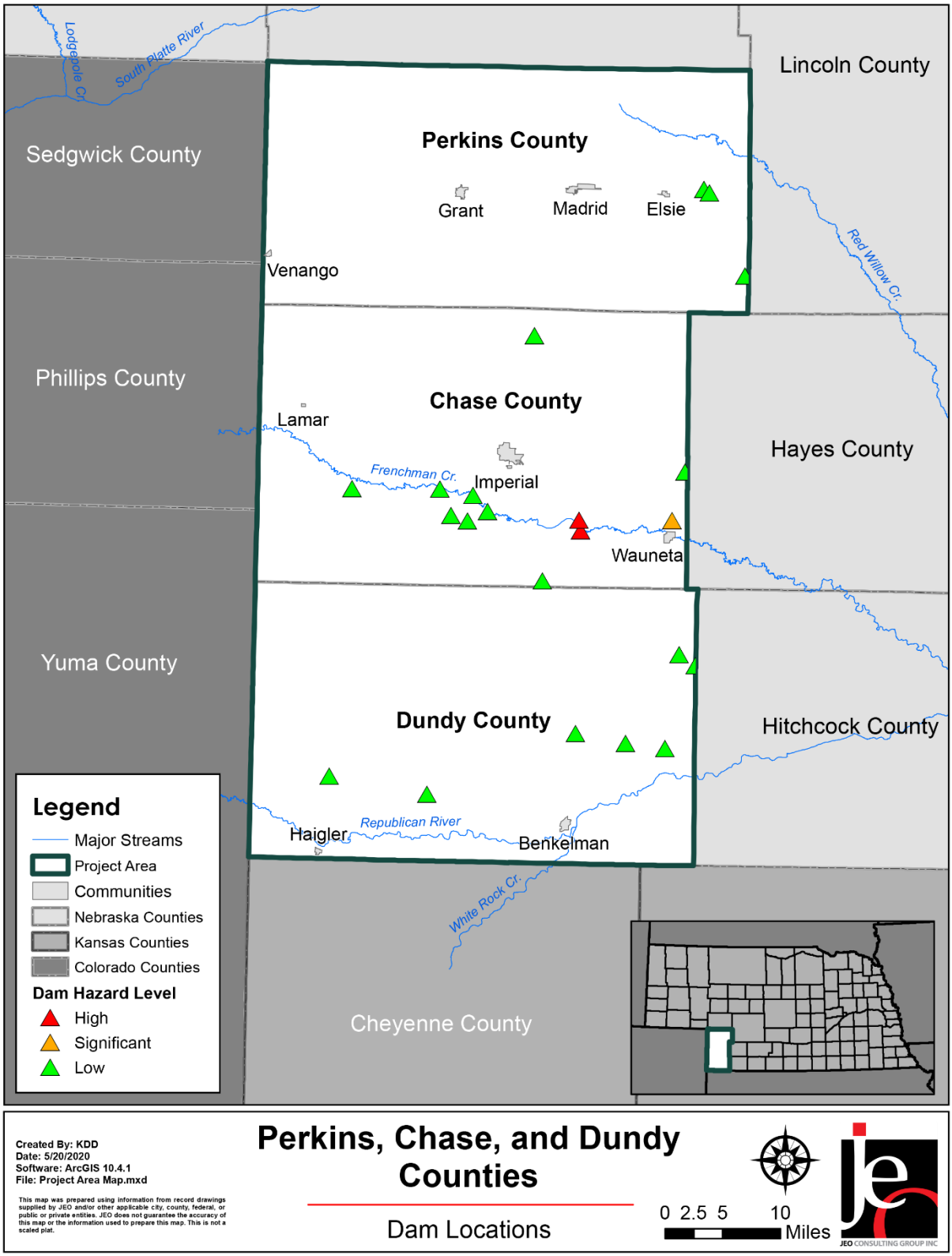
Table 44: Dam Failures

Dam Name	Hazard Class	County	Failure Year	Downstream Community
Kuskie Dam	Low	Perkins County	Prior to 1974	Village of Brule
Arterburn Dam	Low	Chase County	2000-2006	Champion
Resler Dam	Low	Chase County	1956	-
Wine Dam	-	Chase County	1957	-

Source: NeDNR, 2020

41 United States Army Corps of Engineers. June 2020. "National Inventory of Dams." https://nid.sec.usace.army.mil/ords/f?p=105:1:::::::.
42 Chase County Emergency Management Agency. 2017. "Chase County Nebraska Local Emergency Operations Plan."
43 Dundy County Emergency Management Agency. 2020. "Dundy County Nebraska Local Emergency Operations Plan."
44 Perkins County Emergency Management Agency. 2019. "Perkins County Nebraska Local Emergency Operations Plan."
45 Stanford University. 1911-2018. "National Performance of Dams Program Dam Incident Database." Accessed December 2019. http://npdp.stanford.edu/dam_incidents.
46 Nebraska Department of Natural Resources. 2020. "Inventory of Dams" https://gis.ne.gov/portal/apps/webappviewer/index.html?id=2aab04a13817421992dc5398ad462e22. Accessed February 2020.

Figure 13: Dam Locations



Through correspondence with NeDNR, additional information regarding the four dam failures is given below.

- Kuskie Dam: The dam was first inspected in 1974 and at that time, the dam had already breached through the auxiliary spillway. However, the dam owner had constructed a dike at the auxiliary spillway inlet to keep flows from pass through. By 1980, the last time the dam was inspected, the dike had washed out. LiDAR data from 2011 and a 2016 aerial photo show the auxiliary spill has not been repaired.
- Arterburn Dam: The dam breached sometime between the 2000 and 2006 inspections. LiDAR data from 2011 and a 2016 aerial photo shows a breach channel through the dam embankment.
- Resler Dam: The dam was first inspected in 1975 and found to be breached. The dam owner said that the dam had washed out in 1956. No remnants of the dam can be seen in the 1993 aerial photo, later aerial photos, or in the 2011 LiDAR data.
- Wine Dam: The was first inspected in 1975 and found to be breached. Later it was found out that it originally breached in 1957. It is still breached according to the 2011 LiDAR and the 2016 aerial photo.

Average Annual Losses

Due to lack of data and the sensitive nature of this hazard, potential losses are not calculated for this hazard.

Extent

Areas (i.e. agricultural land, out buildings, county roads, and communities) directly downstream of dams are at greatest risk in the case of dam failure. The extent of dam failure is indicated by its hazard classification and location. Note that hazard classification does not indicate the likelihood of a dam failure event to occur, but rather the extent of potential damages that may occur in case of a failure. Thus, the high hazard dams in the planning area would have the greatest impact if they were to fail. If the high hazard dams were to fail, the Village of Wauneta would likely be impacted. Inundation maps are not publicly available due to concerns of vandalism and terrorism. Key facilities located in inundation areas are discussed in each county's LEOP.

Probability

For the purpose of this plan, the probability of dam failure will be stated at less than a four percent annually as four dams have failed in the planning area over the past 109 years.

Regional Vulnerabilities

The following table provides information related to regional vulnerabilities; for jurisdictional-specific vulnerabilities, refer to *Section Seven: Community Profiles*.

Table 45: Regional Dam Failure Vulnerabilities

Sector	Vulnerability
People	-Those living downstream of high hazard dams -Those at recreational sites situated near high hazard dams -Evacuation needs likely with high hazard dam failure events -Hospitals, nursing homes, and the elderly at greater risk due to low mobility -Chase County: LEOP estimated 16% of the population -Perkins County: LEOP estimated 0% of the population -Dundy County: LEOP gave no estimation
Economic	-Loss of downstream agricultural land -Businesses or recreation sites located in inundation areas would be impacted and closed for an extended period of time -Employees of closed businesses may be out of work for an extended period of time
Built Environment	-Damage to facilities, recreation areas, and roads
Infrastructure	-Rural county transportation routes could be closed for extended period of time
Critical Facilities	-Any critical facilities in inundation areas are vulnerable to damages
Climate	-Increased annual precipitation contributes to sustained stress on systems -Changes in water availability and supply can constrain energy production and reservoir stores

DROUGHT

Drought is generally defined as a natural hazard that results from a substantial period of below normal precipitation. Although many erroneously consider it a rare and random event, drought is a normal, recurrent feature of climate. It occurs in virtually all climatic zones, but its characteristics vary significantly from one region to another. A drought often coexists with periods of extreme heat, which together can cause significant social stress, economic losses, and environmental degradation. The planning area is largely rural, which presents an added vulnerability to drought events; drought conditions can significantly and negatively impact the agricultural economic base.

Drought is a slow-onset, creeping phenomenon that can affect a wide range of people, livestock, and industries. While many impacts of these hazards are non-structural, there is the potential that during prolonged drought events structural impacts can occur. Drought normally affects more people than other natural hazards, and its impacts are spread over a larger geographical area. As a result, the detection and early warning signs of drought conditions and assessment of impacts are more difficult to identify than that of quick-onset natural hazards (e.g., flood) that results in more visible impacts. According to the National Drought Mitigation Center (NDMC), droughts are classified into four major types:

Drought is a normal, recurrent feature of climate, although many erroneously consider it a rare and random event. It occurs in virtually all climatic zones, but its characteristics vary significantly from one region to another.

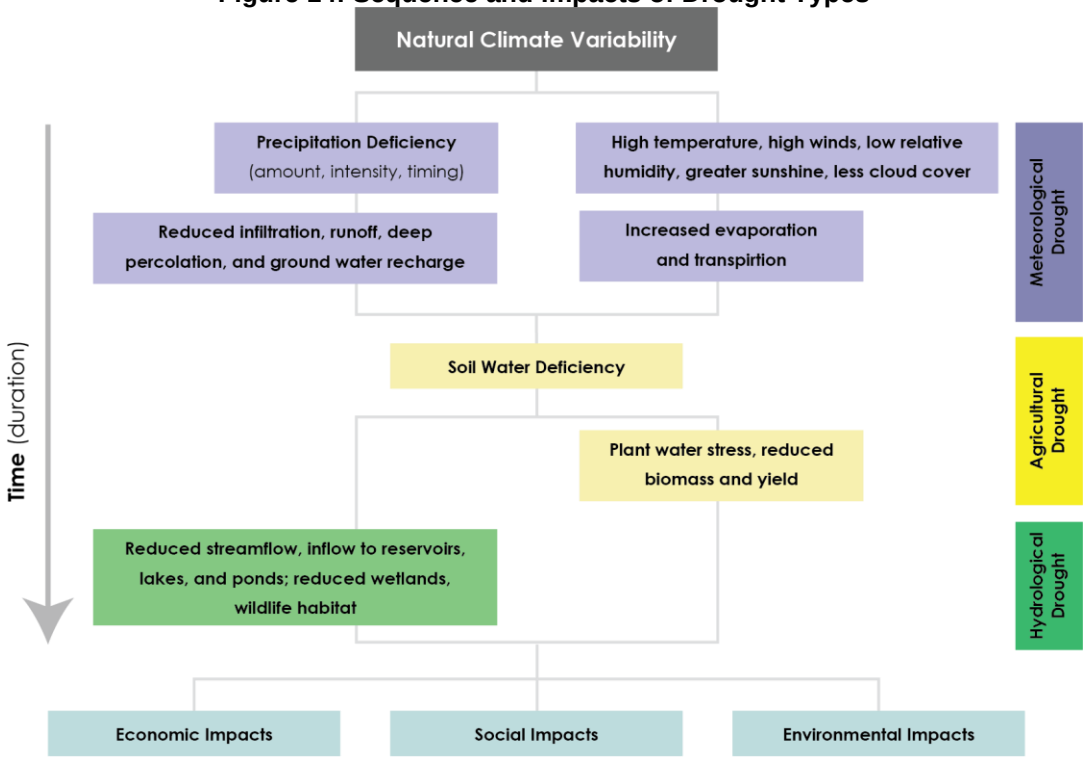
~National Drought Mitigation Center

- **Meteorological Drought** is defined based on the degree of dryness and the duration of the dry period. Meteorological drought is often the first type of drought to be identified and should be defined regionally as precipitation rates and frequencies (norms) vary.
- **Agricultural Drought** occurs when there is deficient moisture that hinders planting germination, leading to low plant population per hectare and a reduction of final yield. Agricultural drought is closely linked with meteorological and hydrological drought; as agricultural water supplies are contingent upon the two sectors.
- **Hydrologic Drought** occurs when water available in aquifers, lakes, and reservoirs falls below the statistical average. This situation can arise even when the area of interest receives average precipitation. This is due to the reserves diminishing from increased water usage, usually from agricultural use or high levels of evapotranspiration, resulting from prolonged high temperatures. Hydrological drought often is identified later than meteorological and agricultural drought. Impacts from hydrological drought may manifest themselves in decreased hydropower production and loss of water-based recreation.
- **Socioeconomic Drought** occurs when the demand for an economic good exceeds supply due to a weather-related shortfall in water supply. The supply of many economic goods includes, but are not limited to, water, forage, food grains, fish, and hydroelectric power.[47]

The following figure indicates different types of droughts, their temporal sequence, and the various types of effects they can have on a community.

47 National Drought Mitigation Center. 2017. "Drought Basics." https://drought.unl.edu/.

Figure 14: Sequence and Impacts of Drought Types



Source: National Drought Mitigation Center, University of Nebraska-Lincoln, 2017[48]

Location

The entire planning area is susceptible to drought impacts.

Historical Occurrences

Table 46 indicates it is reasonable to expect extreme drought to occur 5.1% of the time for the planning area (77 extreme drought months in 1,498 months). Severe drought occurred in 71 months of the 1,498 months of record (4.7% of months). Moderate drought occurred in 102 months of the 1,498 months of record (6.8% of months), and mild drought occurred in 184 of the 1,498 months of record (12.3% of months). Non-drought conditions occurred in 1,064 months, or 71% percent of months. These statistics show that the drought conditions of the planning area are highly variable. The average annual planning area precipitation is approximately 20 inches according to the NCEI.[49]

Table 46: Historic Droughts

Drought Magnitude	Months in Drought	Percent Chance
-1 Magnitude (Mild)	184/1,498	12.3%
-2 Magnitude (Moderate)	102/1,498	6.8%
-3 Magnitude (Severe)	71/1,498	4.7%
-4 Magnitude or Greater (Extreme)	77/1,498	5.1%

Source: NCEI, Jan 1895-Jan 2019[50]

48 National Drought Mitigation Center. 2017. "Types of Drought." https://drought.unl.edu/.

49 NOAA National Centers for Environmental Information. December 2019. "Data Tools: 1981-2010 Normals." [datafile]. https://www.ncdc.noaa.gov/cdo-web/datatools/normals.

50 National Centers for Environmental Information. 1895-2018. Accessed December 6, 2018. https://www7.ncdc.noaa.gov/CDO/CDODivisionalSelect.jsp.

Extent

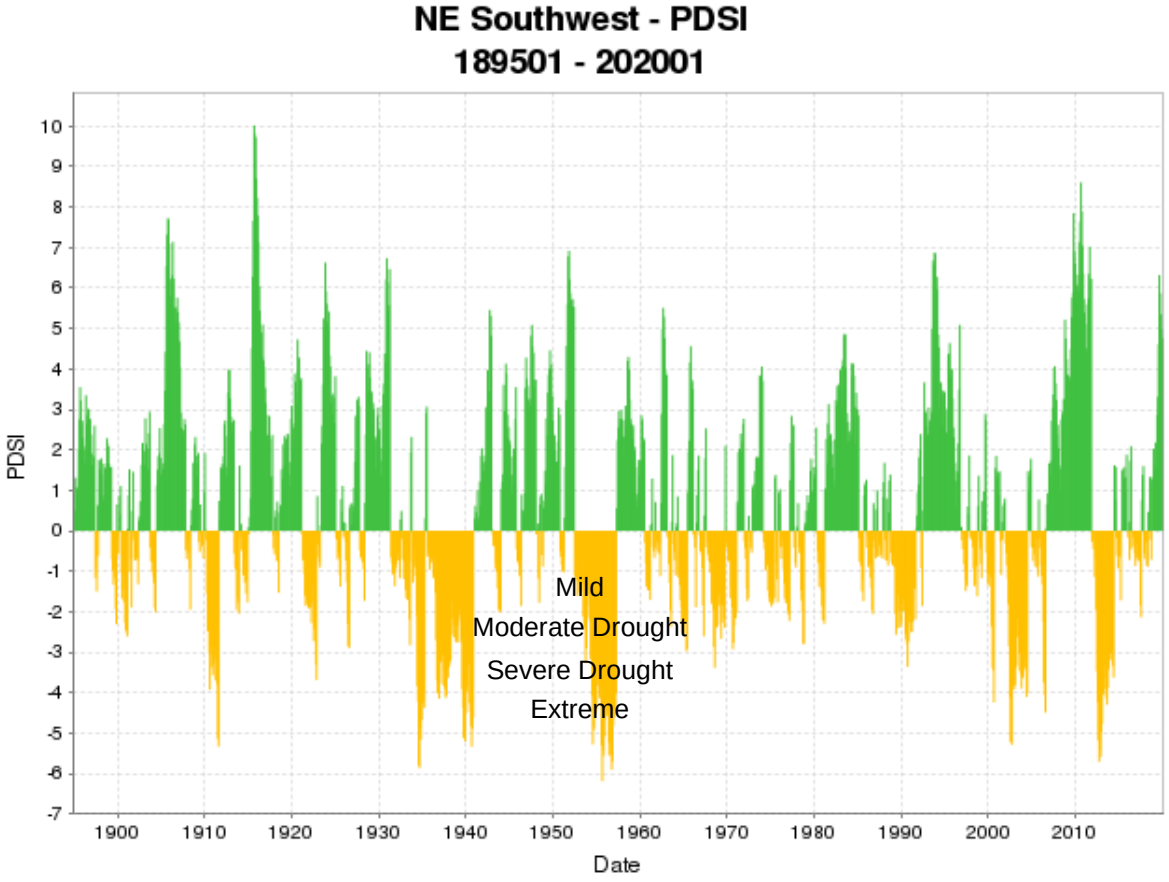
The Palmer Drought Severity Index (PDSI) is utilized by climatologists to standardize global long-term drought analysis. The data for the planning area was collected for Climate Division 7, which includes the planning area. This particular station's period of record started in 1895. Table 47 shows the details of the Palmer classifications. Figure 15 shows drought data from this time period. The negative Y axis represents the extent of a drought, for which '-2' indicates a moderate drought, '-3' a severe drought, and '-4' an extreme drought. The planning area has experienced several extreme droughts and future moderate, severe, and extreme droughts are likely in the future.

Table 47: Palmer Drought Severity Index Classification

Numerical Value	Description	Numerical Value	Description
4.0 or more	Extremely wet	-0.5 to -0.99	Incipient dry spell
3.0 to 3.99	Very wet	-1.0 to -1.99	Mild drought
2.0 to 2.99	Moderately wet	-2.0 to -2.99	Moderate drought
1.0 to 1.99	Slightly wet	-3.0 to -3.99	Severe drought
0.5 to 0.99	Incipient wet spell	-4.0 or less	Extreme drought
0.49 to -0.49	Near normal	--	--

Source: Climate Prediction Center[51]

Figure 15: Palmer Drought Severity Index

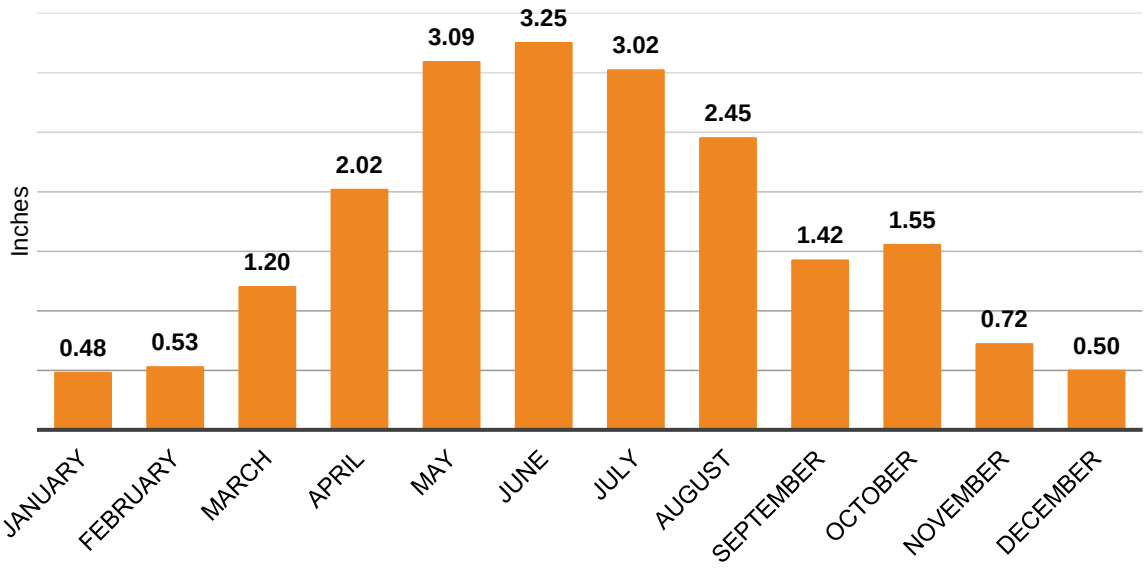


Source: NCEI, Jan. 1895-Jan. 2020

51 National Weather Service. 2017. "Climate Prediction Center." https://www.cpc.ncep.noaa.gov/.

Figure 16 shows the normal average monthly precipitation for the planning area, which is helpful in determining whether any given month is above, below, or near normal in precipitation.

Figure 16: Average Monthly Precipitation for the Planning Area



Source: NCEI, 2019[52]

Average Annual Losses

The annual property estimate was determined based upon NCEI Storm Events Database since 1996. The annual crop loss was determined based upon the RMA Cause of Loss Historical Database since 2000. This does not include losses from displacement, functional downtime, economic loss, injury, or loss of life. The direct and indirect effects of drought are difficult to quantify. Potential losses such as power outages could affect businesses, homes, and critical facilities. High demand and intense use of air conditioning or water pumps can overload the electrical systems and damage infrastructure.

Table 48: Loss Estimate for Drought

Hazard Type	Total Property Loss[2]	Average Annual Property Loss[2]	Total Crop Loss[3]	Average Annual Crop Loss[3]
Drought	$11,000,000	$478,260.87	$106,706,707.44	$5,616,142.50

Source: 1 HPRCC (1899-2019); 2 Indicates data is from NCEI (Jan 1996 to Sept 2019); 3 Indicates data is from USDA RMA (2000 to 2019)

The USDA reported a total of $139,957,809 in drought relief to Nebraska from 2008 to 2011 for all five disaster programs: Supplemental Revenue Assistance Payments (SURE); Livestock Forage Disaster Assistance Program (LFD); Emergency Assistance for Livestock, Honeybees, and Farm-Raised Fish Program (ELAP); Livestock Indemnity Program (LIP); and Tree Assistance Program (TAP).

The extreme drought in 2012 significantly affected the agricultural sector across the State of Nebraska. According to the PDSI, 2012's average severity index was ranked at a -4.47, with extremes in August and September of -7.35 and -7.57 respectively. The Farm Credit Services reported total indemnity payments to Nebraska totaled $1.49 billion from crop loss. Cattle

52 NOAA National Centers for Environmental Information. December 2019. "Data Tools: 1981-2010 Normals." [datafile]. https://www.ncdc.noaa.gov/cdo-web/datatools/normals.

ranching is a large driver of the local planning area's economy. The 2012 drought forced ranchers to cull herds by as much as 60% to cope with reduced forage production with an estimated loss of $200 per head by taking cattle to market earlier than normal. Neighborhood plots and small organic farms up to large-scale corn and soybean productions and ranches all faced agricultural declines. Hay production was down 28%, corn was down 16%, and soybean production dropped by 21%.[53]

Probability

Drought conditions are also likely to occur regularly in the planning year. The following table summarizes the magnitude of drought and monthly probability of occurrence.

Table 49: Period of Record in Drought

PDSI Value	Magnitude	Drought Occurrences by Month	Monthly Probability
4 or more to -0.99	No Drought	1,064/1,498	71.0%
-1.0 to -1.99	Mild Drought	184/1,498	12.3%
-2.0 to -2.99	Moderate Drought	102/1,498	6.8%
-3.0 to -3.99	Severe Drought	71/1,498	4.7%
-4.0 or less	Extreme Drought	65/1,489	4.4%

Source: NCEI, Jan 1895-Jan 2019

Regional Vulnerabilities

The Drought Impact Reporter is a database of drought impacts throughout the United States with data going back to 2000. The Drought Impact Reporter has recorded a total of 31 drought-related impacts throughout the region. This is not a comprehensive list of droughts which may have impacted the planning area. These impacts are summarized in the following table.

Table 50: Drought Impacts in Planning Area

Category	Date	Affected Counties	Title
Agriculture	6/28/2006	Chase	Agriculture impact from media submitted on 6/28/2006
Agriculture	10/26/2005	Chase, Dundy, Perkins	Agriculture impact from media submitted on 10/26/2005
Agriculture	10/24/2007	Chase, Dundy, Perkins	Agriculture impact from media submitted on 10/24/2007
Agriculture	7/12/2012	Dundy	Grazing land adversely affected in Dundy, Hitchcock, and Red Willow Counties in Nebraska
Agriculture, Business & Industry, Fire, Relief, Response & Restrictions, Water Supply & Quality	7/12/2012	Dundy	Large number of fires reported in Dundy County, Nebraska; City of Benkelman institutes watering restrictions

53 National Integrated Drought Information System, National Drought Mitigation Center, and University of Nebraska-Lincoln. 2015. "From Too Much to Too Little: how the central U.S. drought of 2012 evolved out of one of the most devastating floods on record in 2011." https://www.drought.gov/drought/sites/drought.gov.drought/files/media/reports/regional_outlooks/CentralRegion2012DroughtAssessment_1-5-15.pdf.

Agriculture, Plants & Wildlife	12/17/2012	Chase, Dundy, Perkins	Drought led ranchers in western Nebraska to cull cow herds by 25% to 60%
Agriculture, Relief, Response & Restrictions	2/7/2014	Chase, Dundy, Perkins	Drought-Related USDA Disaster Declarations in 2014
Agriculture, Relief, Response & Restrictions	2/3/2015	Dundy	Drought-Related USDA Disaster Declarations in 2015
Agriculture, Relief, Response & Restrictions	5/17/2013	Chase, Dundy, Perkins	Drought-related USDA disaster declarations in 2013
Agriculture, Relief, Response & Restrictions	7/13/2012	Chase, Dundy, Perkins	USDA Announces Streamlined Disaster Designation Process
Agriculture, Relief, Response & Restrictions	3/7/2018	Chase, Dundy, Perkins	Nebraska governor requested natural disaster declaration for 8 counties
Agriculture, Relief, Response & Restrictions	9/1/2016	Chase, Dundy, Perkins	Nebraska's corn yield estimate revised downward
Agriculture, Relief, Response & Restrictions, Water Supply & Quality	4/9/2013	Chase, Dundy, Perkins	The Nebraska Department of Natural Resources ordered that 12,000 acre-feet of water held in four federal Bureau of Reclamation reservoirs be released to honor the Republican River Compact
Agriculture, Relief, Response & Restrictions, Water Supply & Quality	7/20/2012	Dundy	Low flow in several Nebraska rivers brought surface irrigation closures
Agriculture, Water Supply & Quality	4/23/2019	Chase, Dundy, Perkins	Nebraska ranchers hauling water to livestock
Fire, Relief, Response & Restrictions	2/22/2018	Chase, Dundy, Perkins	Nebraskans urged to leave the fireworks to the professionals
Fire, Relief, Response & Restrictions, Tourism & Recreation	9/3/2013	Chase, Dundy, Perkins	Campers in western Nebraska were urged to be particularly careful with campfires over the Labor Day weekend
Plants & Wildlife	6/13/2013	Chase, Dundy, Perkins	Many trees in western Nebraska died from drought, high temperatures and strong winds in 2012
Plants & Wildlife	2/10/2006	Dundy	Plants & Wildlife impact from Government submitted on 2/10/2006
Relief, Response & Restrictions	8/6/2007	Chase, Dundy, Perkins	Relief, Response & Restrictions impact from media submitted on 8/6/2007
Relief, Response & Restrictions	9/14/2006	Chase, Dundy, Perkins	Relief, Response & Restrictions impact from media submitted on 9/14/2006
Relief, Response & Restrictions	9/6/2006	Dundy	Relief, Response & Restrictions impact from media submitted on 9/6/2006

Relief, Response & Restrictions	7/17/2006	Chase, Dundy, Perkins	Relief, Response & Restrictions impact from media submitted on 7/17/2006
Relief, Response & Restrictions	9/6/2006	Chase	Relief, Response & Restrictions impact from Media submitted on 9/6/2006
Relief, Response & Restrictions	11/7/2005	Chase, Dundy, Perkins	Relief, Response & Restrictions impact from Media submitted on 11/7/2005
Relief, Response & Restrictions	10/14/2005	Chase, Dundy, Perkins	Relief, Response & Restrictions impact from Media submitted on 10/14/2005
Relief, Response & Restrictions	10/24/2005	Chase, Dundy, Perkins	Relief, Response & Restrictions impact from Media submitted on 10/24/2005
Relief, Response & Restrictions	11/1/2005	Chase, Dundy, Perkins	Relief, Response & Restrictions impact from Media submitted on 11/1/2005
Relief, Response & Restrictions	3/1/2006	Chase, Dundy, Perkins	Relief, Response & Restrictions impact from Media submitted on 3/1/2006
Relief, Response & Restrictions	11/17/2005	Chase, Dundy, Perkins	Relief, Response & Restrictions impact from Media submitted on 11/17/2005
Relief, Response & Restrictions	9/6/2006	Chase	Relief, Response & Restrictions impact from Media submitted on 9/6/2006

Source: NDMC, 2000-2019[54]

The following table provides information related to regional vulnerabilities. For jurisdictional-specific vulnerabilities, refer to *Section Seven: Community Profiles*.

Table 51: Regional Drought and Extreme Heat Vulnerabilities

Sector	Vulnerability
People	-Insufficient water supply -Loss of jobs in agricultural sector -Residents in poverty if food prices increase
Economic	-Closure of water intensive businesses (carwashes, pools, etc.) -Short-term interruption of business -Loss of tourism dollars -Decrease in cattle prices -Decrease of land prices→ jeopardizes educational funds
Built Environment	-Cracking foundations (residential and commercial structures) -Damages to landscapes
Infrastructure	-Damages to waterlines below ground -Damages to roadways (prolonged extreme events)
Critical Facilities	-Loss of power and impact on infrastructure
Climate	-Increased risk of wildfire events, damaging buildings and agricultural land

54 National Drought Mitigation Center. 2019. "U.S. Drought Impact Reporter." Accessed January 2019. http://droughtreporter.unl.edu/map/.

EXTREME HEAT

Extreme heat is often associated with periods of drought but can also be characterized by long periods of high temperatures in combination with high humidity. During these conditions, the human body has difficulty cooling through the normal method of the evaporation of perspiration. Health risks arise when a person is overexposed to heat. Extreme heat can also cause people to overuse air conditioners, which can lead to power failures. Power outages for prolonged periods increase the risk of heat stroke and subsequent fatalities due to loss of cooling and proper ventilation. The planning area is largely rural, which presents an added vulnerability to extreme heat events; those suffering from an extreme heat event may be farther away from medical resources as compared to those living in an urban setting.

Along with humans, animals also can be affected by high temperatures and humidity. For instance, cattle and other farm animals respond to heat by reducing feed intake, increasing their respiration rate, and increasing their body temperature. These responses assist the animal in cooling itself, but this is usually not sufficient. When animals overheat, they will begin to shut down body processes not vital to survival, such as milk production, reproduction, or muscle building.

Other secondary concerns connected to extreme heat hazards include water shortages brought on by drought-like conditions and high demand. Government authorities report that civil disturbances and riots are more likely to occur during heat waves. In cities, pollution becomes a problem because the heat traps pollutants in densely populated urban areas. Adding pollution to the stresses associated with the heat magnifies the health threat to the urban population.

The National Weather Service (NWS) is responsible for issuing excessive heat outlooks, excessive heat watches, and excessive heat warnings.

- **Excessive heat outlooks** are issued when the potential exists for an excessive heat event in the next three to seven days. Excessive heat outlooks can be utilized by public utility staffs, emergency managers, and public health officials to plan for extreme heat events.
- **Excessive heat watches** are issued when conditions are favorable for an excessive heat event in the next 24 to 72 hours.
- **Excessive heat warnings** are issued when an excessive heat event is expected in the next 36 hours. Excessive heat warnings are issued when an extreme heat event is occurring, is imminent, or has a very high probability of occurring.

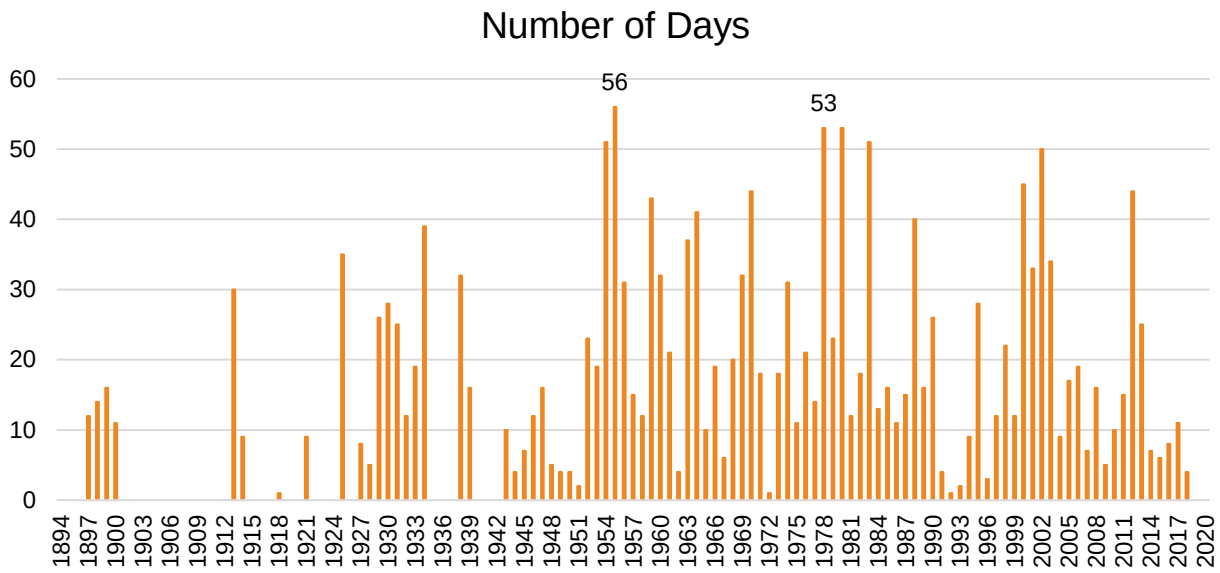
Location

The entire planning area is susceptible to extreme heat impacts.

Historical Occurrences

According to the High Plains Regional Climate Center (HPRCC), on average, the planning area experiences fifteen days above 100°F per year. The planning area experienced the most days on record above 100°F in 1955 with 56 days and in 1978 with 53 days. Conversely, 2019 was the most recent “coolest” year on record, with zero days above 100°F.

Figure 17: Number of Days Above 100°F



Source: HPRCC, 1899-2019

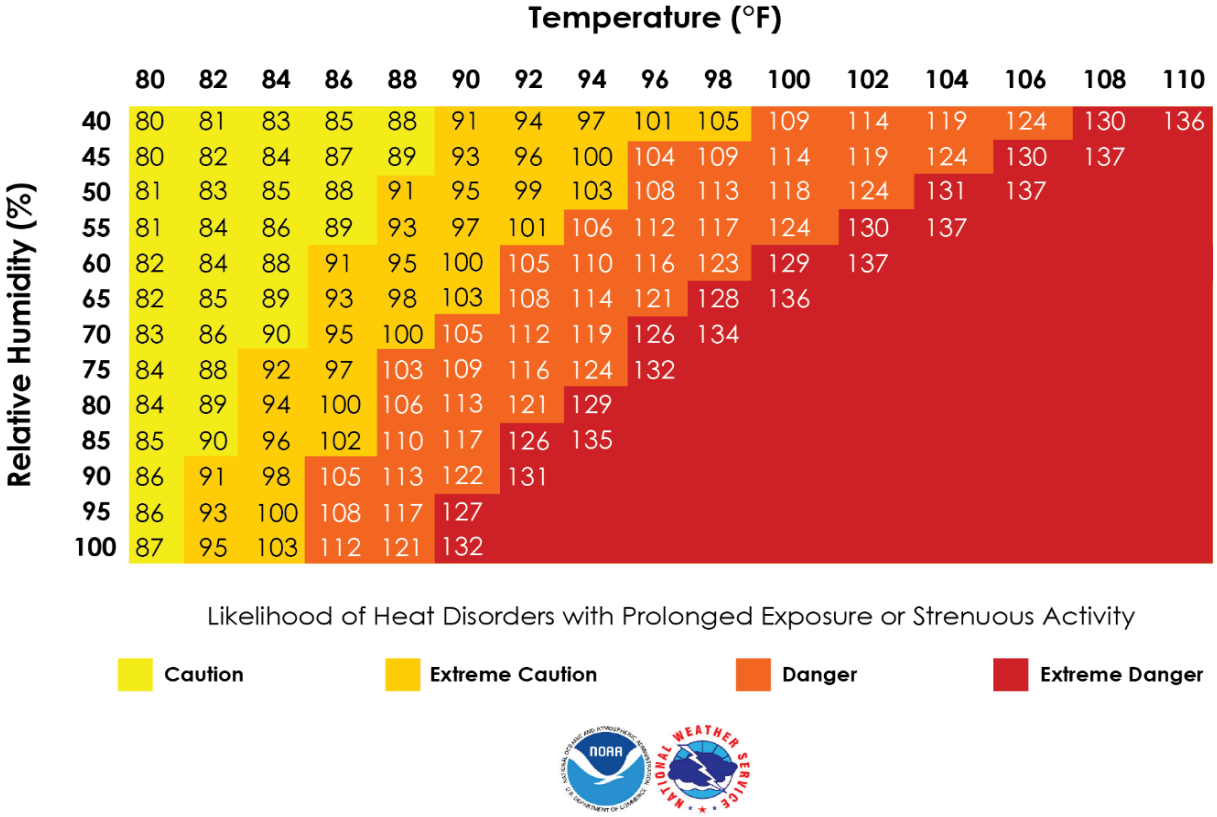
Extent

A key factor to consider regarding extreme heat situations is the humidity level relative to the temperature. As is indicated in the following figure from the National Oceanic and Atmospheric Administration (NOAA), as the relative humidity increases, the temperature needed to cause a dangerous situation decreases. For example, for 100% relative humidity, dangerous levels of heat begin at 86°F whereas a relative humidity of 50%, require 94°F. The combination of relative humidity and temperature result in a heat index as demonstrated below:

$$100\%\ Relative\ Humidity + 86°\mathrm{F} = 112°\mathrm{F}\ Heat\ Index$$

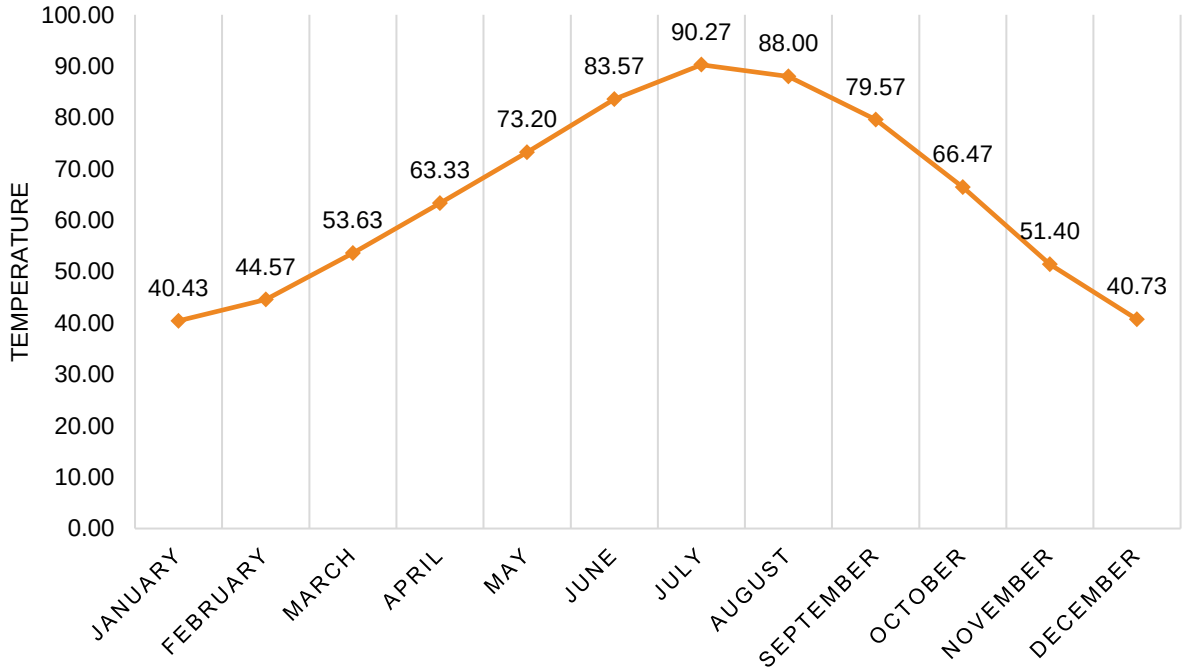
Figure 18 is designed for shady and light wind conditions. Exposure to full sunshine or strong winds can increase hazardous conditions and raise heat index values by up to 15°F. For the purposes of this plan, extreme heat is being defined as temperatures of 100°F or greater. In the planning area, the months with the highest temperatures are June, July, and August.

Figure 18: NOAA Heat Index



Source: NOAA, 2017[55]

Figure 19: Monthly Climate Normals Max Temperature (1981-2010)



Source: NCEI, 2019

55 National Oceanic and Atmospheric Administration, National Weather Service. 2017. "Heat Index." http://www.nws.noaa.gov/om/heat/heat_index.shtml.

Average Annual Losses

The annual property estimate was determined based upon NCEI Storm Events Database since 1996. The annual crop loss was determined based upon the RMA Cause of Loss Historical Database since 2000. This does not include losses from displacement, functional downtime, economic loss, injury, or loss of life. The direct and indirect effects of extreme heat are difficult to quantify. Potential losses such as power outages could affect businesses, homes, and critical facilities. High demand and intense use of air conditioning or water pumps can overload the electrical systems and damage infrastructure.

Table 52: Loss Estimate for Drought

Hazard Type	Avg. Number of Days Above 100°F[1]	Total Property Loss[2]	Average Annual Property Loss[2]	Total Crop Loss[3]	Average Annual Crop Loss[3]
Extreme Heat	15 days	$0	$0	$18,459,537.09	$971,554.58

Source: 1 HPRCC (1899-2019); 2 Indicates data is from NCEI (Jan 1996 to Sept 2019); 3 Indicates data is from USDA RMA (2000 to 2019)

Estimated Loss of Electricity

According to the FEMA Benefit Cost Analysis (BCA) Reference Guide, if an extreme heat event occurred within the planning area, the following table assumes the event could potentially cause a loss of electricity for 10% of the population at a cost of $126 per person per day.[56] In rural areas, the percent of the population affected and duration may increase during extreme events. The assumed damages do not take into account physical damages to utility equipment and infrastructure.

Table 53: Loss of Electricity - Assumed Damage by Jurisdiction

Jurisdiction	(est.) 2017 Population	Population Affected (Assumed)	Electric Loss of Use Assumed Damage Per Day
Chase	3,803	380	$47,880
Dundy	2,017	202	$25,452
Perkins	2,904	290	$36,540
Total	**8,724**	**872**	**$109,872**

Probability

Extreme heat is a regular part of the climate for the planning area; there is a 100% probability that temperatures greater than 100°F will occur annually.

The Union for Concerned Scientists released a report in July 2019 titled *Killer Heat in the United States: Climate Choices and the Future of Dangerously Hot Days*[57] which included predictions for extreme heat events in the future dependent on future climate actions. The table below summarizes those findings for the planning area.

56 Federal Emergency Management Agency. June 2009. "BCA Reference Guide."
57 Union of Concerned Scientists. 2019. "Killer Heat in the United States: Climate Choices and the Future of Dangerously Hot Days." https://www.ucsusa.org/sites/default/files/attach/2019/07/killer-heat-analysis-full-report.pdf.

Table 54: Extreme Heat Predictions for Days over 100F

Jurisdiction	Midcentury Prediction 2036-2065 (days per year)	Late Century Prediction 2070-2099 (days per year)
Chase	16	42
Dundy	20	46
Perkins	16	40

Source: Union of Concerned Scientists

Regional Vulnerabilities

The following table provides information related to regional vulnerabilities. For jurisdictional-specific vulnerabilities, refer to *Section Seven: Community Profiles*.

Table 55: Regional Drought and Extreme Heat Vulnerabilities

Sector	Vulnerability
People	-Heat exhaustion -Heat stroke Vulnerable populations include: -People working outdoors -People without air conditioning -Young children outdoors or without air conditioning -Elderly outdoors or without air conditioning
Economic	-Short-term interruption of business -Loss of power -Agricultural losses
Built Environment	-Damage to air conditioning/HVAC systems if overworked
Infrastructure	-Damages to roadways (prolonged extreme events) -Stressing electrical systems (brownouts during peak usage)
Critical Facilities	-Loss of power
Climate	-Increased risk of wildfire events -Increases in extreme heat conditions are likely, adding stress on livestock, crops, people, and infrastructure

FLOODING

Flooding can occur on a local level, sometimes affecting only a few streets, but can also extend throughout an entire district, affecting whole drainage basins and impacting property in multiple states. Heavy accumulations of ice or snow can also cause flooding during the melting stage. These events are complicated by the freeze/thaw cycles characterized by moisture thawing during the day and freezing at night. There are four main types of flooding: riverine flooding, flash flooding, sheet flooding, and ice jam flooding.

Riverine Flooding

Riverine flooding, slower in nature, is defined as the overflow of rivers, streams, drains, and lakes due to excessive rainfall, rapid snowmelt or ice melt. The areas adjacent to rivers and stream banks that carry excess floodwater during rapid runoff are called floodplains. A floodplain or flood risk area is defined as the lowland and relatively flat area adjoining a river or stream. The terms “base flood” and “100-year flood” refer to the area in the floodplain that is subject to a one percent or greater chance of flooding in any given year. Floodplains are part of a larger entity called a basin or watershed, which is defined as all the land drained by a river and its tributaries.

Flash Flooding

Flash floods, faster in nature than the other types of floods, result from convective precipitation usually due to intense thunderstorms or sudden releases from an upstream impoundment created behind a dam, landslide, or levee. Flash floods are distinguished from regular floods by a timescale of fewer than six hours. Flash floods cause the most flood-related deaths as a result of this shorter timescale. Flooding from excessive rainfall in Nebraska usually occurs between late spring and early fall.

Sheet Flooding

In some cases, flooding may not be directly attributable to a river, stream, or lake overflowing its banks. Rather, it may simply be the combination of excessive rainfall or snowmelt, saturated ground, and inadequate drainage. With no place to go, the water will find the lowest elevations – areas that are often not in a floodplain. This type of flooding, often referred to as sheet flooding, is becoming increasingly prevalent as development exceeds the capacity of the drainage infrastructure, therefore limiting its ability to properly carry and disburse the water flow. Flooding also occurs due to combined storm and sanitary sewers being overwhelmed by the tremendous flow of water that often accompanies storm events. Typically, the result is water backing into basements, which damages mechanical systems and can create serious public health and safety concerns.

Ice Jam Flooding

Ice jams occur when ice breaks up in moving waterways, and then stacks on itself where channels narrow or human-made obstructions constrict the channel. This creates an ice dam, often causing flooding within minutes of the dam formation. Ice formation in streams occurs during periods of cold weather when finely divided colloidal particles called "frazil ice" form. These particles combine to form what is commonly known as “sheet ice.” This type of ice covers the entire river. The thickness of this ice sheet depends upon the degree and duration of cold weather in the area. This ice sheet can freeze to the bottom of the channel in places. During spring thaw, rivers frequently become clogged with this winter accumulation of ice. Because of relatively low stream banks and channels blocked with ice, rivers overtop existing banks and flow overland.

Location

Table 56 shows current statuses of Flood Insurance Rate Map (FIRM) panels. Figure 20 shows the FIRM data for the planning area. For jurisdictional-specific maps as well as an inventory of structures in the floodplain, please refer to *Section Seven: Participant Sections.*

Table 56: FEMA FIRM Panel Status

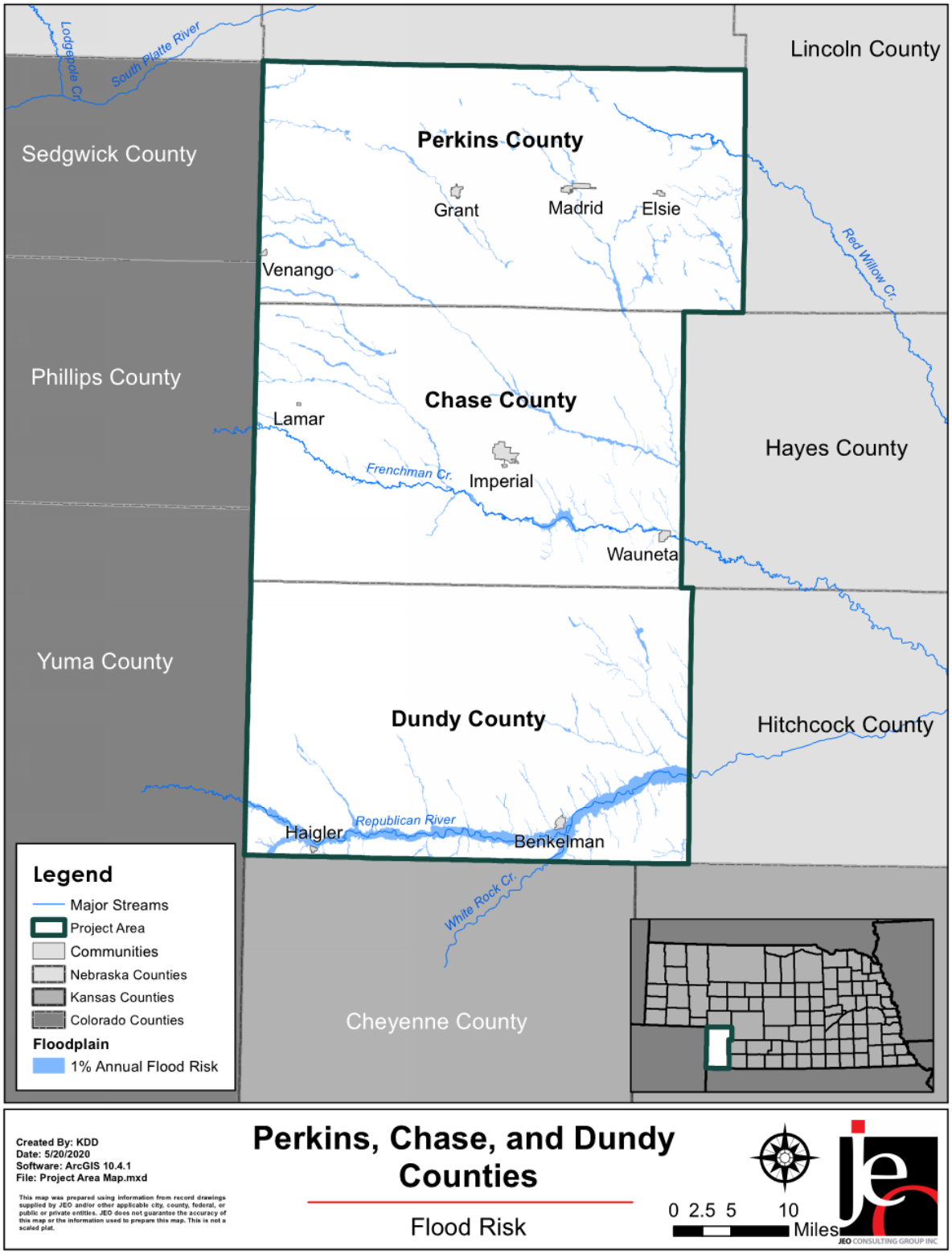
Jurisdiction	Participating in NFIP? (Y/N)	Panel Number	Effective Date
Benkelman	Yes	31057CIND0A, 31057C0470A	10/4/2002
Chase County	Yes	31029CIND0A, 31029C0025C, 31029C0050C, 31029C0075C, 31029C0100C, 31029C0150C, 31029C0175C, 31029C0200C, 31029C0225C, 31029C0250C, 31029C0275C, 31029C0300C, 31029C0325C, 31029C0350C, 31029C0400C, 31029C0425C, 31029C0450C, 31029C0475C, 31029C0500C, 31029C0525C, 31029C0700C	2/20/2008
Dundy County	Yes	31057CIND0A, 31057C0125A, 31057C0150A, 31057C0175A, 31057C0225A, 31057C0250A, 31057C0300A, 31057C0325A, 31057C0350A, 31057C0375A, 31057C0390A, 31057C0395A, 31057C0400A, 31057C0425A, 31057C0450A, 31057C0470A, 31057C0475A, 31057C0485A, 31057C0500A, 31057C0525A	10/4/2002
Elsie	No	31135CIND0A, 31135C0550B	9/2/2005
Grant	Yes	31135CIND0A, 31135C0500B	9/2/2005
Haigler	No	31057CIND0A, 31057C0390A, 31057C0395A	10/4/2002
Imperial	Yes	31029CIND0A, 31029C0275C, 31029C0300C, 31029C0450C, 31029C0475C	2/20/2008
Lamar	No	31029CIND0A, 31029C0225C	2/20/2008
Madrid	Yes	31135CIND0A, 31135C0525B	9/2/2005
Perkins County	Yes	31135CIND0A, 31135C0050B, 31135C0125B, 31135C0225B, 31135C0250B, 31135C0275B, 31135C0300B, 31135C0375B, 31135C0400B, 31135C0425B, 31135C0450B, 31135C0475B, 31135C0500B, 31135C0525B, 31135C0550B, 31135C0575B, 31135C0600B, 31135C0625B, 31135C0650B, 31135C0675B, 31135C0700B, 31135C0750B, 31135C0775B, 31135C0800B	9/2/2005
Venango	Yes	31135CIND0A, 31135C0425B	9/2/2005
Wauneta	Yes	31029CIND0A, 31029C0500C, 31029C0525C	2/4/1987

Source: FEMA, 2020[58,59]

58 Federal Emergency Management Agency. 2019. "FEMA Flood Map Service Center." Accessed June 2020. http://msc.fema.gov/portal/advanceSearch.

59 Federal Emergency Management Agency. 2020. "Community Status Book Report." Accessed June 2020. https://www.fema.gov/national-flood-insurance-program-community-status-book.

Figure 20: 1% Annual Flood Risk Hazard Area



Extent

The NWS has three categories to define the severity of a flood once a river reaches flood stage as indicated in Table 57.

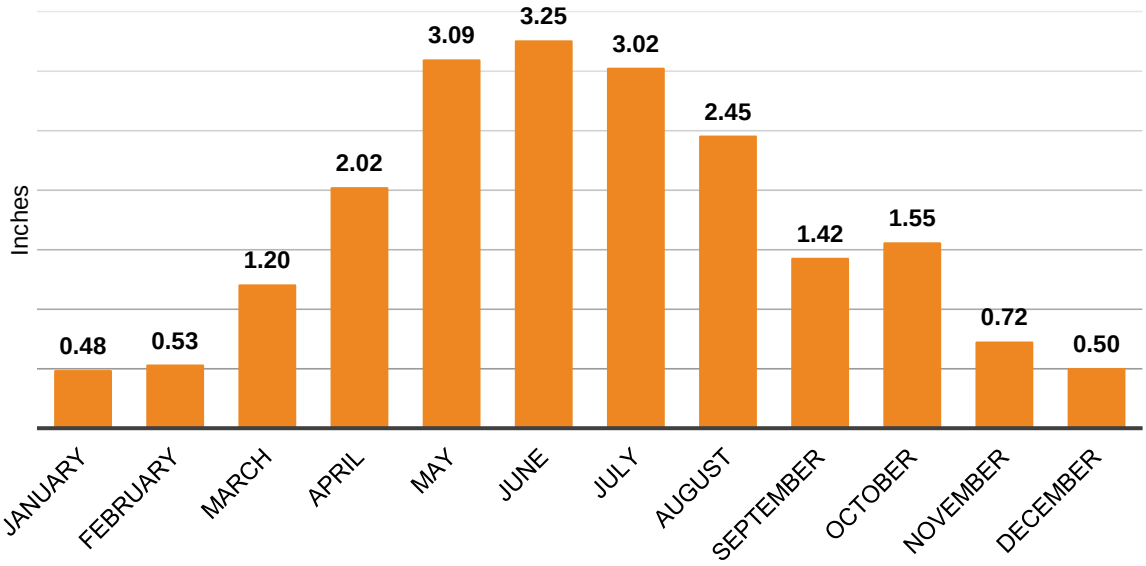
Table 57: Flooding Stages

Flood Stage	Description of flood impacts
Minor Flooding	Minimal or no property damage, but possibly some public threat or inconvenience
Moderate Flooding	Some inundation of structures and roads near streams. Some evacuations of people and/or transfer of property to higher elevations are necessary
Major Flooding	Extensive inundation of structures and roads. Significant evacuations of people and/or transfer of property to higher elevations

Source: NOAA, 2017[60]

Figure 21 shows the normal average monthly precipitation for the planning area, which is helpful in determining whether any given month is above, below, or near normal in precipitation. As indicated in Figure 22, the most common months for flooding within the planning area are June and August.

Figure 21: Average Monthly Precipitation for Planning Area

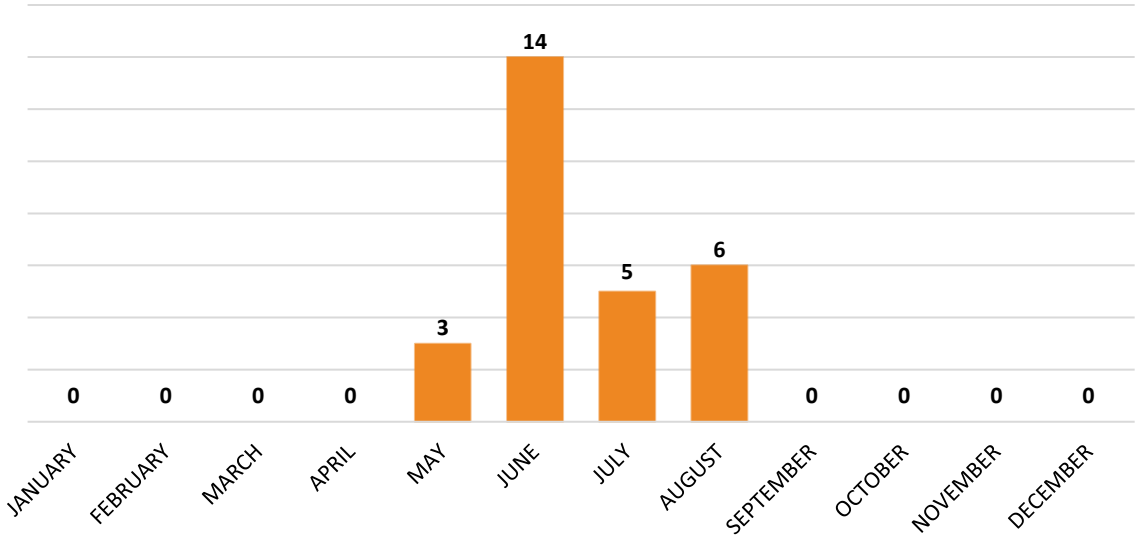


Source: NCEI, 2019[61]

60 National Weather Service. 2017. "Flood Safety." https://www.weather.gov/safety/flood.

61 NOAA National Centers for Environmental Information. December 2019. "Data Tools: 1981-2010 Normals." [datafile]. https://www.ncdc.noaa.gov/cdo-web/datatools/normals.

Figure 22: Monthly Events for Floods/Flash Floods



Source: NCEI, 1996-2019

National Flood Insurance Program (NFIP)

The NFIP was established in 1968 to reduce flood losses and disaster relief costs by guiding future development away from flood hazard areas where feasible; by requiring flood resistant design and construction practices; and by transferring the costs of flood losses to the residents of floodplains through flood insurance premiums.

In return for availability of federally backed flood insurance, jurisdictions participating in the NFIP must agree to adopt and enforce floodplain management standards to regulate development in special flood hazard areas (SFHA) as defined by FEMA's flood maps. One of the strengths of the program has been keeping people away from flooding rather than keeping the flooding away from people—through historically expensive flood control projects.

The following tables summarize NFIP participation and active policies within the planning area.

Table 58: NFIP Participants

Jurisdiction	Participate in NFIP	Eligible-Regular Program	Date Current Map	Sanction	Suspension	Rescinded
Benkelman	Yes	12/29/03	10/04/02	-	-	-
Chase County	Yes	2/20/08	2/20/08 (M)	-	-	-
Dundy County	Yes	10/04/02	10/04/02	-	-	-
Elsie	No	-	-	-	-	-
Grant	Yes	1/29/09	(NSFHA)	-	-	-
Haigler	No	-	10/04/02	8/15/76	-	-
Imperial	Yes	10/27/08	(NSFHA)	-	-	-
Lamar	No	-	-	-	-	-
Madrid	Yes	9/24/84	(NSFHA)	-	-	-
Perkins County	Yes	1/17/06	9/02/05	-	-	-

Jurisdiction	Participate in NFIP	Eligible-Regular Program	Date Current Map	Sanction	Suspension	Rescinded
Venango	Yes	9/24/84	(NSFHA)			
Wauneta	Yes	2/04/87	2/20/08	-	-	-

Source: Federal Emergency Management Agency, National Flood Insurance Program, 2017[62]
**(M) indicates no elevation determined – All Zone A, C, and X; (NSFHA) indicates no special flood hazard area – all Zone C*

Table 59: NFIP Policies in Force and Total Payments

Jurisdiction	Policies In-force	Total Coverage	Total Premiums	Total Losses	Total Payments
Benkelman	0	$0	$0	0	$0
Chase County	0	$0	$0	0	$0
Dundy County	7	$583,100	$7,624	0	$0
Elsie	0	$0	$0	0	$0
Grant	2	$525,000	$724	0	$0
Haigler	0	$0	$0	0	$0
Imperial	0	$0	$0	0	$0
Lamar	0	$0	$0	0	$0
Madrid	0	$0	$0	0	$0
Perkins County	1	$70,000	$234	0	$0
Venango	0	$0	$0	0	$0
Wauneta	3	$525,000	$1,043	1	$3,028

Source: Federal Emergency Management Agency, National Flood Insurance Program, NFIP Community Status Book, 2019[63]

This plan highly recommends and strongly encourages plan participants to enroll, participate, and remain in good standing with the NFIP. Compliance with the NFIP should remain a top priority for each participant. Jurisdictions are encouraged to initiate activities above the minimum participation requirements, which are described in the Community Rating System (CRS) Coordinator's Manual (FIA-15/2017).[64] Currently no jurisdictions in the planning area participate in the CRS program.

NFIP Repetitive Loss Structures

NeDNR was contacted to determine if any existing buildings, infrastructure, or critical facilities are classified as NFIP Repetitive Loss Structures. As of February 6, 2020, there were no repetitive loss properties located in the planning area.

Historical Occurrences

The NCEI reports events as they occur in each community. A single flooding event can affect multiple communities and counties at a time; the NCEI reports these large scale, multi-county events as separate events. The result is a single flood event covering a large portion of the planning area could be reported by the NCEI as several events. According to the NCEI, 27 flash

62 Federal Emergency Management Agency: National Flood Insurance Program. September 2018. "Policy & Claim Statistics for Flood Insurance." Accessed December 2019. https://www.fema.gov/policy-claim-statistics-flood-insurance.
63 Federal Emergency Management Agency: National Flood Insurance Program. December 2019. Policy & Claim Statistics for Flood Insurance." Accessed June 2020. https://www.fema.gov/policy-claim-statistics-flood-insurance.
64 Federal Emergency Management Agency. December 2019. "National Flood Insurance Program Community Rating System: Coordinator's Manual FIA-15/2017." Accessed December 2019. https://www.fema.gov/media-library/assets/documents/8768.

flooding events resulted in $1,890,000 in property damage, while one riverine flooding event resulted in $100,000 in property damage. USDA RMA data does not distinguish the difference between riverine flooding damages and flash flooding damages. The total crop loss according to the RMA is $684,052. Descriptions of the most damaging flood events from the NCEI are below:

- **August 10, 1999:** A thunderstorm producing up to 10 inches of rain caused widespread flooding in Perkins and Keith Counties. In Perkins County, the water washed out an aged bridge nine miles north of Madrid and a culvert three miles southeast of Madrid. Flooding was also reported along the Keith-Perkins County line north of Madrid and Elsie.
- **August 28, 1999:** In the east portion of Perkins County**,** roads and culverts were washed out by flooding associated with torrential rains.
- **June 11, 2007:** First in a wave of systems to push out of Colorado and the Panhandle into Southwest Nebraska during the evening of June 11 through June 13. The initial storm system brought large hail and very heavy rainfall. The storm system then developed into a heavy rainfall event causing extensive flash flooding.
- **June 12, 2010:** A semi-stationary front across the plains over a three-day period remained the focus for thunderstorm development on June 11. The thunderstorms developed initially on the high plains and spread east and intensified producing several large hail events and an isolated tornado in western Nebraska. Overnight as the low-level jet-strengthened storms continued producing heavy rainfall over already saturated grounds that led to flash flooding.
- **July 8, 2011:** Scattered thunderstorms brought large hail and damaging wind gusts across southwestern Nebraska during the early evening hours on July 8. By late evening, heavy rain fell across portions of Perkins County resulting in flash flooding in Venango.

In March 2019, much of the State of Nebraska was impacted by a large winter storm and flood event. Chase, Dundy, and Perkins Counties were some of the only counties in the state that were not impacted by the event and did not have a disaster declaration.

Average Annual Damages

The average damage per event estimate was determined based upon NCEI Storm Events Database since 1996 and the number of historical occurrences. This does not include losses from displacement, functional downtime, economic loss, injury, or loss of life. Flooding causes an average of $86,522 in property damages and $29,741 in crop losses per year for the planning area.

Table 60: Flood Loss Estimate

Hazard Type	Number of Events[1]	Average Events Per Year	Total Property Loss[1]	Average Annual Property Loss [1]	Total Crop Loss[2]	Average Annual Crop Loss [2]
Flooding	28	1.2	$1,990,000	$86,522	$684,052	$29,741

Source: 1 Indicates data is from NCEI (Jan 1996 to Sept 2019); 2 Indicates data is from USDA RMA (2000 to 2019)

Probability

The NCEI reports one flooding and 27 flash flooding events for a total of 28 events from January 1996 to September 2019. Based on the historic record and reported incidents by participating communities, there is a 100% probability that flooding will occur annually in the planning area.

Regional Vulnerabilities

A 2008 national study examining social vulnerability as it relates to flood events found that low-income and minority populations are disproportionately vulnerable to flood events. These groups may lack needed resources to mitigate potential flood events as well as resources that are necessary for evacuation and response. In addition, low-income residents are more likely to live in areas vulnerable to the threat of flooding but lack the resources necessary to purchase flood insurance. The study found that flash floods are more often responsible for injuries and fatalities than prolonged flood events.

Other groups that may be more vulnerable to floods, specifically flash floods, include the elderly, those outdoors during rain events, and those in low-lying areas. Elderly residents may suffer from a decrease or complete lack of mobility and as a result, be caught in flood-prone areas. Residents in campgrounds or public parks may be more vulnerable to flooding events. Many of these areas exist in natural floodplains and can experience rapid rise in water levels resulting in injury or death.

On a state level, the Nebraska's State National Flood Insurance Coordinator's office has studied who lives in special flood hazard areas. According to the NeDNR, floodplain areas have a few unique characteristics which differ from non-floodplain areas:

- Higher vacancy rates within floodplain
- Far higher percentage of renters within floodplain
- Higher percentage of non-family households in floodplain
- More diverse population in floodplain
- Much higher percentage of Hispanic/Latino populations in the floodplain

GIS parcel data was acquired from each county's assessor. This data was analyzed for the location, number, and value of property improvements at the parcel level. Property improvements include any built structures such as roads, buildings, and paved lots. The data did not contain the number of structures on each parcel. A summary of the results of this analysis is provided in Table 61. Locations with a higher percentage of improvements in the floodplain are at a higher vulnerability for flooding.

Table 61: Parcel Improvements and Value in the Floodplain

County	Number of Improvements	Total Improvement Value	Number of Improvements in Floodplain	Value of Improvements in Floodplain	Percentage of Improvements in Floodplain
Chase County[1]	2,652	$290,050,850	276	$17,011,884	10.4%
City of Imperial[1]	937	$143,978,545	0	$0	0%
Village of Wauneta[1]	371	$17,146,521	9	$253,641	2.4%
Dundy County[2]	2,137	$90,976,340	400	$24,950,414	18.7%
City of Benkelman[2]	864	$31,495,741	17	$459,165	2.0%
Village of Haigler[2]	168	$3,400,823	9	$235,056	5.4%
Perkins County[3]	2,203	$240,386,527	141	$14,770,439	6.4%
Village of Elsie[3]	87	$3,541,002	0	$0	0%

County	Number of Improvements	Total Improvement Value	Number of Improvements in Floodplain	Value of Improvements in Floodplain	Percentage of Improvements in Floodplain
City of Grant[3]	593	$50,406,196	0	$0	0%
Village of Madrid[3]	151	$23,372,221	0	$0	0%
Village of Venango[3]	108	$7,290,541	0	$0	0%
Planning Area Total	**6,992**	**$621,413,717**	**817**	**$56,732,737**	**11.7%**

Source: 1 Chase County Assessor, 2018; 2 Dundy County Assessor, 2018; 3 Perkins County Assessor, 2018

The following table is a summary of regional vulnerabilities. For jurisdictional-specific vulnerabilities, refer to *Section Seven: Community Profiles.*

Table 62: Regional Flooding Vulnerabilities

Sector	Vulnerability
People	-Low income and minority populations may lack the resources needed for evacuation, response, or to mitigate the potential for flooding -Elderly or residents with decreased mobility may have trouble evacuating -Residents in low-lying areas, especially campgrounds, are vulnerable during flash flood events -Residents living in the floodplain may need to evacuate for extended periods -Chase County: LEOP estimates 6% of people reside within the one percent annual chance floodplain -Dundy County: LEOP estimates less than 10% of people reside within the one percent annual chance floodplain -Perkins County: LEOP estimates 0% of people reside within the one percent annual chance floodplain
Economic	-Business closures or damages may have significant impacts -Agricultural losses from flooded fields or cattle loss -Closed roads and railways would impact commercial transportation of goods
Built Environment	-Buildings may be damaged
Infrastructure	-Damages to roadways and railways
Critical Facilities	-Wastewater facilities are at risk, particularly those in the floodplain -Critical facilities, especially those in the floodplain, are at risk to damage (critical facilities are noted within individual community profiles)
Climate	-Changes in seasonal and annual precipitation normals will likely increase frequency and magnitude of flood events

HAZARDOUS MATERIALS RELEASE

The following description for hazardous materials is provided by the Federal Emergency Management Agency (FEMA):

> Chemicals are found everywhere. They purify drinking water, increase crop production and simplify household chores. But chemicals also can be hazardous to humans or the environment if used or released improperly. Hazards can occur during production, storage, transportation, use or disposal. You and your community are at risk if a chemical is used unsafely or released in harmful amounts into the environment where you live, work or play.[65]

Hazardous materials in various forms can cause fatalities, serious injury, long-lasting health effects, and damage to buildings, homes, and other property. Many products containing hazardous chemicals are used and stored in homes routinely. Chemicals posing a health hazard include carcinogens, toxic agents, reproductive toxins, irritants, and many other substances that can harm human organs or vital biological processes.

Chemical manufacturers are one source of hazardous materials, but there are many others, including service stations, hospitals, and hazardous materials waste sites. Varying quantities of hazardous materials are manufactured, used, or stored in an estimated 4.5 million facilities in the United States—from major industrial plants to local dry-cleaning establishments or gardening supply stores.

Hazardous materials come in the form of explosives, flammable and combustible substances, poisons, and radioactive materials. Hazardous materials incidents are technological (meaning non-natural hazards created or influenced by humans) events that involve large-scale releases of chemical, biological or radiological materials. Hazardous materials incidents generally involve releases at fixed-site facilities that manufacture, store, process or otherwise handle hazardous materials or along transportation routes such as major highways, railways, navigable waterways and pipelines. A large number of spills also occur during the loading and unloading of chemicals.

The Environmental Protection Agency (EPA) requires the submission of the types and locations of hazardous chemicals being stored at any facility within the state over the previous calendar year. This is completed by submitting a Tier II form to the EPA as a requirement of the Emergency Planning and Community Right-to-Know Act of 1986.[66]

The transportation of hazardous materials is defined by the U.S. Pipeline and Hazardous Materials Safety Administration (PHMSA) as "…a substance that has been determined to be capable of posing an unreasonable risk to health, safety, and property when transported in commerce…"[67] According to PHMSA, hazardous materials traffic in the U.S. now exceeds 1,000,000 shipments per day.[68] Nationally, the U.S. has had 108 fatalities associated with the transport of hazardous materials between 2007 through 2016.[69] While such fatalities are a low probability risk, even one event can harm many people. For example, a train derailment in Crete,

65 Federal Emergency Management Agency. 2017. "Hazardous Materials Incidents." https://www.ready.gov/hazardous-materials-incidents.
66 Emergency Planning and Community Right-to-Know Act of 1986, Pub. L. No. 116 § 10904. (1986).
67 Pipeline and Hazardous Materials Safety Administration. 2017. "Hazmat Safety Community FAQ." https://www.phmsa.dot.gov/about-phmsa/phmsa-faqs.
68 U.S. Department of Transportation. 2015. "2012 Economic Census: Transportation." https://data.census.gov/cedsci/.
69 Pipeline and Hazardous Materials Safety Administration. 2016. "10 Year Incident Summary Reports." https://www.phmsa.dot.gov/hazmat/library/data-stats/incidents.

Nebraska in 1969 allowed anhydrous ammonia to leak from a rupture tanker. The resulting poisonous fog killed nine people and injured 53.

Table 63 demonstrates the nine classes of hazardous material according to the 2016 Emergency Response Guidebook.

Table 63: Hazardous Materials Classes

Class	Type of Material	Divisions
1	Explosives	Division 1.1 – Explosives with a mass explosion hazard Division 1.2 – Explosives with a projection hazard but not a mass explosion hazard Division 1.3 – Explosives which have a fire hazard and either a minor blast hazard or a minor projection hazard or both, but not a mass explosion hazard Division 1.4 – Explosives which present no significant blast hazard Division 1.5 – Very insensitive explosives with a mass explosion hazard Division 1.6 – Extremely insensitive articles which do not have a mass explosion hazard
2	Gases	Division 2.1 – Flammable gases Division 2.2 – Non-flammable, non-toxic gases Division 2.3 – Toxic gases
3	Flammable liquids (and Combustible liquids)	
4	Flammable solids; Spontaneously combustible materials	Division 4.1 – Flammable solids, self-reactive substances and solid desensitized explosives Division 4.2 – Substances liable to spontaneous combustion Division 4.3 – Substances which in contact with water emit flammable gases
5	Oxidizing substances and Organic peroxides	Division 5.1 – Oxidizing substances Division 5.2 – Organic peroxides
6	Toxic substances and infections substances	Division 6.1 – Toxic substances Division 6.2 – Infectious substances
7	Radioactive materials	
8	Corrosive materials	
9	Miscellaneous hazardous materials/products, substances, or organisms	

Source: Emergency Response Guidebook, 2016[70]

Location

There are 61 facility locations across the planning area that submitted Tier II reports to the Nebraska Department of Environment and Energy (NDEE) in 2017. These locations are shown in Figure 23. A listing of hazardous material storage sites can be found in *Section Seven: Community Profiles* for each jurisdiction.

70 U.S. Department of Transportation Pipeline and Hazardous materials Safety Administration. 2016. "2016 Emergency Response Guidebook." https://www.phmsa.dot.gov/hazmat/outreach-training/erg.

Figure 23: Fixed Chemical Sites

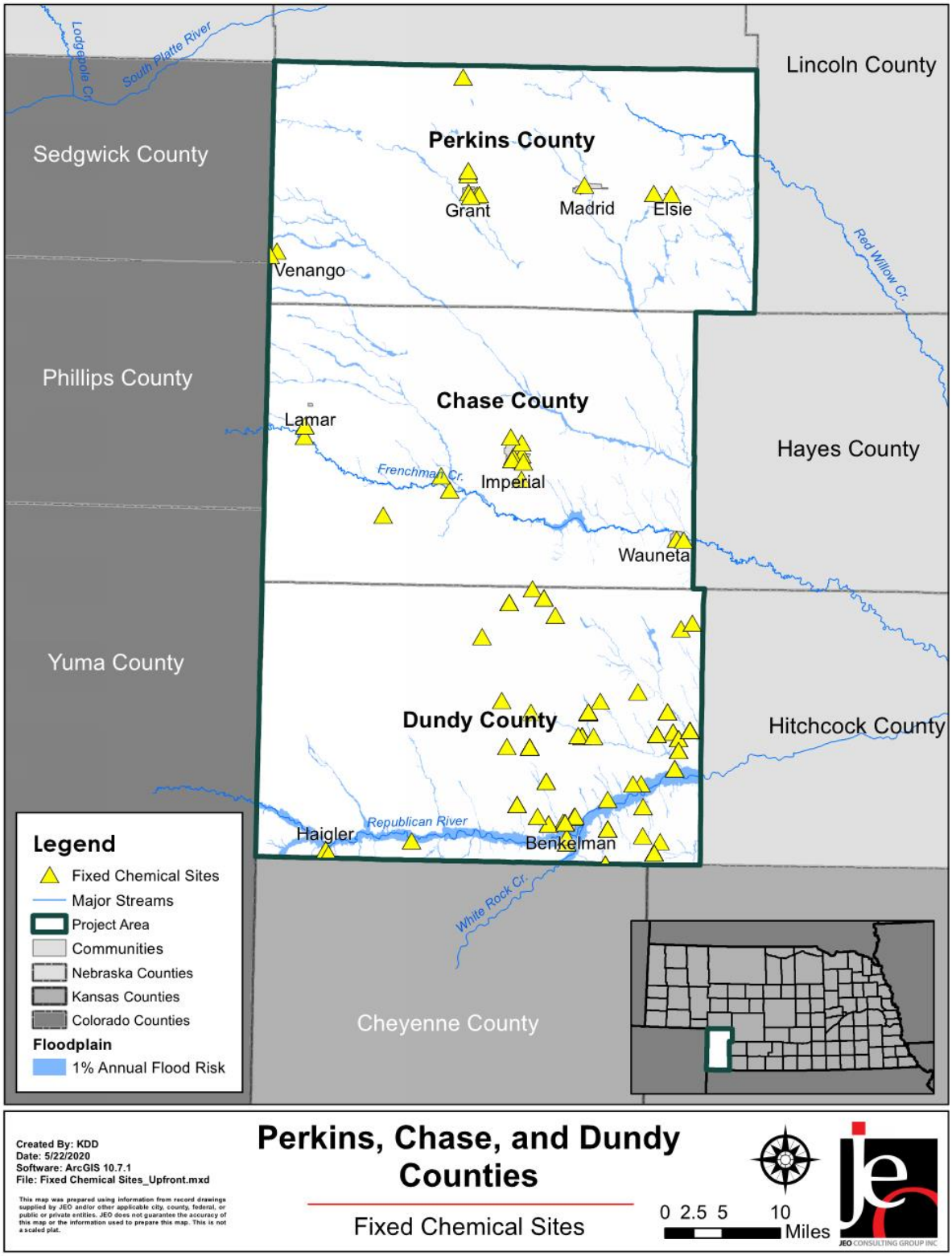
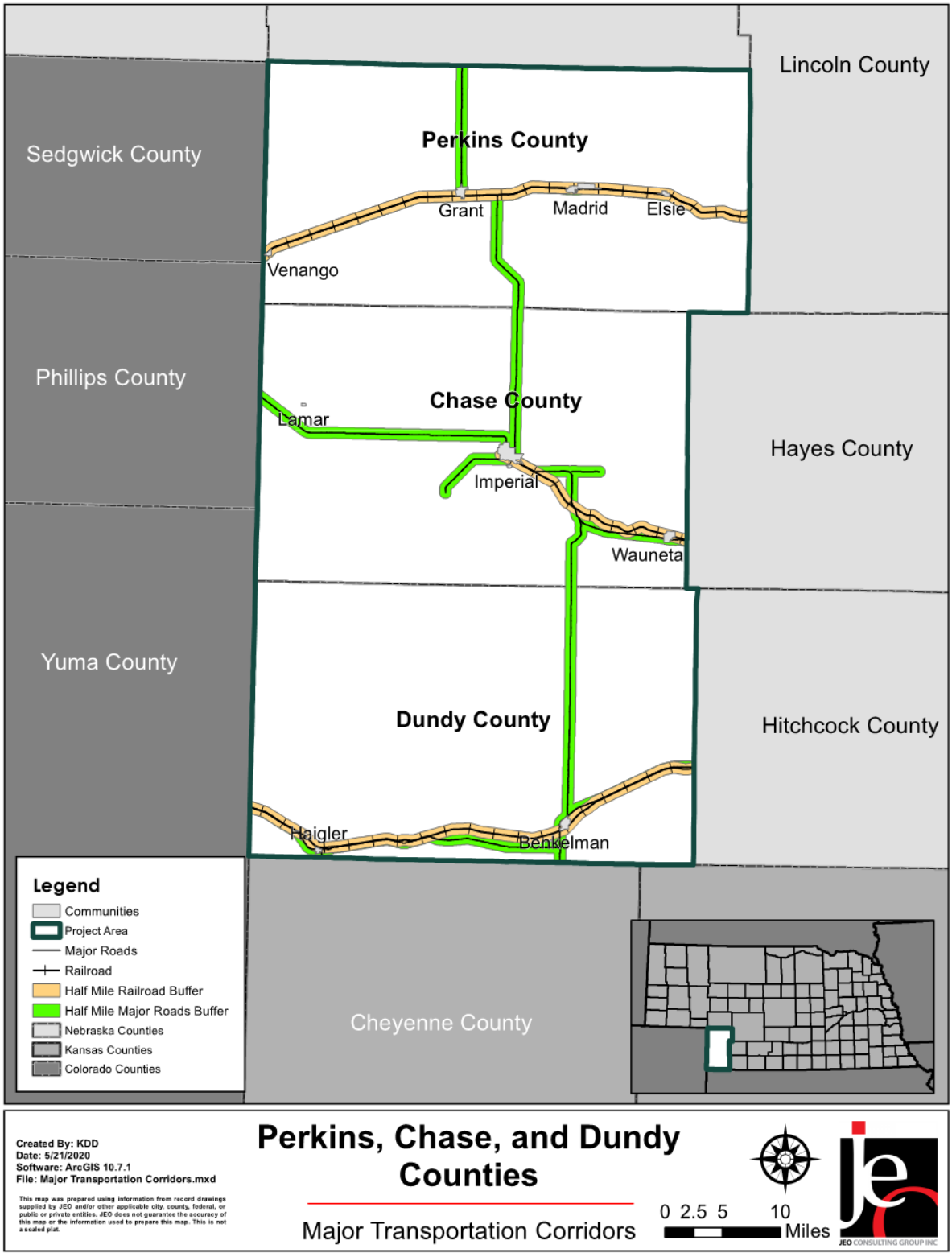


Figure 24: Major Transportation Corridors



Hazardous materials releases during transportation primarily occur on major transportation routes as identified in Figure 24. Participating communities specifically reported transportation along railroads and highways as having the potential to impact their communities. Railroads providing service through the planning area have developed plans to respond to chemical releases along rail routes.

Extent

The extent of hazardous materials releases depends on the type of chemical that is released and how far the spill reaches. Eleven releases have occurred in the planning area, and the total amount spilled ranged from 0 gallons to 2,560 gallons. Of the eleven incidents, there were no fatalities or injuries and most events were localized to a small location. Based on historic records, it is likely that any spill involving hazardous materials will not affect an area larger than a quarter mile from the spill location.

Historical Occurrences

Hazardous Materials Release – Fixed Sites

According to the U.S. Coast Guard's National Response Center database (NRC), there have been four hazardous materials releases at fixed sites from 1990 through 2019 in the planning area. There were no property damages reported for these releases. The following table displays the spills that have occurred throughout the planning area.

Table 64: Hazardous Material Releases (Fixed Site)

Year of Event	Location of Release	Quantity Spilled	Material Involved	Number of Injuries	Property Damage
1995	Grainton	505.5 Gallons	U.A.N.(Fertilizer), Paraquat	0	$0
1998	Benkelman	Unknown Amount	Phenol	0	$0
2006	Imperial	10,000 Pounds	12% Zinc Sulfate Solution	0	$0
2014	Benkelman	Unknown Amount	Ethylene Glycol and Motor Oil	0	$0

Source: National Response Center, 1990-Nov.2019[71]

Hazardous Materials Release – Transportation

According to the Pipeline and Hazardous Materials Safety Administration (PHMSA), seven hazardous materials releases occurred during transportation in the planning area between 1971 and 2019. During these events, there were no injuries, no fatalities, and $2,697 in damages.

The following table provides a list of the historical hazardous materials released during transportation in the planning area.

71 U.S. Coast Guard National Response Center. 2019. "Chemical Pollution and Railroad Incidents, 2000-February 2019." [datafile]. https://nrc.uscg.mil/.

Table 65: Hazardous Materials Release (Transportation)

Date of Event	Location of Release	Failure Description	Material Involved	Method of Transportation	Amount	Total Damage	Evacuation (Yes/No)
2/17/1975	Benkelman	Vehicular Crash	Petroleum Crude Oil	Highway	0	$0	No
8/7/1982	Wauneta	Vehicular Crash	Gasoline Mixed with 10% Ethyl Alcohol	Highway	2,560 LGA	$0	No
4/30/1992	Imperial	Loose Closure Component	Phosphoric Acid Solution	Rail	0.125 LGA	$25	No
4/6/1994	Grant	Auxiliary Valve; Piping or Fittings	Ammonia Anhydrous	Rail	0	$0	No
3/26/1998	Benkelman	Unknown	Petroleum Crude Oil	Highway	1,260 LGA	$2,672	No
5/18/2001	Grant	Cracked Weld or Seam	Flammable Liquids N.O.S.	Highway	0.03125 LGA	$0	No
9/4/2012	Haigler	Leaked Vent	Diesel Fuel	Highway	50 LGA	$0	No

Source: PHMSA, 1971– 2019[72]

Average Annual Damages

Using data from Table 66, average annual damages from hazardous materials releases can be estimated.

Table 66: Hazardous Materials Release Loss Estimate

Hazard Type	Number of Events	Events Per Year	Injuries	Total Damages	Average Annual Chemical Spill Loss
Hazardous Materials Release (Fixed Site)	4	0.14	0	$0	$0
Hazardous Materials Release (Transportation)	7	0.15	0	$2,697	$385

Probability

Hazardous materials releases at fixed site storage areas are likely in the future. Given the historic record of occurrence (four fixed site releases reported in 29 years), the annual probability of occurrence for hazardous materials releases at fixed sites is 14 percent.

The historical record indicates that hazardous materials releases during transport have a 15% chance of occurring annually in the planning area, with seven events over a 48-year period.

72 Pipeline and Hazardous Materials Safety Administration. May 2019. "Incident Statistics: Nebraska." https://www.phmsa.dot.gov/hazmat-program-management-data-and-statistics/data-operations/incident-statistics.

Regional Vulnerabilities

The following table provides information related to regional vulnerabilities; for jurisdictional-specific vulnerabilities, refer to *Section Seven: Community Profiles*.

Table 67: Regional Hazardous Materials Release Vulnerabilities

Sector	Vulnerability
People	-Those in close proximity to chemical fixed sites or transportation corridors could have minor to moderate health impacts -Possible evacuation -Hospitals, nursing homes, and the elderly at greater risk due to low mobility
Economic	-A chemical plant shutdown in smaller communities would have significant impacts to the local economy -Evacuations and closed transportation routes could impact businesses near spill
Built Environment	-Risk of fire or explosion
Infrastructure	-Transportation routes can be closed during evacuations
Critical Facilities	-Critical facilities are at risk of evacuation
Climate	-None

SEVERE THUNDERSTORMS

Severe thunderstorms are common and unpredictable seasonal events throughout Nebraska. A thunderstorm is defined as a storm that contains lightning and thunder, which is caused by unstable atmospheric conditions. When cold upper air sinks and warm moist air rises, storm clouds or "thunderheads" develop, resulting in thunderstorms. This can occur singularly, in clusters, or in lines.

Thunderstorms can develop in fewer than 30 minutes and can grow to an elevation of eight miles into the atmosphere. Lightning, by definition, is present in all thunderstorms and can cause harm to humans and animals, fires to buildings and agricultural lands, and electrical outages in municipal electrical systems. Lightning can strike up to 10 miles from the portion of the storm depositing precipitation. There are three primary types of lightning: intra-cloud, inter-cloud, and cloud to ground. While intra and inter-cloud lightning are more common, communities are potentially impacted when lightning comes in contact with the ground. Lightning generally occurs when warm air mixes with colder air masses resulting in atmospheric disturbances necessary for polarizing the atmosphere. Additionally, hail is a common component of thunderstorms and often occurs in series, with one area having the potential to be hit multiple times in one day. Severe thunderstorms usually occur in the evening during the spring and summer months. Hail can destroy property and crops with sheer force, as some hail stones can fall at speeds up to 100 mph.

Economically, thunderstorms are generally beneficial in that they provide moisture necessary to support Nebraska's largest industry, agriculture. The majority of thunderstorms do not cause damage, but when they escalate to severe storms and/or produce hail, the potential for damages increases. Damages can include: crop losses from wind and hail; property losses due to building and automobile damages from hail; high wind; flash flooding; death or injury to humans and animals from lightning, drowning, or getting struck by falling or flying debris; and personal injury from people without shelter during these events or standing near windows. The potential for damages increases as the size of the hail increases. Figure 25 displays the average number of days with thunderstorms across the country each year. The planning area experiences an average of 40 to 50 thunderstorms over the course of one year.

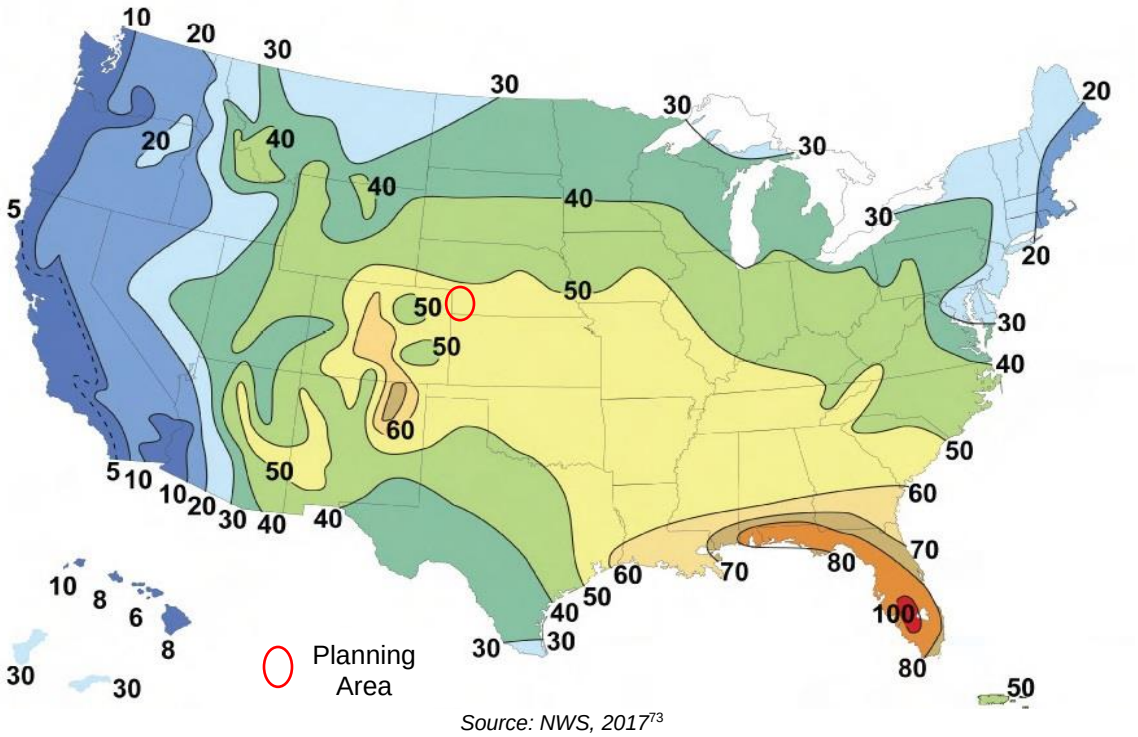
Location

The entire planning area is at risk to thunderstorms due to the regional nature of this type of event.

Extent

The geographic extent of a severe thunderstorm event may be large enough to impact the entire planning area (such as in the case of a squall line, derecho, or long-lived supercell) or just a few square miles, in the case of a single cell that marginally meets severe criteria. The NWS defines a thunderstorm as severe if it contains hail that is one inch in diameter or capable of winds gusts of 58 mph or higher. The Tornado and Storm Research Organization (TORRO) scale is used to classify hailstones and provides some detail related to the potential impacts from hail. Table 68 outlines the TORRO Hail Scale.

Figure 25: Average Number of Thunderstorms



Source: NWS, 2017[73]

Table 68: TORRO Hail Scale

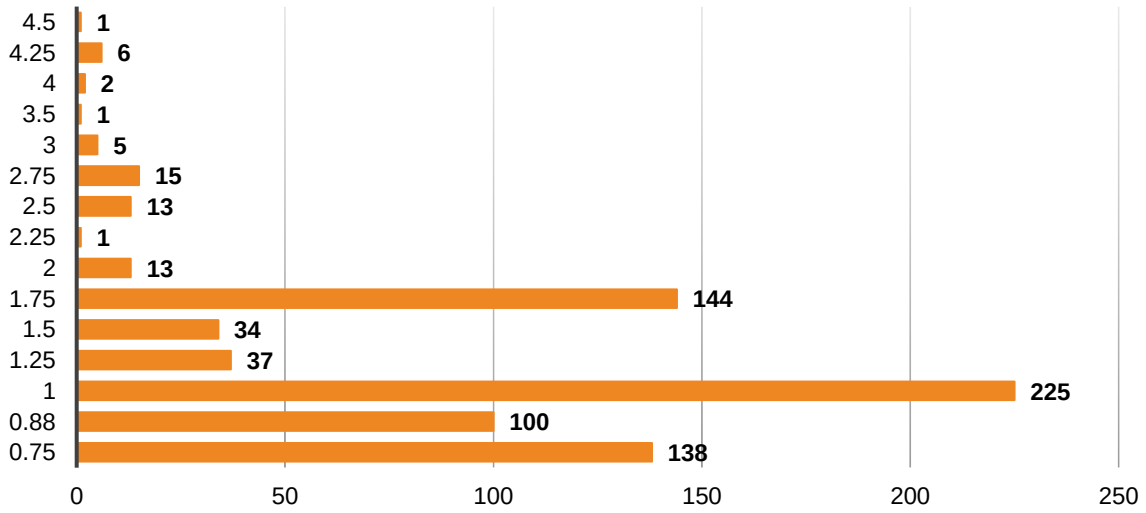
Class	Type of Material	Divisions
H0: Hard Hail	5 mm; (Pea size); 0.2 in	No damage
H1: Potentially Damaging	5 -15 mm (Marble); 0.2 – 0.6 in	Slight general damage to plants and crops
H2: Significant	10 -20 mm (Grape); 0.4 – 0.8 in.	Significant damage to fruit, crops, and vegetation
H3: Severe	20 -30 mm (Walnut); 0.8 – 1.2 in	Severe damage to fruit and crops, damage to glass and plastic structures
H4: Severe	30 -40 mm (Squash Ball); 1.2 – 1.6 in	Widespread damage to glass, vehicle bodywork damaged
H5: Destructive	40 – 50 mm (Golf ball); 1.6 – 2.0 in.	Wholesale destruction of glass, damage to tiled roofs; significant risk or injury
H6: Destructive	50 – 60 mm (chicken egg); 2.0 – 2.4 in	Grounded aircrafts damaged, brick walls pitted; significant risk of injury
H7: Destructive	60 – 75 mm (Tennis ball); 2.4 – 3.0 in	Severe roof damage; risk of serious injuries
H8: Destructive	75 – 90 mm (Large orange); 3.0 – 3.5 in.	Severe damage to structures, vehicles, airplanes; risk of serious injuries
H9: Super Hail	90 – 100 mm (Grapefruit); 3.5 – 4.0 in	Extensive structural damage; risk of severe or even fatal injuries to persons outdoors
H10: Super Hail	>100 mm (Melon); > 4.0 in	Extensive structural damage; risk or severe or even fatal injuries to persons outdoors

Source: TORRO, 2017[74]

73 National Weather Service. 2017. "Introduction to Thunderstorms." https://www.weather.gov/jetstream/tstorms_intro.
74 Tornado and Storm Research Organization. 2017. "Hail Scale." http://www.torro.org.uk/hscale.php.

The NCEI reported 735 individual hail events across the planning area since 1996. As the NCEI reports events per county, this value overestimates the total amount of thunderstorm events. The average hailstone size was 1.26 inches. Events of this magnitude correlate to an H4 Severe classification. It is reasonable to expect H4 classified events to occur several times in a year throughout the planning area. In addition, it is reasonable, based on the number of occurrences, to expect larger hailstones to occur in the planning area annually. The planning area has endured nine H10 hail events (>4.0 inches) during the period of record. Figure 26 shows hail events based on the size of the hail.

Figure 26: Hail Events by Magnitude

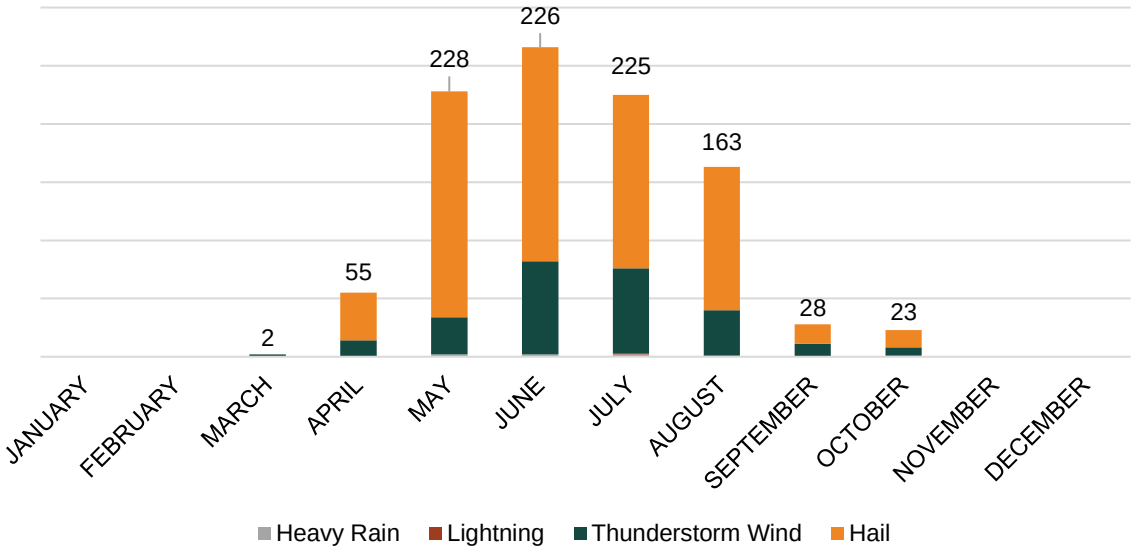


Source: NCEI, 1996-2019

Historical Occurrences

Severe thunderstorms in the planning area usually occur in the afternoon and evening during the summer months (Figure 27).

Figure 27: Severe Thunderstorm Events by Month



Source: NCEI, 1996-2019

The NCEI reports events as they occur in each community. A single severe thunderstorm event can affect multiple communities and counties at a time; the NCEI reports these large scale, multi-county events as separate events. The result is a single thunderstorm event covering the entire region could be reported by the NCEI as several events.

The NCEI reports a total of 258 thunderstorm wind, three heavy rain, three lightning, and 735 hail events in the planning area from January 1996 to September 2019. In total these events were responsible for $6,351,750 in property damages. The USDA RMA data shows that severe thunderstorms caused $178,502,574 in crop damages. No injuries or fatalities were reported in association with these storms.

Average Annual Damages

The average damage per event estimate was determined based upon recorded damages from NCEI Storm Events Database since 1996 and number of historical occurrences. This does not include losses from displacement, functional downtime, economic loss, injury, or loss of life. Severe thunderstorms cause an average of $276,164 per year in property damages.

Table 69: Severe Thunderstorms Loss Estimate

Hazard Type	Number of Events[1]	Average Events Per Year	Total Property Loss[1]	Average Annual Property Loss	Total Crop Loss[2]	Average Annual Crop Loss
Hail	735	32	$4,274,750	$185,859	$178,502,574	$7,760,981
Heavy Rain	3	0.1	$0	$0		
Lightning	3	0.1	$102,000	$4,435		
Thunderstorm Wind	258	11.2	$1,975,000	$85,870		
Total	**999**	**43.4**	**$6,351,750**	**$276,164**	**$178,502,574**	**$7,760,981**

Source: 1 Indicates data is from NCEI (January 1996 to Sept 2019); 2 Indicates data is from USDA RMA (2000 to 2019)

Probability

Based on historical records and reported events, severe thunderstorms events and storms with hail are likely to occur on an annual basis. The NCEI reported a total of 999 severe thunderstorm events between 1996 and 2019, resulting in 100% chance annually for thunderstorms.

Regional Vulnerabilities

The following table provides information related to regional vulnerabilities; for jurisdictional-specific vulnerabilities, refer to *Section Seven: Community Profiles*.

Table 70: Regional Thunderstorm Vulnerabilities

Sector	Vulnerability
People	-Elderly citizens with decreased mobility may have trouble evacuating or seeking shelter -Mobile home residents are risk of injury and damage to their property if the mobile home is not anchored properly -Injuries can occur from not seeking shelter, standing near windows, and shattered windshields in vehicles
Economic	-Damages to buildings and property can cause significant losses to business owners and employees
Built Environment	-Buildings are at risk to hail damage -Downed trees and tree limbs -Roofs, siding, windows, gutters, HVAC systems, etc. can incur damage
Infrastructure	-High winds and lightning can cause power outages and down power lines -Roads may wash out from heavy rains and become blocked from downed tree limbs
Critical Facilities	-Power outages are possible -Critical facilities may sustain damage from hail, lightning, and wind
Climate	-Changes in seasonal precipitation and temperature normals can increase frequency and magnitude of severe storm events

SEVERE WINTER STORMS

Severe winter storms are an annual occurrence in Nebraska. Winter storms can bring extreme cold, freezing rain, heavy or drifting snow, and blizzards. Blizzards are particularly dangerous due to drifting snow and the potential for rapidly occurring whiteout conditions which greatly inhibit vehicular traffic. Generally, winter storms occur between the months of November and March but may occur as early as October and as late as April. Heavy snow is usually the most defining element of a winter storm. Large snow events can cripple an entire jurisdiction by hindering transportation, knocking down tree limbs and utility lines, and structurally damaging buildings.

Extreme Cold

Along with snow and ice storm events, extreme cold is dangerous to the well-being of people and animals. What constitutes extreme cold varies from region to region but is generally accepted as temperatures that are significantly lower than the region's average low temperature. For the planning area, the coldest months of the year are December, January, and February. The average low temperature for these months is below freezing (average low for the three months is 14.2°F). The average high temperature for the months of January, February, and December is near 42°F.[75]

Freezing Rain

Along with snow events, winter storms also have the potential to deposit significant amounts of ice. Ice buildup on tree limbs and power lines can cause them to collapse. This is most likely to occur when rain falls that freezes upon contact, especially in the presence of wind. Freezing rain is the name given to rain that falls when surface temperatures are below freezing. Unlike a mixture of rain and snow, ice pellets or hail, freezing rain is made entirely of liquid droplets. Freezing rain can also lead to many problems on the roads, as it makes them slick, causing automobile accidents, and making vehicle travel difficult.

Blizzards

Blizzards are particularly dangerous due to drifting snow and the potential for rapidly occurring whiteout conditions, which greatly inhibits vehicular traffic. Heavy snow is usually the most defining element of a winter storm. Large snow events can cripple an entire jurisdiction for several days by hindering transportation, knocking down tree limbs and utility lines, structurally damaging buildings, and injuring or killing crops and livestock.

Location

The entire planning area is at risk of severe winter storms.

Extent

The Sperry-Piltz Ice Accumulation Index (SPIA) was developed by the NWS to predict the accumulation of ice and resulting damages. The SPIA assesses total precipitation, wind, and temperatures to predict the intensity of ice storms. Figure 28 shows the SPIA index.

75 High Plains Regional Climate Center. 2020. "Monthly Climate Normals 1981-2010." http://climod.unl.edu/.

Figure 28: SPIA Index

ICE DAMAGE INDEX	* AVERAGE NWS ICE AMOUNT (in inches) *Revised-October, 2011	WIND (mph)	DAMAGE AND IMPACT DESCRIPTIONS
0	< 0.25	< 15	Minimal risk of damage to exposed utility systems; no alerts or advisories needed for crews, few outages.
1	0.10 – 0.25	15 - 25	Some isolated or localized utility interruptions are possible, typically lasting only a few hours. Roads and bridges may become slick and hazardous.
	0.25 – 0.50	> 15	
2	0.10 – 0.25	25 - 35	Scattered utility interruptions expected, typically lasting 12 to 24 hours. Roads and travel conditions may be extremely hazardous due to ice accumulation.
	0.25 – 0.50	15 - 25	
	0.50 – 0.75	< 15	
3	0.10 – 0.25	> = 35	Numerous utility interruptions with some damage to main feeder lines and equipment expected. Tree limb damage is excessive. Outages lasting 1 – 5 days.
	0.25 – 0.50	25 - 35	
	0.50 – 0.75	15 - 25	
	0.75 – 1.00	< 15	
4	0.25 – 0.50	> = 35	Prolonged & widespread utility interruptions with extensive damage to main distribution feeder lines & some high voltage transmission lines/structures. Outages lasting 5 – 10 days.
	0.50 – 0.75	25 - 35	
	0.75 – 1.00	15 - 25	
	1.00 – 1.50	< 15	
5	0.50 – 0.75	> = 35	Catastrophic damage to entire exposed utility systems, including both distribution and transmission networks. Outages could last several weeks in some areas. Shelters needed.
	0.75 – 1.00	> = 25	
	1.00 – 1.50	> = 15	
	> 1.50	Any	

Source: SPIA-Index, 2017[76]

The Wind Chill Index was developed by the NWS to determine the decrease in air temperature felt by the body on exposed skin due to wind. The wind chill is always lower than the air temperature and can quicken the effects of hypothermia or frost bite as it gets lower. Figure 29 shows the Wind Chill Index used by the NWS.

76 SPIA-Index. 2009. "Sperry-Piltz Ice Accumulation Index." Accessed June 2017. http://www.spia-index.com/index.php.

Figure 29: Wind Chill Index Chart

Temperature (°F)

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

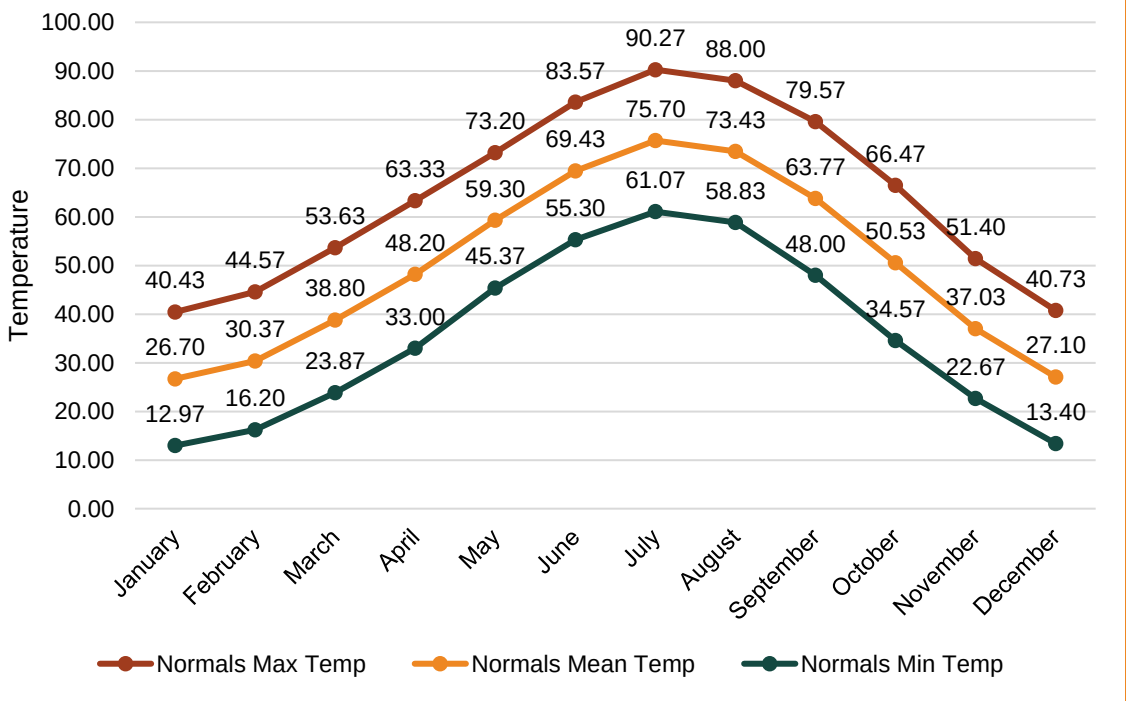
Frostbite Times: 30 Minutes | 10 Minutes | 5 Minutes

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

T = Air Tempurature (°F) **V** = Wind Speed (mph)

Source: NWS, 2017[77]

Figure 30: Monthly Climate Normals Temperature (1981-2010)

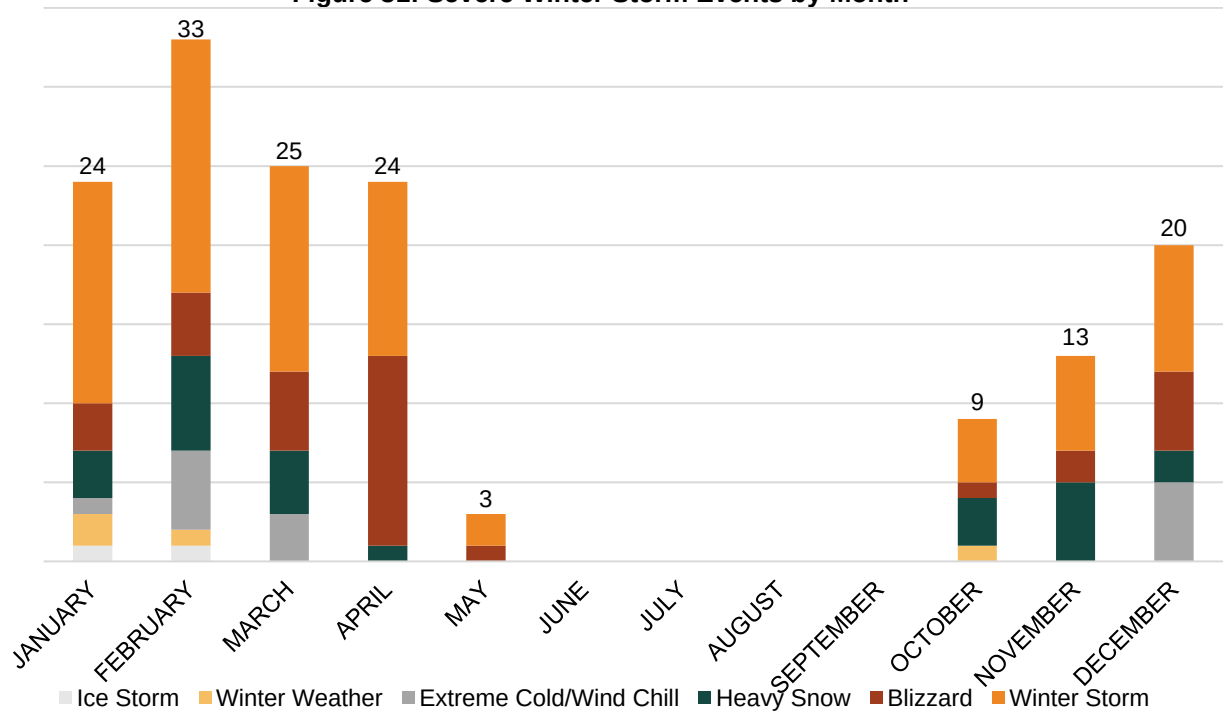


77 National Weather Service. 2001. "Wind Chill Chart." http://www.nws.noaa.gov/om/cold/wind_chill.shtml.

Historical Occurrences

Due to the regional scale of severe winter storms, the NCEI reports events as they occur in each county. According to the NCEI, there were a combined 151 severe winter storm events for the planning area from January 1996 to September 2019. February had the most recorded events for the planning area (Figure 31). These recorded events caused a total of $222,000 in reported property damages and $12,055,749 in crop damages.

Figure 31: Severe Winter Storm Events by Month



According to the NCEI, no injuries or deaths were associated with winter storms in the planning area. Additional information from these events from NCEI and reported by each community are listed in *Section Seven: Community Profiles*.

Average Annual Damages

The average damage per event estimate was determined based upon NCEI Storm Events Database since 1996 and includes aggregated calculations for each of the six types of winter weather as provided in the database. This does not include losses from displacement, functional downtime, economic loss, injury, or loss of life. Severe winter storms have caused an average of $9,653 per year in property damage and $524,163 per year in crop damages for the planning area.

Table 71: Severe Winter Storm Loss Estimate

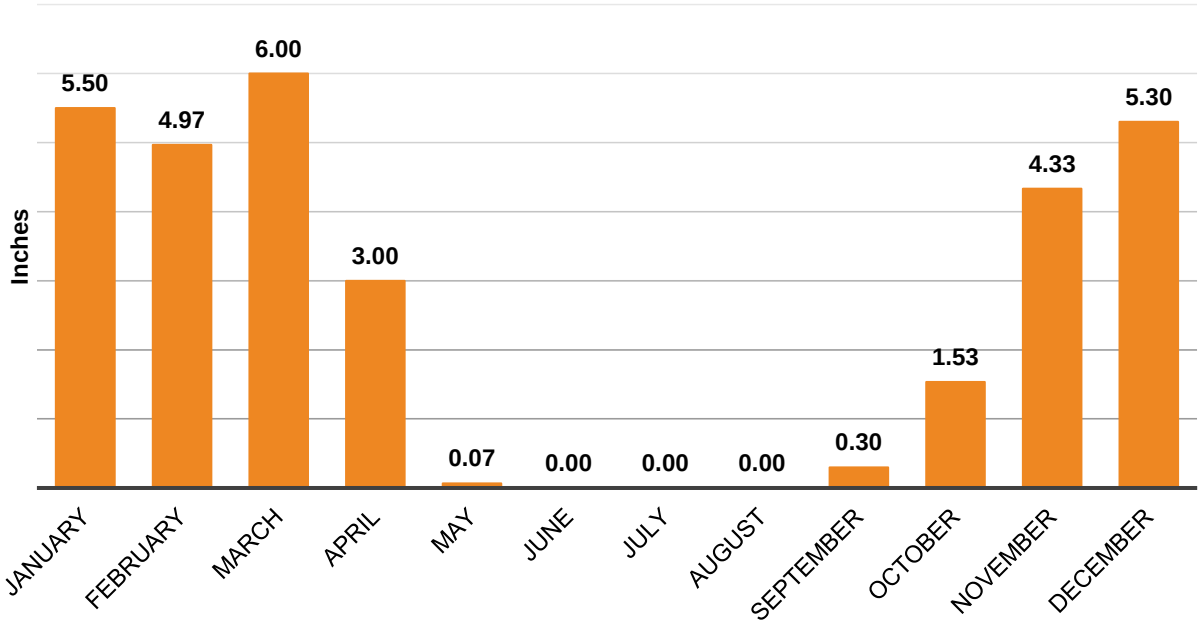
Hazard Type	Number of Events[1]	Average Events Per Year[1]	Total Property Loss[1]	Average Annual Property Loss [1]	Total Crop Loss[2]	Average Annual Crop Loss [2]
Blizzard	33	1.4	$160,000	$6,957	$12,055,749	$524,163
Heavy Snow	24	1	$0	$0		
Ice Storm	2	0	$0	$0		
Winter Storm	74	3.2	$56,000	$2,435		
Winter Weather	5	0.2	$6,000	$261		
Extreme Cold/Wind Chill	13	0.6	$0	$0		
Total	**151**	**6.4**	**$222,000**	**$9,653**	**$12,055,749**	**$524,163**

Source: 1 Indicates data is from NCEI (Jan 1996 to Sept 2019); 2 Indicates data is from USDA RMA (2000 to 2019)

Probability

Average monthly snowfall for the planning area is shown in Figure 32, which shows the snowiest months are between November and April. A common snow event (likely to occur annually) will result in accumulation totals between one and five inches. Often these snow events are accompanied by high winds. It is reasonable to expect wind speeds of 25 to 35 mph with gusts reaching 50 mph or higher. Strong winds and low temperatures can combine to produce extreme wind chills of 20°F to 40°F below zero. With 151 severe winter storm events in 26 years, there is 100% probability that a severe winter storm will occur annually.

Figure 32: Monthly Normal (1981-2010) Snowfall in Inches



Source: High Plains Regional Climate Center, 2020

Regional Vulnerabilities

The following table provides information related to regional vulnerabilities; for jurisdictional-specific vulnerabilities, refer to *Section Seven: Community Profiles*.

Table 72: Regional Severe Winter Storm Vulnerabilities

Sector	Vulnerability
People	-Elderly citizens are at higher risk to injury or death, especially during extreme cold and heavy snow accumulations -Citizens without adequate heat and shelter at higher risk of injury or death
Economic	-Closed roads and power outages can cripple a region for days, leading to significant revenue loss and loss of income for workers
Built Environment	-Heavy snow loads can cause roofs to collapse -Significant tree damage possible, downing power lines and blocking roads
Infrastructure	-Heavy snow and ice accumulation can lead to downed power lines and prolonged power outages -Transportation may be difficult or impossible during blizzards, heavy snow, and ice events
Critical Facilities	-Emergency response and recovery operations, communications, water treatment plants, and others are at risk to power outages, impassable roads, and other damages
Climate	-Changes in seasonal precipitation and temperature normals can increase frequency and magnitude of severe winter storm events

TERRORISM

The Federal Bureau of Investigation (FBI) describes terrorism as either domestic or international, depending on the origin, base, and objectives of the terrorist organization. For the purpose of this report, the following definitions from the FBI will be used:

- Domestic terrorism is the unlawful use, or threatened use, of force or violence by a group or individual based and operating entirely within the United States or Puerto Rico without foreign direction committed against persons or property to intimidate or coerce a government, the civilian population, or any segment thereof in furtherance of political or social objectives.

- International terrorism involves violent acts or acts dangerous to human life that are a violation of the criminal laws of the United States or any state, or that would be a criminal violation if committed within the jurisdiction of the United States or any state. These acts appear to be intended to intimidate or coerce a civilian population, influence the policy of a government by intimidation or coercion, or affect the conduct of a government by assassination or kidnapping. International terrorist acts occur outside the United States or transcend national boundaries in terms of the means by which they are accomplished, the persons they appear intended to coerce or intimidate, or the locale in which their perpetrators operate or seek asylum.

There are different types of terrorism depending on the target of attack, which are

- Political terrorism
- Bio-terrorism
- Cyber-terrorism
- Eco-terrorism
- Nuclear-terrorism
- Narco-terrorism
- Agro-terrorism

Terrorist activities are also classified based on motivation behind the event (such as ideology: i.e. religious fundamentalism, national separatist movements, and social revolutionary movements). Terrorism can also be random with no ties to ideological reasoning.

The FBI also provides clear definitions of a terrorist incident and prevention:

- A terrorist *incident* is a violent act or an act dangerous to human life, in violation of the criminal laws of the United States, or of any state, to intimidate or coerce a government, the civilian population, or any segment thereof, in furtherance of political or social objectives.

- Terrorism *prevention* is a documented instance in which a violent act by a known or suspected terrorist group or individual with the means and a proven propensity for violence is successfully interdicted through investigative activity.

Primarily, threat assessment, mitigation, and response to terrorism are federal and state directives and work in conjunction with local law enforcement. The Office of Infrastructure Protection (IP) within the Federal Department of Homeland Security is a component of the National Programs and Protection Directorate.

The IP leads the coordinated national program to reduce and mitigate risk within 18 national critical infrastructure and key resources (CIKR) sectors from acts of terrorism and natural disasters. The IP also works to strengthen sectors' ability to respond and quickly recover from attacks or other emergencies. This is done through the National Infrastructure Protection Plan (NIPP).

Under the NIPP, a Sector-Specific Agency (SSA) is a federal agency assigned to lead a collaborative process for infrastructure protection for each of the 18 sectors. The NIPP's comprehensive framework allows the IP to provide the cross-sector coordination and collaboration needed to set national priorities, goals, and requirements for effective allocation of resources. More importantly, the NIPP framework integrates a broad range of public and private CIKR protection activities.

SSAs provide guidance about the NIPP framework to state, tribal, territorial, and local homeland security agencies and personnel. They coordinate NIPP implementation within the sector, which involves developing and sustaining partnerships and information-sharing processes, as well as assisting with contingency planning and incident management.

The IP has SSA responsibility for six of the 18 CIKR sectors. Those six are:

- Chemical
- Commercial Facilities
- Critical Manufacturing
- Dams
- Emergency Services
- Nuclear Reactors, Materials and Waste

SSA responsibility for the other 12 CIKR sectors is held by other Department of Homeland Security components and other federal agencies. Those 12 are:

- Agriculture and Food – Department of Agriculture; Food and Drug Administration
- Banking and Finance – Department of the Treasury
- Communications – Department of Homeland Security
- Defense Industrial Base – Department of Defense
- Energy – Department of Energy
- Government Facilities – Department of Homeland Security
- Information Technology – Department of Homeland Security
- National Monuments and Icons – Department of the Interior
- Postal and Shipping – Transportation Security Administration
- Healthcare and Public Health – Department of Health and Human Services
- Transportation Systems – Transportation Security Administration; U.S. Coast Guard
- Water – Environmental Protection Agency

The NIPP requires that each SSA prepare a Sector-Specific Plan, review it annually, and update it as appropriate.

The Department of Homeland Security and its affiliated agencies are responsible for disseminating any information regarding terrorist activities in the country. The system in place is the National Terrorism Advisory System (NTAS). In 2011, NTAS replaced the Homeland Security

Advisory System which was the color-coded system put in place after the September 11th attacks by Presidential Directive 5 and 8 in March of 2002.

NTAS is based on a system of analyzing threat levels and providing either an imminent threat alert or an elevated threat alert.

An ***Imminent Threat Alert*** warns of a credible, specific and impending terrorist threat against the United States.

An ***Elevated Threat Alert*** warns of a credible terrorist threat against the United States.

The Department of Homeland Security, in conjunction with other federal agencies, will decide which level of threat alert should be issued, should credible information be available.

Each alert provides a statement summarizing the potential threat and what, if anything, should be done to ensure public safety.

The NTAS Alerts will be based on the nature of the threat: in some cases, alerts will be sent directly to law enforcement or affected areas of the private sector, while in others, alerts will be issued more broadly to the American people through both official and media channels.

An individual threat alert is issued for a specific time period and automatically expires. It may be extended if new information becomes available or the threat evolves. The ***sunset provision*** contains a specific date when the alert expires, as there will not be a constant NTAS Alert or blanket warning of an overarching threat. If threat information changes for an alert, the Secretary of Homeland Security may announce an updated NTAS Alert. All changes, including the announcement that cancels an NTAS Alert, will be distributed the same way as the original alert.

Location
Terrorism can occur throughout the entire planning area. In rural areas, concerns are primarily related to agro-terrorism and tampering with water supplies. In urban areas, concerns are related to political unrest, activist groups, and others that may be targeting businesses and critical facilities.

Extent
Terrorist attacks can vary greatly in scale and magnitude, depending on the location of the attack.

Historical Occurrences
Previous accounts of terrorism in the planning area were gathered from the Global Terrorism Database, maintained by the University of Maryland and the National Consortium for the Study of Terrorism and Responses to Terrorism (START). This database contains information for over 140,000 terrorist attacks. According to this database, there have been no terrorist incidents in the planning area from 1970 through October 2018.[78]

Average Annual Damages
According to the START Global Terrorism Database (1970-2018) there have been no civil disorder events that have occurred in the planning area. As there were no terrorist events within the planning area, there are no average annual damages.

78 National Consortium for the Study of Terrorism and Responses to Terrorism (START). October 2018. Global Terrorism Database [Data file]. Retrieved from https://www.start.umd.edu/gtd.

Probability

Given zero incidences over a 49-year period, the annual probability for terrorism in the planning area has a less than one percent chance of occurring during any given year. This does not indicate that an event will never occur within the planning area, only that the likelihood of such an event is incredibly low.

Regional Vulnerabilities

The following table provides information related to regional vulnerabilities; for jurisdictional-specific vulnerabilities, refer to *Section Seven: Community Profiles.*

Table 73: Regional Terrorism Vulnerabilities

Sector	Vulnerability
People	-Police officers and first responders at risk of injury or death
Economic	-Damaged businesses can cause loss of revenue and loss of income for workers -Agricultural attacks could cause significant economic losses for the region
Built Environment	-Targeted buildings may sustain heavy damage
Infrastructure	-Water supply, power plants, utilities may be damaged
Critical Facilities	-Police stations and government offices are at a higher risk
Climate	-None

TORNADOES AND HIGH WINDS

High winds typically accompany severe thunderstorms, severe winter storms, tornadoes, and other large low-pressure systems, which can cause significant crop damage, downed power lines, loss of electricity, traffic flow obstructions, and significant property damage including to trees and center-pivot irrigation systems.

The National Weather Service (NWS) defines high winds as sustained wind speeds of 40 mph or greater lasting for 1 hour or longer, or winds of 58 mph or greater for any duration.[79] The NWS issues High Wind Advisories when there are sustained winds of 25 to 39 mph and/or gusts to 57 mph. Figure 33 shows the wind zones in the United States. The wind zones are based on the maximum wind speeds that can occur from a tornado or hurricane event. The planning area is located in Zone III which has maximum winds of 200 mph equivalent to an EF4/5 tornado.

Figure 33: Wind Zones in the U.S.

Source: FEMA, 2016

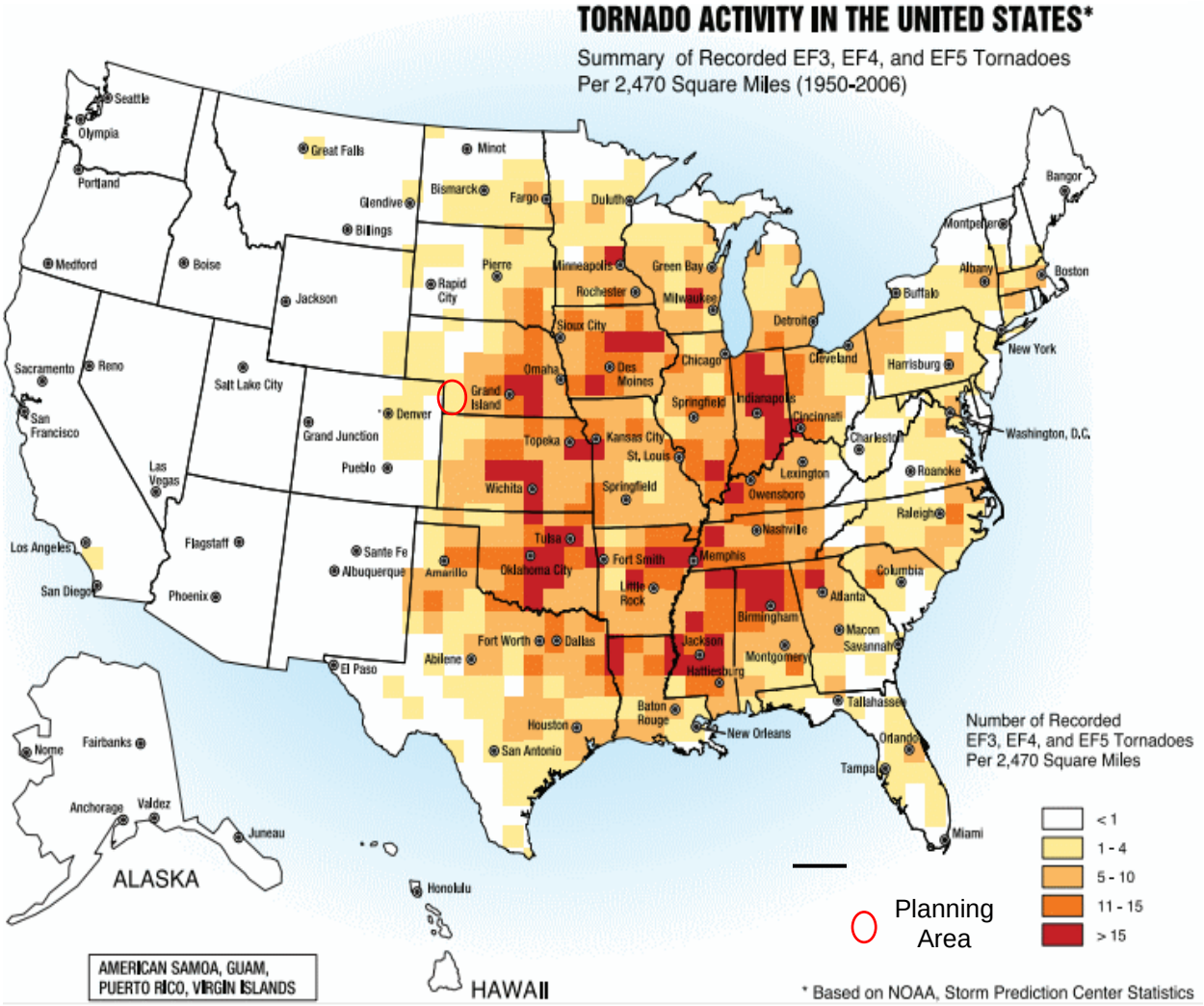
High winds are a critical component of tornado formation. A tornado is typically associated with a supercell thunderstorm. For a rotation to be classified as a tornado, three characteristics must be met:

79 National Weather Service. 2017. "Glossary." http://w1.weather.gov/glossary/index.php?letter=h.

- There must be a microscale rotating area of wind, ranging in size from a few feet to a few miles wide;
- The rotating wind, or vortex, must be attached to a convective cloud base and must be in contact with the ground; and,
- The spinning vortex of air must have caused enough damage to be classified by the Fujita Scale as a tornado.

Once tornadoes are formed, they can be extremely violent and destructive. They have been recorded all over the world, but are most prevalent in the American Midwest and South, in an area known as "Tornado Alley." Approximately 1,250 tornadoes are reported annually in the contiguous United States. Tornadoes can travel distances over 100 miles and reach over 11 miles above ground. Tornadoes usually stay on the ground no more than 20 minutes. Nationally, the tornado season typically occurs between April and July. On average, 80% of tornadoes occur between noon and midnight. In Nebraska, 77% of all tornadoes occur in the months of May, June, and July.

Figure 34: Tornado Activity in the United States



Source: FEMA, 2008[80]

80 Federal Emergency Management Agency. August 2008. "Taking Shelter From the Storm: Building a Safe Room for Your Home or Small Business, 3rd edition."

Nebraska is ranked fifth in the nation for tornado frequency with an annual average of 57 tornadoes between 1991 to 2010.[81] The following figure shows the tornado activity in the United States as a summary of recorded EF3, EF4, and EF5 tornadoes per 2,470 square miles from 1950 through 2006.

Location

High winds commonly occur throughout the planning area. Tornadoes can occur anywhere in the planning area. The impacts would likely be greater in more densely populated areas. The following map shows the historical track locations across the region from 1950 to 2017 according to the Midwestern Regional Climate Center.

The Beaufort Wind Scale can be used to classify wind strength, while the magnitude of tornadoes is measured by the Enhanced Fujita Scale. Table 74 outlines the Beaufort scale, provides wind speed ranking, range of wind speeds per ranking, and a brief description of conditions for each ranking.

Table 74: Beaufort Wind Ranking

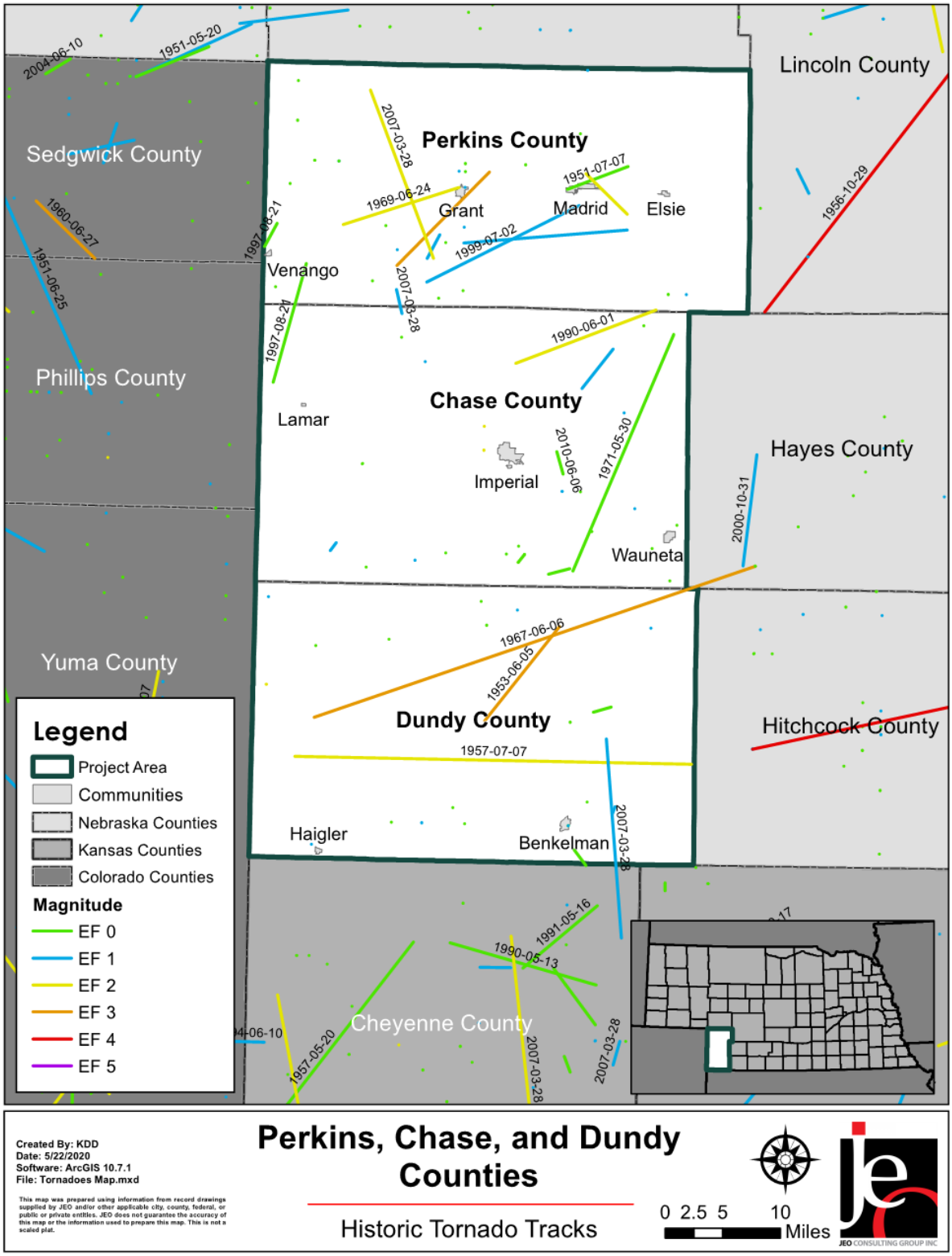
Beaufort Wind Force Ranking	Range of Wind	Conditions
0	<1 mph	Smoke rises vertically
1	1 – 3 mph	Direction shown by smoke but not wind vanes
2	4 – 7 mph	Wind felt on face; leaves rustle; wind vanes move
3	8 – 12 mph	Leaves and small twigs in constant motion
4	13 – 18 mph	Raises dust and loose paper; small branches move
5	19 – 24 mph	Small trees in leaf begin to move
6	25 – 31 mph	Large branches in motion; umbrellas used with difficulty
7	32 – 38 mph	Whole trees in motion; inconvenience felt when walking against the wind
8	39 – 46 mph	Breaks twigs off tree; generally, impedes progress
9	47 – 54 mph	Slight structural damage; chimneypots and slates removed
10	55 – 63 mph	Trees uprooted; considerable structural damages; improperly or mobiles homes with no anchors turned over
11	64 – 72 mph	Widespread damages; very rarely experienced
12 - 17	72 - > 200 mph	Hurricane; devastation

Source: Storm Prediction Center, 2017[82]

81 National Centers for Environmental Information. 2013. "U.S. Tornado Climatology." https://www.ncdc.noaa.gov/climate-information/extreme-events/us-tornado-climatology.

82 Storm Prediction Center: National Oceanic and Atmospheric Administration. 1805. "Beaufort Wind Scale." http://www.spc.noaa.gov/faq/tornado/beaufort.html.

Figure 35: Historic Tornado Tracks



Extent

The Enhanced Fujita Scale replaced the Fujita Scale in 2007. The Enhanced Fujita Scale does not measure tornadoes by their size or width, but rather the amount of damage caused to human-built structures and trees after the event. The official rating category provides a common benchmark that allows comparisons to be made between different tornadoes. The enhanced scale classifies EF0-EF5 damage as determined by engineers and meteorologists across 28 different types of damage indicators, including different types of building and tree damage. To establish a rating, engineers and meteorologists examine the damage, analyze the ground-swirl patterns, review damage imagery, collect media reports, and sometimes utilize photogrammetry and videogrammetry. Based on the most severe damage to any well-built frame house, or any comparable damage as determined by an engineer, an EF-Scale number is assigned to the tornado. The following tables summarize the Enhanced Fujita Scale and damage indicators. According to a recent report from the National Institute of Science and Technology on the Joplin Tornado, tornadoes rated EF3 or lower account for around 96 percent of all tornado damages.[83]

Table 75: Enhanced Fujita Scale

Storm Category	3 Second Gust (mph)	Damage Level	Damage Description
EF0	65-85 mph	Gale	Some damages to chimneys; breaks branches off trees; pushes over shallow-rooted trees; damages to sign boards.
EF1	86-110 mph	Weak	The lower limit is the beginning of hurricane wind speed; peels surface off roofs; mobile homes pushed off foundations or overturned; moving autos pushed off the roads; attached garages might be destroyed.
EF2	111-135 mph	Strong	Considerable damage. Roofs torn off frame houses; mobile homes demolished; boxcars pushed over; large trees snapped or uprooted; light object missiles generated.
EF3	136-165 mph	Severe	Roof and some walls torn off well-constructed houses; trains overturned; most trees in forest uprooted.
EF4	166-200 mph	Devastating	Well-constructed houses leveled; structures with weak foundations blown off some distance; cars thrown, and large missiles generated.
EF5	200+ mph	Incredible	Strong frame houses lifted off foundations and carried considerable distances to disintegrate; automobile sized missiles fly through the air in excess of 100 meters; trees debarked; steel re-enforced concrete structures badly damaged.
EF No rating	--	Inconceivable	Should a tornado with the maximum wind speed in excess of F5 occur, the extent and types of damage may not be conceived. A number of missiles such as iceboxes, water heaters, storage tanks, automobiles, etc. will create serious secondary damage on structures.

Source: NOAA; FEMA

83 Kuligowski, E.D., Lombardo, F.T., Phan, L.T., Levitan, M.L., & Jorgensen, D.P. March 2014. "Final Report National Institute of Standards and Technology (NIST) Technical Investigation of the May 22, 2011, Tornado in Joplin, Missouri."

Table 76: Enhanced Fujita Scale Damage Indicator

Number	Damage Indicator	Number	Damage Indicator
1	Small barns, farm outbuildings	15	School - 1-story elementary (interior or exterior halls)
2	One- or two-family residences	16	School - Junior or Senior high school
3	Single-wide mobile home (MHSW)	17	Low-rise (1-4 story) bldg.
4	Double-wide mobile home	18	Mid-rise (5-20 story) bldg.
5	Apartment, condo, townhouse (3 stories or less)	19	High-rise (over 20 stories)
6	Motel	20	Institutional bldg. (hospital, govt. or university)
7	Masonry apartment or motel	21	Metal building system
8	Small retail bldg. (fast food)	22	Service station canopy
9	Small professional (doctor office, branch bank)	23	Warehouse (tilt-up walls or heavy timber)
10	Strip mall	24	Transmission line tower
11	Large shopping mall	25	Free-standing tower
12	Large, isolated ("big box") retail bldg.	26	Free standing pole (light, flag, luminary)
13	Automobile showroom	27	Tree - hardwood
14	Automotive service building	28	Tree - softwood

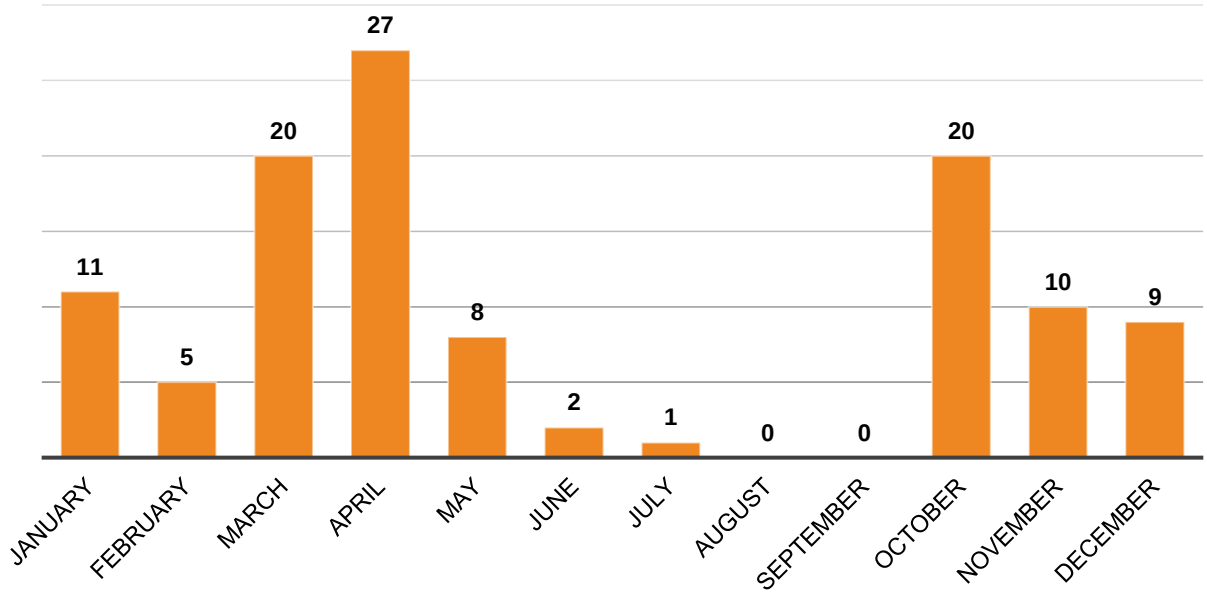
Source: NOAA; FEMA

Using the NCEI reported events, the most common high wind event is a nine on the Beaufort Wind Scale. Based on the historic record, it is most likely that tornadoes that occur within the planning area will be of EF0 strength. Of the 32 reported events, eight were EF1 and one was EF2.

Historical Occurrences

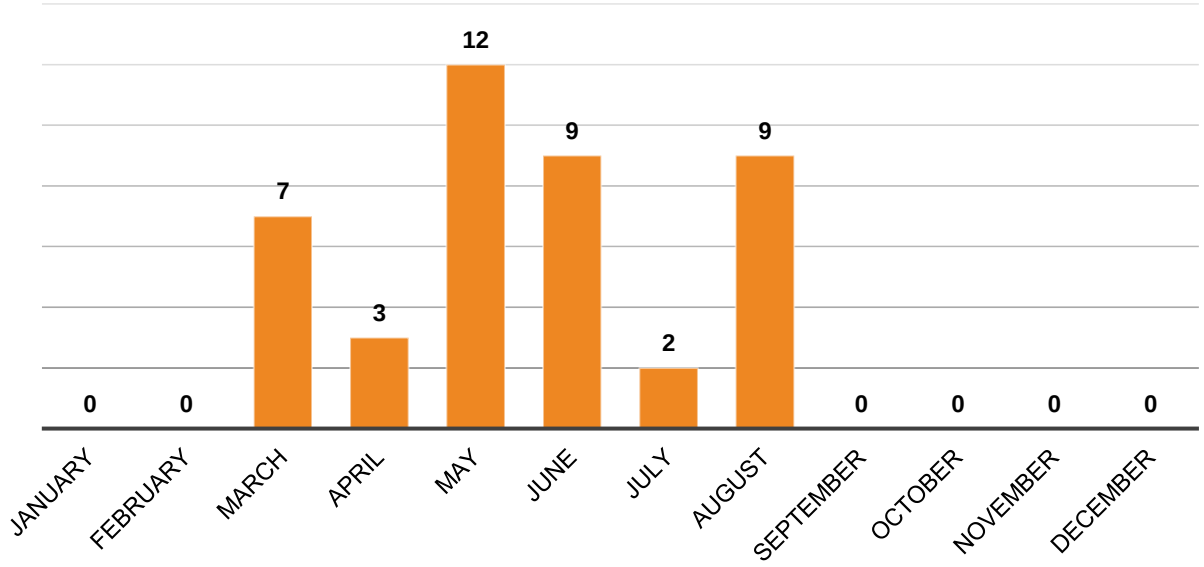
Due to the regional scale of high winds, the NCEI reports events as they occur in each county. While a single event can affect two or more counties at a time, the NCEI reports them as separate events. There were 114 high wind events that occurred between January 1996 and September 2019 and 32 tornadic events ranging from a magnitude of EF0 to EF2. These events were responsible for $3,457,000 in property damages. As seen in Figure 36, most high wind events occur in the spring and winter months. One tornado in 1999 caused one injury. The most damaging tornadoes occurred in Perkins County (2007: $1,200,000) and (1999: $700,000). The events identified by the NCEI are listed in *Section Seven: Community Profiles* for each county. The following figures show that April has the most high wind events and the month of May has the highest number of tornadoes in the planning area.

Figure 36: High Wind Events by Month



Source: NCEI, 1996-2019

Figure 37: Tornadoes by Month in the Planning Area



Source: NCEI, 1996-2019

Average Annual Damages

The average damage per event estimate was determined based upon NCEI Storm Events Database since 1996 and number of historical occurrences. This does not include losses from displacement, functional downtime, economic loss, injury, or loss of life. It is estimated that high wind events caused an average of $15,130 per year in property damage, and an average of $219,462 per year in crop damage for the planning area. Tornadoes cause an average of $135,174 per year in property damage. The RMA did not report crop damages due to tornadic events, but damage to crops from tornadoes is still a concern for the planning area.

Table 77: High Wind Loss Estimate

Hazard Type	Number of Events[1]	Average Events Per Year	Total Property Loss[1]	Average Annual Property Loss[1]	Total Crop Loss[2]	Average Annual Crop Loss[2]
High Winds	114	5	$348,000	$15,130	$5,047,616	$219,462
Tornadoes	32	1.4	$3,109,000	$135,174	$0	$0

Source: 1 Indicates data is from NCEI (Jan 1996 to Sept 2019); 2 Indicates data is from USDA RMA (2000 to 2019)

Probability

Based on historical records and reported events, it is likely that high winds and tornadic events will occur within the planning area annually. For the 23 years examined, there were 114 reported high wind events and 32 tornadoes.

Regional Vulnerabilities

The following table provides information related to regional vulnerabilities; for jurisdictional-specific vulnerabilities, refer to *Section Seven: Community Profiles*.

Table 78: Regional High Wind and Tornado Vulnerabilities

Sector	Vulnerability
People	-Vulnerable populations include those living in mobile homes (especially if they are not anchored properly), nursing homes, and/or schools -People outdoors during events -Citizens without access to shelter below ground or in safe rooms -Elderly with decreased mobility or poor hearing may be higher risk -Lack of multiple ways of receiving weather warnings, especially at night
Economic	-Agricultural losses to both crops and livestock -Damages to businesses and prolonged power outages can cause significant impacts to the local economy, especially with EF3 tornadoes or greater
Built Environment	-All building stock is at risk of significant damages
Infrastructure	-Downed power lines and power outages -All above ground infrastructure at risk to damages -Impassable roads due to debris blocking roadways
Critical Facilities	-All critical facilities are at risk to damages and power outages
Climate	-Changes in seasonal precipitation and temperature normals can increase frequency and magnitude of severe storm events

TRANSPORTATION INCIDENTS

A transportation accident involves an incident between one or more conveyances on land, sea or air. Transportation accidents can cause property damage, bodily injury, and death. Accidents are influenced by several factors, including the type of driver, road condition, weather conditions, density of traffic, type of roadway, signage, and signaling.

In the planning area, automobile accidents are likely to be the most common type of incident as there are very few rail lines and bodies of water. In addition, most of the airports in the three counties are smaller with a low amount of takeoffs and landings.

Location

Transportation incidents can occur anywhere along transportation routes in the planning area but are most likely to occur along major highways due to increased speeds and the higher number of vehicles. Table 79 lists the location of the public and private airports in the planning area. Figure 38 shows the location of the major transportation routes in the planning area.

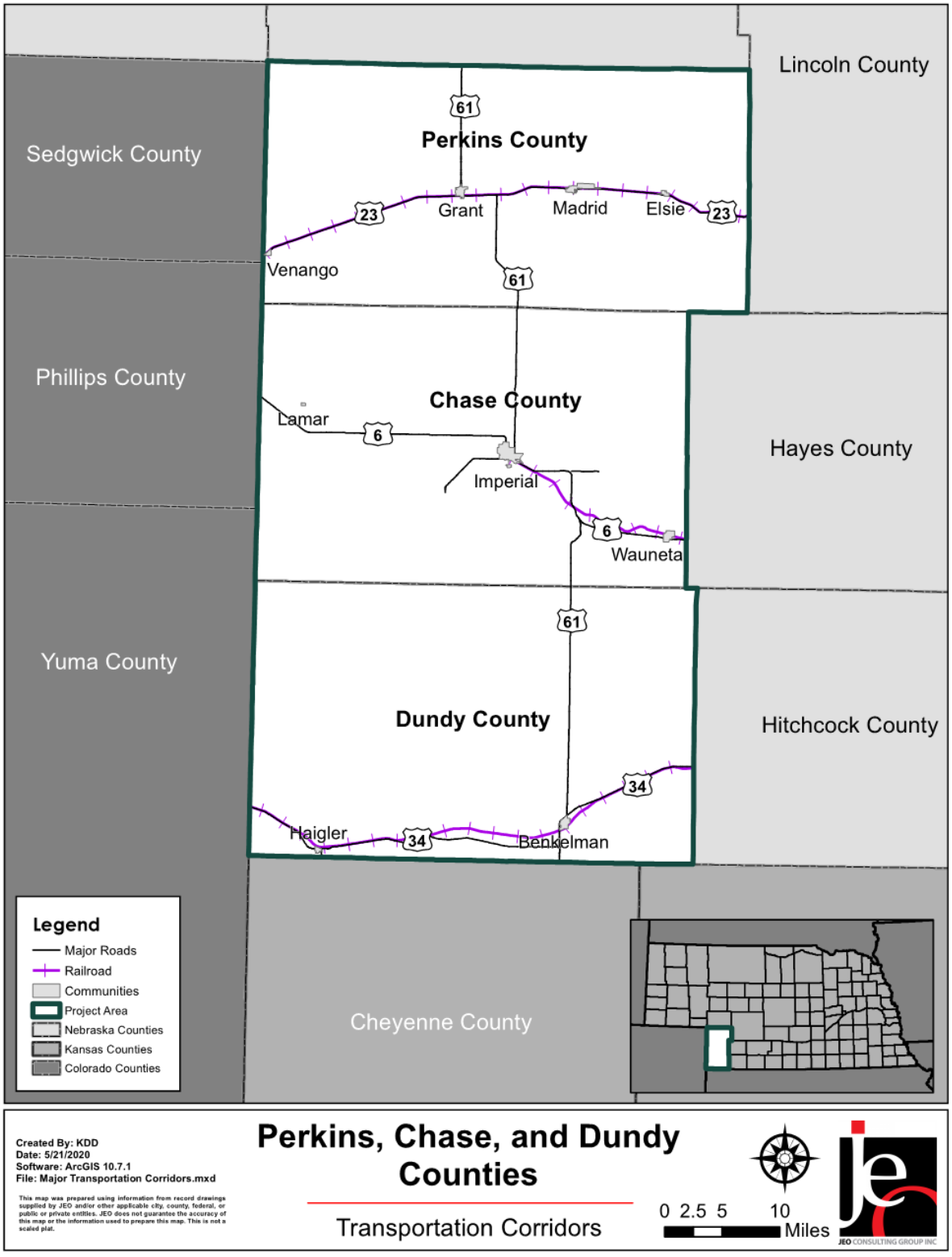
Table 79: Planning Area Airports

Airport	Nearest Community	County
Cornelius Farm Airport	Madrid	Perkins County
Grant Municipal Airport	Grant	Perkins County
Hendricks Field Airport	Grant	Perkins County
Hoppy's Airport	Benkelman	Dundy County
Imperial Municipal Airport	Imperial	Chase County
Jantzen Airport	Madrid	Perkins County
Jones Airport	Benkelman	Dundy County
Kumor Airport	Grant	Perkins County
Larrabee Airport	Lamar	Chase County
Regier Brothers Airport	Madrid	Perkins County

Extent

The extent of automobile, rail, and air incidents is usually localized, however catastrophic events can occur and may require assistance from outside jurisdictions. Transportation incidents can also cause hazard materials releases, which can further increase damages and risk of injury.

Figure 38: Transportation Corridors

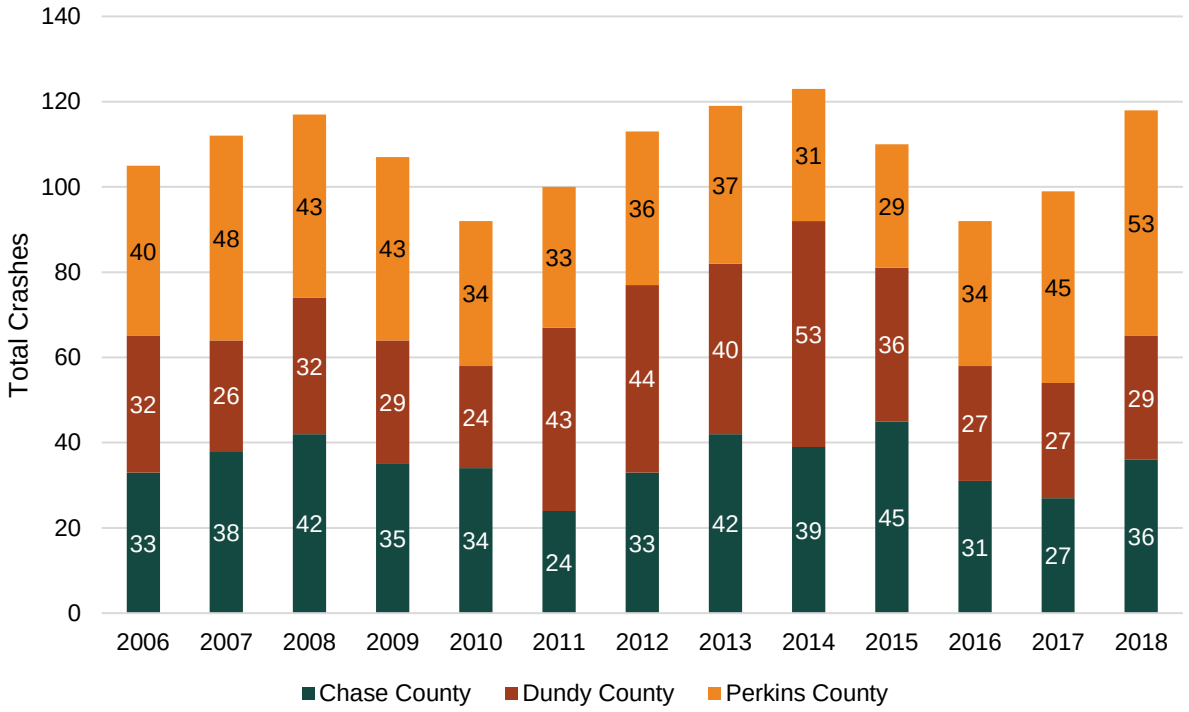


Historical Occurrences

Automobile

The Nebraska Department of Transportation (NDOT) maintains records at the county level for certain automobile related accidents. The following figure shows total crashes from 2006 to 2018 for each county. These events resulted in a total of 1,407 crashes, 450 injuries, and 21 fatalities.

Figure 39: Automobile Crashes



Source: NDOT[84]

Highway Rail

The Federal Railroad Administration (FRA) keeps data on all highway rail accidents since 1975. Table 80 shows the number highway rail accidents by county since 1975. Eight injuries and three fatalities resulted from these events.

Table 80: Historical Highway Rail Incidents

County	Number of Incidents	Injuries	Fatalities
Chase County	9	1	0
Dundy County	16	3	2
Perkins County	14	4	1
Total	**39**	**8**	**3**

Source: Federal Railroad Administration, 1975-2000[85]

84 Nebraska Department of Transportation. February 2020. "Nebraska Traffic Crash Facts Annual Reports 2006-2018." [datafile]. https://dot.nebraska.gov/safety/crash/.

85 Federal Railroad Administration. 2020. "Highway Rail Accidents". https://safetydata.fra.dot.gov/OfficeofSafety/publicsite/on_the_fly_download.aspx.

Aviation

From 1962 through 2019, there have been 12 aviation accidents in the planning area, as reported by the National Transportation Safety Board (NTSB) database. The events resulted in three injuries and five fatalities.

Table 81: Historical Aviation Incidents

Date	County	Phase of Flight	Injuries	Fatalities	Nearest Community
6/19/1983	Dundy	Cruise	0	1	Benkelman
5/5/1984	Chase	Cruise	0	0	Imperial
2/22/1987	Perkins	Maneuvering	1	1	Venango
3/15/1992	Perkins	Maneuvering	0	2	Grant
8/4/1994	Chase	Takeoff	2	0	Imperial
8/7/1996	Perkins	Maneuvering	0	0	Grant
5/14/2003	Dundy	Maneuvering	0	0	Benkelman
9/4/2004	Perkins	Landing	0	0	Grant
4/4/2005	Chase	Approach	0	0	Imperial
10/15/2005	Chase	Takeoff	0	0	Imperial
8/17/2007	Perkins	Landing	0	0	Grant
8/4/2012	Chase	Maneuvering	0	1	Imperial

Source: National Transportation Safety Board, 1962-2019[86]

Average Annual Damages

The average damage per event estimate was determined for each incident type based upon records from NDOT, FRA, NTSB, and number of historical occurrences. This does not include losses from functional downtime, economic loss, injury, or loss of life. Transportation incidents have caused an average of $5,908 per year in property damages to the planning area. RMA data is not available for transportation incidents, but crop damage would be expected to be minimal.

Table 82: Transportation Incidents Loss Estimate

Hazard Type	Number of Events	Average Events Per Year	Total Property Loss	Average Annual Property Loss
Auto[1]	1,407	117.25	N/A	N/A
Aviation[2]	12	0.21	N/A	N/A
Highway Rail[3]	39	0.91	$254,050	$5,908
Total	**1,458**	**118.37**	**$254,050**	**$5,908**

Source:1 NDOT, 2006-2018;2 NTSB 1962-2019;3 FRA 1975-2018

Probability

The probability of transportation incidents is based on the historic record provided by the NDOT, FRA, and NTSB. Based on the historic record, there is a 100% annual probability of auto incidents, a 21% annual probability for aviation incidents and a 91% probability for highway rail incidents occurring in the planning area each year.

86 National Transportation Safety Board. 1962-2019. "Aviation Accident Database & Synopses". https://www.ntsb.gov/_layouts/ntsb.aviation/index.aspx.

Regional Vulnerabilities

The following table provides information related to regional vulnerabilities; for jurisdictional-specific vulnerabilities, refer to *Section Seven: Community Profiles.*

Sector	Vulnerability
People	-Injuries and fatalities to drivers and passengers -Injuries and fatalities to those nearby if hit
Economic	-Prolonged road closures and detours for clean-up
Built Environment	-Potential damage to nearby buildings
Infrastructure	-Damage to roadways, utility poles, and other infrastructure if struck by a vehicle
Critical Facilities	-Roadway closures -Damage to facilities if located near transportation routes
Climate	-None

WILDFIRE

Wildfires, also known as brushfires, forest fires, or wildland fires, are any uncontrolled fire that occurs in the countryside or wildland. Wildland areas may include but are not limited to grasslands, forests, woodlands, agricultural fields, pastures, and other vegetated areas. Wildfires differ from other fires by their extensive size, the speed at which they can spread from the original source, their ability to change direction unexpectedly, and to jump gaps (such as roads, rivers, and fire breaks). While some wildfires burn in remote forested regions, others can cause extensive destruction of homes and other property located in the wildland-urban interface (WUI), the zone of transition between developed areas and undeveloped wilderness (Figure 35).

Lightning starts approximately 10,000 forest fires each year, yet ninety percent of forest fires are started by humans.

~National Park Service

Wildfires are a growing hazard in most regions of the United States, posing a threat to life and property, particularly where native ecosystems meet urban developed areas or where local economies are heavily dependent on open agricultural land. Although fire is a natural and often beneficial process, fire suppression can lead to more severe fires due to the buildup of vegetation, which creates more fuel and increases the intensity and devastation of future fires.

Wildfires are characterized in terms of their physical properties including topography, weather, and fuels. Wildfire behavior is often complex and variably dependent on factors such as fuel type, moisture content in the fuel, humidity, wind speed, topography, geographic location, ambient temperature, the effect of weather on the fire, and the cause of ignition. Fuel is the only physical property humans can control and is the target of most mitigation efforts. The NWS monitors the risk factors including high temperature, high wind speed, fuel moisture (greenness of vegetation), low humidity, and cloud cover in the state on a daily basis (Figure 36). These fire danger predictions are updated regularly and should be reviewed frequently.

Figure 35: Wildland-Urban Interface

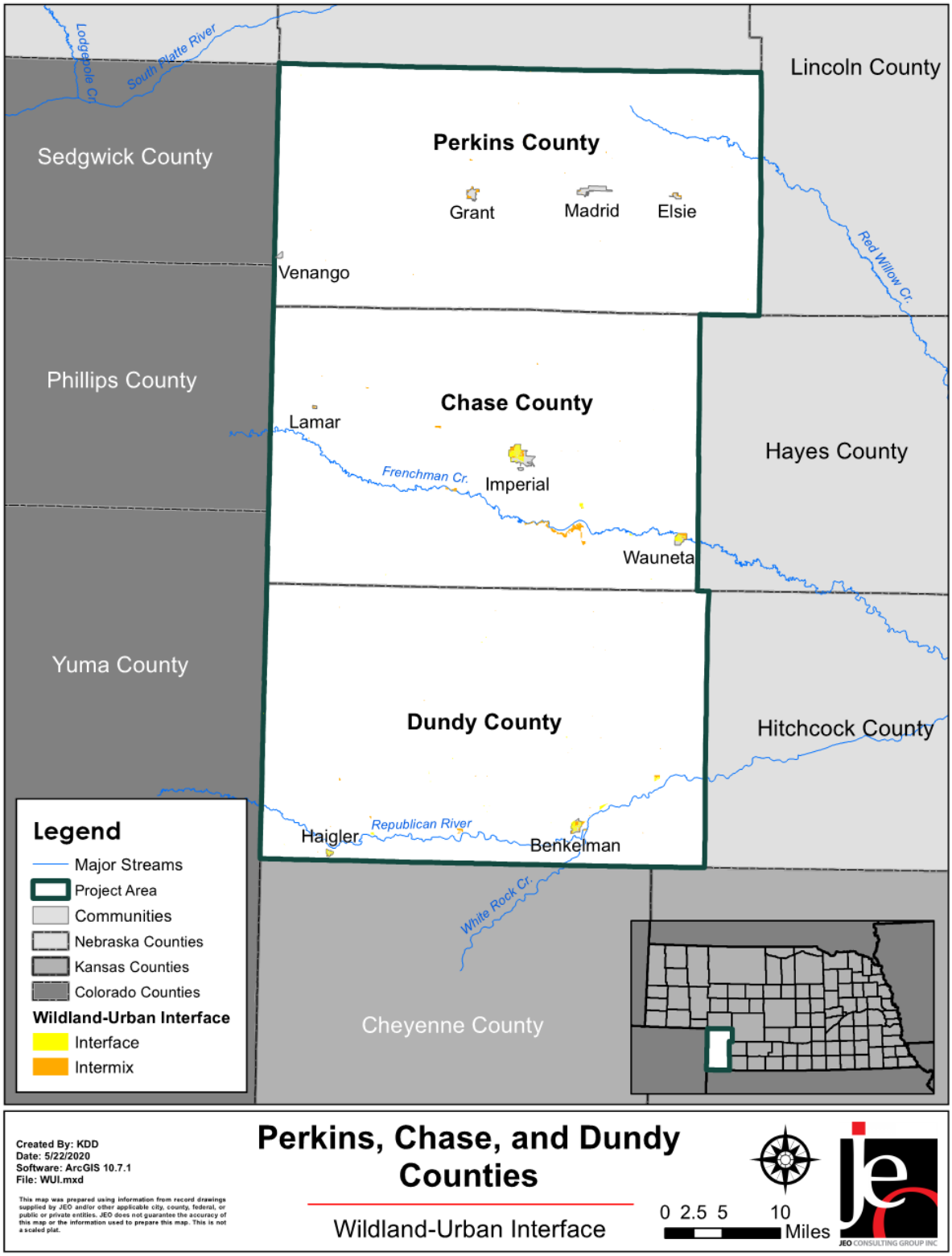
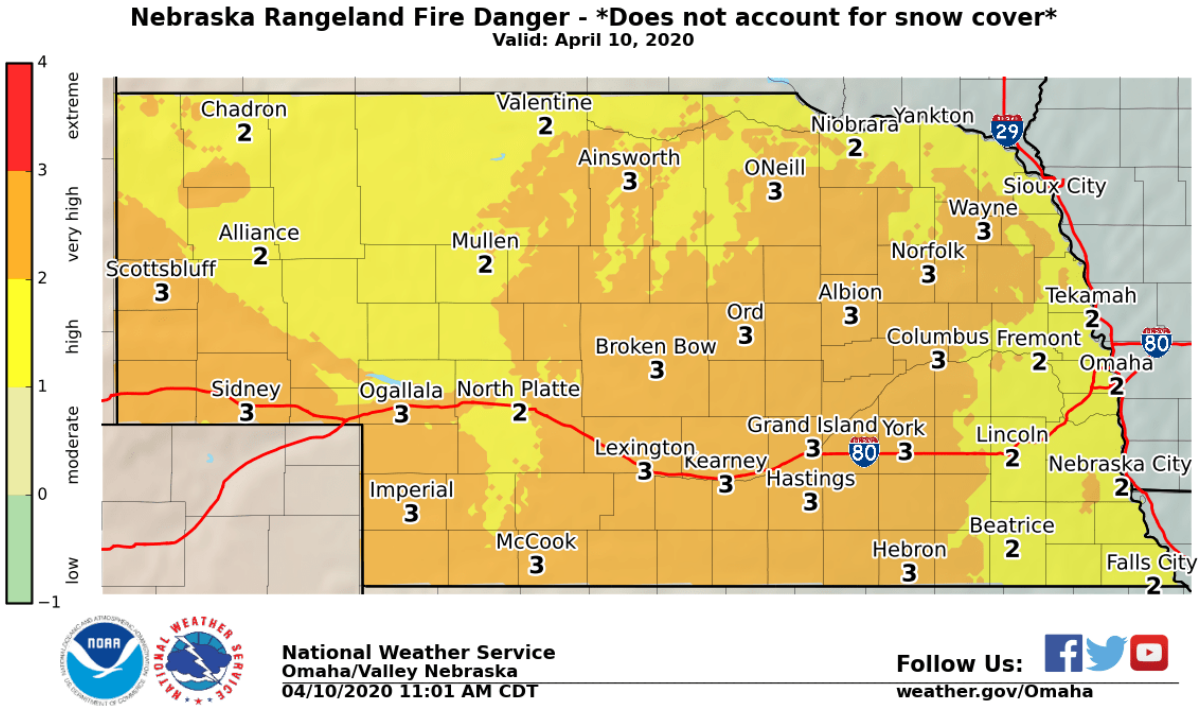


Figure 36: Rangeland Fire Danger



Source: NWS, 2019[87]

Location

For the planning area, nine fire districts were identified to report events: Benkelman Fire District, Elsie Fire District, Grant Fire District, Haigler Fire District, Imperial Rural Fire District, Lamar Fire District, Madrid Fire District, Venango Fire District, and Wauneta Fire District (Figure 40). These fire districts respond to both wildfires and structural fires in cities and villages.

Figure 41 shows the USGS' Mean Fire Return Interval. This model considers a variety of factors, including landscape, fire dynamics, fire spread, fire effects, and spatial context. These vales show how often fires are likely to occur in each area under natural conditions.

As the number of reported wildfires by county indicates, wildfire is a severe threat throughout the planning area. Perkins County has reported the greatest number of fires and has had the greatest number of acres burned.

Table 83: Reported Wildfires by County

County	Reported Wildfires	Acres Burned
Chase	209	4,623
Dundy	221	5,700
Perkins	273	11,324
Total	**703**	**21,647**

Source: Nebraska Forest Service, 2000-2018[88]

87 National Weather Service. January 2019. "Nebraska Fire Danger Map." https://www.weather.gov/oax/fire.
88 Nebraska Forest Service. 2000-2014. "Fire Incident Type Summary." Data Files 2000-2018.

Figure 40: Fire Districts in the Planning Area

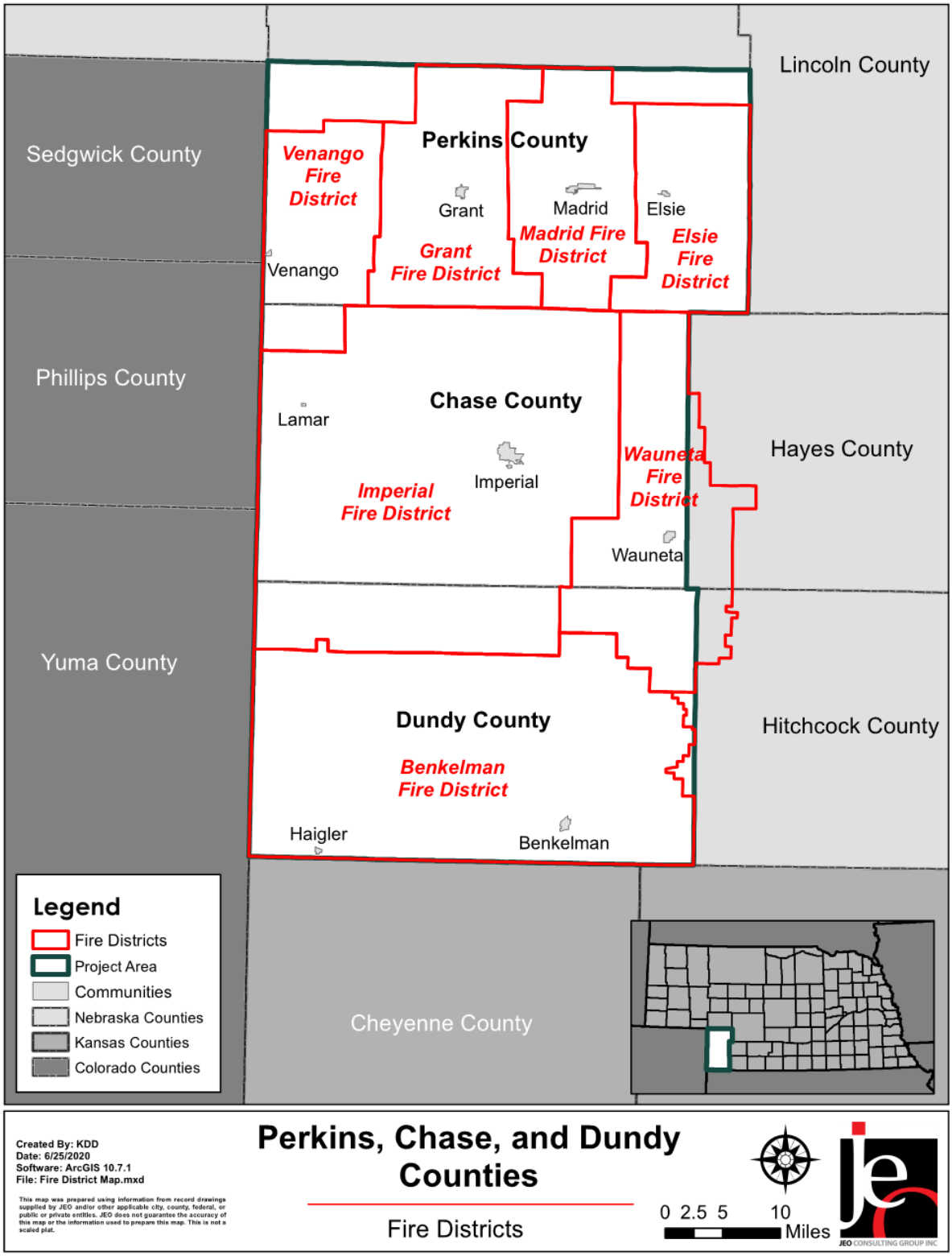
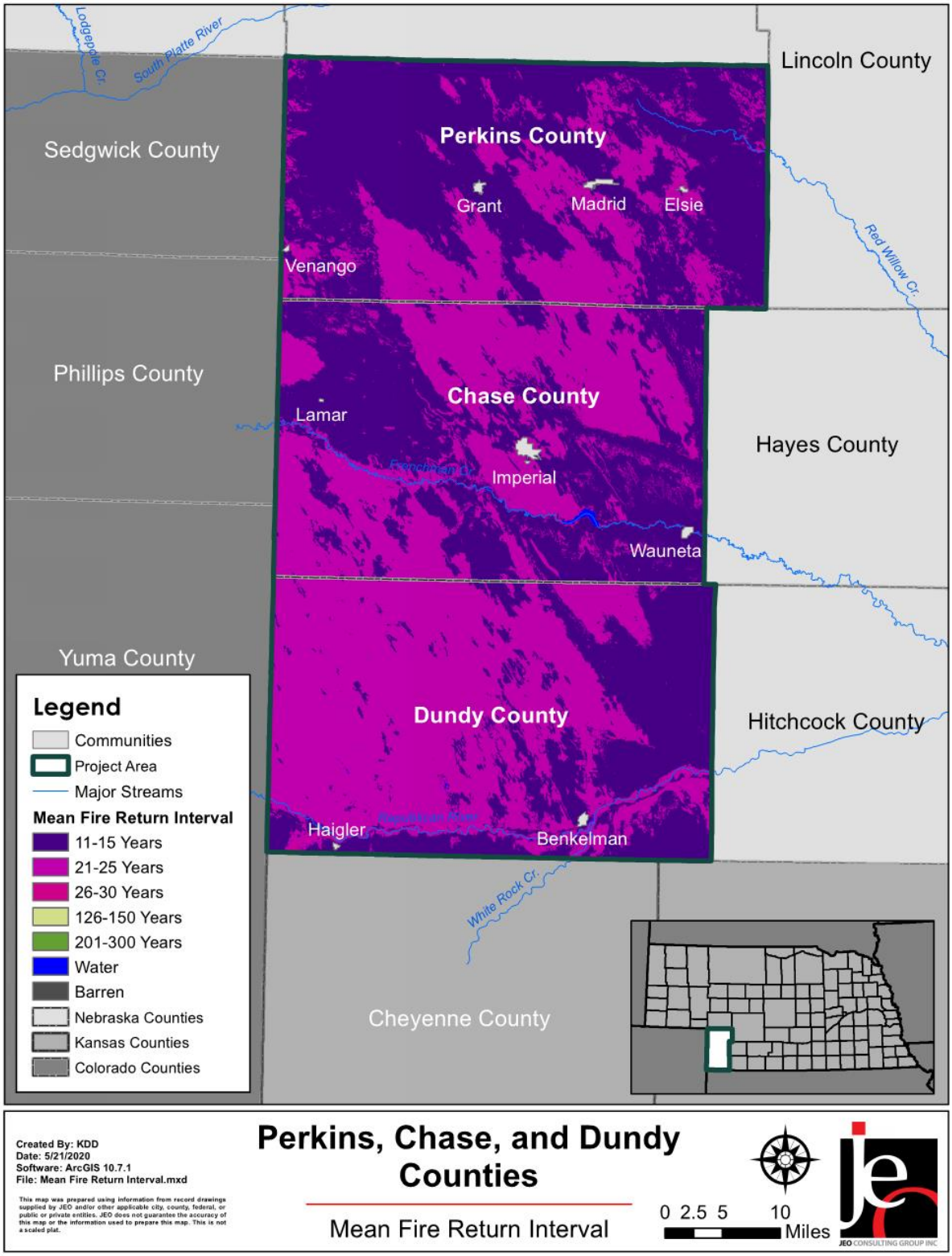


Figure 41: Mean Fire Return Interval

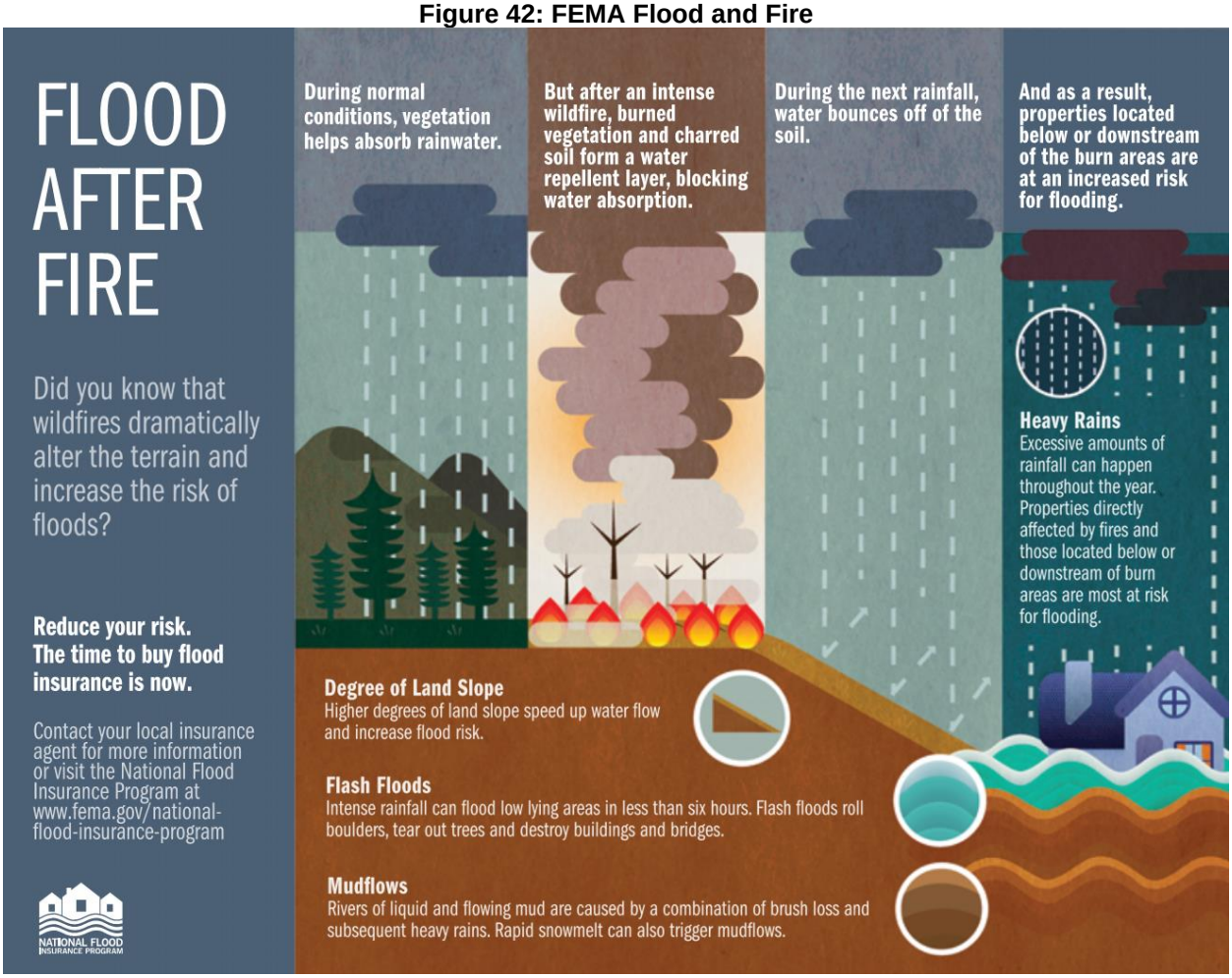


Extent

As seen in Table 83 above, wildfires have burned 21,647 acres of land. In total, there were 703 reported wildfires in the planning area. Of these, 24 fires burned 100 acres or more, with the largest wildfire burning over 6,000 acres in Perkins County in September 2000.

Wildfire also contributes to an increased risk from other hazard events, compounding damages and straining resources. FEMA has provided additional information in recent years detailing the relationship between wildfire and flooding. Wildfire events remove vegetation and harden soil, reducing infiltration capabilities during heavy rain events. Subsequent severe storms that bring heavy precipitation can then escalate into flash flooding, dealing additional damage to jurisdictions.

Figure 42: FEMA Flood and Fire



Source: FEMA, 2018[89]

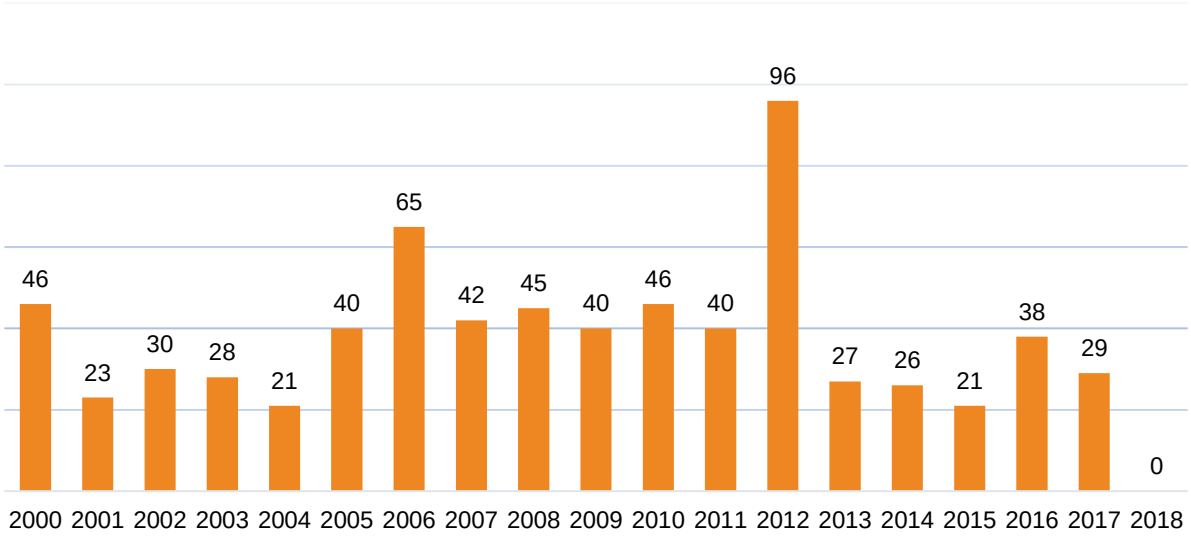
89 Federal Emergency Management Agency. 2018. "Flood After Fire." https://www.fema.gov/flood-after-fire.

Historical Occurrences

Local fire districts reported a total of 703 wildfires, according to the National Forest Service (NFS), from 2000 to 2018. Most fires occurred in 2012 (Figure 43). The reported events burned 21,647 acres. The NFS also reported $283,485 in crop damages. Wildfire events caused nine injuries, two fatalities, threatened 24 homes and 14 other structures, and destroyed four homes and six other structures.

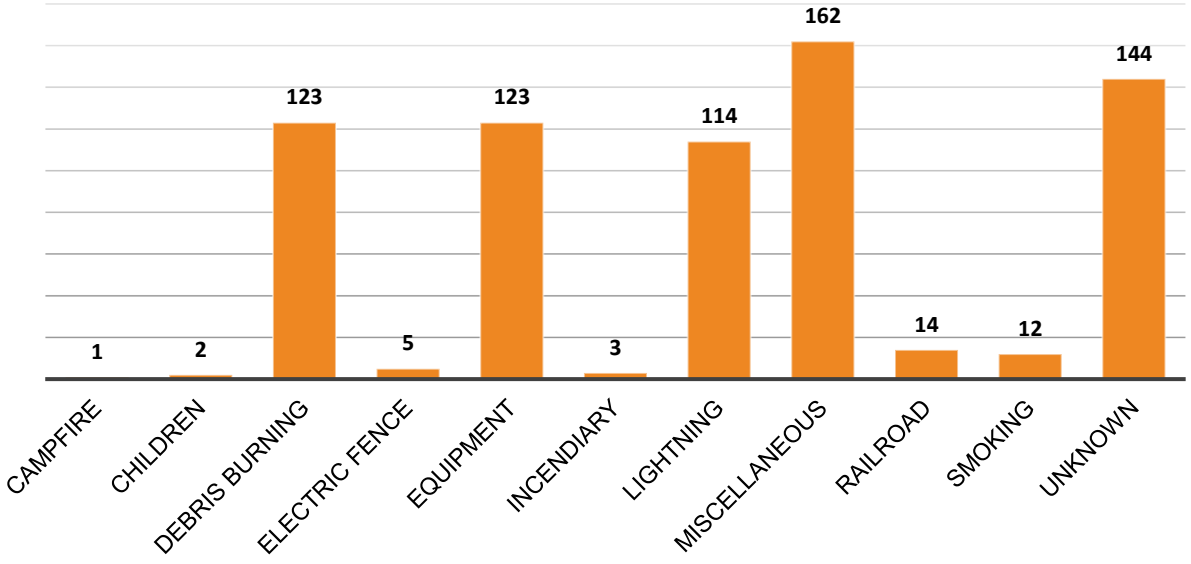
The majority of wildfires in the planning area are caused by miscellaneous (23%), with unknown as the second leading cause (20%) (Figure 44). Wildfires in the planning area have ranged from zero to 6,000 acres, with an average event burning 30 acres.

Figure 43: Number of Wildfires by Year in the Planning Area



Source: Nebraska Forest Service, 2000-2018

Figure 44: Wildfires by Cause in the Planning Area



Source: Nebraska Forest Service, 2000-2018

Average Annual Damages

The average damage per event estimate was determined based upon records from the Nebraska Forest Service Wildfires Database from 2000 to 2018 and number of historical occurrences. This does not include losses from displacement, functional downtime, economic loss, injury, or loss of life. During the 19-year period, 703 wildfires burned 21,647 acres and caused $283,485 in crop damages to the planning area.

Table 84: Wildfire Loss Estimation

Hazard Type	Number of Events	Events Per Year	Total Crop Loss	Average Annual Crop Loss
Wildfires	703	37	$283,485	$5,386,215

Source: Nebraska Forest Service, 2000-2018

Table 85: Wildfire Threats

Hazard Type	Injuries	Homes Threatened or Destroyed	Other Structures Threatened or Destroyed	Total Acres Burned	Average Acres Per Fire
Wildfires	9	28	20	21,647 acres	30

Source: Nebraska Forest Service, 2000-2018

Probability

The probability of wildfire occurrence is based on the historic record provided by the Nebraska Forest Service and reported potential by participating jurisdictions. Based on the historic record, there is a 100% annual probability of wildfires occurring in the planning area each year.

Regional Vulnerabilities

The following table provides information related to regional vulnerabilities; for jurisdictional-specific vulnerabilities, refer to *Section Seven: Community Profiles.*

Table 86: Regional Wildfire Vulnerabilities

Sector	Vulnerability
People	-Risk of injury or death for residents and firefighting personnel -Displacement of people and loss of homes -Lack of transportation poses risk to low income individuals, families, and elderly -Transportation routes may be blocked by fire, preventing evacuation efforts
Economic	-Damages to buildings and property can cause significant losses to business owners -Loss of businesses
Built Environment	-Property damages
Infrastructure	-Damage to power lines and utility structures -Potential loss of firefighting equipment and resources
Critical Facilities	-Risk of damages
Climate	-Increase chance of landslides and erosion -May lead to poor water quality -Post fire, flash flooding events may be exacerbated

SECTION FIVE: MITIGATION STRATEGY

Introduction

The primary focus of the mitigation strategy is to identify action items to reduce the effects of hazards on existing infrastructure and property based on the established goals and objectives. These actions should consider the most cost effective and technically feasible manner to address risk.

The establishment of goals and objectives took place during the kick-off meeting with the Regional Planning Team. Meeting participants reviewed the goals from the 2015 HMP and discussed recommended additions and modifications. The intent of each goal and set of objectives is to develop strategies to account for risks associated with hazards and identify ways to reduce or eliminate those risks.

The Regional Planning Team voted to maintain the same list of goals from the 2015 HMP. These goals and objectives were then shared with all planning team members at the Round 1 public meetings.

Requirement §201.6(c)(3)(i): [The hazard mitigation strategy shall include a] description of mitigation goals to reduce or avoid long-term vulnerabilities to the identified hazards.

Requirement §201.6(c)(3)(ii): [The mitigation strategy shall include a] section that identifies and analyzes a comprehensive range of specific mitigation actions and projects being considered to reduce the effects of each hazard, with particular emphasis on new and existing buildings and infrastructure.

Requirement: §201.6(c)(3)(ii): [The mitigation strategy] must also address the jurisdiction's participation in the National Flood Insurance Program (NFIP), and continued compliance with NFIP requirements, as appropriate.

Requirement: §201.6(c)(3)(iii): [The mitigation strategy section shall include] an action plan describing how the actions identified in section (c)(3)(ii) will be prioritized, implemented, and administered by the local jurisdiction. Prioritization shall include a special emphasis on the extent to which benefits are maximized according to a cost benefit review of the proposed projects and their associated costs.

Requirement §201.6(c)(3)(iv): For multi-jurisdictional plans, there must be identifiable action items specific to the jurisdiction requesting FEMA approval or credit of the plan.

Summary of Changes

The development of the mitigation strategy for this plan update includes the addition of new mitigation actions, updated status or removal of past mitigation actions, and revisions to the mitigation action selection process or descriptions of mitigation actions for consistency across the planning area.

Goals

Below is the final list of goals as determined for this plan update. These goals provide direction to guide participants in reducing future hazard related losses.

Goal 1: Protect Health and Safety of Residents

Goal 2: Reduce Future Losses from Hazard Events

Goal 3: Increase Public Awareness and Educate on the Vulnerability to Hazards

Goal 4: Improve Emergency Management Capabilities

Goal 5: Pursue Multi-Objective Opportunities (whenever possible)

Goal 6: Enhance Overall Resilience and Promote Sustainability

Mitigation Actions

After establishing the goals, local planning teams evaluated and prioritized mitigation actions. These actions included: the mitigation actions identified per community/jurisdiction in the previous plan; additional mitigation actions discussed during the planning process; and recommendations from JEO for additional mitigation actions based on identified needs. JEO provided each participant a preliminary list of mitigation actions to be used as a starting point. This list of alternatives helped participants determine which actions will best assist their respective jurisdiction alleviate damages in the event of a disaster. The listed priority does not indicate which actions will be implemented first but will serve as a guide to determine the order in which each action should be implemented.

These projects are the core of a hazard mitigation plan. The planning teams were instructed that each alternative must be directly related to the goals of the plan and the hazards of top concern for their jurisdiction. Alternatives must be specific activities that are concise and can be implemented individually. Mitigation actions were evaluated based on referencing the community's risk assessment and capability assessment. Communities were encouraged to choose mitigation actions that were realistic and relevant to the concerns identified.

It is important to note that not all of the mitigation actions identified by a community may ultimately be implemented due to limited capabilities, prohibitive costs, low benefit/cost ratio, or other concerns. These factors are not always identified during the planning process. Participants have not committed to undertaking identified mitigation actions in the plan. The cost estimates, priority ranking, potential funding, and identified agencies are used to give communities an idea of what actions may be the most feasible over the next five years. This information will serve as a guide for the participants to assist in hazard mitigation for the future. Additionally, some jurisdictions may identify and pursue additional mitigation actions not identified in this HMP.

Participant Mitigation Actions

Mitigation actions identified by participants of the PCD HMP are found in the Mitigation Actions Project Matrix below. Additional information about selected actions can be found in respective *Section Seven: Community Profiles.* Each action includes the following information in the respective community profile:

- Mitigation Action: General title of the action item
- Description: Brief summary of what the action item(s) will accomplish
- Hazard(s) Addressed: Which hazard the mitigation action aims to address
- Estimated Cost: General cost estimate for implementing the mitigation action for the appropriate jurisdiction
- Potential funding: A list of any potential local funding mechanisms to fund the action
- Timeline: General timeline as established by planning participants

- Priority: General description of the importance and workability in which an action may be implemented (high/medium/low); priority may vary between each community, mostly dependent on funding capabilities and the size of the local tax base
- Lead agency: Listing of agencies or departments which may lead or oversee the implementation of the action item
- Status: A description of what has been done, if anything, to implement the action item

Implementation of the actions will vary between individual plan participants based upon the availability of existing information; funding opportunities and limitations; and administrative capabilities of communities. Establishing a cost-benefit analysis is beyond the scope of this plan and could potentially be completed prior to submittal of a project grant application or as part of a five-year update. Completed, removed, and ongoing or new mitigation actions for each participating jurisdiction can be found in *Section Seven: Community Profiles.*

Mitigation Actions Project Matrix

During public meetings, each participant was asked to review mitigation projects listed in the 2015 HMP and identify new potential mitigation actions, if needed, to reduce the effects of hazards. Selected projects varied per jurisdiction depending upon the significance of each hazard present. The information listed in the following tables is a compilation of new and ongoing mitigation actions identified by jurisdiction. Completed and removed mitigation actions can be found in respective community profiles.

Table 87: Mitigation Actions Selected by Each Jurisdiction

PCD HMP Update - 2020		Chase County	Imperial	Wauneta	Dundy County	Benkelman	Haigler	Perkins County	Elsie	Grant	Madrid	Venango	Benkelman Fire District	Imperial Rural Fire District	Madrid Fire Protection District	Upper Republican NRD	Venango Volunteer Fire Department
Mitigation Actions	**Goal**	Chase County			Dawes County			Perkins County					Special Districts				
Alert/Warning Sirens	1.1, 4.3, 5.2				x	x		x									
Assess Vulnerability to Drought Risk	2.2		x														
Backup and Emergency Generators	1.1	x		x	x	x	x	x		x				x			
Backup Records	2.1			x												x	
Build Facility for Village Equipment	1.1, 2.1, 2.4, 4.3, 5.2										x						
Business Continuity Plans	2.2, 4.3, 5.2				x			x									
Civil Service Improvements	1.1, 2.1, 4.3, 5.2	x						x		x		x	x	x			
Clean and Expand Stormwater Retention Ponds	1.1		x														
Community Education/Awareness	1.1, 3.1, 3.2, 5.2	x			x		x	x		x	x	x					
Community Shelter	1.1											x					

Comprehensive Disaster / Emergency Response Plan	2.1, 4.1, 4.2, 5.1, 6.1	x	x			x					x	x				
Continuity Plans	2.2, 4.3, 5.2		x		x											
Cooling Station Database	1.1, 5.1, 5.2		x													
Designate an Emergency Operations Center	4.1											x				
Develop a Master Plan to Prioritize All Flood Related Projects	2.2											x				
Drainage Study / Stormwater Master Plan	2.2				x		x			x	x					
Emergency Communications	1.1, 4.1, 4.3, 5.2	x						x		x			x			
Evaluate Water Supply	2.2		x													
Facilities for Vulnerable Populations	1.1				x			x								
Facility Monitoring	2.1		x													
Flood-Prone Property Acquisition	1.1, 2.1, 5.2				x											
Flood-Prone Property Mitigation	1.1, 2.1, 5.2				x											
Groundwater / Irrigation / Water Conservation Management Plan	2.2				x					x	x					
Hail-Resistant Roofing	1.1, 2.1, 5.2							x								

Hazardous Tree Removal	1.1, 2.1, 5.2	x	x														
Identify Additional Source of Natural Gas	2.2							x									
Improve/Revise Snow and Ice Removal Program	1.1		x								x						
Improve/Upgrade Bridges	1.1, 2.1, 5.2	x															
Improve Construction Standards and Building Survivability	2.1		x														
Infrastructure Assessment Study	2.2									x							
Install Vehicular Barriers	1.1, 2.1, 5.2		x		x					x							
Lightning Rods	1.1, 2.1, 5.2									x							
Low Impact Development	2.3				x			x									
Mitigation Education	1.1, 3.1, 3.2, 5.2				x												
New Municipal Well	1.1			x					x	x	x						
New Transmission Line	1.1, 2.1, 5.2					x											
Power and Service Lines	1.1, 2.1, 5.2				x	x											
Preserve Natural Floodplain	2.3, 5.2, 6.1				x												
Promote First Aid	1.1, 3.1, 5.2				x			x									
Safe Rooms and Storm Shelters	1.1	x	x		x	x	x	x		x	x	x					
Sheltering in Place Outreach	1.1, 3.1, 5.2				x			x		x							

Short Term Residency Shelters	1.1				x												
Snow Fences	1.1, 2.1, 5.2		x														
South Substation	1.1, 2.1, 5.2					x											
Stabilize/Anchor Fertilizer, Fuel and Propane Tanks	1.1				x												
Stormwater System and Drainage Improvements	2.1	x			x	x	x	x	x	x	x						
Stream Bank Stabilization / Grade Control Structures / Channel Improvements	2.1	x			x												
Street Repairs	1.1		x														
Surge Protectors	2.1	x															
Transportation Drainage Improvements	2.1				x	x											
Update Comprehensive Plan	2.2, 2.3, 5.2, 6.1		x	x						x							
Upgrade Communication Systems	1.1, 4.3, 5.1, 5.2															x	
Upgrade Well House	1.1, 2.1, 5.2																
Vulnerable Population Support Database	1.1, 2.2, 5.2				x			x									
Warning Systems	1.1, 5.1, 5.2	x			x			x									
Water Line Improvements	1.1, 2.1, 5.2					x						x					
Weather Radios	4.3				x					x							

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SECTION SIX: PLAN IMPLEMENTATION AND MAINTENANCE

Monitoring, Evaluating, and Updating the Plan

Participants of the PCD HMP will be responsible for monitoring (annually at a minimum), evaluating, and updating the plan during its five-year lifespan. Hazard mitigation projects will be prioritized by each participant's governing body with support and suggestions from the public and business owners. Unless otherwise specified by each participant's governing body, the governing body will be responsible for implementation of the recommended projects. The lead agency (or appropriate department/staff) identified on each mitigation action will report on the status of projects and include which implementation processes worked well, any difficulties encountered, how coordination efforts are proceeding, and which strategies could be revised.

To assist with plan monitoring, as each project is completed, a detailed timeline of how that project was completed will be written and attached to the plan in a format selected by the governing body. Information that will be included will address project timelines, agencies involved, area(s) benefited, total funding (if complete), etc. At the discretion of each governing body, a local task force will be used to review the original draft of the mitigation plan and to recommend changes.

Reviewing and updating this plan will occur at least every five years. At the discretion of each governing body, updates may be incorporated more frequently, especially in the event of a major hazard. The governing body will start meeting to discuss mitigation updates at least six months prior to the deadline for completing the plan review. The persons overseeing the evaluation process will review the goals and objectives of the previous plan and evaluate them to determine whether they are still pertinent and current. Among other questions, they may want to consider the following:

Requirement §201.6(c)(4)(i): [The plan maintenance process shall include a] section describing the method and schedule of monitoring, evaluating, and updating the mitigation plan within a five-year cycle.

Requirement §201.6(c)(4)(ii): [The plan shall include a] process by which local governments incorporate the requirements of the mitigation plan into other planning mechanisms such as comprehensive or capital improvement plans, when appropriate.

Requirement §201.6(c)(4)(iii): [The plan maintenance process shall include a] discussion on how the community will continue public participation in the plan maintenance process.

- Do the goals and objectives address current and expected conditions?
- If any of the recommended projects have been completed, did they have the desired impact on the goal for which they were identified? If not, what was the reason it was not successful (lack of funds/resources, lack of political/popular support, underestimation of the amount of time needed, etc.)?
- Have either the nature, magnitude, and/or type of risks changed?
- Are there implementation problems?
- Are current resources appropriate to implement the plan?
- Were the outcomes as expected?

- Did the plan partners participate as originally planned?
- Are there other agencies which should be included in the revision process?

Worksheets in *Appendix C* may also be used to assist with plan updates.

In addition, the governing body will be responsible for ensuring that the HMP's goals are incorporated into applicable revisions of each participant's comprehensive plan (if applicable) and any new planning projects undertaken by the participant. The HMP will also consider any changes in comprehensive plans and incorporate the information accordingly in its next update.

Continued Public Involvement

To ensure continued plan support and input from the public and business owners, public involvement will remain a top priority for each participating jurisdiction. Notices for public meetings involving discussions of the HMP should be published and posted in the following locations:

- Public spaces around the jurisdiction
- City/Village Hall
- Websites
- Local radio stations
- Newspapers

Unforeseen Opportunities

If new, innovative mitigation strategies arise that could impact the planning area or elements of this plan, which are determined important, a plan amendment may be proposed and considered separate from the annual review and other proposed plan amendments. PCD should compile a list of proposed amendments received annually and prepare a report for NEMA, by providing applicable information for each proposal, and recommend action on the proposed amendments.

Incorporation into Existing Planning Mechanisms

The Regional Planning Team utilized a variety of plan integration tools to help communities determine how their existing planning mechanisms were related to the Hazard Mitigation Plan. Utilizing FEMA's *Integrating the Local Natural Hazard Mitigation Plan into a Community's Comprehensive Plan*[90] guidance, as well as FEMA's *2015 Plan Integration*[91] guide, each community engaged in a plan integration discussion. This discussion was facilitated by a Plan Integration Worksheet. This document offered an easy way for participants to notify the Regional Planning Team of existing planning mechanisms, and if they interface with the HMP.

Each community referenced all relevant existing planning mechanisms and provided information on how these did or did not address hazards and vulnerability. Summaries of plan integration are found in each participant's *Community Profile*. For communities that lack existing planning mechanisms, especially smaller villages, the HMP may be used as a guide for future activity and development in the community.

90 Federal Emergency Management Agency. November 2013. "FEMA Region X Integrating the Local Natural Hazard Mitigation Plan into a Community's Comprehensive Plan." https://www.fema.gov/media-library-data/1388432170894-6f744a8afa8929171dc62d96da067b9a/FEMA-X-IntegratingLocalMitigation.pdf.

91 Federal Emergency Management Agency. July 2015. "Plan Integration: Linking Local Planning Efforts." https://www.fema.gov/media-library-data/1440522008134-ddb097cc285bf741986b48fdcef31c6e/R3_Plan_Integration_0812_508.pdf.

SECTION SEVEN: COMMUNITY PROFILES

Purpose of Community Profiles

Community Profiles contain information specific to jurisdictions participating in the PCD HMP planning effort. Community Profiles were developed with the intention of highlighting each jurisdiction's unique characteristics that affect its risk to hazards. They may serve as a short reference of identified vulnerabilities and mitigation actions for a jurisdiction as they implement the mitigation plan. Information from individual communities was collected at public and one-on-one meetings and used to establish the plan. Community Profiles may include the following elements:

- Local Planning Team
- Location/Geography
- Climate (County Level)
- Demographics
- Transportation
- Future Development Trends
- Parcel Improvements and Valuations
- Critical Infrastructure and Key Resources
- Historical Hazard Events (County Level)
- Hazard Prioritization
- Governance
- Capability Assessment
- Plan Integration
- Mitigation Actions

In addition, maps specific to each jurisdiction are included such as jurisdiction identified critical facilities, flood prone areas, and a future land use map (when available).

The hazard prioritization information, as provided by individual participants, in *Section Seven: Community Profiles* varies due in large part to the extent of the geographical area, the jurisdiction's designated representatives (who were responsible for completing meeting worksheets), identification of hazards, and occurrence and risk of each hazard type.

The overall risk assessment for the identified hazard types represents the presence and vulnerability to each hazard type area wide throughout the entire planning area. A discussion of certain hazards selected for each Community Profile were prioritized by the local planning team based on the identification of hazards of greatest concern, hazard history, and the jurisdiction's capabilities. The hazards not examined in depth can be found in *Section Four: Risk Assessment.*