Twin Platte NRD

Multi-Jurisdictional Hazard Mitigation Plan

2021

TWIN PLATTE
NATURAL RESOURCES DISTRICT

JEO CONSULTING GROUP

Plan developed for the
Twin Platte NRD by
JEO Consulting Group

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ACS – American Community Survey
BRIC – Building Resilient Infrastructure and Communities
CDC – Centers for Disease Control and Prevention
CF – Cubic Feet
CFR – Code of Federal Regulations
COVID-19 – Coronavirus Disease 2019
CRS – Community Rating System
CWPP – Community Wildfire Protection Plans
CyanoHABs – Cyanobacterial Harmful Algae Blooms
DMA 2000 – Disaster Mitigation Act of 2000
EAB – Emerald Ash Borer
EAP – Emergency Action Plan
EPA – Environmental Protection Agency
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
FR – FEMA's Final Rule
GIS – Geographic Information Systems
HMA – Hazard Mitigation Assistance
HMGP – Hazard Mitigation Grant Program
HMP – Hazard Mitigation Plan
HPSA – Health Professional Shortage Areas
HPRCC – High Plains Regional Climate Center
HRSA – Health Resources and Services Administration
JEO – JEO Consulting Group, Inc.
LEOP – Local Emergency Operations Plan
LGA – Liquid Gallons
MUA – Medically Underserved Areas
MUP – Medically Underserved Populations
NCEI – National Centers for Environmental Information
NDA – Nebraska Department of Agriculture
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
NOAA – National Oceanic and Atmospheric Administration
NPI – Nonpharmaceutical Interventions
NRC – National Response Center
NWS – National Weather Service
PDSI – Palmer Drought Severity Index
PHMSA – U.S. Pipeline and Hazardous Material Safety Administration
Risk MAP – Risk Mapping, Assessment, and Planning
RMA – Risk Management Agency
SBA – Small Business Administration
SPIA – Sperry-Piltz Ice Accumulation Index
START – National Consortium for the Study of Terrorism and Responses to Terrorism
TORRO – Tornado and Storm Research Organization
TPNRD – Twin Platte Natural Resource District
USACE – United States Army Corps of Engineers
USDA – United States Department of Agriculture
USGS – United States Geological Survey
WHO – World Health Organization

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EXECUTIVE SUMMARY

Introduction

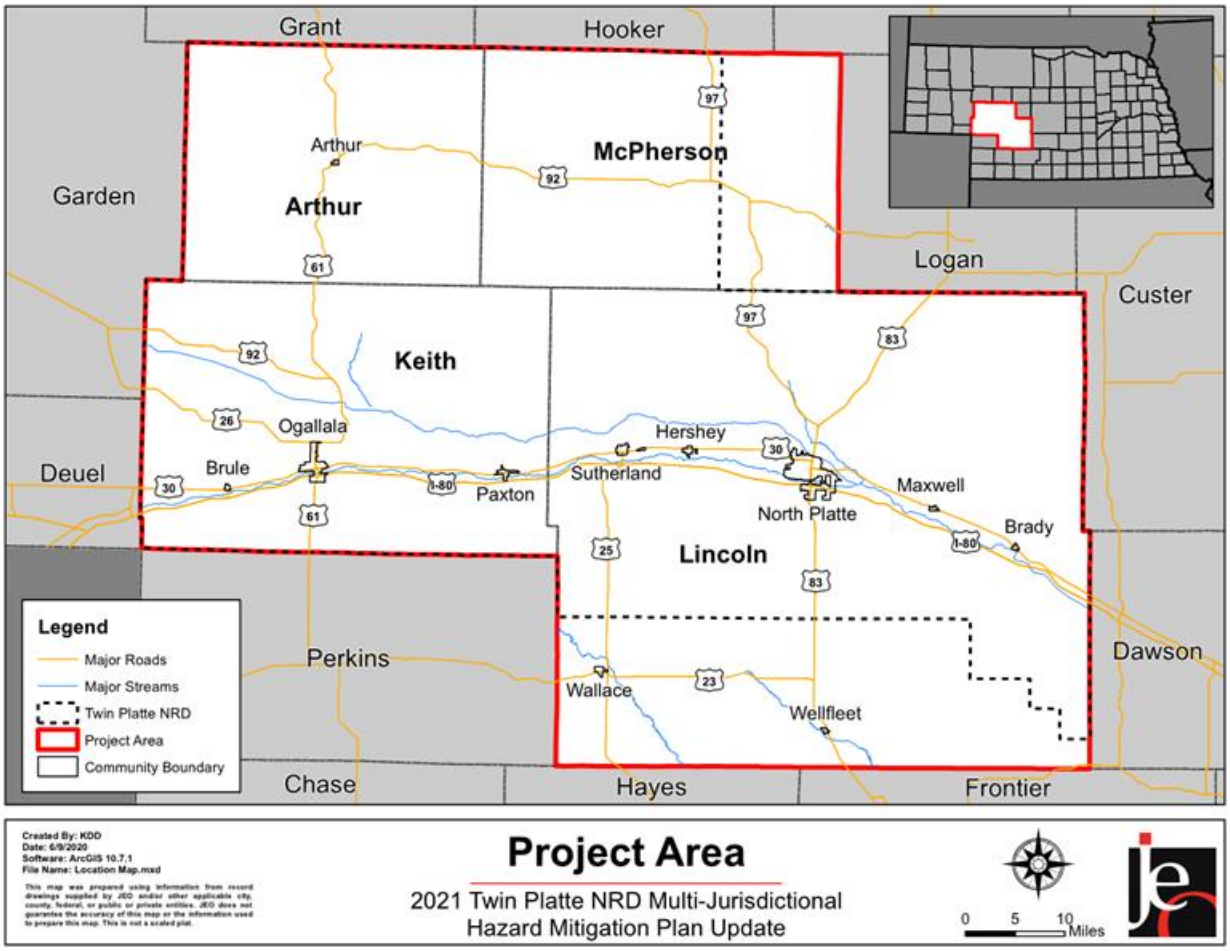
This plan is an update to the Twin Platte Natural Resources District (TPNRD) Hazard Mitigation Plan (HMP) approved in 2015. The plan update was developed in compliance with the requirements of the Disaster Mitigation Act of 2000 (DMA 2000).

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	
Arthur County	**McPherson County**
Village of Arthur	Arthur County Schools
Keith County	Birdwood Irrigation District
Village of Brule	Cody-Dillon Ditch
City of Ogallala	Hershey Public Schools
Village of Paxton	Keith-Lincoln Irrigation District
Lincoln County	North Platte Public Schools
Village of Brady	Paxton Hershey Irrigation District
Village of Hershey	Platte Valley Irrigation District
City of North Platte	Suburban Ditch Company
Village of Sutherland	Western Irrigation District
Village of Wallace	**Twin Platte NRD**
Village of Wellfleet	

Figure 1: Project 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 jurisdictions participating in this plan. The driving motivation behind 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 Hazard Mitigation 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 2016 HMP were reviewed, and the Hazard Mitigation 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 2016 would be carried forward and utilized for the 2021 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 Education 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 prepare for them.

Goal 4: Improve Emergency Management Capabilities

Objective 4.1: Develop or improve Emergency Response Plans, procedures, and abilities; increase the capability to respond.

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 2016 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; the addition of Public Health Emergency as a discussed hazard; 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 are described in the table below.

Table 2: 2016 Plan Comments and Revisions

Comment/Revision from 2016 Review Tool	Location of Revision	Summary of Change
Caution on Element A5. Guidance states that the plan must describe how the jurisdictions will continue to seek public participation after the plan has been approved and during the plan's implementation, monitoring and evaluation. Statements regarding *what should be done* is not as strong as a response to this element as statements regarding what each jurisdiction *intends to do*.	Section 6	Language has been updated to reflect what each jurisdiction will do as opposed to statements regarding what should be done.
The 2008 Blue Book referenced on p. 13 (Table 12) is no longer relevant and has been replaced by the March 2013 FEMA Local Mitigation Planning Handbook.	Table 17	All plans, reports and studies have been reviewed and updated to the most recent version.
It would be appropriate to have a meeting date on the sign-in Sheet on p. PA-B-15.	N/A	N/A
It appears that more critical facilities listed for the community of Arthur may be in the flood hazard area per Figure ARC 6.	Participant Sections	All critical facilities have been mapped and overlaid with the most recent floodplain information to determine if they are located in a flood hazard area.
According to the NCDC data there have been 32 severe winter storms that have occurred since 1996. These storms have resulted in $1,075,000. Identified mitigation actions: Purchase additional snow removal equipment and Improve snow removal program. How would additional snow removal equipment or improved snow removal program reduce the risk of sustaining additional damages in future storms? If extensive property damages are an issues, perhaps enhanced building codes, upgrades to utility services, or tree maintenance programs would limit or reduce further losses in the future.	Participant Sections	An additional emphasis was placed on having mitigation actions reflect the issues identified during hazard prioritization. All mitigation actions were reviewed and new actions were identified if needed by each participating jurisdiction.
Figure ID2 on page F-6, F14, etc., would be more helpful if the participating Irrigation Districts were located on the map.	Participant Section	When available maps of participating jurisdictions are provided.
P.55: The Emergency Response Guidebook is available online at no cost and there is now a free mobile app. It details how to identify the specific or generic hazards of the material(s) involved in an incident and describes how to protect responders and public during the initial response phase of an incident.	N/A	N/A
P.D-64: How does Maxwell's floodplain ordinance "discourage development in the floodplain" when the map on p. D-61 show that the entire community is in the floodplain?	N/A	The Village of Maxwell chose not to participate in this HMP update.
It is not clear why McPherson County has an action to "Maintain Status in NFIP" when the county does not participate in the NFIP.	McPherson County Participant Section	Action was removed during the last plan.

It should be noted as well that due to the coronavirus disease 2019 (COVID-19), some adjustments were made to the planning process to appropriately accommodate plan meeting dates and requirements. To best protect residents and staff members in the planning area, all 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 2016 Hazard Mitigation Plan. A few examples of completed projects include improving warning system, reducing tree damage, becoming a member of Tree City USA, purchasing equipment, mapping infrastructure, and others. In order to build upon these prior successes and to continue implementation of mitigation projects, despite limited resources, communities will need to continue relying upon multi-agency coordination as a means of leveraging resources. Communities across the region have been able to work with a range of entities to complete projects; potential partners for future project implementation include but are not limited to: Nebraska Forest Service (NFS), Nebraska Department of Transportation, Nebraska Department of Natural Resources (NeDNR), Nebraska Emergency Management Agency (NEMA), United States Department of Agriculture (USDA), and United States Army Corps of Engineers (USACE).

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 3: Hazard Occurrences

Hazard	Previous Occurrences	Approximate Annual Probability*	Likely Extent
Agricultural Disease	Animal: 28	Animal Disease 6/6 =100%	~91 animals per event
	Plant: 34	Plant Disease 13/19 = 68%	Crop damage or loss
Chemical Spills (Fixed Site)	91	25/30 = 83%	0 – 20,000 Gallons 25.2 – 3600 Pounds
Chemical Spills (Transportation)	369	46/49 = 94%	0 – 22,000 Gallons
Dam Failure	0	0/109 = Less than 1%	Varies by structure
Drought	434/1,498 months	29%	D1-D4
Earthquakes	0	0/121 = Less than 1%	Less 5.0 on the Richter Scale
Extreme Heat	947	77/128 = 60%	>100°F
Flooding	72	21/24 = 88%	Some inundation of structures (47% of structures) and roads near streams. Some evacuations of people may be necessary (64% of population)
Grass/Wildfires	1,377	17/17 = 100%	Avg 166.25 acres Some homes and structures threatened or at risk
Hail	1,466	24/24 = 100%	Hail range 0.75-4.5” (H2-H4); average 1.23”
High Wind	122	20/24 = 83%	Avg 48 mph; Range 35-68 Estimated Gust
Levee Failure	0	0/120 = Less than 1%	Varies by extent
Public Health Emergency	2	Unknown	Varies by extent
Severe Thunderstorms	560	24/24 = 100%	≤4.25” rainfall Avg 57 mph winds
Severe Winter Storms	207	24/24 = 100%	0.25” – 0.5” Ice 5°-65° below zero (wind chill) 3-14” snow 15-60 mph winds
Terrorism	0	0/47 = Less than 1%	Varies by event
Tornadoes	87	20/24 = 83%	Avg: EF0 Range EF0-EF3

* *Annual Probability = Total Years with an Event Occurrence / Total Years of Record*

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

Table 4: Hazard Loss History

Hazard Type		Count	Property	Crop[2]
Agricultural Disease	Animal Disease[1]	28	2,535 animals	N/A
	Plant Disease[2]	34	N/A	$449,001
Chemical Spills (Fixed Site)[3]		91	N/A	N/A
Chemical Spills (Transportation)[4]		369	$594,997	N/A
Dam Failure[5]		0	N/A	N/A
Drought[6,8]		434/1,498 months	$22,000,000	$51,367,442
Earthquakes[11]		0	$0	N/A
Extreme Heat[7]		Avg 5 days per year	$0	$10,616,932
Flooding[8]	Flash Flood	52	$3,035,000	$660,451
	Flood	20	$996,000	
Grass/Wildfire[12] *12 Injuries*		1,377	114,680 acres	$4,664,542
Hail[8] *2 injuries* Average: 1.23 inches Range: 0.75-4.5 inches		1,466	$57,114,800	$79,276,189
High Wind[8] *8 injuries* Average: 48 kts Range: 35-68 kts		122	$677,500	$7,102,325
Levee Failure[10]		0	$0	N/A
Public Health Emergency		2	N/A	N/A
Severe Thunderstorms[8] *8 injuries*	Heavy Rain	7	$0	$6,311,953
	Lightning	19	$106,000	
	Thunderstorm Wind Average: 51 kts Range: 50-103 kts	534	$5,016,700	
Severe Winter Storms[8] *2 injuries* *3 fatalities*	Blizzard	28	$55,000	$5,686,647
	Extreme Cold/Wind Chill	20	$0	
	Heavy Snow	21	$10,000	
	Ice Storm	0	$0	
	Winter Storm	137	$94,000	
	Winter Weather	1	$1,000,000	
Terrorism[9]		0	$0	N/A
Tornadoes[8] *15 injuries* Average: EF0 Range: EF0-EF4		87	$4,430,750	N/A
Total		**4,633**	**$95,047,661**	**$166,169,219**

N/A: Data not available
1 NDA (2014-November 2020)
2 USDA RMA (2000-2019)
3 NRC (1990-February 2020)
4 PHSMA (1971-July 2020)
5 NeDNR Correspondence
6 NOAA (1895-October 2020)

7 NOAA (1893-July 2020)
8 NCEI (1996-December 2019)
9 University of Maryland (1970 - 2018)
10 USACE (1900-July 2020)
11 USGS (1900-July 2020)
12 NFS (2000-2017)

Events like agricultural disease, extreme heat, wildfires, severe thunderstorms, and severe winter storms will occur annually. Other hazards like drought, dam failure, and terrorism will occur less often. The scope of events and how they will manifest themselves locally is not known regarding hazard occurrences. Historically, drought, hail, extreme heat, 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 $51 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).

Hail

Hail events occur on an annual basis in conjunction with severe thunderstorms. Hail is one of the more frequently occurring hazards and has impacted both the agricultural sector and the built environment. The National Centers for Environmental Information (NCEI) has recorded 1,466 hail events in 24 years. These events have caused over $57 million in property damages and $79 million in crop losses. Common impacts resulting from hail include, but are not limited to damage to roofs, windows, and siding; damage to mechanical systems located outdoors including HVAC systems; damage to vehicles; and destruction of crops; and injuries or deaths to cattle.

Severe Thunderstorms

Thunderstorms 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 series, with one area potentially impacted multiple times in one day and producing a range of associated hazards, including strong winds, heavy rain, and lightning strikes. Severe thunderstorms are most likely to occur between May and August, with the highest number of events happening in June. The NCEI recorded 615 severe thunderstorm events in 24 years across the four-county planning area. These events caused over $5 million in property damages. 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 discussed in the hazard profiles for hail and high winds.

Vulnerable populations related to severe thunderstorms include residents of mobile homes (10% 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 prepare and respond to events appropriately.

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 assist in preventing future losses.

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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.

The TPNRD has 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 ensure the counties and participating jurisdictions are 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 eligible for pre- and post-disaster mitigation funding.[2] These funds currently 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.[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.

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.

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.
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.

- **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.

- **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.

Plan Financing and Preparation

Regarding the plan financing and preparation, the TPNRD is the “sub-applicant” that is the eligible entity that submits a sub-application for FEMA assistance to the “Applicant”. The “Applicant” in this case is the State of Nebraska. If HMA funding is awarded, the sub-applicant becomes the “sub-grantee” and is responsible for managing the sub-grant and complying with program requirements and other applicable federal, state, territorial, tribal, and local laws and regulations.

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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, TPNRD 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 Hazard Mitigation Planning Team was established; the function of the Hazard Mitigation 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.
- It imposes an external discipline on the process.

Both FEMA and NEMA recommend this multi-jurisdictional approach through the cooperation of counties, regional emergency management, and natural resources districts. TPNRD utilized the

multi-jurisdiction planning process recommended by FEMA (Local Mitigation Plan Review Guide[9], Local Mitigation Planning Handbook[10], and Mitigation Ideas: A Resource for Reducing Risk to Natural Hazards[11]) 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.

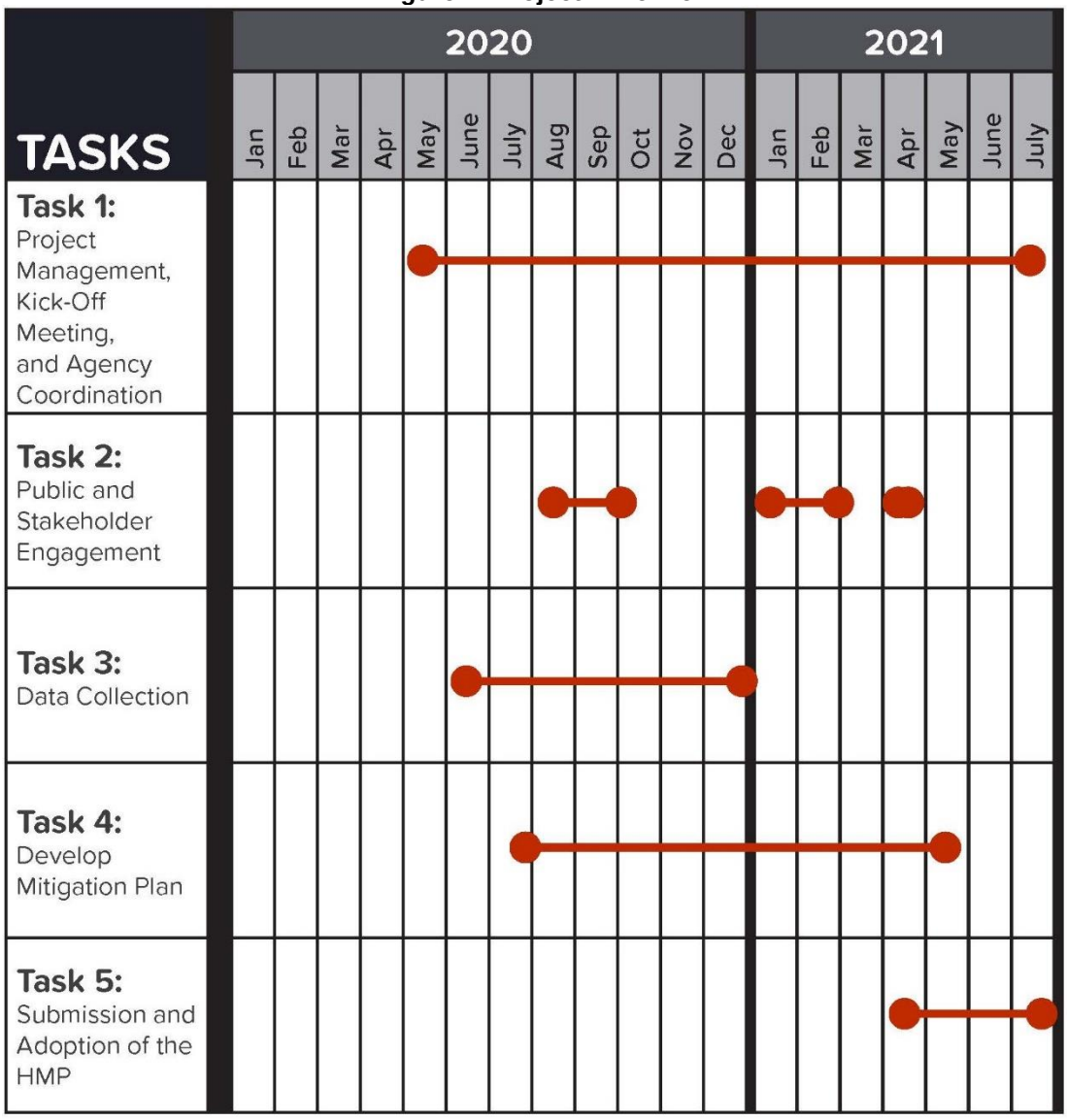
Organization of Resources

Plan Update Process

TPNRD applied for PDM funding for their multi-jurisdictional hazard mitigation plan in fiscal year 2018. JEO Consulting Group, INC. (JEO) was contracted in September 2018 to guide and facilitate the planning process and assemble the multi-jurisdictional hazard mitigation plan. For the planning area, Glen Bowers with TPNRD 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.

9 Federal Emergency Management Agency. 2011. "Local Mitigation Plan Review Guide." https://www.fema.gov/media-library/assets/documents/23194.
10 Federal Emergency Management Agency. 2013. "Local Mitigation Planning Handbook." https://www.fema.gov/media-library/assets/documents/31598.
11 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, TPNRD 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 5. Staff from NEMA and NeDNR provided additional technical support.

Table 5: Hazard Mitigation Planning Team

Name	Title	Jurisdiction
Glen Bowers	Water Programs Field Coordinator	Twin Platte NRD
Bill Simpson	Emergency Manager	Arthur County
Brandon Myers	Emergency Manager	Lincoln County
David Kling	Emergency Manager	Keith County
Tom Burch	Emergency Manager	McPherson County
Heather Thole	Hazard Mitigation Planning Specialist	NEMA
***Karl Dietrich**	Planner	JEO Consulting Group
***Phil Luebbert**	Project Coordinator	JEO Consulting Group
***Kayla Vondracek**	Planning Intern	JEO Consulting Group
***Heather Thole**	Planning Specialist	NEMA
***Adele Phillips**	Floodplain Mitigation Planner	NeDNR

**Served as a consultant or advisory role.*

A kick-off meeting was held on June 9, 2020 over zoom, to discuss an overview of the planning process between JEO staff and members of the Hazard Mitigation 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 Hazard Mitigation Planning Team and strategies for public engagement throughout the planning process. Table 6 shows kick-off meeting attendees.

Table 6: Kick-off Meeting Attendees

Name	Title	Jurisdiction
Bill Simpson	Emergency Manager	Arthur County
Brandon Myers	Emergency Manager	Lincoln County
Dave Kling	Emergency Manager	Keith County
Glen Bowers	Water Programs Field Coordinator	Twin Platte NRD
Tom Burch	Emergency Manager	McPherson County
Karl Dietrich	Planner	JEO Consulting Group
Phil Luebbert	Project Coordinator	JEO Consulting Group
Mary Baker	Resiliency Strategist	JEO Consulting Group

Table 7 shows the date, location, and agenda items of for the kick-off meeting.

Table 7: Kick-off Meeting Location and Time

Location and Time	Agenda Items
Online Zoom Meeting June 9, 2020 9:00am	-Consultant and planning team responsibilities -Overview of plan update process and changes from 2016 HMP -Review and adoption of goals and objectives -Plan goals/objectives -Hazard identification -Project schedule and dates/locations for public meetings

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 22 stakeholder groups or entities that were identified and sent letters to participate. Both the North Platte Care Center and Nebraska Forest Service attended meetings. Any comments these stakeholders provided were incorporated into the appropriate community profiles (see *Section Seven*). NEMA also attended meetings and provided data and guidance during the planning process. The general public was encouraged to

participate through the project website by providing comments to the Hazard Mitigation Planning Team members. No comments were received from the general public.

Table 8: Notified Stakeholder Groups

Organizations		
American Shizuki	Mid-Plains Community College (North Platte)	North Platte PE
Azria Health Sutherland	Mid-Plains Community College (Ogallala)	North Platte Regional Airport
Centennial Park Retirement Village	Nebraska Forest Service	Ogallala Community Hospital
Indian Hills Manor	North Platte Airport Authority	Searle Field
Liberty House	North Platte Area Chamber and Development Corporation	Union Pacific Railroad
Linden Court	North Platte Care Center	Wel-Life at Ogallala
Linden Estates	North Platte Nebraska Hospital	

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, and NRDs. Jurisdictions outside of the planning area did not participate in the planning process.

Table 9: Notified Neighboring Jurisdictions

Notified Neighboring Jurisdictions	
Central Platte NRD	Logan County
Custer County	Lower Loup NRD
Dawson County	Middle Republican NRD
Frontier County	North Platte NRD
Garden County	Perkins County
Grant County	South Platte NRD
Hayes County	Thomas County
Hooker County	Upper Loup NRD
Deuel County	Upper Republican NRD

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 are not available for Round 1 or 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. Table 10 provides a summary of outreach activities utilized in this process.

Table 10: Outreach Activity Summary

Action	Intent
Project Website	Informed the public and local/planning team members of past, current, and future activities (https://jeo.com/twin-platte-nrd-multi-jurisdictional-hazard-mitigation-plan-update).
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.
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 Twin Platte NRD HMP and how to get involved. Flyers were shared with all Hazard Mitigation Planning team members to distribute.
Word-of-Mouth	Staff discussed the plan with jurisdictions throughout the planning process.

Round 1 Meetings: Hazard Identification

At the Round 1 meetings, jurisdictional representatives (i.e., the local planning teams) reviewed the 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 of hazards reviewed, see *Section Four: Risk Assessment.)*.

Due to COVID-19 numbers across Nebraska, Round 2 meetings were held via an online and phone format rather than in-person public workshop meetings. 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 11 shows the date and location of meetings held for the Round 1 meeting phase of the project.

Table 11: 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**
Virtual Zoom Meeting Online or by Phone, 8:00pm	Thursday, October 8, 2020
Virtual Zoom Meeting Online or by Phone, 3:00pm	Wednesday, October 14, 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 2016 TPNRD HMP; identify the top concerns from each

jurisdiction; and to begin reviewing and updating community profiles for demographics, capabilities, and critical facilities. 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 with JEO staff. Follow-up one-on-one meetings were held for communities who did not have representatives present at public meetings either through watching a recording of the meeting or via conference call with a member of the Hazard Mitigation Planning Team.

Table 12: Round 1 Meeting Attendees

Name	Title	Jurisdiction
Online Zoom Meeting – Thursday, October 8, 2020		
Dave Hardin	Street Superintendent/Planning/Zoning	Village of Arthur/Arthur County
Glen Bowers	Water Programs Field Coordinator	Twin Platte NRD
Jane Davis	Superintendent	Hershey Public Schools
Mark McConnell	Board President	Keith-Lincoln Irrigation District
Thomas Wolfgang	Board Chairperson	Village of Hershey
Tom Burch	Emergency Management	McPherson County
Karl Dietrich	Planner	JEO Consulting Group
Phil Luebbert	Project Coordinator	JEO Consulting Group
Online Zoom Meeting – Wednesday, October 14, 2020		
Al Bahnsen	Board Chairperson	Village of Brule
Allie Smith	Ex-Clerk	Village of Brady
Bill Simpson	Emergency Manager	Arthur County
Brandon Myers	Emergency Manager	Lincoln County
Brent Burklund	City Engineer	City of North Platte
Brett Nason	County Commissioner	McPherson County
Bruce Smith	City Manager	City of Ogallala
Carolyn Riggs	Administrator	North Platte Care Center
David Kling	Emergency Manager	Keith County
Dennis Thompson	Fire Chief	Ogallala Fire District
Glen Bowers	Water Programs Field Coordinator	Twin Platte NRD
Henry Henderson	Maintenance Assistant	Village of Sutherland
Jane Skinner	Clerk	City of Ogallala
James Branam	Maintenance Department	North Platte Care Center
Joan Ervin	County Commissioner	Keith County
Layne Groseth	Public Service Director	City of North Platte
Melissa Wilson	Clerk/Treasurer	Village of Sutherland
Michael Stroud	Maintenance Department	North Platte Care Center
Ruth Hasenauer	Board Chairperson	Village of Wellfleet
Sam Haworth	Board Member	Village of Sutherland
Shelby Morrison	Clerk/Treasurer	Village of Hershey
Stuart Simpson	Executive Director of Finance, Facilities and Operations	North Platte Public Schools
Wade Turner	Utility Superintendent	Village of Paxton
Karl Dietrich	Planner	JEO Consulting Group
Phil Luebbert	Project Coordinator	JEO Consulting Group

Table 13: Round 1 One-on-One Meeting Attendees

Name	Title	Jurisdiction
Mary May	Clerk/Treasurer	Village of Wallace
Jeff Orr	Board President	Platte Valley Irrigation District
Barry Schaeffer	Superintendent	Arthur County Schools
Bill Henry	County Commissioner	Lincoln County
Dennis Schilz	President	Western Irrigation District
Phil Armstrong	Treasurer	Western Irrigation District
Stephen Palser	Secretary	Western Irrigation District

Round 2 Meetings: Mitigation Strategies

Round 2 meetings are designed to identify and prioritize mitigation measures and evaluate potential integration of the HMP alongside other local planning mechanisms. Mitigation actions and plan integration are essential components in effective hazard mitigation plans. Participating jurisdictions were asked to identify any new mitigation actions to pursue alongside continued actions from the 2016 HMP and provide copies or descriptions of current jurisdictional plans in which hazard mitigation goals and principals can be integrated. Participating jurisdictions were also asked to review the information collected from the Round 1 meeting related to their community through this planning process for accuracy. Information/data reviewed included 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*).

There was also a brief discussion about the planning process, when the plan would be available for public review and comment, annual review of the plan, and the approval and grant opportunities available once the plan was approved. As with Round 1 meetings, any jurisdictions unable to attend were given the opportunity to have a one-on-one phone conference with the consultant or view a recording of the meeting in order to meet plan participation requirements and complete required information.

Due to the continuation of the COVID-19 Pandemic, Round 2 meetings were again held via an online and phone format to protect the health of participants and help reduce the spread of the virus. Table 14 shows the date and location of meetings held for Round 2 Meetings. Meeting attendees are identified in Table 15 and Table 16.

Table 14: Round 2 Meeting Dates and Locations

Agenda Items	
Identify new mitigation actions, review of local data and community profile, discuss review process, discuss available grants and eligibility, and complete plan integration tool.	
Location and Time	**Date**
Virtual Zoom Meeting Online or by Phone, 2:00pm	Wednesday, February 10, 2021
Online Zoom Meeting Online or by Phone, 7:00pm	Thursday, February 11, 2021

Table 15: Round 2 Meeting Attendees

Name	Title	Jurisdiction
Zoom Meeting – Wednesday, February 10, 2021		
Bill Henry	County Commissioner	Lincoln County
Brandon Myers	Emergency Manager	Lincoln County

Name	Title	Jurisdiction
Bruce Smith	City Manager	City of Ogallala
Casey Kendall	Utility Superintendent	Village of Sutherland
Dave Kling	Emergency Manager	Keith County
Dennis Schilz	President	Western Irrigation District
Dennis Thompson	Fire Chief	North Platte Fire District
Frank Fleecs	Board Member	Village of Sutherland
Glen Bowers	Water Programs Field Coordinator	Twin Platte NRD/ Western Canal Irrigation District
Heather Thole	Hazard Mitigation Planning Specialist	NEMA
Henry Henderson	Maintenance Assistant	Village of Sutherland
James Herman	Police Chief	City of Ogallala
Jane Davis	Superintendent	Hershey Public Schools
Jane Skinner	City Clerk/Treasurer	City of Ogallala
Jim Knothe	Board Member	Village of Paxton
Joan Ervin	County Commissioner	Keith County
Ken Knoepfel	Planning and Zoning	City of Ogallala
Mark McConnel	Board President	Keith & Lincoln County Irrigation District
Matt Smith	Street Superintendent	City of Ogallala
Melissa Wilson	Clerk/Treasurer	Village of Sutherland
Ruth Hasenauer	Board Chairperson	Village of Wellfleet
Sandy Benson	Community Wildfire Protection Plan Coordinator	Nebraska Forest Service
Stuart Simpson	Executive Director of Finance, Facilities and Operations	North Platte Public Schools
Tom Burch	Emergency Manager	McPherson County
Wade Turner	Utility Superintendent	Village of Paxton
Karl Dietrich	Planner	JEO Consulting Group
Phil Luebbert	Project Manager	JEO Consulting Group
Mary Baker	Resilience Strategist	JEO Consulting Group
Kayla Vondracek	Planning Intern	JEO Consulting Group
Zoom Meeting – Thursday, February 11, 2021		
Al Bahnsen	Board Chairperson	Village of Brule
Heather Thole	Hazard Mitigation Planning Specialist	NEMA
Glen Bowers	Water Programs Field Coordinator	Twin Platte NRD
Richard Bodenhamer	Board Member	Birdwood Irrigation District
Sharon Axthelm	Clerk	Village of Brady
Karl Dietrich	Planner	JEO Consulting Group
Phil Luebbert	Project Manager	JEO Consulting Group
Mary Baker	Resilience Strategist	JEO Consulting Group

Table 16: Round 2 One-on-One Attendees

Name	Title	Jurisdiction
Mary May	Clerk/Treasurer	Village of Wallace
Jeff Orr	Board President	Platte Valley Irrigation District
Shelby Morrison	Clerk/Treasurer	Village of Hershey
Bill Simpson	Emergency Manager	Arthur County
Barry Schaeffer	Superintendent	Arthur County Schools
David Hardin	Street Superintendent	Village of Arthur
Cody-Dillon Ditch Board	-	Cody-Dillon Ditch
Paxton Hershey Irrigation District Board	-	Paxton Hershey Irrigation District
Suburban Ditch Company Board	-	Suburban Ditch Company

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. Specific references are included as footnotes when used as applicable. The following table is not exhaustive as many studies, plans, and data resources at the local level are not publicly available. Individual examples of plan integration are identified in *Section Seven: Community Profiles*.

Table 17: 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	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
Final Rule (2007) https://www.fema.gov/emergency-managers/risk/hazard-mitigation/regulations-guidance/archive	National Flood Insurance Program Community Status Book (2020) https://www.fema.gov/flood-insurance/work-with-nfip/community-status-book
Hazard Mitigation Assistance Unified Guidance (2015) https://www.fema.gov/sites/default/files/2020-07/fy15_HMA_Guidance.pdf	National Response Framework (2019) https://www.fema.gov/emergency-managers/national-preparedness/frameworks/response
Hazard Mitigation Assistance Guidance and Addendum (2015) https://www.fema.gov/sites/default/files/2020-07/fy15_hma_addendum.pdf	Robert T. Stafford Disaster Relief and Emergency Assistance Act (2019) https://www.fema.gov/disasters/stafford-act
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 (2017) https://www.nass.usda.gov/Publications/AgCensus/2017/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 https://www.fema.gov/grants/guidance-tools/benefit-cost-analysis
Plans and Studies	
Twin Platte NRD Hazard Mitigation Plan (2016) https://jeo.com/twin-platte-nrd-multi-jurisdictional-hazard-mitigation-plan-update	Nebraska Drought Mitigation and Response Plan (2000) http://carc.nebraska.gov/docs/NebraskaDrought.pdf
Flood Insurance Studies https://msc.fema.gov/portal/home	State of Nebraska Hazard Mitigation Plan (2019) https://nema.nebraska.gov/sites/nema.nebraska.gov/files/doc/hazmitplan2019.pdf
Fourth National Climate Assessment (2018) https://nca2018.globalchange.gov/	State of Nebraska Hazard Mitigation Plan (2014) https://nema.nebraska.gov/sites/nema.nebraska.gov/files/doc/hazmitplan.pdf
National Climate Assessment (2014) https://nca2014.globalchange.gov/	State of Nebraska Flood Hazard Mitigation Plan https://nema.nebraska.gov/sites/nema.nebraska.gov/files/doc/flood-hazmit-plan.pdf
Data Sources/Technical Resources	
Arbor Day Foundation – Tree City Designation https://www.arborday.org/programs/treecityusa/directory.cfm	Nebraska Department of Natural Resource – Geographic Information Systems (GIS) https://dnr.nebraska.gov/data
Environmental Protection Agency - Chemical Storage Sites	Nebraska Department of Natural Resources https://dnr.nebraska.gov/

https://myrtk.epa.gov/info/search.jsp	
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 https://nema.nebraska.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 http://www.nfs.unl.edu/
National Drought Mitigation Center – Drought Impact Reporter http://droughtreporter.unl.edu/map/	Nebraska Public Power District Service https://www.nppd.com/
National Drought Mitigation Center – Drought Monitor http://droughtmonitor.unl.edu/	Nebraska State Historical Society https://history.nebraska.gov/
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/flood-insurance	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 Management 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	United States Geological Survey

http://nep.education.ne.gov/	http://www.usgs.gov/
Nebraska Department of Education http://educdirsrc.education.ne.gov/	United States 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 HMP draft 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 April 26, 2021 through May 26, 2021. Participating jurisdictions were emailed and mailed a letter notifying them of this public review period. The HMP was also made available on the project website (https://jeo.com/twin-platte-nrd-multi-jurisdictional-hazard-mitigation-plan-update) to download the document. Jurisdictions and the public could make provide comments via mail, email, or by using the comment box on the project website. A review of the comments and who they were from can be found below.

- Keith County: Provided updates to the county profile.
- City of North Platte: Updated transportation route information in the community profile.
- Village of Brady: Provided updates to the village profile.
- Nebraska Forest Service: Provided comments on the upfront grass/wildfire section and grass/wildfire sections throughout individual community profiles.

All changes and comments from participating jurisdictional representatives (i.e., local planning teams) and stakeholders were incorporated into the plan.

Plan Adoption and Implementation

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 NEMA's 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.

Hazard mitigation plans are living documents. Once an HMP has been adopted locally, participants are responsible for implementing identified projects, maintaining the plan with relevant information, and fully updating the plan every five years. The plan must be monitored, evaluated, and updated on a five-year or less cycle. Those who participated directly in the planning process would be logical champions during the annual reviews and five-year cycle update of the plan. It is critical the plan be reviewed and updated annually or when a hazard event occurs that significantly affects the area or individual participants. These annual reviews are the responsibility of each jurisdiction's local planning team and should be documented and reflected in the plan via amendments. However, participants are encouraged to work alongside the plan sponsor, TPNRD or the consultant, JEO, to document updates and revise the HMP.

Additional implementation of the mitigation plan should include integrating HMP goals, objectives, and mitigation actions into county and local comprehensive or capital improvement plans as they are developed or updated. *Section Six* describes the system that jurisdictions participating in the 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.

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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 description of the planning area's characteristics to create a summary profile for the region. Specific 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

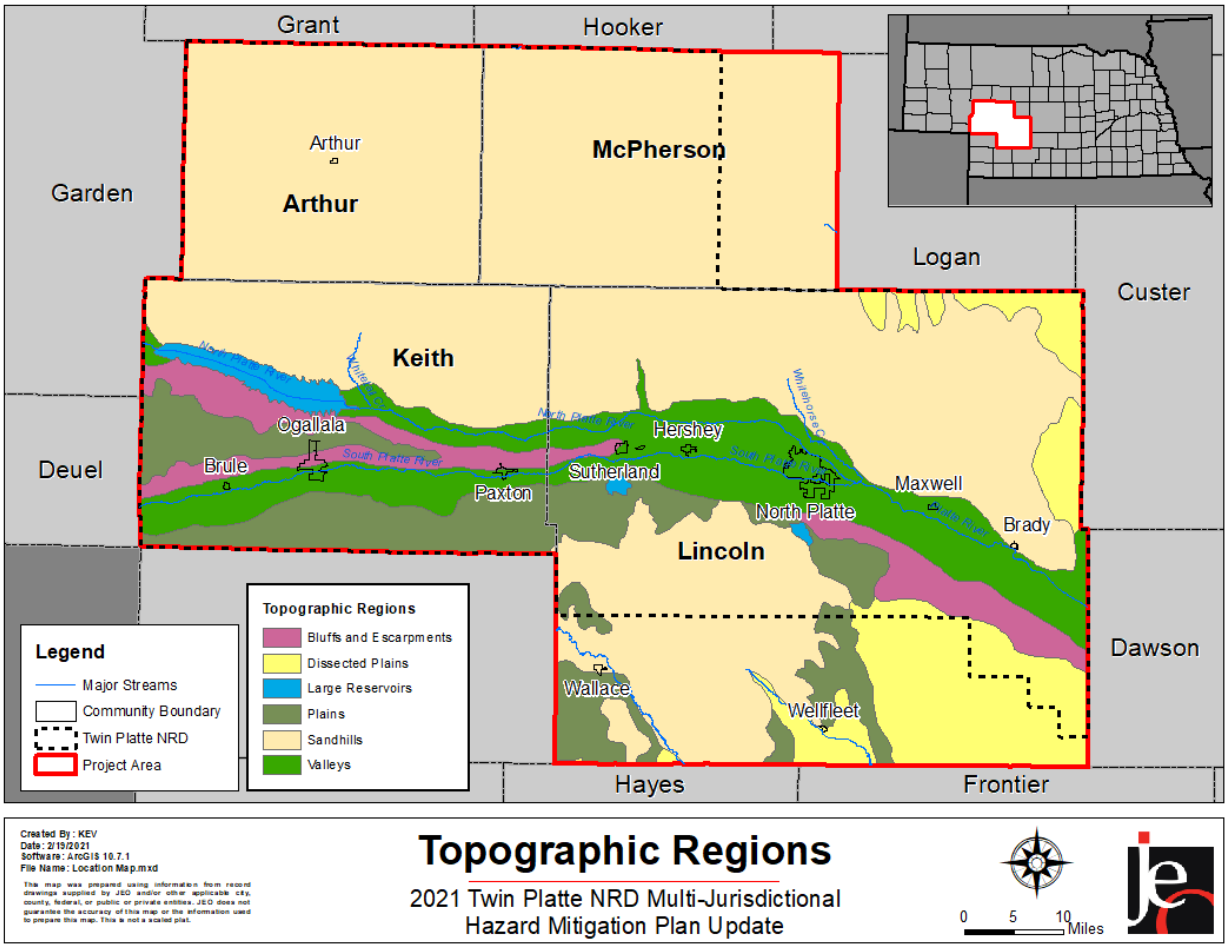
TPNRD's planning area includes the west central portion of Nebraska and spans 5,263 square miles. For the purpose of this plan update, the planning area includes all of Arthur, Keith, Lincoln, and McPherson counties. The planning area has a diverse range of topographic regions including bluffs and escarpments, dissected plains, large reservoirs, plains, sandhills, and valleys (Figure 3). Descriptions of these topographic regions are below.

- **Bluffs and escarpments**: Rugged land with very steep and irregular slopes.
- **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.
- **Sandhills**: Hilly land composed of low to high dunes of sand stabilized by grass cover.
- **Valleys**: Flat-lying land along the major streams.[12]

The region resides in the South Platte, Middle Platte, North Platte, Loup, and Republican River watersheds. Main waterways in the planning area include the North and South Platte Rivers and Lake McConaughy. The North Platte and South Platte Rivers join to form the Platte River near the City of North Platte in Lincoln County. Lake McConaughy draws tens of thousands of visitors each year to the planning area for lake-related activities.

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

Figure 3: Topography



Demographics and At-Risk Populations

As noted above, the planning area includes all of Arthur, Keith, Lincoln, and McPherson counties. The U.S. Census Bureau collects specific demographic information for each county. The estimated population of the planning area is 44,404.[13]

Table 18: Estimated Population for Planning Area

Age	Planning Area	State of Nebraska
<5	4.9%	6.9%
5-19	20.1%	20.6%
20-64	51.9%	57.5%
>64	23.1%	15%
Median	42.9	36.4

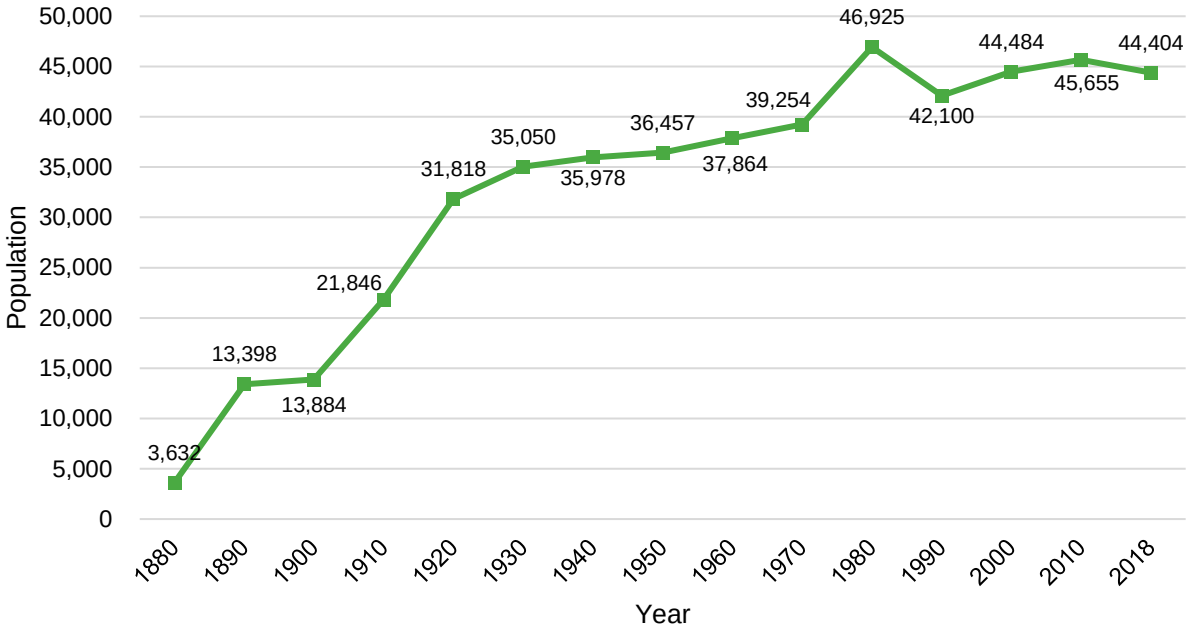
Source: U.S. Census Bureau

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

13 United States Census Bureau. 2018. "S0101: Age and Sex.". https://data.census.gov/cedsci/.

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 potential issues be incorporated into hazard mitigation plans, as well as other planning mechanisms within the community.

Figure 4: Planning Area Population, 1880-2018



Source: U.S. Census Bureau[14]

The planning area has displayed a relatively stable population since the 2000. While the U.S. Census Bureau conducts a formal census every ten years, the estimated population of the four-county planning area in 2018 was 44,404. 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 issues due to language barriers. Several outliers may be considered when discussing potentially at-risk populations, including:

- 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.

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]

14 United States Census Bureau. 2018. "S0101: Age and Sex.". https://data.census.gov/cedsci/.

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

Dependent children under 20 years old are one of the most vulnerable populations to disasters.[16] The majority of people in this age group do not have access to independent financial resources and transportation. They 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 approximately 20% of the planning area's population younger than 20, 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 5 is a map of the school district boundaries.

Table 19: School Inventory

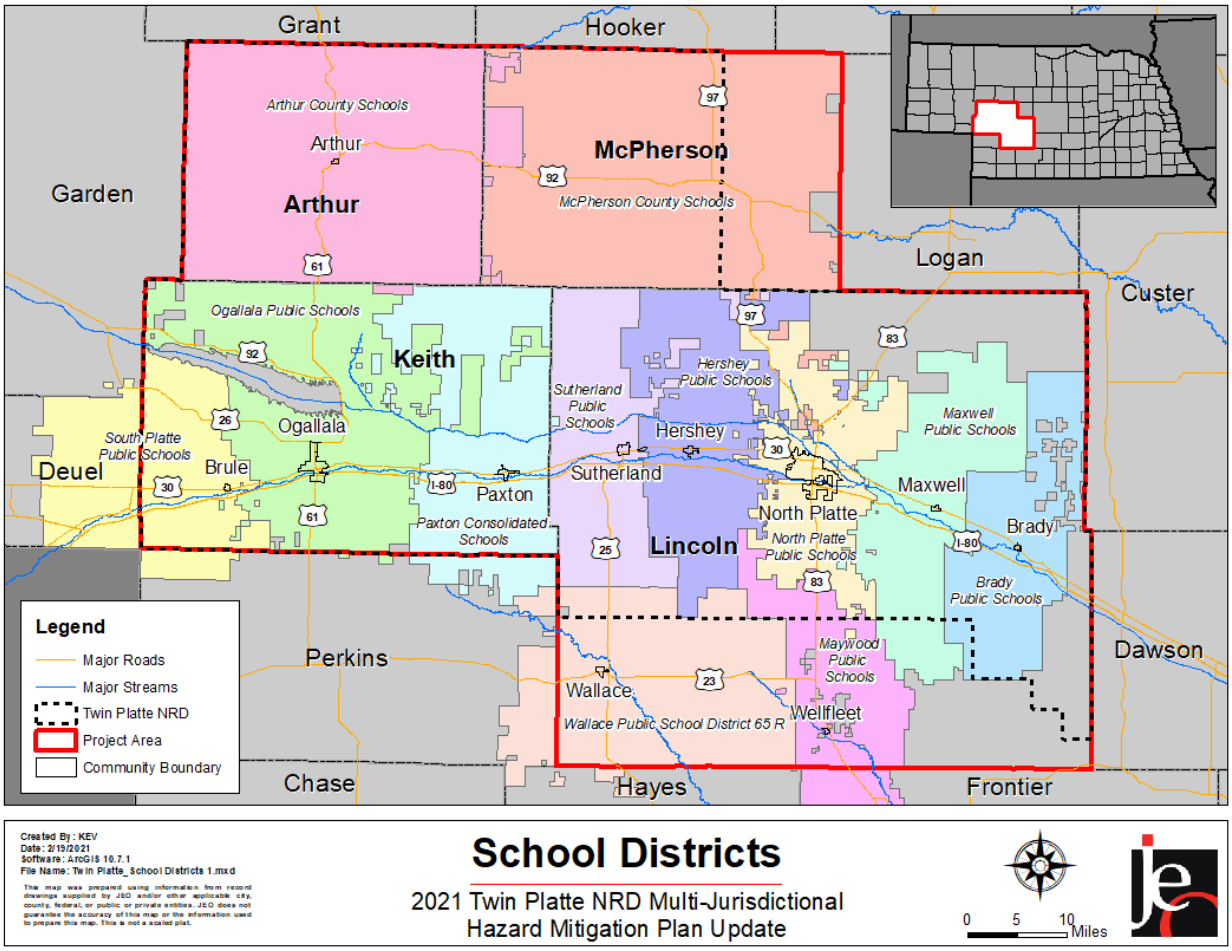
School District	Total Enrollment (2018-2019)	Total Teachers
Arthur County Schools	125	15
Hershey Public Schools	523	38
Ogallala Public Schools	901	74
Lincoln County Schools	42,020	3,145
North Platte Public Schools	4,230	266
McPherson County Schools	65	13
Paxton Consolidated Schools	219	20

Source: Nebraska Department of Education[17]

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 December 2020. http://nep.education.ne.gov/.

Figure 5: Regional School Districts



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 20 identifies the number and capacity of care facilities throughout the planning area.

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

Table 20: Inventory of Care Facilities

Jurisdiction	Hospitals	Hospital Beds	Health Clinics	Adult Care Homes	Adult Care Beds	Assisted Living Homes	Assisted Living Beds
Arthur	0	0	0	0	0	0	0
Keith	1	18	1	1	82	1	34
Lincoln	1	116	0	4	334	4	233
McPherson	0	0	0	0	0	0	0

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 21 provides statistics per county regarding households with English as a second language (ESL) and population reported as in poverty within the past 12 months.

Table 21: ESL and Poverty At-Risk Populations

County	Percent That Speaks English as Second Language	Families Below Poverty Level
Arthur	0.7%	10.3%
Keith	5.6%	11.7%
Lincoln	4%	12.2%
McPherson	0%	17%

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 in remote rural areas away from urban amenities; 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 of hazard events. 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 taking action 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

19 Department of Health and Human Services. December 2020. "Assisted Living Facilities." http://dhhs.ne.gov/licensure/Documents/ALF%20Roster.pdf.
20 Department of Health and Human Services. December 2020. "Hospitals." http://dhhs.ne.gov/licensure/Documents/Hospital%20Roster.pdf#search=hospital%20roster.
21 Department of Health and Human Services. December 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. December 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/.

with limited English proficiency would be at an increased vulnerability to all hazards within the planning area.

Similar to residents below the poverty line, racial minorities tend to have access to fewer financial and systemic resources that would enable them to implement hazard mitigation projects and to respond and recover from hazard events, including residence in standard housing and possession of 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 22).

Table 22: Racial Composition Trends

Race	2010		2018		% Change
	Number	% of Total	Number	% of Total	
White, Not Hispanic	42,780	94%	42,368	95%	1%
Black	283	1%	554	1%	0%
American Indian and Alaskan Native	69	0%	215	0%	0%
Asian	242	1%	174	0%	-1%
Native Hawaiian and Other Pacific Islander	24	0%	28	0%	0%
Other Races	918	2%	267	1%	-1%
Two or More Races	1,122	2%	808	2%	0%
Total Population	**45,438**	**-**	**44,404**	**-**	**-**

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

Built Environment and Structural Inventory

The U.S. 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 26 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 Lincoln County has the highest percentage of renter-occupied housing units in the planning area. The City of North Platte, the largest community in the planning area, has more than 42 percent of housing stock occupied by renters.

Arthur County has the highest percentage of vacant housing units compared to the other three counties. 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: 2018 ACS 5-year estimate." https://data.census.gov/cedsci/.

Table 23: Housing Characteristics

Jurisdiction	Total Housing Units				Occupied Housing Units			
	Occupied		Vacant		Owner		Renter	
	#	%	#	%	#	%	#	%
Arthur County	193	69.9%	83	30.1%	131	67.9%	62	32.1%
Keith County	3,844	70.5%	1,608	29.5%	2,712	70.6%	1,132	29.4%
Lincoln County	14,985	89.3%	1797	10.7%	9,780	65.3%	5,205	34.7%
McPherson County	203	82.2%	44	17.8%	139	68.5%	64	31.5%
Arthur	69	70.4%	29	29.6%	40	58%	29	42%
Brady	162	94.7%	9	5.3%	123	75.9%	39	24.1%
Brule	185	87.3%	27	12.7%	145	78.4%	40	21.6%
Hershey	243	84.4%	45	15.6%	192	79%	51	21%
Maxwell	102	85.7%	17	14.3%	95	93.1%	7	6.9%
North Platte	10,482	91.4%	985	8.6%	5,995	57.2%	4,487	42.8%
Ogallala	2,278	95.7%	103	4.3%	1,414	62.1%	864	37.9%
Paxton	219	88.0%	30	12%	162	74%	57	26%
Sutherland	622	92%	54	8%	494	79.4%	128	20.6%
Wallace	117	90.7%	12	9.3%	89	76.1%	28	23.9%
Wellfleet	22	88.0%	3	12%	20	90.9%	2	9.1%
Planning Area	**33,726**	**85.3%**	**4,846**	**14.7%**	**21,531**	**73.1%**	**12,195**	**26.9%**

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 24 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 24: Selected Housing Characteristics

	Arthur	Keith	Lincoln	McPherson	Total
Occupied Housing Units	193 (69.9%)	3,844 (70.5%)	14,985 (89.3%)	203 (82.2%)	19,225
Lacking Complete Plumbing Facilities	0.0%	0.1%	0.0%	0.0%	(0.1%)
Lacking Complete Kitchen Facilities	0.0%	0.5%	2.3%	0.0%	(2.8%)
No Telephone Service Available	0.0%	2.2%	3.0%	1.0%	(6.2%)
No Vehicles Available	0.0%	6.0%	6.9%	1.0%	(13.9%)
Mobile Homes	7.2%	23.1%	8.3%	8.1%	(46.7%)

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

Approximately six 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

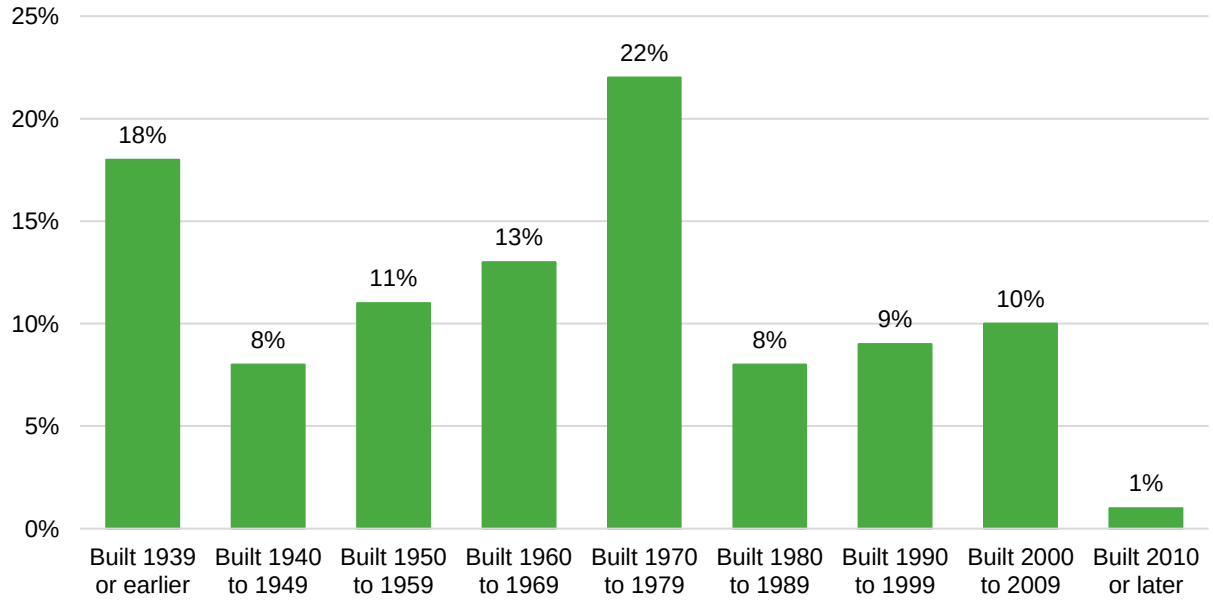
27 U.S. Census Bureau. 2020. "Selected Housing Characteristics: 2018 ACS 5-year estimate." https://data.census.gov/cedsci/.
28 U.S. Census Bureau. 2020. "Selected Housing Characteristics: 2018 ACS 5-year estimate." https://data.census.gov/cedsci/.

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 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. The CodeRED system is available for many communities and residents to use in the planning area. This opt-in program sends emergency alerts and hazard event updates to cellular devices located within specific geographical areas based on cell tower reception. Additionally, emergency managers, the National Weather Service, and other government agencies can utilize FEMA's Integrated Public Alert and Warning System (IPAWS) to send emergency alerts and weather warnings to cellphones within a designated area. Like CodeRED, notifications are sent to all cellphone users within specific geographical areas without needing to opt-in.

Approximately 13.4 percent of housing units in the planning area are mobile homes. Keith County has the highest rate of mobile homes in its housing stock at 23.1 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 13.9 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 (72%), with 18% of homes built prior to 1939 (Figure 6). 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 6: Housing Age in Planning Area



Source: U.S. Census Bureau[29]

29 United States Census Bureau. 2018. "DP04: Selected Housing Characteristics". https://data.census.gov/cedsci/.

State and Federally Owned Properties

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

Table 25: State and Federally Owned Facilities

Facility	Nearest Community
Arthur County	
Keith County	
Clear Creek WMA	Lemoyne, NE
Lake McConaughy SRA	Lewellen, NE
Ogallala Strip WMA	Ogallala, NE
Lincoln County	
Birdwood Lake WMA	North Platte, NE
Box Elder Canyon WMA	Maxwell, NE
Brady WMA	Brady, NE
Buffalo Bill Ranch SRA	North Platte, NE
Cedar Valley WMA	Wellfleet, NE
Chester Island WMA	Brady, NE
East Hershey WMA	Hershey, NE
East Sutherland WMA	Hershey, NE
Fremont Slough WMA	North Platte, NE
Hansen Memorial Reserve WMA	Wellfleet, NE
Hershey WMA	Hershey, NE
Jeffrey Lake WMA	Brady, NE
Maloney Reservoir SRA	North Platte, NE
Mid-Plains Community College	North Platte, NE
Muskrat Run WMA	North Platte, NE
North River WMA	Hershey, NE
Pawnee Slough WMA	Maxwell, NE
Platte WMA	North Platte, NE
Sutherland Reservoir SRA	Sutherland, NE
Wapiti WMA	Wellfleet, NE
Wellfleet WMA	Wellfleet, NE
West Brady WMA	Brady, NE
West Gothenburg WMA	Brady, NE
West Maxwell WMA	Maxwell, NE
McPherson County	

Source: Nebraska Game & Parks,[30] U.S National Park Service[31]

Mid-Plains Community College is a two-year public institution located in west-central Nebraska. The college was established because of state legislature enacted in 1973 and 1975. Three separately founded and already existing educational institutions merged to form Mid-Plains Community College. The college serves 18 counties, with two main campuses in North Platte and one campus in McCook. Additional extended campuses are in Broken Bow, Valentine, Ogallala, and Imperial.

The entire college system has an annual enrollment of approximately 16,000 credit and non-credit students. The college offers many majors and technical and occupational programs. The North Platte-South campus is located on the southern end of the city and outside the floodplain. The

[30] Nebraska Game and Parks. 2020. "Public Access ATLAS." https://maps.outdoornebraska.gov/PublicAccessAtlas/.
[31] U.S National Park Service. 2020. "Parks." https://www.nps.gov/state/ne/index.htm.

North Platte-North campus is located on the southeast edge of the city near The South Platte River. Parts of the North Campus reside in the 0.2 percent annual chance floodplain.[32]

Historical Sites

According to the National Register of Historic Places for Nebraska by the National Park Service, there are 23 historic sites located in the planning area. Several of the sites are located in the one percent annual chance floodplain.

Table 26: Historical Sites

Site Name	Date Listed	Nearest Community, County	In Floodplain
Archeological Site 25KH67	12/4/2001	Paxton, Keith	Unknown
Archeological Site 25KH68	12/4/2001	Brule, Keith	Unknown
Beauvais' Ranche Archeological Site	2/20/1975	Brule, Keith	Unknown
California Hill	7/15/1974	Brule, Keith	N
Diamond Springs Stage Station Site	10/15/1970	Brule, Keith	Y
First Arthur County Courthouse and Jail	1/10/1990	Arthur, Arthur	N
Fort McPherson National Cemetery	3/7/2012	Maxwell, Lincoln	Y
Fox Theatre	5/9/1985	North Platte, Lincoln	N
Front Street	11/21/2014	Ogallala, Keith	Y
Gainsforth, Dr. Burdette and Myrna, House	12/5/2002	Ogallala, Keith	N
Hotel Yancey	5/9/1985	North Platte, Lincoln	Y
Johnston Memorial Building	3/20/1986	Wallace, Lincoln	N
Keystone Community Church	1/1/1979	Keystone, Keith	N
Leonidas A. Brandhoefer Mansion	10/3/1973	Ogallala, Keith	N
Lincoln County Courthouse	1/10/1990	North Platte, Lincoln	Y
North Platte US Post Office and Federal Building	3/4/2009	North Platte, Lincoln	Y
O'Fallons Bluff	7/12/1974	Sutherland, Lincoln	Y
Ogallala US Post Office	5/11/1992	Ogallala, Keith	N
Pilgrim Holiness Church	6/18/1979	Arthur, Arthur	N
Roscoe State Aid Bridge	6/29/1992	Roscoe, Keith	Y
Scout's Rest Ranch	1/30/1978	North Platte, Lincoln	Y
Standard Oil Red Crown Service Station	8/20/2004	Ogallala, Keith	Y
Sutherland State Aid Bridge	6/29/1992	Sutherland, Lincoln	Y

Source: National Park Service[33]

32 Mid-Plains Community College. February 2021. http://mpcc.edu/about-mpcc/general-information/mpcc-history
33 National Park Service. January 2021. "National Register of Historic Places NPGallery Database." https://npgallery.nps.gov/nrhp.

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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 27: 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 same methodology as 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 will examine 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 will be conducted across the entire planning area, *Section Seven* will discuss community-specific assets at risk for relevant hazards. Analysis for regional risk will examine historic impacts and losses and what is possible should the hazard occur in the future. Risk analysis will include 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 will provide 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 have been 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 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.

Requirement §201.6(c)(2)(iii): For multi-jurisdictional plans, the risk assessment must assess each jurisdiction's risks where they vary from the risks facing the entire planning 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 are 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 there is a robust historic record and for which monetary damaged are recorded. 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:

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

Each hazard will be included, while those which have caused significant damages or occurred in significant numbers are discussed in detail. It should be noted NCEI data are not all inclusive and the database provides very limited information on crop losses. To provide a better picture of the crop losses associated with the hazards within the planning area, crop loss information provided by the Risk Management Agency (RMA) of the USDA was also utilized for this update of the plan for counties with available data. The collected data were from 2000 to 2019. Data for all the hazards are not always available, so only those with an available dataset are included in the loss estimation.

Annual probability can be calculated based on the total years of record and the total number of years in which an event occurred. An example of the annual probability estimate is found below:

$$\textbf{Annual Probability } (\%) = \frac{Total\ Years\ with\ an\ Event\ Occuring\ (\#)}{Total\ Years\ of\ Record\ (\#)}\ x\ 100$$

Hazard Identification

The identification of relevant hazards for the planning area began with a review of the 2019 State 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 28: Hazards Addressed in the Plan

Hazards Addressed in the Plan		
Agricultural Disease	Extreme Heat	Public Health Emergency
Chemical Spills (Fixed Site)	Flooding	Severe Thunderstorms
Chemical Spills (Transportation)	Grass/Wildfires	Severe Winter Storms
Dam Failure	Hail	Terrorism
Drought	High Wind	Tornadoes
Earthquake	Levee Failure	

Hazard Elimination

Given the location and history of the planning area, hazards from 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. This approach is consistent with the 2021 Nebraska State 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. This approach is consistent with the 2021 Nebraska State HMP.

- **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 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 2021 Nebraska State HMP.

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. Annual probability is based off the number of years that had at least one event.

Table 29: Regional Risk Assessment

Hazard	Previous Occurrences	Approximate Annual Probability*	Likely Extent
Agricultural Disease	Animal: 28	Animal Disease 6/6 =100%	~91 animals per event
	Plant: 34	Plant Disease 13/19 = 68%	Crop damage or loss
Chemical Spills (Fixed Site)	91	25/30 = 83%	0 – 20,000 Gallons 25.2 – 3600 Pounds
Chemical Spills (Transportation)	369	46/49 = 94%	0 – 22,000 Gallons
Dam Failure	0	0/109 = Less than 1%	Varies by structure
Drought	434/1,498 months	29%	D1-D4
Earthquakes	0	0/121 = Less than 1%	Less 5.0 on the Richter Scale
Extreme Heat	947	77/128 = 60%	>100°F
Flooding	72	21/24 = 88%	Some inundation of structures (47% of structures) and roads near streams. Some evacuations of people may be necessary (64% of population)
Grass/Wildfires	1,377	17/17 = 100%	Avg 166.25 acres Some homes and structures threatened or at risk
Hail	1,466	24/24 = 100%	Hail range 0.75-4.5” (H2-H4); average 1.23”
High Wind	122	20/24 = 83%	Avg 48 mph; Range 35-68 Estimated Gust
Levee Failure	0	0/120 = Less than 1%	Varies by extent
Public Health Emergency	2	Unknown	Varies by extent
Severe Thunderstorms	560	24/24 = 100%	≤4.25” rainfall Avg 57 mph winds

Hazard	Previous Occurrences	Approximate Annual Probability*	Likely Extent
Severe Winter Storms	207	24/24 = 100%	0.25" – 0.5" Ice 5°-65° below zero (wind chill) 3-14" snow 15-60 mph winds
Terrorism	0	0/47 = Less than 1%	Varies by event
Tornadoes	87	20/24 = 83%	Avg: EF0 Range EF0-EF3

** Annual Probability = Total Years with an Event Occurrence / Total Years of Record*

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

Table 30: Loss Estimation for the Planning Area

Hazard Type		Count	Property	Crop[2]
Agricultural Disease	Animal Disease[1]	28	2,535 animals	N/A
	Plant Disease[2]	34	N/A	$449,001
Chemical Spills (Fixed Site)[3]		91	N/A	N/A
Chemical Spills (Transportation)[4]		369	$594,997	N/A
Dam Failure[5]		0	N/A	N/A
Drought[6,8]		434/1,498 months	$22,000,000	$51,367,442
Earthquakes[11]		0	$0	N/A
Extreme Heat[7]		Avg 5 days per year	$0	$10,616,932
Flooding[8]	Flash Flood	52	$3,035,000	$660,451
	Flood	20	$996,000	
Grass/Wildfire[12] *12 Injuries*		1,377	114,680 acres	$4,664,542
Hail[8] *2 injuries* Average: 1.23 inches Range: 0.75-4.5 inches		1,466	$57,114,800	$79,276,189
High Wind[8] *8 injuries* Average: 48 kts Range: 35-68 kts		122	$677,500	$7,102,325
Levee Failure[10]		0	$0	N/A
Public Health Emergency		2	N/A	N/A
Severe Thunderstorms[8] *8 injuries*	Heavy Rain	7	$0	$6,311,953
	Lightning	19	$106,000	
	Thunderstorm Wind Average: 51 kts Range: 50-103 kts	534	$5,016,700	
Severe Winter Storms[8] *2 injuries* *3 fatalities*	Blizzard	28	$55,000	$5,686,647
	Extreme Cold/Wind Chill	20	$0	
	Heavy Snow	21	$10,000	
	Ice Storm	0	$0	

Hazard Type		Count	Property	Crop[2]
	Winter Storm	137	$94,000	
	Winter Weather	1	$1,000,000	
Terrorism[9]		0	$0	N/A
Tornadoes[8] *15 injuries* Average: EF0 Range: EF0-EF4		87	$4,430,750	N/A
Total		**4,633**	**$95,047,661**	**$166,169,219**

N/A: Data not available
1 NDA (2014-November 2020)
2 USDA RMA (2000-2019)
3 NRC (1990-February 2020)
4 PHSMA (1971-July 2020)
5 NeDNR Correspondence
6 NOAA (1895-October 2020)
7 NOAA (1893-July 2020)
8 NCEI (1996-December 2019)
9 University of Maryland (1970 - 2018)
10 USACE (1900-July 2020)
11 USGS (1900-July 2020)
12 NFS (2000-2017)

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. The following table summarizes the SBA Disasters involving the planning area since 2006.

Table 31: SBA Declarations

Declaration Date	Disaster Declaration Number	Title	Primary Counties	Contiguous Counties
1/26/2006	NE-00005	Severe Winter Storm	Lincoln, McPherson	-
1/7/2007	NE-00011	Severe Winter Storm	Keith, Lincoln	-
7/24/2007	NE-00014	Severe Storms, and Flooding	Lincoln	-
8/29/2007	NE-00017	Severe Storms and Flooding	Arthur, Keith, McPherson	-
6/20/2008	NE-00021	Severe Storms, Flooding, and Tornados	Lincoln, McPherson	-
7/31/2009	NE-00027	Severe Storms, Tornados, and Flooding	Arthur, Lincoln	-
4/21/2010	NE-00035	Severe Storms, Ice Jams, and Flooding	Severe Storms, Ice Jams, and Flooding	-

Declaration Date	Disaster Declaration Number	Title	Primary Counties	Contiguous Counties
7/15/2010	NE-00038	Severe Storms, Flooding, and Tornados	Arthur, Lincoln, McPherson	-
9/7/2011	NE-00041	Flooding	Lincoln	Keith, McPherson
7/18/2011	NE-00042	Flooding	Lincoln	Keith, McPherson
8/12/2011	NE-00043	Flooding	Lincoln	-
10/5/2011	NE-00045	Severe Storms with Excessive Rain, Hail, and High Winds	Keith	Arthur, Lincoln, McPherson
11/9/2011	NE-00046	Severe Storms with Excessive Rain, Flash	Arthur	Keith, Lincoln, McPherson
4/1/2013	NE-00049	Drought	Arthur, Keith, Lincoln, McPherson	-
12/10/2013	NE-00053	Drought	Arthur, Keith, Lincoln, McPherson	-
12/9/2014	NE-00056	Drought	Keith, Lincoln	Arthur, McPherson
1/18/2015	NE-00059	Drought	Arthur, McPherson	Keith, Lincoln
6/25/2015	NE-00065	Severe Storms, Straight-line Winds, and Flooding	-	-

Source: Small Business Administration, 2006-2019[34]

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 19 presidential disaster declarations since 1967.

Table 32: Presidential Disaster Declarations

Disaster Declaration Number	Declaration Date	Title	Affected Counties	Public Assistance
228	7/18/1967	Severe Storms and Flooding	Arthur	-
1027	9/5/1994	Severe Snow and Ice Storm	Lincoln	-
1190	1/11/1997	Severe Snowstorms, Rain, and Strong Winds	Lincoln	-
1373	5/16/2001	Severe Winter Storms, Flooding, and Tornadoes	Keith, Lincoln, McPherson	-
1480	7/21/2003	Severe Storms and Tornadoes	McPherson	-
3245	9/13/2005	Hurricane Katrina Evacuees	Arthur, Keith, Lincoln, McPherson	-

34 Small Business Administration. 2001-2019. [data files]. Office of Disaster Assistance | Resources." https://www.sba.gov/offices/headquarters/oda/resources/1407821.

Disaster Declaration Number	Declaration Date	Title	Affected Counties	Public Assistance
1627	1/26/2006	Severe Winter Storm	Lincoln, McPherson	-
1674	1/7/2007	Severe Winter Storm	Keith, Lincoln	-
1714	7/24/2007	Severe Storms and Flooding	Lincoln	-
1721	8/29/2007	Severe Storms and Flooding	Arthur, Keith, McPherson	-
1770	6/20/2008	Severe Storms, Tornadoes, and Flooding	Lincoln, McPherson	$36,258,650.19
1853	7/31/2009	Severe Storms, Tornadoes, and Flooding	Arthur, Lincoln	-
1902	4/21/2010	Severe Storms, Ice Jams, and Flooding	Arthur	-
1924	7/15/2010	Severe Storms and Flooding	Arthur, Lincoln, McPherson	-
4013	8/12/2011	Flooding	Lincoln	$62,808,331.04
3323	6/18/2011	Flooding	Lincoln	-
4225	6/25/2015	Severe Storms, Tornadoes, Straight-line Winds, and Flooding	Arthur, Lincoln	-
4375	6/29/2018	Severe Winter Storm and Straight-Line Winds	Keith	-
4420	3/21/2019	Severe Winter Storm, Straight-Line Winds, and Flooding	Arthur, Lincoln	$173,640,224.19

Source: Federal Emergency Management Agency, 1953-2019[35]

Climate Adaptation

Long-term climate trends have shifted throughout the 21st century and have created significant changes in precipitation and temperature which have altered the severity and subsequent impacts from severe weather events. The Regional and Local Planning Teams identified changes in the regional climate as a top concern impacting communities, Indian tribes, residents, local economies, and infrastructure throughout the planning area. Discussions on temperature, precipitation, and climate impacts are included below.

The planning area is located in the Northern Great Plains region of the United States, which includes Montana, Wyoming, North Dakota, South Dakota, and Nebraska. A large elevation change across the region contributes to high geographical, ecological, and climatological variability, including a strong gradient of decreasing precipitation moving from east to west across the region. Significant weather extremes impact this area, including winter storms, extreme heat and cold, severe thunderstorms, drought, and flood producing rainfall. The Fourth National Climate Assessment has provided an overview of potential impacts within the planning area.[36]

- **Water**: Water is the lifeblood of the Northern Great Plains, and effective water management is critical to the region's people, crops and livestock, ecosystems, and energy industry. Even small changes in annual precipitation can have large effects downstream; when coupled with the variability from extreme events, these changes make managing these resources a challenge. Future changes in precipitation patterns, warmer

35 Federal Emergency Management Agency. 2020. "Disaster Declarations." Accessed June 2020. https://www.fema.gov/disasters.
36 U.S. Global Change Research Program. 2018. "Fourth National Climate Assessment". https://nca2018.globalchange.gov/.

temperatures, and the potential for more extreme rainfall events are very likely to exacerbate these challenges.

- **Agriculture:** Agriculture is an integral component of the economy, the history, and the culture of the Northern Great Plains. Recently, agriculture has benefited from longer growing seasons and other recent climatic changes. Some additional production and conservation benefits are expected in the next two to three decades as land managers employ innovative adaptation strategies, but rising temperatures and changes in extreme weather events are very likely to have negative impacts on parts of the region. Adaptation to extremes and to longer-term, persistent climate changes will likely require transformative changes in agricultural management, including regional shifts of agricultural practices and enterprises.

- **Recreation and Tourism:** Ecosystems across the Northern Great Plains provide recreational opportunities and other valuable goods and services that are at risk in a changing climate. Rising temperatures have already resulted in shorter snow seasons, lower summer stream flows, and higher stream temperatures. These changes have important consequences for local economies that depend on winter or river-based recreational activities. Climate-induced land-use changes in agriculture can have cascading effects on closely entwined natural ecosystems, such as wetlands, and the diverse species and recreational amenities they support.

- **Energy:** Fossil fuel and renewable energy production and distribution infrastructure is expanding within the Northern Great Plains. Climate change and extreme weather events put this infrastructure at risk, as well as the supply of energy it contributes to support individuals, communities, and the U.S. economy as a whole. The energy sector is also a significant source of greenhouse gases and volatile organic compounds that contribute to climate change and ground-level ozone pollution.

Nebraska's Changing Climate

The United States as a whole is experiencing significant changes in temperature, precipitation, and severe weather events resulting from climate change. According to a University of Nebraska report (Understanding and Assessing Climate Change: Implications for Nebraska), the following changes can be expected for Nebraska's future climate:[37]

- Increase in extreme heat events (days over 100°F).
- 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 and Platte River from reduced snowpack in the Rocky Mountains.
- Additional 30-40 days in the frost-free season.

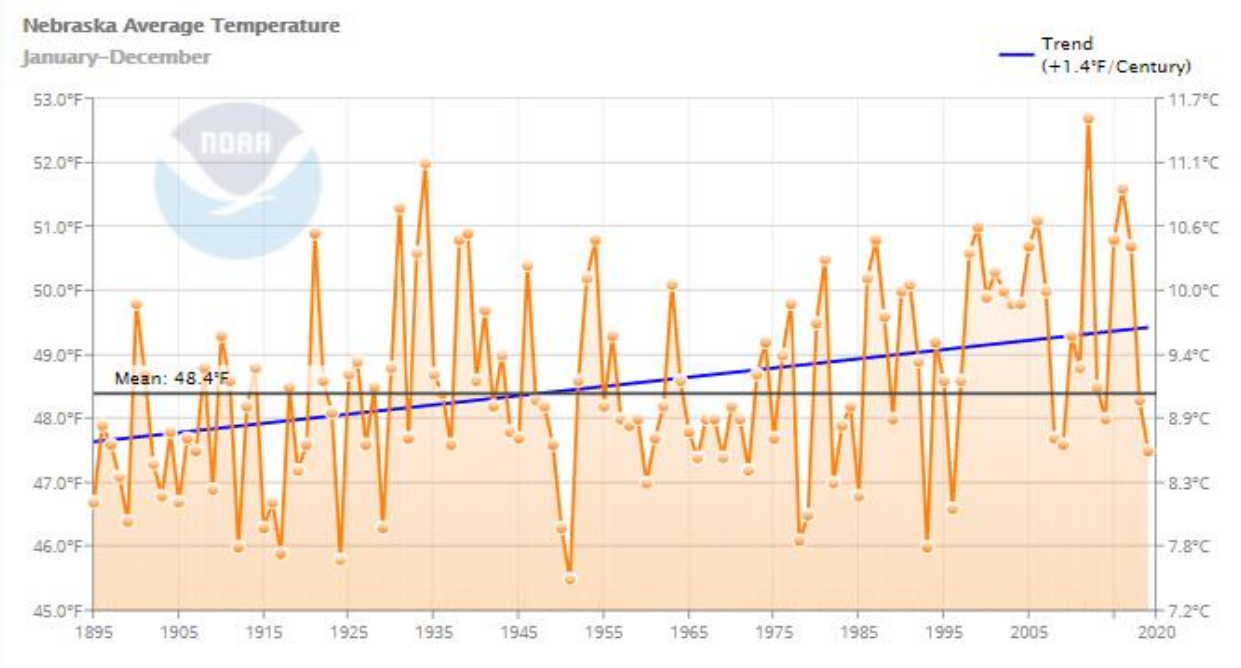
Changes in Temperature

Since 1895 Nebraska's overall average temperature has increased by almost 1.5°F (Figure 7). Climate modeling suggests warmer temperature conditions will continue in the coming decades

37 University of Nebraska-Lincoln. 2014. "Understanding and Assessing Climate Change: Implications for Nebraska". http://snr.unl.edu/download/research/projects/climateimpacts/2014ClimateChange.pdf.

and rise steadily into mid-century. Warming has increased the most in winter and spring months with winter minimum temperatures rising 2-4°F. In addition, there is greater warming for nighttime lows than for daytime highs. Since 1985, the length of the frost season has increased by an average of more than one week across Nebraska, with the length likely to continue to increase in the future. Projected temperature changes range from 4-9°F by 2099.[38]

Figure 7: Average Temperature (1895-2020)



Source: NOAA, 2020[39]

Changes in Precipitation

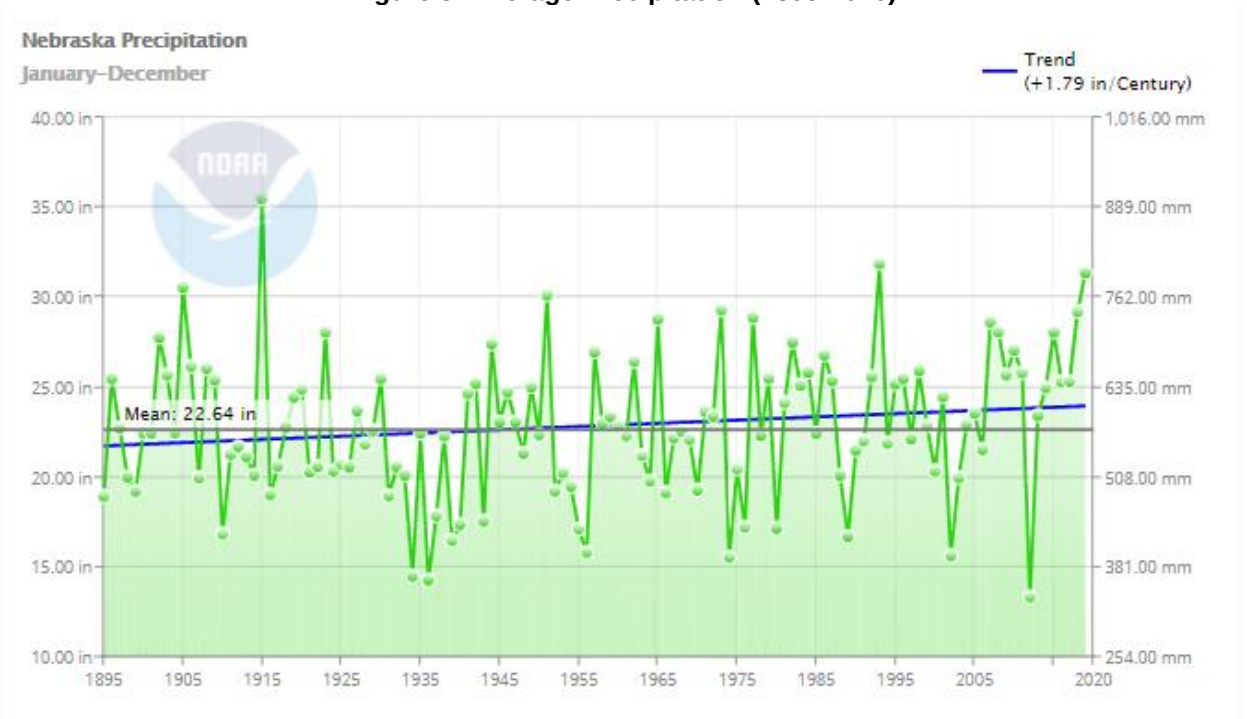
Changing extremes in precipitation are anticipated in the coming decades, with more significant rain and snowfall events and more intense drought periods. Seasonal variations will be heightened, with more frequent and more significant rainfall expected in the spring and winter and hotter, drier periods in the summer. Since 1895, yearly annual precipitation for Nebraska has increased slightly (Figure 8). This trend is expected to continue as the impacts of climate change continue to be felt. Climate modeling may show only moderate precipitation and streamflow changes; however, the state is already at risk to large annual and seasonable variability as seen by flooding and drought events occurring in concurrent years. There will likely be more days with a heavy precipitation event (rainfall of greater than one inch per day) across the state. Precipitation varies significantly across the state (Figure 9) and moves in a longitudinal gradient. The east receives twice as much precipitation (35 inches annually) as the Nebraska Panhandle (15 inches) on average.[40]

38 University of Nebraska-Lincoln. 2014. "Understanding and Assessing Climate Change: Implications for Nebraska". http://snr.unl.edu/download/research/projects/climateimpacts/2014ClimateChange.pdf.

39 NOAA. 2020. "Climate at a Glance: Statewide Time Series.". Accessed September 2020. https://www.ncdc.noaa.gov/cag/statewide/time-series/25/tavg/12/12/1895-2020?base_prd=true&begbaseyear=1901&endbaseyear=2000&trend=true&trend_base=100&begtrendyear=1895&endtrendyear=2020.

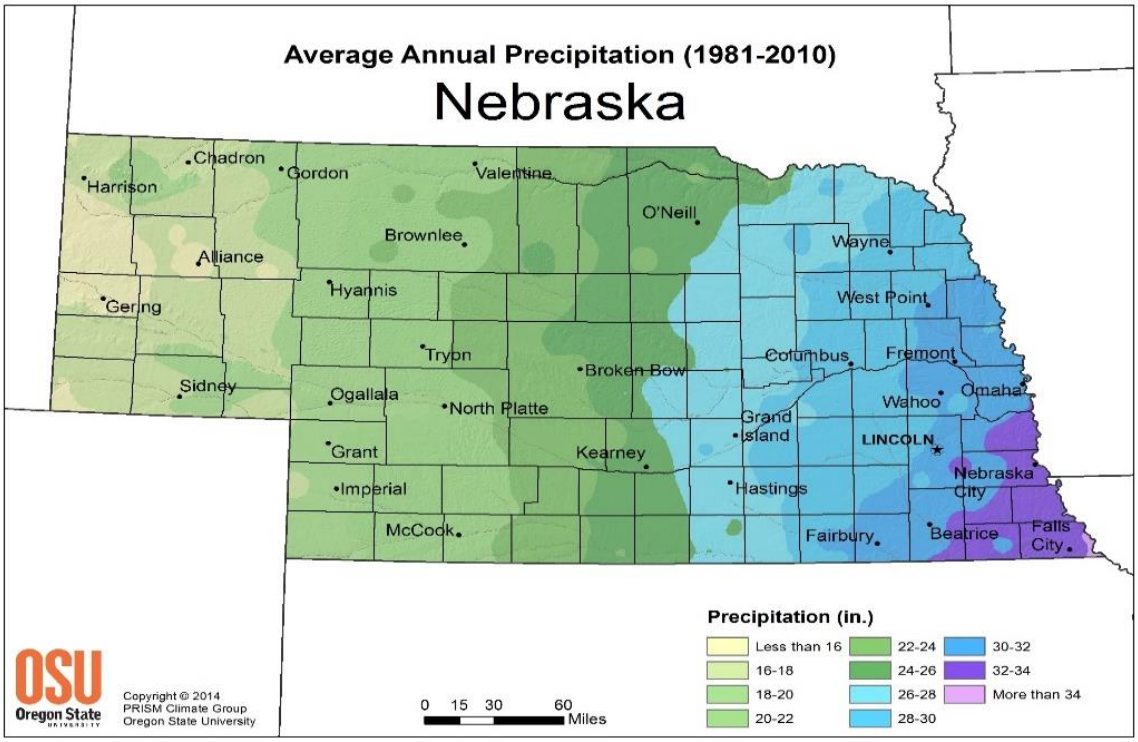
40 North Central Climate Collaborative. January 2020. "NC3 Nebraska Climate Summary." Accessed April 2021. https://northcentralclimate.org/files/2020/01/nc3-Nebraska-Climate-Summary-FINAL_2.12.pdf?x24082.

Figure 8: Average Precipitation (1895-2020)



Source: NOAA, 2020[41]

Figure 9: Average Annual Precipitation for Nebraska (1981-2010)



Source: Oregon State University PRISM Climate Group, 2014

41 U.S. Drought Monitor. January 2021. "Time Series.". Accessed February 2021. https://droughtmonitor.unl.edu/Data/Timeseries.aspx.

Impacts from Climate Change

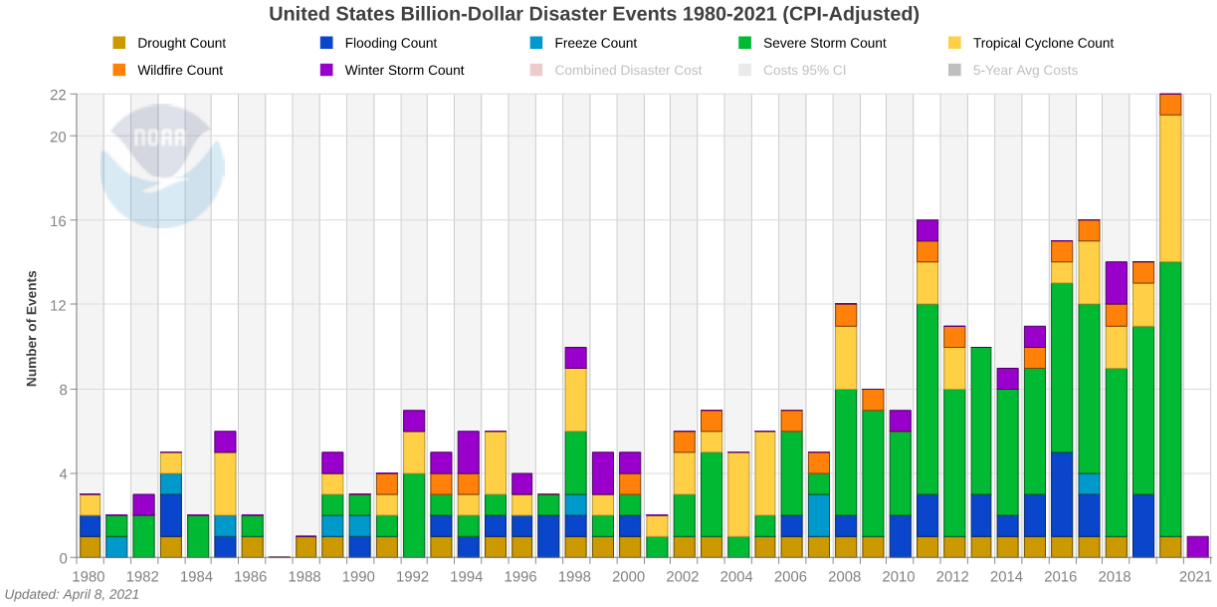
Observed changes in the intensity and frequency of extreme events are a significant concern now and in the future because of the social, environmental, and economic costs associated with their impacts. Challenges that are expected to affect communities, environments, and residents as a result of climate change include:

- Developing and maintaining sustainable agricultural systems.
- Resolving increasing competition among land, water, and energy resources.
- Conserving vibrant and diverse ecological systems.
- Enhancing the resilience of the region's people to the impacts of climatic extremes.

Certain groups of people may face greater difficulty when dealing with the impacts of a changing climate. Older adults, immigrant communities, and those living in poverty are particularly susceptible. Additionally, specific industries and professions tied to weather and climate, like outdoor tourism, commerce, and agriculture, are especially vulnerable.[42]

As seen in the figure below, the United States is experiencing an increase in the number of billion-dollar natural disasters due to increases in development and climate change.

Figure 10: U.S. Billion-Dollar Disaster Events (1980-2021)



Source: NOAA, 2021[43]

Agriculture

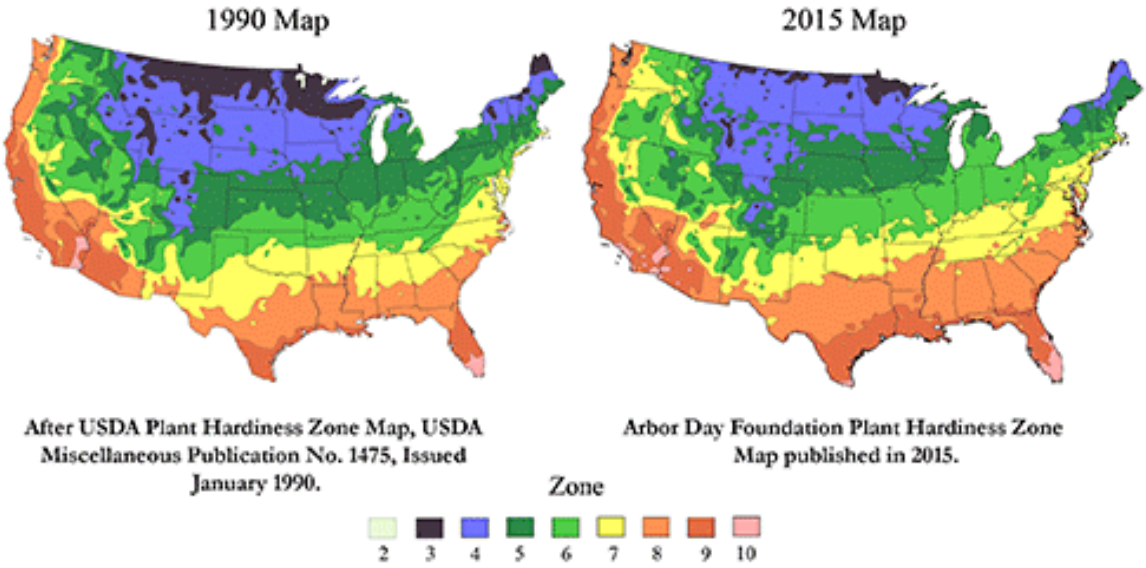
The agricultural sector will experience an increase in droughts, an increase in grass and wildfire events, changes in the growth cycle as winters warm, an influx of new and damaging agricultural diseases or pests, and changes in the timing and magnitude of rainfall. As described in the Plant Hardiness Zone map available for the United States (Figure 11), these changes have shifted the annual growing season and expected agricultural production conditions. Nebraska is vulnerable to changes in growing season duration and growing season conditions as a heavily agriculturally

42 U.S. Environmental Protection Agency. "Climate Impacts on Society." Accessed April 2021. https://19january2017snapshot.epa.gov/climate-impacts/climate-impacts-society_.html.

43 NOAA National Centers for Environmental Information. 2021. "U.S. Billion-Dollar Weather and Climate Disasters". https://www.ncdc.noaa.gov/billions/.

dependent state. These added stressors on agriculture could have devastating economic effects if new agricultural and livestock management practices are not adopted.

Figure 11: Plant Hardiness Zone Change



Source: Arbor Day Foundation, 2018[44]

Air Quality

Rising temperatures will also impact air quality. Harmful air pollutants and allergens increase as temperatures increase. More extended periods of warmth contribute to longer pollen seasons that allow plant spores to travel farther and increase exposure to allergens. More prolonged exposure to allergens can increase the risk and severity of asthma attacks and worsen existing allergies in individuals.[45] An increase in air pollutants can occur from the increased number of grass/wildfires. The public can be exposed to harmful particulate matter from smoke and ash that can cause various health issues. Depending on the length of exposure, age, and individual susceptibility, effects from wildfire smoke can range from eye and respiratory irritation to severe disorders like bronchitis, asthma, and aggravation of pre-existing respiratory and cardiovascular diseases.[46]

Water Quality

Increasing temperatures, shifting precipitation patterns, and extreme weather events impact water quality throughout the state. With the increasing intensity and frequency of extreme precipitation events, impacts to water systems ultimately threaten human health. Events can lead to flooding and stormwater runoff that can carry pollutants across landscapes and threaten human health by contaminating water wells, groundwater, and other bodies of water. Common pollutants include pesticides, bacteria, nutrients, sediment, animal waste, oil, and hazardous waste.

As average temperatures increase, water temperatures also rise and put water bodies at risk for eutrophication and excess algal growth that reduce water quality. In agricultural landscapes this can be exacerbated from major storm events that cause sediment and nutrients such as phosphorous and nitrogen to runoff into nearby water sources. The runoff can contribute to the

44 Arbor Day Foundation. 2018. "Hardiness Zones." https://www.arborday.org/media/map_change.cfm.
45 Asthma and Allergy Foundation of America. 2010. "Extreme Allergies and Climate Change." Accessed 2021. https://www.aafa.org/extreme-allergies-and-climate-change/.
46 AirNow. 2019. "Wildfire Smoke: A Guide for Healthcare Professionals." Accessed 2021. https://www.airnow.gov/sites/default/files/2020-10/wildfire-smoke-guide-revised-2019-chapters-1-3_0.pdf.

buildup of nutrients in the water, increasing plant and algae growth that can deplete oxygen and kill aquatic life. Nutrient enrichment can lead to toxic cyanobacterial harmful algae blooms (cyanoHABs), which can be harmful to animal and human health. CyanoHABs can cause economic damage such as decreasing property values, reducing recreational revenue, and increasing the costs for treating drinking water.[47]

Zoonotic Disease

Changes in temperature and precipitation can alter the geographic range of disease-carrying insects and pests. Mosquitoes that transmit viruses such as Zika, West Nile and dengue may become more prevalent in Nebraska because of the increased temperatures and precipitation. These diseases may initially spread faster as the local population is not aware of the proper steps to reduce their risk.

Energy

As the number of 100°F days increases, along with warming nights, the stress placed on the energy grid will likely increase and possibly lead to more power outages. Severe weather events also stress emergency production, infrastructure transmission, and transportation. Roads, pipelines, and rail lines are all at risk of damages from flooding, extreme heat, erosion, or added stress from increased residential demands.[48] Critical facilities and vulnerable populations that are not prepared to handle periods of power outages, particularly during heat waves, will be at risk.

Drought and Extreme Heat

An increase in average temperatures will contribute to the raise in the frequency and intensity of hazardous events like extreme heat and drought, which will cause significant economic, social, and environmental impacts on Nebraskans. Although drought is a natural part of the climate system, increasing temperatures will increase evaporation rates, decrease soil moisture, and lead to more intense droughts in the future, having negative impacts on farming and community water systems. Extreme heat events have adverse effects on both human and livestock health. Heatwaves may also impact plant health, with negative effects on crops during essential growth stages. Increasing temperatures and drought may reduce the potential for aquifers to recharge, which has long-term implications for the viability of agriculture in Nebraska.

Grass/Wildfire

Rising temperatures will likely increase the frequency and intensity of grass/wildfires. Warmer temperatures cause snow to melt sooner and create drier soils and forests, which act as kindling to ignite fires. Dry and dead trees will increase fuel loads causing fires to spread much quicker. Additionally, warmer nighttime temperatures contribute to the continued spread of wildfires over multiple days.[49]

Severe Storms and Flooding

Nebraska experiences frequent snowstorms and ice storms during winter, which can produce heavy snowfall and high wind gusts that lead to whiteout conditions. In the warmer months, convective storms are common and include flash flood-producing rainstorms and severe thunderstorms capable of producing hail, damaging winds, and tornadoes. As temperatures continue to rise, more water vapor evaporates into the atmosphere, creating increased humidity,

47 USGS. "Nutrients and Eutrophication". Accessed February 2021. https://www.usgs.gov/mission-areas/water-resources/science/nutrients-and-eutrophication?qt-science_center_objects=0#qt-science_center_objects.

48 USGCRP, 2018: Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II: Report-in-Brief [Reidmiller, D.R., C.W. Avery, D.R. Easterling, K.E. Kunkel, K.L.M. Lewis, T.K. Maycock, and B.C. Stewart (eds.)]. U.S. Global Change Research Program, Washington, DC, USA, 186 pp.

49 NASA Global Climate Change. September 2019. "Satellite Data Record Shows Climate Change's Impact on Fires." Accessed 2021. https://climate.nasa.gov/news/2912/satellite-data-record-shows-climate-changes-impact-on-fires/.

which can increase the frequency and intensity of these storms. An increase in severe storms and heavy rain events will lead to more flooding and larger magnitude flood events. These severe storm and flooding events can cause increased damages to structures and put more people at risk of injury or death.

Future Adaptation and Mitigation

The planning area will have to adapt to a changing climate and its impacts or experience an increase in economic losses, property damages, agricultural damages, and loss of life. Past events have typically informed HMPs to be more resilient to future events. This HMP includes strategies for the planning area to address these changes and increase resilience. However, future updates of this HMP should consider including adaptation as a core strategy to be better informed by future projections on the frequency, intensity, and distribution of hazards. Jurisdictions in the planning area should consider past and future climate changes and impacts when incorporating mitigation actions into local planning processes.

Hazard Profiles

Information from participating jurisdictions was collected and reviewed alongside hazard occurrence, magnitude, and event narratives as provided by local, state, and federal databases. Based on this information, profiled hazards were determined to either have a historical record of occurrence or the potential for occurrence in the future. 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 each respective community profile (see *Section Seven* of this plan). The following table identifies the prioritization of hazards by participating jurisdictions (i.e., hazards of top concern). Local jurisdictional planning teams selected these hazards from the regional hazard list as the prioritized hazards for the community based on historical hazard occurrences, potential impacts, and the jurisdictions' capabilities. However, it is important to note that while a jurisdiction may not have selected a specific hazard to be profiled, hazard events can impact any community at any time and their selection is not a full indication of risk.

Table 33: Top Hazards of Concern

Jurisdiction	Agricultural Disease	Chemical (Fixed Site)	Chemical (Transportation)	Dam Failure	Drought	Earthquakes	Extreme Heat	Flooding	Grass/Wildfire	Hail	High Winds	Levee Failure	Public Health Emergency	Severe Thunderstorms	Severe Winter Storms	Terrorism	Tornadoes
Twin Platte NRD				X	X			X	X		X			X			X
Arthur County			X						X	X					X		X
Village of Arthur			X						X	X				X	X		X
Keith County	X		X	X				X					X		X		X
Village of Brule				X				X						X			
City of Ogallala				X				X		X				X	X		X
Village of Paxton			X					X	X	X				X	X		X
Lincoln County				X				X	X	X			X	X	X		X
Village of Brady	X		X	X									X		X		
Village of Hershey			X	X				X		X			X	X			X

Jurisdiction	Agricultural Disease	Chemical (Fixed Site)	Chemical (Transportation)	Dam Failure	Drought	Earthquakes	Extreme Heat	Flooding	Grass/Wildfire	Hail	High Winds	Levee Failure	Public Health Emergency	Severe Thunderstorms	Severe Winter Storms	Terrorism	Tornadoes
City of North Platte			X	X				X		X					X		X
Village of Sutherland				X				X	X					X	X		X
Village of Wallace								X	X	X	X			X	X		X
Village of Wellfleet					X			X		X	X			X			X
McPherson County					X				X					X	X		X
Arthur County Schools			X						X	X			X	X	X		X
Birdwood Irrigation District				X	X			X									
Cody-Dillon Ditch				X	X												
Hershey Public Schools			X	X				X								X	X
Keith Lincoln-Irrigation District			X	X	X		X	X						X			
North Platte Public Schools			X					X								X	
Paxton Hershey Irrigation District				X	X			X									

Jurisdiction	Agricultural Disease	Chemical (Fixed Site)	Chemical (Transportation)	Dam Failure	Drought	Earthquakes	Extreme Heat	Flooding	Grass/Wildfire	Hail	High Winds	Levee Failure	Public Health Emergency	Severe Thunderstorms	Severe Winter Storms	Terrorism	Tornadoes
Platte Valley Irrigation District				X													
Suburban Ditch Company				X	X			X									
Western Irrigation District				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 $973 million.[50]

Table 34 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 34: Livestock Inventory

County	Market Value of 2017 Livestock Sales	Cattle and Calves	Hogs and Pigs	Poultry Egg Layers	Sheep and Lambs
Arthur	$25,126,000	35,676	(D)	72	0
Keith	$83,384,000	52,424	0	71	(D)
Lincoln	$569,997,000	304,257	624	1,813	1,591
McPherson	$26,257,000	40,716	(D)	117	0
Total	**$704,764,000**	**433,073**	**624**	**2,073**	**1,591**

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

The following tables provide the value and acres of land in farms for the planning area. Lincoln County has the highest number of farms and land (acres) in farms in the planning area, as well as high crop sales, which accounts for nearly 70% of sales in the four-county area. Corn is the most prevalent crop type in the region followed by soybeans.

Table 35: Land and Value of Farms in the Planning Area

County	Number of Farms	Land in Farms (acres)	Market Value of 2017 Crop Sales
Arthur	95	452,733	$2,389,000
Keith	318	491,482	$78,469,000
Lincoln	1,040	1,356,769	$185,239,000
McPherson	109	488,982	$2,142,000
Total	**1,562**	**2,789,966**	**$268,239,000**

Source: U.S. Census of Agriculture, 2017

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

Table 36: Crop Values

County	Corn		Soybeans		Wheat	
	Acres Planted	Value (2017)	Acres Planted	Value (2017)	Acres Planted	Value (2017)
Arthur	2,903	(D)	(D)	(D)	(D)	(D)
Keith	104,456	$48,880,000	16,258	$9,193,000	32,601	(D)
Lincoln	209,988	$121,372,000	64,933	$35,608,000	8,688	$1,286,000
McPherson	1,741	$1,672,000	0	-	(D)	(D)
Total	**319,088**	**$171,924,000**	**81,191**	**$44,801,000**	**41,289**	**$1,286,000**

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

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 28 instances of animal disease reported between January 2014 and November 2020 by the NDA (Table 37). These outbreaks affected 2,535 animals.

Table 37: Livestock Diseases Reported in the Planning Area

Year	County	Disease	Population Impacted
2014	Lincoln	Bovine Viral Diarrhea	4
2014	Lincoln	Bovine Paratuberculosis	1
2015	Keith	Bovine Viral Diarrhea	2000
2015	Lincoln	Bovine Paratuberculosis	1
2015	Lincoln	Bovine Bluetongue	1
2015	Lincoln	Enzootic Bovine Leukosis	1
2015	Lincoln	Equine Rhinopneumonitis	1
2015	Lincoln	Bovine Vesicular Stomatis	1
2016	Arthur	Bovine Paratuberculosis	1
2016	Keith	Bovine Paratuberculosis	1
2016	Lincoln	Bovine Paratuberculosis	2
2016	Lincoln	Bovine Bluetongue	1
2016	Lincoln	Enzootic Bovine Leukosis	2
2017	Keith	Equine West Nile Virus	1
2017	Lincoln	Bovine Viral Diarrhea	1
2017	Lincoln	Bovine Paratuberculosis	2
2018	Keith	Infectious Bovine Rhinotracheitis/Infectious Pustul	500
2018	Lincoln	Bovine Bluetongue	1
2018	Lincoln	Enzootic Bovine Leukosis	1
2018	McPherson	Bovine Paratuberculosis	1
2019	Lincoln	Bovine Bluetongue	1

Year	County	Disease	Population Impacted
2019	Lincoln	Enzootic Bovine Leukosis	3
2019	Lincoln	Equine Vesicular Stomatis	1
2019	Lincoln	Bovine Anaplasmosis	2
2019	McPherson	Porcine Paratuberculosis	1
2020	Arthur	Porcine Reporductive and Respiratory Syndrome	1
2020	Lincoln	Bovine Paratuberculosis	1
2020	Lincoln	Equine Herpesvirus 4	1

Source: Nebraska Department of Agriculture, January 2014- November 2020[51]

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.

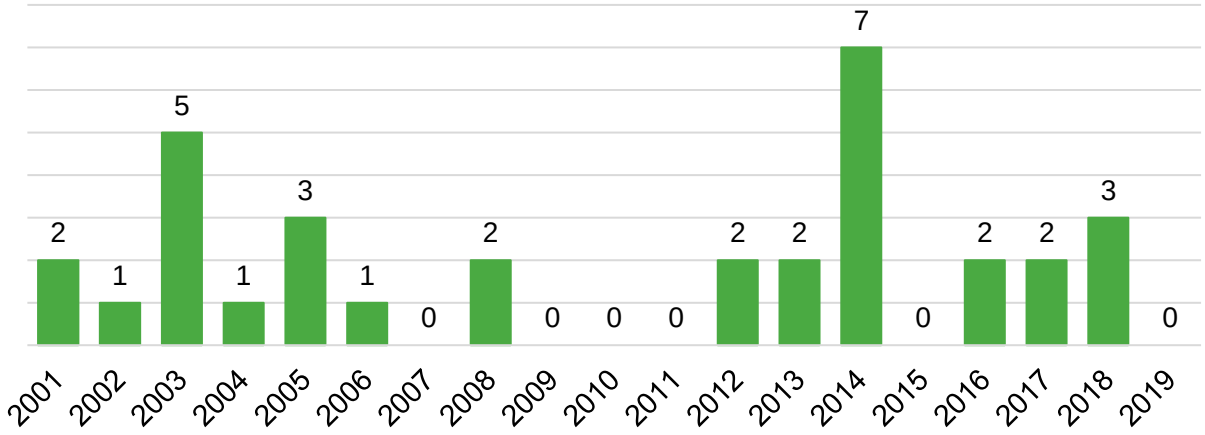
Table 38: Common Crop Diseases in Nebraska by Crop Types

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

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

The RMA provides data on plant disease events and plant losses in the planning area. There are 34 instances of plant diseases reported from 2000-2019 by the RMA (Figure 12). These outbreaks caused $449,001 in crop losses.

Figure 12: Plant Disease Events by Year



Source: NDA, 2000-2019

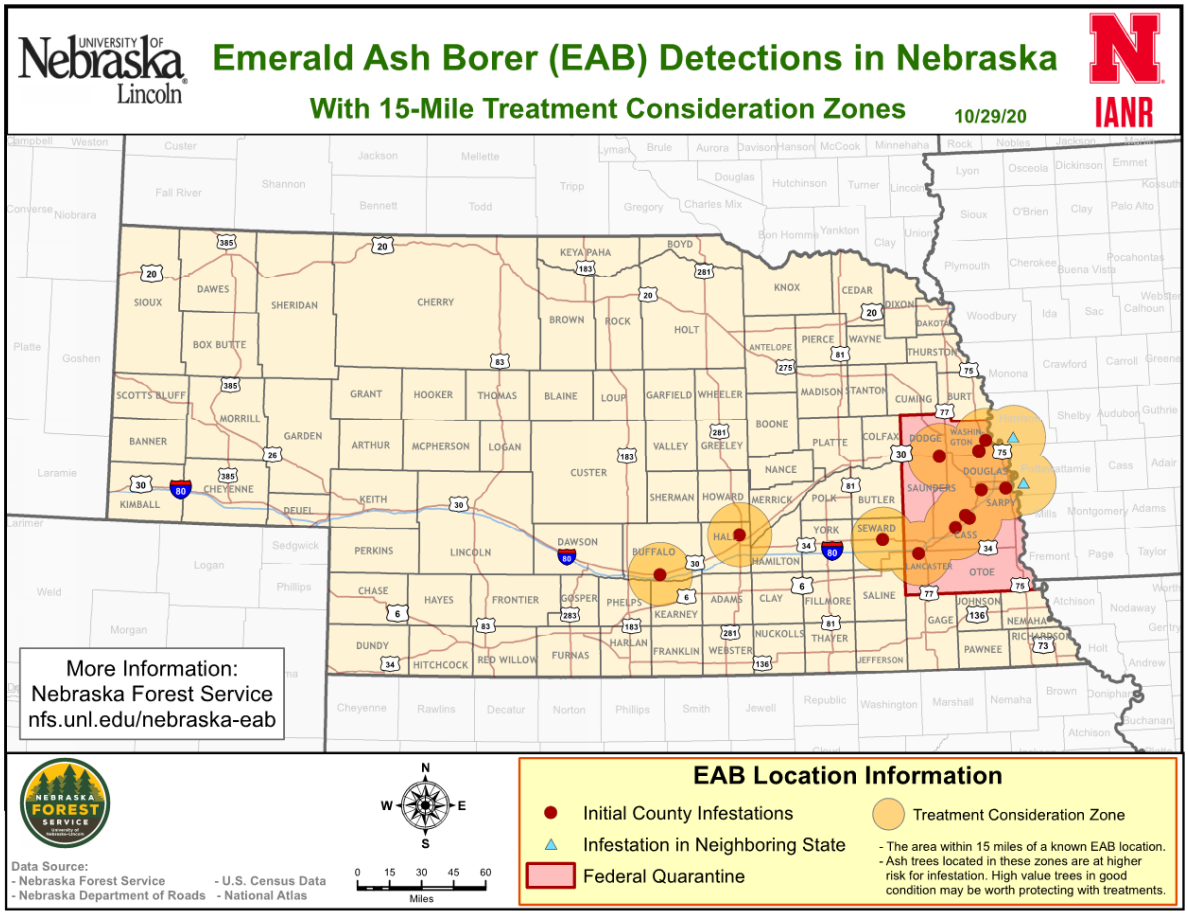
Emerald Ash Borer

The spread and presence of the Emerald Ash Borer (EAB) have become a rising concern for many Nebraskan communities in recent years. The beetle spreads through transport of infected ash trees, lumber, and firewood. All species of North American ash trees are vulnerable to infestation. Confirmed cases of EAB have been found in three Canadian provinces and 35 US states, primarily in the eastern, southern, and midwestern regions. The two most recent infestation confirmations came from South Dakota and Vermont in early 2018; however, EAB can be found in Iowa, Missouri, Kansas, South Dakota, and Colorado. Nebraska's confirmed cases occurred on private land in Omaha and Greenwood in 2016.[52] Figure 13 shows the locations of Nebraska's confirmed EAB cases as of October 2020. Additional confirmed cases have likely occurred and many communities across the state are prioritizing the removal of ash trees to help curb potential infestations and tree mortality.

While adult beetles cause little damage, larvae damage trees by feeding on the inner bark of mature and growing trees, causing tunnels. Effects of EAB infestation include extensive damage to trees by birds, canopy dieback, bark splitting, and water sprout growth at the tree base, and eventual tree mortality. EAB has impacted millions of trees across North America, killing young trees one to two years after infestation and mature trees three to four years after infestation.[53] Estimated economic impacts to Nebraska's 44 million ash trees exceed $981 million.[54] Dead or dying trees affected by EAB are also more likely to cause damage during high winds, severe thunderstorms, or severe winter storms from weakened or hazardous limbs and can contribute a significant fuel load to grass/wildfire events.

52 Emerald Ash Borer Information Network. April 2018. "Emerald Ash Borer." http://www.emeraldashborer.info/.
53 Arbor Day Foundation. 2015. "Emerald Ash Borer." https://www.arborday.org/trees/health/pests/emerald-ash-borer.cfm.
54 "Nebraska Emerald Ash Borer Response Plan." May 2015. https://nfs.unl.edu/NebraskaEABResponsePlan.pdf.

Figure 13: EAB Detections in Nebraska



Average Annual Losses

According to the USDA RMA (2000-2019) there were 34 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 39: Agricultural Plant Disease Losses

Hazard Type	Number of Events	Events per Year	Total Crop Loss	Average Annual Crop Loss
Plant Disease	34	1.8	$449,001	$23,632

Source: RMA, 2000-2019

Table 40: Agricultural Livestock Disease Losses

Hazard Type	Number of Events	Events per Year	Total Animal Losses	Average Animal Losses per Event
Animal Disease	28	4	2,535	91

Source: NDA, 2014-November 2020

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 (at least one animal disease outbreak reported in all seven years), for the purposes of this plan, the annual probability of animal disease occurrence is 100 percent. Given the historic record of occurrence for agricultural plant disease events (13 out of 19 years with a reported event), the annual probability of agricultural plant disease occurrence is 68%.

Regional Vulnerabilities

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

Table 41: 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

CHEMICAL SPILLS (FIXED SITES)

The following description of hazardous materials is provided by 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.[55]

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.

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.[56]

Fixed sites are those that involve chemical manufacturing sites and stationary storage facilities. Table 42 demonstrates the nine classes of hazardous material according to the 2016 Emergency Response Guidebook.

[55] Federal Emergency Management Agency. 2017. "Hazardous Materials Incidents." https://www.ready.gov/hazardous-materials-incidents.
[56] Emergency Planning and Community Right-to-Know Act of 1986, Pub. L. No. 116 § 10904. 1986.

Table 42: 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 infectious 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	

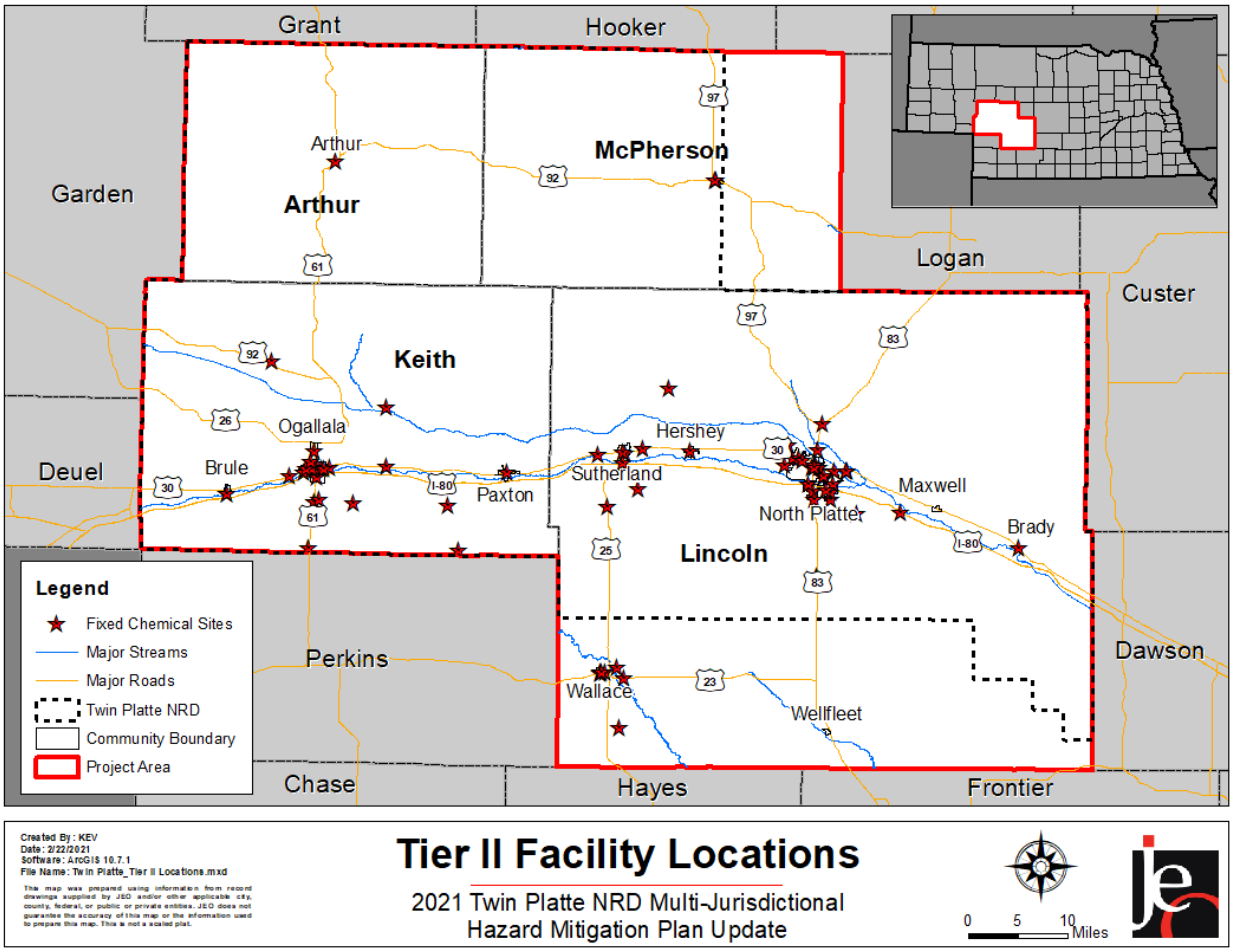
Source: Emergency Response Guidebook, 2016[57]

Location

There are 73 locations across the planning area that house hazardous materials, according to the Tier II reports submitted to the Nebraska Department of Environment and Energy in 2019. A list of chemical storage sites can be found in *Section Seven: Community Profiles* for each county. Figure 14 shows the location of the chemical sites.

57 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 14: Tier II Facility Locations



Historical Occurrences

According to the U.S Coast Guard's National Response Center (NRC) database, there have been 91 fixed site chemical spills from 1990 to February 2020 in the planning area. There was one evacuation as a result of a chemical spill. There were no property damages reported for these releases.

Extent

The extent of chemical spills at fixed sites varies and depends on the type of chemical that is released, with most events localized to the facility. 91 releases have occurred in the planning area, and the total amount spilled ranged from 1 to 20,000 gallons or 25.2 to 11,012 pounds of pollutant. Anhydrous ammonia and oil were the most spilled pollutant. Of the 91 chemical spills, one event in 2005 led to evacuations after a relief valve released anhydrous ammonia. There were no injuries or hospitalizations from the event.

Probability

Based on the historic record of reported incidents, there is an 83 percent probability (25 out of 30 years with an occurrence) that a fixed site chemical release event will occur annually in the planning area.

Regional Vulnerabilities

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

Table 43: Regional Chemical and Radiological Fixed Site Vulnerabilities

Sector	Vulnerability
People	-Those in close proximity could have minor to severe 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 on the local economy
Built Environment	-Risk of fire or explosion
Infrastructure	-Transportation routes can be closed during evacuations
Critical Facilities	-Critical facilities are at risk of evacuation or damage from fire or explosion
Climate	-None

CHEMICAL SPILLS (TRANSPORTATION)

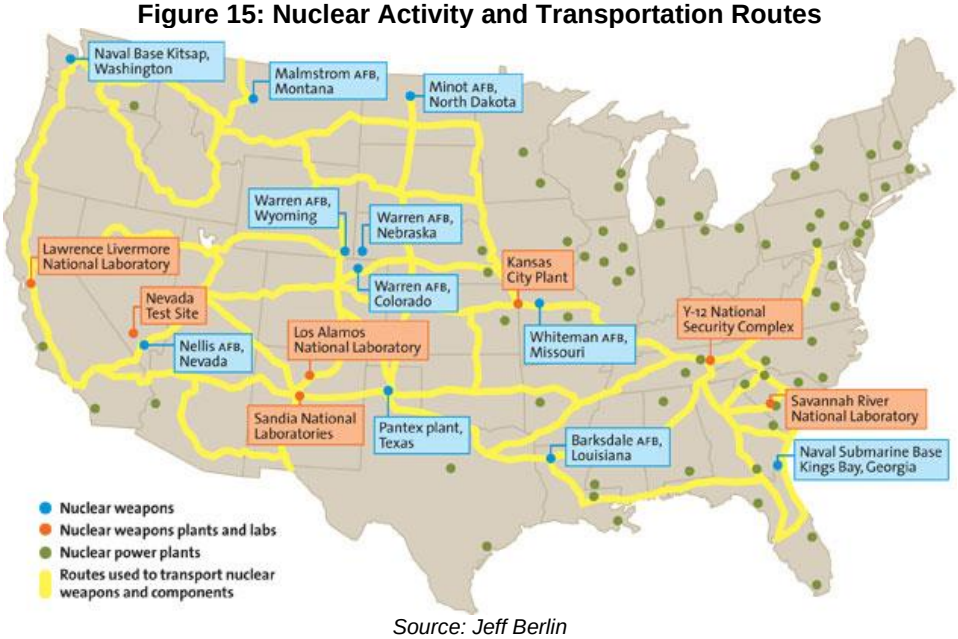
The transportation of hazardous materials is defined by the U.S. Pipeline and Hazardous Materials Safety Administration (PHMSA) as "…a substance that has been determined to be capable of posing an unreasonable risk to health, safety, and property when transported in commerce…"[58] According to PHMSA, hazardous materials traffic in the U.S. now exceeds 1,000,000 shipments per day.[59]

Nationally, the U.S has had 116 fatalities associated with the transport of hazardous materials between 2007 through 2017.[60] While such fatalities are a low probability risk, even one event can harm many people. For example, a train derailment in Crete, Nebraska, in 1969 allowed anhydrous ammonia to leak from a ruptured tanker. The resulting poisonous fog killed nine people and injured 53.

Location

Chemical releases can occur during transportation, primarily on major transportation routes as identified in Figure 15 and Figure 16. A large number of spills also typically occur during the loading and unloading of chemicals. In Lincoln County, North Platte is home to the Union Pacific Railroad's Bailey Yard, which is the largest railroad classification yard in the world. The yard covers 2,850 acres, has 315 miles of track, and a total length of eight miles. At Bailey Yard, approximately 10,000 railroad cars come through every 24 hours, with over 9,000 locomotives processed at the yard's fueling and service center each month.[61] According to PHMSA there are two gas transmission pipelines traveling through Keith and Lincoln Counties and two hazardous liquid pipelines traveling through Keith and Lincoln Counties.[62]

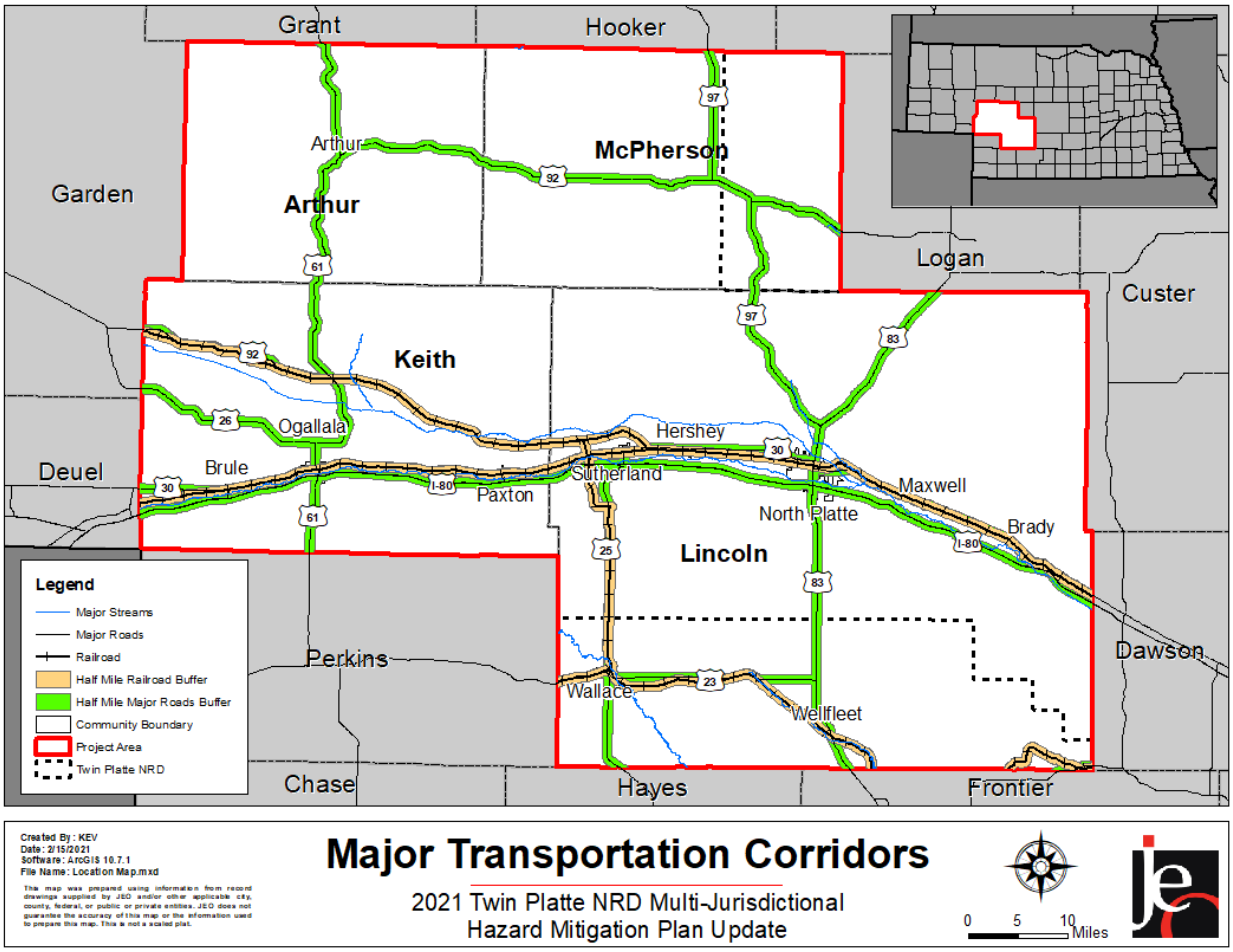
Figure 15: Nuclear Activity and Transportation Routes



Source: Jeff Berlin

58 Pipeline and Hazardous Materials Safety Administration. 2018. "Hazmat Safety Community FAQ." https://phmsa.dot.gov/regulations.
59 U.S. Department of Transportation. 2015. "2012 Economic Census: Transportation." https://www.census.gov/library/publications/2015/econ/ec12tcf-us.html.
60 Pipeline and Hazardous Materials Safety Administration. 2017. "10 Year Incident Summary Reports." https://www.phmsa.dot.gov/hazmat/library/data-stats/incidents.
61 Visit North Platte Nebraska. 2020. "Union Pacific Bailey Yard." https://visitnorthplatte.com/directory-posts/union-pacific-bailey-yard/https://www.phmsa.dot.gov/hazmat/library/data-stats/incidents.
62 Pipeline and Hazardous Materials Safety Administration. 2019. "National Pipeline Mapping System." https://www.npms.phmsa.dot.gov/.

Figure 16: Major Transportation Routes with Half Mile Buffer



Historical Occurrences

PHMSA reports that 369 chemical spills have occurred during transportation in the planning area between 1971 and May 2020. During these events, there was $594,997 in damages with one fatality and 12 injuries. The following table provides a list of those chemical transportation events that have caused some of the most significant damages, injuries, or death.

Table 44: Historical Chemical Spills 1971-May 2020

Date of Event	Location of Release	Failure Description	Material Involved	Transportation Method	Injuries or Fatalities	Total Damage
10/7/1974	North Platte	Vehicle Accident	0 LGA Gasoline	Highway	1 Fatality	$0
11/11/1991	North Platte	Loose Component	200 LGA Flammable Liquids	Rail	4 Injuries	$1,900
2/16/1993	North Platte	Defective Component	-	Rail	1 Injury	$1,900
4/22/1993	North Platte	Vehicle Accident	1,746 LGA Fuel Oil	Highway	0	$115,000
8/3/1993	North Platte	Punctured	6.6 LGA Sodium Hydroxide	Highway	1 Injury	$150

Date of Event	Location of Release	Failure Description	Material Involved	Transportation Method	Injuries or Fatalities	Total Damage
6/27/1996	North Platte	Vehicle Accident	2,800 LGA Gasoline	Highway	0	$39,300
8/23/1999	North Platte	Loose Component	-	Rail	2 Injuries	$0
10/9/1999	Brule	Vehicle Accident	9.38 LGA Carbon Dioxide	Highway	0	$41,459
5/11/2001	North Platte	Improper Preparation	0.13 CF Anhydrous Ammonia	Rail	1 Injury	$300
9/21/2001	North Platte	-	1 LGA Sulfuric Acid	Rail	1 Injury	$0
5/18/2007	North Platte	Missing Component or Device	10 LGA Flammable Liquids	Rail	2 Injuries	$3,880

Source: PHMSA, 1971-May 2020[63]

Extent

The probable extent of chemical spills during transportation is difficult to anticipate and depends on the type and quantity of chemical released. Releases that have occurred during transportation in the planning area ranged from zero to 72,000 liquid gallons (LGA) and 0.134 to 607.5 cubic feet (CF). Four of the events led to an evacuation.

Average Annual Losses

The average damage per event estimate was determined based upon PHMSA's Incidents Reports since 1971 and the number of historical occurrences. This does not include losses from displacement, functional downtime, economic loss, injury, or loss of life. This hazard causes, on average, less than $11,900 per year in property damages.

Table 45: Chemical Transportation Losses

Hazard Type	Number of Events	Events Per Year	Total Property Loss	Average Annual Property Loss
Chemical Transportation Spills	369	7.4	$594,997	$11,900

Source: PHMSA 1971-June 2020

Probability

Based on the historic record of reported incidents, there is a 94 percent probability (46 out of 49 years with an occurrence) that a transportation chemical release event will occur annually in the planning area.

63 Pipeline and Hazardous Materials Safety Administration. 2020. "Office of Hazardous Materials Safety: Incident Reports Database Search." Accessed July 2020. https://www.phmsa.dot.gov/hazmat/library/data-stats/incidents.

Regional Vulnerabilities

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

Table 46: Regional Chemical and Radiological Transportation Vulnerabilities

Sector	Vulnerability
People	-Those in close proximity to transportation corridors -Possible evacuation -Hospitals, nursing homes, and the elderly at greater risk due to low mobility
Economic	-Evacuations and closed transportation routes could impact businesses near spill
Built Environment	-Risk of fire or explosion
Infrastructure	-Transportation routes can be closed
Critical Facilities	-Critical facilities near major transportation corridors are at risk
Climate	-None

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."[64]

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 47: 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[65]

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.

64 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.

65 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 and U.S. Army Corps of Engineers (USACE) regulate 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 34 dams located within the planning area, with classifications ranging from low to high hazard. Figure 17 maps the location of these dams in the planning area.

Table 48: Dams in the Planning Area

County	Low Hazard	Significant Hazard	High Hazard
Arthur	1	0	0
Keith	4	0	5
Lincoln	14	2	3
McPherson	0	0	0
Total	**19**	**2**	**8**

Source: USACE, 2020[66]

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

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 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 eight high hazard dams located within the planning area. Five are in Keith County and three are in Lincoln County.

Table 49: High Hazard Dams in the Planning Area

County	Dam Name	NID ID	Purpose	Dam Height (Feet)	Max Storage (Acre Ft)	Last Inspection Date
Keith	Brule Creek 1-A	NE00211	Flood Control	53	2,731	6/10/2020
Keith	Cure Creek 1-A	NE00210	Flood Control	35	326	5/22/2019
Keith	Kingsley Dam	NE01048	Hydroelectric, Irrigation, Recreation	163	21,609	9/5/2019
Keith	Ogallala 6 (West Dam)	NE02331	Flood Control	32	170	5/22/2019
Keith	Ogallala 7 (East Dam)	NE02334	Flood Control	38	515	5/22/2019
Lincoln	Sutherland Dam	NE01051	Earthfill	66	181,500	6/19/2018
Lincoln	Maloney Dam	NE01052	Earthfill	44	21,000	6/20/2018
Lincoln	Jeffrey Dam	NE01036	Earthfill	70	12,100	8/16/2016

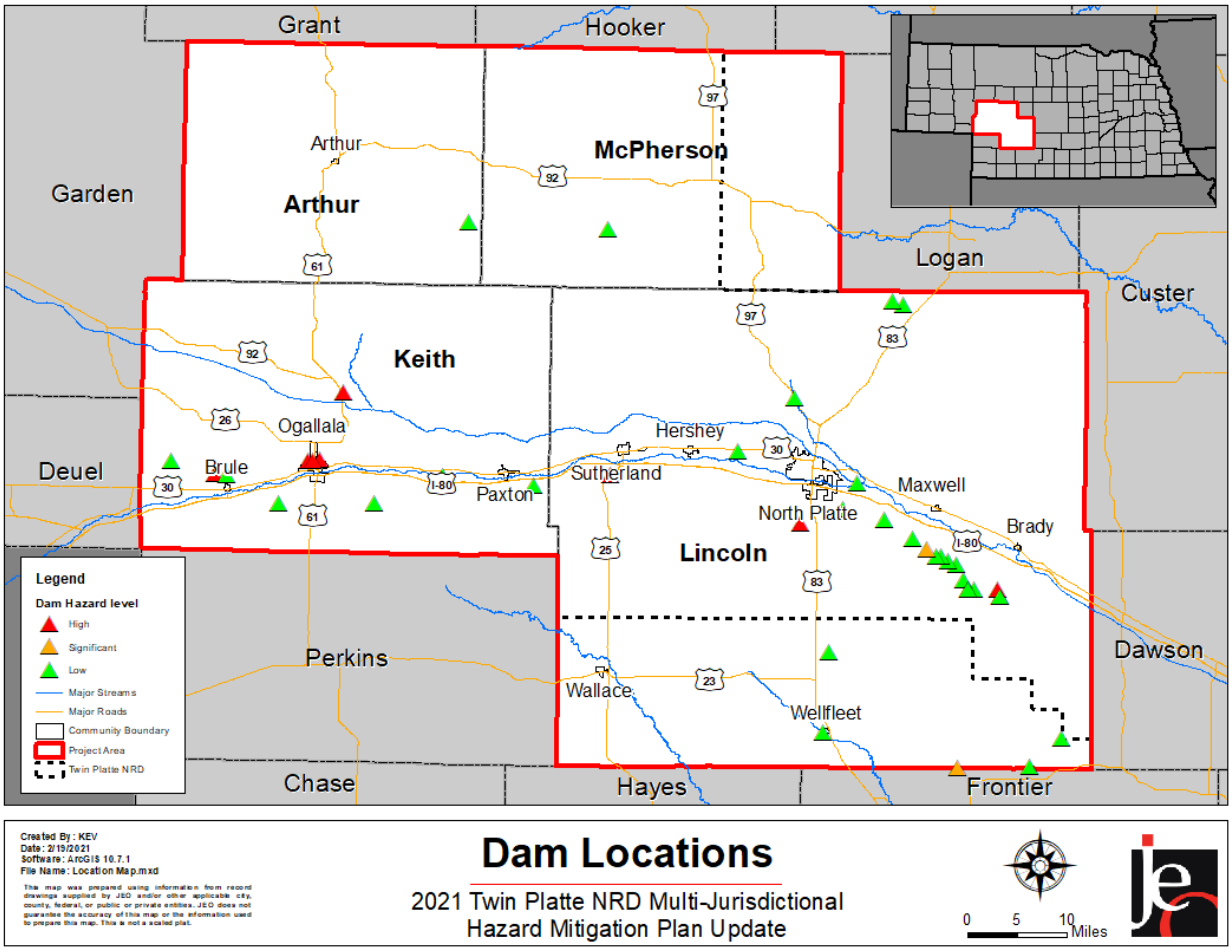
Source: USACE, 2020[67]

Upstream Dams Outside the Planning Area

According to the Arthur, Keith, Lincoln, and McPherson Counties' Local Emergency Operations Plans, [68,69,70,71] there are no upstream dams outside of the planning area that would impact the counties.

67 United States Army Corps of Engineers. June 2020. "National Inventory of Dams." https://nid.sec.usace.army.mil/ords/f?p=105:1:::::::.
68 Arthur County Emergency Management Agency. 2017. "Arthur County Local Emergency Operations Plan."
69 Keith County Emergency Management Agency. 2017. "Keith County Local Emergency Operations Plan."
70 Lincoln County Emergency Management Agency. 2019. "Lincoln County Local Emergency Operations Plan."
71 McPherson County Emergency Management Agency. 2017. "McPherson County Local Emergency Operations Plan."

Figure 17: Dam Locations



Historical Occurrences

According to the NeDNR, there are no reported dam failures within the planning area.

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. 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 one percent annually as no dams have failed in the planning area.

Regional Vulnerabilities

The following table provides information related to regional vulnerabilities; for jurisdictional-specific vulnerabilities, refer to *Section Seven: Community Profiles*. The planning area is home to the Kingsley Dam which is the highest ranked dam in the state based on population at risk. A failure of this dam would impact downstream communities located along the Platte River.

Table 50: 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 -Arthur County: LEOP estimated 2% of the population would be affected -Keith County: LEOP estimated 20% of the population would be affected -Lincoln County: LEOP estimated 85% of the population would be affected -McPherson 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	-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.

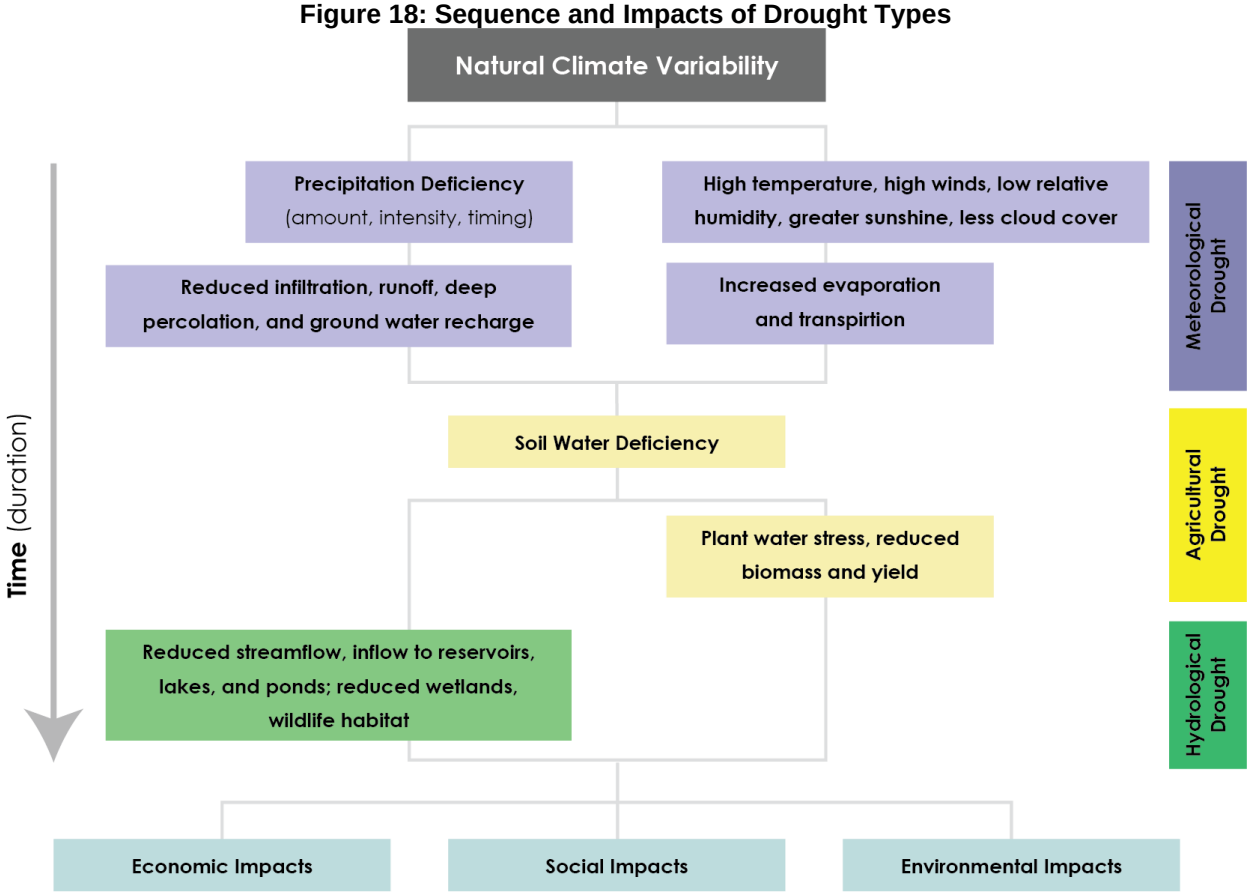
- **Hydrologic Drought** occurs when water available in aquifers, lakes, and reservoirs falls below the statistical average. This situation can arise even when the area of interest receives average precipitation. This is due to the reserves diminishing from increased water usage, usually from agricultural 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.[72]

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

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

Figure 18: Sequence and Impacts of Drought Types



Source: National Drought Mitigation Center, University of Nebraska-Lincoln, 2017[73]

Location

The entire planning area is susceptible to drought impacts.

Historical Occurrences

Table 51 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 20.8 inches according to the NCEI.[74]

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

74 NOAA National Centers for Environmental Information. July 2020. "Data Tools: 1981-2010 Normals." [datafile]. https://www.ncdc.noaa.gov/cdo-web/datatools/normals.

Table 51: 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-Oct 2019[75]

Extent

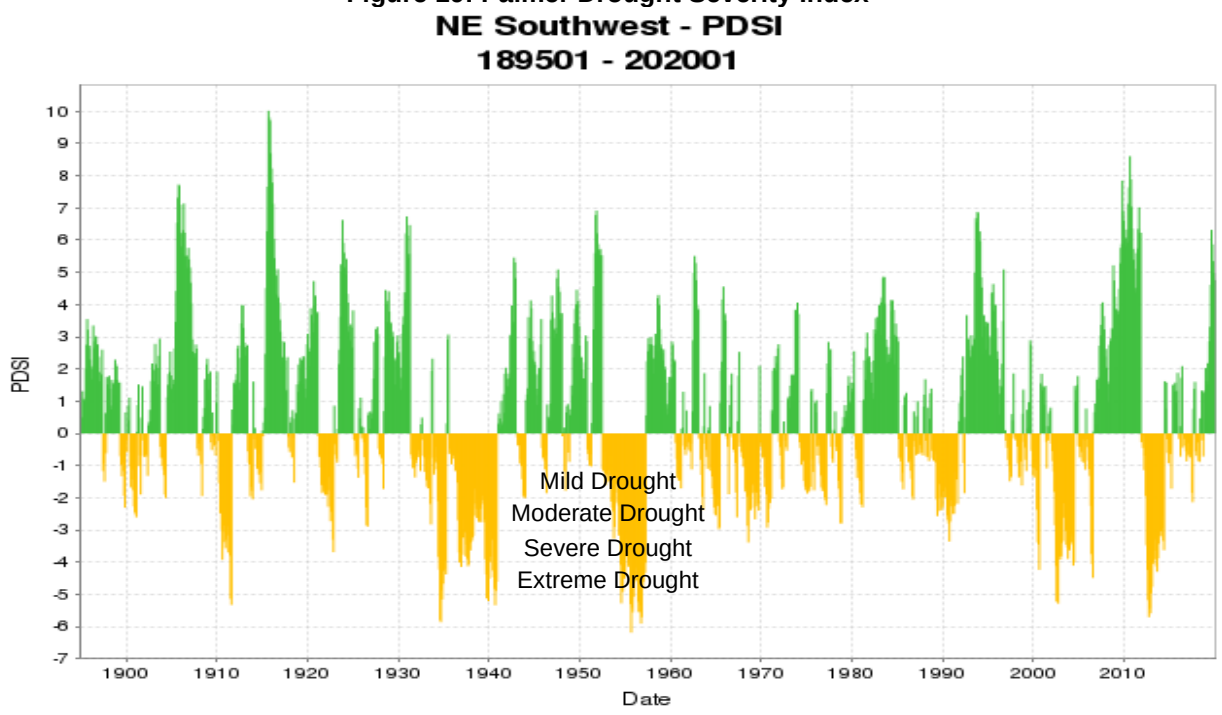
The Palmer Drought Severity Index (PDSI) is utilized by climatologists to standardize global long-term drought analysis. The data for the planning area was collected for Climate Division 7, which includes the planning area. This particular station's period of record started in 1895. Table 52 shows the details of the Palmer classifications. Figure 19 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 moderate, severe, and extreme droughts are likely in the future.

Table 52: 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[76]

Figure 19: Palmer Drought Severity Index

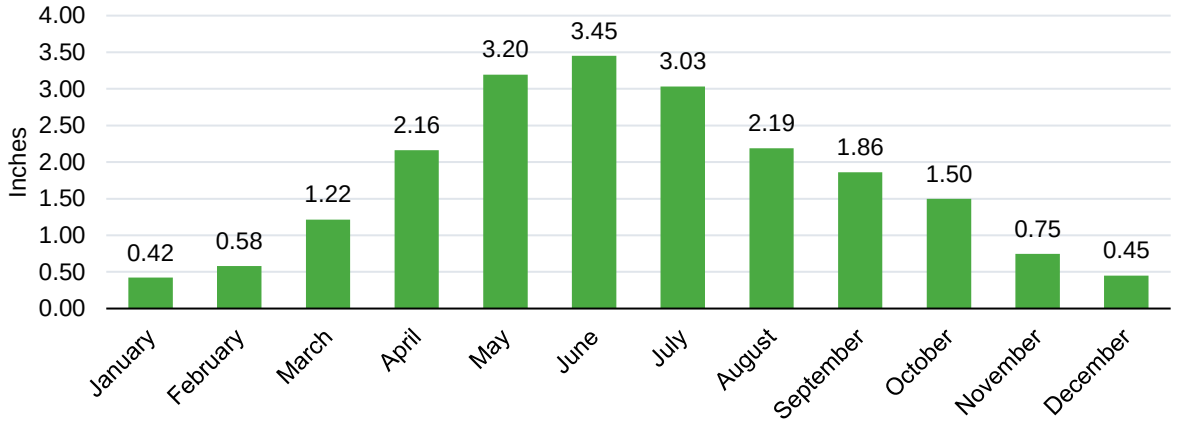


Source: NCEI, Jan. 1895-Jan. 2020

75 National Centers for Environmental Information. 1895-2019. Accessed July 23, 2020. https://www7.ncdc.noaa.gov/CDO/CDODivisionalSelect.jsp.
76 National Weather Service. 2017. "Climate Prediction Center." https://www.cpc.ncep.noaa.gov/.

Figure 20 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. Prolonged deviation from the norm showcases drought conditions and influence growing conditions for farmers.

Figure 20: Average Monthly Precipitation for the Planning Area



Source: NCEI, 2019[77]

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 53: 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	$22,000,000	$956,521.74	$51,367,442	$2,703,549.58

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

Probability

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

Table 54: 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-Dec 2019

77 NOAA National Centers for Environmental Information. July 2020. "Data Tools: 1981-2010 Normals." [datafile]. https://www.ncdc.noaa.gov/cdo-web/datatools/normals.

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 131 drought-related impacts throughout the region. One drought impact in 2003 cost Central Nebraska Public Power District approximately $5 million after water shortages in Lake McConaughy reduced the ability to generate hydroelectricity. Other notable drought impacts are summarized in the following table. This is not a comprehensive list of droughts that may have impacted the planning area, however.

Table 55: Notable Drought Impacts in Planning Area

Category	Date	Affected Counties	Title
Agriculture, Plants & Wildlife	9/13/2020	Arthur, Keith, Lincoln, McPherson	Grass growth slowed in western Nebraska
Relief, Response & Restrictions, Water Supply & Quality	7/30/2013	Keith, Lincoln	Central Nebraska Public Power and Irrigation District reducing releases from Lake McConaughy
Energy, Water Supply & Quality	5/9/2013	Keith, Lincoln	Electric power generation levels below peak production for Central Nebraska Public Power District
Agriculture, Relief, Response & Restrictions, Water Supply & Quality	1/1/2013	Keith, Lincoln	Reduced water allotment for irrigators in the Central Nebraska Public Power and Irrigation District
Agriculture, Relief, Response & Restrictions, Water Supply & Quality	1/1/2013	Lincoln	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, Water Supply & Quality	8/7/2012	Arthur, Keith, Lincoln, McPherson	Nebraska ranchers hauling water to livestock
Agriculture, Relief, Response & Restrictions,Water Supply & Quality	7/19/2012	Keith, Lincoln	Low flow in several Nebraska rivers brought surface irrigation closures
Plants & Wildlife	6/1/2012	Arthur, Keith, Lincoln, McPherson	Many trees in western Nebraska died from drought, high temperatures and strong winds in 2012
Agriculture, Plants & Wildlife	5/1/2012	Arthur, Keith, Lincoln, McPherson	Drought led ranchers in western Nebraska to cull cow herds by 25 to 60 percent
Agriculture, Fire, Plants & Wildlife	1/1/2012	McPherson	Drought causing pasture problems for livestock producer in McPherson County, Nebraska
Relief, Response & Restrictions, Water Supply & Quality	1/7/2009	Keith	Lawsuit over groundwater use in western Nebraska
Water Supply & Quality	8/5/2008	Keith, Lincoln	Water from Johnson, Jeffrey, and Midway Lakes is being used for irrigation from August 11 through August 26 rather than Lake McConaughy to preserve the

Category	Date	Affected Counties	Title
			amount of water in the lake as it remains low after years of drought.
Plants & Wildlife	1/1/2007	Keith	Far fewer eagles have been seen this year at the Kingsley power plant near Lake McConaughy and at the Johnson J-2 power plant near Lexington, Nebraska.
Relief, Response & Restriction	9/13/2006	Arthur, Keith, Lincoln, McPherson	Governor Dave Heineman announced that 39 Nebraska counties will receive $3.6 million in livestock drought assistance from the USDA.
Relief, Response & Restriction	7/17/2006	Arthur, Keith, Lincoln, McPherson	The U.S. Agriculture Secretary Mike Johanns has designated 49 Nebraska counties as primary disaster areas due to the ongoing drought as requested by Governor Heineman. An additional 10 counties were designated as contiguous disaster areas.
Agriculture	6/15/2006	Lincoln	The U.S. Department of Agriculture approved an additional 8 counties for emergency grazing on Conservation Reserve Program land.
Relief, Response & Restriction	4/5/2006	Lincoln	Continued drought conditions have lowered water levels along Lake Maloney, causing a portion of the lake's sandy bottom to be exposed. Residents who live near the lake report that blowing sand and silt from the lake bottom is settling in and near their homes.
Relief, Response & Restriction	11/4/2005	Arthur, Keith, Lincoln	The U.S. Department of Agriculture designated 13 counties as disaster areas because of drought and other weather events.
Water Supply & Quality	3/25/2005	Lincoln	Nebraska Public Power District has drilled 38 news wells around Gerald Gentleman Power Plant at Sutherland. The action was taken to ensure adequate water levels in the Sutherland reservoir and to stay within cooling water discharge temperature limits.
Energy	12/31/2004	Keith	Drought curtailed hydropower production at Lake McConaughy in western Nebraska.
Relief, Response & Restriction	7/1/2004	Arthur, Keith, Lincoln, McPherson	Due to severe drought conditions, the Nebraska Farm Services Agency announced on July 2 that farmers and ranchers in 24 Nebraska counties are eligible to use Conservation Reserve Program acres for emergency grazing.
Relief, Response & Restriction	6/24/2004	Arthur, Keith, Lincoln, McPherson	19 Nebraska counties were declared disaster areas due to ongoing drought by the U.S. Secretary of Agriculture.

Category	Date	Affected Counties	Title
Relief, Response & Restriction	1/1/2004	McPherson	The U.S. Department of Agriculture designated the following Nebraska counties as primary natural disaster areas on Dec. 28, 2004, due to drought that occurred from Jan. 1, 2004, and continuing:
Water Supply & Quality	1/1/2004	Keith	The Central Nebraska Public Power and Irrigation District is losing revenue because water releases are low and result in less hydropower production.
Tourism & Recreation	1/1/2004	Keith	Recreation has suffered during drought at Lake McConaughy, where annual visits have fallen from 1 million to 650,000 people, according to the Mitch Gerstenkorn, supervisor of the lake for the Nebraska Game and Parks Commission.
Society and Public Health	10/29/2003	Keith	Drought conditions have lowered water levels at Lake McConaughy and partially exposed the original site of Lemoyne, a Keith County town that was intentionally flooded and relocated in 1941 in conjunction with the lake's creation.
Relief, Response & Restriction	5/30/2003	Keith	According to the Lake McConaughy Superintendent, drought-induced lower water levels have led to a decrease in visitation and recreation at the lake.
Water Supply & Quality	2/6/2003	Keith	Lake McConaughy may become bone dry in Keith County, Nebraska
Tourism & Recreation, Water Supply & Quality	1/31/2003	Keith	Drought causing economic losses in Nebraska
Water Supply & Quality	1/1/2003	Keith, Lincoln	Central Nebraska Public Power and Irrigation District, which owns Lake McConaughy, lost a total of about $5 million dollars in 2003-2004 because there was not enough water in the lake to generate hydroelectricity.
Agriculture	1/1/2003	Lincoln	The 2002 drought led to no hay in North Platte and farmers were forced to sell their livestock to avoid bankruptcy.
Agriculture, Water Supply & Quality	10/14/2002	Keith, Lincoln	Irrigation districts are affected by drought in Central Nebraska
Water Supply & Quality	7/10/2001	Keith	Lake McConaughy was low on flow in Keith County, Nebraska

Source: NDMC, 2000-2020[78]

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

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

Table 56: Regional Drought 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

EARTHQUAKES

An earthquake is the result of a sudden release of energy in the Earth's tectonic plates that creates seismic waves. The seismic activity of an area refers to the frequency, type, and size of earthquakes experienced over a period of time. Although rather uncommon, earthquakes do occur in Nebraska and are usually small, generally not felt, and cause little to no damage. Earthquakes are measured by magnitude and intensity. Magnitude is measured by the Richter Scale, a base-10 logarithmic scale, which uses seismographs around the world to measure the amount of energy released by an earthquake. Intensity is measured by the Modified Mercalli Intensity Scale, which determines the intensity of an earthquake by comparing actual damage against damage patterns of earthquakes with known intensities. The following tables summarize the Richter Scale and Modified Mercalli Scale.

Table 57: Richter Scale

Richter Magnitudes	Earthquake Effects
Less than 3.5	Generally not felt, but recorded.
3.5 – 5.4	Often felt, but rarely causes damage.
Under 6.0	At most, slight damage to well-designed buildings. Can cause major damage to poorly constructed buildings over small regions.
6.1 – 6.9	Can be destructive in areas up to about 100 kilometers across where people live.
7.0 – 7.9	Major earthquake. Can cause serious damage over larger areas.
8 or greater	Great earthquake. Can cause serious damage in areas several hundred kilometers across.

Source: FEMA, 2016[79]

Table 58: Modified Mercalli Intensity Scale

Scale	Intensity	Description of Effects	Corresponding Richter Scale Magnitude
I	Instrumental	Detected only on seismographs	
II	Feeble	Some people feel it	< 4.2
III	Slight	Felt by people resting, like a truck rumbling by	
IV	Moderate	Felt by people walking	
V	Slightly Strong	Sleepers awake; church bells ring	< 4.8
VI	Strong	Trees sway; suspended objects swing, objects fall off shelves	< 5.4
VII	Very Strong	Mild Alarm; walls crack; plaster falls	< 6.1
VIII	Destructive	Moving cars uncontrollable; masonry fractures, poorly constructed buildings damaged	
IX	Ruinous	Some houses collapse; ground cracks; pipes break open	< 6.9
X	Disastrous	Ground cracks profusely; many buildings destroyed; liquefaction and landslides widespread	< 7.3
XI	Very Disastrous	Most buildings and bridges collapse; roads, railways, pipes and cables destroyed; general triggering of other hazards	< 8.1
XII	Catastrophic	Total destruction; trees fall; ground rises and falls in waves	> 8.1

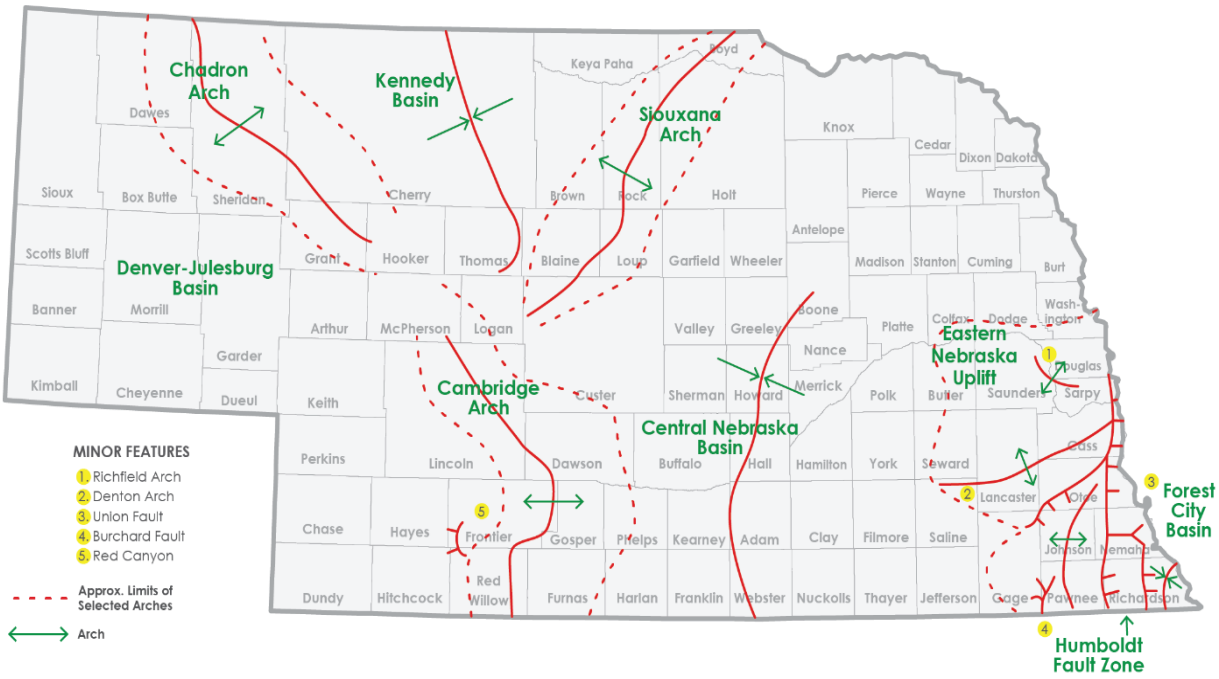
Source: FEMA, 2016

79 Federal Emergency Management Agency. 2016. "Earthquake." https://www.fema.gov/earthquake.

Location

The planning area has one fault line crossing it. The Cambridge Arch Fault is active in the planning area. The following figure shows the fault lines in Nebraska.

Figure 21: Fault Lines in Nebraska



Source: Nebraska Department of Natural Resources

Historical Occurrences

According to the United States Geological Survey (USGS), there have been zero earthquakes that have occurred in the planning area since 1900.

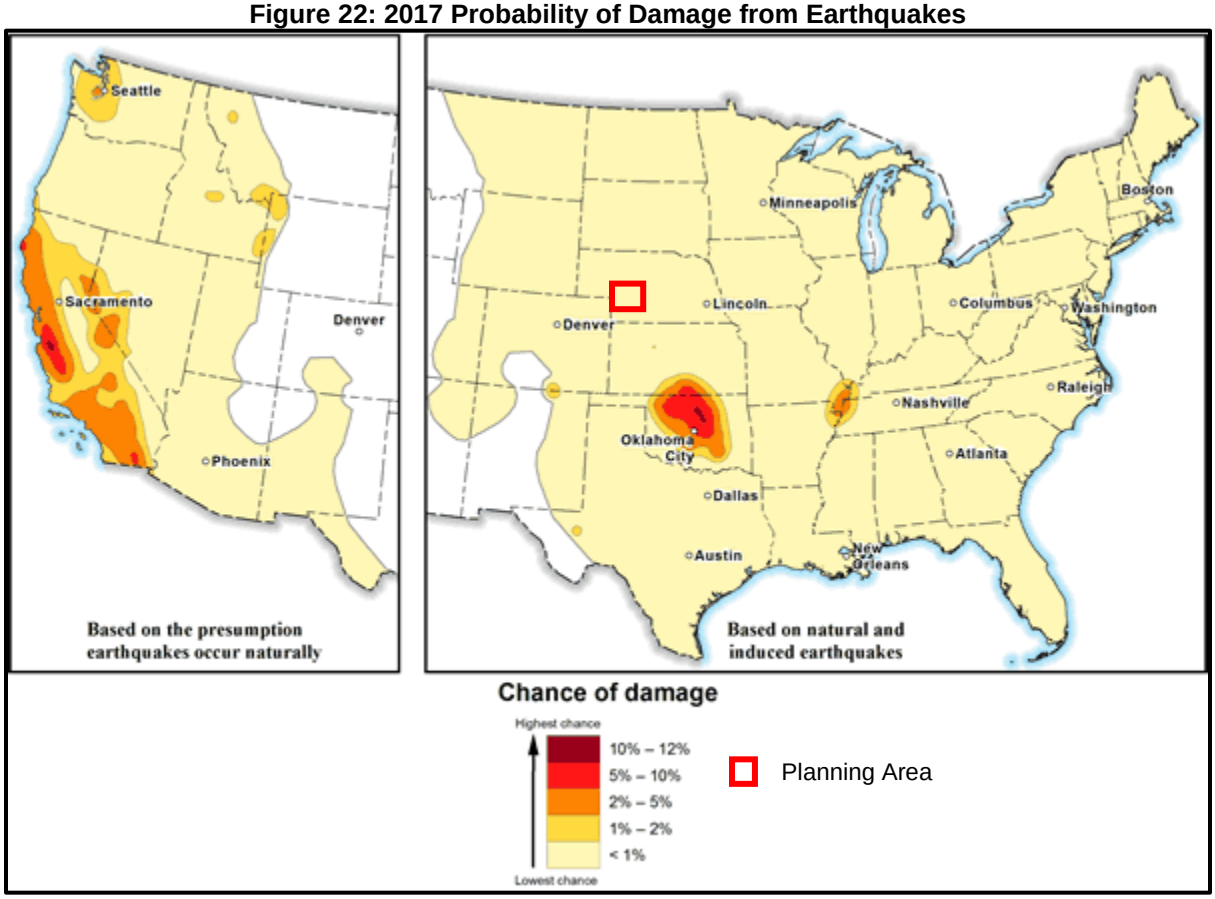
Extent

If an earthquake were to occur in the planning area, it would likely measure between 5.0 or less on the Richter Scale. Very little to no damage is anticipated from events of these magnitudes.

Average Annual Losses

Due no historical earthquakes and low earthquake risk for the area, it is not feasible to utilize the 'event damage estimate formula' to estimate potential losses for the planning area. Figure 22 shows the probability of damage from earthquakes, according to the USGS. The figure shows that the planning area has a less than one percent chance of damages from earthquakes.

Figure 22: 2017 Probability of Damage from Earthquakes



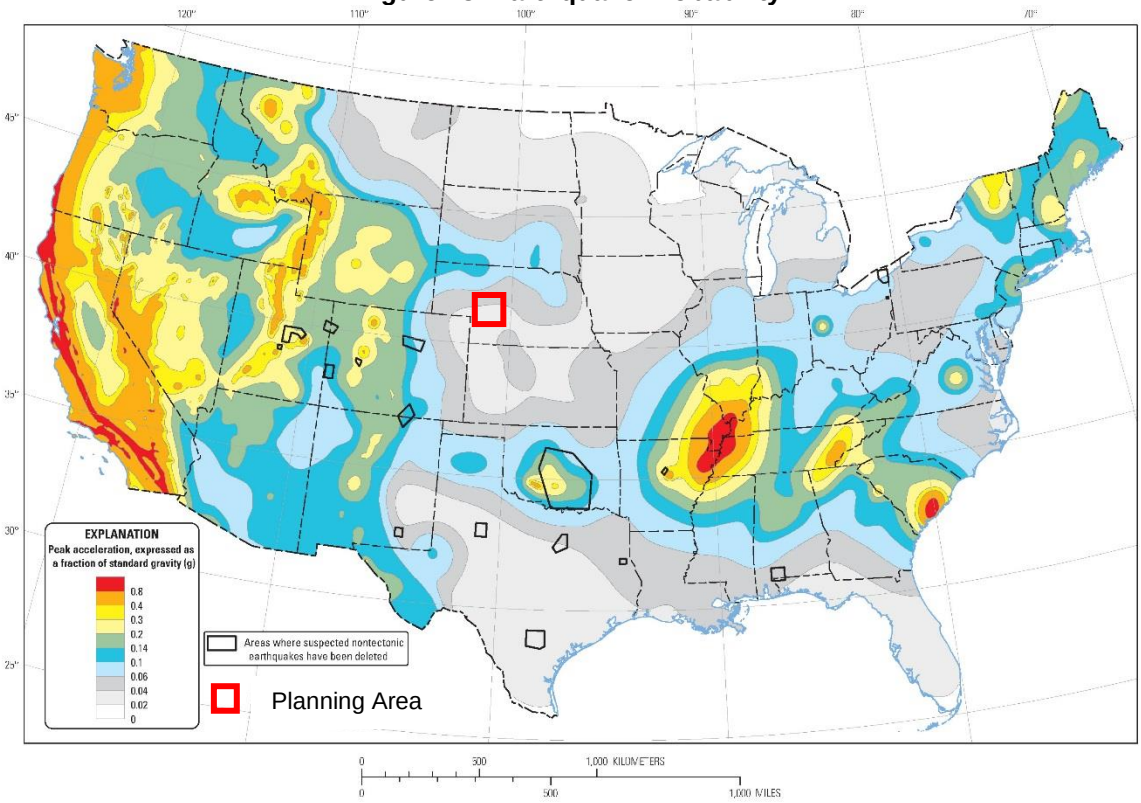
Source: USGS, 2017[80]

Probability

The following figure visualizes the probability of a 5.0 or greater earthquake occurring in the planning area within 50 years. Based on zero occurrences of earthquakes over 120-year period, the probability of an earthquake in the four-county region in any given year is less than one percent.

80 United States Geological Survey. 2017. "Short-term Induced Seismicity Models: 2017 One-Year Model." https://earthquake.usgs.gov/hazards/induced/index.php#2017.

Figure 23: Earthquake Probability



Source: USGS 2009 PSHA Model
**Map shows the two-percent probability of exceedance in 50 years of peak ground acceleration.*

Regional Vulnerabilities

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

Table 59: Regional Earthquakes Vulnerabilities

Sector	Vulnerability
People	-Risk of injury or death from falling objects and structures
Economic	-Short term interruption of business
Built Environment	-Damage to buildings, homes, or other structures from foundation cracking, falling objects, shattered windows, etc.
Infrastructure	-Damage to subterranean infrastructure (i.e. waterlines, gas lines, etc.) -Damage to roadways
Critical Facilities	-Same as all other structures
Climate	-None

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. 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.

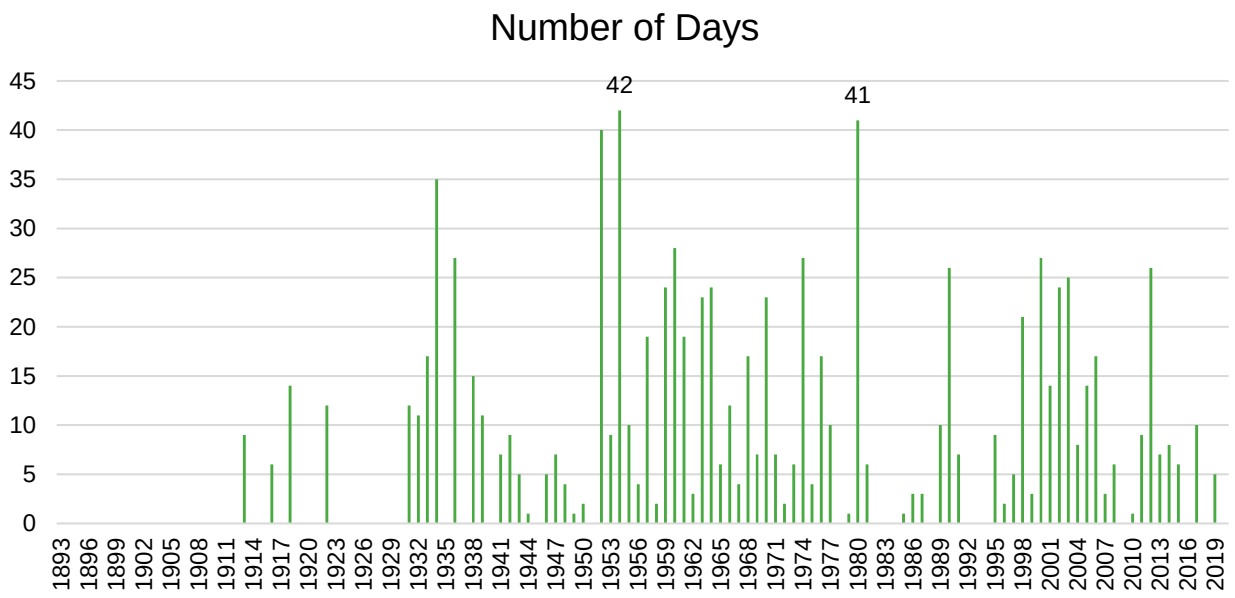
Location

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 five days above 100°F per year. The planning area experienced the most days on record above 100°F in 1954 with 42 days and in 1980 with 41 days. Conversely, 2018 was the most recent “coolest” year on record, with zero days above 100°F.

Figure 24: Number of Days Above 100°F



Source: HPRCC, 1893-2019

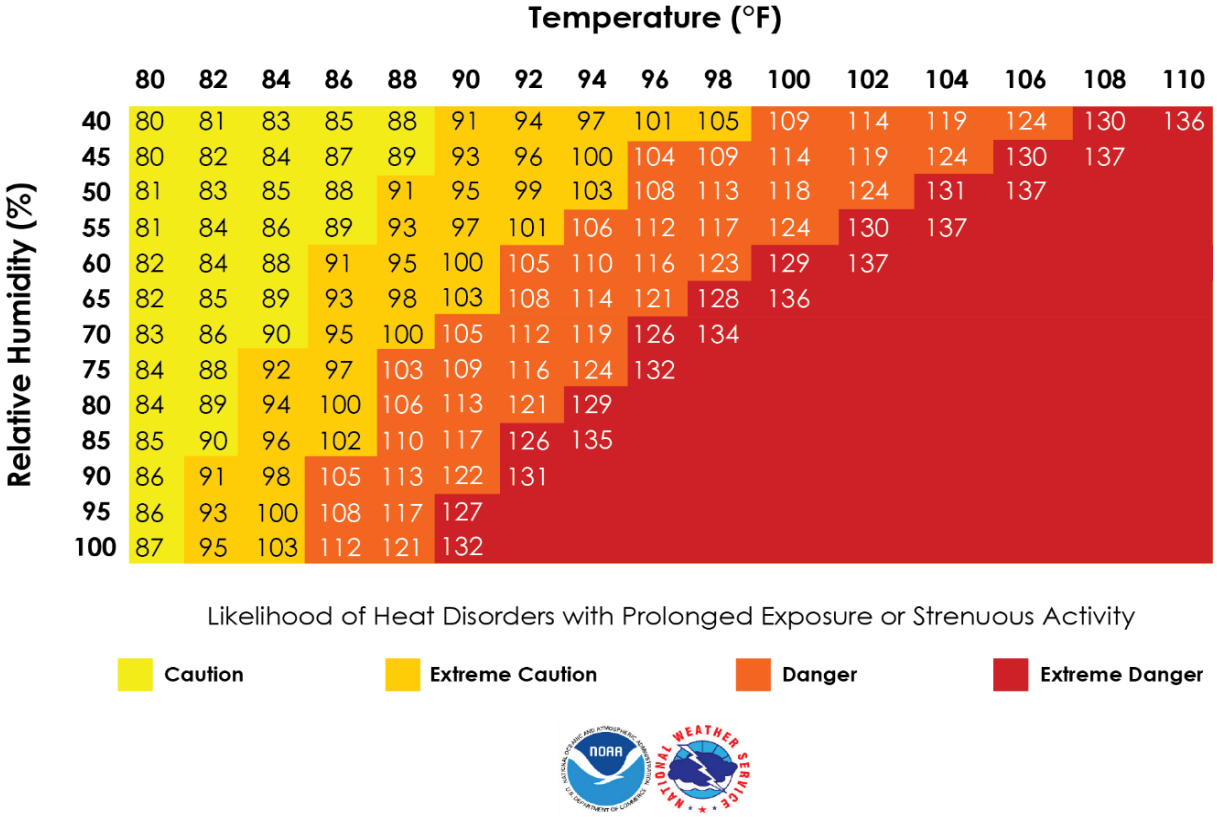
Extent

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, 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:

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

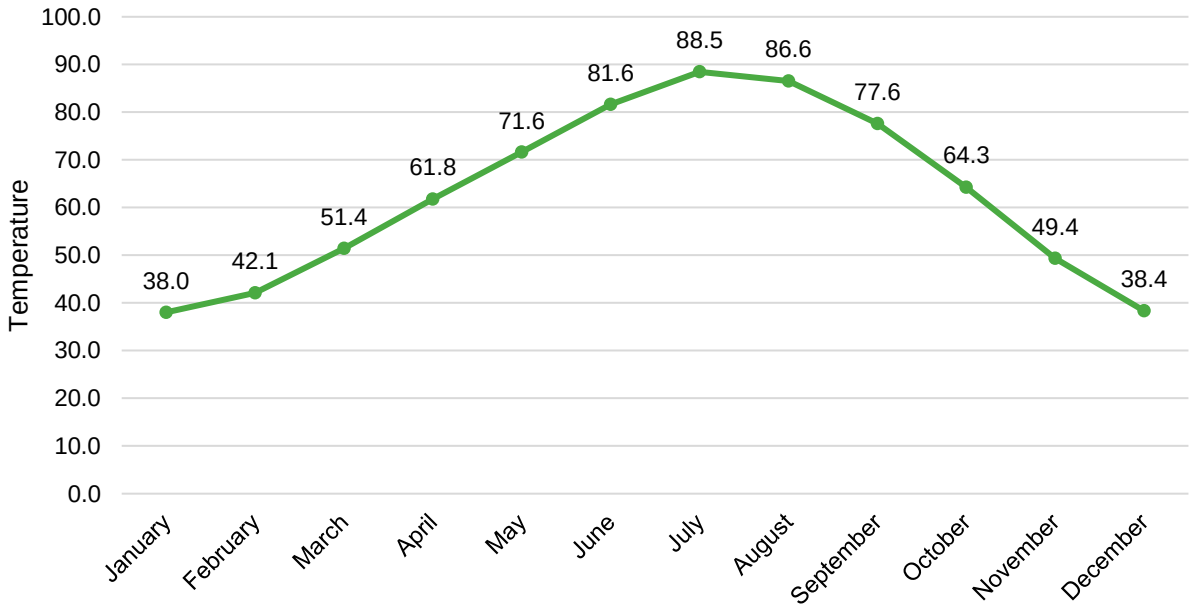
Figure 25 is designed for shady and light wind conditions. Exposure to full sunshine or strong winds can increase hazardous conditions and raise heat index values by up to 15°F. For the purposes of this plan, extreme heat is being defined as temperatures of 100°F or greater. In the planning area, the months with the highest temperatures are June, July, and August.

Figure 25: NOAA Heat Index



Source: NOAA, 2017[81]

Figure 26: Monthly Climate Normals Max Temperature (1981-2010)



Source: NCEI, 2019

81 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 60: Loss Estimate for Extreme Heat

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	5 days	$0	$0	$10,616,932	$461,606

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

Estimated Loss of Electricity

According to the FEMA Benefit Cost Analysis 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.[82] 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 61: Loss of Electricity - Assumed Damage by Jurisdiction

Jurisdiction	(est.) 2017 Population	Population Affected (Assumed)	Electric Loss of Use Assumed Damage Per Day
Arthur	418	42	$5,292
Keith	8,099	810	$102,060
Lincoln	35,433	3,543	$446,418
McPherson	454	45	$5,670
Total	**44,404**	**4,440**	**$559,440**

Probability

Extreme heat is a regular part of the climate for the planning area; with 77 years out of 128 having at least one day of 100°F. The probability that extreme heat will occur in any given year in the planning area is 60 percent.

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*[83] 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.

82 Federal Emergency Management Agency. June 2009. "BCA Reference Guide."
83 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 62: Extreme Heat Predictions for Days over 100F

Jurisdiction	Midcentury Prediction 2036-2065 (days per year)	Late Century Prediction 2070-2099 (days per year)
Arthur	10	32
Keith	14	39
Lincoln	43	11
McPherson	37	7

Source: Union of Concerned Scientists, 1971-2019[84]

Regional Vulnerabilities

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

Table 63: Regional 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

84 Union of Concerned Scientists. 2019. "Extreme Heat and Climate Change: Interactive Tool". https://www.ucsusa.org/global-warming/global-warming-impacts/extreme-heat-interactive-tool?location=lancaster-county--ne

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, stormwater flooding, and ice jam flooding.

Riverine Flooding

Riverine flooding, typically slower developing with a moderate to long warning time, 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 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 draining to a river and its tributaries.

Flash Flooding

Flash floods, typically rapidly developing with little to no warning time, result from convective precipitation usually due to intense thunderstorms or sudden releases due to a failure of 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 because of this shorter timescale. Flooding from excessive rainfall events in Nebraska usually occurs between late spring and early fall.

Stormwater 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 capacity. 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 stormwater flooding, is becoming increasingly prevalent as development exceeds the capacity of drainage infrastructure, therefore limiting its ability to convey stormwater. Flooding also occurs due to combined storm and sanitary sewers being overwhelmed by the high flows that often accompany storm events. Typical impacts range from dangerously flooded roads to water backing up into homes or 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 or winter freezing, 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. This type of flooding tends to ore frequently occur on wide, shallow rivers such as the Platte, although other rivers can be impacted.

Location

The region resides in the South Platte, Middle Platte, North Platte, Loup, and Republican River watersheds. These rivers as well as their tributaries are potential locations for flooding to occur.

Table 64 shows current statuses of Flood Insurance Rate Map (FIRM) panels. Figure 27 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 64: FEMA FIRM Panel Status

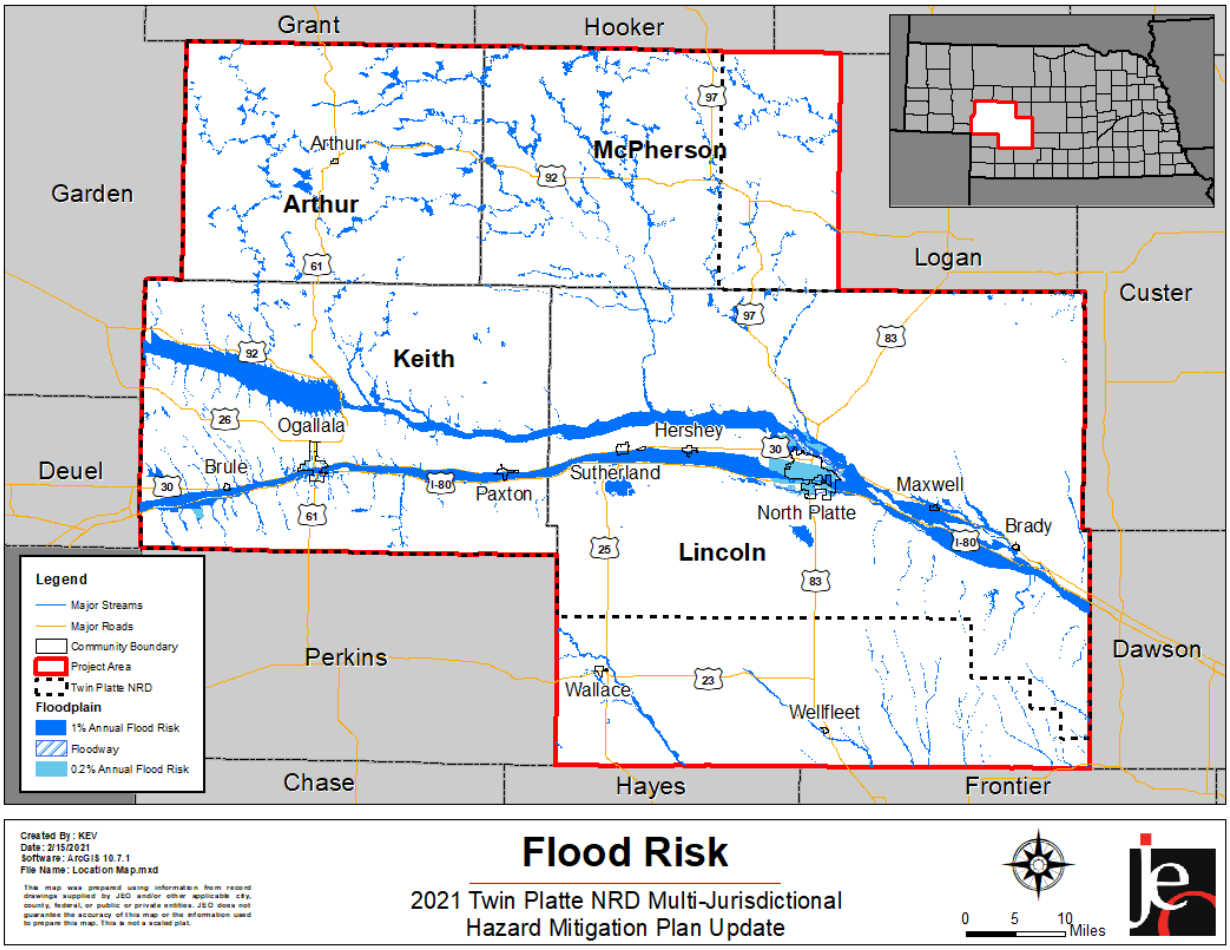
Jurisdiction	Participating in NFIP? (Y/N)	Panel Number	Effective Date
Arthur County	N	Unmapped	N/A
Arthur	N	310006	1/10/1975
Brady	Y	31111CIND0A, 31111C0950C, 31111C0965C	1/2/2009
Brule	Y	31101CIND0A, 31101C0575C	9/30/2005
Hershey	Y	31111CIND0A, 31111C0570C, 31111C0590C	1/2/2009
Keith County	Y	31101CIND0A, 31101C0025C, 31101C0075C, 31101C0100C, 31101C0125C, 31101C0150C, 31101C0175C, 31101C0200C, 31101C0225C, 31101C0250C, 31101C0275C, 31101C0300C, 31101C0325C, 31101C0350C, 31101C0375C, 31101C0400C, 31101C0425C, 31101C0450C, 31101C0475C, 31101C0500C, 31101C0525C, 31101C0550C, 31101C0575C, 31101C0600C, 31101C0625C, 31101C0650C, 31101C0675C, 31101C0700C	9/30/2005
Lincoln County	Y	31111CIND0A, 31111C0950C, 31111C0965C, 31111CIND0A, 31111C0570C, 31111C0590C, 31111CIND0A, 31111C0910C, 31111CIND0A, 31111C0615C, 31111C0620C, 31111C0640C, 31111C0855C, 31111C0860C, 31111C0880C, 31111CIND0A, 31111C0545C, 31111C0565C, 31111CIND0A, 31111C1235C31111CIND0A, 31111C1340C, 31111C1555C	1/2/2009
Maxwell	Y	31111CIND0A, 31111C0910C	1/2/2009
McPherson County	N	Unmapped	N/A
North Platte	Y	31111CIND0A, 31111C0615C, 31111C0620C, 31111C0640C, 31111C0855C, 31111C0860C, 31111C0880C	1/2/2009
Ogallala	Y	31101CIND0A, 31101C0425C, 31101C0450C, 31101C0600C, 31101C0625C	9/30/2005
Paxton	Y	31101CIND0A, 31101C0525C, 31101C0700C	9/30/2005
Sutherland	Y	31111CIND0A, 31111C0545C, 31111C0565C	1/2/2009
Wallace	N	31111CIND0A, 31111C1235C	1/2/2009
Wellfleet	N	31111CIND0A, 31111C1340C, 31111C1555C	1/2/2009

Source: FEMA, 2020[85,86]

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

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

Figure 27: 1% and 0.2% Annual Flood Risk Hazard Areas



**Floodplains in Arthur County and McPherson County are based off a HAZUS created floodplain.*

Risk Map Products

Risk Mapping, Assessment, and Planning (Risk MAP) is a FEMA program that provides communities with flood information and additional flood risk data (e.g., flood depth grids, percent chance grids, areas of mitigation interest, etc.) that can be used to enhance their mitigation plans and better protect their citizens. None of the counties have Risk MAP products and there are currently no planned Risk MAP projects in the planning area. NeDNR hosts the Risk MAP products on an interactive web map, which can be viewed on their webpage: https://dnr.nebraska.gov/floodplain.

Extent

The NWS has three categories to define the severity of a flood once a river reaches flood stage as indicated in Table 65.

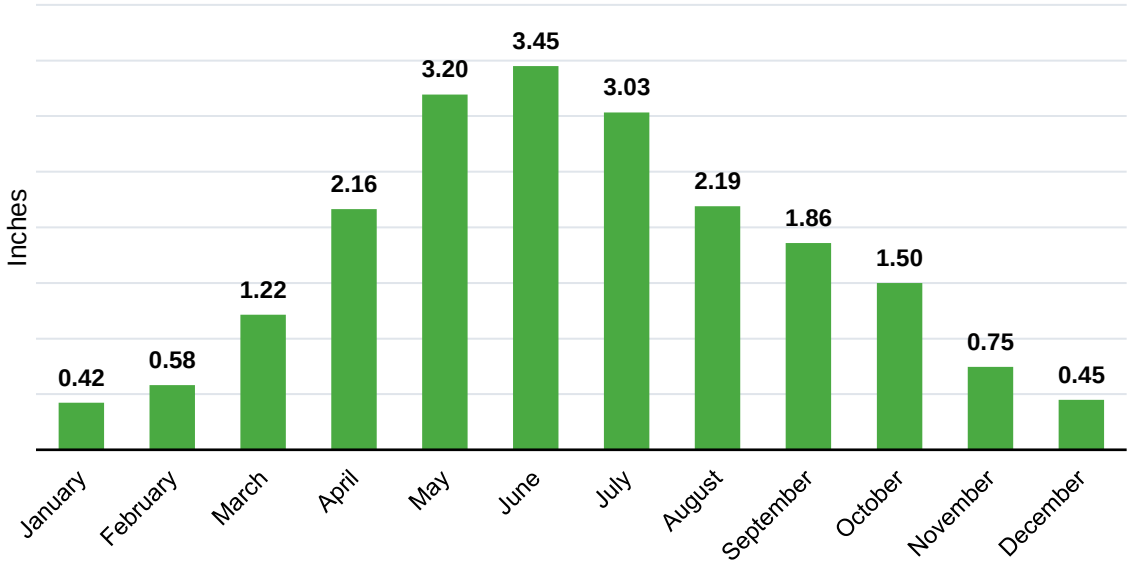
Table 65: Flooding Stages

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[87]

Figure 28 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 29, the most common months for flooding within the planning area are May and June.

Figure 28: Average Monthly Precipitation for Planning Area

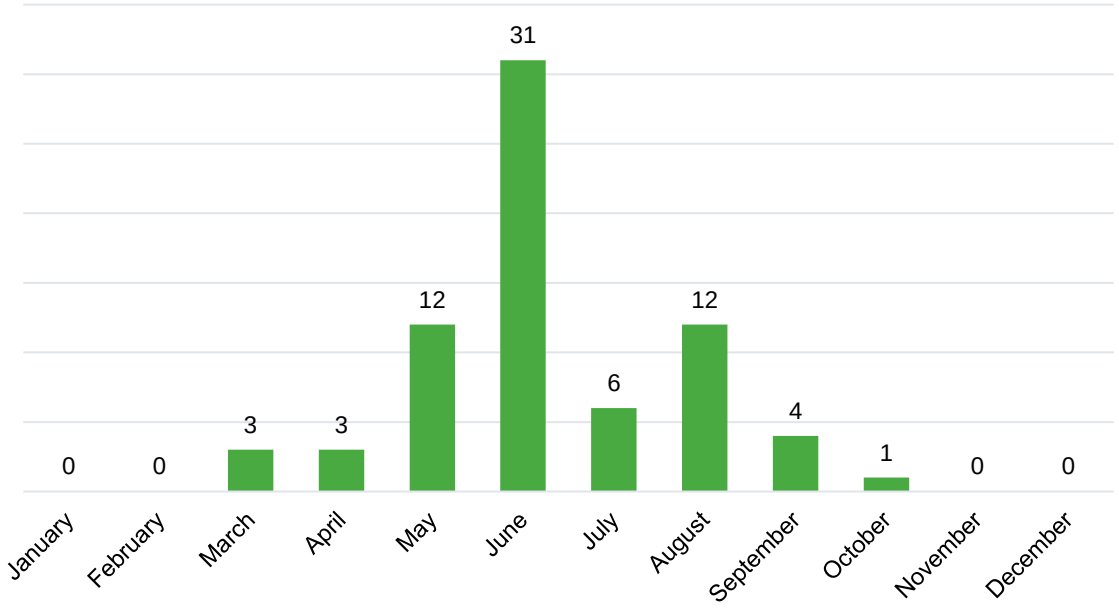


Source: NCEI, 2019[88]

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

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

Figure 29: 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 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 66: NFIP Participants

Jurisdiction	Participate in NFIP	Eligible-Regular Program	Date Current Map	Sanction	Suspension	Rescinded
Arthur County	No	-	-	-	-	-
Arthur	No	-	-	-	-	-
Brady	Yes	06/03/86	01/02/09(M)	-	-	-
Brule	Yes	09/27/85	09/30/05	-	-	-
Hershey	Yes	08/19/87	01/02/09(M)	-	-	-
Keith County	Yes	09/27/85	09/30/05	-	-	-
Lincoln County	Yes	08/01/87	01/02/09(M)	-	-	-
Maxwell	Yes	09/27/85	01/02/09(M)	-	-	-

Jurisdiction	Participate in NFIP	Eligible-Regular Program	Date Current Map	Sanction	Suspension	Rescinded
McPherson County	No	-	-	-	-	-
North Platte	Yes	11/01/79	01/02/09	-	-	-
Ogallala	Yes	09/30/87	09/30/05	-	-	-
Paxton	Yes	09/27/85	09/30/05	-	-	-
Sutherland	Yes	09/27/85	01/02/09(M)	-	-	-
Wallace	No	-	-	-	-	-
Wellfleet	No	-	-	-	-	-

Source: Federal Emergency Management Agency, National Flood Insurance Program, 2017[89]
**(M) indicates no elevation determined – All Zone A, C, and X*

The NFIP Emergency Program allows a community to voluntarily participate in the NFIP if no flood hazard information is available for their area; the community has a Flood Hazard Bound Map but no FIRM; or the community has been identified as flood-prone for less than a year.

Table 67: NFIP Policies in Force and Total Payments

Jurisdiction	Policies In-force	Total Coverage	Total Premiums	Total Losses	Total Payments
Hershey	20	$1,878,600	$23,678	4	$5,332
Keith County	7	$681,900	$5,404	4	$27,085
Lincoln County	59	$9,606,000	$63,492	4	$1,000
Maxwell	17	$1,399,600	$17,598	4	$42,700
North Platte	125	$35,916,600	$87,470	63	$205,202
Ogallala	19	$6,942,900	$38,628	2	$11,468
Sutherland	3	$157,500	$2,298	1	$0

Source: HUDEX, July 2019

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.[90] 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 2020, there were no repetitive loss or severe repetitive loss properties located in the planning area.

NFIP RL: Repetitive Loss Structure refers to a structure covered by a contract for flood insurance under the NFIP that has incurred flood-related damage on two occasions during a 10-year period, each resulting in at least a $1,000 claim payment.

89 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.
90 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.

NFIP SRL: Severe Repetitive Loss Properties are defined as single or multifamily residential properties that are covered under an NFIP flood insurance policy and:

(1) That have incurred flood-related damage for which four or more separate claims payments have been made, with the amount of each claim (including building and contents payments) exceeding $5,000, and with the cumulative amount of such claim payments exceeding $20,000; or

(2) For which at least two separate claims payments (building payments only) have been made under such coverage, with cumulative amount of such claims exceeding the market value of the building.

(3) In both instances, at least two of the claims must be within 10 years of each other, and claims made within 10 days of each other will be counted as one claim.

HMA RL: A repetitive loss property is a structure covered by a contract for flood insurance made available under the NFIP that:

(1) Has incurred flood-related damage on two occasions, in which the cost of the repair, on the average, equaled or exceeded 25 percent of the market value of the structure at the time of each such food event; and

(2) At the time of the second incidence of flood-related damage, the contract for flood insurance contains increased cost of compliance coverage.

HMA SRL: A severe repetitive loss property is a structure that:

(1) Is covered under a contract for flood insurance made available under the NFIP.

(2) Has incurred flood related damage –

(a) For which four or more separate claims payments (includes building and contents) have been made under flood insurance coverage with the amount of each such claim exceeding $5,000, and with the cumulative amount of such claim payments exceeding $20,000; or

(b) For which at least two separate claims payments (includes only building) have been made under such coverage, with the cumulative amount of such claims exceeding the market value of the insured structure.

Purpose of the HMA definitions: The HMA definitions were allowed by the Biggert-Waters Flood Insurance Reform Act of 2012 to provide an increased federal cost share under the FMA grant when a property meets the HMA definition.

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, 52 flash flooding events resulted in $3,035,000 in property damage, while 20 riverine flooding events resulted in $996,000 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 $660,451. Descriptions of the most damaging flood events from the NCEI are below:

- **August 28, 1999 – Flash Flood – Lincoln County:** Roads and culverts were washed out in the southwest part of Lincoln County. A Madrid couple was unable to stop their Buick before hitting a washed-out road 1 mile west of Wallace on Highway 23. The car was swept away. Both people escaped the car, and one person was able to get to dry land and call for help. The other was rescued after clinging to a tree for more than two hours. Both individuals were treated at Grant Community Hospital and released. The event caused $1,000,000 in property damages.
- **July 6, 2002 – Flash Flood – Keith County:** Flood waters inundated hotels and businesses along Interstate 80 in Ogallala. One bridge and numerous roads were damaged or washed out. One person was killed four miles west of Ogallala as a bridge approach collapsed on Interstate 80. There were 64 homes with water damage. There were $800,000 in damages from the event.
- **May 28-29, 2007 – Flash Flood – Lincoln County:** Thunderstorms produced very heavy rainfall of 2 to 6 inches across Lincoln County. Asher Road 4 miles southwest of Wellfleet washed out creating a crater of 1/2 mile long by 4 feet deep. A bridge washed out south of Wellfleet on the Hayes Center Road. Highways 23, 25 and 83 were under water in several locations. Numerous secondary roads were severely damaged due to water over the roads. Houses north of the railroad tracks in Maxwell flooded with 2 1/2 feet of water. In total the two-day event caused $600,000 in property damage.
- **September 18, 2013 – Flood – Keith County:** Flooding occurred along the South Platte River. Cropland and pastureland along the river were flooded. The Nebraska Link 51A Link and Nebraska Link 51B connecting Interstate 80 with the communities of Brule and Roscoe were closed. At least three businesses sustained minor flooding in Brule and Ogallala. Septic problems were noted at several residences around Brule causing some basement damage. Two homes southeast of Roscoe near Nebraska Link 51B suffered severe damage. The event caused $335,000 in damages.

In March 2019, much of the State of Nebraska was impacted by a large winter storm and flood event. Within the planning area, Arthur and Lincoln counties were impacted by the event and had a disaster declaration, whereas Keith and McPherson counties did not. NCEI data estimates there was $165,000 in damages in the planning area from the event. The NeDNR has collected and reviewed extensive data records from the flood event. An event-wide ArcGIS Story Map has been developed and provides an excellent resource to understand the cause, duration, impacts, and recovery efforts from this event. The ArcGIS Story Map can be viewed at: https://storymaps.arcgis.com/stories/9ce70c78f5a44813a326d20035cab95a.

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 $175,261 in property damages and $34,761 in crop losses per year for the planning area.

Table 68: Flood Loss Estimate

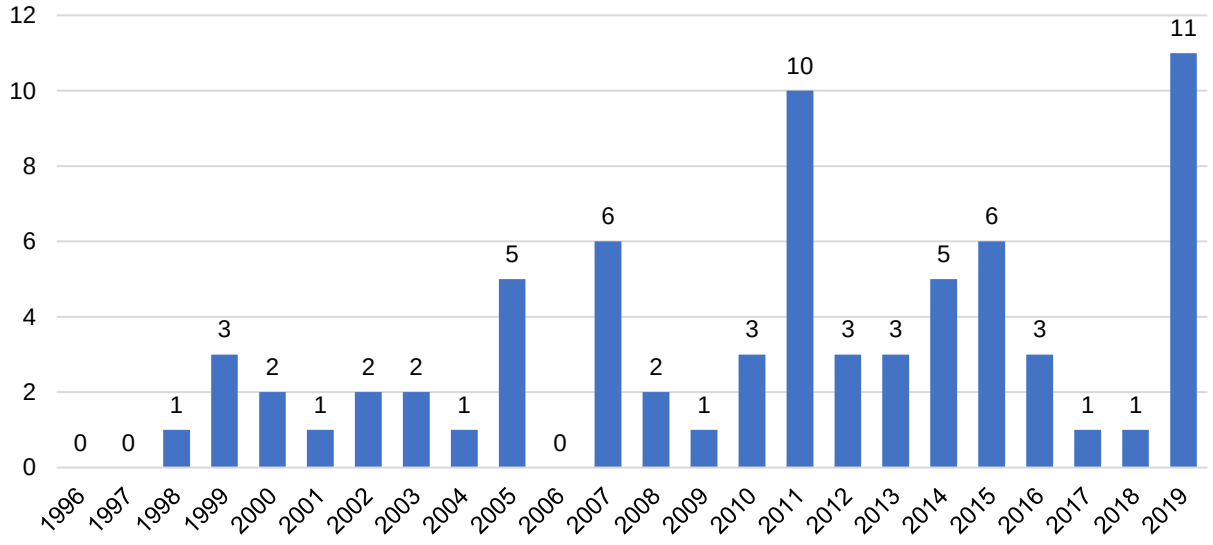
Hazard Type	Number of Events[1]	Average Events Per Year	Total Property Loss[1]	Average Annual Property Loss [1]	Total Crop Loss[2]	Average Annual Crop Loss [2]
Flooding	72	3.1	$4,031,000	$175,261	$660,451	$34,761

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

Probability

The NCEI reports 20 flooding and 52 flash flooding events for a total of 72 events from January 1996 to December 2019. Some years had multiple flooding events, while others had zero. Figure 30 shows the events broken down by year. Based on the historic record of reported incidents, there is an 88 percent probability (21 out of 24 years with an occurrence) that flooding will occur annually in the planning area.

Figure 30: Yearly Events for Floods/Flash Floods



Source: NCEI, 1996-2019

Regional Vulnerabilities

Low-income and minority populations are disproportionately vulnerable to flood events.[91] 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.

91 Cutter, Susan and Finch, Christina. February 2008. "Temporal and Spatial Changes in Social Vulnerability to Natural Hazards".

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

To analyze parcels and populations located in the floodplain, GIS parcel data were acquired from each County 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 for the four-county planning area is provided in the following table. Specific jurisdictional parcel improvements in the floodplain can be found in the corresponding community profiles in *Section Seven*.

Table 69: Parcel Improvements and Value in the 1% Annual Flood Risk Area

County	Number of Improvements	Total Improvement Value	Number of Improvements in Floodplain	Value of Improvements in Floodplain	Percentage of Improvements in Floodplain
***Arthur**	311	$28,085,860	93	$8,992,420	29.9%
Keith	4,933	$566,138,538	573	$120,216,880	11.5%
Lincoln	15,024	$2,222,525,974	1,553	$275,052,810	10.3%
***McPherson**	336	$23,683,877	123	$8,108,358	36.6%
Total	**20,604**	**$2,840,434,249**	**2,342**	**$412,370,468**	**11.4%**

Source: County Assessors, 2018
**Based off a HAZUS created floodplain.*

Table 70: Parcel Improvements and Value in the 0.2% Annual Flood Risk Area

County	Number of Improvements	Total Improvement Value	Number of Improvements in Floodplain	Value of Improvements in Floodplain	Percentage of Improvements in Floodplain
***Arthur**	311	$28,085,860	N/A	N/A	N/A
Keith	4,933	$566,138,538	153	$14,016,730	3.1%
Lincoln	15,024	$2,222,525,974	7,151	$1,199,194,604	47.6%
***McPherson**	336	$23,683,877	N/A	N/A	N/A
Total	**20,604**	**$2,840,434,249**	**7,304**	**$1,213,211,334**	**35.4%**

Source: County Assessors, 2018
**Based off a HAZUS created floodplain.*

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

Table 71: 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 -Arthur County: LEOP estimates 2% of people reside within the one percent annual chance floodplain -Keith County: LEOP estimates less than 10% of people reside within the one percent annual chance floodplain -Lincoln County: LEOP estimates 77% of people reside within the one percent annual chance floodplain -McPherson County: No estimate given in LEOP
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

GRASS/WILDFIRE

Wildfires, also known as brush fires, forest fires, or wildland fires, are uncontrolled fires that occur 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 potential 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 and grassland regions, others can cause extensive destruction of homes and other property located in the wildland-urban interface, the zone of transition between developed areas and undeveloped wilderness (Figure 31).

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

~National Park Service

Grass/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.

Wildfire behavior is often complex and variably dependent on factors such as fuel type and moisture content, humidity, wind speed, topography, geographic location, and ambient temperature. Fuel is the only one of these factors that 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 32). These fire danger predictions are updated regularly and should be reviewed frequently by local planning teams.

Counties within the planning area are part of three different Community Wildfire Protection Plans (CWPP). Arthur and McPherson County are part of the 2019 Western Sandhills CWPP. Keith County is part of the 2019 Southwest Nebraska CWPP, and Lincoln County will be part of the Loess Canyons CWPP region once the update is completed in 2021. The purpose of the CWPPs is to help effectively manage wildfires and increase collaboration and communication among organizations who manage fire. The CWPPs discuss county specific historical wildfire occurrences and impacts, identifies areas most at risk from wildfires, discusses protection capabilities, and identifies wildfire mitigation strategies. These documents are updated every five years.

Figure 31: Wildland-Urban Interface

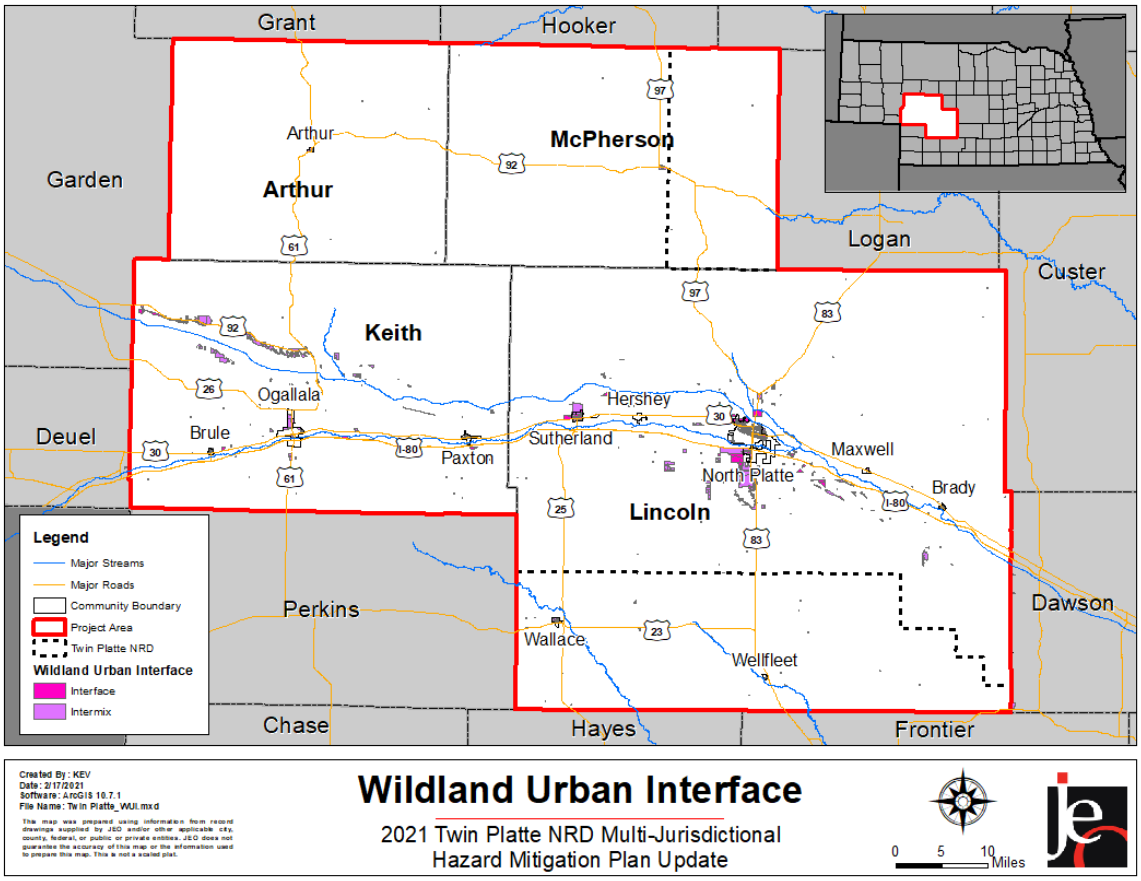
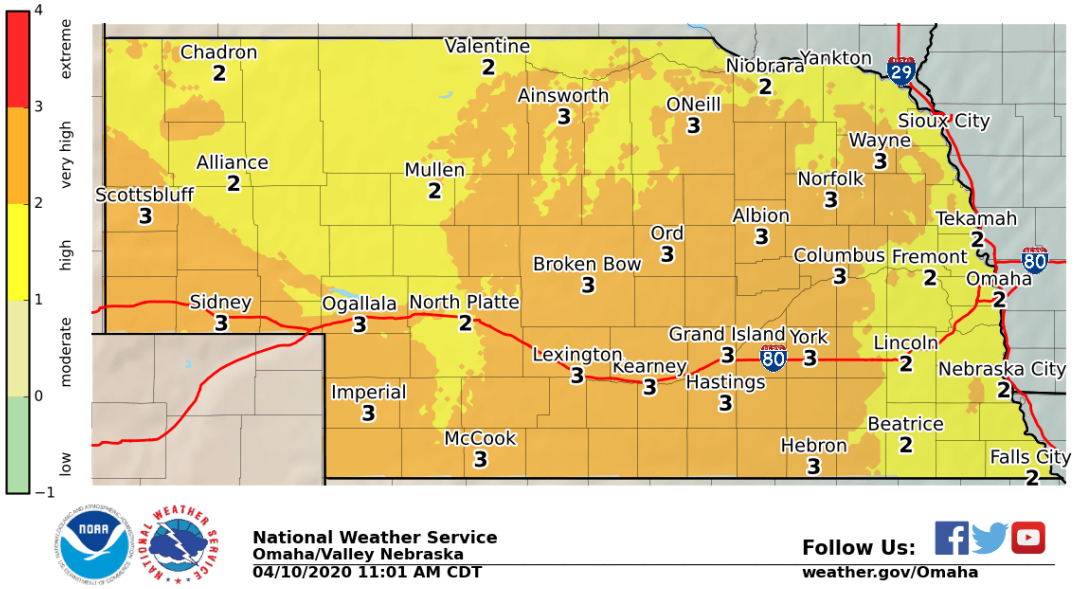


Figure 32: Rangeland Fire Danger



Source: NWS, 2019[92]

92 National Weather Service. January 2019. "Nebraska Fire Danger Map." https://www.weather.gov/oax/fire.

Location

For the planning area, 11 fire districts were identified to report events: Arthur Fire Department, Brady Fire Department, Brule Fire Department, Hershey Fire Department, Maxwell Fire Department, North Platte Fire Department, Ogallala Fire Department, Paxton Fire Department, Sutherland Fire Department, Tryon Fire Department, and Wallace Fire Department (Figure 33). There are 19 fire districts that have at least part of their district in the planning area. These fire districts respond to both wildfires and structural fires in cities and villages.

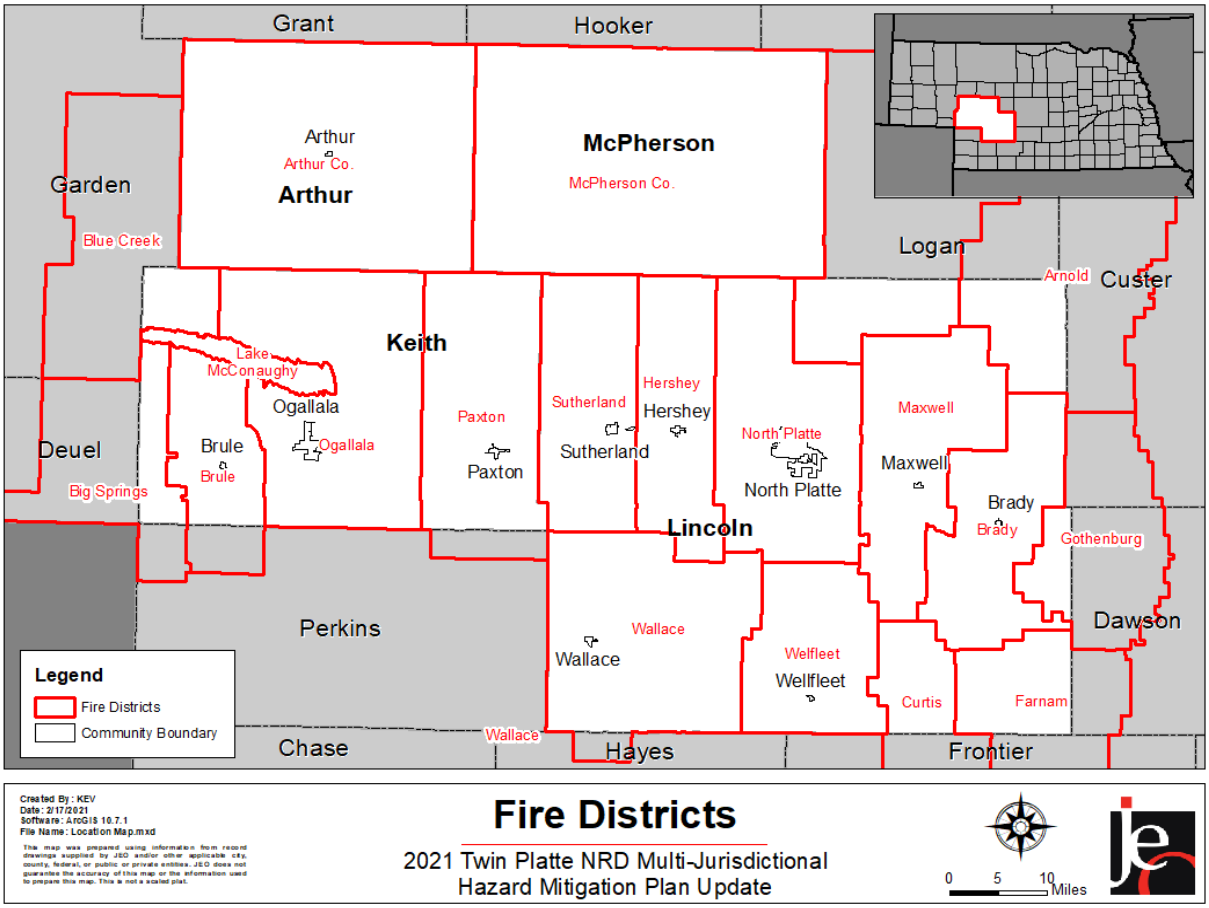
As the number of reported wildfires by county indicates, wildfire is a severe threat throughout the planning area. Lincoln County has reported the greatest number of fires, but Keith County has had the greatest number of acres burned.

Table 72: Reported Wildfires by County

County	Reported Wildfires	Acres Burned
Arthur	83	30,127
Keith	331	61,587
Lincoln	899	19,384
McPherson	64	3,582
Total	**1,377**	**114,680**

Source: Nebraska Forest Service, 2000-2018[93]

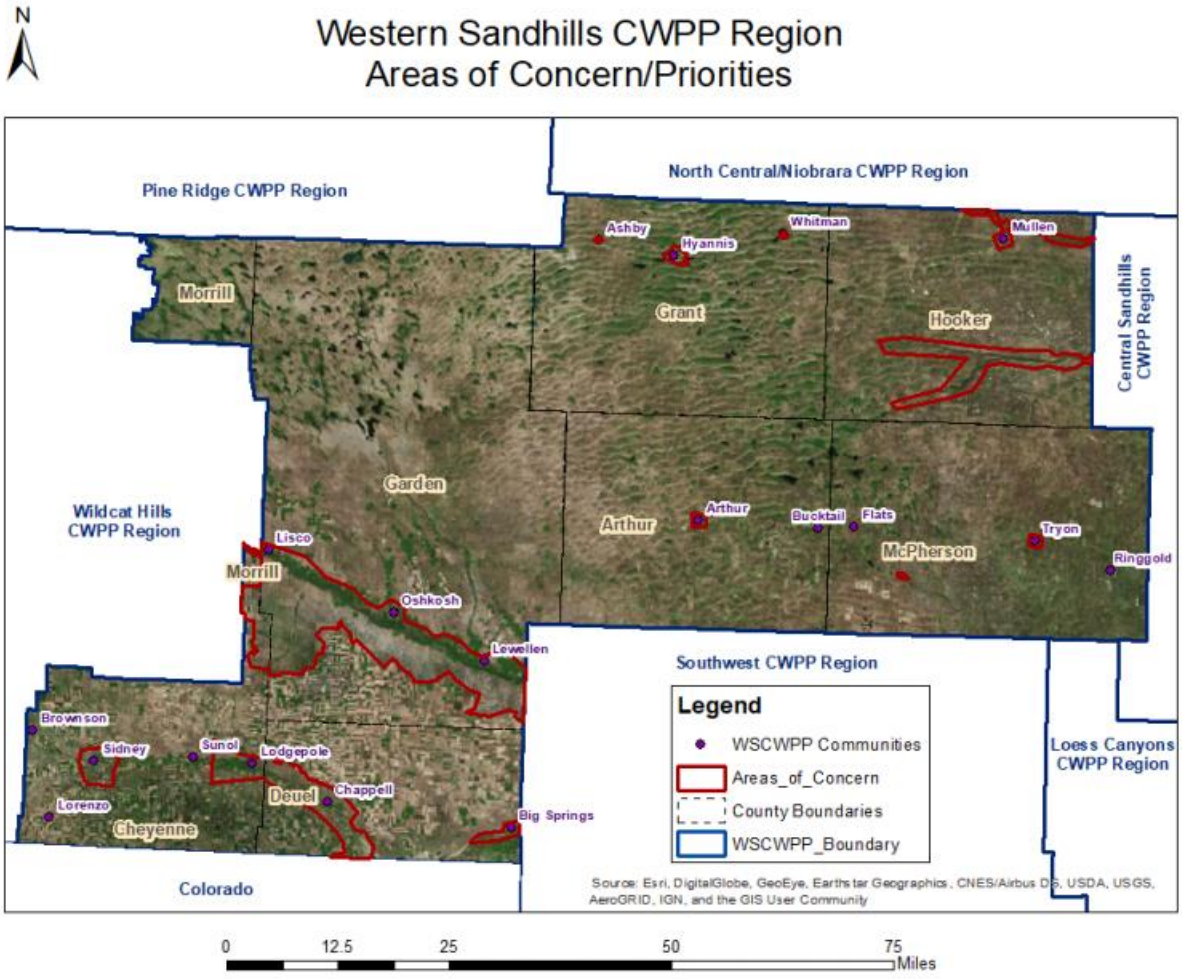
Figure 33: Fire Districts in the Planning Area



93 Nebraska Forest Service. 2000-2014. "Fire Incident Type Summary." Data Files 2000-2018.

The CWPPs identified areas of concern for the counties as show in Figure 34 and Figure 35. These locally identified areas of concern are specific sites that are at greatest risk for wildfire and where vegetative fuels reduction activities can be targeted. This does not mean that areas outside mapped areas of concern do not have their own risk, but rather the areas identified are of greater concern for fire risk reduction.[94]

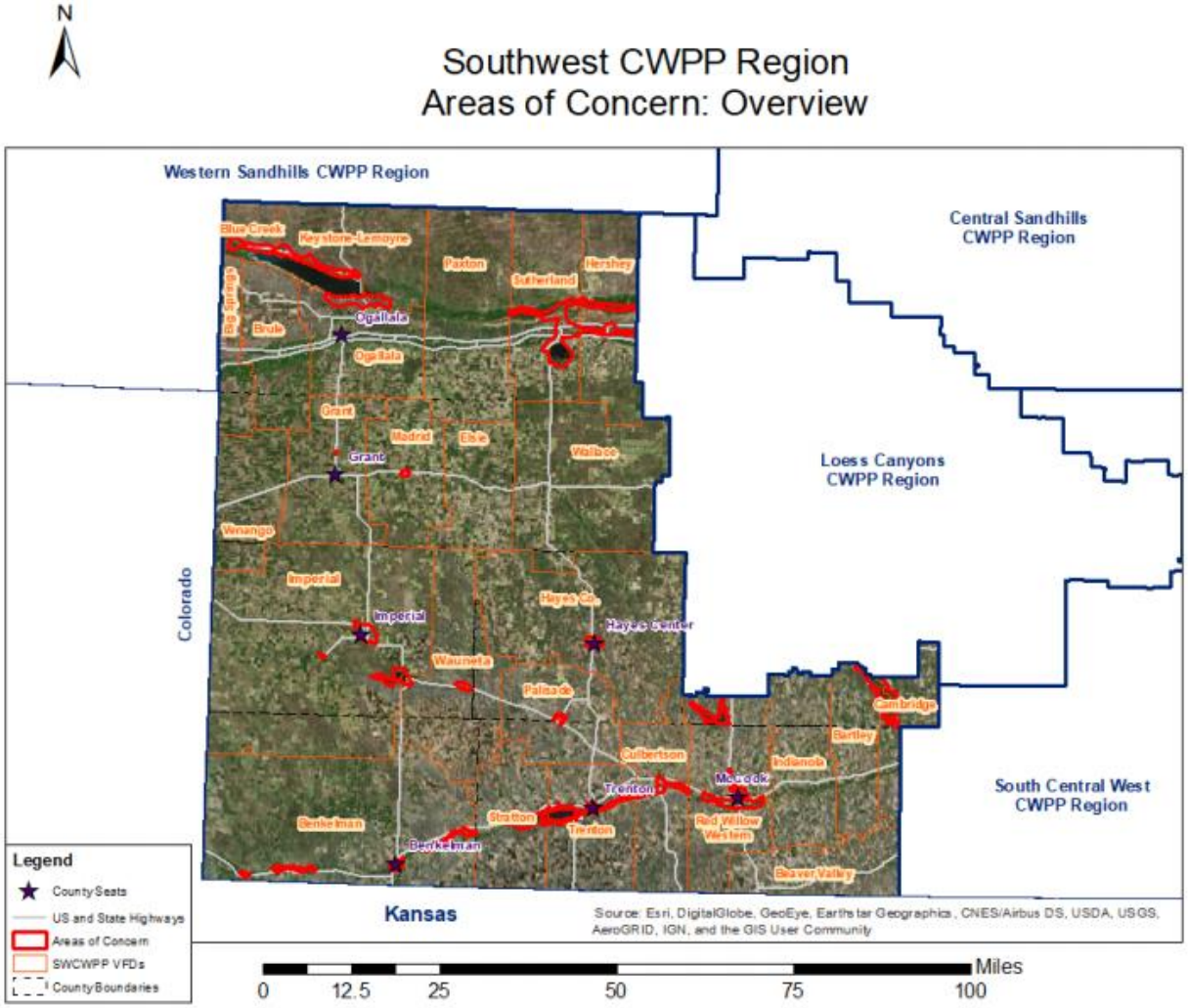
Figure 34: Areas of Concern - Arthur and McPherson Counties



Source: Nebraska Forest Service, Oct. 2019

94 Nebraska Forest Service. October 2019. "Western Sandhills Community Wildfire Protection Plan". https://nfs.unl.edu/documents/CWPP/Western.pdf.

Figure 35: Areas of Concern - Keith County and Part of Lincoln County



Source: Nebraska Forest Service, July 2019

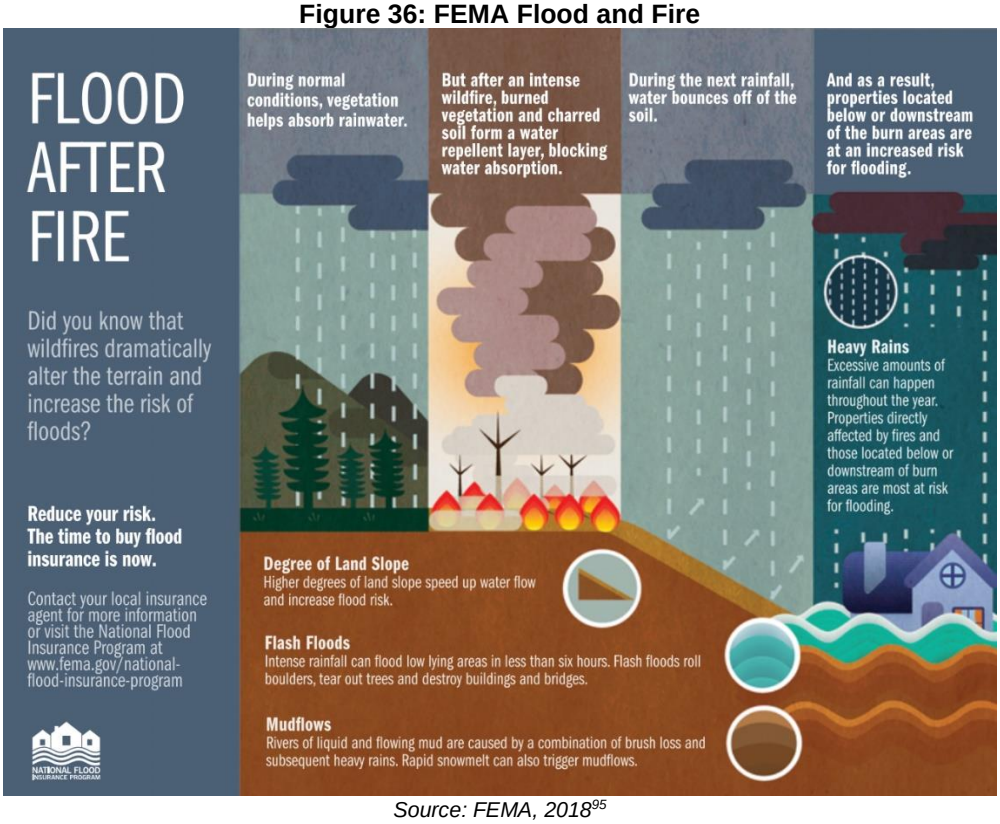
Extent

As seen in Table 72 above, wildfires have burned 114,680 acres of land. In total, there were 1,377 reported wildfires in the planning area. Of these, 65 fires burned 100 acres or more, with the largest wildfire burning over 50,000 acres in Keith County in 2012.

Grass/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.

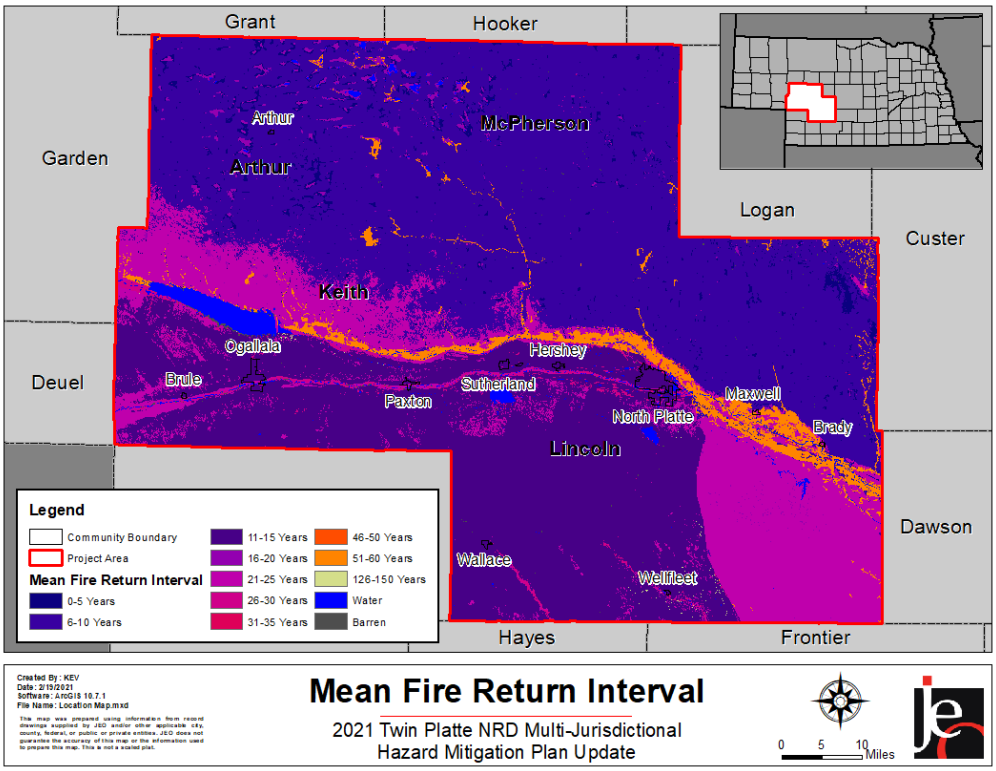
Figure 37 shows the USGS' Mean Fire Return Interval. This model considers a variety of factors, including landscape, fire dynamics, fire spread, fire effects, and spatial context. These vales show how often fires are likely to occur in each area under natural conditions.

Figure 36: FEMA Flood and Fire



Source: FEMA, 2018[95]

Figure 37: Mean Fire Return Interval



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

Historical Occurrences

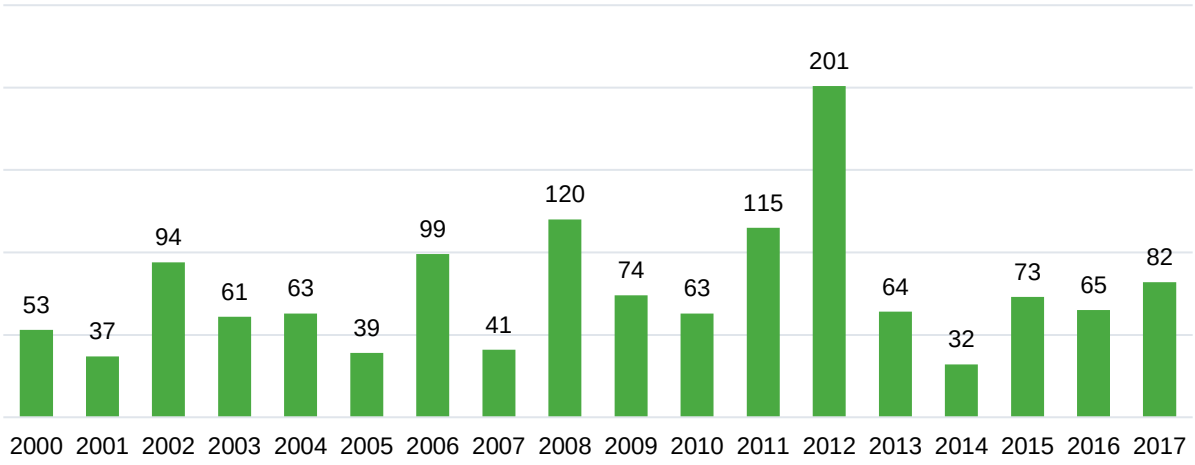
Local fire districts reported a total of 1,377 wildfires, according to the Nebraska Forest Service, from 2000 to 2017. Most fires occurred in 2012 (Figure 38). The reported events burned 114,680 acres. The fire districts also reported $4,664,542 in crop damages. Wildfire events caused 12 injuries, threatened 75 homes and 109 other structures, and destroyed six homes and 15 other structures. Significant fires are outlined below:

Keith County – 2012: Known as the Keith County Complex Fire, the event was six wildfires that were started by lightning and burned 50,000 acres. The fire took five days to contain and required the help of 58 fire departments, helicopters, aerial fire suppression planes, and heavy equipment.

Arthur, McPherson, and Keith Counties – 2015: A lightning started fire caused 30,000 acres to burn across all three counties. The event threatened 15 homes and structures.

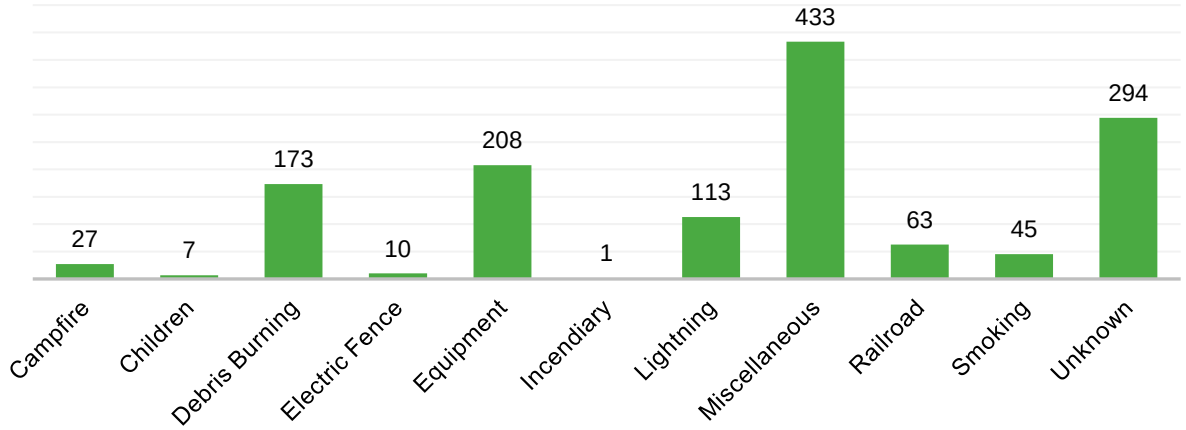
The majority of wildfires in the planning area are caused by miscellaneous (31.5%), with unknown as the second leading cause (21%) (Figure 39). Wildfires in the planning area have ranged from zero to 23,000 acres, with an average event burning 166.25 acres.

Figure 38: Number of Wildfires by Year in the Planning Area



Source: Nebraska Forest Service, 2000-2017

Figure 39: 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 2017 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, 1,377 wildfires burned 114,680 acres and caused $4,664,542 in crop damages to the planning area.

Table 73: Wildfire Loss Estimation

Hazard Type	Number of Events	Events Per Year	Total Crop Loss	Average Annual Crop Loss
Wildfires	1,377	77	$4,664,542	$259,141

Source: Nebraska Forest Service, 2000-2017

Table 74: Wildfire Threats

Hazard Type	Injuries	Homes Threatened or Destroyed	Other Structures Threatened or Destroyed	Total Acres Burned	Average Acres Per Fire
Wildfires	12	81	124	114,680 acres	166.25

Source: Nebraska Forest Service, 2000-2017

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 of reported incidents, there is a 100 percent probability (17 out of 17 years with an occurrence) that a grass/wildfire event will occur annually in the planning area (Figure 38).

Regional Vulnerabilities

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

Table 75: 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

HAIL

According to the NWS, hail is defined as a showery precipitation in the form of irregular pellets or balls of ice more than five millimeters in diameter, falling from a cumulonimbus cloud. Early in the developmental stages of a hailstorm, ice crystals form within a low-pressure front due to the rapid rising of warm air into the upper atmosphere and the subsequent cooling of the air mass. Frozen droplets gradually accumulate on the ice crystals until, having developed sufficient weight; they fall as precipitation, in the form of balls or irregularly shaped masses of ice. The size of hailstones is a direct function of the size and severity of the storm. High velocity updraft winds are required to keep hail in suspension in thunderclouds. The strength of the updraft is a function of the intensity of heating at the Earth's surface. Higher temperature gradients relative to elevation above the surface result in increased suspension time and hailstone size.

Location

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

Extent

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 76 outlines the TORRO Hail Scale.

Table 76: TORRO Hail Scale

TORRO Classification / Intensity	Typical Hail Diameter	Typical Damage Impacts
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	>100mm (Melon); >4.0 in	Extensive structural damage; risk of severe or even fatal injuries to persons outdoors

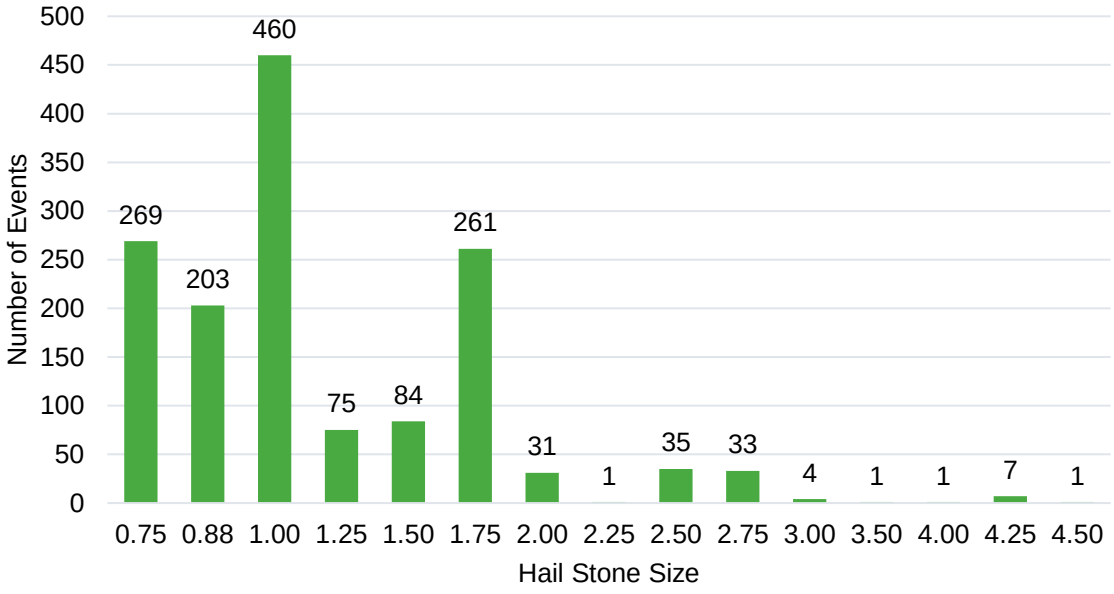
Source: TORRO, 2019[96]

Of the 1,466 hail events reported for the planning area, the average hailstone size was 1.23 inches. Events of this magnitude correlate to an H4 classification. It is reasonable to expect H4

96 Tornado and Storm Research Organization. 2019. "Hail Scale." http://www.torro.org.uk/hscale.php.

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 ten H10 hail events (>4.0 inches) during the period of record. Figure 40 shows hail events based on the size of the hail.

Figure 40: Hail Events by Magnitude



Source: NCEI, 1996- Dec 2019

Historical Occurrences

The NCEI reports events as they occur in each community. A single hail 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 hail event covering a large portion of the planning area could be reported by the NCEI as several events. The NCEI reports a total of 1,466 hail events in the planning area between January 1996 and December 2019. These events were responsible for $ 57,114,800 in property damages and $79,276,189 in crop damages. The following narratives are NCEI descriptions of the two events which caused the most property damage in the planning area.

- **Lincoln County (North Platte) – July 20, 2003:** Ping-pong ball to baseball size hail struck the east side of the city. Hail damaged the bodies of nearly every vehicle and broke some windshields at an auto dealership and in residential areas on the east and south side of North Platte. The hail also damaged eight skylights in the Wal-Mart Super Center store. One middle aged woman was struck in the head by a hailstone in the Wal-Mart parking lot. She was taken to the hospital for stitches. Estimated property damages totaled $7,050,000.

- **Lincoln County (North Platte) – April 14, 2012:** Tennis ball size hail fell on the west side of North Platte, with a few pieces that large also falling on the east side of the city. In some parts of the city large hail fell off and on for almost two hours. Estimated property damages totaled $30,000,000.

Average Annual Losses

The average per event estimate was based on the NCEI Storm Events Database since 1996 and number of historical occurrences as described above. This does not include losses from displacement, functional downtime, economic loss, injury, or loss of life.

Table 77: Hail Loss Estimate

Hazard Type	Number of Events[1]	Events Per Year[1]	Total Property Loss[1]	Average Annual Property Loss[1]	Total Crop Loss[2]	Average Annual Crop Loss[2]
Hail	1,466	74.6	$57,114,800	$2,483,252	$79,276,189	$4,172,431

Source: 1 Indicates the data is from NCEI (1996-Dec 2019),2 Indicates data is from USDA RMA (2000- 2019)

Probability

Based on historic records and reported events, hail is likely to occur several times annually within the planning area. The NCEI reported 1,466 hail events between 1996 and December 2019, or approximately 75 hail occurrences per year. Based on the historic record of reported incidents, there is a 100 percent probability (24 out of 24 years with an occurrence) that a hail event will occur annually in the planning area.

Regional Vulnerabilities

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

Table 78: Regional Hail Vulnerabilities

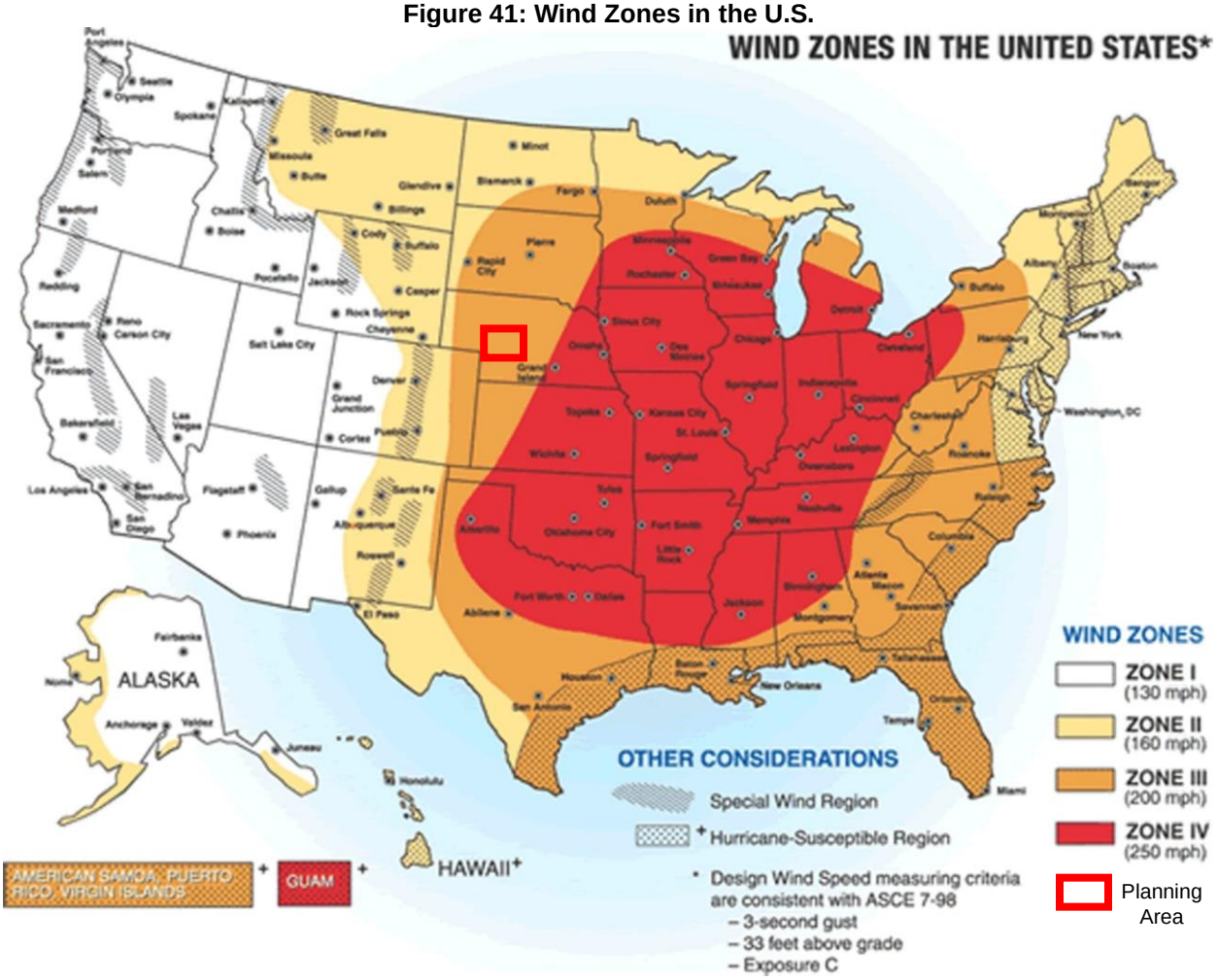
Sector	Vulnerability
People	-Injuries can occur from: not seeking shelter, standing near windows, and shattered windshields in vehicles
Economic	-Damages to buildings and property can cause significant losses to business owners
Built Environment	-Roofs, siding, windows, gutters, HVAC systems, etc. can incur damage
Infrastructure	-Power lines and utilities can be damaged
Critical Facilities	-Property damages and power outages
Climate	-Changes in seasonal precipitation and temperature normal can increase frequency and magnitude of hail and severe storm events
Other	-High winds, lightning, heavy rain, and possibly tornadoes can occur with this hazard

HIGH WIND

High winds typically accompany severe thunderstorms, severe winter storms, 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 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.[97] The NWS issues High Wind Advisories when there are sustained winds of 25 to 39 miles per hour and/or gusts to 57 mph. Figure 41 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 tornado.

Figure 41: Wind Zones in the U.S.



Source: FEMA, 2016

97 National Weather Service. 2009. "Glossary." http://w1.weather.gov/glossary/index.php?letter=h.

Location
High winds commonly occur throughout the planning area. The impacts would likely be greater in more densely populated areas.

Extent
The Beaufort Wind Scale can be used to classify wind strength, and the Enhanced Fujita Scale measures the magnitude of tornadoes. Table 79 outlines the Beaufort Scale, provides wind speed ranking, range of wind speeds per ranking, and a brief description of conditions for each ranking.

Table 79: 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

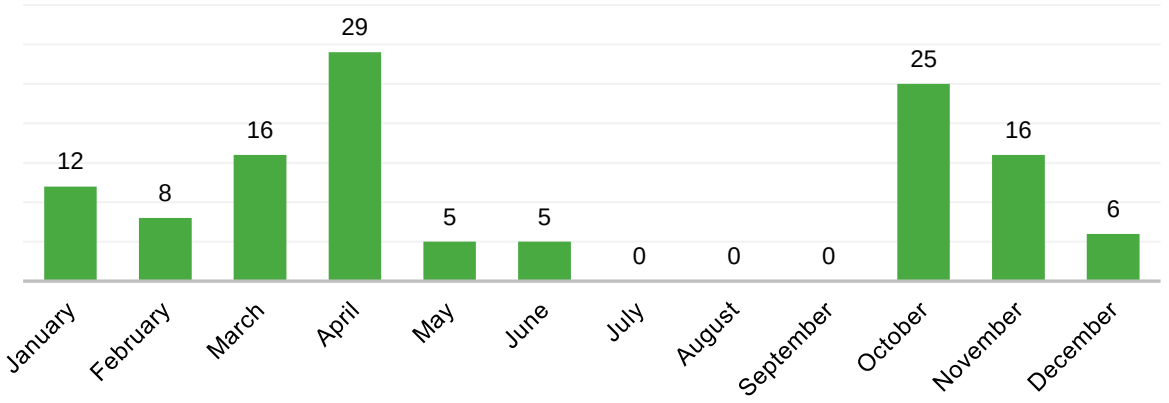
Source: Storm Prediction Center, 2017[98]

Using the NCEI reported events, the most common high wind event is ranked a level 9 on the Beaufort Wind Force Scale. The reported high wind events had an average of 48 mph winds. High wind is likely to occur annually in the planning area.

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 122 high wind events that occurred between January 1996 and December 2019. These events were responsible for $677,500 in property damages and $7,102,325 in crop damages. As seen in Figure 42, most high wind events occur in the late fall and winter months.

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

Figure 42: High Wind Events by Month



Source: NCEI, 1996-December 2019

Average Annual Losses

The average damage per event estimated 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 can cause an average of $29,455 per year in property damage, and an average of $373,807 per year in crop damage for the planning area.

Table 80: High Wind Loss Estimate

Hazard Type	Number of Events[1]	Events Per Year[1]	Total Property Loss[1]	Average Annual Property Loss[1]	Total Crop Loss[2]	Average Annual Crop Loss[2]
High Wind	122	5.3	$677,500	$29,455	$7,102,325	$373,807

Source: 1 Indicates the data is from NCEI (1996-Dec 2019) 2 Indicates data is from USDA RMA (2000-2019)

Probability

Based on the historic record of reported incidents, there is an 83 percent probability (20 out of 24 years with an occurrence) that a high wind event will occur annually in the planning area.

Regional Vulnerabilities

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

Table 81: Regional High Wind Vulnerabilities

Sector	Vulnerability
People	-Vulnerable populations include those living in mobile homes, especially if they are not anchored properly -People outdoors during events
Economic	-Agricultural losses -Damages to businesses and prolonged power outages can cause significant impacts to the local economy
Built Environment	-All building stock are at risk to damages from high winds
Infrastructure	-Downed power lines and power outages -Downed trees blocking road access
Critical Facilities	-All critical facilities are at risk to damages from high winds
Climate	-Changes in seasonal precipitation and temperature normal can increase frequency and magnitude of high wind and severe storm events

LEVEE FAILURE

According to FEMA:

> The United States has thousands of miles of levee systems. These manmade structures are most commonly earthen embankments designed and constructed in accordance with sound engineering practices to contain, control, or divert the flow of water to provide some level of protection from flooding. Some levee systems date back as far as 150 years. Some levee systems were built for agricultural purposes. Those levee systems designed to protect urban areas have typically been built to higher standards. Levee systems are designed to provide a specific level of flood protection. No levee system provides full protection from all flooding events to the people and structures located behind it. Thus, some level of flood risk exists in these levee-impacted areas.

Levee failure can occur several ways. A breach of a levee is when part of the levee breaks away, leaving a large opening for floodwaters to flow through. A levee breach can be gradual by surface or subsurface erosion, or it can be sudden. A sudden breach of a levee often occurs when there are soil pores in the levee that allow water to flow through causing an upward pressure greater than the downward pressure from the weight of the soil of the levee. This under seepage can then resurface on the backside of the levee and can quickly erode a hole to cause a breach. Sometimes the levee actually sinks into a liquefied subsurface below.

Another way a levee failure can occur is when the water overtops the crest of the levee. This happens when the flood waters simply exceed the lowest crest elevation of the levee. An overtopping can lead to significant erosion of the backside of the levee and can result to a breach and thus a levee failure.

The USACE, who is responsible for federal levee oversight and inspection of levees, has three ratings for levee inspections.

Table 82: USACE Levee Rating Categories

Ratings	Description
Acceptable	All inspection items are rated as Acceptable
Minimally Acceptable	One or more inspection items are rated as Minimally Acceptable or one or more items are rated as Unacceptable and an engineering determination concludes that the Unacceptable inspection items would not prevent the segment/system from performing as intended during the next flood event
Unacceptable	One or more items are rated as Unacceptable and would prevent the segment/system from performing as intended, or a serious deficiency noted in past inspections has not been corrected within the established timeframe, not to exceed two years

Source: USACE

Location

According to USACE's National Levee Database, there are no levees in the planning area. However, the Hazard Mitigation Planning Team identified several unmapped private levees along the North Platte and South Platte Rivers that exist that could result in some flood risk if they were to fail.

Historical Occurrences

There have been no recorded instances of levee failure in the planning area.

Extent
Given that there are no mapped levees within the planning area, we are not able to identify the exact impacts of levee failure. If any unmapped levees were to fail, they would likely result in minor flooding of farm or ranchland.

Average Annual Losses
There are no recorded instances of levee failure in the planning area, so average annual losses are $0.

Probability
With no mapped levees in the planning area, there is a less than 1% chance that levee failure will occur in the planning area annually.

Regional Vulnerabilities
The following table summarizes regional vulnerabilities; for jurisdictional-specific vulnerabilities, refer to *Section Seven: Community Profiles*.

Table 83: Regional Vulnerabilities

Sector	Vulnerability
People	-Minimal risk from unmapped private levees and berms
Economic	-Minimal impact to agricultural lands
Built Environment	-All buildings within leveed areas are at risk to damages
Infrastructure	-Minimal impact to infrastructure. Likely to be localized
Critical Facilities	-None. There are no critical facilities in leveed areas
Climate	-Changes in seasonal precipitation and temperature normals can increase strain on any unmapped private levees and berms

PUBLIC HEALTH EMERGENCY

According to the World Health Organization (WHO), a public health emergency is:

> "an occurrence or imminent threat of an illness or health condition, caused by bio terrorism, epidemic or pandemic disease, or (a) novel and highly fatal infectious agent or biological toxin, that poses a substantial risk of a significant number of human facilities or incidents or permanent or long-term disability" (WHO/DCD, 2001). The declaration of a state of public health emergency permits the governor to suspend state regulations and change the functions of state agencies.[99]

The number of cases that qualifies as a public health emergency depends on several factors including the illness, its symptoms, ease in transmission, incubation period, and available treatments or vaccinations. With the advent of sanitation sewer systems and other improvements in hygiene since the 19th century, the spread of infectious disease has greatly diminished. Additionally, the discovery of antibiotics and the implementation of universal childhood vaccination programs have played a major role in reducing human disease impacts. Today, human disease incidences are carefully tracked by the Centers for Disease Control and Prevention (CDC) and state organizations for possible epidemics and to implement control systems. Novel illnesses or diseases have the potential to develop annually and significantly impact residents and public health systems.

Some of the best actions or treatments for public health emergencies are nonpharmaceutical interventions (NPI). These are readily available behaviors or actions, and response measures people and communities can take to help slow the spread of respiratory viruses such as influenza. Understanding NPIs and increasing the capacity to implement them in a timely way, can improve overall community resilience during a pandemic. Using multiple NPIs simultaneously can reduce influenza transmission in communities even before vaccination is available.[100]

Pandemics are global or national disease outbreaks. These types of illnesses, such as influenza, can easily spread person-to-person, cause severe illness, and are difficult to contain. An especially severe pandemic can lead to high levels of illness, death, social disruption, and economic turmoil. Past pandemic events include:

- 1918 Spanish Flu: the H1N1 influenza virus spread world-wide during 1918 and 1919. It is estimated that at least 50 million people worldwide died during this pandemic with about 675,000 deaths alone in the United States. No vaccine was ever developed, and control efforts included self-isolation, quarantine, increased personal hygiene, disinfectant use, and social distancing.

- 1957 H2N2 Virus: a new influenza A virus emerged in Eastern Asia and eventually crossed into coastal U.S. cities in summer of 1957. In total 1.1 million people worldwide died of the flu with 116,000 of those in the United States.

99 World Health Organization. 2008. Accessed April 2020. "Glossary of humanitarian Terms." https://www.who.int/hac/about/definitions/en/.

100 U.S. Department of Health and Human Services. 2017. "Pandemic Influenza Plan: 2017 Update." https://www.cdc.gov/flu/pandemic-resources/pdf/pan-flu-report-2017v2.pdf.

- 1968 H3N2 Virus: an influenza A virus discovered in the United States in September 1968 which killed over 100,000 citizens. The majority of deaths occurred in people 65 years and older.

- 2009 H1N1 Swine Flu: a novel influenza A virus discovered in the United States and spread quickly across the globe. This flu was particularly prevalent in young people while those over 65 had some antibody resistance. The CDC estimated the U.S. had over 60.8 million cases and 12,469 deaths.

- 2019 COVID-19: the novel influenza A virus which originated in Wuhan China and spread globally. As of February 2, 2021, the CDC reported over 26,277,125 cases and 445,264 deaths attributed to COVID-19. Efforts to control and limit the virus included self-isolation, quarantine, increased cleaning measures, social distancing and vaccinations. Significant impacts to the national and global economy have been caused by COVID-19.

The State of Nebraska Department of Health and Human Services requires doctors, hospitals, and laboratories to report on many communicable diseases and conditions to monitor disease rates for epidemic events. Additionally, regional or county health departments monitor local disease outbreaks and collect data relevant to public health. The West Central District Health Department covers Arthur, Lincoln, and McPherson Counties. The Southwest Nebraska Public Health Department covers Keith County.

Location

Human disease outbreaks can occur anywhere in the planning area. Public heath emergencies or pandemic threshold levels are dependent on the outbreak type, transmission vectors, location, and season. Normal infectious disease patterns are changing due to increasing human mobility and climate change. Rural populations are particularly at risk for animal-related diseases while urban areas are at greater risk from community spread type illnesses. All residents throughout the planning area are at risk during public health emergencies. All areas within the planning area experienced impacts from COVID-19 specifically during 2020.

Historical Occurrences

Cases and fatalities associated with Public Health Emergencies vary between illness types and severity of outbreak. Past major outbreaks in Nebraska have specifically included the H1N1 Swine Flu in 2009 and COVID-19 in 2020.

- H1N1 Swine Flu (2009) – outbreaks were first reported in mid-April 2009 and spread rapidly. The new flu strand for which immunity was nonexistent in persons under 60 years old was similar in many ways to typical seasonal influenza. Symptoms of H1N1 included fever greater than 100°F, cough, and sore throat. County specific counts of H1N1 are not available, however a total of 71 confirmed cases were reported by June 12, 2009.[101] Outbreaks in Nebraska were typically seen sporadically with occasional cluster outbreaks at summer camps for youth. The U.S. Public Health Emergency for the H1N1 Influenza outbreak expired on June 23, 2010. The CDC developed and encouraged all US residents to receive a yearly flu vaccination to protect against potential exposures. The H1N1 continues to appear annually and persons in the planning area are at risk of infection in the future.

101 Centers for Disease Control and Prevention. June 2009. “Novel H1N1 Flu Situation Update.” https://www.cdc.gov/h1n1flu/updates/061209.htm.

- COVID-19 (2020) – In January 2020, the CDC confirmed the first case of COVID-19 in the United States, and it quickly spread across the country. By March 2020, the World Health Organization declared COVID-19 a pandemic and travel bans were instituted around the globe. Primary symptoms of the infection included cough, fever or chills, shortness of breath or difficulty breathing, fatigue, muscle and body aches, headache, loss of taste or smell, sore throat, and others. The first confirmed case of COVID-19 in the State of Nebraska was a 36-year-old Omaha resident in early March. Counties and cities throughout the planning area have instituted directed health measures to protect residents from the spread of COVID-19.

The table below displays COVID-19 confirmed cases and deaths as of February 1, 2021. This data will likely increase as time goes on until the entire population can be vaccinated.

Table 84: COVID-19 Cases in the Planning Area

County	Population	Total Number of Tests	Confirmed Cases	Fatalities
Arthur	418	65	23	0
Keith	8,099	2,859	651	3
Lincoln	35,433	15,767	3,575	47
McPherson	454	91	26	1
Total	**43,905**	**18,782**	**4,271**	**51**

Source: Nebraska Department of Health and Human Services[102]

Extent

Those most affected by public heath emergencies are typically the very young, the very old, the immune-compromised, the economically vulnerable, and the unvaccinated. Roughly 25% of the planning area's population is 18 years or younger, and 23% of the planning area is 65 years or older. These factors increase vulnerability to the impacts of pandemics. Refer to *Section Three: Planning Area Profile* for further discussion of age and economic vulnerability in the planning area. It is not possible to determine the extent of individual public health emergency events, as the type and severity of a novel outbreak cannot be predicted. However, depending on the disease type, a significant portion of residents may be at risk to illness or death.

The extent of a public health emergency is closely tied to the proximity or availability of health centers and services. It should be noted that while Keith and Lincoln Counties each have one hospital to serve the area, Arthur and McPherson Counties have none. The following table identifies hospitals in the planning area.

Table 85: Hospitals in the Planning Area

County	Facility Name	Nearest Community	Total Licensed Beds
Keith	Ogallala Community Hospital	Ogallala	18
Lincoln	North Platte Nebraska Hospital Corporation	North Platte	116

Source: Nebraska Department of Health and Human Services[103]

Certain geographic areas, populations, and facilities may experience a shortage of health care professionals which results in a lack of access to health care in an area. The Health Resources and Services Administration (HRSA) assigns specific designations to shortage areas to focus limited resources on communities with the most need. Shortage designations include Health

102 Nebraska Department of Health and Human Services. February 1, 2021. "Coronavirus COVID-19 Nebraska Cases by the Nebraska Department of Health and Human Services (DHHS)". https://experience.arcgis.com/experience/ece0db09da4d4ca68252c3967aa1e9dd.
103 Department of Health and Human Services. December 2020. "Hospitals." http://dhhs.ne.gov/licensure/Documents/Hospital%20Roster.pdf.

Professional Shortage Areas (HPSAs), Medically Underserved Areas (MUAs) and Medically Underserved Populations (MUPs). Health Professional Shortage Areas are designated based on shortages in primary care, dental, or mental health providers in a geographic area, facility, or population. HPSAs are determined based on the number of health professionals relative to a high need population. The following table identifies HPSA designations in the planning area.

Table 86: Health Care Professional Shortage Areas in the Planning Area

County	Designation Type	Designation ID	Designation Date	Type of Care
Keith	Geographic HPSA	1319382751	4/22/2019	Primary Care
Arthur, Keith, Lincoln, McPherson	Geographic HPSA	7312770380	7/20/1978	Mental Health

Source: Health Resources and Services Administration[104]

Medically Underserved Areas and Populations are designated by the HRSA as areas or populations having high poverty rates, high infant mortality rates, high elderly populations, or an insufficient number of primary care providers. The following tables identifies MUA designations in the planning area.

Table 87: Medically Underserved Areas/Populations in the Planning Area

County	Designation Type	Designation ID	Designation Date	Type of Care
Arthur	MUA	02001	4/17/1981	Primary Care
McPherson	MUA	02028	4/17/1981	Primary Care

Source: Health Resources and Services Administration[105]

Immunodeficiency disorders (such as diabetes), obesity, or other pre-existing health complications reduce the ability of the body to fight infection. Diabetes prevalence per county and for the state are listed in the table below.

Table 88: Diabetes Prevalence in the Planning Area

County	Diagnosed Diabetes Rate (Total Adults Age 20+)
Arthur	5.1%
Keith	6.5%
Lincoln	10.5%
McPherson	8.6%
State of Nebraska*	8.0%

Source: Centers of Disease Control and Prevention, 2017[106]
**State data is from 2016.*

Nebraska state law (Title 173) requires all students have the following vaccinations: poliomyelitis, Diphtheria, pertussis, tetanus, measles, mumps, rubella, Hepatitis B, and varicella (chicken pox). The Vaccines for Children program is a federally funded and state-operated vaccine supply program that provides free vaccines to children under 18 who are of American Indian or Alaska Native descent, enrolled in Medicaid, uninsured, or underinsured. Additionally, the HPV vaccination series is recommended for teenagers and influenza vaccinations are recommended yearly for those over six months old. Individuals without vaccinations are at greater risk of contracting diseases or carrying diseases to others.

104 Health Resources and Services Administration. 2021. "HPSA Find." https://data.hrsa.gov/tools/shortage-area/hpsa-find
105 Health Resources and Services Administration. 2021. "MUA Find." https://data.hrsa.gov/tools/shortage-area/mua-find
106 Centers for Disease Control and Prevention. 2017. "Diagnosed diabetes prevalence – Nebraska." https://gis.cdc.gov/grasp/diabetes/DiabetesAtlas.html.

Average Annual Losses

The national economic burden of influenza medical costs, medical costs plus lost earnings, and total economic burden was $10.4 billion, $26.8 billion, and $87.1 billion respectively in 2007.[107] However, associated costs with pandemic response are much greater. Current estimated costs for COVID-19 in the United States exceed $16 trillion. Specific costs do not include losses from displacement, functional downtime, economic loss, injury, or loss of life. The direct and indirect effects of significant health impacts are difficult to quantify.

Probability

There is no pattern as to when public health emergencies will occur. Based on historical records, it is likely that small-scale disease outbreaks will occur annually within the planning area. However, large scale emergency events (such as seen with COVID-19) cannot be predicted.

Regional Vulnerabilities

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

Sector	Vulnerability
People	-Vulnerable populations include the very young, the very old, the unvaccinated, the economically vulnerable, and those with immunodeficiency disorders. -Institutional settings such as prisons, dormitories, long-term care facilities, day cares, and schools are at higher risk to contagious diseases -Poverty, rurality, underlying health conditions, and drug or alcohol use increase chronic and infectious disease rates
Economic	-Large scale or prolonged events may cause businesses to close, which could lead to significant revenue loss and loss of income for workers
Built Environment	-Increased number of unoccupied business structures
Infrastructure	-Transportation routes may be closed if a quarantine is put in place -Healthcare facilities in the planning area may be overwhelmed quickly by widespread events
Critical Facilities	-Healthcare facilities in the planning area may be overwhelmed quickly by widespread events -Critical facilities could see suspended action or reduced resources due to sick staff
Climate	-Climate change impacts on extreme weather, air quality, transmission of disease via insects and pests, food security, and water quality increase threats of disease

107 Molinari, N.M., Ortega-Sanchez, I.R., Messonnier, M., Thompson, W.W., Wortley, P.M., Weintraub, E., & Bridges, C.B. April 2007. "The annual impact of seasonal influenza in the US: measuring disease burden and costs." DOI: 10.1016/j.vaccine.2007.03.046.

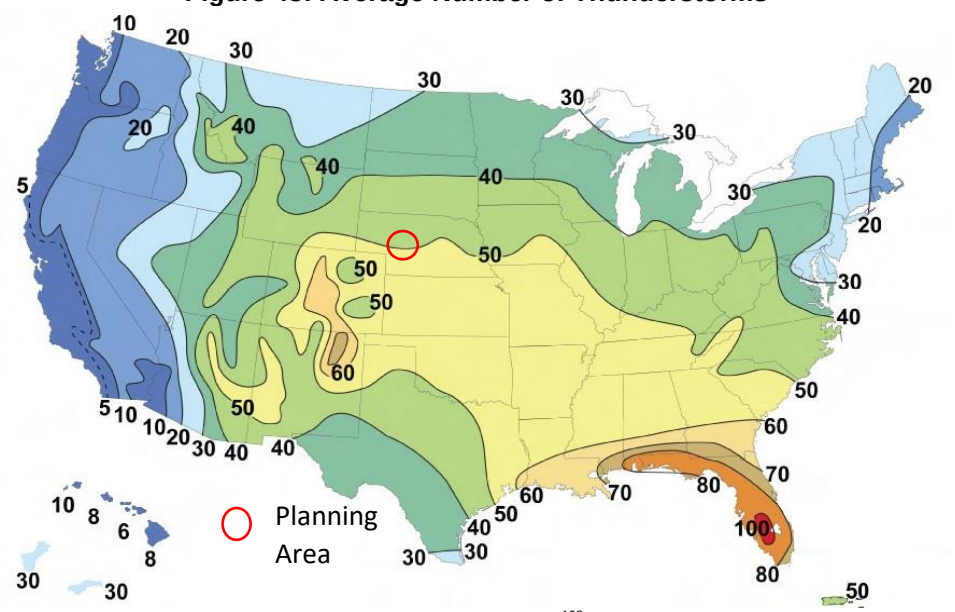
SEVERE THUNDERSTORMS

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 the cold upper air sinks and the 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. Severe thunderstorms usually occur in the evening during the spring and summer months.

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, the potential for damages increases. Damages can include crop losses from wind; property losses due to building and automobile damages from high wind, flash flooding, and death or injury to humans and animals from lightning, drowning, or getting struck by falling or flying debris. Figure 43 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.

Figure 43: Average Number of Thunderstorms



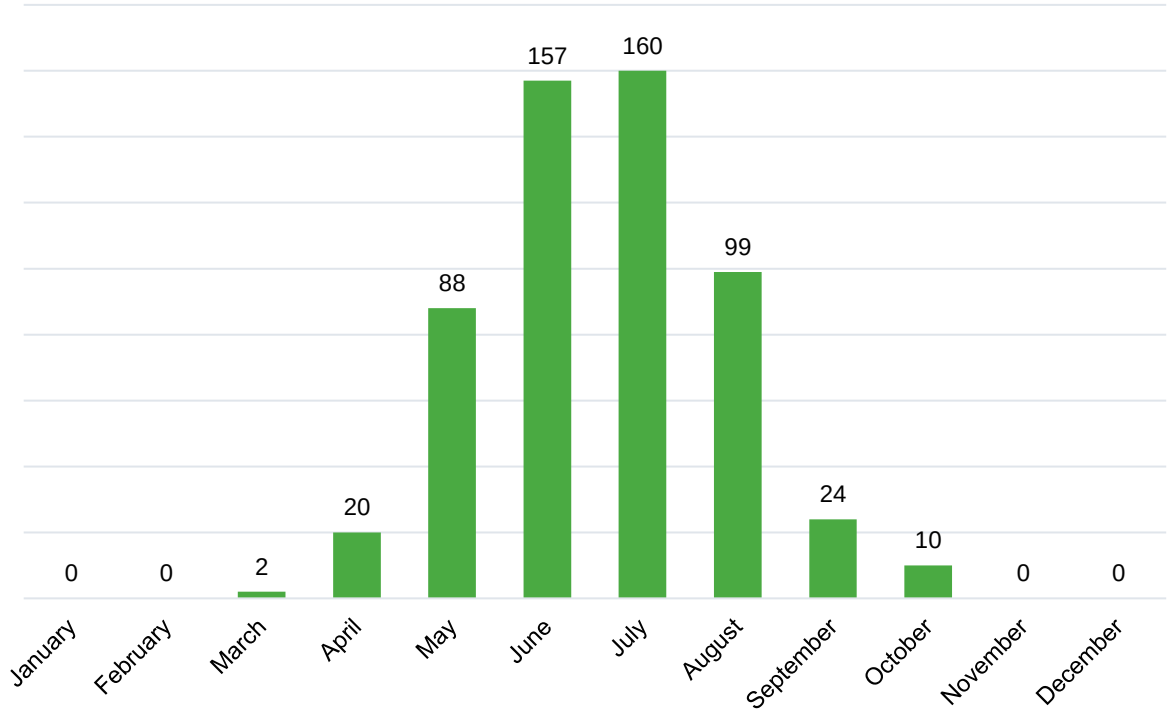
Source: NWS, 2017[108]

108 National Weather Service. 2017. "Introduction to Thunderstorms." http://www.srh.noaa.gov/jetstream/tstorms/tstorms_intro.html.

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

Historical Occurrences
Severe thunderstorms in the planning area usually occur in the afternoon and evening during the summer months (Figure 44).

Figure 44: 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 534 thunderstorm wind, seven heavy rain, and 19 lightning events in the planning area from March 1996 to December 2019. In total these events were responsible for $5,122,700 in property damages. The USDA RMA data shows that severe thunderstorms caused $6,311,953 in crop damages. Eight injuries were reported in association with these storms.

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 is capable of winds gusts of 58 mph or higher.

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 $222,726 per year in property damages.

Table 89: 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
Heavy Rain	7	0.3	$0	$0	$6,311,953	$332,208
Lightning	19	0.83	$106,000	$4,609		
Thunderstorm Wind	534	23.2	$5,016,700	$218,117		
Total	**2,276**	**98.9**	**$5,122,700**	**$222,726**	**$6,311,953**	**$332,208**

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

Probability

Based on historical records and reported events, severe thunderstorms events are likely to occur on an annual basis. Based on the historic record of reported incidents, there is a 100 percent probability (24 out of 24 years with an occurrence) that a severe thunderstorm event will occur annually in the planning area.

Regional Vulnerabilities

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

Table 90: 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.[109]

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 45 shows the SPIA index.

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

Figure 45: SPIA Index

ICE DAMAGE INDEX	*AVERAGE ICE AMOUNT (in inches) *Revised: Oct. 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 and widespread utility interruptions with extensive damage to main distribution feeder lines and 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 weeeks in some areas. Shelters needed.
	0.75 –1.00	> – 25	
	1.00 –1.50	> – 15	
	> 1.50	Any	

(Categories of damage are based upon combinations of precipitation totals, temperatures and wind speeds/directions.)

Source: SPIA-Index, 2017[110]

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 46 shows the Wind Chill Index used by the NWS.

Average monthly snowfall for the planning area is shown in Figure 48, which shows the snowiest months are between January and March. 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.

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

Figure 46: 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

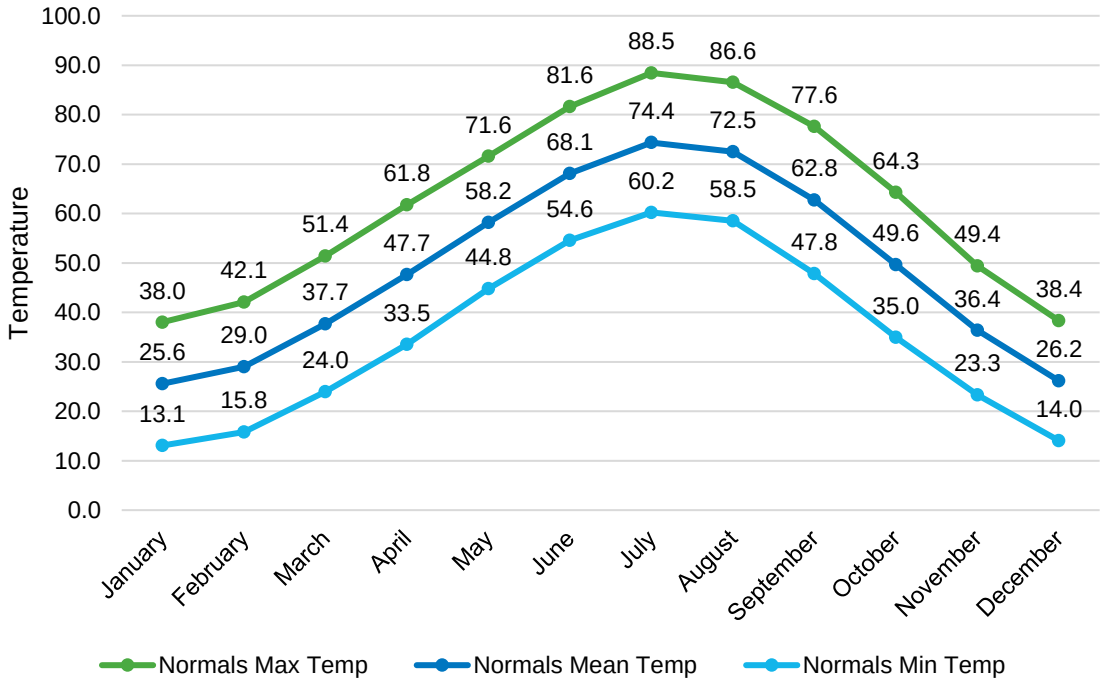
Frostbite Times — 30 Minutes — 10 MInutes — 5 Minutes

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)

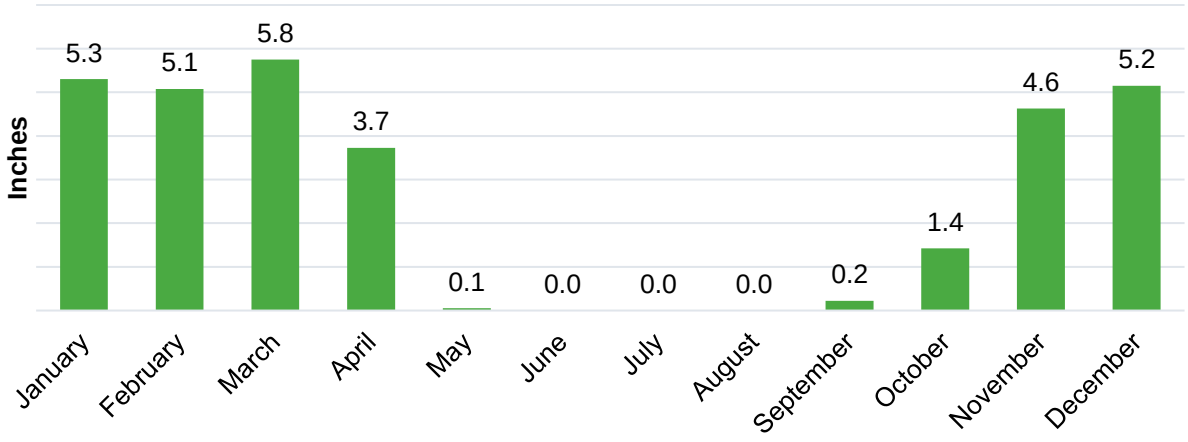
Source: NWS, 2017[111]

Figure 47: Monthly Climate Normals Temperature (1981-2010)



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

Figure 48: Monthly Normal (1981-2010) Snowfall in Inches



Source: High Plains Regional Climate Center, 2020

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 207 severe winter storm events for the planning area from January 1996 to December 2019. February had the most recorded events for the planning area. These recorded events caused a total of $1,159,000 in reported property damages and $5,686,647 in crop damages.

According to the NCEI, there were two injuries and three deaths 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 $50,391 per year in property damage and $299,297 per year in crop damages for the planning area.

Table 91: 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	28	1.2	$55,000	$2,391		
Heavy Snow	21	0.91	$10,000	$435		
Winter Storm	137	5.9	$94,000	$4,087		
Winter Weather	1	0.04	$1,000,000	$43,478	$5,686,647	$299,297
Extreme Cold/Wind Chill	20	0.87	$0	$0		
Total	**207**	**9**	**$1,159,000**	**$50,391**	**$5,686,647**	**$299,297**

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

Probability

Based on historical records and reported events, severe winter storm events are likely to occur on an annual basis. Based on the historic record of reported incidents, there is a 100 percent probability (24 out of 24 years with an occurrence) that a severe winter storm event will occur annually in the planning area.

Regional Vulnerabilities

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

Table 92: 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

According to the Federal Bureau of Investigation (FBI), there is no single, universally accepted definition of terrorism. Terrorism is defined in the Code of Federal Regulations as "the unlawful use of force and violence against persons or property to intimidate or coerce a government, the civilian population, or any segment thereof in furtherance of political or social objectives".[112] Terrorist activities are also classified based on motivation behind the event (such as religious fundamentalism, national separatist movements, and social revolutionary movements). Terrorism can also be random with no ties to ideological reasoning.

The FBI further describes terrorism as either domestic or international, depending on the origin, base, and objectives of the terrorist organization. For this plan, 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

Threat assessment, mitigation, and response to terrorism are federal and state directives that work in conjunction with local law enforcement. Terrorism is addressed at the federal level by the US Department of Homeland Security and at the state level by the Nebraska Emergency Management Agency.

112 Terrorism, 28 U.S. Code Section 0.85

Location
Terrorism can occur throughout the entire planning area. Urban areas, schools, and government buildings are more likely to see terroristic activity. However, water systems of any size could be vulnerable as well as computer systems from cyber-terrorism.

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. 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.[113]

Average Annual Damages
As there were no terrorist events within the planning area, there are no average annual damages.

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 93: Regional Terrorism Vulnerabilities

Sector	Vulnerability
People	-Police officers and first responders at risk of injury or death -Civilians at risk of injury or death -Students and staff at school facilities at risk of injury or death from school shootings
Economic	-Damaged businesses can cause loss of revenue and loss of income for workers -Agricultural attacks could cause significant economic losses for the region -Risk of violence in an area can reduce income flowing into and out of that area
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

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

TORNADOES

A tornado is typically associated with a supercell thunderstorm. For a rotation to be classified as a tornado, three characteristics must be met.

- 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.
- 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 percent of tornadoes occur between noon and midnight. In Nebraska, 77 percent of all tornadoes occur in the months of May, June, and July.

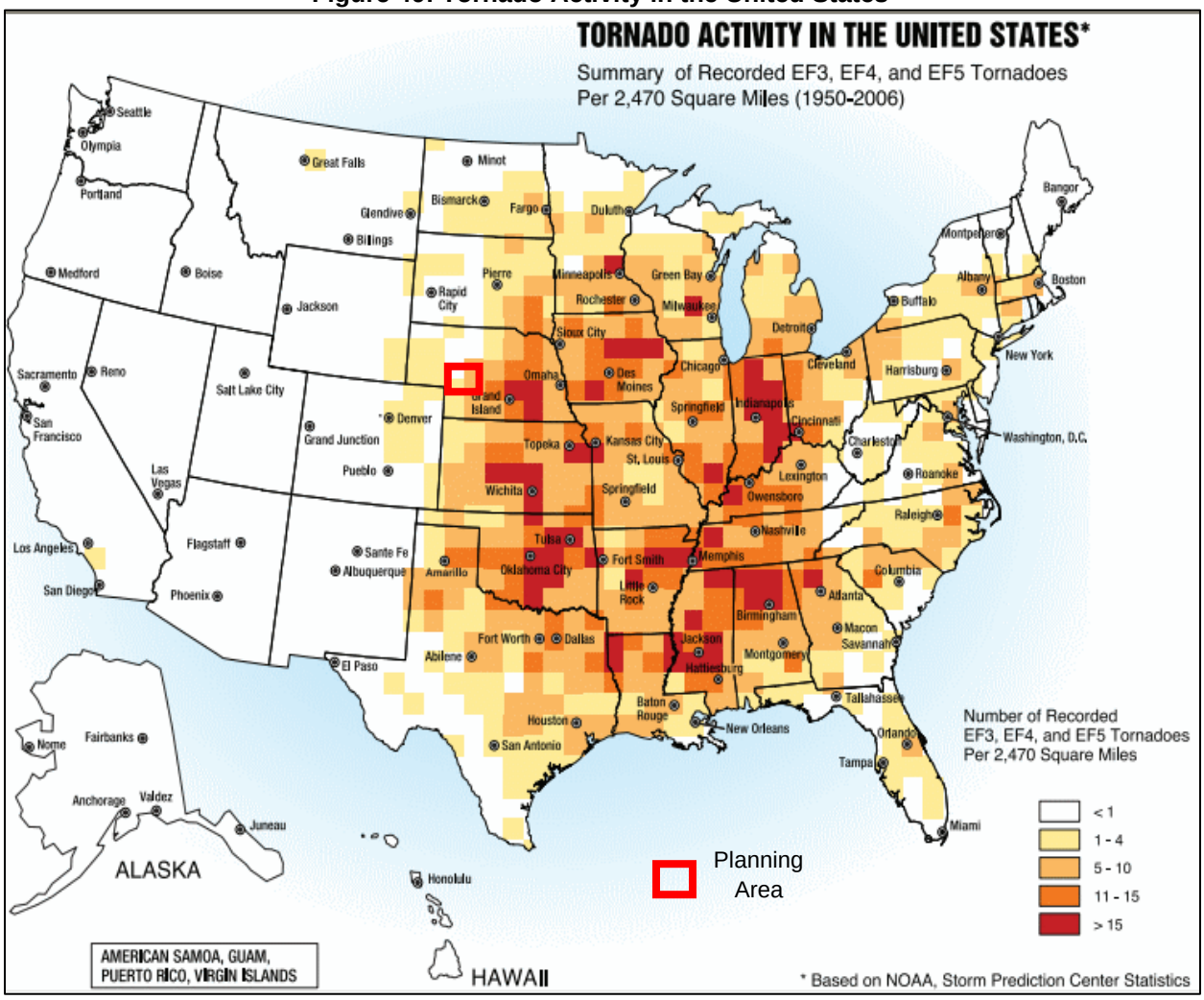
Nebraska is ranked fifth in the nation for tornado frequency with an annual average of 57 tornadoes between 1991 to 2010.[114] The following figure shows the tornado activity in the United States as a summary of recorded EF3, EF4, and EF5 tornadoes per 2,470 square miles from 1950 through 2006.

Location

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.

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

Figure 49: Tornado Activity in the United States



Source: FEMA, 2008[115]

Historical Occurrences

The NCEI reported a total of 87 tornado events from January 1996 to December 2019. The events caused an estimated $4,430,750 in property damage and resulted in 15 injuries. In March 2012 an EF3 tornado caused $750,000 in damages in North Platte. The event caused two injuries and damaged several homes, a center irrigation pivot, and 15 tanker cars in the Union Pacific Bailey Yard.

The following figure shows that the month of June is the busiest month of the year followed by May and July with the highest number of tornadoes in the planning area.

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

Figure 50: Historic Tornado Tracks

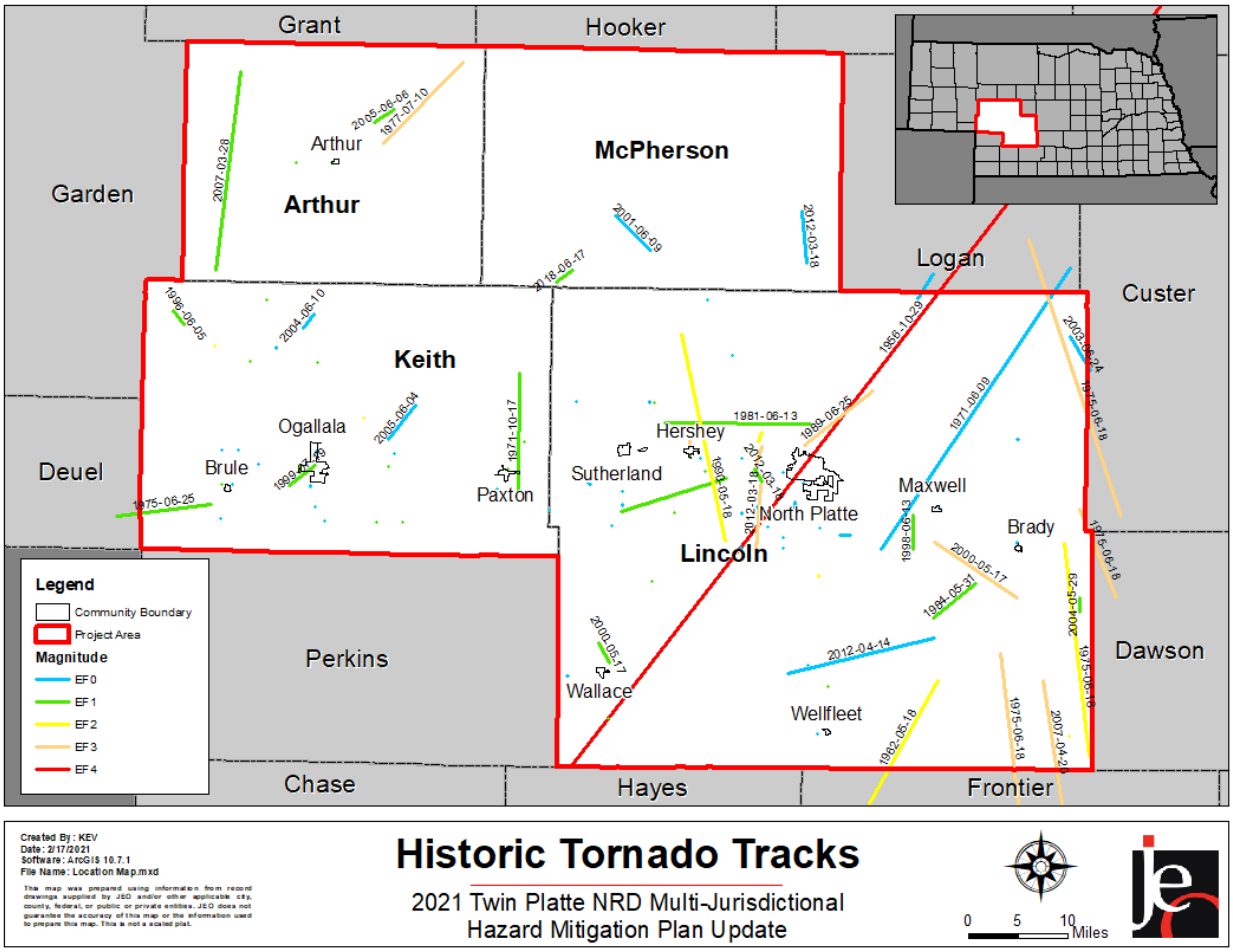
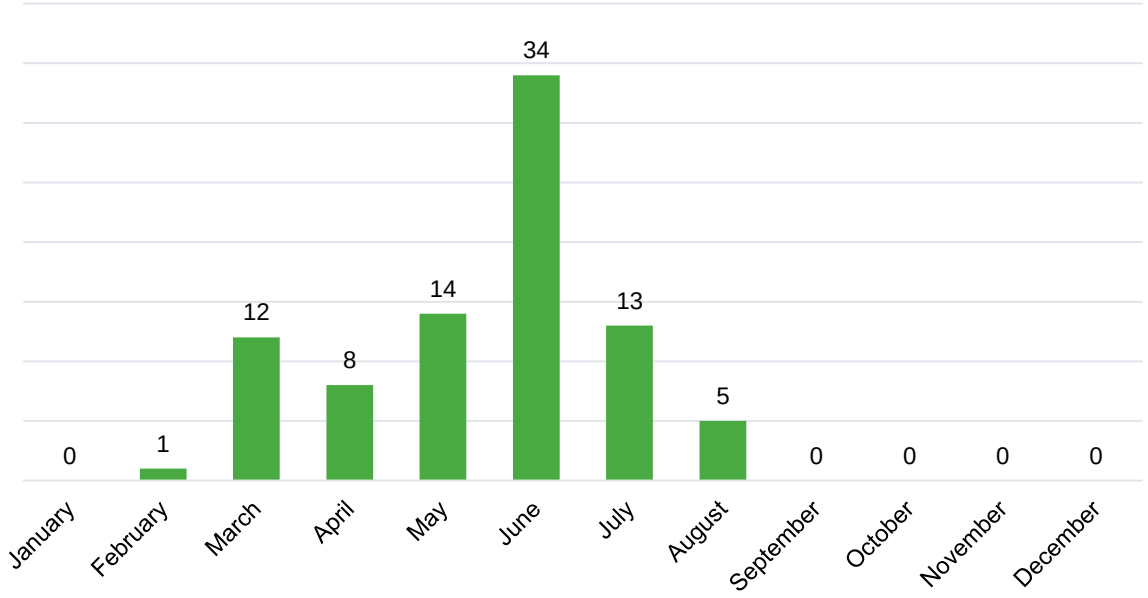


Figure 51: Tornadoes by Month in the Planning Area



Source: NCEI, 1996-December 2019

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.[116]

Table 94: Enhanced Fujita Scale

Storm Category	Three 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

116 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 95: 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

Based on historic record, it is most likely that tornadoes within the planning area will be of EF0 strength. Of the 87 reported tornado events, 11 were EF1, one was EF2, and four were EF3.

Average Annual Damages

The average damage per event estimated was determined based upon NCEI Storm Events Database since 1996. This does not include losses from displacement, functional downtime, economic loss, injury, or loss of life. Tornadoes cause an average of $184,615 per year in property damage. Tornadoes cause an average of $134 per year in crop damage.

Table 96: Tornado Loss Estimate

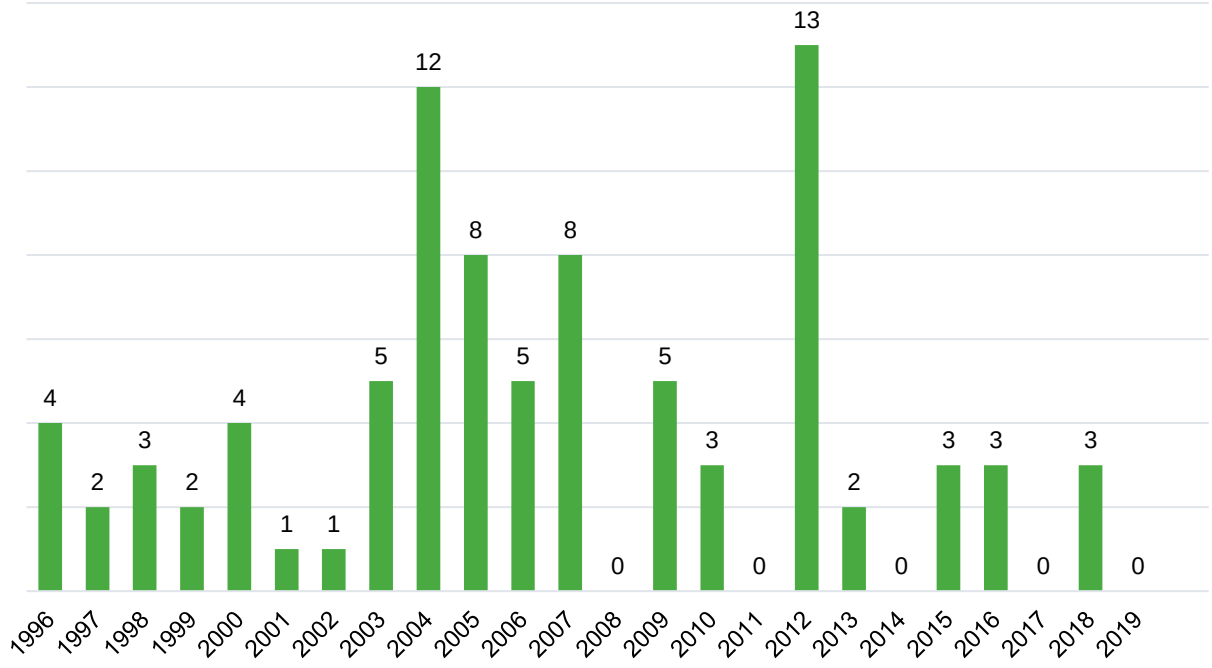
Hazard Type	Number of Events[1]	Events Per Year[1]	Total Property Loss[1]	Average Annual Property Loss[1]	Total Crop Loss[2]	Average Annual Crop Loss[2]
Tornado	87	3.6	$4,430,750	$184,615	$2,548	$134

Source: 1 Indicates data is from NCEI (1996-Dec 2019); 2 Indicates data is from USDA RMA (2000-2019)

Probability

Based on historical records and reported events, it is likely that tornadic events will occur within the planning area almost annually. Based on the historic record of reported incidents, there is an 83 percent probability (20 out of 24 years with an occurrence) that a tornado event will occur annually in the planning area.

Figure 52: Tornado Events Per Year



Source: NCEI, 1996-Dec 2019

Regional Vulnerabilities

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

Table 97: Regional 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 a safe room -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
Built Environment	-All building stock are at risk of significant damages
Infrastructure	-Downed power lines and power outages -Downed trees blocking road access -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 normal can increase frequency and magnitude of severe storm events

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 Hazard Mitigation Planning Team. Meeting participants reviewed the goals from the 2016 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 Hazard Mitigation 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, 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 Education 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

Selected Mitigation Actions

After establishing the goals, local planning teams evaluated and prioritized mitigation actions. These actions included: the mitigation actions identified per jurisdiction in the previous plan and additional mitigation actions discussed during the planning process. The Hazard Mitigation Planning Team provided each participant a link to the FEMA Handbook as a list of mitigation actions to be used as a starting point. Participants were also encouraged to think of actions that may need FEMA grant assistance and to review their hazard prioritization for potential mitigation actions. These suggestions helped participants determine which actions would best assist their respective jurisdiction in alleviating damages in the event of a disaster. The listed priority rating does not indicate which actions will be implemented first but serves as a guide in determining the order in which each action should be implemented. Participants were informed of the STAPLEE (Social, Technical, Administrative, Political, Legal, Economic, Environmental) feasibility review process and were encouraged to use it when determining priorities.

These projects are the core of a hazard mitigation plan. The local planning teams were instructed that each action must directly relate to the goals of the plan and the hazards of top concern for their jurisdiction. Actions 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. Jurisdictions were encouraged to choose mitigation actions that were realistic and relevant to the concerns identified.

A final list of alternatives was established including the following information: description of action; which hazard(s) the action mitigates; responsible party; priority; cost estimate; potential local funding sources; and estimated timeline. This information was established through input from participants and determination by the Hazard Mitigation Planning Team.

It is important to note that not all the mitigation actions identified by a jurisdiction may ultimately be implemented due to limited capabilities, prohibitive costs, low benefit-cost ratio, or other concerns. These factors may not be identified during this planning process. The cost estimates, priority rating, potential funding, and identified agencies are used to give communities an idea of what actions may be 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 TPNRD 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.
- 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 2016 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. Goals listed in the table relate to the overall goals and objectives approved by the Hazard Mitigation Planning Team. For example, if a mitigation action lists goal 2.2, then that action meets Goal #2 Objective 2.

Table 98: Mitigation Actions Selected by Each Jurisdiction 1 of 2

Mitigation Actions	Goal	Twin Platte NRD	Arthur County	Village of Arthur	Keith County	Village of Brule	City of Ogallala	Village of Paxton	Lincoln County	Village of Brady	Village of Hershey	City of North Platte	Village of Sutherland	Village of Wallace	Village of Wellfleet
Alert/Warning Sirens	1.1, 4.3, 5.2							X							
Backup and Emergency Generators	1.1		X		X	X		X	X			X	X	X	
Bank Stabilization	2.1								X						
Channel and Bridge Improvements	2.1								X		X				
Clean Ditches	2.1												X		
Critical Facility Siting	1.1, 2.1, 5.2										X				
Dam Failure Exercise	4.1, 4.2, 5.2										X				
Drainage Ditches	2.1								X		X				
Drainage Study/Stormwater Master Plan	2.2	X									X				
Emergency Fuel Supply Plan	2.2										X				
Emergency Management Exercise	4.1, 4.2, 5.2								X						
Emergency Operations	4.1								X						
Evacuation Plan	2.2, 4.2, 5.2												X		
Facility Flood Proofing	1.1, 2.1, 5.2								X						
Flood Proofing Critical Facilities	2.1											X			
Grade Control Structures	2.1										X				
Groundwater Recharge	5.1	X													

Mitigation Actions	Goal	Twin Platte NRD	Arthur County	Village of Arthur	Keith County	Village of Brule	City of Ogallala	Village of Paxton	Lincoln County	Village of Brady	Village of Hershey	City of North Platte	Village of Sutherland	Village of Wallace	Village of Wellfleet
Improve Electrical Service	2.1							X				X			
Improve Snow/Ice Removal Program	1.1								X						
Improve Warning Systems	1.1, 5.1, 5.2				X							X			
Lightning Rods	1.1, 2.1, 5.2										X				
New Fire Hall	1.1												X		
New Municipal Well	1.1							X					X		
Participate in the NFIP	2.2, 2.3, 5.1, 5.2													X	
Provide Adequate Fire Protection	1.1		X												
Public Awareness/Education	1.1, 3.1, 3.2, 5.2	X		X							X				
Purchase Snowplow	1.1, 2.1, 4.3, 5.2							X	X						
Radio Readers on Meters	2.1													X	
Raise Existing Wells	1.1, 2.1, 5.2												X		
Reduce Fire Damage	1.1, 2.1, 5.2	X			X							X			
Reduce Flow Restrictions	2.1	X			X		X					X	X		
Reduce Tree Damage	1.1, 2.1, 5.2	X	X												
Storm Shelters / Safe Rooms	1.1							X			X	X			
Stormwater Management Committee	2.2, 2.3, 5.1, 5.2										X				

Mitigation Actions	Goal	Twin Platte NRD	Arthur County	Village of Arthur	Keith County	Village of Brule	City of Ogallala	Village of Paxton	Lincoln County	Village of Brady	Village of Hershey	City of North Platte	Village of Sutherland	Village of Wallace	Village of Wellfleet
Stormwater System and Drainage Improvements	2.1				X	X	X	X		X	X		X	X	X
Stream Bank / Grade Structure Improvements	2.1	X										X			
Update Floodplain Information/Mapping	2.2, 2.3, 5.2											X			
Windbreak Improvements	1.1, 2.1, 5.2	X													

Table 99: Mitigation Actions Selected by Each Jurisdiction 2 of 2

Mitigation Actions	Goal	McPherson County	Arthur County Schools	Birdwood Irrigation District	Cody-Dillon Ditch	Hershey Public Schools	Keith-Lincoln Irrigation District	North Platte Public Schools	Paxton Hershey Irrigation District	Platte Valley Irrigation District	Suburban Ditch Company	Western Irrigation District
Access Control	1.1		X									
Backup and Emergency Generators	1.1	X	X			X						
Canal Maintenance	2.1			X	X		X		X	X	X	X
Flood and Mold Remediation	2.1							X				
Groundwater Recharge	5.1				X		X		X	X	X	X
Reduce Flow Restrictions	2.1	X		X			X		X	X	X	X
Repair Flood Damage	2.1									X	X	
Storm Shelters / Safe Rooms	1.1					X						

Mitigation Actions	Goal	McPherson County	Arthur County Schools	Birdwood Irrigation District	Cody-Dillon Ditch	Hershey Public Schools	Keith-Lincoln Irrigation District	North Platte Public Schools	Paxton Hershey Irrigation District	Platte Valley Irrigation District	Suburban Ditch Company	Western Irrigation District
Stormwater System and Drainage Improvements	2.1					X						
Update Comprehensive Plan	2.2, 2.3, 5.2, 6.1	X										

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SECTION SIX: PLAN IMPLEMENTATION AND MAINTENANCE

Monitoring, Evaluating, and Updating the Plan

Each participating jurisdiction in the TPNRD HMP is 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 local planning team, the governing body will be responsible for implementing the recommended projects. The responsible party for the various implementation actions will report on the status of all projects and include which implementation processes worked well, any difficulties encountered, how coordination efforts are proceeding, and which strategies could be revised.

As projects or mitigation actions are implemented, a detailed timeline of how that project was completed should 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 cost (if complete), etc. At the discretion of each governing body, local planning team members, and other identified relevant stakeholders should review the original draft of the mitigation plan and recommend applicable changes.

Plan review and updates will occur every five years at the minimum. At the discretion of each governing body, updates may be incorporated more frequently, especially in the event of a major hazard or as additional mitigation needs are identified. Local planning team members should engage with the public, other elected officials, and multiple departments as they review and update the plan. 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 review and updates.

In addition, the governing body will be responsible for ensuring that the HMP's goals are incorporated into applicable revisions of other planning mechanisms per jurisdiction. These plans may include: Comprehensive Plan, Capital Improvement Plans, Zoning Ordinances, Floodplain Ordinances, Building Codes, and/or Watershed Management Plans. Future updates of this HMP will review and update discussions of plan integration per community as appropriate.

Continued Public Involvement

To ensure continued plan support and input from the public and business owners, public involvement should remain a top priority for each participating jurisdiction. Notices for public meetings involving discussion of an action on mitigation updates should be published and posted in the following locations:

- Public spaces around the jurisdiction
- City/Village Hall
- Websites
- Social media
- Local radio stations
- Local newspapers
- Regionally distributed newsletters

Any amendments to the HMP as determined through public involvement or community actions must be submitted to NEMA for inclusion in the final HMP.

Integrating Other Capabilities

There are a number of state and federal agencies with capabilities that can be leveraged during HMP updates or mitigation action implementation. A description of some regional resources is provided below.

Nebraska Emergency Management Agency

NEMA is an agency that is a part of the Military Department in the State of Nebraska. NEMA is responsible for emergency management, which is usually divided into four phases: preparedness, response, recovery, and mitigation.

NEMA is responsible for developing the state hazard mitigation plan, which serves as a comprehensive set of guidelines for hazard mitigation across the state. The state hazard mitigation officer and other mitigation staff members play an active role in assisting in the development local hazard mitigation plans. Representatives from the state hazard mitigation program serve as technical guides to local planning teams and regularly participate in local mitigation planning meetings. The state hazard mitigation staff also oversees the hazard mitigation assistance programs: HMGP and BRIC; and works with the Governor's taskforce to prioritize projects requesting funding assistance through the HMGP and BRIC.

The main objective in NEMA's preparedness process is to develop plans and procedures to help facilitate any response that may need to occur during a hazard event. NEMA assists communities

in the development of county or city/village planning documents; assists with the development of exercises for existing plans and procedures; conducts trainings for community officials, assist emergency management related groups (Citizen Emergency Response Teams, Citizen Corps, Medical Reserve Corps, Fire Corps, and other interest groups); and provide technical resources and expertise throughout the state.

NEMA's role during a response is to assist communities in responding to hazard events *when the need for assistance exceeds the local capabilities and resources*. This includes facilitating and tracking grants, coordinating local needs, providing state and federal level assistance through activation of Emergency Operation Centers, Mass Critical Shelters, Emergency Alert Systems and providing technical, logistical, and administrative resources and expertise before, during, and after incidents. The main purpose of the recovery phase is to perform actions that allow the return of normal living, or better conditions. The secondary role of the recovery phase is grant administration and tracking, project monitoring, damage assessment, collaborating with communities on effective recovery options and opportunities, serving as liaison between federal level entities and local representatives, and serving as a technical resource throughout the recovery process. For more information regarding the plans and NEMA's responsibilities as well as their ongoing projects, please go to http://www.nema.nebraska.gov/.

Nebraska Department of Natural Resources

The NeDNR is committed to providing Nebraska's citizens and leaders with the data and analyses they need to make appropriate natural resource decisions for the benefit of all Nebraskans both now and in the future. This state agency is responsible in the area of surface water, groundwater, floodplain management, dam safety, natural resource planning, integrated water management, storage of natural resources and related data, and administration of state funds.

NeDNR plays a significant role in protecting and conserving water resources through the oversight of surface and groundwater status and integrated water management. The NeDNR is also responsible for a non-structural program of floodplain management, coordination and assistance with the National Flood Insurance Program as well as the FMA grant program, reviewing and approving engineering plans for new dams, rehabilitating old dams, and high hazard dam emergency preparedness plans. NeDNR was active throughout the hazard planning process and provided extensive resources and technical support for hazard risk and vulnerability analysis such as flood and dam failure. NeDNR also works with communities in many capacities including assisting in flood mapping needs and the completion of Benefit Cost Analysis. For more information regarding NeDNR's responsibilities as well as their ongoing projects, please go to http://dnr.nebraska.gov/.

Silver Jackets Program

The Silver Jackets program is also worth mentioning for their extensive role in providing a formal and consistent strategy for an interagency approach to planning and implementing measures to reduce the risks associated with flooding and other natural hazards. It brings together multiple state, federal, and sometimes tribal and local agencies to learn from one another and apply their knowledge to reduce risk. Both NEMA and NeDNR play an active role on the Nebraska Silver Jackets team. At this time the Silver Jackets do not have any projects taking place in the Twin Platte NRD planning area.

Nebraska Forest Service

The agency's mission statement is "To enrich the lives of all Nebraskans by protecting, restoring, and utilizing Nebraska's tree and forest resources. The state agency provides resources, information, and facilitates research to promote healthy forests.

The NFS achieves these goals through a variety of programs. The Rural Forestry Assistance program aids landowners in need of forest management help. Some of these services include assistance and advice on forest and woodlot management, windbreak establishment and management, reforestation, and other forestry related issues. The forest health program is responsible for maintaining a list of the most prominent pest problems in Nebraska along with the trees affected, control recommendations, and timing. The wildland fire protection program is responsible for protecting wildlands from fire. The state does not have a fire suppression force within the forest service like other states. They rely on local firefighters to handle the suppression of these fires. The agency does provide air support and equipment to the local firefighters if the assistance is needed. The agency also assists Nebraska's communities to be ready for wildfire by helping them prepare Community Wildfire Protection Plans. CWPPs gather local resources to enhance wildfire mitigation and preparedness. The plans identify steps for communities to take to help reduce the risk of damage from wildfires. For more information regarding the NFS's responsibilities as well as their ongoing projects, please go to http://nfs.unl.edu/.

Unforeseen Opportunities

If new, innovative mitigation strategies arise that could impact the planning area or elements of this plan, which are determined to be of importance, a plan amendment may be proposed and considered separate from the annual review and other proposed plan amendments. Twin Platte NRD, as the plan sponsor, provides an opportunity for jurisdictions to compile proposed amendments annually and send them to NEMA, and subsequently to FEMA, for a plan amendment. Such amendments should include all applicable information for each proposal including description of changes, identified funding, responsible agencies, etc.

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*[117] guidance, as well as FEMA's *2015 Plan Integration*[118] guide, each jurisdiction engaged in a plan integration discussion. This discussion was facilitated by a Plan Integration Worksheet, created by the Hazard Mitigation Planning Team. This document offered an easy way for participants to notify the Hazard Mitigation Planning Team of existing planning mechanisms, and if they interface with the HMP.

Each jurisdiction 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 jurisdictions that lack existing planning mechanisms, especially smaller villages, the HMP may be used as a guide for future activity and development in the jurisdiction.

117 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.

118 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 Twin Platte NRD planning effort. Community Profiles were developed with the intention of highlighting each jurisdiction's unique characteristics that affect its risk to hazards. Community Profiles may serve as a short reference of identified vulnerabilities and mitigation actions for a jurisdiction as they implement the mitigation plan. Information from individual jurisdictions 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 and Geography
- Transportation
- Demographics
- Employment and Economics
- Housing
- Future Development Trends
- Parcel Improvements and Valuation
- Community Lifelines
- Governance
- Capability Assessment
- Plan Integration
- Historical Occurrences
- Hazard Prioritization
- Mitigation Strategy

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, 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 throughout the entire planning area. A discussion of certain hazards selected for each Community Profile was 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*.