



Quad Counties

Multi-Jurisdictional Hazard Mitigation Plan

2021



Plan prepared by
JEO Consulting Group

HAZARD MITIGATION REGIONAL PLANNING TEAM

Table 1: Quad Counties HMP Regional Planning Team

Name	Title	Jurisdiction
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Chris Becker	County Sheriff/Emergency Manager	Harlan County
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Harlan County Appendix (Includes Harlan County, City of Alma, Village of Huntley, Village of Orleans, Village of Ragan, Village of Republican City, Village of Stamford, Alma Fire District, Alma Public Schools, Orleans Fire District, Republican City Rural Fire District, and Stamford Rural Fire Department)	
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LIST OF ACRONYMS

ACS – American Community Survey
BRIC – Building Resilient Infrastructure and Communities
CFR – Code of Federal Regulations
COVID-19 – Coronavirus Disease 2019
CRS – Community Rating System
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 Investigations
FEMA – Federal Emergency Management Agency
FIRM – Flood Insurance Rate Map
FMA – Flood Mitigation Assistance Program
GIS – Geographic Information Systems
HMA – Hazard Mitigation Assistance
HMGP – Hazard Mitigation Grant Program
HMP – Hazard Mitigation Plan
HPRCC – High Plains Regional Climate Center
IBC – International Building Code
JEO – JEO Consulting Group, Inc.
LEOP – Local Emergency Operations Plan
LGA – Liquid Gallon
MPH – miles per hour
NCEI – National Centers for Environmental Information
NDA – Nebraska Department of Agriculture
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
NRC – National Response Center
NRD – Natural Resources District
NWS – National Weather Service
PDM – Pre-Disaster Mitigation Program
PDSI – Palmer Drought Severity Index
PHMSA – U.S. Pipeline and Hazardous Material Safety Administration
RMA – Risk Management Agency
SBA – Small Business Administration
SEAT – Single Engine Air Tanker
SPIA – Sperry-Piltz Ice Accumulation Index
START – National Consortium for the Study of Terrorism and Responses to Terrorism

TORRO – Tornado and Storm Research Organization
USACE – United States Army Corps of Engineering
USDA – United States Department of Agriculture
USGS – United States Geological Survey

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EXECUTIVE SUMMARY

Introduction

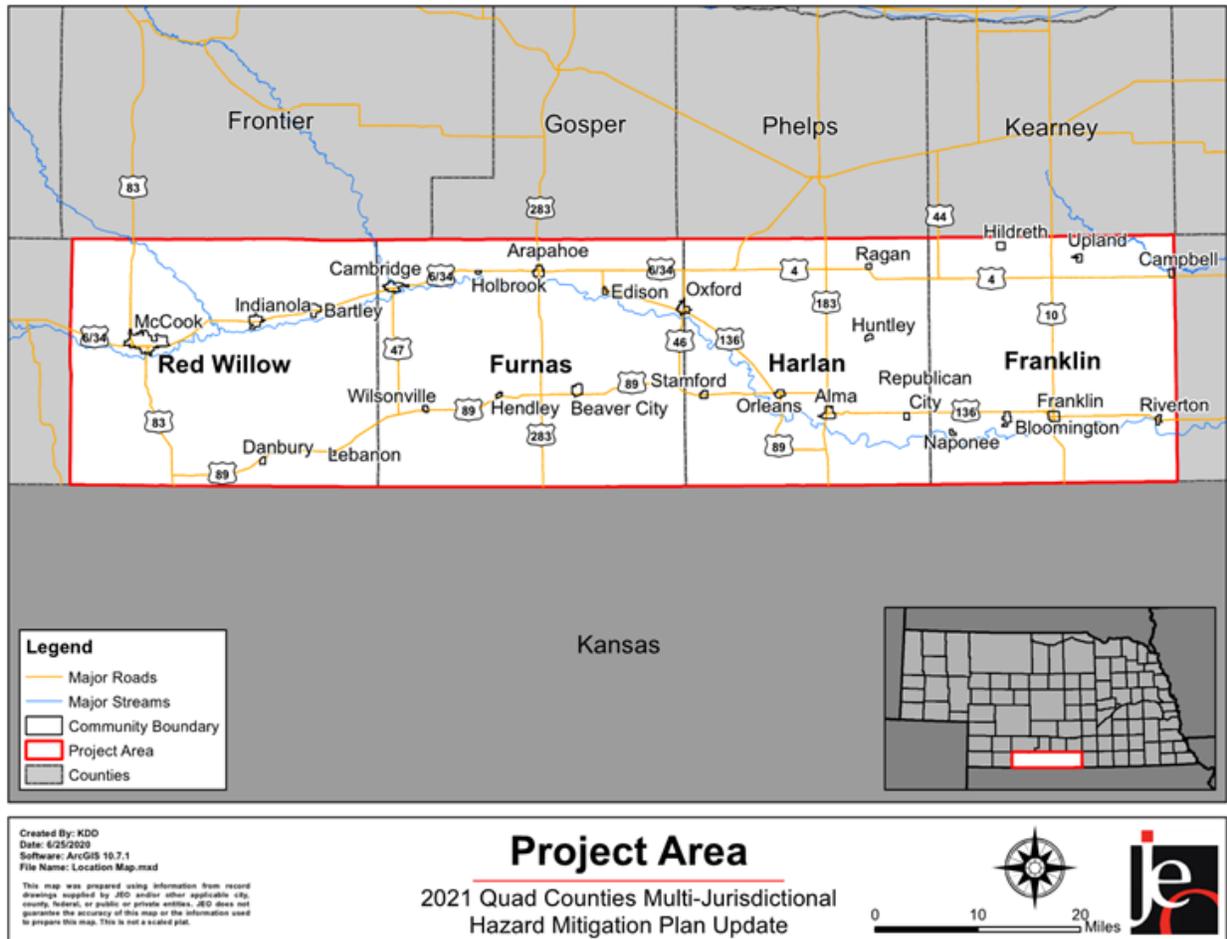
This plan is an update to the Quad Counties Hazard Mitigation Plan (HMP) approved in July 2016. The plan update was developed in compliance with the requirements of the Disaster Mitigation Act of 2000 (DMA 2000).

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 2: Participating Jurisdictions

Participating Jurisdictions	
Lower Republican NRD	Village of Huntley
Middle Republican NRD	Village of Orleans
Franklin County	Village of Ragan
Village of Bloomington	Village of Republican City
Village of Campbell	Village of Stamford
City of Franklin	Red Willow County
Village of Hildreth	Village of Bartley
Village of Naponee	Village of Danbury
Village of Riverton	City of Indianola
Village of Upland	City of McCook
Furnas County	Other Special Districts
City of Arapahoe	Alma Fire District
City of Beaver City	Alma Public Schools
City of Cambridge	Arapahoe-Holbrook Public Schools
Village of Edison	Orleans Fire District
Village of Hendley	Republican City Rural Fire District
Village of Holbrook	Southwest Fire Department
Village of Oxford	Stamford Rural Fire Department
Harlan County	Wilcox-Hildreth Public Schools
City of Alma	-

Figure 1: Hazard Mitigation Plan 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 communities 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 Regional 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 Regional Planning Team agreed that they are still relevant and applicable for this plan update. The goals for this plan update are as follows:

Goal 1: Protect Health and Safety of Residents

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

Goal 2: Reduce Future Losses from Hazard Events

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

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

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

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

Objective 3.1: Develop and provide information to residents and businesses about the types of hazards they are exposed to, what the effects may be, where they occur, and what they can do to be better prepared 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 out to and include new participating jurisdictions, special districts, and stakeholder groups, such as fire districts and school districts; a more specific hazard risk assessment applicable to the planning area; and the inclusion of additional mitigation strategies. This update also works to unify the various planning mechanisms in place throughout the participating communities (i.e., comprehensive plans, local emergency operation plans, zoning ordinances, building codes, etc.) to ensure that the goals and objectives identified in those planning mechanisms are consistent with the strategies and projects included in this plan. Regional hazards identified in the plan were also updated. The planning team decided to combine hazards that had similar impacts or occurred simultaneously. Other changes as described in the 2016 Quad Counties HMP review tool are described in the table below.

Table 3: Summary of Changes Based on 2016 Comments

Comments from 2016 Review Tool	Location of Revision	Summary of Change
In the future, please note the presence of any dams or levees outside of the planning area whose failure could impact the planning area.	Section 4, Dam Failure, Levee Failure	Any upstream dams or levees were identified.
Risk assessment for individual jurisdictions would be more meaningful if maps could be combined to show flood inundation areas and critical facilities.	Participant Sections	All critical facility maps now include floodplain information.
The planning area outline needs to be adjusted in Figure 13, Figure 15, Figure 21. Figure 15 has no legend.	Upfront, Participant Sections	All maps have been updated during the planning process.
Consider using a bar chart rather than a pie chart to convey the extent and frequency of hail events.	Severe Thunderstorms	A bar chart is used for extent and frequency.
Table FSC.5. How can the per capita income exceed the median household income?	Section 3	All census data has been updated during the planning process.
The outcome of the two-step assessment for each participant remains unclear, or simply doesn't seem to be captured anywhere. There is no substantive information on abilities to expand or improve on any existing policies or programs.	Participant Sections	The capability assessment has been updated during this plan update.
The plan author and plan participants might benefit from additional review of Mitigation Ideas: A Resource for Reducing Risk to Natural Hazards. In some jurisdictions, there seems to be an over-reliance on response actions and relatively few mitigation actions.	Participant Sections	Participants were able to identify new mitigation actions and were given a link to the Mitigation Ideas: A Resource for Reducing Risk to Natural Hazards.
Element C6 requires information on what was done to integrate mitigation into other planning mechanisms and what will be done to integrate mitigation into other planning mechanisms.	Participant Sections	Plan integration sections have been updated to discuss what has been done and what will be done to integrate planning mechanisms.
Cambridge had a drainage study done recently, but nothing transpired. Studies do not necessarily lead to actions but are more likely to identify issues and concerns and make recommendations for potential actions.	Cambridge Participant Section	Updated information has been gathered on all plans and studies.
Cambridge Public Schools are located in the floodplain. No actions address this situation. Flooding and potential damages are listed as a concern.	N/A	Cambridge Public Schools chose not to participate in the plan update.

It should also be noted that due to the outbreak of the coronavirus disease 2019 (COVID-19), some adjustments were made to the planning process to appropriately accommodate plan meetings and requirements. To best provide options for residents and staff members in the planning area, meetings were held via an online/phone one-on-one format and in-person public workshop meetings. Additional changes are described in *Section Two: Planning Process*.

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 becoming a member of Tree City USA, updating warning systems, installing new alert sirens, updating floodplain regulations, drainage improvements, installing backup generators, purchasing weather radios, and others. 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 the 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 includes 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 table provides an overview of the risk assessment. The likely extent is based off historical data. Many hazards may see increased extents due climate change. The potential effects of climate change are discussed in *Section 4: Risk Assessment*.

Table 4: Regional Risk Assessment

Hazard	Previous Occurrences	Approximate Annual Probability*	Likely Extent
Animal and Plant Disease	Animal Disease: 47	Animal Disease 6/6 = 100%	~2 animals per event
	Plant Disease: 61	Plant Disease 16/21 = 76%	Crop damage or loss
Chemical Spills	Fixed Site: 14	Fixed Site 10/30 = 33%	0 – 6,000 gallons 0 – 4,320 lbs
	Transportation: 23	Transportation 15/49 = 31%	0 – 3,980 gallons
Dam Failure	13	11/130 = 8%	Varies by Structure
Drought	483/1,501 months of drought	32%	D1-D2
Earthquakes	3	2/120 = 2%	<5.0 Magnitude
Extreme Heat	2,787	106/128 = 83%	>100°F
Flooding	45	17/25 = 68%	Some inundation of structures (<1% of structures) and roads near streams. Some evacuations of people may be necessary (<1% of population)
Grass/Wildfires	793	20/20 = 100%	Avg 5.76 acres Some homes and structures threatened or at risk
Levee Failure	0	0/120 = <1%	Varies by extent
Severe Thunderstorms	1,069	25/25 = 100%	≥2.5" rainfall Avg 56 mph winds; Hail range 0.5"-4.5" average 1.29"
Severe Winter Storms	330	25/25 = 100%	0.25 – 0.5" Ice 15°-35° below zero (wind chill) 1-6.5" snow 20-45 mph winds
Terrorism	2	2/49 = 4%	Varies by event
Tornadoes & High Winds	123	Tornadoes 19/25 = 76%	Avg: EF0 Range EF0-EF4
	47	High Winds 22/25 = 88%	Avg 58 mph; Range 40-75 mph

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

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

Table 5: Loss Estimation for the Planning Area

	Hazard Type	Count	Property	Crop²
Animal and Plant Disease	Animal Disease ¹	47	70 animals	N/A
	Plant Disease ²	61	N/A	\$544,624
Chemical Spills	Fixed Site ³	14	\$0	N/A
	Transportation ⁴ <i>8 Fatalities</i>	23	\$10,109	N/A
Dam Failure⁵		13	\$0	N/A
Drought⁶		483/1,501 months of drought	N/A	\$239,760,365
Earthquakes¹²		3	\$0	N/A
Extreme Heat⁷		Avg 22 days per year >100°F	N/A	\$26,463,846
Flooding⁸	Flash Flood	29	\$753,000	\$452,337
	Flood	16	\$1,180,000	
Grass/Wildfire⁹ <i>10 Injured</i>		793	7,226 acres	\$300,856
Levee Failure¹⁰		0	N/A	N/A
Severe Thunderstorms⁸ <i>9 Injured</i>	Hail	680	\$9,136,000	\$65,515,815
	Heavy Rain	35	\$15,000	
	Lightning	9	\$290,000	
	Thunderstorm Wind	345	\$12,834,200	
Severe Winter Storms⁸	Blizzard	38	\$825,000	\$19,492,754
	Extreme Cold/Wind Chill	12	\$0	
	Heavy Snow	27	\$0	
	Ice Storm	14	\$4,110,000	
	Winter Storm	131	\$500,000	
	Winter Weather	108	\$65,000	
Terrorism¹¹		2	\$0	N/A
Tornadoes & High Winds⁸ <i>1 Fatality, 1 Injury</i>	High Winds	123	\$4,334,240	\$4,636,553
	Tornadoes	47	\$2,299,500	
Total		2,570	\$36,352,049	\$357,103,990

N/A: Data not available

1 NDA (2014-November 2020)

2 USDA RMA (2000-2020)

3 NRC (1990-February 2020)

4 PHMSA (1971-July 2020)

5 NeDNR Correspondence

6 NOAA (1895-July 2020)

7 HPRCC (1897-July 2020)

8 NCEI (1996-2020)

9 NFS (2000-2020)

10 USACE NLN, (1900-July 2020)

11 University of Maryland (1970-2018)

12 USGS (1900-July 2020)

Executive Summary

Events like agricultural disease, severe winter storms, and severe thunderstorms will occur annually. Other hazards like levee failure, 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, severe thunderstorms, and severe winter storms 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 \$236 million in total crop loss was reported for the planning area since 2000.

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

Severe Thunderstorms

Thunderstorms differ from many other hazards. They are generally large in magnitude, have a long duration, and travel across large areas and through multiple jurisdictions within a single region. Additionally, thunderstorms often occur in series, with one area potentially impacted multiple times in one day and producing a range of associated hazards, including hail, 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 1,041 severe thunderstorm events in 24 years across the four-county planning area. These events caused over \$22 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, and localized flooding.

Vulnerable populations related to severe thunderstorms include residents of mobile homes (8% 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.

Severe Winter Storms

Severe winter storms occur annually in the planning area, typically between November and March. Winter storms can bring extreme cold temperatures, freezing rain and ice, and heavy or drifting snow. Blizzards are particularly dangerous and can significantly impact the planning area. The NCEI reported 322 severe winter storm events that caused over \$11 million in property damages in 24 years. Impacts resulting from severe winter storms include but are not limited to hypothermia and frost bite, closure of transportation routes, downed power lines and power outages, collapsed roofs from heavy snow loads, and closure of critical facilities. The most vulnerable citizens within the planning area are children, the elderly, individuals and families below the poverty line, and those new to the area.

Mitigation Strategies

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

SECTION ONE: INTRODUCTION

Hazard Mitigation Planning

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

Natural hazards, such as severe winter storms, high winds and tornadoes, severe thunderstorms, flooding, extreme heat, drought, agriculture diseases, and grass/wildfires are part of the world around us. Human-caused hazards are a product of the society and can cause significant impacts to communities. Human-caused hazards include levee failure, dam failure, chemical and radiological fixed site hazards, chemical and radiological transportation incidents, public health emergencies, terrorism, and/or civil disorder. These hazard events can occur as a part of normal operation or because 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, 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.

Quad Counties has prepared this multi-jurisdictional hazard mitigation plan 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 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.



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.”

Disaster Mitigation Act of 2000

The U.S. Congress passed the Disaster Mitigation Act of 2000 to amend the Robert T. Stafford Disaster Relief and Emergency 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 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 Rule⁸ published in the Federal Register on November 30, 2007, at 44 Code of Federal Regulations (CFR) Part 201.

Hazard Mitigation Assistance

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

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

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

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

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 and reduce the flooding risk in the mapped floodplain.
- **BRIC:** To qualify for pre-disaster mitigation funds, local jurisdictions must adopt a mitigation plan that is approved by FEMA. BRIC assists states, territories, tribes, and local governments in undertaking hazard mitigation projects that reduce the risks they face from disasters and natural hazards. BRIC replaced the Pre-Disaster Mitigation (PDM) program in 2020, and targets community related infrastructure plans and projects.

Plan Financing and Preparation

Regarding plan financing and preparation, the Harlan County Emergency Management 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 regulation.

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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, the four counties 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 Regional 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. Quad Counties utilized the multi-jurisdiction planning process recommended by FEMA (Local Mitigation Plan

Review Guide¹⁰, Local Mitigation Planning Handbook¹¹, and Mitigation Ideas: A Resource for Reducing Risk to Natural Hazards¹²) 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 is 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

Bringing 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

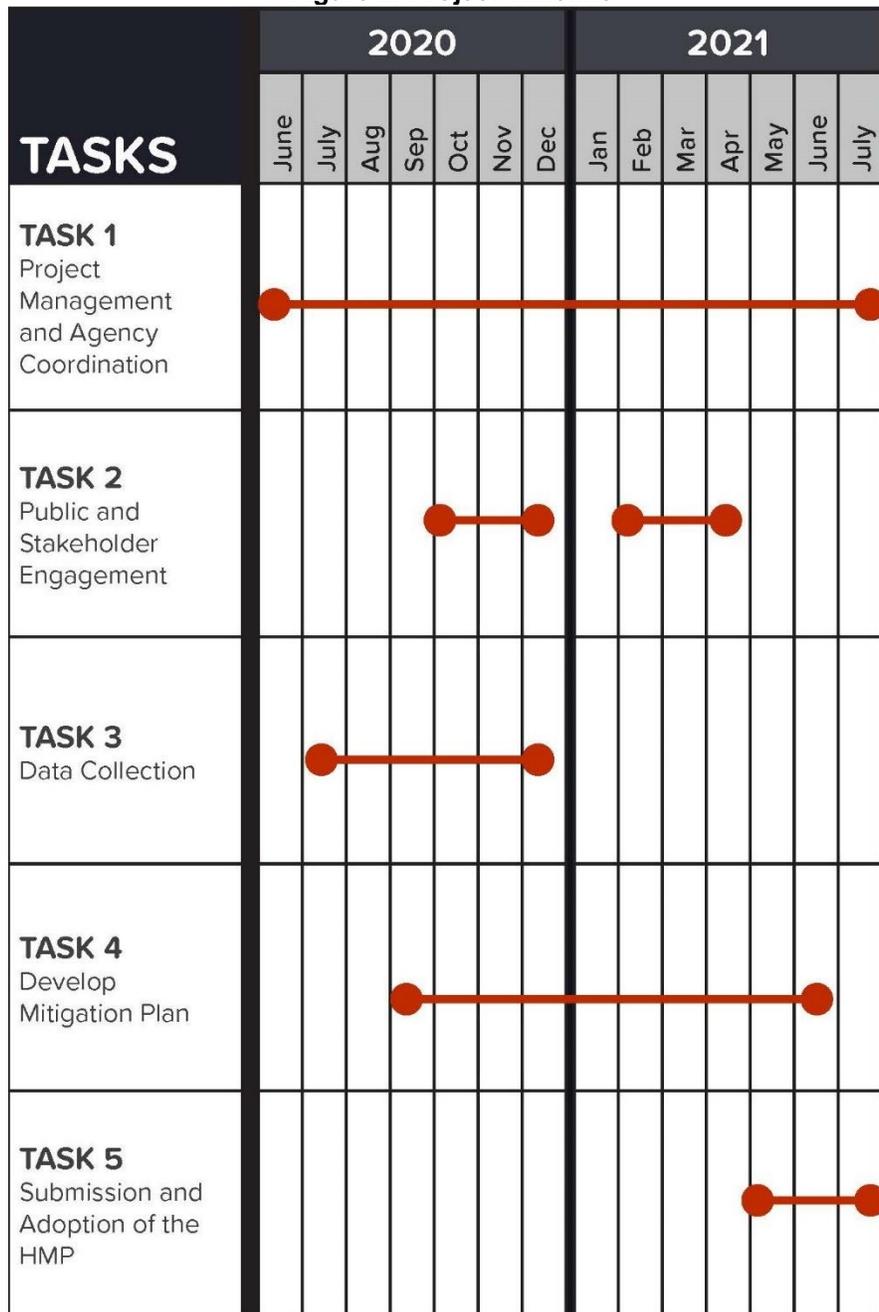
Quad Counties secured PDM funding for their multi-jurisdictional hazard mitigation plan in fiscal year 2018 and contracted JEO Consulting Group, Inc. (JEO) in November 2018 to guide and facilitate the planning process and assemble the multi-jurisdictional hazard mitigation plan. For the planning area, Chris Becker (Harlan County Emergency Manager) led the development of the plan and served as the primary point of contact throughout the project. A clear timeline of this plan update process is provided in Figure 2.

10 Federal Emergency Management Agency. 2011. "Local Mitigation Plan Review Guide." <https://www.fema.gov/media-library/assets/documents/23194>.

11 Federal Emergency Management Agency. 2013. "Local Mitigation Planning Handbook." <https://www.fema.gov/media-library/assets/documents/31598>.

12 Federal Emergency Management Agency. 2013. "Mitigation Ideas: A Resource for Reducing Risk to Natural Hazards." https://www.fema.gov/media-library-data/20130726-1904-25045-0186/fema_mitigation_ideas_final508.pdf.

Figure 2: Project Timeline



Regional Hazard Mitigation Planning Team

At the beginning of the planning process, emergency managers from all four counties and JEO staff identified key contacts who would constitute the Hazard Mitigation Planning Team. This planning team, comprised of local participants and the consultant, was established to guide the planning process, review the existing plan, and service as a liaison to plan participants throughout the planning area. A list of Regional Hazard Mitigation Planning Team members can be found in the following table. Staff from NEMA and NeDNR provided additional technical support.

Table 6: Hazard Mitigation Planning Team

Name	Title	Jurisdiction
Alan Kotschwar	Emergency Manager	Red Willow County
Chris Becker	Emergency Manager/County Sheriff	Harlan County
Roger Powell	Emergency Manager	Furnas County
Jerry Archer	Emergency Manager/County Sheriff	Franklin County
*Karl Dietrich	Planner	JEO Consulting Group
*Phil Luebbert	Project Coordinator	JEO Consulting Group
*Anthony Kohel	Planner	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 July 10, 2020 over Microsoft Teams, to discuss an overview of the planning process between JEO staff and the emergency managers. 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 Regional Planning Team and strategies for public engagement throughout the planning process. Table 7 shows kick-off meeting attendees. Table 8 shows the date, location, and agenda items of for the kick-off meeting.

Table 7: Kick-off Meeting Attendees

Name	Title	Jurisdiction
Diana Wilkinson	Deputy Emergency Manager	Red Willow County
Chris Becker	Emergency Manager/County Sheriff	Harlan County
Jerry Archer	Emergency Manager/County Sheriff	Franklin County
Alan Kotschwar	Emergency Manager	Red Willow County
Roger Powell	Emergency Manager	Furnas County
Karl Dietrich	Planner	JEO Consulting Group
Phil Luebbert	Project Coordinator	JEO Consulting Group

Table 8: Kick-off Meeting Location and Time

Location and Time	Agenda Items
Online Microsoft Teams Meeting July 10, 2020 11:00am	-Consultant and Regional Planning Team responsibilities -Overview of plan update process and changes from 2016 HMP -Plan goals and objectives -Public involvement and outreach -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 34 stakeholder groups or entities that were identified and sent letters to participate. The following table lists entities notified of the planning process. Stakeholders provided input which was 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 9: Notified Stakeholder Groups

Organizations		
Alma Chamber of Commerce	Good Samaritan Society- Alma	Orleans Chamber of Commerce
Alma Municipal Airport	Good Samaritan Society- Arapahoe	South Central Area Agency on Aging
American Red Cross - Central Plains	Harlan County Health	South Central Economic Development
Arapahoe Chamber of Commerce	Heritage Plaza Retirement Village	South Central Regional CERT
Arapahoe Municipal Airport	Hillcrest Nursing Home	Southern Power District
Beaver City Manor	McCook Ben Nelson Regional Airport	Southwest Nebraska CERT
Burlington Northern Santa Fe Railroad	McCook Chamber of Commerce	St Patrick Elementary
Cambridge Chamber of Commerce	McCook Community Hospital	Tri-Valley Assisted Living
Cambridge Municipal Airport	McCook Economic Development Corporation	Tri-Valley Health System
Franklin County Memorial Hospital	McCook PPD	Twin Valleys PPD
Funeral Home-Cambridge	Nebraska Forest Service	West Central Nebraska Area Agency on Aging
Golden Living Center - Franklin		

Neighboring Jurisdictions

Neighboring jurisdictions were notified and invited to participate in the planning process and are listed in the following table. Invitation and informational letters were sent to county and regional emergency managers as well as natural resources districts. Jurisdictions outside of the planning area did not participate in the planning process.

Table 10: Notified Neighboring Jurisdictions

Notified Neighboring Jurisdictions	
Adams County, NE	Little Blue NRD
Frontier County, NE	Tri Basin NRD
Gosper County, NE	Rawlins County, KS
Hayes County, NE	Decatur County, KS
Hitchcock County, NE	Norton County, KS
Kearney County, NE	Phillips County, KS
Phelps County, NE	Smith County, KS
Webster County, NE	

Participant Involvement

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

To be a participant in the development of this plan update, jurisdictions were required to have a minimum of one representative present at the Round 1 and Round 2 meetings or attend a follow-up meeting with a Regional Planning Team 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 include diverse input on the meeting documents. Sign-in sheets from all public meetings can be found in *Appendix A*. 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 or follow-up meetings, and invitations to complete surveys and worksheets required for the planning process. Table 11 provides a summary of outreach activities utilized in this process.

Table 11: Outreach Activity Summary

Action	Intent
Project Website	Informed the public and local/planning team members of past, current, and future activities (https://jeo.com/quad-counties-multi-jurisdictional-hmp-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.
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*).

Table 12 shows the date and location of meetings held for the Round 1 meeting phase of the project. Due to the COVID-19 pandemic, the Regional Planning Team determined that both in-person and virtual meeting options were held.

Table 12: Round 1 Meeting Dates and Locations

Agenda Items	
General overview of the HMP planning 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
Cambridge City Hall Cambridge, NE, 7:00pm	Wednesday, October 28, 2020
Johnson Community Center Alma, NE, 7:00pm	Thursday, October 29, 2020
Virtual Zoom Meeting Online or by Phone, 7:00pm	Wednesday, November 4, 2020
Virtual Zoom Meeting Online or by Phone, 2:00pm	Thursday, November 5, 2020

The intent of these meetings was to familiarize the jurisdictional representatives with an overview of the work to be completed over the next several months, discuss 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 Quad Counties HMP; identify the top concerns from each jurisdiction; and to begin reviewing community profiles for demographics, capabilities, and critical facilities. These meetings also served as an opportunity to gather input on the identification of hazards, such as records of historical occurrences and the community’s capability to mitigate and respond to those events.

Figure 3: Round 1 Meeting in Alma, NE



The following tables show the attendees from 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 JEO staff.

Table 13: Round 1 Meeting Attendees

Name	Title	Jurisdiction
Cambridge, NE – Wednesday, October 28, 2020		
Teresa Youngquist	Clerk/Treasurer	City of Beaver City, Village of Henley, Village of Holbrook
Kandra Kinne	Clerk/Treasurer	City of Cambridge
Kent Tidyman	City Manager	Village of Edison
Roger Powell	Emergency Manager/Floodplain Administrator	Furnas County
Mitchell Nelms	Utility Superintendent	City of Indianola
Nate Schneider	City Manager/Floodplain Administrator	City of McCook
Scott Clifford	County Surveyor/Floodplain Administrator	Red Willow County
Duane Hoffman	Public Works Director/Floodplain Administrator	Village of Oxford
David Gunderson	Mayor	City of Cambridge
Jim Jones	Funeral Director	City of Cambridge
Jessica Fisher	CEO	Tri Valley Health System
Phil Luebbert	Project Coordinator	JEO Consulting Group
Karl Dietrich	Planner	JEO Consulting Group
Anthony Kohel	Planner	JEO Consulting Group

Alma, NE – Thursday, October 29, 2020

Jennifer Woodis	Chief of Police	City of Franklin
Jerry Archer	County Sheriff/Emergency Manager	Franklin County
Chris Becker	County Sheriff/Emergency Manager	Harlan County
Dale Casper	Utility Superintendent/Chief of Police	Village of Hildreth
Casey Bantam	Floodplain Administrator	Village of Orleans
Mark Twohig	Fire Chief	Wilcox Fire District
Martha Orcutt	Board Member	Village of Republican City
Eileen Rainey	Community Consultant	South Central Economic Development District
Brian Seyler	Fire Chief	Alma Fire District
Mike Clements	County Supervisor – District 3	Harlan County
Phil Luebbert	Project Coordinator	JEO Consulting Group
Karl Dietrich	Planner	JEO Consulting Group
Anthony Kohel	Planner	JEO Consulting Group

Zoom – Wednesday, November 4, 2020

George Griffith	Superintendent	Arapahoe-Holbrook Public Schools
Ronni Harding	Village Clerk/Treasurer	Village of Bartley
Shirley Axtell	Village Clerk/Treasurer	Village of Danbury

Zoom – Thursday, November 5, 2020

Dale Sprague	Board Member	Village of Huntley
Lisa Howsden	Village Treasurer	Village of Huntley

Name	Title	Jurisdiction
Colt Livingston	Groundwater Programs Specialist	Middle Republican NRD
Justin Patterson	Superintendent	Wilcox-Hildreth Public Schools
Lorri Bantam	City Administrator/Floodplain Administrator	City of Alma
Diana Wilkinson	Deputy Emergency Manager	Red Willow County
Alan Kotschwar	County Sheriff/Emergency Manager	Red Willow County
Donna Tannahill	City Clerk/Treasurer	City of Arapahoe
Greg Schievelbein	Utility Superintendent	City of Arapahoe

Table 14: Round 1 One-on-One Meeting Attendees

Name	Title	Jurisdiction
Jon Davis	Superintendent	Alma Public Schools
Todd Porter	Superintendent	Southwest Public Schools
Belinda Tolle	Village Clerk	Village of Upland

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 an increase in 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. The following table lists the dates and times of the meetings for the Mitigation Strategies phase of this project. Meeting attendees are identified in Table 16 and Table 17.

Table 15: Round 2 Meeting Dates and Locations

Agenda Items	
Identify new mitigation actions, review 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, 7:00pm	Tuesday, January 26, 2021
Virtual Zoom Meeting Online or by Phone, 2:00pm	Thursday, January 28, 2021

Table 16: Round 2 Meeting Attendees

Name	Title	Jurisdiction
Zoom Meeting – Tuesday, January 26, 2021		
Ronni Harding	Village Clerk/Treasurer	Village of Bartley
Casey Bantam	Floodplain Administrator	Village of Orleans
Todd Abraham	Chairman	Village of Edison
Jerry Archer	County Sheriff/Emergency Manager	Franklin County
Bob Conway	Board Member	Campbell Fire Department
Nate Schneider	City Manager/Floodplain Administrator	City of McCook
Scott Clifford	County Surveyor/Floodplain Administrator	Red Willow County
Eugene Axtell	Representative	Village of Danbury
Shirley Axtell	Village Clerk/Treasurer	Village of Danbury
Sandy Benson	Forest Fuels Management Specialist	Nebraska Forest Service
Karl Dietrich	Planner	JEO Consulting Group
Phil Luebbert	Project Manager	JEO Consulting Group
Mary Baker	Resilience Strategist	JEO Consulting Group
Zoom Meeting – Thursday, January 28, 2021		
Belinda Tolle	Village Clerk	Village of Upland
Holly Tallent	Board Member	Village of Upland
Ron Tolle	Maintenance Supervisor	Village of Upland
Jeff Linner	Chairman/Fire Chief	Village of Upland, Upland Fire District
Jennifer Woodis	Chief of Police	City of Franklin
Teresa Youngquist	Clerk/Treasurer	City of Beaver City, Village of Hendley
Todd Porter	Superintendent	Southwest Public Schools
Roger Powell	Emergency Manager/Floodplain Administrator	Furnas County
Todd Siel	General Manager	Lower Republican NRD
Donna Tannahill	City Clerk/Treasurer	City of Arapahoe
Diana Wilkinson	Deputy Emergency Manager	Red Willow County
George Griffith	Superintendent	Arapahoe Public Schools
Alan Kotschwar	County Sheriff/Emergency Manager	Red Willow County
Colt Livingston	Groundwater Programs Specialist	Middle Republican NRD
Martha Orcutt	Board Member	Village of Republican City
David Gunderson	Mayor	City of Cambridge
Kandra Kinne	Clerk/Treasurer	City of Cambridge
Steven Platt	Village Clerk	Village of Huntley
John Davis	Superintendent	Alma Public Schools
Sandy Benson	Forest Fuels Management Specialist	Nebraska Forest Service
Karl Dietrich	Planner	JEO Consulting Group

Name	Title	Jurisdiction
Phil Luebbert	Project Manager	JEO Consulting Group

Table 17: Round 2 One-on-One Meeting Attendees

Name	Title	Jurisdiction
Brad Wolfe	Firefighter	Republican City Fire District
Debra Lucht	Village Clerk	Village of Riverton
Dale Casper	Utility Superintendent/Chief of Police	Village of Hildreth
Mitchell Nelms	Utility Superintendent	City of Indianola

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 18: 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	
Nemaha NRD Hazard Mitigation Plan (2015) https://jeo.com/nnrhd-hmp	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)

Section Two | Planning Process

	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 https://myrtk.epa.gov/info/search.jsp	Nebraska Department of Natural Resources https://dnr.nebraska.gov/
Federal Emergency Management Agency http://www.fema.gov	Nebraska Department of Natural Resources – Dam Inventory http://prodmaps2.ne.gov/html5DNR/?viewer=daminventory
FEMA Flood Map Service Center https://msc.fema.gov/portal/advanceSearch	Nebraska Department of Revenue – Property Assessment Division www.revenue.ne.gov/PAD
High Plains Regional Climate Center http://climod.unl.edu/	Nebraska Department of Transportation http://dot.nebraska.gov/
National Agricultural Statistics Service http://www.nass.usda.gov/	Nebraska Emergency Management Agency 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 http://nep.education.ne.gov/	United States Geological Survey 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 opened to allow for participants and community members at large to review the plan and provide comments and suggest changes. The public review period was open from April 12, 2021, through May 12, 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/quad-counties-multi-jurisdictional-hmp-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.

- City of Alma: Provided updates on the community profile and updated business names.
- Nebraska Forest Service: Provided comments on the upfront grass/wildfire section and grass/wildfire sections throughout individual community profiles.
- NeDNR: Reviewed the upfront flooding and drought section and provided updates.

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 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 their county emergency manager 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 Quad Counties HMP have established to monitor the plan; provides a description of how, when, and by whom the HMP process and mitigation actions will be evaluated; presents the criteria used to evaluate the plan; and explains how the plan will be maintained and updated.

SECTION THREE: PLANNING AREA PROFILE

Introduction

To identify jurisdictional vulnerabilities, it is vitally important to understand the people and built environment of the planning area. The following section is meant to provide an overall 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. Instead, this section will highlight at-risk populations and characteristics of the built environment that add to regional vulnerabilities.

Planning Area Geographic Summary

The planning area covers a total of 2,589 square miles in south central Nebraska including all of Franklin, Furnas, Harlan, and Red Willow counties. The planning area is comprised of several different topographic regions: dissected plains, plains, valleys, and large reservoirs (Figure 4). Dissected plains are represented by hilly lands with moderate to steep slopes and sharp ridge crests. Plains are represented by flat-lying land above the valley and are made of sandstone or stream-deposited silt, clay, sand, and gravel overlain by wind-deposited silt (called *loess*). Valleys are flat-lying land along major streams and large reservoirs are constructed for purposes such as water storage for irrigation, generation of electricity, flood control, and/or recreation.¹³

The main waterways in the planning area are the Republican River, Medicine Creek, Red Willow Creek, and Harlan County Lake. The Quad Counties planning area is part of the Republican River Basin, which can support crop agriculture, when irrigation is available, and ranching and cattle operations. The planning area is located in the Lower Republican and Middle Republican Natural Resources Districts.

Demographics and At-Risk Populations

As noted above, the planning area includes all of Franklin, Furnas, Harlan, and Red Willow counties. The U.S. Census Bureau collects specific demographic information for each county. The estimated population of the planning area is 22,036. This population includes a range of demographics and persons at risk from natural and man-made disasters.

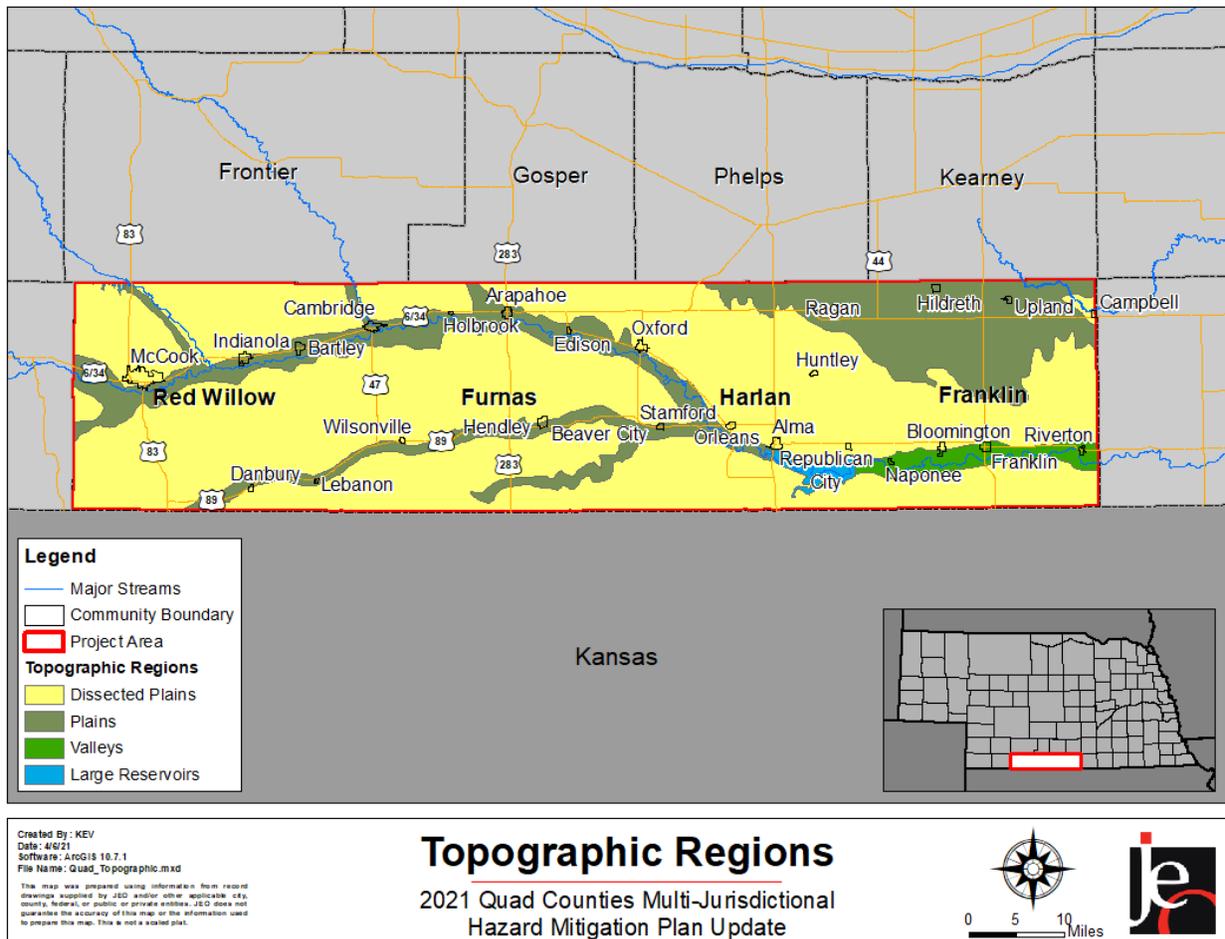
Table 19: Estimated Age Breakdown for Planning Area

Age	Planning Area	State of Nebraska
<5	5.8%	6.9%
5-19	18.8%	20.6%
20-64	53.1%	57.5%
>64	22.3%	15.1%
Median	46.6	36.4

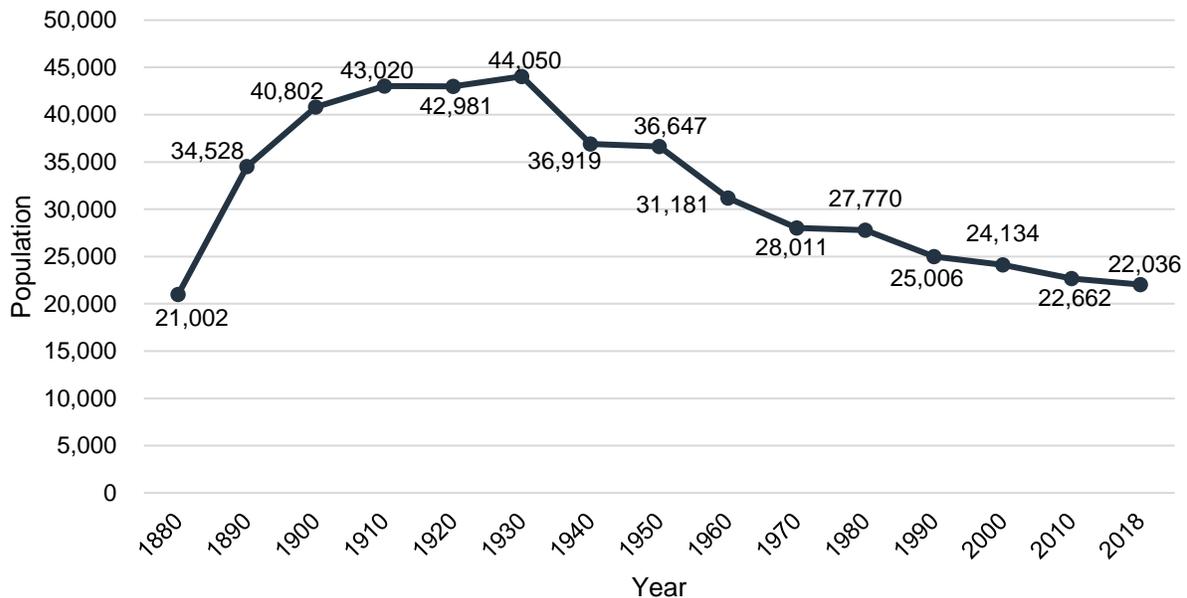
Source: U.S. Census Bureau

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

Figure 4: Topography



Community and regional vulnerability are impacted by growing or declining populations. Communities growing quickly may lack resources to provide services for all community members 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 because of vacant and/or dilapidated structures, an inability to properly maintain critical facilities and/or infrastructure, and higher levels of unemployment and population 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 5: Planning Area Population, 1880-2018

Source: U.S. Census Bureau¹⁴

The planning area has seen a gradual decline in population since 1930 with population decline slowing since 1970. Subsequent updates to this HMP should include updated census data from the 2020 census to determine if this trend is continuing.

At-Risk Populations

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

- 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

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 or transportation. They also lack practical knowledge necessary to respond appropriately during a disaster. Despite this vulnerability, children are generally overlooked in disaster planning because the presence of a caretaker is assumed. With nearly 25% of the planning area’s population younger than 20, children are a key vulnerable group to address in the planning process.

¹⁴ United States Census Bureau. 2018. “S0101: Age and Sex.” [database file]. <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>.

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.

Section Three | Planning Area Profile

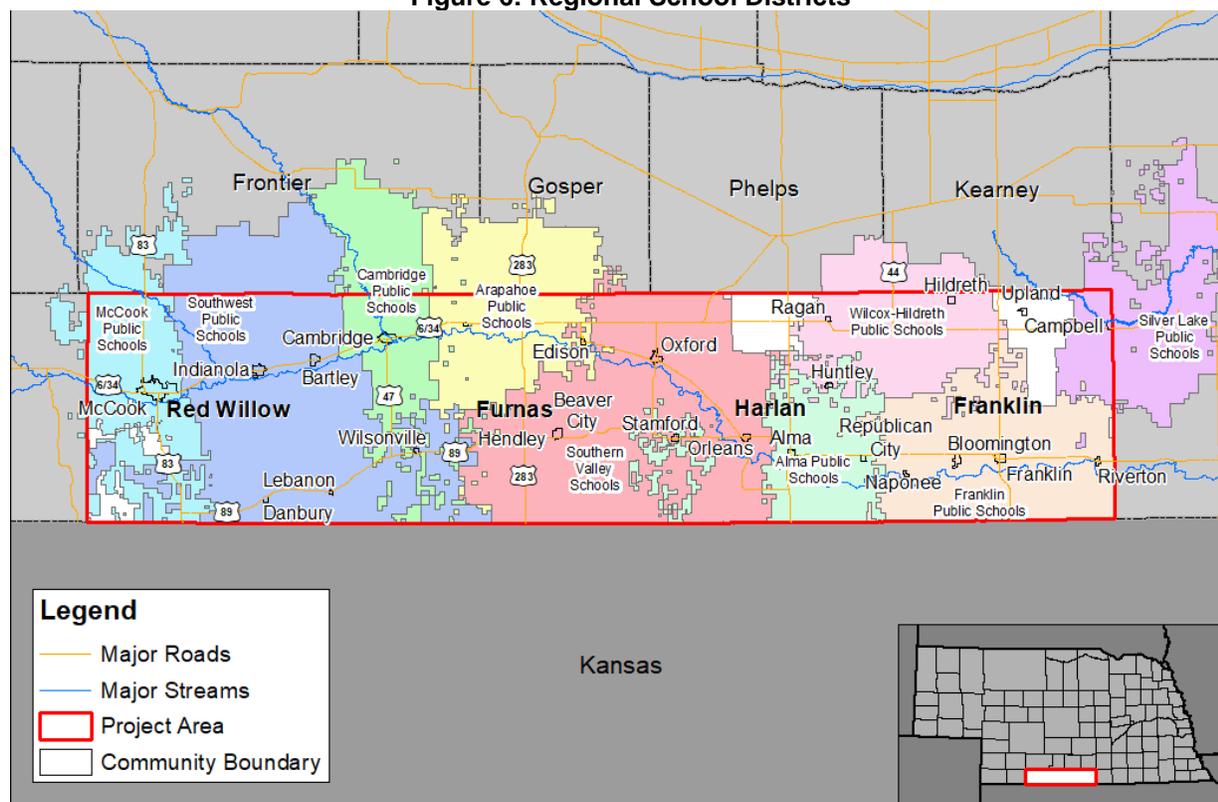
Schools house a high number of children and adults within the planning area during the daytime hours of weekdays, as well as during special events on evenings and weekends. The following table identifies the various school districts located within the planning area, and Figure 6 is a map of the school district boundaries. This list is comprehensive and does not represent only the school districts participating in this plan.

Table 20: School Inventory

School District	Total Enrollment (2019-2020)	Total Teachers
Alma Public Schools	344	32
Arapahoe-Holbrook Public Schools	351	27
Cambridge Public Schools	316	30
Franklin Public Schools	296	29
McCook Public Schools	1,426	94
Southern Valley Schools	359	39
Southwest Public Schools	274	31
Wilcox-Hildreth Public Schools	213	24

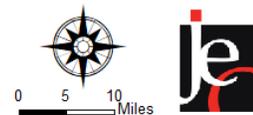
Source: Nebraska Department of Education¹⁷

Figure 6: Regional School Districts



Created By: KEV
 Date: 4/6/21
 Software: ArcGIS 10.7.1
 File Name: Quad_School Districts.mxd
 This map was prepared using information from record drawings supplied by JEO and/or other applicable city, county, federal, or private entities. JEO does not guarantee the accuracy of this map or the information used to prepare this map. This is not a scaled plan.

School Districts
 2021 Quad Counties Multi-Jurisdictional
 Hazard Mitigation Plan Update



¹⁷ Nebraska Department of Education. 2019. "Nebraska Education Profile." Accessed March 2021. <http://nep.education.ne.gov/>.

Like minors, seniors (age 65 and older) are often more significantly impacted by temperature extremes and severe weather. 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 for proper bodily functions. 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 elderly populations live throughout the planning area, there is the potential that they will be located in higher concentrations at care facilities. Table 21 identifies the number and capacity of care facilities throughout the planning area.

Table 21: Inventory of Care Facilities

Jurisdiction	Hospitals	Hospital Beds	Health Clinics	Rural Health Clinics	Adult Care Homes	Adult Care Beds	Assisted Living Homes	Assisted Living Beds
Franklin	1	14	0	3	1	42	1	18
Furnas	1	20	0	3	2	58	3	47
Harlan	1	19	0	1	1	53	1	16
Red Willow	1	25	1	1	1	100	3	84
Planning Area	4	78	1	8	5	253	8	165

Source: Nebraska Department of Health and Human Services^{19,20,21,22,23}

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 22 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 22: ESL and Poverty At-Risk Populations

County	Percent That Speaks English as Second Language	Families Below Poverty Level
Franklin	2.5%	10.9%
Furnas	3.3%	7.2%
Harlan	3.5%	6.6
Red Willow	1.9%	7.2%

Source: U.S. Census Bureau^{24,25}

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

19 Department of Health and Human Services. March 2021. "Assisted Living Facilities." <http://dhhs.ne.gov/licensure/Documents/ALF%20Roster.pdf>.

20 Department of Health and Human Services. March 2021. "Health Clinics." <http://dhhs.ne.gov/licensure/Documents/ALF%20Roster.pdf>.

21 Department of Health and Human Services. March 2021. "Hospitals."

<http://dhhs.ne.gov/licensure/Documents/Hospital%20Roster.pdf#search=hospital%20roster>.

22 Department of Health and Human Services. March 2021. "Long Term Care Facilities."

<http://dhhs.ne.gov/licensure/Documents/LTCRoster.pdf#search=long%20term%20care%20facilities%20roster>

23 Department of Health and Human Services. March 2021. "Rural Health Clinic."

http://dhhs.ne.gov/licensure/Documents/RHC_Roster.pdf#search=hospital%20roster.

24 U.S. Census Bureau. 2020. "Language Spoken at Home: 2018 ACS 5-year estimate." <https://data.census.gov/cedsci/>.

25 U.S. Census Bureau. 2020. "Selected Economic Characteristics: 2018 ACS 5-year estimate." <https://data.census.gov/cedsci/>.

Residents below the poverty line may lack resources to prepare for, respond to, or recover from hazard events. Residents with limited economic resources might struggle to prioritize the implementation of mitigation measures over more immediate needs. Further, residents with limited economic resources are more likely to live in older, more vulnerable structures. These structures could be mobile homes; located in the floodplain; located near know hazard sites (i.e., chemical storage areas); located in remote rural areas away from urban amenities; 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 are that would be English. Residents who struggle with English in the written form may not have sufficient information related to local concerns to effectively mitigate potential impacts. Residents with limited English proficiency would be at an increased vulnerability to all hazards within the planning area.

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 23).

Table 23: Racial Composition Trends

Race	2010		2018		% CHANGE
	Number	% of Total	Number	% of Total	
White, Not Hispanic	22,139	98%	21,246	96%	-4.0%
Black	44	0%	126	1%	1.9%
American Indian and Alaskan Native	127	1%	54	0%	-0.6%
Asian	49	0%	56	0%	0.1%
Native Hawaiian and Other Pacific Islander	6	0%	8	0%	0.3%
Other Races	158	1%	161	1%	0%
Two or More Races	177	1%	385	2%	1.2%
Total Population	22,700	-	22,036	-	-

Source: U.S. Census Bureau^{26,27}

26 U.S. Census Bureau. 2020. "Race: 2010 ACS 5-year estimate." <https://data.census.gov/cedsci/>.
 27 U.S. Census Bureau. 2020. "Race: 2018 ACS 5-year estimate." <https://data.census.gov/cedsci/>.

Built Environment and Structural Inventory

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

Of the occupied housing units in the planning area, more than 24 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 Furnas County has the highest percentage of renter-occupied housing units in the planning area. The cities of Arapahoe and McCook both have more than 30 percent of housing stock occupied by renters.

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

Table 24: Housing Characteristics

Jurisdiction	Total Housing Units				Occupied Housing Units			
	Occupied		Vacant		Owner		Renter	
	#	%	#	%	#	%	#	%
Franklin County	1,354	79.1	358	20.9	1,131	83.5	223	16.5
Bloomington	55	67.9	26	32.1	55	100	0	0
Campbell	143	83.1	29	16.9	129	90.2	14	9.8
Franklin	443	77.7	127	22.3	338	76.3	105	23.7
Hildreth	199	94.3	12	5.7	167	83.9	32	16.1
Naponee	54	62.1	33	37.9	44	81.5	10	18.5
Riverton	36	47.4	40	52.6	34	94.4	2	5.6
Upland	73	82	16	18	58	79.5	15	20.5
Furnas County	2,142	79.0	571	21	1,540	71.9	602	28.1
Arapahoe	471	84.9	84	15.1	318	67.5	153	32.5
Beaver City	258	68.3	120	31.7	207	80.2	51	19.8
Cambridge	599	88.7	76	11.3	420	70.1	179	29.9
Edison	83	84.7	15	15.3	61	73.5	22	26.5
Hendley	10	50.0	10	50.0	8	80.0	2	20.0
Holbrook	101	70.6	42	29.4	72	71.3	29	28.7
Oxford	335	81.7	75	18.3	235	70.1	100	29.9
Harlan County	1,521	63.8	863	36.2	1,218	80.1	303	19.9
Alma	627	83.3	126	16.7	486	77.5	141	22.5
Huntley	14	100	0	0	14	100	0	0
Orleans	232	81.4	53	18.6	168	72.4	64	27.6
Ragan	20	74.1	7	25.9	19	95.0	1	5.0
Republican City	76	32.5	158	67.5	70	92.1	6	7.9
Stamford	63	58.3	45	41.7	61	96.8	2	3.2
Red Willow County	4,459	83.9	853	16.1	3,279	73.5	1,180	26.5
Bartley	136	82.4	29	17.6	113	83.1	23	16.9
Danbury	43	57.3	32	42.7	35	81.4	8	18.6
Indianola	236	84.3	44	15.7	191	80.9	45	19.1
Lebanon	31	48.4	33	51.6	24	77.4	7	22.6
McCook	3,239	85.1	567	14.9	2,258	69.7	981	30.3
Planning Area	9,476	78.2%	2,645	21.8%	7,168	75.6%	2,308	24.4%

Source: U.S. Census Bureau²⁸

The US Census provides information related to housing units and potential areas of vulnerability. The selected characteristics examined in Table 25 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.

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

Table 25: Selected Housing Characteristics

	Franklin	Furnas	Harlan	Red Willow	Total
Occupied Housing Units	1,354	2,142	1,521	4,459	9,476
Lacking Complete Plumbing Facilities	0.0%	1.5%	0.5%	0.2%	0.5%
Lacking Complete Kitchen Facilities	0.1%	3.3%	0.4%	2.4%	1.9%
No Telephone Service Available	0.6%	1.4%	1.1%	3.0%	2.0%
Housing Unit with No Vehicles Available	1.8%	5.0%	1.8%	5.7%	4.4%
Mobile Homes	4.0%	1.7%	22.9%	5.6%	10.1%

Source: U.S. Census Bureau²⁹

Approximately two 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 cellular telephones are now the primary form of telephone service. However, this lack of access to landline telephone service does represent a population at increased risk to disaster impacts. Reverse 911 systems are designed to contact households via landline services and as a result, some homes in hazard 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 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.

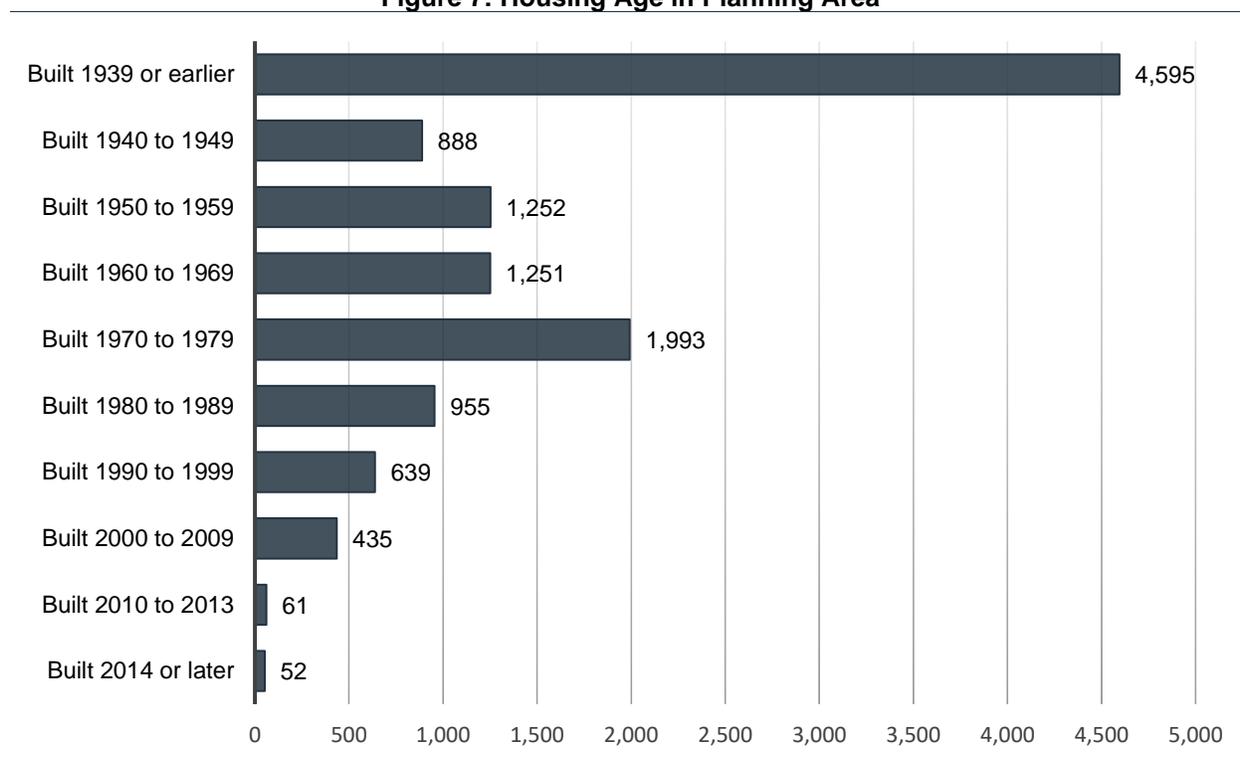
Approximately 10 percent of housing units in the planning area are mobile homes. Harlan County has the highest rate of mobile homes in its housing stock at 22.9 percent. Mobile homes have a higher risk of sustaining damages during high wind events, tornadoes, severe thunderstorms, and severe winter storms. Mobile homes that are either not anchored or are anchored incorrectly can be overturned by 60 mph winds. A thunderstorm is classified as severe when wind speeds exceed 58 mph, placing improperly anchored mobile homes at risk. Furthermore, approximately 4.4 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 vast majority of homes within the planning area were built prior to 1980 (82%), with 38% of homes built prior to 1939 (Figure 7). Housing age can serve as an indicator of risk, as structures built prior to state building codes being developed may be more vulnerable. According to the Department of Housing and Urban Development, older homes are at greater risk of poor repair and dilapidation resulting in blighted or substandard properties. Residents living in these homes maybe at higher risk to the impacts of high winds, tornadoes, severe winter storms, and thunderstorms. Across the state, the first building codes were adopted in 1987, but prior to this time, codes and building standards were established (or not) by each county and community. The

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

State of Nebraska later adopted the International Building Code (IBC) 2000 codes (adopted in 2003), the IBC 2009 codes (adopted in 2010), and the IBC 2018 codes as of 2020.

Figure 7: Housing Age in Planning Area



Source: U.S. Census Bureau³⁰

State and Federally Owned Properties

The following table provides an inventory of state and federally owned properties within the planning area by county. In addition to the properties listed below, the Nebraska Department of Transportation has maintenance shops located throughout the planning area, as well as multiple US Post Offices in many of the communities. Electrical substations and state maintenance buildings are critical for continuity of operations (not included below), while recreational areas may house a vulnerable population with no permanent shelter facilities in case of high wind, severe thunderstorm, or tornado events.

Table 26: State and Federally Owned Facilities

Facility or Area	Nearest Community
Franklin County	
Alfon C. Haring Memorial WMA	Riverton, NE
Ash Grove WMA	Franklin, NE
Limestone Bluffs WMA	Franklin, NE
Macon Lakes WPA	Franklin, NE
Quadhamer WPA	Hildreth, NE
Ritterbush WPA	Hildreth, NE
Spoonbill Flats WPA	Hildreth, NE
Furnas County	
Burton's Bend WMA	Oxford, NE

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

Facility or Area	Nearest Community
Oxford WMA	Oxford, NE
Cambridge Diversion Dam WMA	Cambridge, NE
Harlan County	
Burton's Bend WMA	Orleans, NE
Harlan County Reservoir	Alma, NE
South Sacramento WMA	Ragan, NE
Southeast Sacramento WMA	Wilcox, NE
Red Willow County	
Red Willow Diversion Dam WMA	McCook, NE
Red Willow Reservoir SRA	McCook, NE
Red Willow Reservoir WMA	McCook, NE

Source: Nebraska Game & Parks,³¹ U.S. National Park Service³²

Mid-Plains Community College is a two-year public institution located in Nebraska. Nebraska state legislation established the college in bills 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 main campuses in McCook and North Platte. Additional extended campuses are in Broken Bow, Imperial, Ogallala, and Valentine.

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 McCook campus is located on the northeast part of the city and outside the floodplain.³³

Historical Sites

According to the National Register of Historic Places for Nebraska by the National Park Service, there are 21 historic sites located in the planning area.

Table 27: Historical Sites

Site Name	Date Listed	Nearest Community	County	In Floodplain?
Alma City Auditorium and Sale Barn	7/11/2014	Alma	Harlan	N
Cambridge State Aid Bridge	6/29/1992	Cambridge	Furnas	Unknown
Doyle Archeological Site	12/4/1974	McCook	Red Willow	Unknown
Dupee Music Hall	9/26/1985	Franklin	Franklin	No
Faling, W.H., House	11/22/1999	Cambridge	Furnas	
First Congregational Church, U.C.C	9/14/1982	Naponee	Franklin	No
Franklin Bridge	6/29/1992	Franklin	Franklin	Yes
Franklin County Courthouse	7/5/1990	Franklin	Franklin	No
Keystone Hotel	7/5/2001	McCook	Red Willow	No
Lincoln Hotel	7/6/1989	Franklin	Franklin	No
Lost Creek Archeological Site	5/26/1983	Bloomington	Franklin	Unknown
McCook Public-Carnegie Library	9/12/1985	McCook	Red Willow	No
McCook YMCA	3/9/2000	McCook	Red Willow	No
Norris, Senator George William, House	5/28/1967	McCook	Red Willow	No

31 Nebraska Game and Parks. 2021. "Public Access ATLAS." <https://maps.outdoornebraska.gov/PublicAccessAtlas/>.

32 U.S. National Park Service. 2021. "Parks." <https://www.nps.gov/state/ne/index.htm>.

33 Mid-Plains Community College. March 2021. <http://mpcc.edu/about-mpcc/general-information/mpcc-history>

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Site Name	Date Listed	Nearest Community	County	In Floodplain?
Prairie Dog Creek Bridge	6/29/1992	Orleans	Harlan	Yes
Red Willow County Courthouse	7/5/1990	McCook	Red Willow	No
Republican River Bridge	6/29/1992	Riverton	Franklin	Yes
Sappa Creek Bridge	6/29/1992	Stamford	Harlan	Yes
Second-Generation Norden Bombsight Vault	6/17/1993	McCook	Red Willow	No
Sutton, H.P., House	5/22/1978	McCook	Red Willow	No
Turkey Creek Bridge	6/29/1992	Ragan	Harlan	Yes

Source: National Park Service³⁴

34 National Park Service. March 2021. "National Register of Historic Places NPGallery Database." <https://npgallery.nps.gov/nrhp>.

SECTION FOUR: RISK ASSESSMENT

Introduction

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

Table 28: 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 (NFIP) insured structures that have been repetitively damaged floods.

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

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 is available. Additional loss estimates are provided separately for those hazards for which sufficient data is available. These estimates can be found within the relevant hazard profiles.

Average annual losses from historical occurrences can be calculated for those hazards for which there is a robust historic record and for which monetary damages 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 are data available for recorded events. During this planning process, vetted and cleaned NCEI data are available for January 1996 to 2020. Although some data are available back to 1950, this plan update only utilizes the more current and more accurate data available. Wildfire data are available from the Nebraska Forest Service from 2000 to 2020.
- **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 city.

An example of the Event Damage Estimate is found below:

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

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 2020. 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:

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

Hazard Identification

The identification of relevant hazards for the planning area began with a review of the 2019 State of Nebraska HMP and the previous 2016 Quad Counties HMP. 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. From the previous plan Chemical Spills (Fixed Site) and Chemical Spills (Transportation) were combined into one hazard, Chemical Spills. In addition, Hail was combined with Severe Thunderstorms, and Tornadoes and High Winds were combined. The Regional Planning Team chose not to profile Public Health Emergency as it is already covered by local health district plans.

Table 29: Hazards Addressed in the Plan

Hazards Addressed in the Plan		
Animal and Plant Disease	Extreme Heat	Severe Winter Storms
Chemical Spills	Flooding	Terrorism
Dam Failure	Grass/Wildfires	Tornadoes and High Winds
Drought	Levee Failure	
Earthquake	Severe Thunderstorms	

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 recorded event.

Table 30: Regional Risk Assessment

Hazard	Previous Occurrences	Approximate Annual Probability*	Likely Extent
Animal and Plant Disease	Animal Disease: 47	Animal Disease 6/6 = 100%	~2 animals per event
	Plant Disease: 61	Plant Disease 16/21 = 76%	Crop damage or loss
Chemical Spills	Fixed Site: 14	Fixed Site 10/30 = 33%	0 – 6,000 gallons 0 – 4,320 lbs
	Transportation: 23	Transportation 15/49 = 31%	0 – 3,980 gallons
Dam Failure	13	11/130 = 8%	Varies by Structure
Drought	483/1,501 months of drought	32%	D1-D2
Earthquakes	3	2/120 = 2%	<5.0 Magnitude
Extreme Heat	2,787	106/128 = 83%	>100°F
Flooding	45	17/25 = 68%	Some inundation of structures (<1% of structures) and roads near streams. Some evacuations of people may be necessary (<1% of population)
Grass/Wildfires	793	20/20 = 100%	Avg 5.76 acres Some homes and structures threatened or at risk
Levee Failure	0	0/120 = <1%	Varies by extent
Severe Thunderstorms	1,069	25/25 = 100%	≥2.5" rainfall Avg 56 mph winds; Hail range 0.5"-4.5" average 1.29"
Severe Winter Storms	330	25/25 = 100%	0.25 – 0.5" Ice 15°-35° below zero (wind chill) 1-6.5" snow 20-45 mph winds
Terrorism	2	2/49 = 4%	Varies by event
Tornadoes & High Winds	123	Tornadoes 19/25 = 76%	Avg: EF0 Range EF0-EF4
	47	High Winds 22/25 = 88%	Avg 58 mph; Range 40-75 mph

* 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 31: Loss Estimation for the Planning Area

	Hazard Type	Count	Property	Crop ²
Animal and Plant Disease	Animal Disease ¹	47	70 animals	N/A
	Plant Disease ²	61	N/A	\$544,624
Chemical Spills	Fixed Site ³	14	\$0	N/A
	Transportation ⁴ 8 Fatalities	23	\$10,109	N/A
Dam Failure⁵		13	\$0	N/A
Drought⁶		483/1,501 months of drought	N/A	\$239,760,365
Earthquakes¹²		3	\$0	N/A
Extreme Heat⁷		Avg 22 days per year >100°F	N/A	\$26,463,846
Flooding⁸	Flash Flood	29	\$753,000	\$452,337
	Flood	16	\$1,180,000	
Grass/Wildfire⁹ 10 Injured		793	7,226 acres	\$300,856
Levee Failure¹⁰		0	N/A	N/A
Severe Thunderstorms⁸ 9 Injured	Hail	680	\$9,136,000	\$65,515,815
	Heavy Rain	35	\$15,000	
	Lightning	9	\$290,000	
	Thunderstorm Wind	345	\$12,834,200	
Severe Winter Storms⁸	Blizzard	38	\$825,000	\$19,492,754
	Extreme Cold/Wind Chill	12	\$0	
	Heavy Snow	27	\$0	
	Ice Storm	14	\$4,110,000	
	Winter Storm	131	\$500,000	
	Winter Weather	108	\$65,000	
Terrorism¹¹		2	\$0	N/A
Tornadoes & High Winds⁸ 1 Fatality, 1 Injury	High Winds	123	\$4,334,240	\$4,636,553
	Tornadoes	47	\$2,299,500	
Total		2,570	\$36,352,049	\$357,103,990

N/A: Data not available

1 NDA (2014-November 2020)

2 USDA RMA (2000-2020)

3 NRC (1990-February 2020)

4 PHMSA (1971-July 2020)

5 NeDNR Correspondence

6 NOAA (1895-July 2020)

7 HPRCC (1897-July 2020)

8 NCEI (1996-2020)

9 NFS (2000-2020)

10 USACE NLN, (1900-July 2020)

11 University of Maryland (1970-2018)

12 USGS (1900-July 2020)

Historical Disaster Declarations

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

Farm Service Agency Small Business Administration Disasters

The U.S. Small Business Administration (SBA) was created in 1953 as an independent agency of the federal government to aid, counsel, assist, and protect the interests of small business concerns, to preserve free competitive enterprise, and maintain and strengthen the overall economy of our nation. A program of the SBA includes disaster assistance for those affected by major natural disasters. There were 12 SBA disasters involving the planning area since 2006.

Table 32: SBA Declarations

Declaration Date	Disaster Declaration Number	Title	Primary Counties	Contiguous Counties
1/26/2006	NE-00005	Severe Winter Storm	Furnas, Red Willow	-
1/7/2007	NE-00011	Severe Winter Storm	Franklin, Furnas, Harlan, Red Willow	-
6/20/2008	NE-00021	Severe Storms, Flooding, and Tornadoes	Furnas, Red Willow	-
3/26/2010	NE-00033	Severe Storms and Snowstorm	Furnas, Harlan	-
7/15/2010	NE-00038	Severe Storms, Flooding, and Tornadoes	Harlan	-
8/25/2011	NE-00044	Severe Storms, Tornadoes, Straight-line Winds, and Flooding	Furnas, Red Willow	-
3/12/2013	NE-00047	Drought	Furnas, Red Willow	Harlan
4/1/2013	NE-00049	Drought	Franklin, Harlan	Furnas
12/10/2013	NE-00053	Drought	Franklin, Furnas, Harlan, Red Willow	-
12/9/2014	NE-00056	Drought	Red Willow	Furnas
7/24/2014	NE-00062	Severe Storms, Tornadoes, Straight-line Winds, and Flooding	Franklin, Furnas, Harlan	-
1/28/2015	NE-00059	Drought	Furnas	Franklin, Harlan, Red Willow

Source: Small Business Administration, 2006-2019³⁵

Presidential Disaster Declarations

The presidential disaster declarations involving the planning area from 1962 to 2019 are summarized in the following table. Declarations prior to 1962 are not designated by county on the FEMA website and are not included below.

³⁵ Small Business Administration. 2001-2019. [data files]. Office of Disaster Assistance Resources." <https://www.sba.gov/offices/headquarters/oda/resources/1407821>.

Table 33: Presidential Disaster Declarations

Disaster Declaration Number	Declaration Date	Title	Affected Counties	Public Assistance
228	7/18/1967	Severe Storms and Flooding	Franklin, Furnas, Harlan	-
873	7/4/1990	Severe Storms	Red Willow	-
998	6/23/1993	Severe Storms and Flooding	Franklin, Furnas, Harlan	-
1027	4/10/1994	Severe Snow and Ice Storm	Furnas, Harlan, Red Willow	-
1190	10/24/1997	Severe Snowstorms, Rain, and Strong Winds	Franklin, Furnas, Harlan, Red Willow	-
1517	5/20/2004	Severe Storms, Tornadoes, and Flooding	Franklin, Red Willow	-
1627	1/27/2005	Severe Winter Storm	Furnas, Red Willow	-
1674	1/7/2007	Severe Winter Storm	Franklin, Furnas, Harlan, Red Willow	-
1770	5/22/2008	Severe Storms, Tornadoes, and Flooding	Furnas, Red Willow	\$36,258,650.19
1878	12/22/2009	Severe Winter Storms and Snowstorms	Furnas, Harlan	-
1924	6/1/2010	Severe Storms and Flooding	Harlan	-
3245	8/29/2005	Hurricane Katrina Evacuees	Franklin, Furnas, Harlan, Red Willow	-
4014	6/19/2011	Severe Storms, Tornadoes, Straight Line Winds, and Flooding	Furnas, Red Willow	-
4183	6/14/2014	Severe Storms, Tornadoes, Straight Line Winds, and Flooding	Franklin, Furnas, Harlan	-
4321	4/29/2017	Severe Winter Storm and Straight-Line Winds	Furnas, Red Willow	-
4387	6/17/2018	Severe Storms, Tornadoes, Straight Line Winds, and Flooding	Harlan	\$173,640,224.19
4420	3/9/2019	Severe Winter Storm, Straight Line Winds, and Flooding	Franklin, Furnas, Harlan	-

Source: Federal Emergency Management Agency, 1953-2019³⁶

36 Federal Emergency Management Agency. 2020. "Disaster Declarations." Accessed June 2020. <https://www.fema.gov/disasters>.

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.³⁷

- **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 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.

37 U.S. Global Change Research Program. 2018. "Fourth National Climate Assessment". <https://nca2018.globalchange.gov/>.

Nebraska's Changing Climate

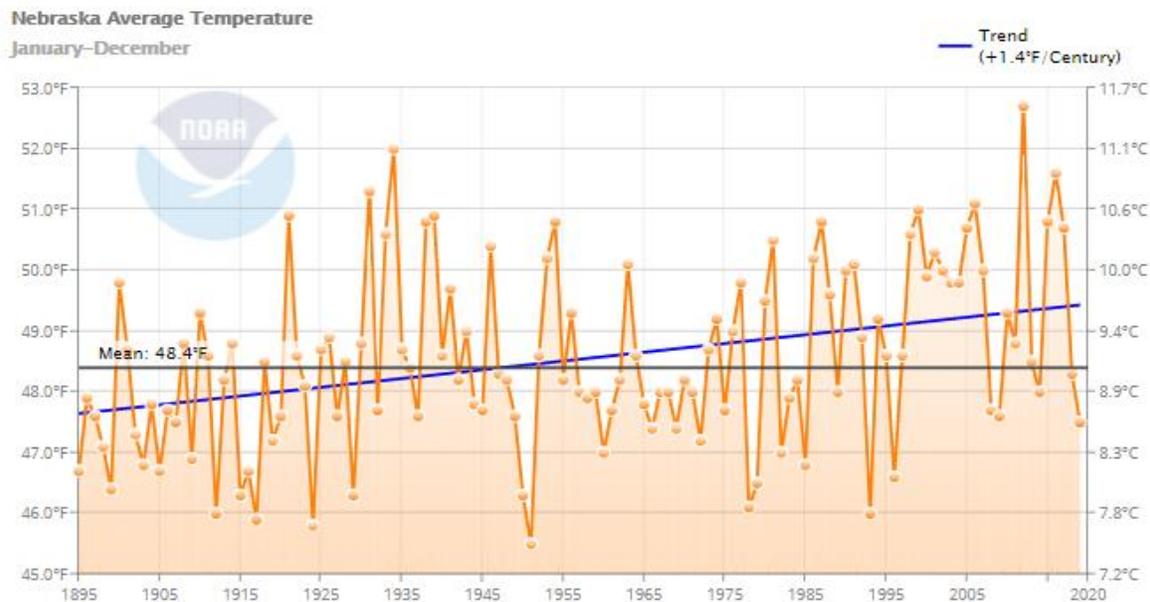
The United States as a whole is experiencing significant changes in temperature, precipitation, and severe weather events resulting from climate change. According to a University of Nebraska report (Understanding and Assessing Climate Change: Implications for Nebraska), the following changes can be expected for Nebraska's future climate:³⁸

- 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 8). Climate modeling suggests warmer temperature conditions will continue in the coming decades 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 2099.³⁹

Figure 8: Average Temperature (1895-2020)



Source: NOAA, 2020⁴⁰

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

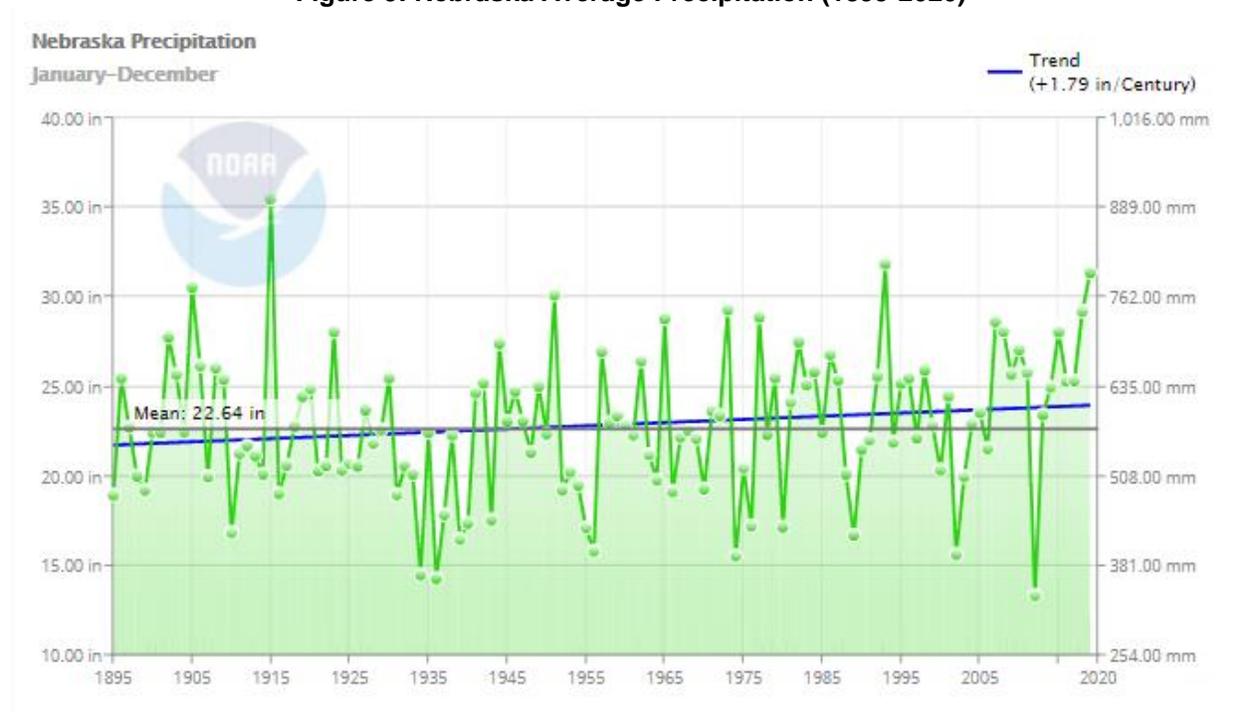
39 University of Nebraska-Lincoln. 2014. "Understanding and Assessing Climate Change: Implications for Nebraska". <http://snr.unl.edu/download/research/projects/climateimpacts/2014ClimateChange.pdf>.

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

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 9). 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 10) and moves in a longitudinal gradient. The east receives twice as much precipitation (35 inches annually) as the Nebraska Panhandle (15 inches) on average.⁴¹

Figure 9: Nebraska Average Precipitation (1895-2020)

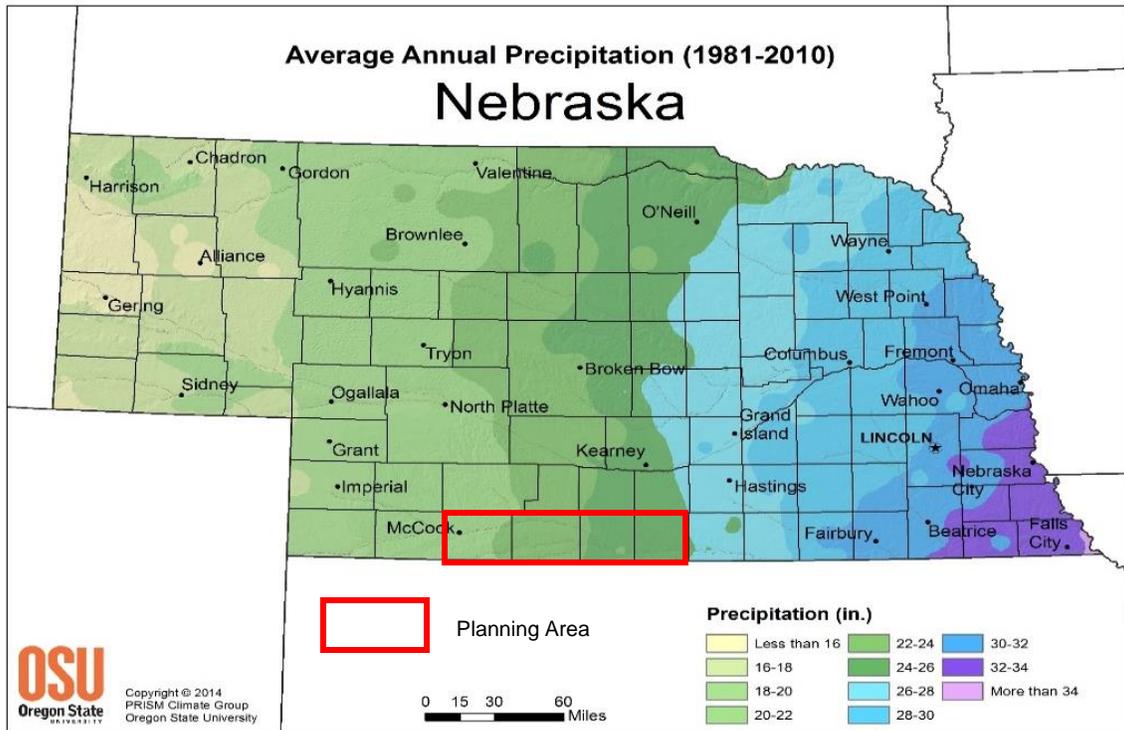


Source: NOAA, 2020⁴²

41 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.

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

Figure 10: Average Annual Precipitation for Nebraska (1981-2010)



Source: Oregon State University PRISM Climate Group, 2014

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:

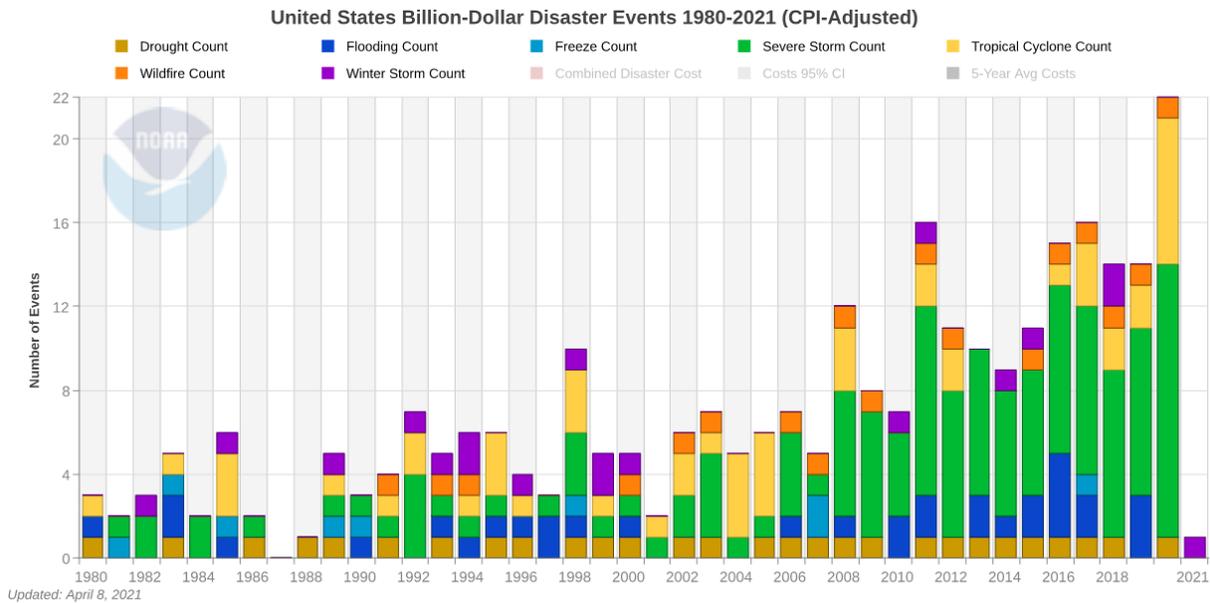
- Developing and maintaining sustainable agricultural systems.
- Resolving increasing competition among land, water, and energy resources.
- Conserving vibrant and diverse ecological systems.
- Enhancing the resilience of the region’s people to the impacts of climatic extremes.

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.⁴³

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.

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

Figure 11: U.S. Billion-Dollar Disaster Events 1980-2021

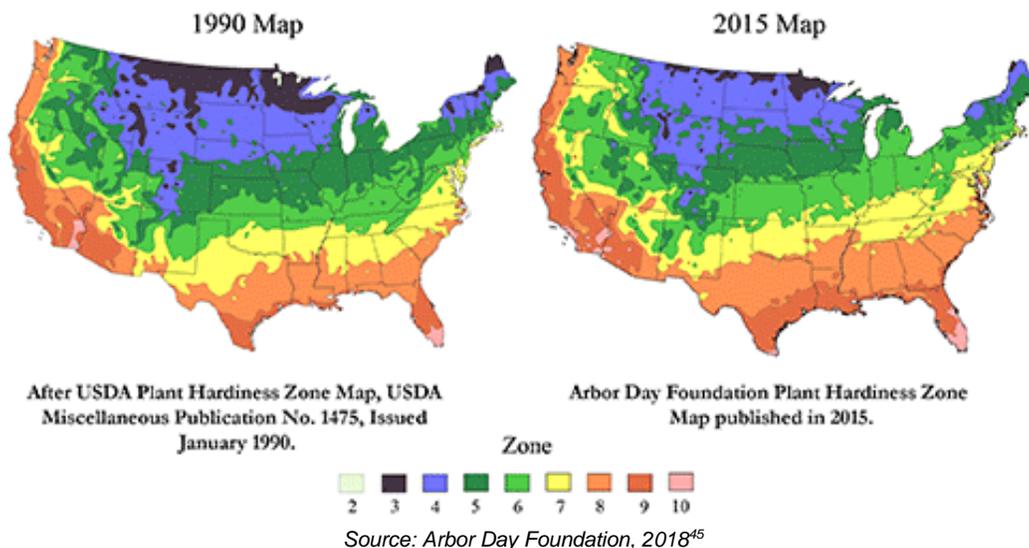


Source: NOAA, 2021⁴⁴

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

Figure 12: Plant Hardiness Zone Change



44 NOAA National Centers for Environmental Information. 2021. "U.S. Billion-Dollar Weather and Climate Disasters". <https://www.ncdc.noaa.gov/billions/>.
 45 Arbor Day Foundation. 2018. "Hardiness Zones." https://www.arborday.org/media/map_change.cfm.

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.⁴⁶ 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.⁴⁷

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 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.⁴⁸

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.⁴⁹ Critical facilities and vulnerable populations that are not prepared to handle periods of power outages, particularly during heat waves, will be at risk.

46 Asthma and Allergy Foundation of America. 2010. "Extreme Allergies and Climate Change." Accessed 2021. <https://www.aafa.org/extreme-allergies-and-climate-change/>.

47 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.

48 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.

49 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.

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.⁵⁰

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, 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.

50 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/>.

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 34: Top Hazards of Concern

Jurisdiction	Animal and Plant Disease	Chemical Spills	Dam Failure	Drought	Earthquakes	Extreme Heat	Flooding	Grass/Wildfire	Levee Failure	Severe Thunderstorms	Severe Winter Storms	Terrorism	Tornadoes and High Winds
Middle Republican NRD		X	X	X			X						
Lower Republican NRD		X	X	X			X			X			X
Franklin County			X	X			X			X	X		X
Village of Bloomington											X		
Village of Campbell				X						X			X
City of Franklin		X					X			X	X		X
Village of Hildreth						X		X		X			
Village of Naponee						X				X	X		X
Village of Riverton			X				X	X					
Village of Upland		X		X		X		X		X	X	X	X
Furnas County			X				X		X	X	X		X
City of Arapahoe				X				X		X	X		X
City of Beaver City	X			X		X		X		X	X		X
City of Cambridge	X		X	X			X	X	X	X	X		X
Village of Edison							X			X	X		X

Section Four | Risk Assessment

Jurisdiction	Animal and Plant Disease	Chemical Spills	Dam Failure	Drought	Earthquakes	Extreme Heat	Flooding	Grass/Wildfire	Levee Failure	Severe Thunderstorms	Severe Winter Storms	Terrorism	Tornadoes and High Winds
Village of Hendley							X	X		X	X		X
Village of Holbrook	X						X	X		X			X
Village of Oxford		X		X			X	X		X			
Harlan County	X		X	X			X			X	X		X
City of Alma	X	X					X			X	X		X
Village of Huntley							X			X	X		X
Village of Orleans				X			X	X		X	X		X
Village of Ragan										X	X		X
Village of Republican City				X				X		X	X		X
Village of Stamford							X	X		X	X		X
Red Willow County		X	X	X			X		X	X	X		X
Village of Bartley						X	X		X	X	X		X
Village of Danbury				X				X		X	X		X
City of Indianola			X	X			X		X	X	X		X
City of McCook		X	X			X	X			X	X		X
Alma Fire District		X					X	X		X	X		X
Alma Public Schools										X	X		X
Arapahoe-Holbrook Public School										X	X		X
Orleans Fire District								X					
Republican City Rural Fire District	X		X	X				X					
Southwest Public Schools						X				X	X		X
Stamford Rural Fire Department								X					
Wilcox-Hildreth Public Schools										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 \$695 million.⁵¹

Table 35 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 35: Livestock Inventory

County	Market Value of 2017 Livestock Sales	Cattle and Calves	Hogs and Pigs	Poultry Egg Layers	Sheep and Lambs
Franklin	\$16,201,000	25,741	208	129	330
Furnas	\$138,871,000	51,368	(D)	306	789
Harlan	\$66,336,000	48,436	2,812	254	210
Red Willow	\$116,391,000	65,166	9,949	646	59
Total	\$337,799,000	190,711	12,969	1,335	1,388

Source: U.S. Census of Agriculture, 2017

*(D) Withheld to avoid disclosing data for individual farms.

According to the NDA, the primary crops grown throughout the state include alfalfa, corn, sorghum, soybeans, and wheat. The following tables provide the value and acres of land in farms for the planning area. Furnas County has the highest number of farms, most land in farms, and highest crop sales in the four-county area. Corn is the most prevalent crop type in the region followed by soybeans.

Table 36: Land and Value of Farms in the Planning Area

County	Number of Farms	Land in Farms (Acres)	Market Value of 2017 Crop Sales
Franklin	317	316,479	\$90,656,000
Furnas	377	450,289	\$101,518,000
Harlan	281	333,710	\$93,939,000
Red Willow	333	439,377	\$71,804,000
Total	1,308	1,539,855	\$357,917,000

Source: U.S. Census of Agriculture, 2017

51 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 37: Crop Values

County	Corn		Soybeans		Wheat	
	Acres Planted	Value (2017)	Acres Planted	Value (2017)	Acres Planted	Value (2017)
Franklin	95,304	\$55,354,000	58,244	\$32,152,000	6,115	\$942,000
Furnas	136,035	\$67,453,000	46,889	\$21,658,000	38,791	\$6,710,000
Harlan	108,152	\$59,370,000	52,082	28,901,000	18,465	\$2,886,000
Red Willow	100,100	\$45,343,000	18,057	\$9,729,000	44,811	\$9,456,000
Total	439,591	\$227,520,000	175,272	\$92,440,000	108,182	\$19,994,000

Source: U.S. Census of Agriculture, 2017

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 47 instances of animal disease reported between January 2014 and November 2020 by the NDA (Table 38). These outbreaks affected 70 animals.

Table 38: Livestock Diseases Reported in the Planning Area

Year	County	Disease	Population Impacted
2014	Furnas	Bovine Viral Diarrhea	2
	Furnas	Bovine Paratuberculosis	1
	Furnas	Bovine Bluetongue	2
	Furnas	Porcine Reproductive and Respiratory Syndrome	2
	Harlan	Bovine Viral Diarrhea	1
	Harlan	Bovine Paratuberculosis	1
	Red Willow	Bovine Bluetongue	1
	Red Willow	Porcine Reproductive and Respiratory Syndrome	1
2015	Furnas	Porcine Paratuberculosis	1
	Furnas	Bovine Bluetongue	1
	Furnas	Bovine Leptospirosis	1
	Furnas	Porcine Reproductive and Respiratory Syndrome	1
	Red Willow	Enzootic Bovine Leukosis	1
	Red Willow	Equine Vesicular Stomatitis	1
2016	Furnas	Bovine Paratuberculosis	2
	Furnas	Bovine Bluetongue	2
	Furnas	Bovine Leptospirosis	1
	Furnas	Porcine Epidemic Diarrhea	4
	Furnas	Bovine Anaplasmosis	1
	Red Willow	Bovine Paratuberculosis	2

Year	County	Disease	Population Impacted
2017	Red Willow	Bovine Bluetongue	1
	Red Willow	Bovine Anaplasmosis	2
	Furnas	Bovine Viral Diarrhea	1
	Furnas	Bovine Paratuberculosis	1
	Furnas	Bovine Bluetongue	1
	Furnas	Porcine Delta Coronavirus	1
2018	Red Willow	Bovine Paratuberculosis	1
	Furnas	Bovine Viral Diarrhea	1
	Furnas	Bovine Paratuberculosis	1
	Harlan	Bovine Paratuberculosis	1
	Red Willow	Bovine Paratuberculosis	2
	Red Willow	Bovine Bluetongue	1
2019	Red Willow	Enzootic Bovine Leukosis	1
	Franklin	Bovine Paratuberculosis	1
	Furnas	Bovine Viral Diarrhea	1
	Furnas	Bovine Paratuberculosis	1
	Furnas	Bovine Bluetongue	1
	Harlan	Bovine Viral Diarrhea	1
	Red Willow	Bovine Bluetongue	1
2020	Red Willow	Enzootic Bovine Leukosis	3
	Franklin	Bovine Paratuberculosis	1
	Furnas	Bovine Paratuberculosis	3
	Furnas	Bovine Bluetongue	1
	Red Willow	Bovine Bluetongue	5
	Red Willow	Bovine Leptospirosis	4
	Red Willow	Enzootic Bovine Leukosis	2
Red Willow	Epizootic Hemorrhagic Disease	1	

Source: Nebraska Department of Agriculture, January 2014- November 2020⁵²

The most prevalent animal diseases seen across the planning area were Bovine Paratuberculosis and Bovine Bluetongue. The economic impacts of outbreaks can negatively impact businesses, farmers, ranchers, and communities reliant on the agricultural sector.

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 39: Common Crop Diseases in Nebraska by Crop Types

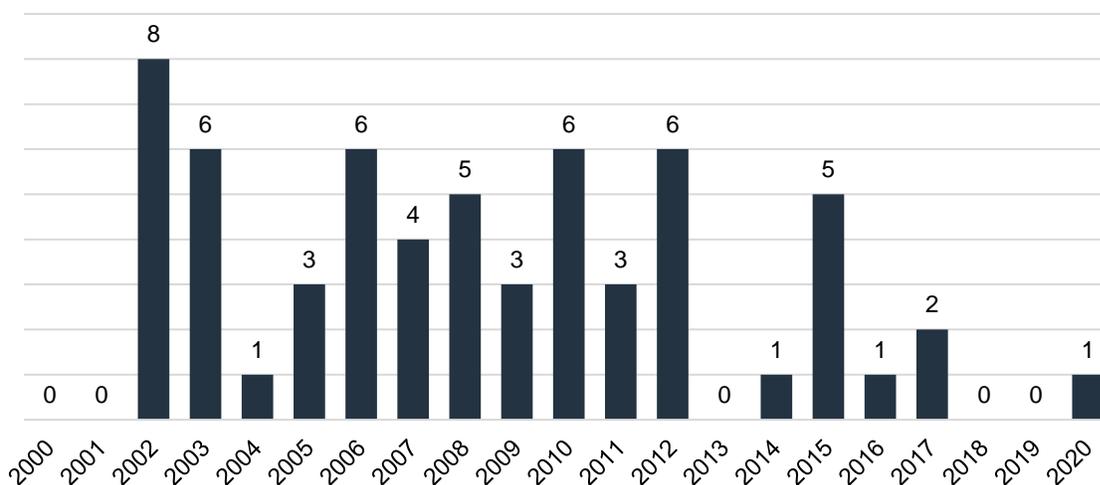
Crop Diseases		
Corn	Anthracnose	Southern Rust
	Bacterial Stalk Rot	Stewart’s Wilt
	Common Rust	Common Smut
	Fusarium Stalk Rot	Gross’s Wilt
	Fusarium Root Rot	Head Smut
	Gray Leaf Spot	Physodrama
	Maize Chlorotic Mottle Virus	
Soybeans	Anthracnose	Pod and Stem Blight
	Bacterial Blight	Purple Seed Stain
	Bean Pod Mottle	Rhizoctonia Root Rot
	Brown Spot	Sclerotinia Stem Rot
	Brown Stem Rot	Soybean Mosaic Virus

52 Nebraska Department of Agriculture. 2020. "Livestock Disease Reporting." <http://www.nda.nebraska.gov/animal/reporting/index.html>.

Crop Diseases		
	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	Emerald Ash Borer	Dutch Elm Disease
	Burr Oak Blight	Leaf Spot and Blight
	Powdery Mildew	Crown Gall
	Canker (various types)	Root Rot
	Pine Wilt Disease	

The RMA provides data on plant disease events and plant losses in the planning area. There are 61 instances of plant diseases reported between January 2000 and July 2020 by the RMA (Figure 13). These outbreaks caused \$486,810 in plant losses.

Figure 13: Plant Disease Events by Year



Source: NDA, 2000-July 2020

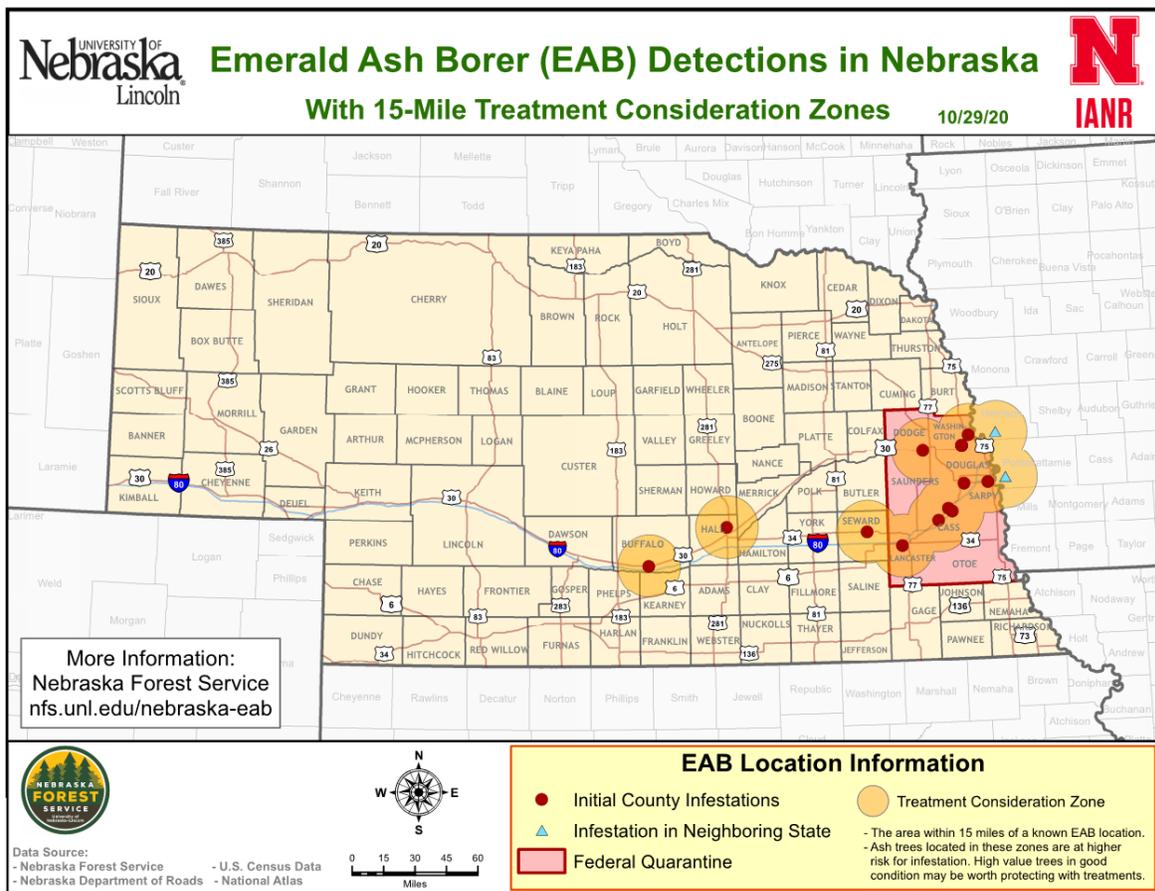
Emerald Ash Borer

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 2016.⁵³ Figure 14 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.

53 Emerald Ash Borer Information Network. April 2018. “Emerald Ash Borer.” <http://www.emeraldashborer.info/>.

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.⁵⁴ Estimated economic impacts to Nebraska's 44 million ash trees exceed \$981 million.⁵⁵ 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.

Figure 14: EAB Detections in Nebraska



Average Annual Losses

According to the USDA RMA (2000-2020) there were 61 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.

54 Arbor Day Foundation. 2015. "Emerald Ash Borer." <https://www.arborday.org/trees/health/pests/emerald-ash-borer.cfm>.
 55 "Nebraska Emerald Ash Borer Response Plan." May 2015. <https://nfs.unl.edu/NebraskaEABResponsePlan.pdf>.

Table 40: Agricultural Plant Disease Losses

Hazard Type	Number of Events	Events Per Year	Total Crop Loss	Average Annual Crop Loss
Plant Disease	61	3.1	\$544,624	\$27,231

Source: RMA, 2000-2020

Table 41: Agricultural Livestock Disease Losses

Hazard Type	Number of Events	Events Per Year	Total Animal Losses	Average Animal Losses Per Event
Animal Disease	47	6.7	70	1.5

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. However, the planning area is heavily dependent on the agricultural economy. Changes in climate (as discussed previously) may significantly alter the frequency and magnitude of disease outbreaks. Any severe plant or animal disease outbreak which may impact this sector would negatively impact the entire planning area.

Probability

Based on the historic record of reported incidents, there is a 100 percent probability (6 out of 6 years with an occurrence) that agricultural animal disease will occur annually in the planning area. Based on the historic record of reported incidents, there is a 76 percent probability (16 out of 21 years with an occurrence) that agricultural plant disease 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 42: 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 Infrastructure	None
Critical Facilities	-Transportation routes can be closed during quarantine
Climate	None -Exacerbate outbreaks, impacts, and/or recovery period -Changes in seasonal normals can promote spread of invasive species and agricultural disease

CHEMICAL SPILLS

The following description of hazardous chemicals 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. Spills 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.⁵⁶

Hazardous chemicals 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.

Varying quantities of hazardous chemicals 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. Chemical spill 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 1986.⁵⁷ Table 43 demonstrates the nine classes of hazardous materials according to the 2016 Emergency Response Guidebook.

Table 43: 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

⁵⁶ Federal Emergency Management Agency. 2017. "Hazardous Materials Incidents." <https://www.ready.gov/hazardous-materials-incident>.

⁵⁷ Emergency Planning and Community Right-to-Know Act of 1986, Pub. L. No. 116 § 10904. 1986.

Class	Type of Material	Divisions
		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*⁵⁸

Location

There are 96 locations across the planning area that house large quantities of chemicals or 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 15 shows the location of the chemical sites.

Transportation chemical spills occur primarily on major transportation routes as identified in Figure 16. A large number of spills also typically occur during the loading and unloading of chemicals. According to PHMSA there are several gas transmission pipelines traveling through the four counties. In addition, there is a hazardous liquid pipeline that travels through Harlan County and Franklin County.⁵⁹

58 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>.

59 Pipeline and Hazardous Materials Safety Administration. 2019. "National Pipeline Mapping System." <https://www.npms.phmsa.dot.gov/>.

Figure 15: Tier II Facility Locations

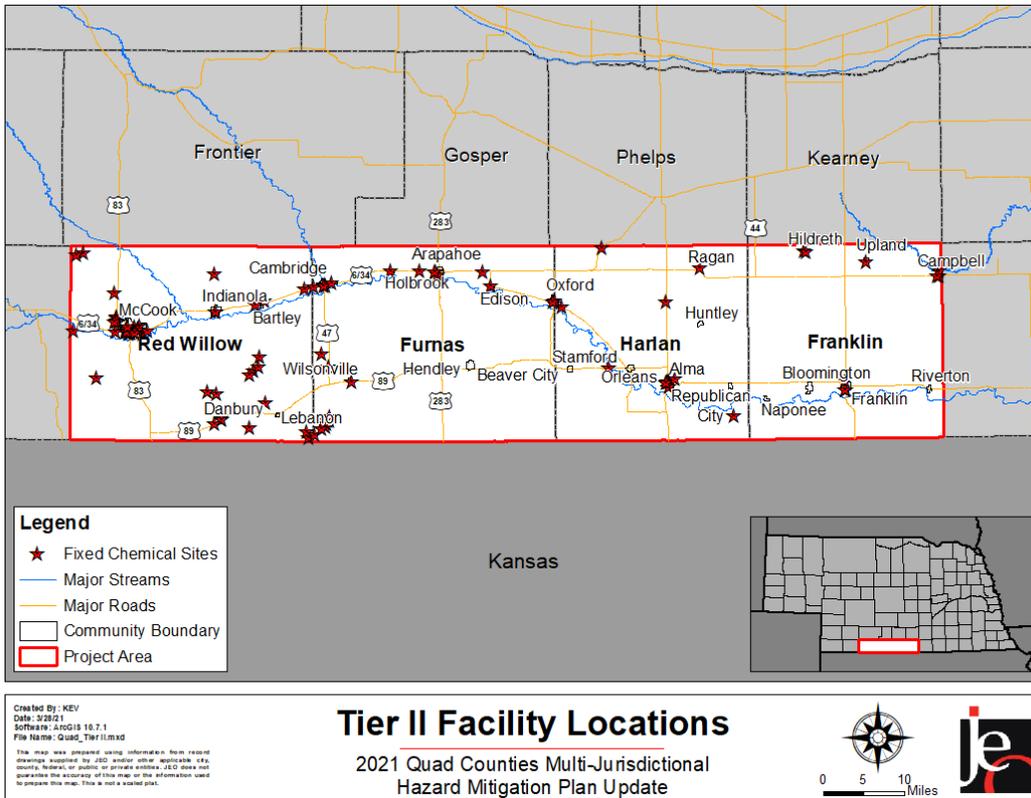
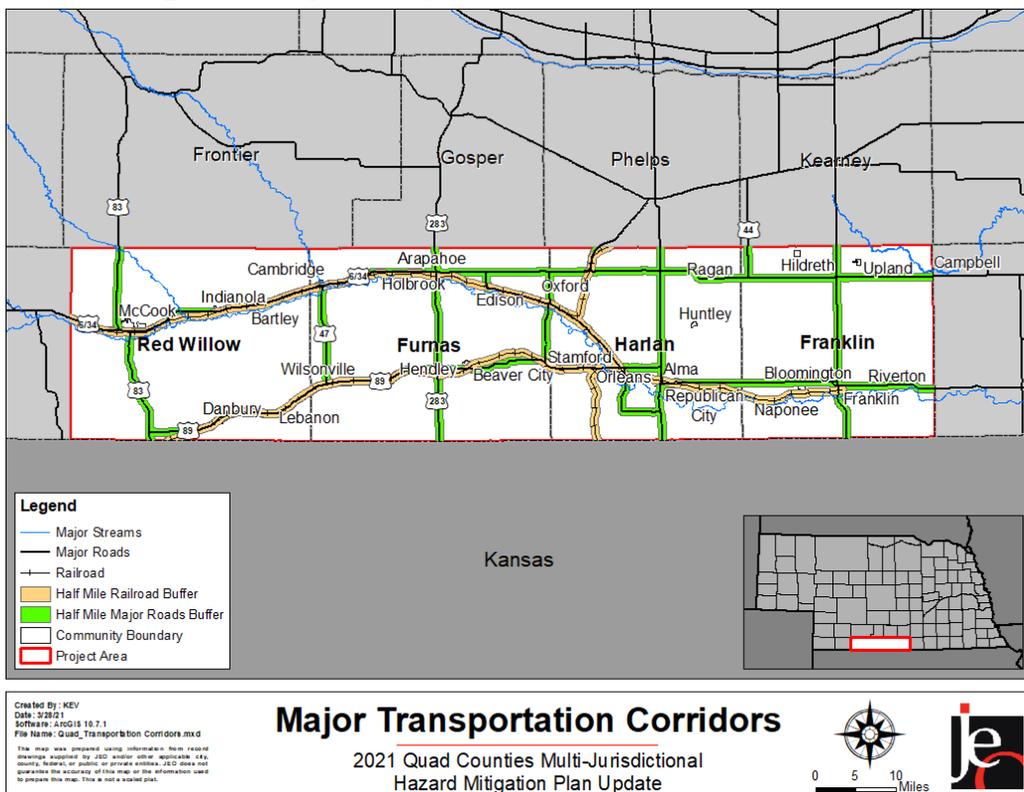


Figure 16: Major Transportation Routes with Half Mile Buffer



Historical Occurrences

Chemical Spills – Fixed Sites

According to the U.S. Coast Guard's National Response Center database (NRC), there have been 14 fixed site chemical spills from 1990 to February 2020 in the planning area. There were no evacuations or injuries because of a chemical spill. There were no property damages reported for these releases. The following table lists only those events with the largest quantity of material released.

Table 44: Chemical Fixed Site Incidents

Year of Event	Location of Release	Quantity Spilled	Material Involved	Number of Injuries
1995	Alma	6,000 Gallons	Liquid Nitrogen Solution	0
1998	Oxford	4,500 Gallons	Herbicide	0
2006	Franklin	4,320 Pounds	Anhydrous Ammonia	0

Source: National Response Center, 1990-Feb. 2020

Chemical Spills – Transportation

According to the Pipeline and Hazardous Materials Safety Administration (PHMSA), 23 hazardous materials releases occurred during transportation in the planning area between 1971 and 2020. During these events, there were no injuries, eight fatalities, and \$10,109 in damages. The following table provides a list of the most damaging chemical spills during transportation in the planning area.

Table 45: Chemical Spills Transportation Incidents

Date of Event	Location of Release	Failure Description	Material Involved	Transportation Method	Total Damage	Injuries or Fatalities
7/2/1996	Upland	N/A	10 LGA Methyl Parathion Liquid	Highway	\$2,000	No
2/27/2010	McCook	Loose Closure Component	20 LGA Potassium Hydroxide Solution	Rail	\$3,800	No
10/4/2012	McCook	Impact with Sharp Object	1 LGA Unknown	Highway	\$4,000	No

Source: PHMSA, 1971– 2020⁶⁰

Extent

The extent of chemical spills varies and depends on the type of chemical that is released. For most events the spills were localized to the facility or transportation container. There were 37 reported releases in the planning area, and the total amount spilled ranged from less than 1 to 6,000 gallons or 35 to 4,320 pounds of chemical.

Average Annual Damages

The average damage per event estimate was determined based upon PHMSA's Incidents Reports, the National Response Center, and the number of historical occurrences. This does not include losses from displacement, functional downtime, or economic loss.

⁶⁰ Pipeline and Hazardous Materials Safety Administration. July 2020. "Incident Statistics: Nebraska." <https://www.phmsa.dot.gov/hazmat-program-management-data-and-statistics/data-operations/incident-statistics>.

Table 46: Chemical Spill Loss Estimate

Hazard Type	Number of Events	Events Per Year	Injuries	Total Damages	Average Annual Chemical Spill Loss
Fixed Site	14	0.5	0	\$0	\$0
Transportation	23	0.5	0	\$10,109	\$206
Total	37	1	0	\$10,109	\$206

Probability

Based on the historic record of reported incidents, there is a 33 percent probability (10 out of 30 years with an occurrence) that a fixed site chemical release event will occur annually in the planning area. Based on the historic record of reported incidents, there is a 31 percent probability (15 out of 49 years with an occurrence) that a transportation chemical release 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 47: Regional Hazardous Materials Release Vulnerabilities

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

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.”⁶¹

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 48: 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, 2013⁶²

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.

61 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.

62 Nebraska Department of Natural Resources. 2013. “Classification of Dams: Dam Safety Section.” <https://dnr.nebraska.gov/sites/dnr.nebraska.gov/files/doc/dam-safety/resources/Classification-Dams.pdf>.

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

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

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

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

Location

According to USACE's National Institute of Dams, there are a total of 177 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 49: Dams in the Planning Area

County	Low Hazard	Significant Hazard	High Hazard
Franklin	29	1	0
Furnas	62	3	0
Harlan	42	0	1
Red Willow	38	0	1
Total	171	4	2

Source: USACE, 2020⁶³

63 United States Army Corps of Engineers. June 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 two high hazard dams located within the planning area. One is in Harlan County, and one is in Red Willow County.

Table 50: High Hazard Dams in the Planning Area

County	Dam Name	NID ID	Purpose	Dam Height	Max Storage (Acre Ft)	Last Inspection Date
Harlan	Harlan County Dam	NE01066	Flood Control	107 ft	840,561	4/29/2015
Red Willow	Kelley Creek West Dam	NE00672	Flood Control	34 ft	1,183	7/9/2019

Source: USACE, 2020⁶⁴

Upstream Dams Outside the Planning Area

There are three high hazard dams located upstream of the planning area which, if they were to fail, would likely impact the region. The Furnas County and Red Willow County Local Emergency Operations Plans (LEOP) identifies the upstream Enders Dam, Trenton Dam, and Medicine Creek Dam as dams that could affect the planning area.^{65,66,67,68}

Table 51: High Hazard Upstream Dams Outside the Planning Area

County	Dam Name	NID ID	Purpose	Dam Height	Max Storage (Acre Ft)	Last Inspection Date
Chase	Enders Dam	NE01070	Irrigation	103 ft	98,960	7/24/2017
Frontier	Medicine Creek Dam	NE01073	Irrigation	115 ft	195,997	8/24/2017
Hitchcock	Trenton Dam	NE01078	Irrigation	100 ft	353,901	7/18/2017

Source: USACE, 2020⁶⁹

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

65 Franklin County Emergency Management Agency. 2017. "Franklin County Local Emergency Operations Plan."

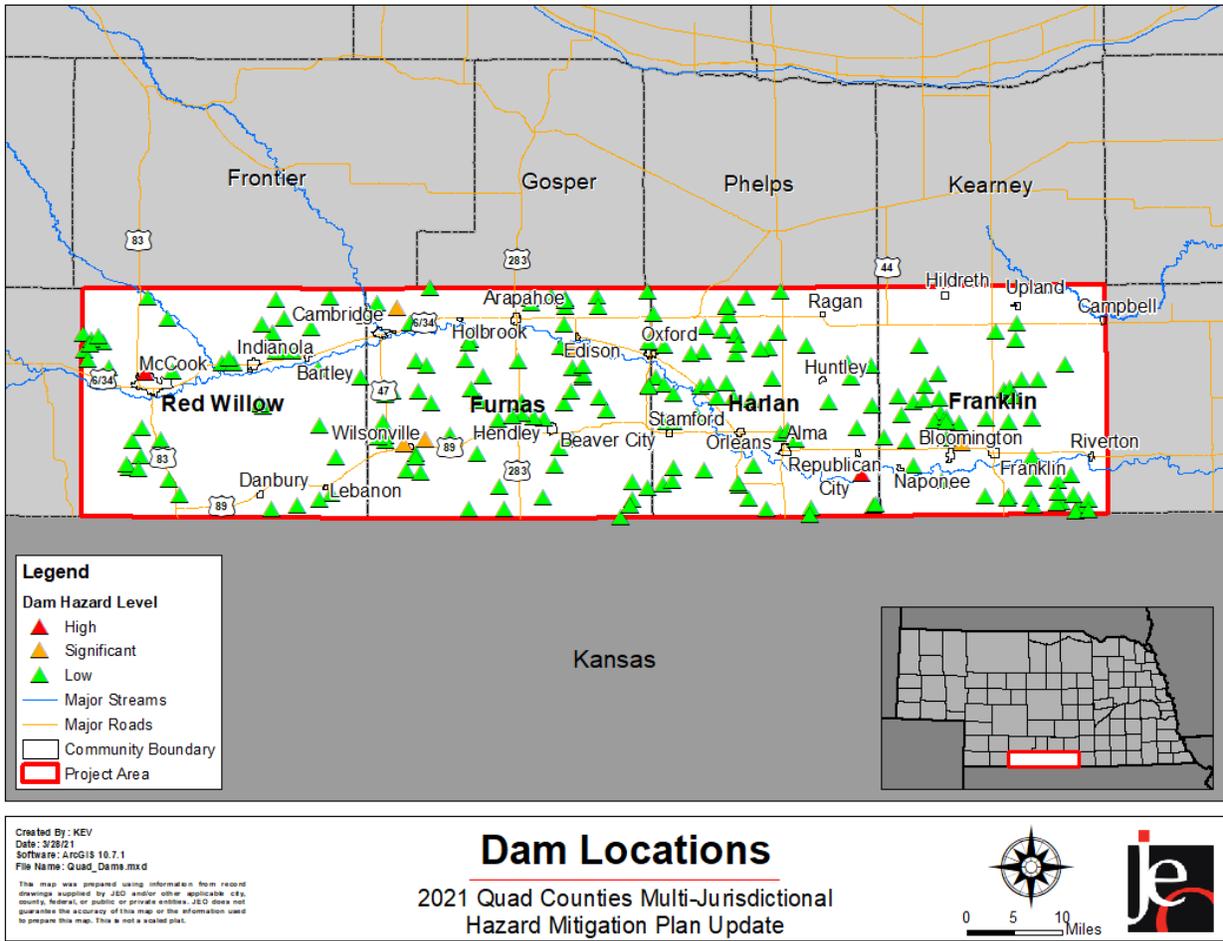
66 Furnas County Emergency Management Agency. 2019. "Furnas County Local Emergency Operations Plan."

67 Harlan County Emergency Management Agency. 2018. "Harlan County Local Emergency Operations Plan."

68 Red Willow County Emergency Management Agency. 2016. "Red Willow County Local Emergency Operations Plan."

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

Figure 17: Dam Locations



Historical Occurrences

Through communication with NeDNR, there have been 13 reported dam failures within the planning area. There were no reported damages from the dam failure events.

Table 52: Dam Failures

Dam Name	Hazard Class	County	Failure Year	Downstream Damage
Bartels Dam 615	Low	Franklin	1988	None
Batten Dam	Low	Harlan	1983	None
Gallatin Dam	Low	Red Willow	1990	Unknown
Golter Overflow Dam	Low	Furnas	1986	Unknown
Kees Dam	-	Furnas	1950	None
LaHa East Dam	-	Harlan	2000	None
Lueking Dam 3649	-	Furnas	2005	None
Malleck Dam	Low	Red Willow	1978	None
McDonald Dam	Low	Harlan	2009	None
Peterson South Dam	Low	Harlan	1986	Unknown
Schluntz Dam	Low	Harlan	2009	None
Steinkruger Dam 3807	Minimal	Franklin	2007	None
Stockton Dam	-	Furnas	1960	None

Source: NeDNR, 2021

Average Annual Losses

There were no reported damages from any of the dam failures. In general, dam failure events would be confined to damage in the inundation area. Community members in the planning area that wish to quantify and evaluate the threat of dam failure should contact their County Emergency Management, local NRD, or the NeDNR to view EAPs and breach inundation area maps.

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

Based on the historic record of reported incidents, there is an eight percent probability (11 out of 130 years with an occurrence) that dam failure 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 53: Regional Dam Failure Vulnerabilities

Sector	Vulnerability
People	<ul style="list-style-type: none"> -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 -Franklin County: LEOP estimated 12% of the population -Furnas County: LEOP estimated 40% of the population -Harlan County: LEOP gave no estimation -Red Willow County: LEOP estimated 25% of the population
Economic	<ul style="list-style-type: none"> -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	<ul style="list-style-type: none"> -Damage to facilities, recreation areas, and roads
Infrastructure	<ul style="list-style-type: none"> -Rural county transportation routes could be closed for extended period of time
Critical Facilities	<ul style="list-style-type: none"> -Any critical facilities in inundation areas are vulnerable to damages
Climate	<ul style="list-style-type: none"> -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.

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 result in more visible impacts. According to the National Drought Mitigation Center, 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.

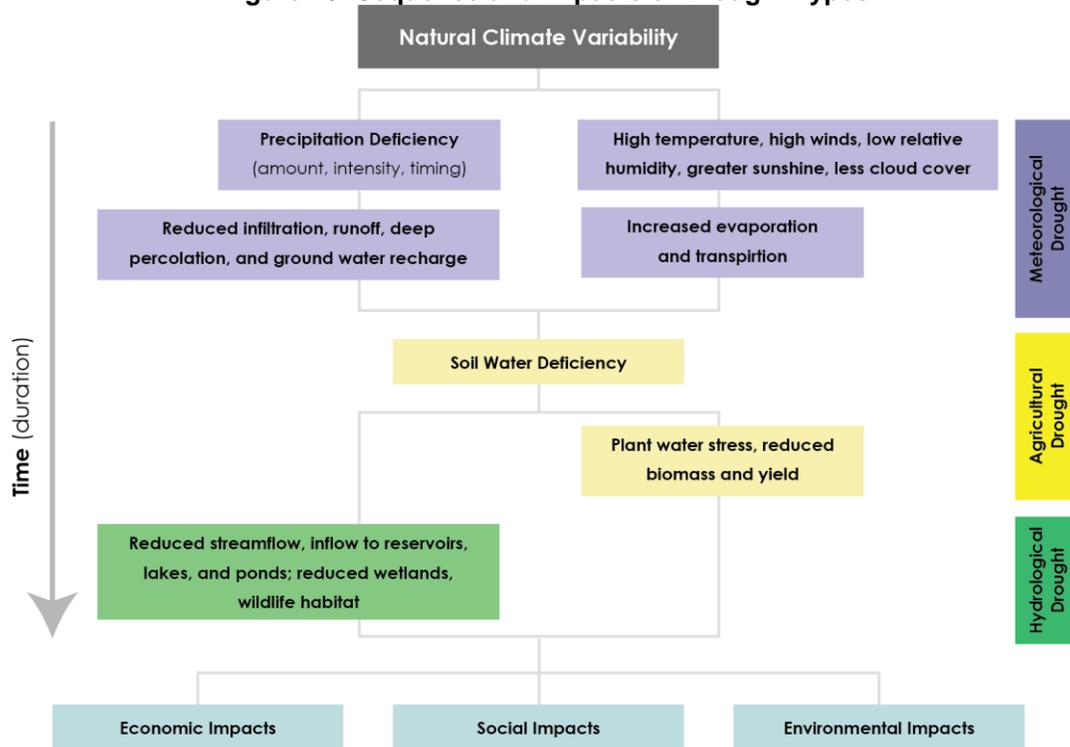
~National Drought Mitigation Center

- **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.⁷⁰

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

⁷⁰ 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, 2017⁷¹

Location

The entire planning area is susceptible to drought impacts.

Historical Occurrences

Table 54 indicates it is reasonable to expect extreme drought to occur 6.4% of the time for the planning area (96 extreme drought months in 1,501 months). Severe drought occurred in 56 months of the 1,501 months of record (3.7% of months). Moderate drought occurred in 135 months of the 1,501 months of record (9.0% of months), and mild drought occurred in 196 of the 1,501 months of record (13.1% of months). Non-drought conditions occurred in 1,018 months, or 68% 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 24.4 inches according to the NCEI.⁷²

Table 54: Historic Droughts

Drought Magnitude	Months in Drought	Percent Chance
-1 Magnitude (Mild)	196/1,501	13.1%
-2 Magnitude (Moderate)	135/1,501	9.0%
-3 Magnitude (Severe)	56/1,501	3.7%
-4 Magnitude or Greater (Extreme)	96/1,501	6.4%

Source: NCEI, Jan 1895- Dec 2020⁷³

71 National Drought Mitigation Center. 2017. "Types of Drought." <https://drought.unl.edu/>.

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

73 National Centers for Environmental Information. 1895-January 2020. Accessed July 23, 2020. <https://www7.ncdc.noaa.gov/CDO/CDODivisionalSelect.jsp>.

Extent

The Palmer Drought Severity Index (PDSI) is utilized by climatologists to standardize global long-term drought analysis. The data for the planning area was collected for Climate Division 8, which includes the planning area. This particular station’s period of record started in 1895. Table 55 shows the details of the Palmer classifications.

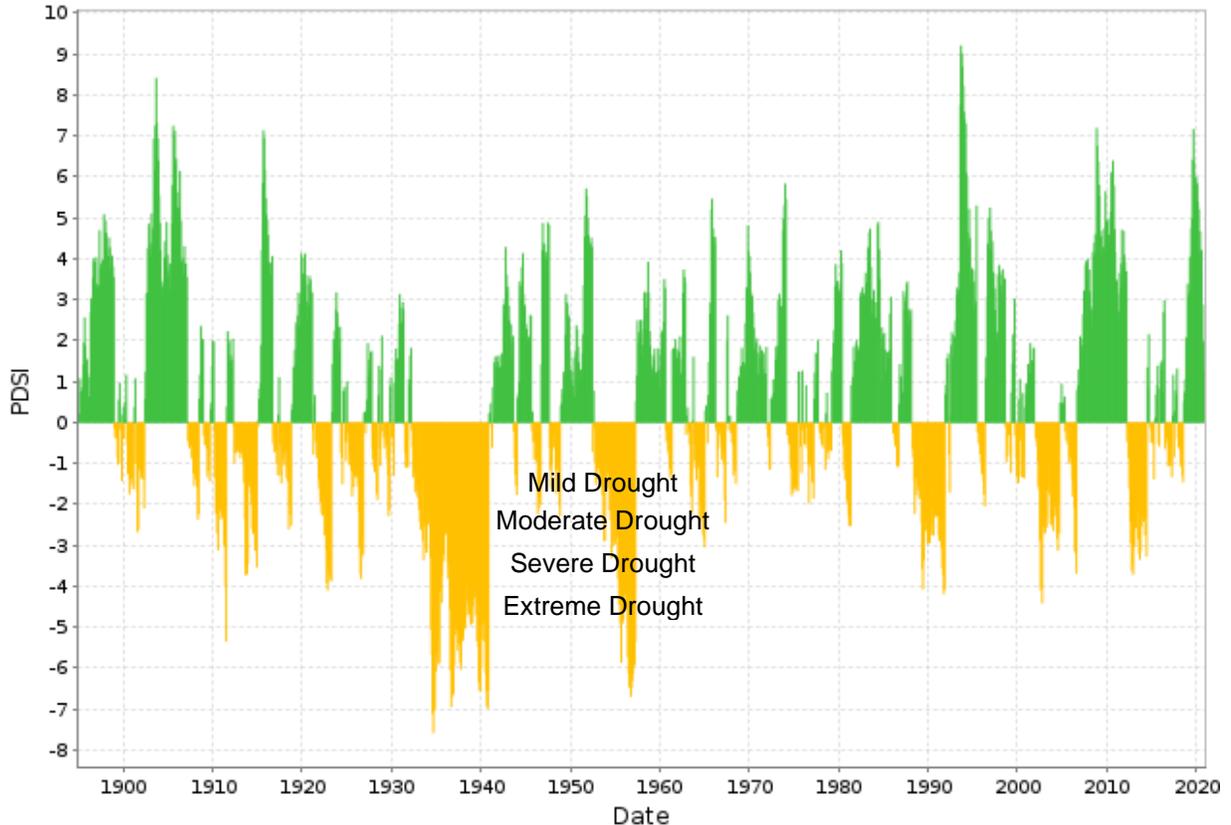
Figure 19 shows drought data from this time period. The negative Y axis represents the extent of a drought, for which ‘-2’ indicates a moderate drought, ‘-3’ a severe drought, and ‘-4’ an extreme drought. The planning area has experienced several extreme droughts and moderate, severe, and extreme droughts are likely in the future.

Table 55: 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 Center⁷⁴

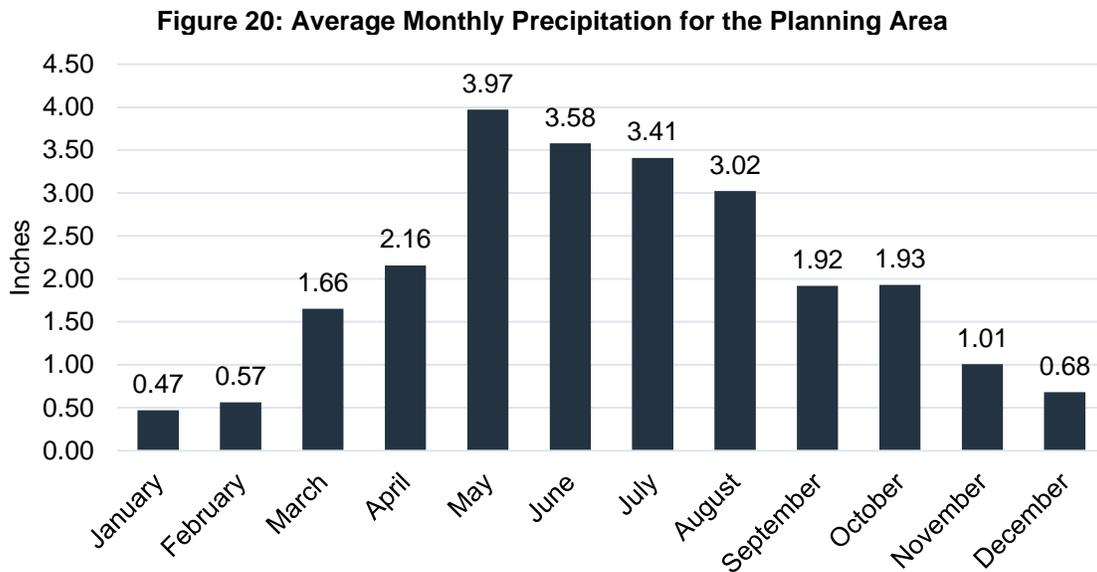
**Figure 19: Palmer Drought Severity Index
NE South Central - PDSI
189501 - 202012**



Source: NCEI, Jan. 1895-Jan. 2020

74 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.



Source: NCEI, 2020⁷⁵

Average Annual Losses

The annual property estimate for the planning area was determined based upon NCEI Storm Events Database since 1996. The annual crop loss for the planning area 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 56: 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	\$0	\$0	\$239,760,365	\$11,988,018

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 2020)

Probability

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

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

Table 57: Period of Record in Drought

PDSI Value	Magnitude	Drought Occurrences by Month	Monthly Probability
4 or more to -0.99	No Drought	1,018/1,501	68.0%
-1.0 to -1.99	Mild Drought	196/1,501	13.1%
-2.0 to -2.99	Moderate Drought	135/1,501	9.0%
-3.0 to -3.99	Severe Drought	56/1,501	3.7%
-4.0 or less	Extreme Drought	96/1,501	6.4%

Source: NCEI, Jan 1895-Dec 2020

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 48 drought-related impacts throughout the region. The most 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 58: Notable Drought Impacts in Planning Area

Category	Date	Affected Counties	Title
Plants & Wildlife, Relief, Response & Restrictions, Water Supply & Quality	1/25/2000	Franklin	Water pumped into Nebraska's Rainwater Basin
Tourism & Recreation, Water Supply & Quality	1/31/2003	Harlan	drought causing economic losses in Nebraska
Agriculture, Relief, Response & Restrictions	6/9/2006	Furnas, Red Willow	Nebraska governor requested natural disaster declaration for 8 counties
Agriculture, Plants & Wildlife	5/1/2012	Franklin, Furnas, Harlan, Red Willow	Drought led ranchers in western Nebraska to cull cow herds by 25 to 60 percent
Plants & Wildlife	6/1/2012	Furnas, Red Willow	Many trees in western Nebraska died from drought, high temperatures and strong winds in 2012
Agriculture, Fire	6/1/2012	Red Willow	Dryland corn affected, grass fires reported in Red Willow County, Nebraska
Agriculture	6/1/2012	Red Willow	Grazing land adversely affected in Dundy, Hitchcock, and Red Willow counties in Nebraska
Fire, Relief, Response & Restrictions	6/28/2012	Franklin, Furnas, Harlan, Red Willow	Nebraskans urged to leave the fireworks to the professionals
Fire, Relief, Response & Restrictions	7/3/2012	Furnas	Sale, use of fireworks prohibited in Cambridge, Nebraska
Agriculture, Relief, Response & Restrictions, Water Supply & Quality	7/19/2012	Franklin, Furnas, Harlan, Red Willow	Low flow in several Nebraska rivers brought surface irrigation closures
Agriculture, Water Supply & Quality	8/7/2012	Franklin, Furnas, Harlan, Red Willow	Nebraska ranchers hauling water to livestock

Category	Date	Affected Counties	Title
Plants & Wildlife, Tourism & Recreation, Water Supply & Quality	10/5/2012	Franklin	Nebraska's Rainwater Basin being refilled with groundwater
Agriculture, Relief, Response & Restrictions, Water Supply & Quality	1/1/2013	Franklin, Furnas, Harlan, Red Willow	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	8/24/2014	Red Willow	Dryland corn suffering in Red Willow County, Nebraska
Agriculture	7/20/2017	Red Willow	Pasture grasses depleted in Red Willow County, Nebraska
Agriculture, Plants & Wildlife	9/13/2020	Furnas, Red Willow	Grass growth slowed in western Nebraska

Source: NDMC, 2000-March 2021⁷⁶

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

Table 59: Regional Drought and Extreme Heat Vulnerabilities

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

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

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 tables summarize the Richter Scale and Modified Mercalli Scale.

Table 60: 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, 2016⁷⁷

Table 61: 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

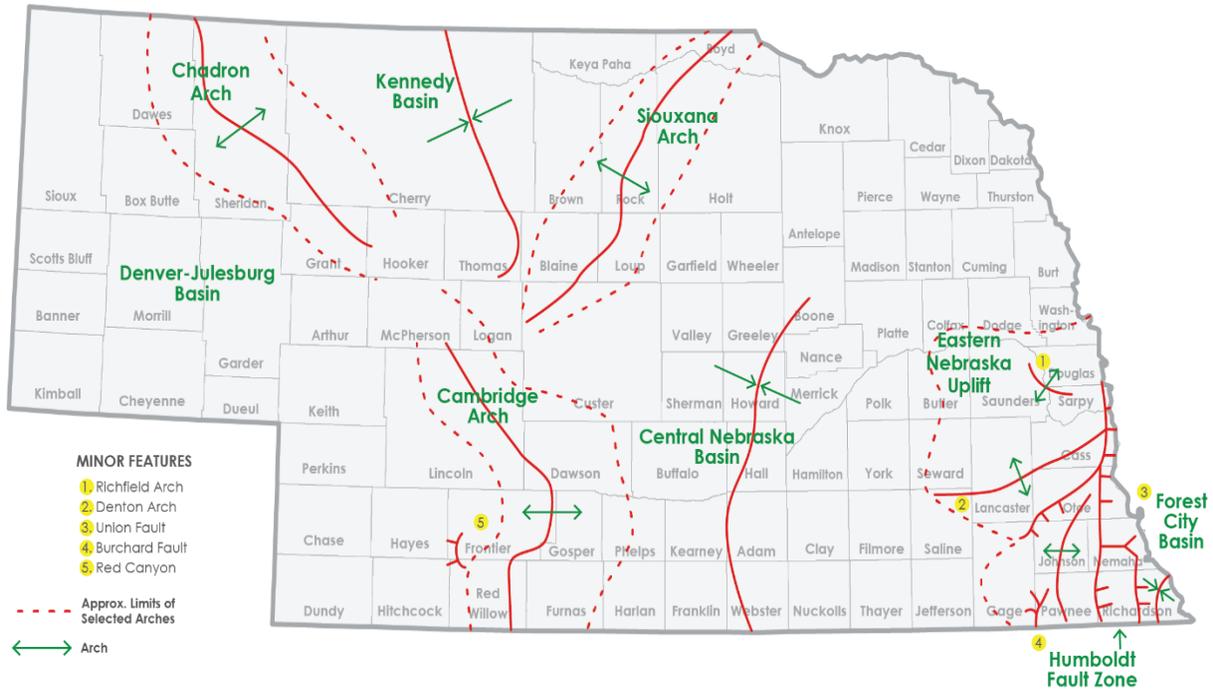
Source: FEMA, 2016

⁷⁷ Federal Emergency Management Agency. 2016. "Earthquake." <https://www.fema.gov/earthquake>.

Location

The planning area has one fault line crossing through it and one fault line that passes near it. The Cambridge Arch Fault is active in the planning area and the Central Nebraska Basin passes just outside Franklin County on the east side. The following figure shows the fault lines in Nebraska.

Figure 21: Fault Lines in Nebraska

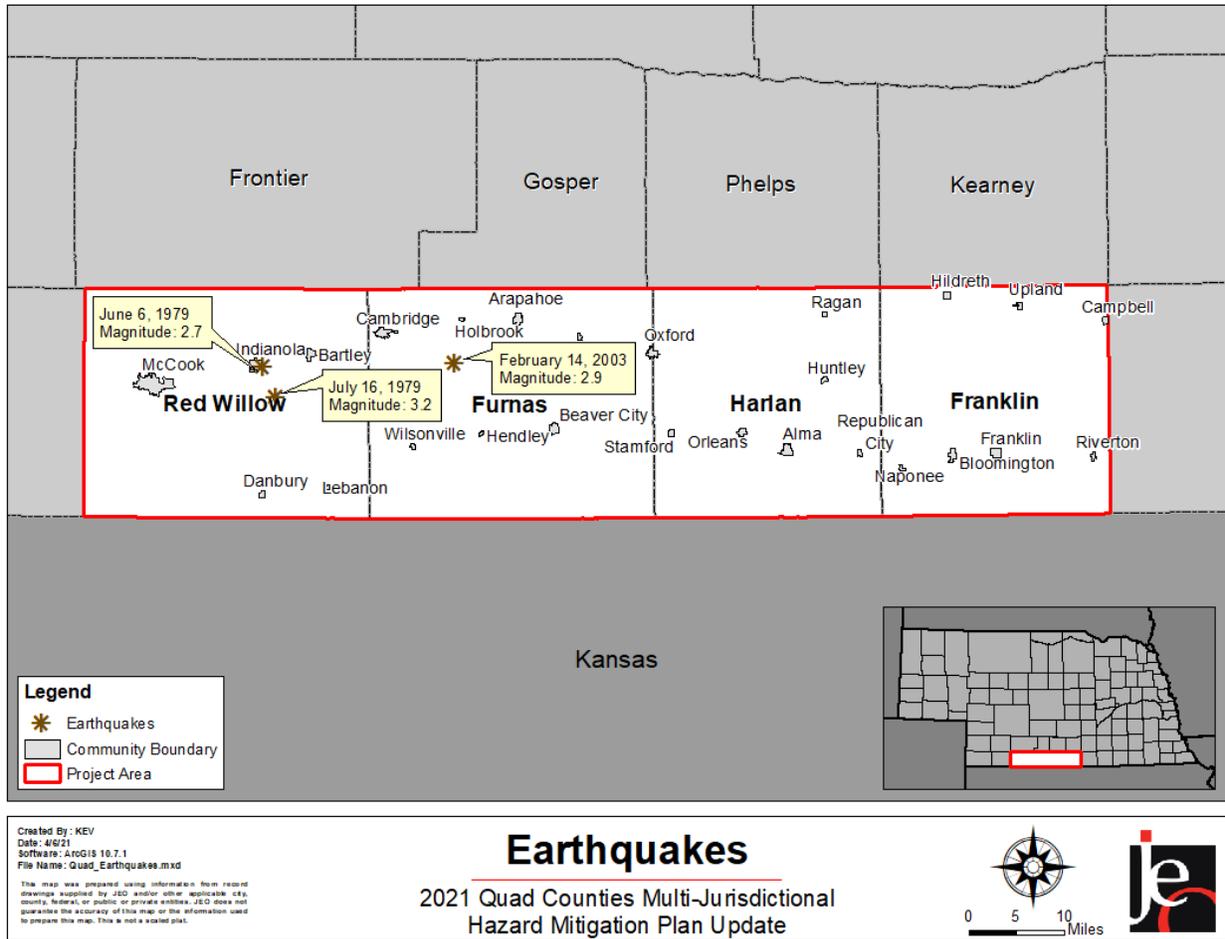


Source: Nebraska Department of Natural Resources

Historical Occurrences

Figure 22 displays historical occurrences of earthquakes in the planning area since 1900. The strongest earthquake was a 3.2 in July 1979 that occurred in northeastern Red Willow County. A second earthquake occurred in Red Willow County in June 1979 with a magnitude of 2.7. The most recent earthquake in the planning area occurred in Furnas County in February 2003 with a magnitude of 2.9.

Figure 22: Earthquakes in Quad Counties



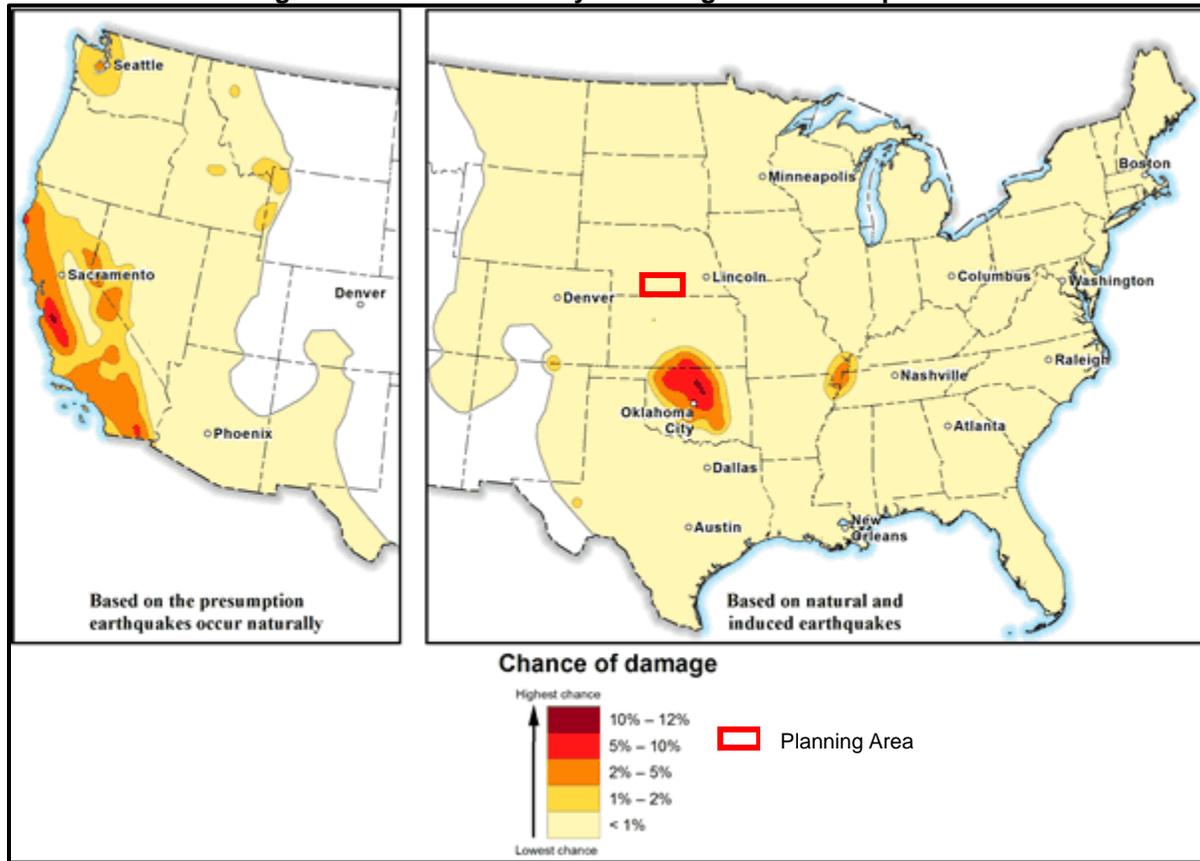
Extent

If an earthquake were to occur in the planning area, it would likely measure 4.0 or less on the Richter Scale. Very little to no damage is anticipated from events of these magnitudes.

Average Annual Losses

Due to the lack of reported damages from 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 23 shows the probability of damage from earthquakes, according to the United States Geological Survey. The figure shows that the planning area has a less than one percent chance of damages from earthquakes.

Figure 23: 2017 Probability of Damage from Earthquakes



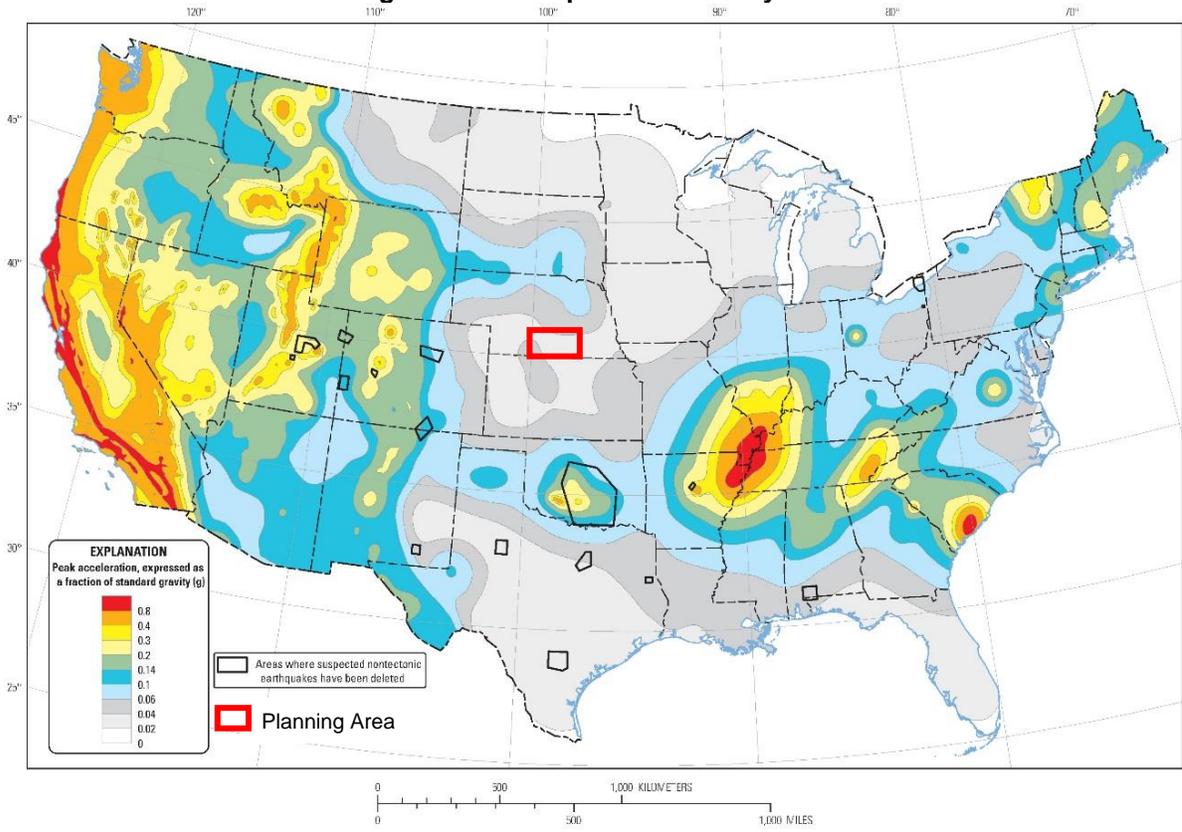
Source: USGS, 2017⁷⁸

Probability

The following figure visualizes the probability of a 5.0 or greater earthquake occurring in the planning area within 50 years. Based on the historic record of reported incidents, there is a less than two percent probability (2 out of 121 years with an occurrence) that an earthquake will occur annually in the planning area.

⁷⁸ United States Geological Survey, 2017. "Short-term Induced Seismicity Models: 2017 One-Year Model." <https://earthquake.usgs.gov/hazards/induced/index.php#2017>.

Figure 24: 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 62: 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.

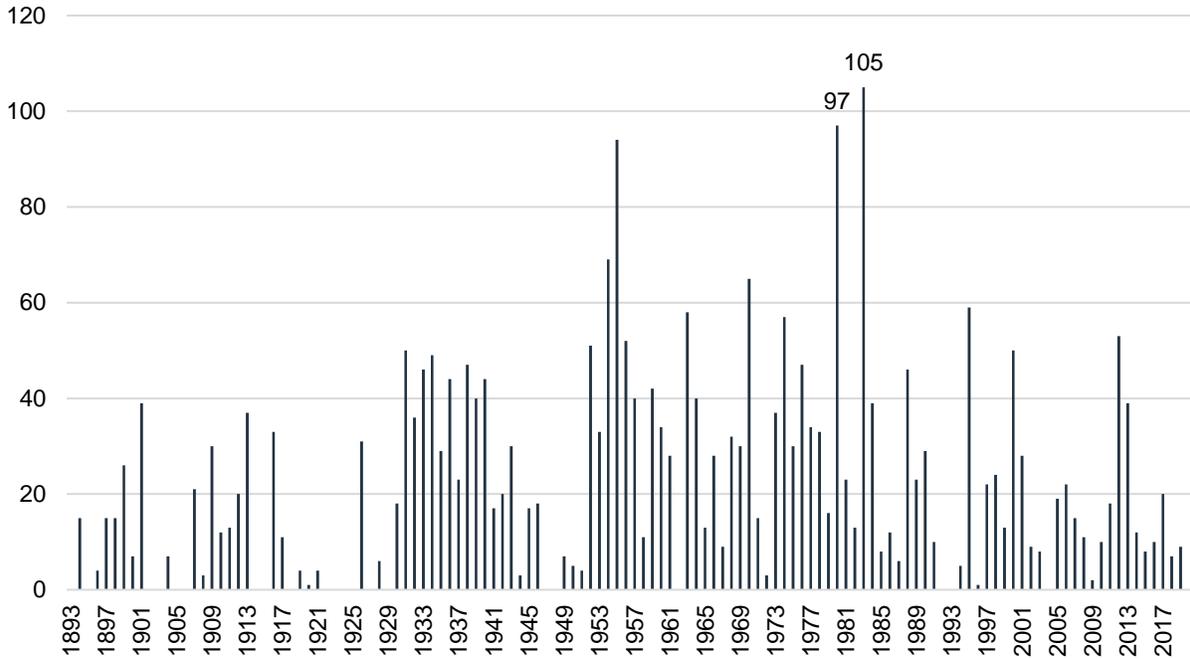
Location

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 22 days above 100°F per year. The planning area experienced the most days on record above 100°F in 1983 with 105 days and in 1980 with 97 days. Conversely, 2004 was the most recent “coolest” year on record, with zero days above 100°F.

Figure 25: Number of Days Above 100°F



Source: HPRCC, 1893-2020

Extent

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

$$100\% \text{ Relative Humidity} + 86^\circ\text{F} = 112^\circ\text{F Heat Index}$$

Figure 26 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 26: NOAA Heat Index Temperature (°F)

	80	82	84	86	88	90	92	94	96	98	100	102	104	106	108	110
40	80	81	83	85	88	91	94	97	101	105	109	114	119	124	130	136
45	80	82	84	87	89	93	96	100	104	109	114	119	124	130	137	
50	81	83	85	88	91	95	99	103	108	113	118	124	131	137		
55	81	84	86	89	93	97	101	106	112	117	124	130	137			
60	82	84	88	91	95	100	105	110	116	123	129	137				
65	82	85	89	93	98	103	108	114	121	128	136					
70	83	86	90	95	100	105	112	119	126	134						
75	84	88	92	97	103	109	116	124	132							
80	84	89	94	100	106	113	121	129								
85	85	90	96	102	110	117	126	135								
90	86	91	98	105	113	122	131									
95	86	93	100	108	117	127										
100	87	95	103	112	121	132										

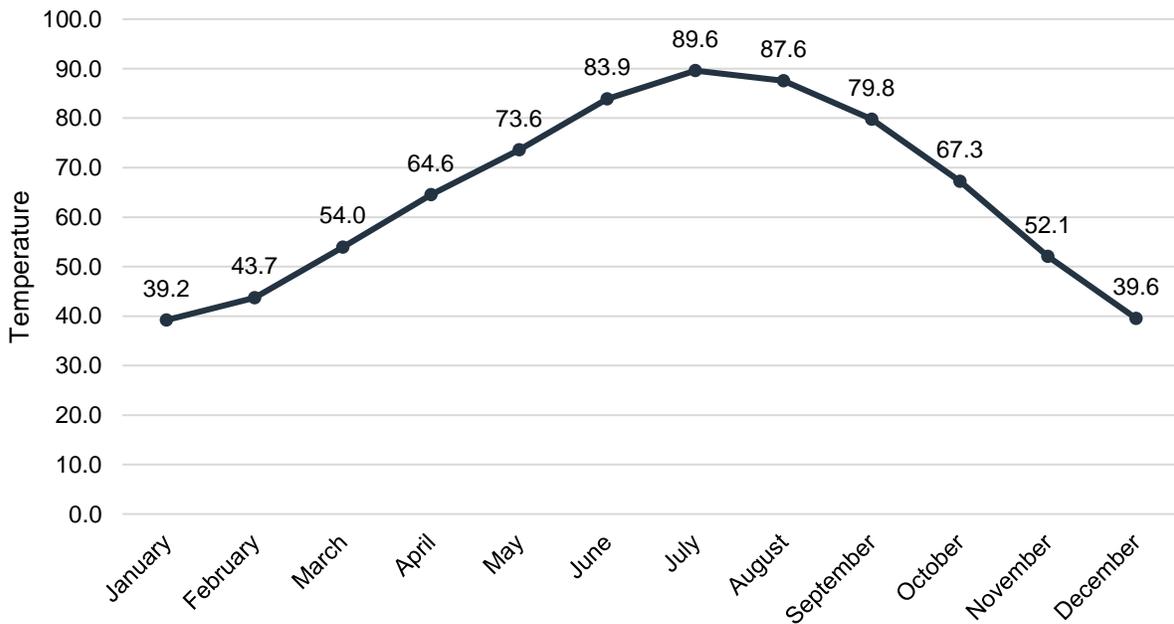
Likelihood of Heat Disorders with Prolonged Exposure or Strenuous Activity

Caution
 Extreme Caution
 Danger
 Extreme Danger



Source: NOAA, 2017⁷⁹

Figure 27: Monthly Climate Normals Max Temperature (1981-2010)



Source: NCEI, 2020

79 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 63: 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	22 days	\$0	\$0	\$26,463,846	\$1,323,192

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 2020)

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.⁸⁰ In rural areas, the percent of the population affected, and duration may increase during extreme events. The assumed damages do not consider physical damages to utility equipment and infrastructure.

Table 64: Loss of Electricity - Assumed Damage by Jurisdiction

Jurisdiction	(est.) 2017 Population	Population Affected (Assumed)	Electric Loss of Use Assumed Damage Per Day
Franklin	3,006	301	\$37,926
Furnas	4,786	479	\$60,354
Harlan	3,438	344	\$43,344
Red Willow	10,806	1,081	\$136,206
Total	22,036	2,205	\$277,830

Probability

Extreme heat is a regular part of the climate for the planning area; with 106 years out of 128 having at least one day over 100°F. The average number of days above 100°F for those years was 22. Based on the historic record of reported incidents, there is an 83 percent probability (106 out of 128 years with an occurrence) that extreme heat will occur annually in the planning area.

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*⁸¹ 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.

⁸⁰ Federal Emergency Management Agency. June 2009. "BCA Reference Guide."

⁸¹ 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 65: Extreme Heat Predictions for Days over 100°F

Jurisdiction	Historical Average 1971-2000 (Days Per Year)	Midcentury Prediction 2036-2065 (Days Per Year)	Late Century Prediction 2070-2099 (Days Per Year)
Franklin	4	33	60
Furnas	5	36	63
Harlan	4	33	60
Red Willow	2	28	54

Source: Union of Concerned Scientists, 1971-2019⁸²

Regional Vulnerabilities

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

Table 66: Regional Drought and Extreme Heat Vulnerabilities

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

⁸² 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=lanca-ster-county--ne>

FLOODING

Flooding due to rainfall can occur on a local level, sometimes affecting only a few streets, but can also extend throughout an entire region, impacting whole drainage basins and property in multiple states. Heavy accumulations of ice or snow can also cause flooding during the melting and freezing stage. There are four main types of flooding in the planning area: 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 Republican River is the only river that flows through the planning area. This river as well as its tributaries are potential locations for flooding to occur.

Table 67 shows current statuses of Flood Insurance Rate Map (FIRM) panels. Figure 28 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*.

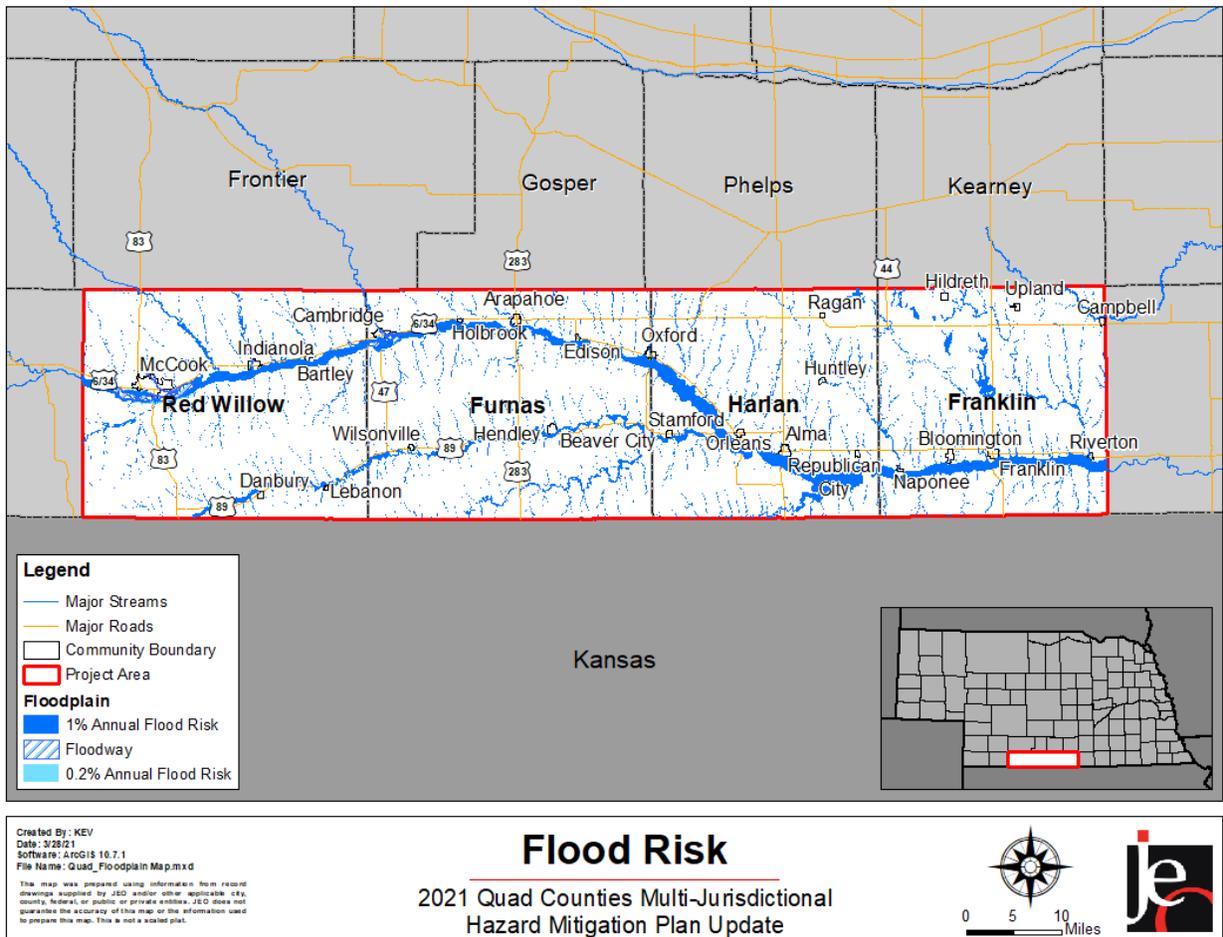
Table 67: FEMA FIRM Panel Status

Jurisdiction	Panel Numbers	Effective Date
Franklin County	31061CIND0A, 31061C0025C, 31061C0050C, 31061C0075C, 31061C0100C, 31061C0125C, 31061C0150C, 31061C0175C, 31061C0200C, 31061C0225C, 31061C0250C, 31061C0275C, 31061C0300C, 31061C0325C, 31061C0350C, 31061C0375C	9/30/2005
Bloomington	31061CIND0A, 31061C0300C	9/30/2005
Campbell	31061CIND0A, 31061C0125C	9/30/2005
Franklin	31061CIND0A, 31061C0325C	9/30/2005
Hildreth	31061CIND0A, 31061C0050C	9/30/2005
Naponee	31061CIND0A, 31061C0275C	9/30/2005
Riverton	31061CIND0A, 31061C0350C	9/30/2005
Upland	-	9/30/2005
Furnas County	31065CIND0A, 31065C0016C, 31065C0017C, 31065C0018C, 31065C0019C, 31065C0025C, 31065C0050C, 31065C0075C, 31065C0100C, 31065C0125C, 31065C0175C, 31065C0200C, 31065C0225C, 31065C0250C, 31065C0275C, 31065C0276C, 31065C0325C, 31065C0350C, 31065C0375C, 31065C0400C, 31065C0425C	3/2/2009
Arapahoe	31065CIND0A, 31065C0075C, 31065C0100C	3/2/2009
Beaver City	31065C0400C, 31065C0250C, 31065CIND0A	3/2/2009
Cambridge	31065C0025C, 31065C0019C, 31065C0018C, 31065C0017C, 31065C0016C, 31065CIND0A	3/2/2009
Edison	31065C0100C, 31065CIND0A	3/2/2009
Hendley	31065C0375C, 31065C0225C, 31065CIND0A	3/2/2009
Holbrook	31065C0075C, 31065C0050C, 31065CIND0A	3/2/2009
Oxford	31065C0276C, 31065C0275C, 31065C0125C, 31065CIND0A	3/2/2009
Wilsonville	31065CIND0A, 31065C0350C	3/2/2009
Harlan County	31083CIND0A, 31083C0025B, 31083C0050B, 31083C0075B, 31083C0100B, 31083C0125B, 31083C0150B, 31083C0165B, 31083C0175B, 31083C0190B, 31083C0200B, 31083C0210B, 31083C0225B, 31083C0250B, 31083C0275B, 31083C0300B, 31083C0310B, 31083C0325B, 31083C0330B, 31083C0350B, 31083C0355B, 31083C0375B	2/18/2009
Alma	31083CIND0A, 31083C0310B, 31083C0330B	2/18/2009
Huntley	31083C0225B, 31083C0210B, 31083CIND0A	2/18/2009
Orleans	31083CIND0A, 31083C0190B	2/18/2009
Ragan	31083CIND0A, 31083C0100B	2/18/2009
Republican City	31083C0355B, 31083CIND0A	2/18/2009
Stamford	31083C0165B, 31083CIND0A	2/18/2009
Red Willow County	31145CIND0B, 31145C0025C, 31145C0050C, 31145C0075C, 31145C0100C, 31145C0125C, 31145C0150C, 31145C0175C, 31145C0185C, 31145C0195C, 31145C0200C, 31145C0205C, 31145C0215C, 31145C0225C, 31145C0230C, 31145C0235D,	2/4/2009

Jurisdiction	Panel Numbers	Effective Date
	31145C0250C, 31145C0275C, 31145C0300C, 31145C0325C, 31145C0350C, 31145C0375C, 31145C0400C, 31145C0425C, 31145C0450C	
Bartley	31145CIND0B, 31145C0125C, 31145C0275C	2/4/2009
Danbury	31145CIND0B, 31145C0400C	2/4/2009
Indianola	31145CIND0B, 31145C0100C, 31145C0230C, 31145C0235D	2/4/2009
Lebanon	31145CIND0B, 31145C0425C	2/4/2009
McCook	31145CIND0B, 31145C0050C, 31145C0075C, 31145C0185C, 31145C0195C, 31145C0200C, 31145C0205C, 31145C0215C, 31145C0225C	2/4/2009

Source: FEMA, 2020^{83, 84}

Figure 28: 1% and 0.2% Annual Flood Risk Hazard Areas



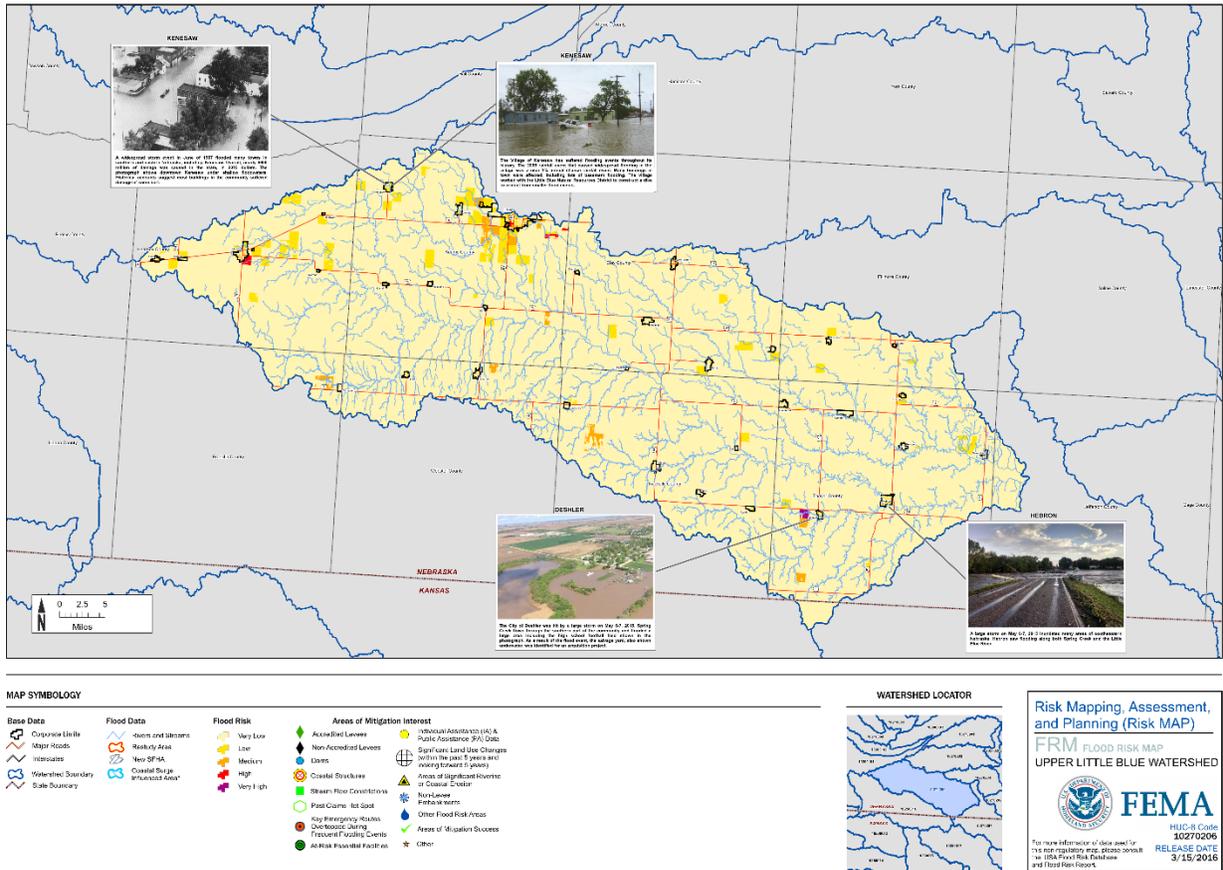
⁸³ Federal Emergency Management Agency. 2019. "FEMA Flood Map Service Center." Accessed July 2020. <http://msc.fema.gov/portal/advanceSearch>.

⁸⁴ Federal Emergency Management Agency. 2020. "Community Status Book Report." Accessed July 2020. <https://www.fema.gov/national-flood-insurance-program-community-status-book/>.

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. A small portion of Franklin County including the Village of Campbell has gone through the Risk MAP process. Figure 29 show the boundary. No other locations in the planning area have planned Risk MAP projects at this time. NeDNR hosts the Risk MAP products on an interactive web map, which can be viewed on their webpage: <https://dnr.nebraska.gov/floodplain>.

**Figure 29: Risk MAP Products in the Planning Area
Flood Risk Map: Upper Little Blue Watershed**



Source: FEMA

Extent

The NWS has three categories to define the severity of a flood once a river reaches flood stage as indicated in Table 68.

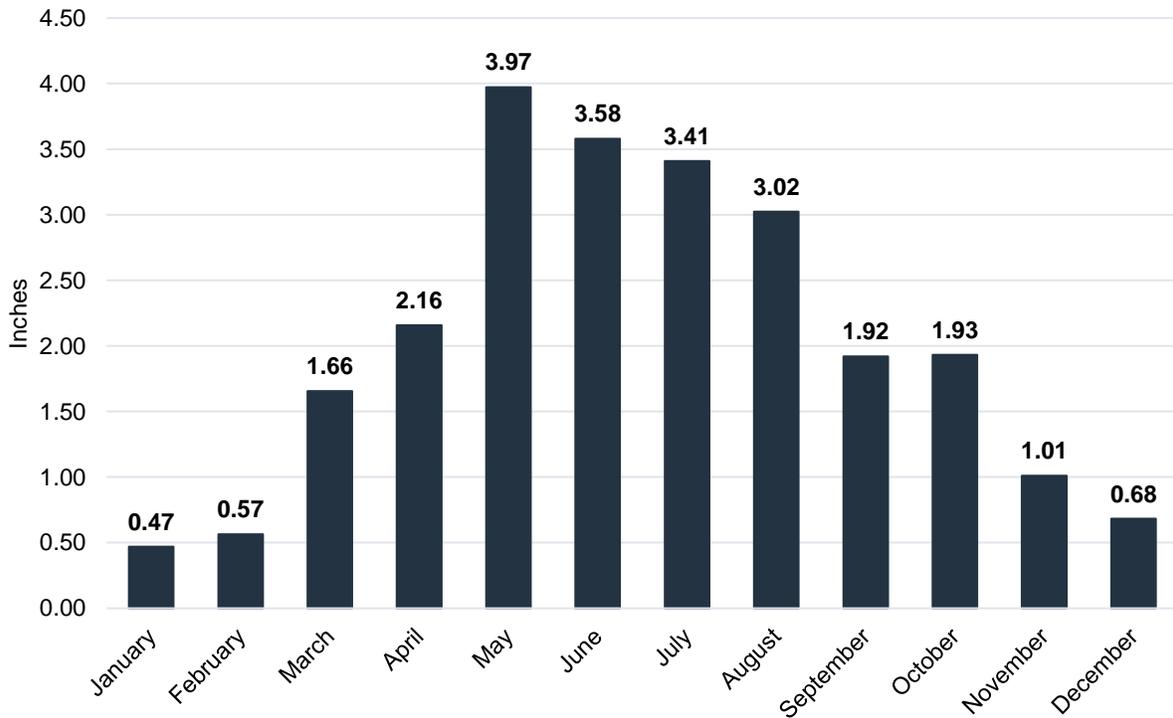
Table 68: Flooding Stages

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, 2019⁸⁵

Figure 30 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 31, the most common months for flooding within the planning area are May and June.

Figure 30: Average Monthly Precipitation for Planning Area

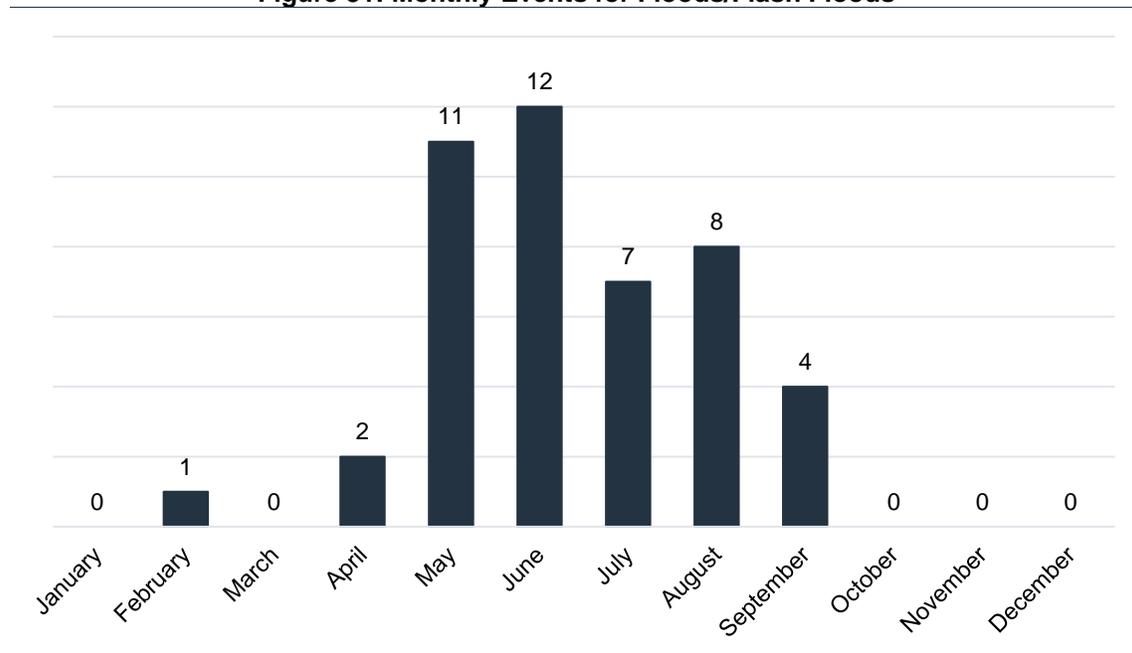


Source: NCEI, 2019⁸⁶

⁸⁵ National Weather Service. 2020. "Severe Weather 101- Floods." <https://www.nssl.noaa.gov/education/svrwx101/floods/faq/>.

⁸⁶ NOAA National Centers for Environmental Information. December 2019. "Data Tools: 1981-2010 Normals." [datafile]. <https://www.ncdc.noaa.gov/cdo-web/datatools/normals>.

Figure 31: Monthly Events for Floods/Flash Floods



Source: NCEI, 1996-2020

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 69: NFIP Participants

Jurisdiction	Participate in NFIP	Eligible-Regular Program	Date Current Map	Sanction	Suspension	Rescinded
Franklin County	Yes	9/30/05	9/30/05	-	-	-
Bloomington	No	-	-	-	-	-
Campbell	Yes	3/1/01	9/30/05	-	-	-
Franklin	Yes	1/1/87	9/30/05	-	-	-
Hildreth	No	-	-	-	-	-
Naponee	No	-	-	-	-	-
Riverton	Yes	3/1/01	9/30/05	-	-	-
Upland	No	-	-	-	-	-
Furnas County	Yes	3/2/09	3/2/09	-	-	-
Arapahoe	No	-	-	-	-	-
Beaver City	Yes	8/1/86	3/2/09(M)	-	-	-

Jurisdiction	Participate in NFIP	Eligible-Regular Program	Date Current Map	Sanction	Suspension	Rescinded
Cambridge	Yes	3/28/80	3/2/09	-	-	-
Edison	No	-	-	-	-	-
Hendley	No	-	-	-	-	-
Holbrook	No	-	-	-	-	-
Oxford	Yes	3/2/9	3/2/09(M)	-	-	-
Wilsonville	Yes	11/7/01	3/2/09(M)	-	-	-
Harlan County	Yes	2/18/09	2/18/09	-	-	-
Alma	Yes	2/18/09	2/18/09	-	-	-
Huntley	No	-	-	-	-	-
Orleans	Yes	5/1/88	2/18/09(M)	-	-	-
Ragan	Yes	2/18/09	NSFHA	-	-	-
Republican City	Yes	2/18/09	2/18/09(M)	-	-	-
Stamford	Yes	2/18/09	2/18/09(M)	-	-	-
Red Willow County	Yes	5/1/88	11/16/11(M)	-	-	-
Bartley	Yes	2/4/09	2/4/09	-	-	-
Danbury	No	-	-	-	-	-
Indianola	Yes	11/16/90	11/16/11	-	-	-
Lebanon	No	-	-	-	-	-
McCook	Yes	5/2/83	2/4/09	-	-	-

Source: Federal Emergency Management Agency, National Flood Insurance Program, 2017⁸⁷

*(M) indicates no elevation determined – All Zone A, C, and X

*NSFHA indicates No Special Flood Hazard Area - All Zone C

Table 70: NFIP Policies in Force and Total Payments

Jurisdiction	Policies In-Force	Total Premiums	Total Coverage	Total Losses	Total Payments
Franklin County	4	\$3,816	\$644,700	0	\$0
Bloomington	N/P	N/A	N/A	N/A	N/A
Campbell	0	\$0	\$0	0	\$0
Franklin	0	\$0	\$0	0	\$0
Hildreth	N/P	N/A	N/A	N/A	N/A
Naponee	N/P	N/A	N/A	N/A	N/A
Riverton	1	\$395	\$280,000	2	\$1,858
Upland	N/P	N/A	N/A	N/A	N/A
Furnas County	2	\$1,739	\$281,700	1	\$4,118
Arapahoe	N/P	N/A	N/A	N/A	N/A
Beaver City	Yes	8/1/86	3/2/09(M)	-	-
Cambridge	2	\$2,048	\$309,000	2	\$0
Edison	N/P	N/A	N/A	N/A	N/A
Hendley	N/P	N/A	N/A	N/A	N/A
Holbrook	N/P	N/A	N/A	N/A	N/A
Oxford	0	\$0	\$0	0	\$0
Wilsonville	0	\$0	\$0	0	\$0
Harlan County	5	\$4,935	\$1,430,000	0	\$0
Alma	1	\$214	\$42,000	0	\$0
Huntley	N/P	N/A	N/A	N/A	N/A
Orleans	0	\$0	\$0	0	\$0
Ragan	0	\$0	\$0	0	\$0

87 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>.

Jurisdiction	Policies In-Force	Total Premiums	Total Coverage	Total Losses	Total Payments
Republican City	0	\$0	\$0	0	\$0
Stamford	0	\$0	\$0	0	\$0
Red Willow County	6	\$4,862	\$731,200	8	\$32,450
Bartley	0	\$0	\$0	0	\$0
Danbury	N/P	N/A	N/A	N/A	N/A
Indianola	0	\$0	\$0	0	\$0
Lebanon	N/P	N/A	N/A	N/A	N/A
McCook	10	\$10,275	\$3,367,700	3	\$3,084

Source: HUDEX, July 2019

N/A: Not Applicable; N/P: Not a Participant

This plan highly recommends and strongly encourages plan participants to enroll, participate, and remain in good standing with the NFIP. Compliance with the NFIP should remain a top priority for each participant. Jurisdictions are encouraged to initiate activities above the minimum participation requirements, which are described in the Community Rating System (CRS) Coordinator's Manual (FIA-15/2017).⁸⁸ 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 properties located in the planning area.

Historical Occurrences

The NCEI reports events as they occur in each community. A single flooding event can affect multiple communities and counties at a time; the NCEI reports these large scale, multi-county events as separate events. The result is a single flood event covering a large portion of the planning area could be reported by the NCEI as several events. According to the NCEI, 29 flash flooding events resulted in \$753,000 in property damage, while 16 riverine flooding events resulted in \$1,180,000 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 \$452,337. Descriptions of the most damaging flood events from the NCEI are below:

- **July 4, 2000 – Flood/Flash Flood – Franklin County:** Heavy rains and the resulting runoff caused flooding to occur along the Little Blue River. Numerous roadways were flooded. Damage was done to several road bridges and a couple of railway bridges. Total property damage from the event was \$600,000.
- **May 23, 2008 – Flood/Flash Flood – Red Willow, Franklin, Harlan Counties:** Several days of heavy rainfall resulted in widespread flooding of county roads. Total Damage across all three counties was \$300,000.
- **August 16, 2015 – Flood/Flash Flood – Furnas County:** Multiple roads were under water in and around the Edison area due to flash flooding. In Edison, Ag Valley Coop sustained some of the worst damage as flood waters infiltrated the first-floor office. Other homes and buildings in and around Edison were also flooded. Damage from the flooding was \$100,000.

⁸⁸ 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>.

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 \$77,320 in property damages and \$22,615 in crop losses per year for the planning area.

Table 71: Flood Loss Estimate

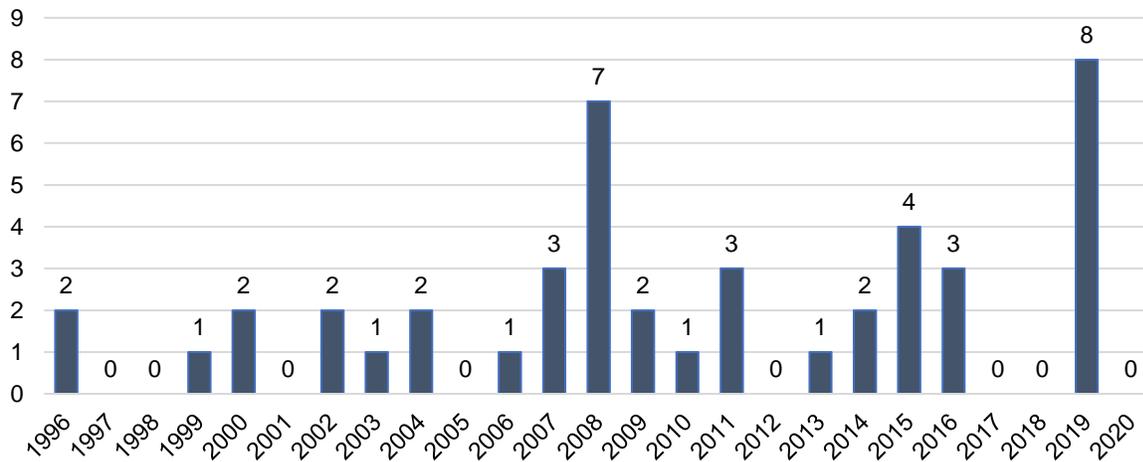
Hazard Type	Number of Events ¹	Average Events Per Year ¹	Total Property Loss ¹	Average Annual Property Loss ¹	Total Crop Loss ²	Average Annual Crop Loss ²
Flash Flood	29	1.16	\$753,000	\$30,120	\$452,337	\$22,615
Flood	16	0.64	\$1,180,000	\$47,200		
Total	45	1.80	\$1,933,000	\$77,320	\$452,337	\$22,615

Source: 1 Indicates data is from NCEI (Jan 1996-December 2020); 2 Indicates data is from NCEI (Jan 2000-June 2020)

Probability

The NCEI reports 29 flash flood and 16 flood events for a total of 45 events from January 1996 to December 2020. Some years had multiple flooding events, while others had zero. Figure 33 shows the events broken down by year. Based on the historic record of reported incidents, there is a 68 percent probability (17 out of 25 years with an occurrence) that flooding will occur annually in the planning area.

Figure 33: Yearly Events for Floods/Flash Floods



Source: NCEI, 1996-March 2020

Regional Vulnerabilities

Low-income and minority populations are disproportionately vulnerable to flood events.⁸⁹ 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.

⁸⁹ Cutter, Susan and Finch, Christina. February 2008. "Temporal and Spatial Changes in Social Vulnerability to Natural Hazards".

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

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

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

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 tables. Specific jurisdictional parcel improvements in the floodplain can be found in the corresponding community profiles in *Section Seven*.

Table 72: 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
Franklin County	2,147	\$125,291,135	423	\$30,139,890	19.7%
Furnas County	3,055	\$197,093,540	477	\$48,801,685	15.6%
Harlan County	2,207	\$176,040,125	198	\$17,143,310	9.0%
Red Willow County	4,927	\$548,409,936	432	\$53,034,638	8.8%
Planning Area Total	12,336	\$1,046,834,736	1,530	\$149,119,523	12.4%

Source: 1 Franklin County Assessor, 2018; 2 Furnas County Assessor, 2018; 3 Harlan County Assessor, 2018; 4 Red Willow County Assessor, 2020

Table 73: 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
Franklin County	2,147	\$125,291,135	N/A	N/A	N/A
Furnas County	3,055	\$197,093,540	12	\$510,910	0.4%
Harlan County	2,207	\$176,040,125	N/A	N/A	N/A
Red Willow County	4,927	\$548,409,936	38	\$2,651,612	0.8%
Planning Area Total	12,336	\$1,046,834,736	50	\$3,162,522	<1%

Source: 1 Franklin County Assessor, 2018; 2 Furnas County Assessor, 2018; 3 Harlan County Assessor, 2018; 4 Red Willow County Assessor, 2020

N/A: The county does not have a mapped 0.2% annual flood risk area, so it is not known how many improvements are in the floodplain.

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

Table 74: Regional Flooding Vulnerabilities

Sector	Vulnerability
People	<ul style="list-style-type: none"> -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
Economic	<ul style="list-style-type: none"> -Business closures or damages may have significant impacts -Agricultural losses from flooded fields, cattle loss, and soil erosion -Closed roads and railways would impact commercial transportation of goods
Built Environment Infrastructure	<ul style="list-style-type: none"> -Buildings may be damaged -Damages to roadways and railways
Critical Facilities	<ul style="list-style-type: none"> -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	<ul style="list-style-type: none"> -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 any 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 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 34).

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

~National Park Service

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

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 35). These fire danger predictions are updated regularly and should be reviewed frequently.

The Nebraska Forest Service created the South Central West Community Wildfire Protection Plan (CWPP) in 2021. This plan includes Furnas, Harlan, and Franklin Counties. Red Willow County is part of the Southwest Nebraska CWPP which was written in 2019. The purpose of a CWPP 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, identify areas most at risk from wildfires, discuss protection capabilities, and identify wildfire mitigation strategies. These documents are updated every five years.

During the last five years, the Natural Resources Conservation Service (NRCS) in Alma reported cost-share projects used to treat 17,000 acres in Franklin, Furnas, and Harlan Counties. In addition, the Twin Valley Weed Management Area helped remove 10,519 acres of undesirable woody vegetation using their cost-share program. Over 3,800 acres in Franklin, Furnas, and Harlan Counties were treated using prescribed fires in the last five years. To help respond to wildfires, a permanent Single Engine Air Tanker (SEAT) base is located in the City of McCook. This is one of five permanent SEAT bases in Nebraska. A SEAT can help quickly attack small fires located in difficult terrain and keep them from growing into larger wildfires.⁹⁰

⁹⁰ Nebraska Forest Service. April 2021. "South Central West Community Wildfire Protection Plan". <https://nfs.unl.edu/documents/CWPP/SouthCentralWest.pdf>

Figure 34: Wildland-Urban Interface

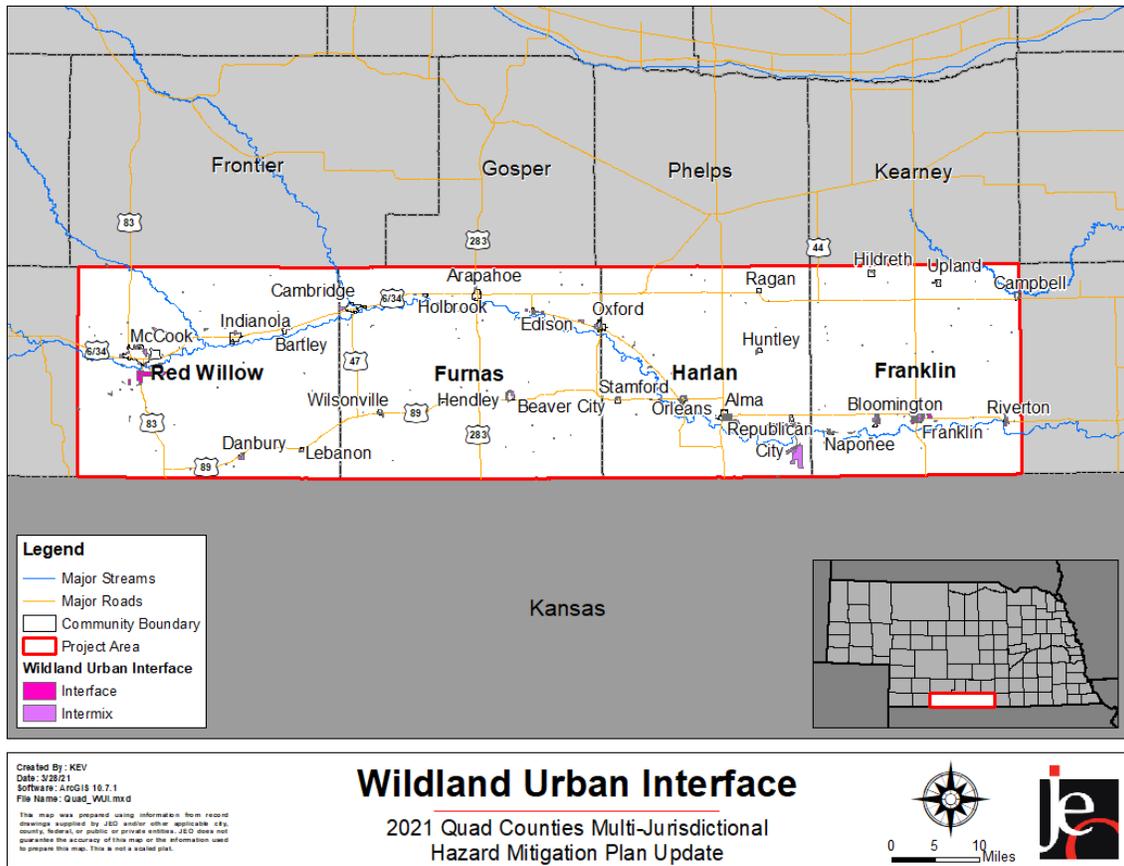
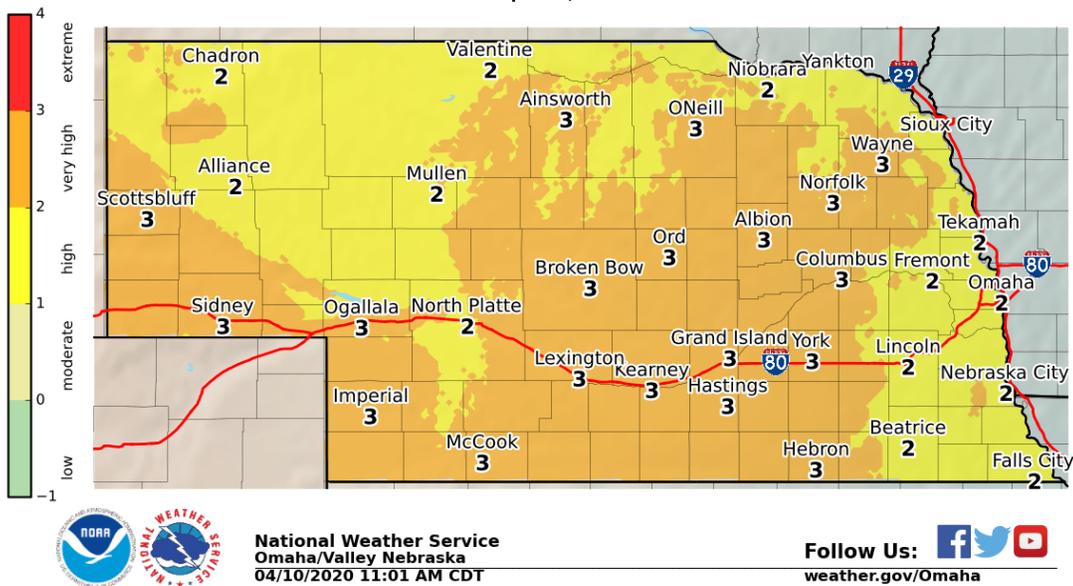


Figure 35: Rangeland Fire Danger

Nebraska Rangeland Fire Danger - *Does not account for snow cover*
Valid: April 10, 2020



Source: NWS, 2019⁹¹

91 National Weather Service. January 2019. "Nebraska Fire Danger Map." <https://www.weather.gov/omx/fire>.

Location

For the planning area, 21 fire districts were identified to report events: Alma Fire Department, Bartley Fire Department, Beaver City Fire Department, Beaver Valley Fire Department, Cambridge Fire Department, Campbell Fire Department, Franklin Fire Department, Hildreth Fire Department, Holbrook-Edison-Arapahoe Fire Department, Holdrege Fire Department, Indianola Fire Department, Naponee Fire Department, Orleans Fire Department, Oxford Fire Department, Red Willow Western Fire Department, Republican City Fire Department, Riverton Fire Department, Stamford Fire Department, Upland Fire Department, Wilcox Fire Department, and Wilsonville Fire Department (Figure 36). These fire districts respond to both wildfires and structural fires in cities and villages.

Figure 36: Fire Districts in the Planning Area

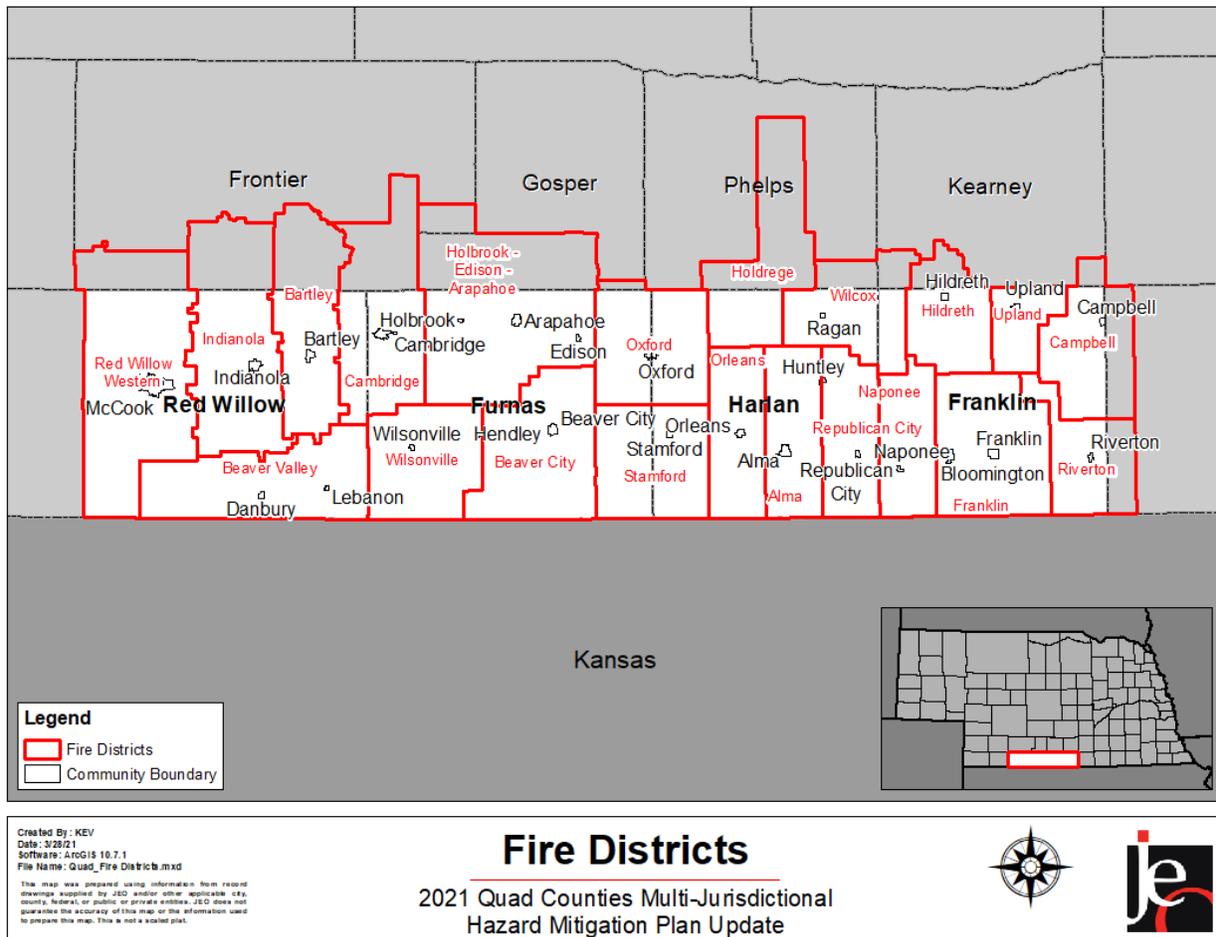
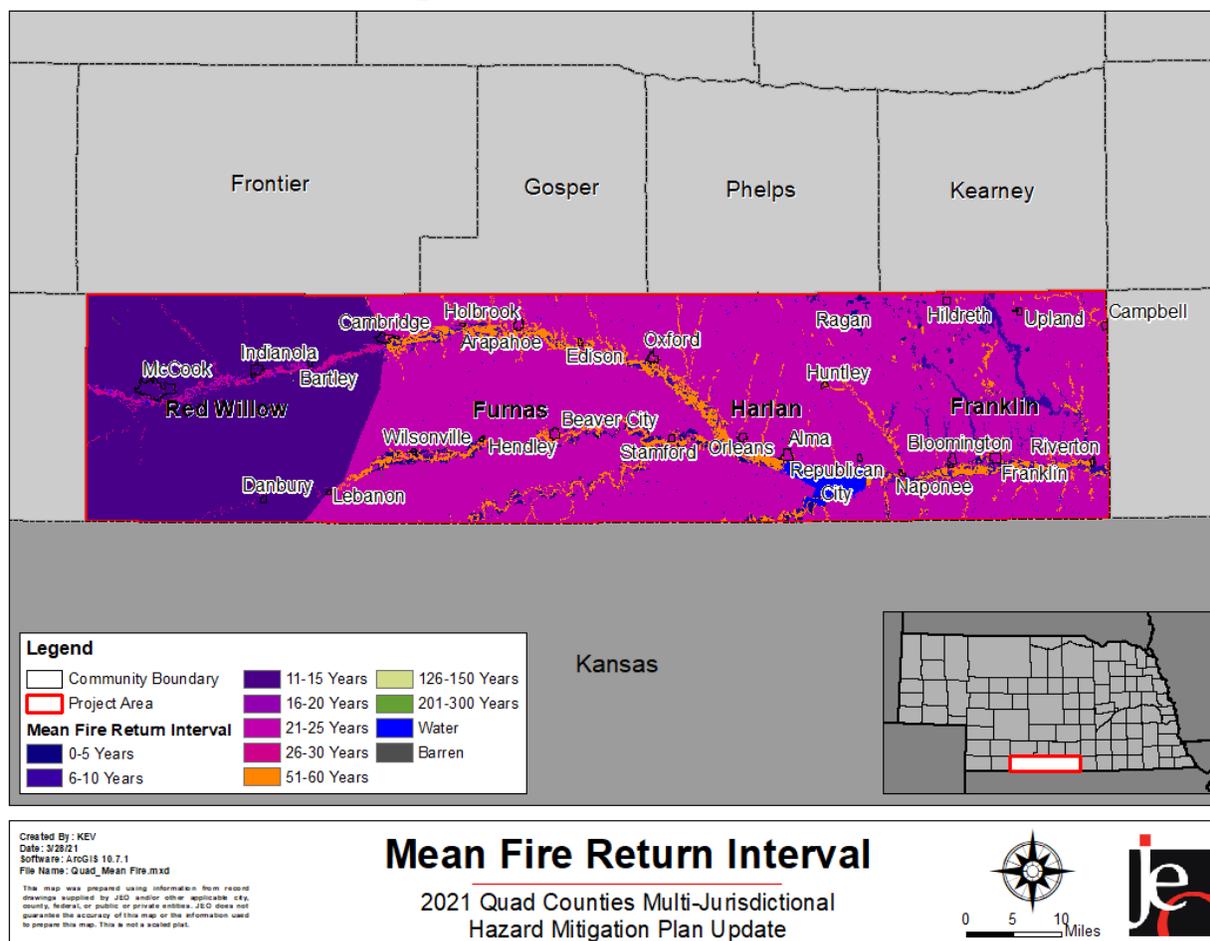


Figure 37 shows the USGS’ Mean Fire Return Interval. This model considers a variety of factors, including landscape, fire dynamics, fire spread, fire effects, and spatial context. These values show how often fires are likely to occur in each area under natural conditions.

Figure 37: Mean Fire Return Interval



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

Table 75: Reported Wildfires by County

County	Reported Wildfires	Acres Burned
Franklin	213	2,271
Furnas	274	2,690
Harlan	79	527
Red Willow	227	1,738
Total	793	7,226

Source: Nebraska Forest Service, 2000-2020⁹²

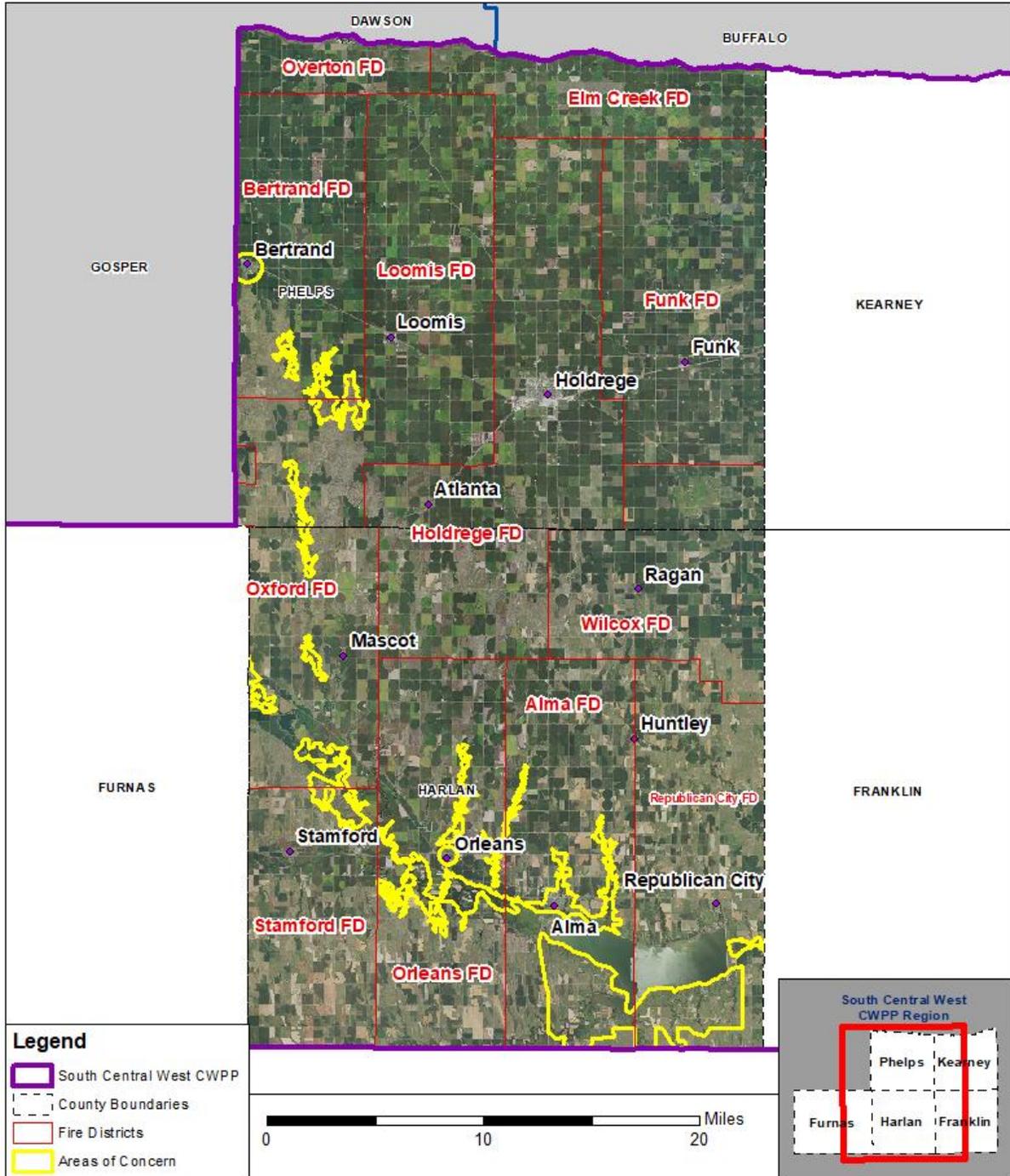
The CWPP identified areas of concern for the region, as shown in Figure 38, Figure 39, Figure 40, and Figure 41. These locally identified areas of concern are specific sites that are at greatest risk for wildfire and where vegetative fuels reduction activities can be targeted.⁹³ This does not mean that areas outside mapped areas of concern do not have their own fire risk, but rather the areas identified are of greater concern for fire risk reduction.

92 Nebraska Forest Service. 2000-2020. "Fire Incident Type Summary."

93 Nebraska Forest Service. 2021. "Community Wildfire Protection Plans." <https://nfs.unl.edu/community-wildfire-protection-plan>.

Figure 38: Harlan County Areas of Concern

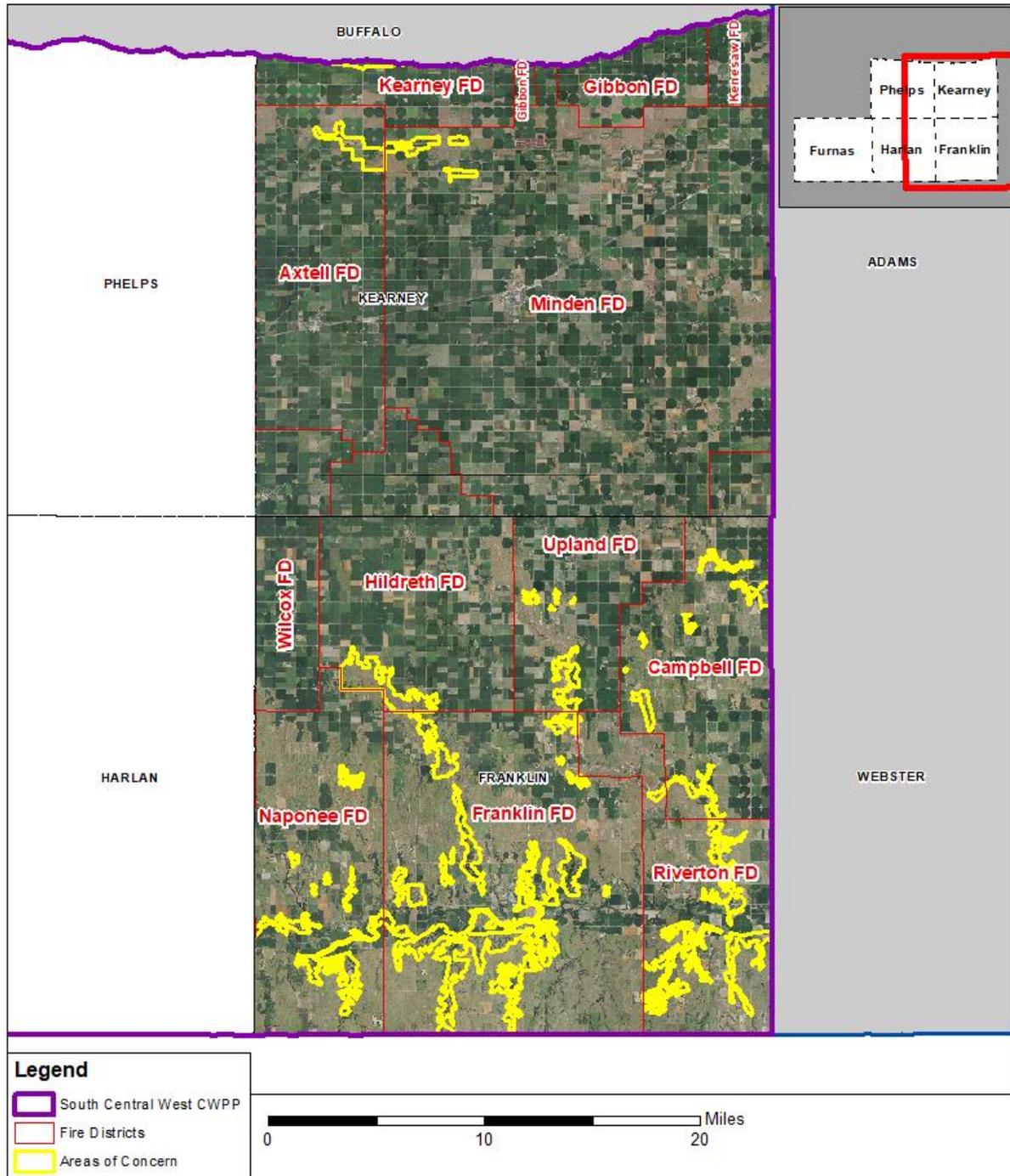
South Central West CWPP Region
 Areas of Concern: Phelps and Harlan Counties



Source: Nebraska Forest Service, April 2021
 Note: Area also includes Phelps County, which is not part of the planning area.

Figure 39: Franklin County Areas of Concern

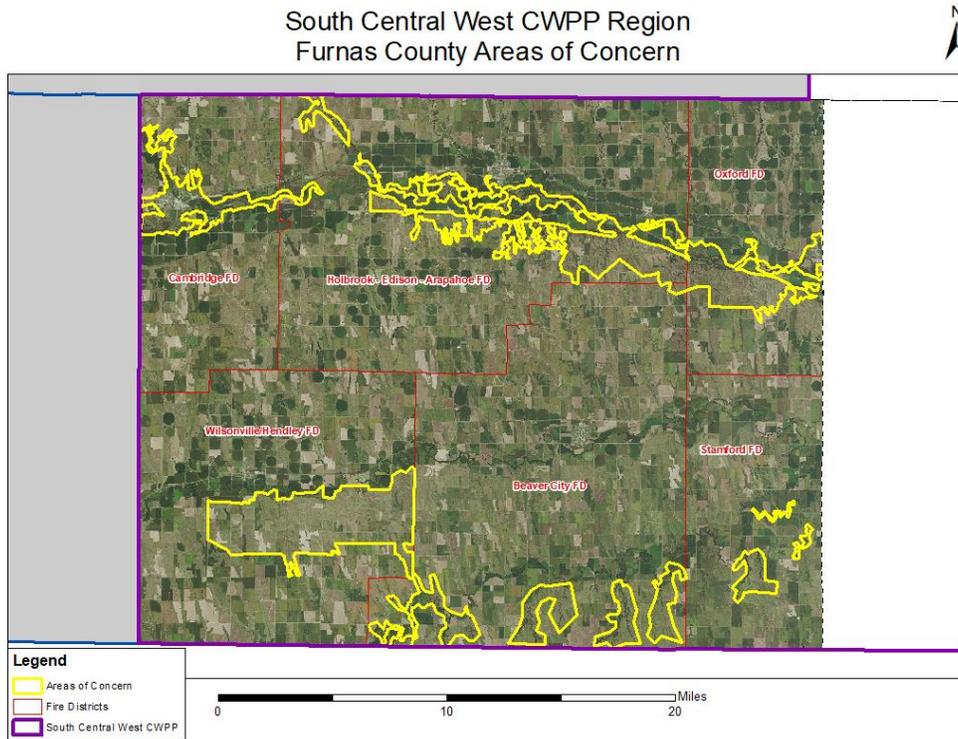
South Central West CWPP Region
 Areas of Concern: Franklin and Kearney Counties



Source: Nebraska Forest Service, April 2021
 Note: Area also includes Kearney County, which is not part of the planning area.

Figure 40: Furnas County Areas of Concern

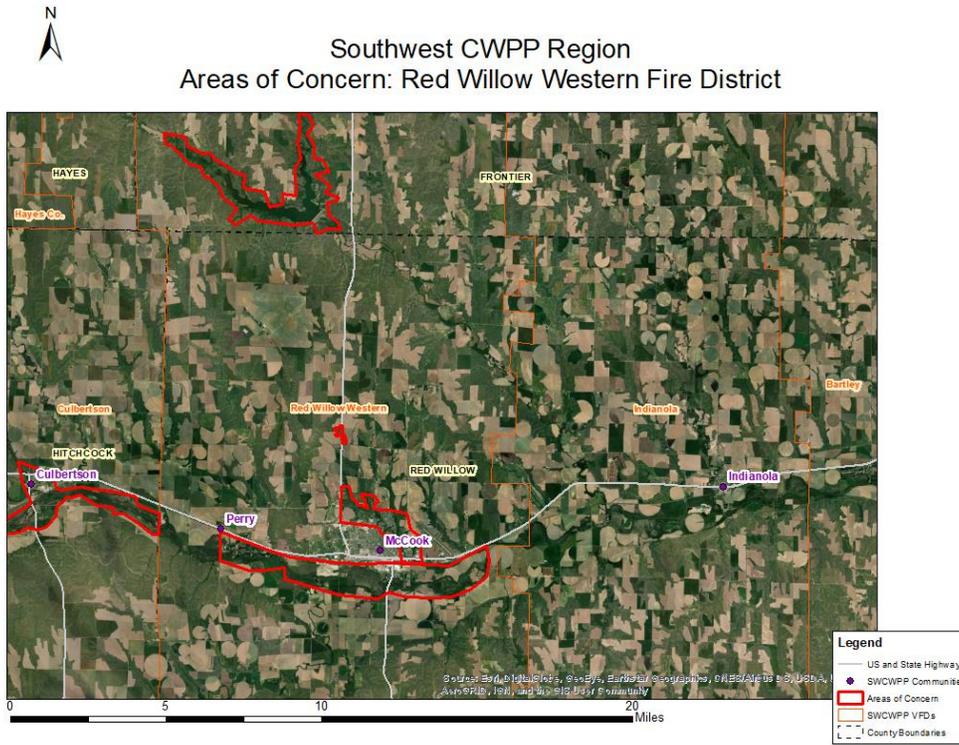
South Central West CWPP Region
Furnas County Areas of Concern



Source: Nebraska Forest Service, April 2021

Figure 41: Red Willow County Areas of Concern

Southwest CWPP Region
Areas of Concern: Red Willow Western Fire District



Source: Nebraska Forest Service, July 2019

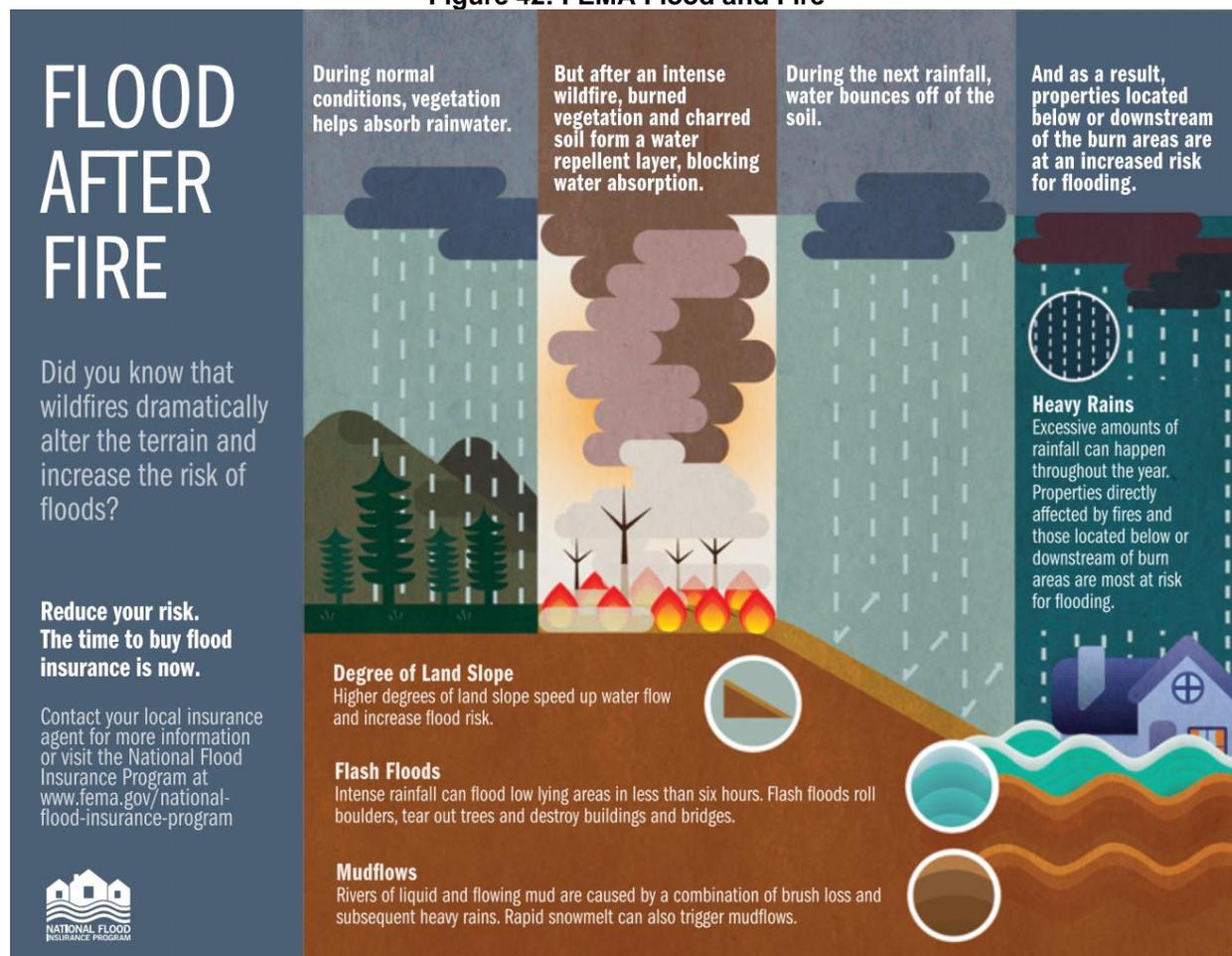
Note: Area also includes Hayes, Hitchcock, and Frontier Counties, which are not part of the planning area

Extent

As seen in Table 75 above, grass/wildfires have burned 7,226 acres of land. In total, there were 793 reported grass/wildfires in the planning area. Of these, 18 fires burned 100 acres or more, with the largest wildfire burning over 400 acres in Furnas County in April 2011.

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 42: FEMA Flood and Fire



Source: FEMA, 2018⁹⁴

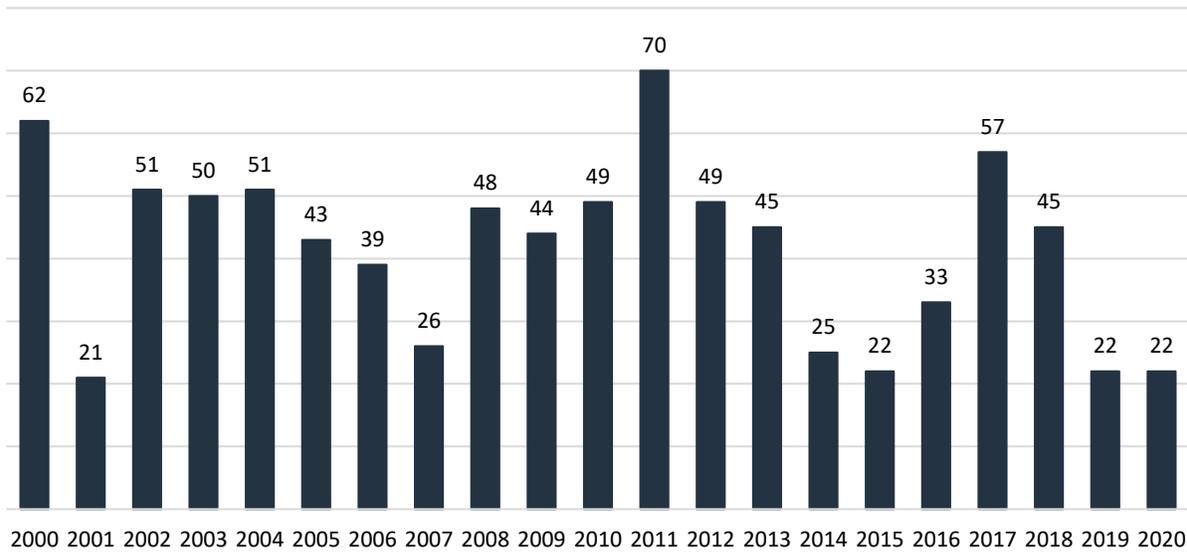
94 Federal Emergency Management Agency. 2018. "Flood After Fire." <https://www.fema.gov/flood-after-fire>.

Historical Occurrences

Local fire districts reported a total of 793 grass/wildfires, according to the NFS, from January 2000 to July 2020. The reported events burned 7,226 acres and caused \$300,856 in crop loss. Grass/wildfire events caused ten injuries, threatened 82 homes and 36 other structures, and destroyed three homes and 11 other structures. Most reported fires occurred in 2011 (Figure 43).

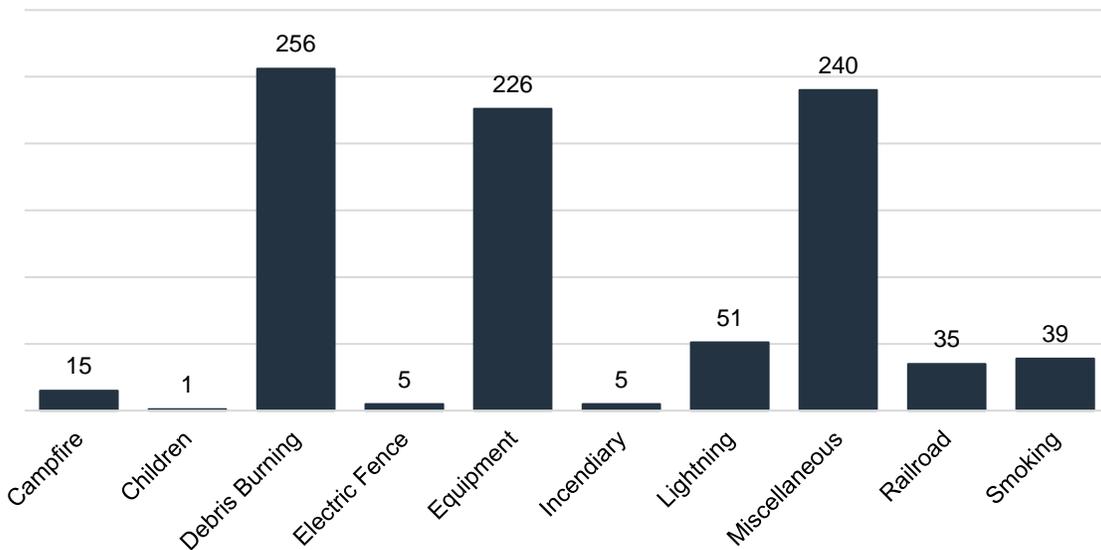
The majority of grass/wildfires in the planning area are caused by debris burning (29.3%), with miscellaneous as the second leading cause (27.5%) (Figure 44). Fires in the planning area have ranged from zero to 400 acres, with an average event burning 9.2 acres.

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



Source: Nebraska Forest Service, 2000-July 2020

Figure 44: Wildfires by Cause in the Planning Area



Source: Nebraska Forest Service, 2000- July 2020

Average Annual Losses

The average damage per event estimate was determined based upon records from the Nebraska Forest Service Wildfires Database from January 2000 to July 2020 and number of historical occurrences. This does not include losses from displacement, functional downtime, economic loss, injury, or loss of life. During the 21-year period, 793 wildfires burned 7,226 acres and caused \$300,856 in crop damage in the planning area.

Table 76: Grass/Wildfire Loss Estimation

Hazard Type	Number of Events	Events Per Year	Average Acres per Fire	Total Property Loss	Total Crop Loss	Average Annual Crop Loss
Grass/Wildfire	793	38	9.2	7,226 acres	\$300,856	\$14,326

Source: Nebraska Forest Service, 2000-July 2020

Table 77: Wildfire Threats

Hazard Type	Injuries	Fatalities	Homes Threatened or Destroyed	Other Structures Threatened or Destroyed
Grass/Wildfire	10	0	167	47

Source: Nebraska Forest Service, 2000-July 2020

Probability

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 (20 out of 20 years with an occurrence) that a grass/wildfire event will occur annually in the planning area (Figure 43).

Regional Vulnerabilities

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

Table 78: 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
Critical Facilities	-Risk of damages
Climate	-Changes in seasonal temperature and precipitation normals can increase frequency and severity of wildfire events -Changes in climate can help spread of invasive species, changing potential fuel load in wildland areas

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 79: 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

There are four levees located within the four-county planning area as reported in U.S. Army Corps of Engineers National Levee Database. See Figure 45 and Table 80 for information on the location of the levees and their respective levee protect areas. Beyond the USACE’s National Levee Database, there is no known comprehensive list of levees that exists in the planning area especially for private agricultural levees. Thus, it is not possible at this time to document the location of non-federal levees, the areas they protect, nor the potential impact of these levees.

Figure 45: Leveed Area

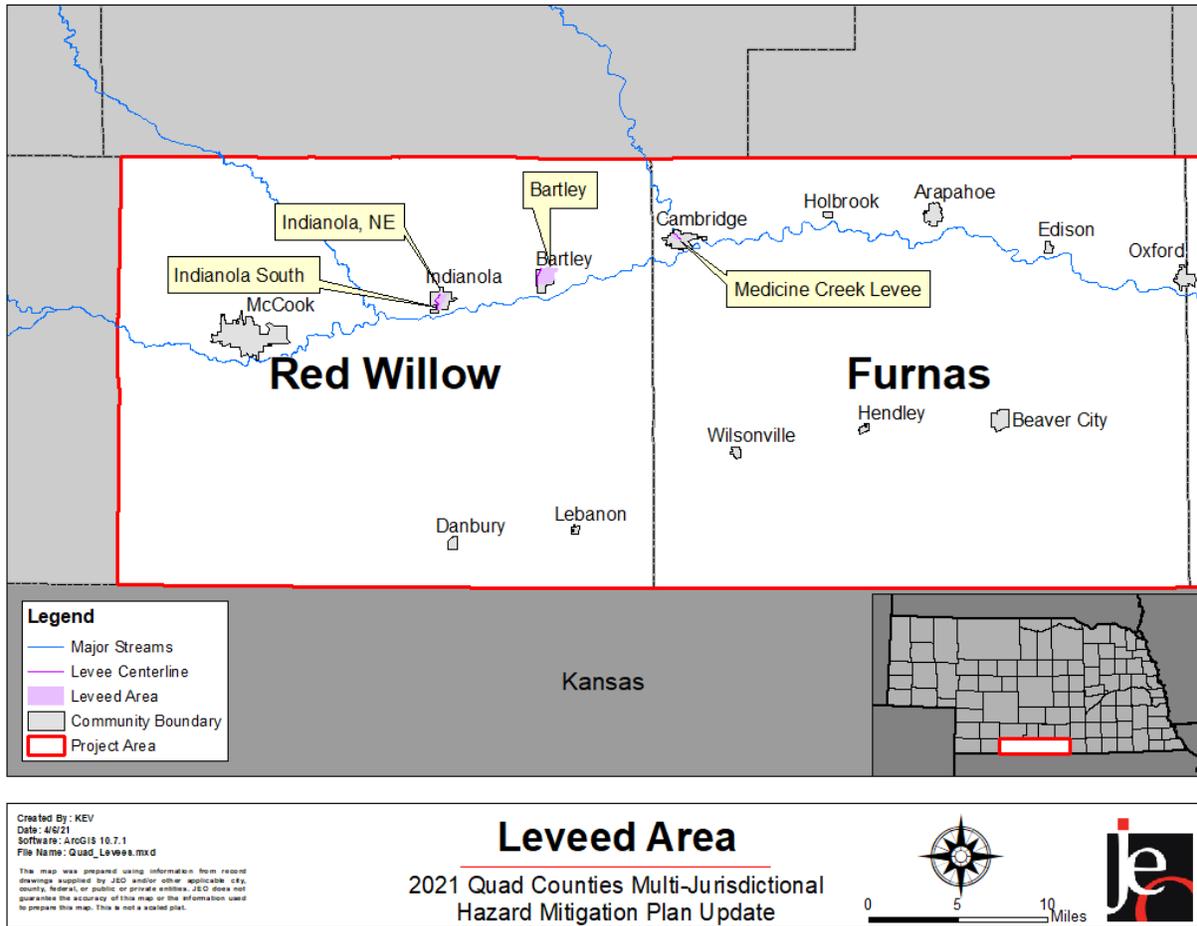


Table 80: Levees in the Planning Area

Name	Sponsor	Location	Year Constructed	Length (Miles)	Protected Area (sq. miles)	Risk Level	FEMA Accredited	USACE Status
Medicine Creek Levee	Nebraska	Cambridge	-	0.55	0.08	Not Screened	Non-Accredited	Not Enrolled
Bartley	USACE	Bartley	1951	1.82	1.01	Low	Non-Accredited	Inactive
Indianola, NE	USACE	Indianola	1949	1.17	0.26	Low	Accredited	Active
Indianola South	Nebraska	Indianola	1949	0.36	0.11	Not Screened	Non-Accredited	Not Enrolled

Source: USACE Levee Database⁹⁵

95 U.S Army Corps of Engineers. 2021. "Levee Database". <https://levees.sec.usace.army.mil/#/>.

Levees Outside the Planning Area

There were no upstream levee concerns discussed in the county local emergency operations plans.

Historical Occurrences

As there is no formal database of historical levee failures, the following sources were consulted: members of the Regional Planning Team, local newspapers and media outlets, and USACE. There have been no recorded instances of levee failure in the planning area.

Extent

The National Levee Database includes estimates on structures at risk, property value, and people at risk for each levee system, where possible. Structures at risk is the estimated number of structures in the leveed area. Most significant structures will be included but some minor sheds or miscellaneous structures may not be included. Property value is an estimated sum of the structure value, structure contents and vehicles in the leveed area. This value does not include land value, economic productivity loss or transportation infrastructure values (i.e. bridges, runways, roads). People at risk is the estimated population within the leveed area. It is not a life-loss projection as that calculation includes other factors not included in this number.

A total of 656 structures are at risk within the leveed areas, which are valued at \$255,130,000. Additionally, an estimated 1,317 people are at risk of injury or death if these levees were to fail.

Table 81: Potential Losses

Levee	Population	Number of Structures	Property Vale
Medicine Creek Levee	144	63	\$13,300,000
Bartley	433	273	\$99,100,000
Indianola, NE	409	304	\$139,000,000
Indianola South	27	16	\$3,730,000
Total	1,013	656	\$255,130,000

Source: USACE Levee Database

Average Annual Losses

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

Probability

No levee failure incidents have been reported in 120 years, so 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 82: 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

SEVERE THUNDERSTORMS

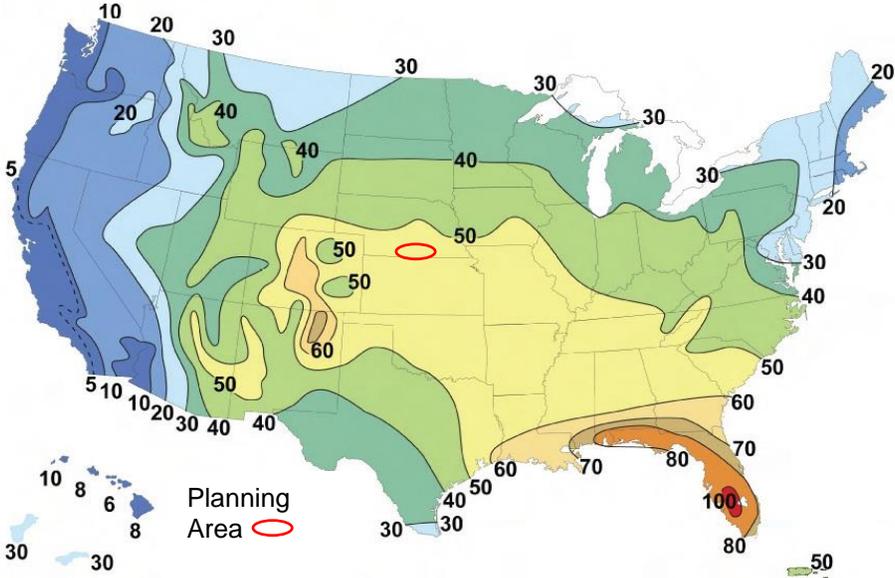
Severe thunderstorms are common and unpredictable seasonal events throughout Nebraska. A thunderstorm is defined as a storm that contains lightning and thunder, which is caused by unstable atmospheric conditions. When the cold upper air sinks and the warm, moist air rises, storm clouds or “thunderheads” 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 46 displays the average number of days with thunderstorms across the country each year. The planning area experiences an average of 50 thunderstorms over the course of one year.

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.

Figure 46: Average Number of Thunderstorms



Source: NWS, 2017⁹⁶

Location

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

Extent

The geographic extent of a severe thunderstorm event may be large enough to impact the entire planning area (such as in the case of a squall line, derecho, or long-lived supercell) or just a few square miles, in the case of a single cell that marginally meets severe criteria. The NWS defines a thunderstorm as severe if it contains hail that is one inch in diameter or capable of winds gusts of 58 mph or higher. The Tornado and Storm Research Organization (TORRO) scale is used to classify hailstones and provides some detail related to the potential impacts from hail. Table 83 outlines the TORRO Hail Scale.

Table 83: TORRO Hail Scale

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

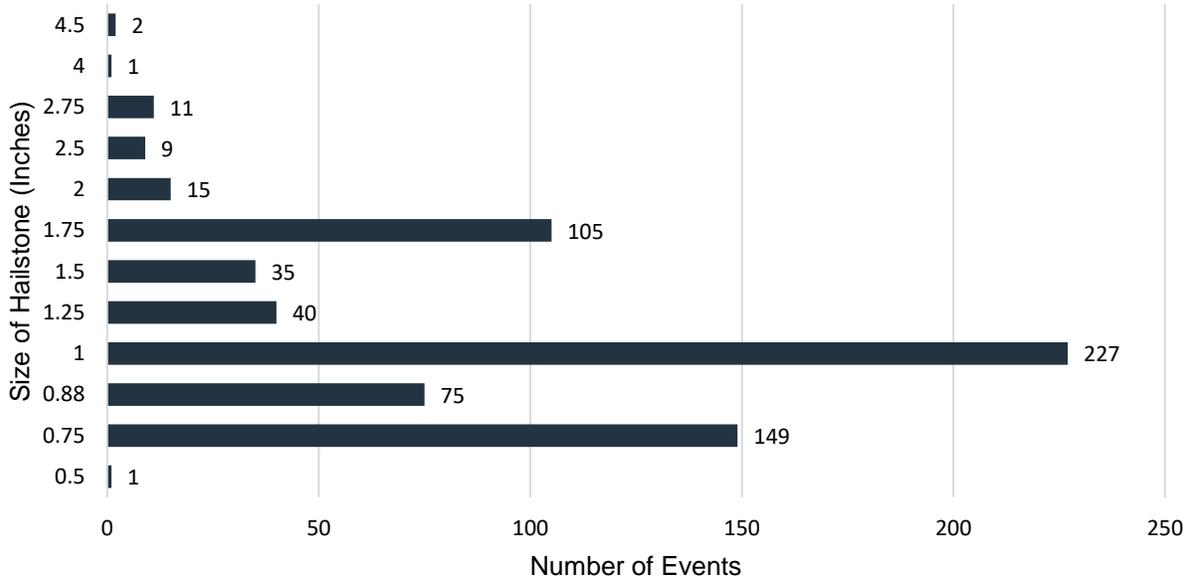
96 National Weather Service. 2017. "Introduction to Thunderstorms." https://www.weather.gov/jetstream/tstorms_intro.

Class	Type of Material	Divisions
H8: Destructive	75 – 90 mm (Large orange) 3.0 – 3.5 in.	Severe damage to structures, vehicles, airplanes; risk of serious injuries
H9: Super Hail	90 – 100 mm (Grapefruit) 3.5 – 4.0 in	Extensive structural damage; risk of severe or even fatal injuries to persons outdoors
H10: Super Hail	>100 mm (Melon) > 4.0 in	Extensive structural damage; risk or severe or even fatal injuries to persons outdoors

Source: TORRO, 2017⁹⁷

The NCEI reported 680 individual hail events across the planning area since 1996. As the NCEI reports events per county, this value overestimates the total amount of thunderstorm events. The average hailstone size was 1.17 inches. Events of this magnitude correlate to an H3 Severe classification. It is reasonable to expect H3 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 three H10 hail events (>4.0 inches) during the period of record. Figure 47 shows hail events based on the size of the hail.

Figure 47: Hail Events by Magnitude



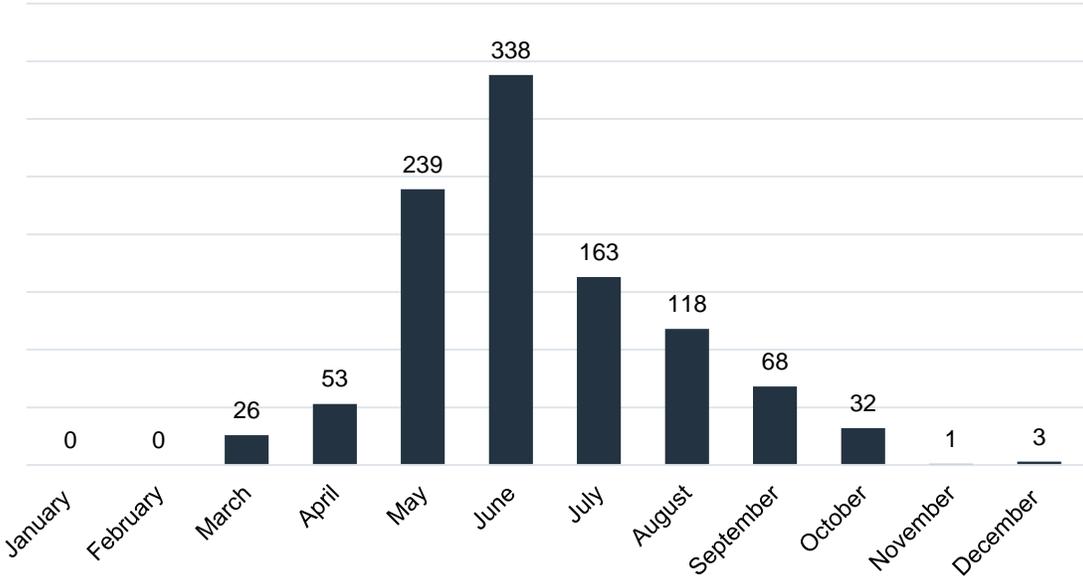
Source: NCEI, 1996-2019

Historical Occurrences

Severe thunderstorms in the planning area usually occur in the afternoon and evening during the summer months (Figure 48).

97 Tornado and Storm Research Organization. 2017. "Hail Scale." <http://www.torro.org.uk/hscale.php>.

Figure 48: 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 345 thunderstorm wind, 35 heavy rain, and 9 lightning, and 680 hail events in the planning area from March 1996 to December 2019. In total these events were responsible for \$22,275,200 in property damages. The USDA RMA data shows that severe thunderstorms caused \$65,515,815 in crop damages. six injuries were reported in association with these storms.

Average Annual Losses

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 \$891,008 per year in property damages and \$3,119,800 in crop damage.

Table 84: Severe Thunderstorms 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	680	27.2	\$9,136,000	\$365,440	\$65,515,815	\$3,119,800
Heavy Rain	35	1.4	\$15,000	\$600		
Lightning	9	0.4	\$290,000	\$11,600		
Thunderstorm Wind	345	13.8	\$12,834,200	\$513,368		
Total	1,069	42.8	\$22,275,200	\$891,008	\$65,515,815	\$3,119,800

Source: 1 Indicates data is from NCEI (1996-March 2020); 2 Indicates data is from USDA RMA (2000-June 2020)

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 (25 out of 25 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 85: Regional Thunderstorm Vulnerabilities

Sector	Vulnerability
People	<ul style="list-style-type: none"> -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	<ul style="list-style-type: none"> -Damages to buildings and property can cause significant losses to business owners
Built Environment	<ul style="list-style-type: none"> -Buildings are at risk to wind damage -Downed trees and tree limbs
Infrastructure	<ul style="list-style-type: none"> -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	<ul style="list-style-type: none"> -Power outages are possible -Critical facilities may sustain damage from lightning and wind
Climate	<ul style="list-style-type: none"> -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.⁹⁸

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 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 49 shows the SPIA index.

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

Figure 49: SPIA Index

ICE DAMAGE INDEX	*AVERAGE ICE AMOUNT (in inches) <i>Revised: Oct. 2011</i>	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 weeks in some areas. Shelters needed.
	0.75 – 1.00	> – 25	
	1.00 – 1.50	> – 15	
	> 1.50	Any	

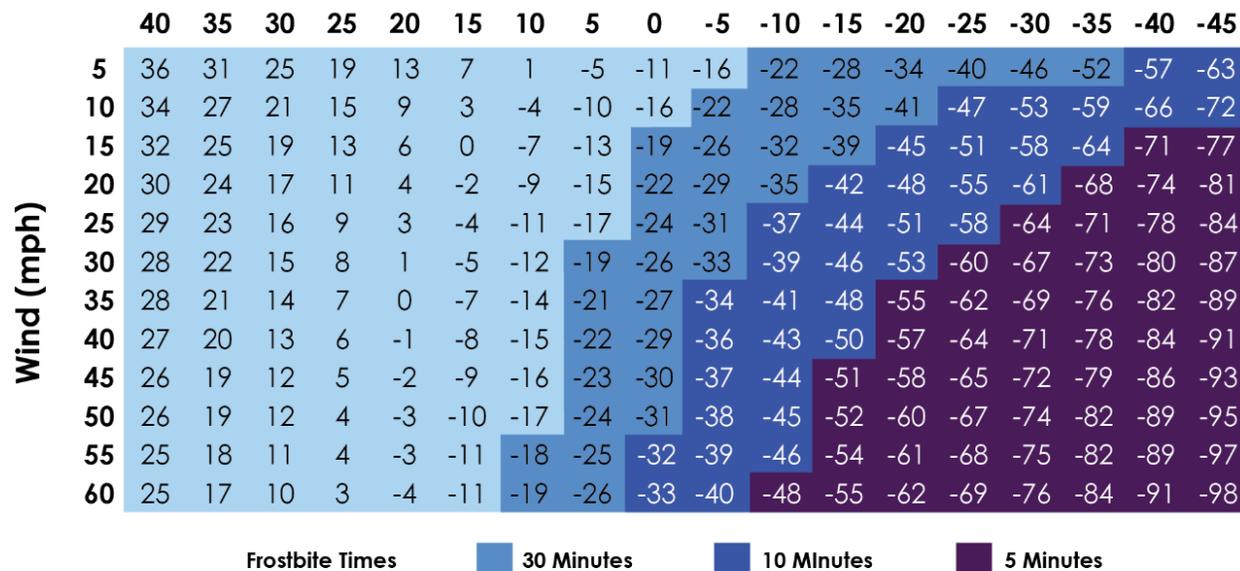
(Categories of damage are based upon combinations of precipitation totals, temperatures and wind speeds/directions.)

Source: SPIA-Index, 2017⁹⁹

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 50 shows the Wind Chill Index used by the NWS.

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

Figure 50: Wind Chill Index Chart
Temperature (°F)



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

T = Air Temperature (°F) V = Wind Speed (mph)

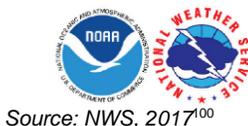
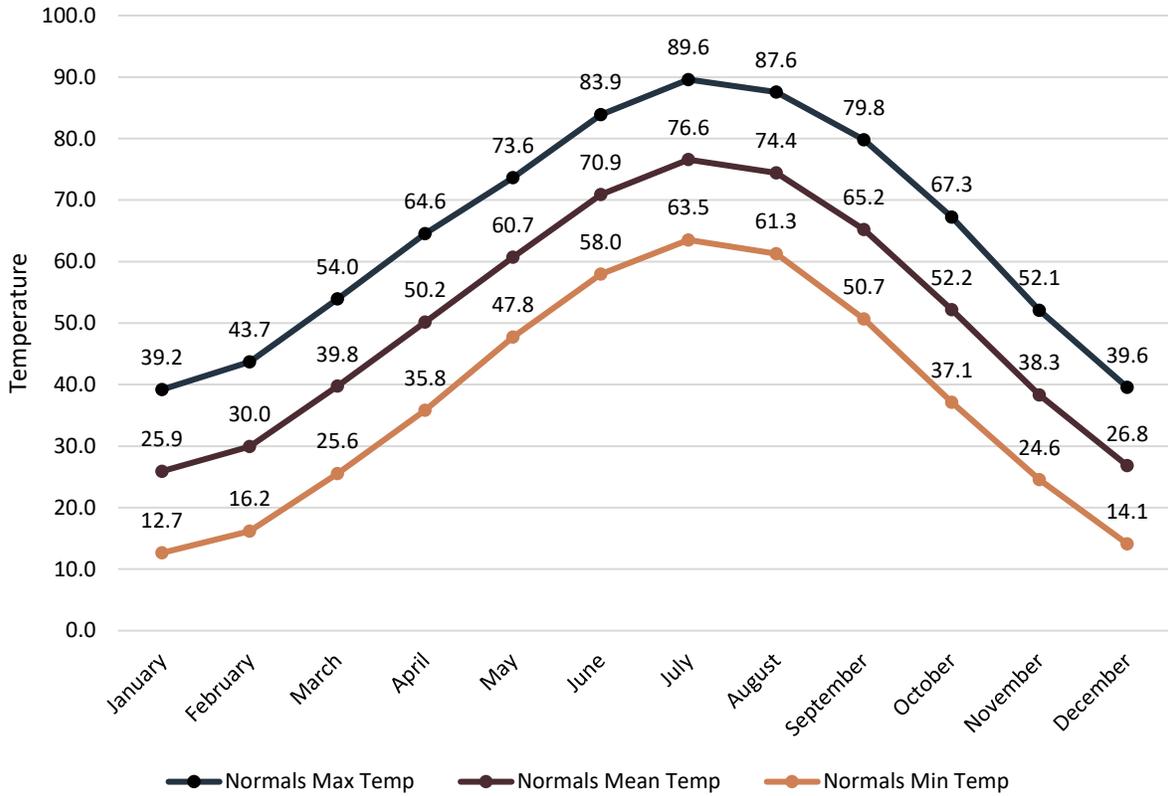


Figure 51 shows the monthly climate normals for the planning area. December, January, and February are the coldest months. The average low temperatures for these months are all below freezing (average low for the three months is 14.3°F). The average high temperatures for the months of January, February, and December are near 40.8°F.

Average monthly snowfall for the planning area is shown in Figure 52, which shows the snowiest months are between November 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.

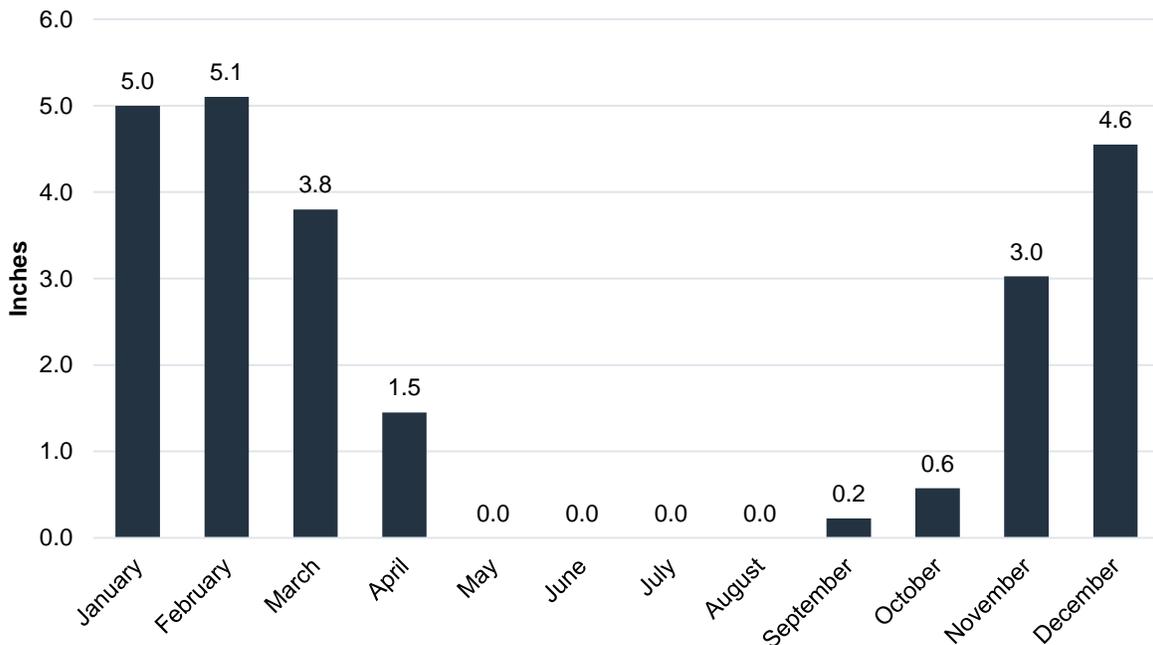
¹⁰⁰ National Weather Service. 2001. "Wind Chill Chart." http://www.nws.noaa.gov/om/cold/wind_chill.shtml.

Figure 51: Monthly Climate Normals Temperature (1981-2010)



Source: NCEI, 1981-2010

Figure 52: Monthly Normal Snowfall in Inches



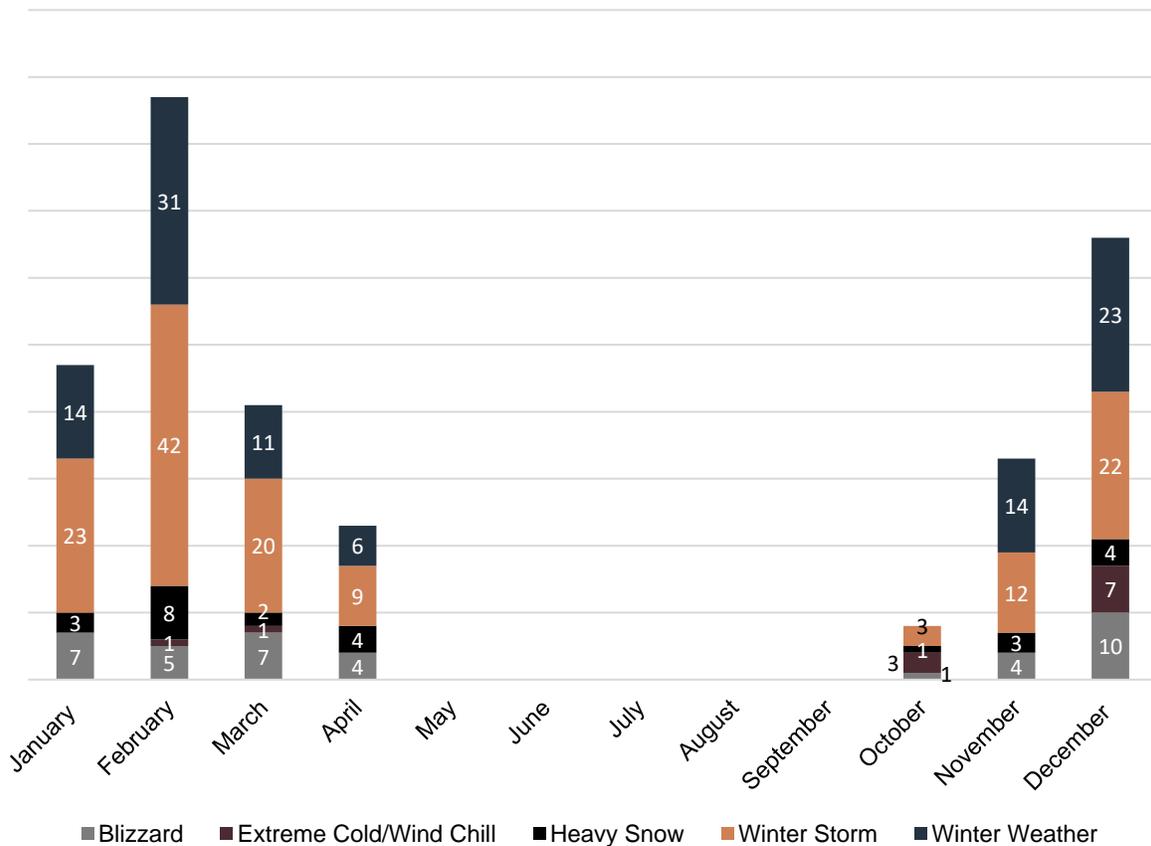
Source: High Plains Regional Climate Center, 1981-2010¹⁰¹

101 High Plains Regional Climate Center. 1981-2010. "Monthly Climate Normal". <http://climod.unl.edu/>. Accessed November 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 330 severe winter storm events for the planning area from January 1996 to July 2020. February had the most recorded events for the planning area (Figure 53). These recorded events caused a total of \$5,500,000 in reported property damages and \$19,492,754 in crop damages. One event accounted for \$3,000,000 of the total property damages. The event was an ice storm in Franklin County that occurred in December of 2006. According to the NCEI, there were no injuries or deaths associated with winter storms in the planning area.

Figure 53: Severe Winter Storm Events by Month



Average Annual Losses

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 \$220,000 per year in property damage and \$928,226 per year in crop damages for the planning area.

Table 86: Severe Winter Storm 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
Blizzard	38	1.5	\$825,000	\$33,000	\$19,492,754	\$928,226
Extreme Cold/Wind Chill	12	0.5	\$0	\$0		
Heavy Snow	27	1.1	\$0	\$0		
Ice Storm	14	0.6	\$4,110,000	\$164,400		
Winter Storm	131	5.2	\$500,000	\$20,000		
Winter Weather	108	4.3	\$65,000	\$2,600		
Total	330	13.2	\$5,500,000	\$220,000		

Source: 1 Indicates data is from NCEI (1996-July 2020); 2 Indicates data is from USDA RMA (2000-July 2020)

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 (25 out of 25 years with an occurrence) that a severe winter storm 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 87: 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 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” (28 C.F.R. Section 0.85)¹⁰². 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 attached, which are:

- Political Terrorism
- Bioterrorism
- Cyber-Terrorism
- Eco-Terrorism
- Nuclear Terrorism
- Narco-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.

¹⁰² Terrorism, 28 U.S. Code Section 0.85

Location

Terrorist activity within the planning area is possible throughout the region. 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 were two terrorist incidents in the planning area from 1970 – October 2018.¹⁰³ One incident occurred in Red Willow County on April 2013. An explosive device was discovered at the airport in McCook, Nebraska, United States. The device was safely defused without incident and no group claimed responsibility for the unsuccessful attack. The second incident occurred in Furnas County on October 22, 2017. An assailant breached a secure area of an Amtrak passenger train, travelling from California to Missouri and triggered an emergency stop in Oxford, Nebraska, United States. There were no reported casualties.

Average Annual Damages

According to the START Global Terrorism Database (1970-2018) there have been no civil disorder events that have occurred in the planning area. Although there were two terrorist incidents within the planning area, there were no damages.

Probability

Based on the historic record of reported incidents, there is a four percent probability (2 out of 49 years with an occurrence) that a terrorism event will occur annually in the planning area.

Regional Vulnerabilities

The following table provides information related to regional vulnerabilities.

Table 88: 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 business 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 all at risk of damage
Critical Facilities	-Police stations and governmental offices are at higher risk
Climate	-None

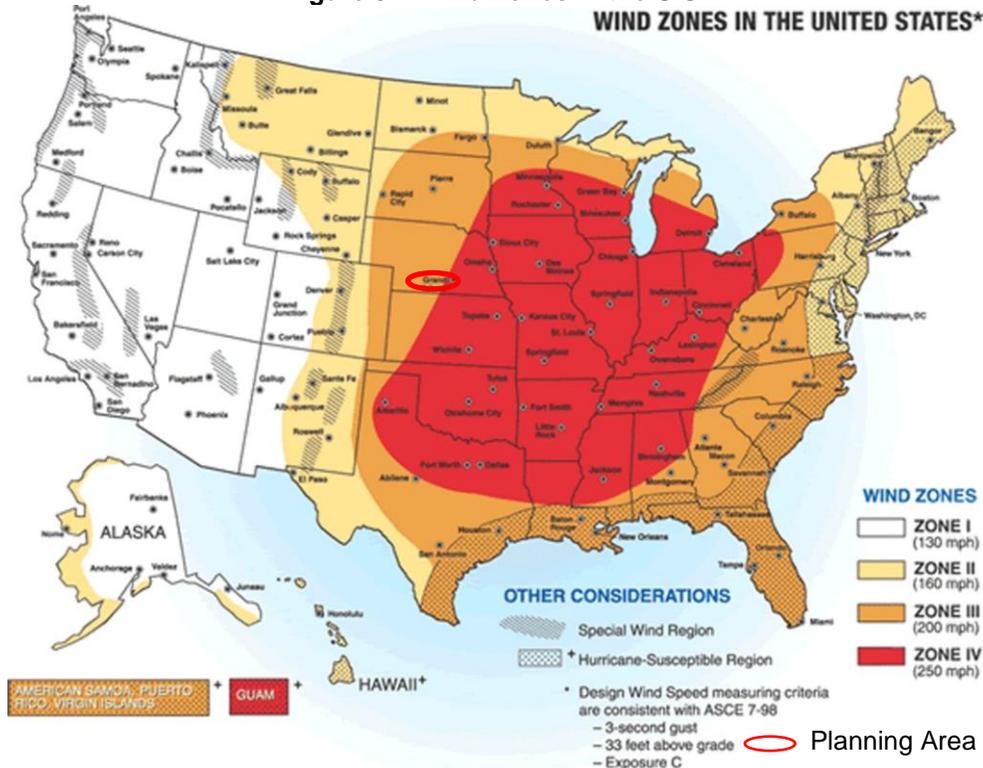
¹⁰³ National Consortium for the Study of Terrorism and Responses to Terrorism. October 2018. Global Terrorism Database [Data file]. Retrieved from <https://www.start.umd.edu/gtd>.

TORNADOES AND HIGH WINDS

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

The National Weather Service (NWS) defines high winds as sustained wind speeds of 40 mph or greater lasting for 1 hour or longer, or winds of 58 mph or greater for any duration.¹⁰⁴ 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 54 shows the wind zones in the United States. The wind zones are based on the maximum wind speeds that can occur from a tornado or hurricane event. The planning area is located in Zone III which has maximum winds of 200 mph equivalent to an EF4/5 tornado.

Figure 54: Wind Zones in the U.S.



Source: FEMA, 2016

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

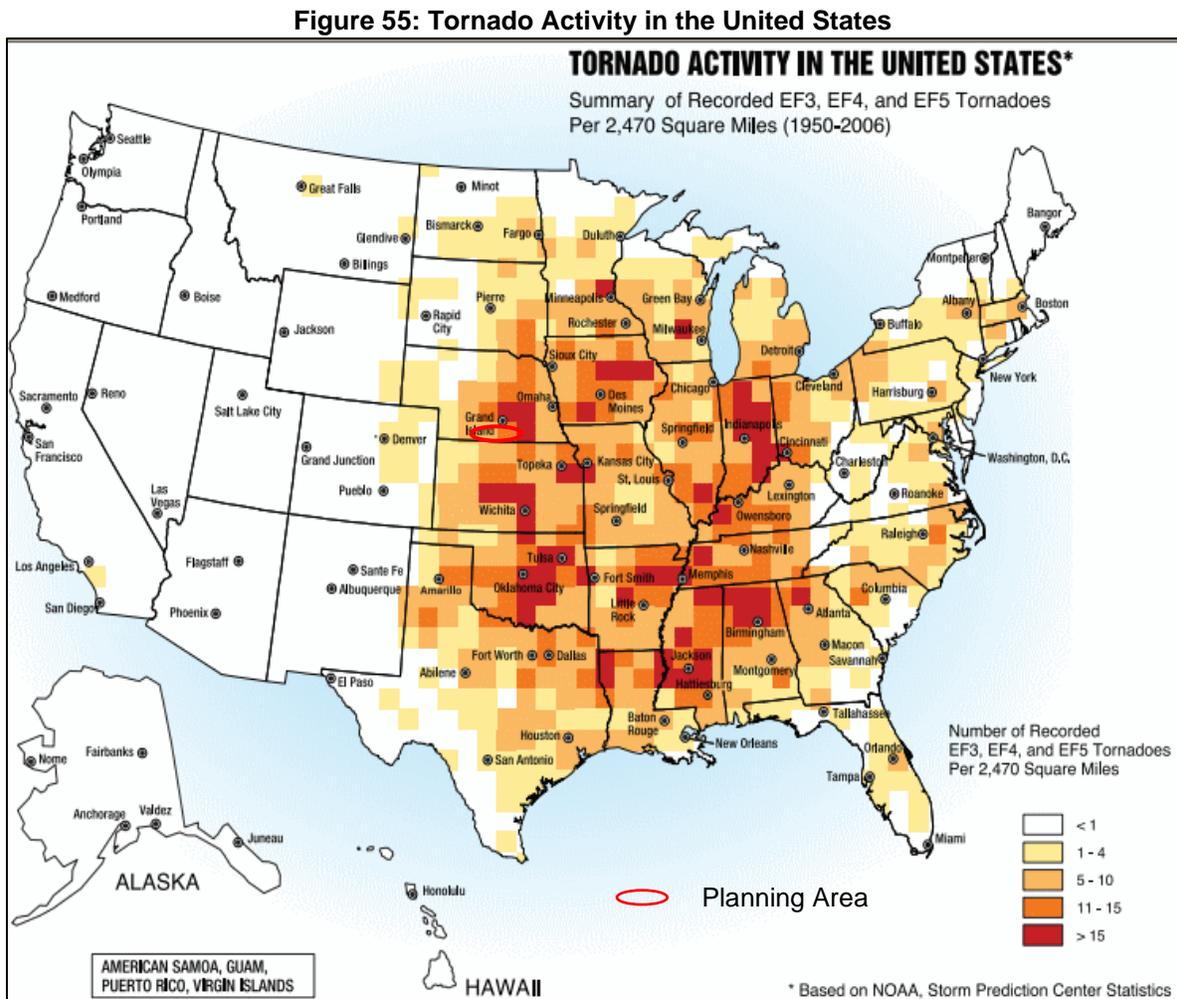
- There must be a microscale rotating area of wind, ranging in size from a few feet to a few miles wide.
- The rotating wind, or vortex, must be attached to a convective cloud base and must be in contact with the ground.

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

- 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 2010.¹⁰⁵ 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 1950-2006.



Source: FEMA, 2008¹⁰⁶

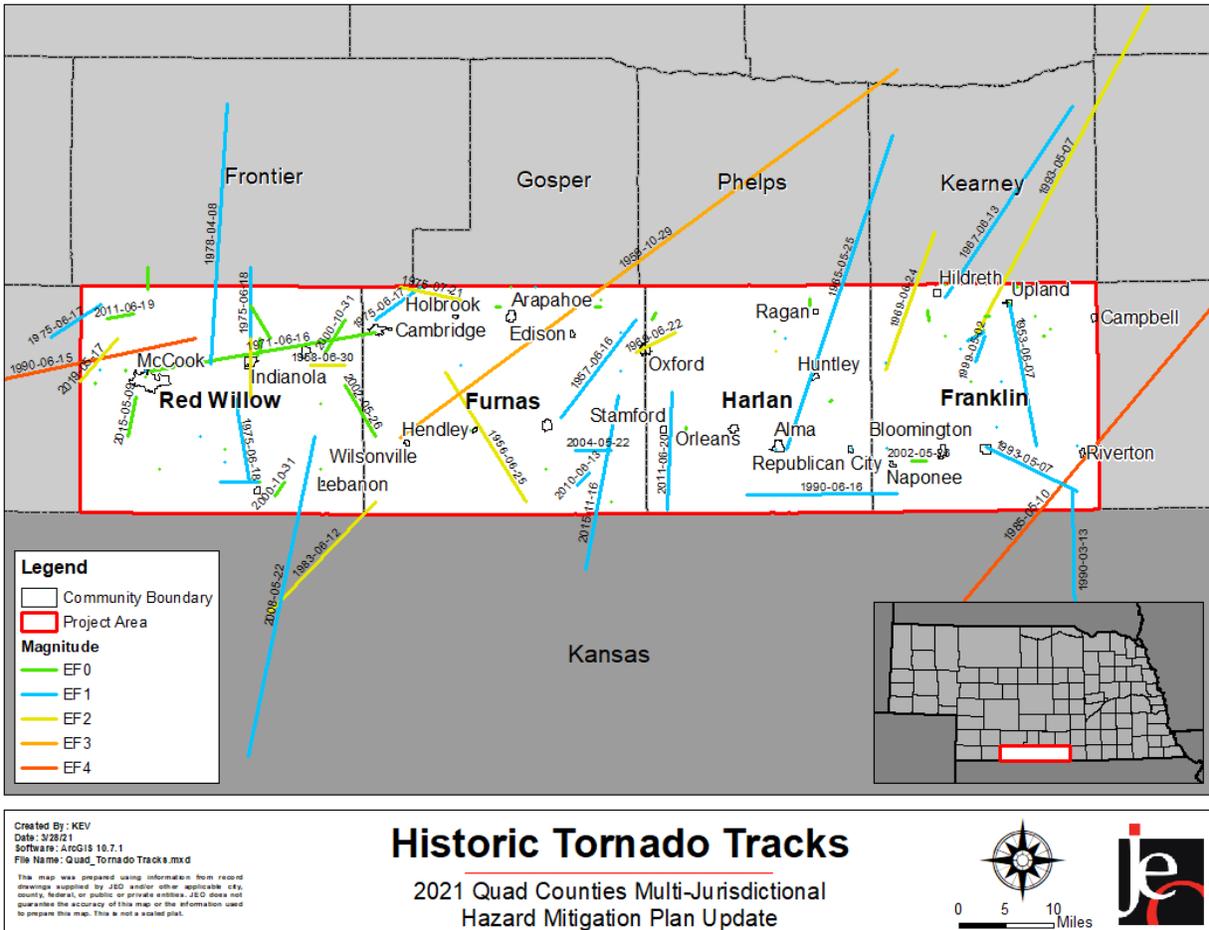
105 National Centers for Environmental Information. 2013. “U.S. Tornado Climatology.” <https://www.ncdc.noaa.gov/climate-information/extreme-events/us-tornado-climatology>.

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

Location

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

Figure 56: Historic Tornado Tracks



Extent

The Beaufort Wind Scale can be used to classify wind strength. Table 89 outlines the Beaufort scale, provides wind speed ranking, range of wind speeds per ranking, and a brief description of conditions for each ranking.

Table 89: 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

Beaufort Wind Force Ranking	Range of Wind	Conditions
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, 2017¹⁰⁷

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.¹⁰⁸

Table 90: 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.

107 Storm Prediction Center: National Oceanic and Atmospheric Administration. 1805. "Beaufort Wind Scale." <http://www.spc.noaa.gov/faq/tornado/beaufort.html>.
 108 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."

Storm Category	Three Second Gust (MPH)	Damage Level	Damage Description
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

Table 91: 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	17	Low-rise (1-4 story) bldg.
4	Double-wide mobile home	18	Mid-rise (5-20 story) bldg.
5	Apartment, condo, townhouse (3 stories or less)	19	High-rise (over 20 stories)
6	Motel	20	Institutional bldg. (hospital, govt. or university)
7	Masonry apartment or motel	21	Metal building system
8	Small retail bldg. (fast food)	22	Service station canopy
9	Small professional (doctor office, branch bank)	23	Warehouse (tilt-up walls or heavy timber)
10	Strip mall	24	Transmission line tower
11	Large shopping mall	25	Free-standing tower
12	Large, isolated ("big box") retail bldg.	26	Free standing pole (light, flag, luminary)
13	Automobile showroom	27	Tree - hardwood
14	Automotive service building	28	Tree - softwood

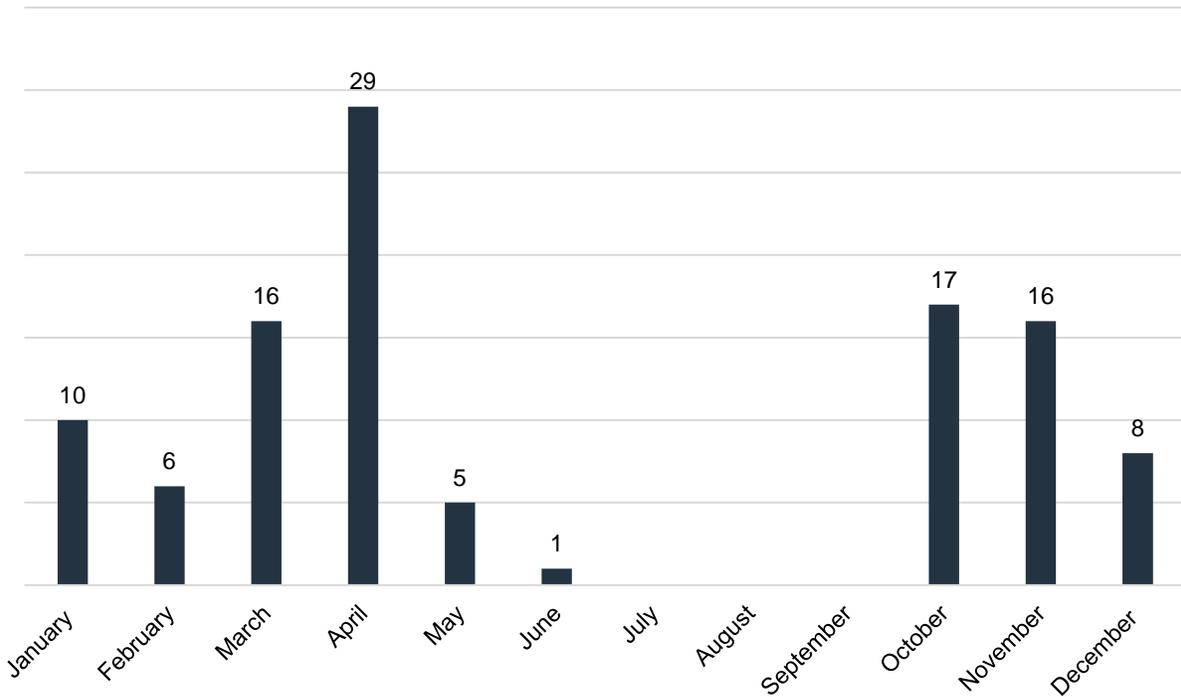
Source: NOAA; FEMA

Using the NCEI reported events, the most common high wind event is a nine on the Beaufort Wind Scale. Based on the historic record, it is most likely that tornadoes that occur within the planning area will be of EF0 strength. Of the 47 reported events, nine were EF1 and two were EF2.

Historical Occurrences

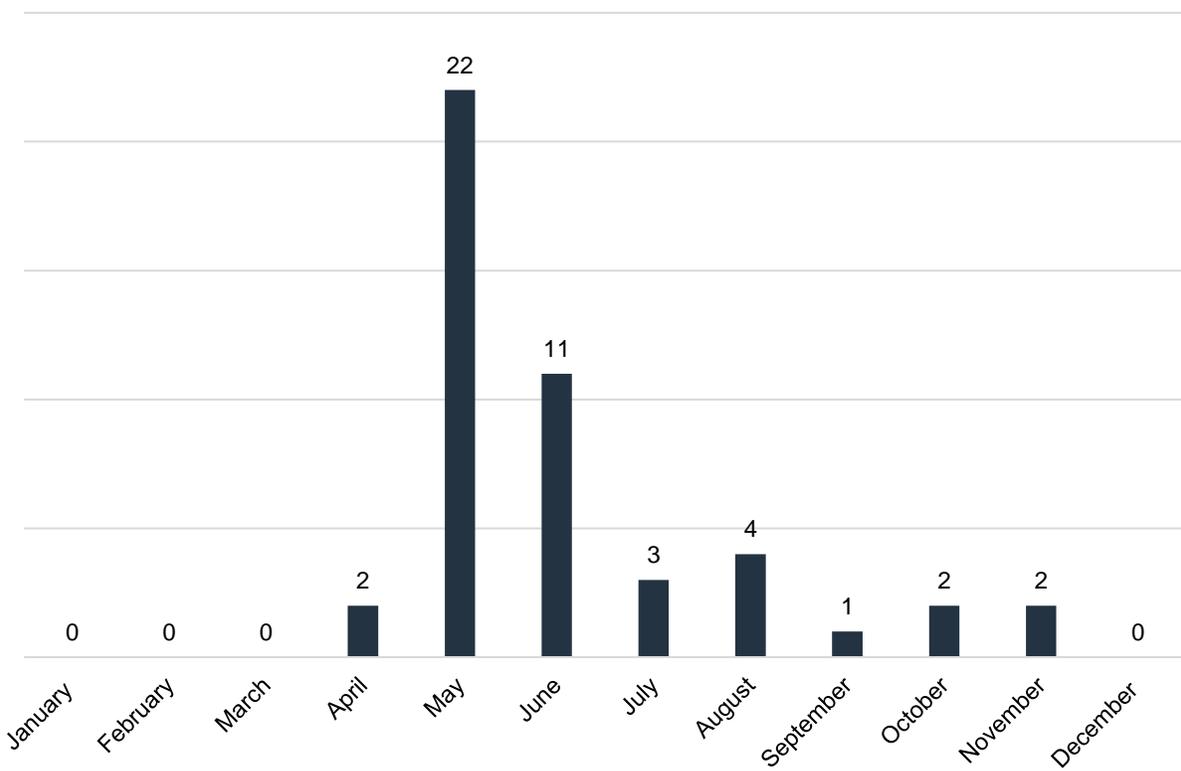
The NCEI reported a total of 47 tornado and 123 high wind events from January 1996 to March 2020. The events caused an estimated \$6,633,740 in property damage and resulted in one injury and one death. In August 1996 an EF2 tornado caused \$750,000 in damages to houses, campers, and grain bins in and around Indianola. The following figures show that April has the most high wind events and the month of May has the highest number of tornadoes in the planning area.

Figure 57: High Wind Events by Month in the Planning Area



Source: NCEI, 1996-2020

Figure 58: Tornadoes by Month in the Planning Area



Source: NCEI, 1996-2020

Average Annual Damages

The average damage per event estimate was determined based upon NCEI Storm Events Database since 1996 and number of historical occurrences. This does not include losses from displacement, functional downtime, economic loss, injury, or loss of life. It is estimated that high wind events caused an average of \$173,370 per year in property damage, and an average of \$231,697 per year in crop damage for the planning area. Tornadoes cause an average of \$91,980 per year in property damage and \$130 per year in crop damage for the planning area.

Table 92: Tornado and 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 Winds	123	4.9	\$4,334,240	\$173,370	\$4,633,946	\$231,697
Tornadoes	47	1.9	\$2,299,500	\$91,980	\$2,607	\$130
Total	170	6.8	\$6,633,740	\$265,350	\$4,636,553	\$231,827

Source: ¹ Indicates data is from NCEI (Jan 1996 to March 2020); ² Indicates data is from USDA RMA (2000 to 2020)

Probability

Based on historical records and reported events, it is likely that tornadic and high wind events will occur within the planning area almost annually. Based on the historic record of reported incidents, there is a 76 percent probability (19 out of 25 years with an occurrence) that a tornado will occur annually in the planning area and an 88 percent probability (22 out of 25 years with an occurrence) that high winds will occur annually in the planning area.

Regional Vulnerabilities

The following table provides information related to regional vulnerabilities.

Table 93: Regional High Wind and Tornado Vulnerabilities

Sector	Vulnerability
People	<ul style="list-style-type: none"> -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	<ul style="list-style-type: none"> -Agricultural losses to both crops and livestock -Damages to businesses and prolonged power outages can cause significant impacts to the local economy
Built Environment	<ul style="list-style-type: none"> -All building stock are at risk of significant damages
Infrastructure	<ul style="list-style-type: none"> -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	<ul style="list-style-type: none"> -All critical facilities are at risk to damages and power outages
Climate	<ul style="list-style-type: none"> -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 HMP's established goals and objectives. These actions should consider the most cost effective and technically feasible manner to address risk.

The plan's goals and objectives were established during the kick-off meeting with the Regional 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 Regional Planning Team voted to maintain the same list of goals from the 2016 HMP. These goals and objectives were then shared with all planning team members at the Round 1 public meetings.

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 Regarding the Vulnerabilities to Hazards

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

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

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

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

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

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 Regional 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 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 jurisdiction's risk assessment and capability assessment. Communities 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 Regional 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 jurisdictions 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 Quad Counties HMP are found in the Mitigation Actions Project Matrix below. Additional information about selected actions can be found in *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 Regional Planning Team. For example, if a mitigation action lists goal 2.2, then that action meets Goal #2 Objective 2.

Table 94: Mitigation Actions Selected by Each Jurisdiction 1 of 3

Mitigation Actions	Goal	Franklin County	Village of Bloomington	Village of Campbell	City of Franklin	Village of Hildreth	Village of Naponee	Village of Riverton	Village of Upland	Furnas County	City of Arapahoe	City of Beaver City	City of Cambridge	Village of Edison	Village of Hendley
Alert/Warning Sirens	1.1, 4.3, 5.2													X	X
Backup and Emergency Generators	1.1			X		X		X	X	X	X		X		X
Bury Power Lines	1.1, 2.1, 5.2			X											
Civil Service Improvements	1.1, 2.1, 4.3, 5.2								X						
Cooling Station Database	1.1						X								
Emergency Communications	1.1, 4.1, 4.3, 5.2								X						
Emergency Response Plan	4.1, 4.2, 5.2													X	
Hazardous Tree Removal	1.1, 2.1, 5.2			X		X									
Impact Resistant Roof Coverings	1.1, 2.1, 5.2						X								
New Fire Hall	1.1							X							
New Roof for Equipment Storage Building	2.1							X							
New Municipal Well	1.1			X		X		X							
New Water Tower	1.1		X												
Participate in the NFIP	2.2, 2.3, 5.1, 5.2						X								
Power, Service, Electrical, and Water Distribution Lines	1.1, 2.1, 5.2					X							X		
Public Awareness/Education	1.1, 3.1, 3.2, 5.2			X	X	X	X		X	X		X			
Replace Water Mains	2.1		X												

Mitigation Actions	Goal	Franklin County	Village of Bloomington	Village of Campbell	City of Franklin	Village of Hildreth	Village of Naponee	Village of Riverton	Village of Upland	Furnas County	City of Arapahoe	City of Beaver City	City of Cambridge	Village of Edison	Village of Hendley
Sewer Project	2.1					X								X	
Storm Shelters / Safe Rooms	1.1		X		X	X			X			X	X		
Stormwater and Drainage Improvements	2.1		X					X			X	X	X		
Tree City USA	2.2, 2.3, 5.1, 5.2			X		X	X		X			X			
Update Comprehensive Plan	2.2, 2.3, 5.2, 6.1									X					
Warning Systems	1.1, 5.1, 5.2					X	X								
Water Line Mapping	2.1								X						

Table 95: Mitigation Actions Selected by Each Jurisdiction 2 of 3

Mitigation Actions	Goal	Village of Holbrook	Village of Oxford	Harlan County	City of Alma	Village of Huntley	Village of Orleans	Village of Ragan	Village of Republican City	Village of Stamford	Red Willow County	Village of Bartley	Village of Danbury	City of Indianola
Alert/Warning Sirens	1.1, 4.3, 5.2		X		X		X	X						X
Assess Vulnerability to Drought Risk	2.2		X											
Backup and Emergency Generators	1.1	X	X			X	X	X				X		
Bridge/Road Repairs and Replacements	1.1, 2.1, 5.2			X										
Civil Service Improvements	1.1, 2.1, 4.3, 5.2	X	X				X	X	X					X
Debris Removal	1.1			X										

Section Five | Mitigation Strategy

Mitigation Actions	Goal	Village of Holbrook	Village of Oxford	Harlan County	City of Alma	Village of Huntley	Village of Orleans	Village of Ragan	Village of Republican City	Village of Stamford	Red Willow County	Village of Bartley	Village of Danbury	City of Indianola
Develop a Drought Management Plan	2.2		X						X					
Drainage Study / Stormwater Master Plan	2.2		X				X			X		X		X
Establish Formal Drought Response Protocols	2.2		X											
Floodplain Management	2.3, 5.2, 6.1										X			
Hazardous Tree Removal	1.1, 2.1, 5.2	X	X			X			X					
Incorporate Native Species into Municipal Landscapes	2.1		X											
Lagoon Improvements	1.1, 2.1, 5.2						X							
Monitor Drought Conditions	4.1, 5.1, 5.2, 6.1		X											
New Municipal Well	1.1						X							
Participate in the NFIP	2.2, 2.3, 5.1, 5.2	X												
Power, Service, Electrical, and Water Distribution Lines	1.1, 2.1, 5.2		X					X	X					
Public Awareness/Education	1.1, 3.1, 3.2, 5.2	X	X	X			X	X	X			X	X	X
Source Water Contingency Plan	2.2		X				X							
Stabilize/Anchor Fertilizer, Fuel, and Propane Tanks	1.1		X											
Storm Shelters / Safe Rooms	1.1	X	X	X	X		X	X	X		X	X	X	

Mitigation Actions	Goal	Village of Holbrook	Village of Oxford	Harlan County	City of Alma	Village of Huntley	Village of Orleans	Village of Ragan	Village of Republican City	Village of Stamford	Red Willow County	Village of Bartley	Village of Danbury	City of Indianola
Stormwater and Drainage Improvements	2.1	X	X	X						X	X	X	X	X
Stream Bank Stabilization / Grade Control Structure / Channel Improvement	2.1		X							X	X			X
Tree City USA	2.2, 2.3, 5.1, 5.2	X					X	X	X					
Update Comprehensive Plan	2.2, 2.3, 5.2, 6.1		X											
Updating Chlorination Equipment	1.1							X						
Warning Systems	1.1, 5.1, 5.2										X			

Table 96: Mitigation Actions Selected by Each Jurisdiction 3 of 3

Mitigation Actions	Goal	City of McCook	Alma Fire District	Alma Public Schools	Arapahoe-Holbrook Public Schools	Orleans Fire District	Republican City Rural Fire District	Southwest Public Schools	Stamford Rural Fire Department	Wilcox-Hildreth Public Schools	Lower Republican NRD	Middle Republican NRD
Access Control	1.1			X								
Alert/Warning Sirens	1.1, 4.3, 5.2	X										
Backup and Emergency Generators	1.1		X	X	X			X		X		
Backup Municipal Records	2.1	X										

Section Five | Mitigation Strategy

Mitigation Actions	Goal	City of McCook	Alma Fire District	Alma Public Schools	Arapahoe-Holbrook Public Schools	Orleans Fire District	Republican City Rural Fire District	Southwest Public Schools	Stamford Rural Fire Department	Wilcox-Hildreth Public Schools	Lower Republican NRD	Middle Republican NRD
Civil Service Improvements	1.1, 2.1, 4.3, 5.2	X	X				X		X			
Develop a Drought Management Plan	2.2											X
Drainage Study / Stormwater Master Plan	2.2	X										
Emergency Communications	1.1, 4.1, 4.3, 5.2	X										
Hazardous Tree Removal	1.1, 2.1, 5.2	X										
New Fire Hall	1.1					X						
Power, Service, Electrical, and Water Distribution Lines	1.1, 2.1, 5.2	X										
Public Awareness/Education	1.1, 3.1, 3.2, 5.2	X										
Stabilize/Anchor Fertilizer, Fuel, and Propane Tanks	1.1	X										
Storm Shelters / Safe Rooms	1.1	X	X		X							
Stormwater and Drainage Improvements	2.1	X										
Stream Bank Stabilization / Grade Control Structure / Channel Improvement	2.1	X										

Mitigation Actions	Goal	City of McCook	Alma Fire District	Alma Public Schools	Arapahoe-Holbrook Public Schools	Orleans Fire District	Republican City Rural Fire District	Southwest Public Schools	Stamford Rural Fire Department	Wilcox-Hildreth Public Schools	Lower Republican NRD	Middle Republican NRD
Telemetry on Water Meters	2.1										X	
Thompson Creek Watershed Project	2.1										X	
Turkey Creek Watershed Project	2.1										X	
Train Staff	1.1		X									
Weather Radios	4.3	X										

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SECTION SIX: PLAN IMPLEMENTATION AND MAINTENANCE

Monitoring, Evaluating, and Updating the Plan

Each participating jurisdiction in the Quad Counties 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:

- 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?

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.

Section Six | Implementation and Maintenance

- Did the plan partners participate as originally planned?
- Should other agencies be included in the revision process?

Plan update worksheets in *Appendix C* may also be used to assist jurisdictions in reviewing and updating the plan.

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 jurisdiction 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.

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. Harlan, Furnas, Franklin, and Red Willow counties, as the plan sponsors, provide 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 Hazard Mitigation Planning Team utilized a variety of plan integration tools to help communities determine how their existing planning mechanisms were related to the Quad Counties HMP. Utilizing FEMA's *Integrating the Local Natural Hazard Mitigation Plan into a Community's Comprehensive Plan*¹⁰⁹ guidance, as well as FEMA's *2015 Plan Integration*¹¹⁰ 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.

109 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>.

110 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 Quad Counties 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
- Demographics
- Transportation
- Employment and Economics
- Housing
- Future Development Trends
- Parcel Improvements and Valuations
- Community Lifelines
- Historical Occurrences
- Hazard Prioritization
- Governance
- Capability Assessment
- Plan Integration
- 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*.