Nemaha Natural Resources District

Hazard Mitigation Plan 2020

Plan developed for
Nemaha NRD by
JEO Consulting Group

HAZARD MITIGATION REGIONAL PLANNING TEAM

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LIST OF ACRONYMS

ACS – American Community Survey
BCA – Benefit Cost Analysis
BRIC – Building Resilient Infrastructure and Communities
CFR – Code of Federal Regulations
CFS – cubic feet per second
CRS – Community Rating System
DFIRM – Digital Flood Insurance Rate Map
DHS – Department of Homeland Security
DMA 2000 – Disaster Mitigation Act of 2000
EAB – Emerald Ash Borer
EAP – Emergency Action Plan
EPA – Environmental Protection Agency
EPZ – Emergency Planning Zone
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
FR – FEMA's Final Rule
GIS – Geographic Information Systems
HMA – Hazard Mitigation Assistance
HMGP – Hazard Mitigation Grant Program
HMP – Hazard Mitigation Plan
HPRCC – High Plains Regional Climate Center
JEO – JEO Consulting Group, Inc.
LEOP – Local Emergency Operations Plan
LGA – Liquid Gallon
MHSW – Mobile Home Single Wide
MPH – miles per hour
NCEI – National Centers for Environmental Information
NDA – Nebraska Department of Agriculture
NDEE – Nebraska Department of Environment and Energy
NDMC – National Drought Mitigation Center
NDOT – Nebraska Department of Transportation
NeDNR – Nebraska Department of Natural Resources
NEMA – Nebraska Emergency Management Agency
NFIP – National Flood Insurance Program
NFS – Nebraska Forest Service
NNRD – Nemaha Natural Resources District
NOAA – National Oceanic and Atmospheric Administration
NPDP – National Performance of Dam Program
NPS – National Park Service
NRC – National Response Center
NRD – Natural Resources District
NSFHA – No Special Flood Hazard Area
NWS – National Weather Service
PDM – Pre-Disaster Mitigation Program
PDSI – Palmer Drought Severity Index
PHMSA – U.S. Pipeline and Hazardous Material Safety Administration
PSHA – Probabilistic Seismic Hazard Analysis
Risk MAP – Risk Mapping, Assessment, and Planning
RMA – Risk Management Agency
SBA – Small Business Administration
SFHA – Special Flood Hazard Area
SHMO – State Hazard Mitigation Officer
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
WUI – Wildland Urban Interface

EXECUTIVE SUMMARY

INTRODUCTION

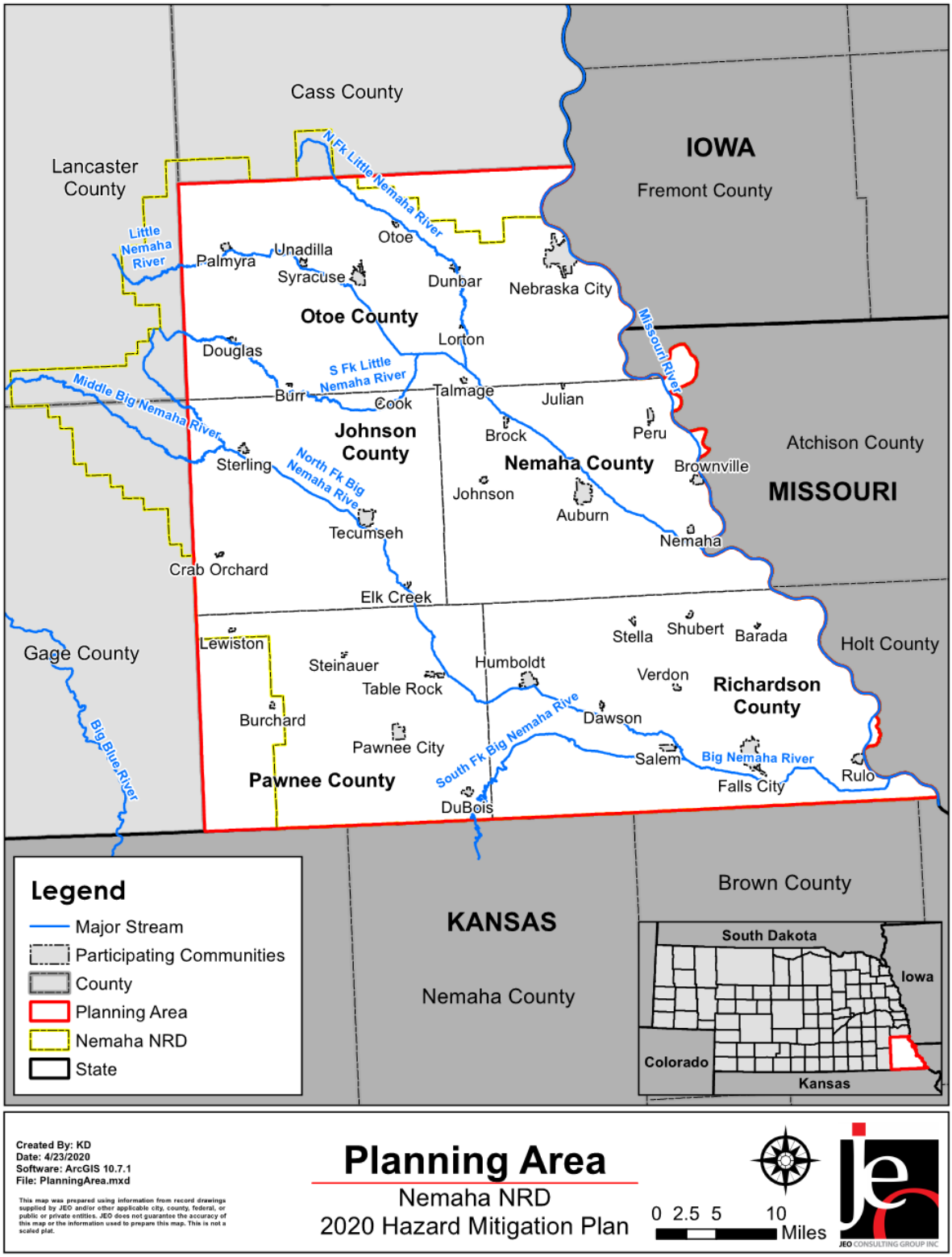
This plan is an update to the Nemaha Natural Resources District (NNRD) Hazard Mitigation Plan (HMP) approved in July 2015. The plan update was developed in compliance with the requirements of the Disaster Mitigation Act of 2000 (DMA 2000).

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

Table 1: Participating Jurisdictions

PARTICIPATING JURISDICTIONS	
Nemaha Natural Resources District	
Southeast District Health Department	
Johnson County	City of Syracuse
Village of Cook	Village of Talmage
Village of Elk Creek	Village of Unadilla
Village of Sterling	Nebraska City Public Schools
City of Tecumseh	Palmyra School District OR-1
Cook Fire District	Palmyra Rural Fire District
Elk Creek Volunteer Fire Department	Syracuse Volunteer Fire Department
Johnson County Central Public Schools	Talmage Rural Fire Department
Sterling Rural Fire District	Unadilla Volunteer Fire & Rescue
Nemaha County	**Pawnee County**
City of Auburn	Village of Burchard
Village of Brock	Village of DuBois
Village of Brownville	City of Pawnee City
Village of Johnson	Village of Steinauer
Village of Julian	Village of Table Rock
Village of Nemaha	Humboldt-Table Rock-Steinauer School District
City of Peru	Table Rock Fire District
Auburn Fire Department	**Richardson County**
Peru Rural Fire District-21	Village of Dawson
Otoe County	City of Falls City
Village of Burr	City of Humboldt
Village of Douglas	Village of Rulo
Village of Dunbar	Village of Salem
Village of Lorton	Village of Shubert
City of Nebraska City	Village of Stella
Village of Otoe	Village of Verdon
Village of Palmyra	Dawson Rural Fire Department

Figure 1: Map of Planning Area



GOALS AND OBJECTIVES

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

Goals from the 2015 HMP were reviewed, and the Planning Team agreed that they are still relevant and applicable for this plan update with minor modifications. Objective 3.2 was a new addition for this process and included in response to post-flood cleanup following the March 2019 flooding. 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.

Objective 2.2: Develop hazard-specific plans, conduct studies or assessments, and retrofit buildings and facilities to mitigate 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.

Objective 2.4: Reduce or eliminate economic impacts from hazards.

GOAL 3: INCREASE PUBLIC AWARENESS AND EDUCATION ON THE VULNERABILITY TO HAZARDS

Objective 3.1: Develop and provide information to the public and property owners about their risk and vulnerability to hazards.

Objective 3.2: Develop plans and educational tools on post-disaster cleanup of unusual sources of debris (e.g. cornstalks, orphan containers, etc.).

GOAL 4: IMPROVE EMERGENCY MANAGEMENT CAPABILITIES

Objective 4.1: Develop or improve City and/or County Emergency Response Plan(s) and procedures and increase the capability to respond.

Objective 4.2: Develop or improve Evacuation Plans and procedures.

Objective 4.3: Improve warning systems and ability to communicate to the public 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 local planning endeavors (e.g., comprehensive plans, zoning ordinance, subdivision regulation, etc.).

SUMMARY OF CHANGES

The hazard mitigation planning process undergoes several changes during each plan update to best accommodate the planning area and specific conditions. Changes from the 2015 Hazard Mitigation Plan and planning process in this update included: greater efforts to reach out to and include new participating jurisdictions, special districts, and stakeholder groups, such as fire districts, school districts, and the public health district; a more specific hazard risk assessment applicable to the planning area; and the inclusion of additional mitigation strategies. This update also works to unify the various planning mechanisms in place throughout the participating communities (i.e. comprehensive plans, local emergency operation plans, zoning ordinances, building codes, etc.) to ensure that the goals and objectives identified in those planning mechanisms are consistent with the strategies and projects included in this plan. Other changes as described in the 2015 Nemaha NRD Hazard Mitigation Plan review tool are described in the table below.

Table 2: Summary of Changes Based on 2015 Comments

COMMENT/REVISION FROM 2015 REVIEW TOOL	LOCATION OF REVISION	SUMMARY OF CHANGE
The Auburn Board of Public Works would not be a separate participant from the City of Auburn	Section Seven: City of Auburn Community Profile	The Auburn Board of Public Works participated with the City of Auburn and provided information and mitigation alternatives for inclusion in the Community Profile.
Why was the 2010 NNRD HMP posted?	N/A	The 2010 NNRD HMP was not posted on the project website. However, the 2015 HMP was available to jurisdictions on the website for ease of access during the plan update process. A draft of the 2020 HMP was also available online during the public review period.
HAZUS was used to generate the floodplain for Richardson County. It is also a tool that can provide loss information for flooding and earthquakes in all counties.	N/A	HAZUS was not utilized during this planning process. Since the completion of the 2015 HMP, Richardson County's Digital Flood Insurance Rate Map (DFIRM) was completed.

It should also be noted that due to the outbreak of the coronavirus disease 2019 (COVID-19), some adjustments were made in the midst of the planning process to plan meeting dates and requirements. To best protect residents and staff members in the planning area, Round 2 meetings were held via an online or phone one-on-one format rather than in-person public workshop meetings. Additional changes are described in Section Two.

PLAN IMPLEMENTATION

Various communities across the planning area have implemented hazard mitigation projects following the 2015 Hazard Mitigation Plan. A few examples of completed projects include alert and warning sirens, civil service improvements (e.g. purchase of pumper truck), filling an old well, flood-prone property acquisition, equipment upgrades, floodplain regulations and mapping, and others. In order to build upon these prior successes and to continue implementing mitigation projects, despite limited resources, communities will need to continue relying upon multi-agency coordination as a means of leveraging resources. Communities across the region have been able to work with a range of entities to complete projects; potential partners for future project implementation include, but are not limited to: Nebraska Forest Service (NFS), Nebraska Department of Transportation (NDOT), 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 tables provide an overview of each hazard's risk assessment and associated losses.

Table 3: Regional Risk Assessment

HAZARD	PREVIOUS OCCURRENCE EVENTS/YEARS	APPROXIMATE ANNUAL PROBABILITY	LIKELY EXTENT
Agricultural Animal Disease	69/6	100%	~36 animals per event
Agricultural Plant Disease	76/20	100%	Unavailable
Chemical & Radiological Fixed Site Spills	33/30	Chemical: 100% Radiological: <1%	0 – 25,000 Gallons 0 – 9,000 lbs
Chemical & Radiological Transportation Spills	24/49	Chemical: 49% Radiological: <1%	0 – 145 Gallons 0 – 115 lbs
Dam Failure	2/130	2%	Varies by Structure
Drought & Extreme Heat	493/1,500 months of drought Avg 6 days per year >100°F	33% 100%	D1-D2 >100°F
Earthquakes	3/120	3%	<5.0 Magnitude
Flooding	210/24	100%	Some inundation of structures (<1% of structures) and roads near streams. Some evacuations of people may be necessary (<1% of population)
High Winds & Tornadoes	107/24	100%	Avg: EF0 Range EF0-EF2 Avg 48mph; Range 35-62 EG
Levee Failure	7/120	6%	Varies by extent
Severe Thunderstorms	815/24	100%	≥1" rainfall Avg 54 mph winds; Hail range 0.75-2.75" (H2-H4); average 1.1"
Severe Winter Storms	281/24	100%	0.25 – 0.5" Ice 20°-40° below zero (wind chill) 1-5" snow 25-35 mph winds
Terrorism & Civil Disorder	0/49	<1%	Varies by event
Wildfire	1,225/19	100%	<35 acres Some homes and structures threatened or at risk

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

Table 4: Loss Estimation for the Planning Area

HAZARD TYPE		COUNT	PROPERTY	CROP[2]
Agricultural Disease	Animal Disease[1]	69	2,469 animals	N/A
	Plant Disease[2]	76	N/A	$623,210
Chemical & Radiological Fixed Site Spills[3] *2 injuries*		33	$0	N/A
Chemical & Radiological Transportation Spills[4] *1 fatality, 3 injuries*		24	$159,399	N/A
Dam Failure[5]		2	N/A	N/A
Drought[6] **and Extreme Heat**[7,8]		493/1,500 months of drought Avg 6 days per year >100°F	N/A	$171,110,842
Earthquakes[13]		3	$0	N/A
Flooding[8] *1 injury*	Flash Flood	60	$1,880,000	$19,094,862
	Flood	150	$4,196,000	
High Winds & Tornadoes[8] *1 fatality, 1 injury*	High Winds	65	$100,000	$2,088,445
	Tornadoes	42	$20,709,000	
Levee Failure[10,11]		7	N/A	N/A
Severe Thunderstorms[8]	Hail	517	$30,000	$64,430,823
	Heavy Rain	24	$0	
	Lightning	8	$368,000	
	Thunderstorm Wind	264	$634,000	
Severe Winter Storms[8] *1 fatality*	Blizzard	26	$0	$1,973,350
	Extreme Cold/Wind Chill	20	$0	
	Heavy Snow	30	$5,000,000	
	Ice Storm	17	$2,600,000	
	Winter Storm	162	$0	
	Winter Weather	26	$0	
Terrorism & Civil Disorder[12]		0	$0	N/A
Wildfire[9] *1fatality, 2 injuries*		1,225	23,841 acres	$30,054
Total		**2,854**	**$35,676,399**	**$259,351,586**

N/A: Data not available
1 NDA (2014-2019)
2 USDA RMA (2000-2019)
3 NRC (1990-2019)
4 PHMSA (1971-2019)
5 Stanford NPDP (1890-2019)
6 NOAA (1895-2019)
7 HPRCC (1897-2019)
8 NCEI (1996-2019)
9 NFS (2010-2018)
10 USAC NLD (1900-2019)
11 USACE (2019)
12 University of Maryland (1970-2018)
13 USGS (1900-2019)

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

DROUGHT AND EXTREME HEAT

Drought is a regular and reoccurring phenomenon in the planning area and the state of Nebraska. Historical data show that droughts have occurred with regularity across the planning area and recent research indicates that trend will continue and intensify. Drought most commonly affects the agricultural sector. Over $171 million in total crop loss was reported for the planning area since 2000 due to drought and excessive heat.

Prolonged drought events can profoundly affect the planning area and the 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, limited water supplies (drinking water, irrigation, and fire suppression), and decrease in recreational opportunities.

FLOODING

Flooding is one of the most significant hazards for the planning area. Significant flood events (since 1996) have occurred in 1996, 2005, 2007, 2008, 2010, 2011, 2015, and 2019, causing millions of dollars in property and crop damages. Both flash flooding and riverine flooding are expected to be continual hazards for the planning area due to the proximity of the Missouri River, Little Nemaha River, and Big Nemaha River.

One compounding factor is the stress on levee systems during high water events, particularly along the Missouri River. Floods along the Missouri River tend to be prolonged in nature as they were in 2011 and 2019, potentially stressing these levees or eroding the embankments. Levees that breach or overtop will allow floodwaters into communities or agricultural areas damaging infrastructure, buildings, and crops. Flooding events can and have damaged municipal infrastructure, businesses, and residential homes; force residents to evacuate; damage agricultural fields; and close and/or damage roadways and major transportation corridors.

HIGH WINDS AND TORNADOES

Tornado events can occur anywhere in the planning area. Forty-two tornado events have been recorded in the planning area in 24 years and caused significant damages to infrastructure, residential homes, vehicles, power and service lines, and transportation corridors. Tornadoes may disproportionally impact vulnerable populations including mobile home residents, homeowners without storm shelters or basements, residents with decreased mobility, or facilities without shelters that house large numbers of people (i.e. schools, nursing homes, hospitals, etc.).

SEVERE THUNDERSTORMS

Thunderstorms differ from many other hazards in that they are generally large in magnitude, have a long duration, and travel across large areas and through multiple jurisdictions within a single region. Additionally, thunderstorms often occur in a series, with one area potentially impacted multiple times in one day. Severe thunderstorms are most likely to occur between the months of May and September with the highest number of events occurring in June. The National Centers for Environmental Information (NCEI) recorded 264 severe thunderstorm events in 24 years. These events caused over $664,000 in property damages. Typical impacts resulting from severe thunderstorms include but are not limited to: loss of power; obstruction of transportation routes; grass/wildfires starting from lightning strikes; localized flooding; and damages discussed in the hazard profiles for hail and high winds. Vulnerable populations related to severe thunderstorms include: residents of mobile homes (approximately three percent of housing units); citizens with decreased mobility; and those caught outside during storm events. Most residents within the planning area are familiar with severe thunderstorms and know how to appropriately prepare and respond to events.

Severe Winter Storms

Severe winter storms occur 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 261 severe winter storm events that caused over $7 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 a socially and economically responsible action to prevent long term risks from natural and human-caused hazard events.

FEMA definition of Hazard Mitigation

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

Natural hazards, such as severe winter storms, tornadoes and high winds, severe thunderstorms, flooding, extreme heat, drought, agriculture diseases (plant and animal), earthquakes, and 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 fixed site hazards, chemical transportation incidents, terrorism, and/or civil disorder. These hazard events can occur as a part of normal operation or as a result of human error. All jurisdictions participating in this planning process are vulnerable to a wide range of natural and human-caused hazards that threaten the safety of residents, have the potential to damage or destroy both public and private property, cause environmental degradation, or disrupt the local economy and overall quality of life.

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

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

DISASTER MITIGATION ACT OF 2000

The U.S. Congress passed the Disaster Mitigation Act of 2000 to amend the Robert T. Stafford Disaster Relief and Emergency Assistance Act.[1] Section 322 of the DMA 2000 requires that state and local governments develop, adopt, and routinely update a hazard mitigation plan to remain eligible for pre- and post-disaster mitigation funding.[2] These funds include the Hazard Mitigation Grant Program (HMGP)[3], Building Resilient Infrastructure and Communities (BRIC)[4], and the Flood Mitigation Assistance Program

[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/pdf/about/stafford_act.pdf.

[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 (BRIC)." Last modified June 9, 2020. https://www.fema.gov/bric.

(FMA)[5]. The Federal Emergency Management Agency (FEMA) administers these programs under the Department of Homeland Security (DHS).[6]

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

HAZARD MITIGATION ASSISTANCE

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

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

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

- FEMA Mitigation Directorate

- **HMGP:** To qualify for post-disaster mitigation funds, local jurisdictions must have adopted a mitigation plan that is approved by FEMA. HMGP provides funds to states, territories, Indian tribal governments, local governments, and eligible private non-profits following a presidential disaster declaration. The DMA 2000 authorizes up to seven percent of HMGP funds available to a state after a disaster to be used for the development of state, tribal, and local mitigation plans.
- **FMA:** To qualify to receive grant funds to implement projects such as acquisition or elevation of flood-prone homes, local jurisdictions must prepare a mitigation plan. Furthermore, local jurisdictions must be participating communities in the National Flood Insurance Program (NFIP). The goal of FMA is to reduce or eliminate claims under the NFIP.
- **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.

PLAN FINANCING AND PREPARATION

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

[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.

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

Requirement §201.6(b): Planning process. An open public involvement process is essential to the development of an effective plan. In order to develop a more comprehensive approach to reducing the effects of natural disasters, the planning process shall include:

(1) An opportunity for the public to comment on the plan during the drafting stage and prior to plan approval;

(2) An opportunity for neighboring communities, local and regional agencies involved in hazard mitigation activities, and agencies that have the authority to regulate development, as well as businesses, academia and other private and non-profit interests to be involved in the planning process; and

(3) Review and incorporation, if appropriate, of existing plans, studies, reports, and technical information.

Requirement §201.6(c)(1): The plan shall document the planning process used to develop the plan, including how it was prepared, who was involved in the process, and how the public was involved.

MULTI-JURISDICTIONAL APPROACH

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

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

Both FEMA and NEMA recommend this multi-jurisdictional approach through the cooperation of counties, regional emergency management, and natural resources districts. The NNRD utilized the multi-jurisdiction planning process recommended by FEMA (Local Mitigation Plan Review Guide[10], Local Mitigation Planning Handbook[11], and Mitigation Ideas: A Resource for Reducing Risk to Natural Hazards[12]) to develop this plan.

[10] Federal Emergency Management Agency. 2011. "Local Mitigation Plan Review Guide." https://www.fema.gov/media-library-data/20130726-1809-25045-7498/plan_review_guide_final_9_30_11.pdf.

[11] Federal Emergency Management Agency. 2013. "Local Mitigation Planning Handbook." https://www.fema.gov/media-library-data/20130726-1910-25045-9160/fema_local_mitigation_handbook.pdf.

[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.

HAZARD MITIGATION PLANNING PROCESS

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

Organization of Resources

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

Assessment of Risk

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

Mitigation Plan Development

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

Plan Implementation and Progress Monitoring

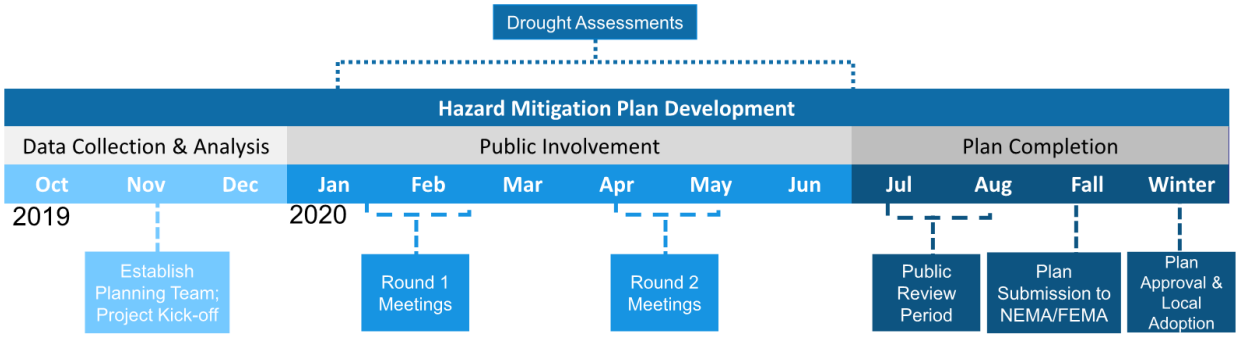
- Bring the plan to life by implementing specific mitigation projects and changing day-to-day operations. It is critical that the plan remains relevant to succeed. Thus, it is important to conduct periodic evaluations and revisions, as needed.

ORGANIZATION OF RESOURCES

PLAN UPDATE PROCESS

The Nemaha NRD secured funding for their multi-jurisdictional hazard mitigation plan (HMP) in October 2019 following a grant application process through the Pre-Disaster Mitigation grant program. JEO Consulting Group, INC. (JEO) was contracted in October 2018 to assist with the grant development; guide and facilitate the planning process; and assemble the multi-jurisdictional hazard mitigation plan. For the planning area, Bob Hilske (General Manager with Nemaha NRD) led plan development and served as the primary point-of-contact throughout the project. A clear timeline of this plan update process is provided in Figure 2.

Figure 2: Project Timeline



Regional Planning Team

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

Table 5: Hazard Mitigation Regional Planning Team

NAME	TITLE	JURISDICTION
Amanda Burki	Emergency Manager	Johnson and Pawnee Counties
Bob Hilske	General Manager	Nemaha NRD
Brian Kirkendall	Emergency Manager and Floodplain Administrator	Richardson County
Gregg Goebel	Emergency Manager	Otoe Count
J. Renee Crister	Emergency Management Director	Nemaha County
Jeff Rowell	Emergency Management Deputy Director	Nemaha County
Jill Rogman	Administrative Assistant	Nemaha NRD
Johnathan Bailey	Assessor and Floodplain Administrator	Pawnee County
*McKenzie Slack	Recovery Specialist	Nebraska Emergency Management Agency
*Jessica Scharf	Recovery Specialist	Nebraska Emergency Management Agency
*Katie Ringland	Chief Floodplain Management Section	Nebraska Department of Natural Resources
*Adele Phillips	Floodplain Mitigation Planner	Nebraska Department of Natural Resources
*Becky Appleford	Project Manager	JEO Consulting Group
*Karl Dietrich	Planner	JEO Consulting Group
*Mary Baker	Resiliency Strategist	JEO Consulting Group

**Served as a consultant or advisory role*

A kick-off meeting was held on November 18, 2019, to discuss an overview of the planning process between JEO staff and the Regional Planning Team. Preliminary discussion was held over hazards to be included in this plan, changes to be incorporated since the last plan, goals and objectives, identification of key stakeholders to include in the planning process, and a general schedule for the plan update. This meeting also assisted in clarifying the role and responsibilities of the Regional Planning Team and strategies for public engagement throughout the planning process. Table 6 shows kick-off meeting attendees.

Table 6: Kick-off Meeting Attendees

NAME	TITLE	JURISDICTION
Amanda Burki	Emergency Manager	Johnson and Pawnee Counties
Bob Hilske	General Manager	Nemaha NRD
Gregg Goebel	Emergency Manager	Otoe County
J. Renee Crister	Emergency Management Director	Nemaha County
Jeff Rowell	Emergency Management Deputy Director	Nemaha County
Jill Rogman	Administrative Assistant	Nemaha NRD
*Haley Stoker	Hazard Mitigation Specialist	NEMA

NAME	TITLE	JURISDICTION
*McKenzie Slack	Hazard Mitigation Specialist	NEMA
*Becky Appleford	Project Manager	JEO Consulting Group
*Karl Dietrich	Planner	JEO Consulting Group
*Mary Baker	Resiliency Strategist	JEO Consulting Group

**Served as a consultant or advisory role*

Table 7 shows the location, time, and agenda for the kick-off meeting.

Table 7: Meeting Locations and Times

LOCATION AND TIME	AGENDA ITEMS
Nemaha NRD 62161 Hwy 136 Tecumseh, NE November 18, 2019 10:00am	-Consultant and Planning Team responsibilities –Overview of plan update process and changes from 2015 HMP –Discussion of drought assessment and management plan -Plan Goals/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. Thirty-one stakeholder groups or entities were identified and sent letters to participate. These included one nuclear power plant, 14 assisted living or long-term care facilities, seven hospitals or health care providers, three private schools, three Farm Service Agencies, and one tribal nation. While no other entities were incorporated as participating jurisdictions, the following entities attended meetings: Johnson County Hospital and Pawnee County Memorial Hospital & Rural Health Clinic. These entities provided input, which was incorporated into their respective county profiles (see *Section Seven*). The Sac & Fox Nation of Missouri in Kansas and Nebraska also attended meetings. Their information was included in the Richardson County profile as a portion of their reservation falls within this county. NEMA and NeDNR also attended meetings and provided data and guidance during the planning process.

Table 8: Notified Stakeholder Groups

ORGANIZATIONS		
Belle Terrace	Johnson County Hospital	Pawnee County Memorial Hospital & Rural Health Clinic
CHI Health St. Mary's	Jonesbrook Estates	Premier Estates of Pawnee
Colonial Acres Nursing Home	Morton Place	Prestige Care Center of Nebraska City
Community Medical Center and Humboldt Family Medicine	Nebraska City Lourdes Central	Sac & Fox Nation of Missouri in Kansas and Nebraska
Cooper Nuclear Power Plant	Nebraska Department of Natural Resources	Sacred Heart Schools
Fall City Care Center	Nebraska Emergency Management Agency	St. Andrew Elementary School
Fall City Nursing and Rehabilitation Center	Nemaha County Hospital	Syracuse Area Health
Good Samaritan Society	Otoe County Farm Service Agency	Tecumseh Family Health
Good Samaritan Society – Linden View	Pawnee & Richardson Counties Farm Service Agency	Tecumseh State Correctional Institution
Good Samaritan Society & Ridgeview Towers	Pawnee City Assisted Living	The Ambassador Nebraska City
Johnson & Nemaha Counties Farm Service Agency		

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 clerks, county and regional emergency managers, and NRDs. Jurisdictions outside of the planning area did not participate.

Table 9: Notified Neighboring Jurisdictions

NOTIFIED JURISDICTIONS	
Atchison County, Missouri	Holt County, Missouri
Brown County, Kansas	Lancaster County, Nebraska
Cass County, Nebraska	Marshall County, Kansas
Fremont County, Iowa	Nemaha County, Kansas
Gage County, Nebraska	

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 at a minimum one representative present at the Round 1 and Round 2 meetings or attend a follow-up meeting with a JEO staff member. Some jurisdictions sent multiple representatives to meetings. For jurisdictions who had only one representative, they were encouraged to bring meeting materials back to their governing bodies, to 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.

While the intent was for all public meetings to be held in person, Round 2 meetings were held virtually using the web conferencing tool Zoom to maintain project schedule and ensure the safety and health of participants. Participation requirements were the same as Round 1 meetings that were held in person, and any person unable to attend the scheduled virtual meeting were provided the opportunity to meet over the phone to maintain social distancing guidelines. Additional information regarding the transition to online meetings can be found under the Round 2 Meetings section.

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 10 provides a summary of outreach activities utilized in this process.

Table 10: Outreach Activity Summary

ACTION	INTENT
Project Website	Informed the public and local/planning team members of past, current, and future activities (https://jeo.com/nnrd-hmp)
Project Announcement	Project announcement sent to participants, stakeholders, and neighboring jurisdictions and requested points of contact
Round 1 Meeting Letters or 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 or 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 of 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

ACTION	INTENT
Project Flyer	Flyers were posted about the Nemaha NRD HMP and how to get involved. Flyers were posted at multiple locations throughout all counties and shared with all planning team members and stakeholders at meetings
Word-of-Mouth	Staff discussed the plan with jurisdictions throughout the planning process

Assessment of Risk

ROUND 1 MEETINGS: HAZARD IDENTIFICATION

At the Round 1 meetings, jurisdictional representatives (i.e. the local planning teams) reviewed the 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 11 shows the date and location of meetings held for the Round 1 meeting phase of the project.

Table 11: Round 1 Meeting Dates and Locations

AGENDA ITEMS	
General overview of the HMP 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**
Nemaha County 4-H Building Auburn NE, 6:30PM	Thursday, January 16, 2020
Syracuse Fire Hall Syracuse NE, 6:30PM	Thursday, January 23, 2020
Nemaha NRD Office Tecumseh NE, 6:30PM	Tuesday, February 4, 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 2015 NNRD 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 Auburn, NE

Source: JEO Consulting Group

The following tables show the attendees from each jurisdiction who attended Round 1 meetings or had a one-on-one discussion for Round 1 with JEO staff. Follow-up one-on-one meetings were held for communities who did not have representatives present at public meetings either through in-person meetings or via conference call with JEO staff.

Table 12: Round 1 Meeting Attendees

NAME	TITLE	JURISDICTION
Auburn – Thursday, January 16, 2020		
Bob Hilske	General Manager	Nemaha NRD
Brent Lottman	Fire Chief and Nemaha County Sheriff	Peru Rural Fire Department
Brian Kirkendall	Emergency Manager and Floodplain Administrator	Richardson County
Carol Woerlen	Clerk	Village of Julian
Dave Hunter, Jr	General Manager - Auburn Board of Public Works	City of Auburn
Dave Pease	Mayor	City of Peru
Gary Jorn	City Administrator	Falls City
Gary Stuchal	Board Member	Village of Brownville
Grant Brueggemann	Director	Southeast District Health Department

NAME	TITLE	JURISDICTION
James Cockerham	Village Board Member	Village of Verdon
Jan Richardson	Clerk	Village of Dawson/Dawson Rural Fire Protection District
Jeff Rowell	Deputy Director	Nemaha County
Jerry Joy	Board Chairperson	Village of Stella
Jon McQueen	Public Information Officer	Falls City Volunteer Fire Department
Kari Lottman	Assistant Principal	Humboldt-Table Rock-Steinauer School District
Mike Ramsey	Fire Chief	Falls City Rural Fire Department
Paul Fish	Board Member	Village of Brownville
Rachael Brook	Brock and Johnson Clerk and Johnson Floodplain Administrator Clerk	Village of Brock/ Village of Johnson/ Village of Talmage
Renee Crister	Emergency Manager	Nemaha County
Sherri Edmundson	Superintendent	Humboldt-Table Rock-Steinauer School District
Steve Darveau, Jr	Highway Superintendent	Richardson County
Sherry Heskett	Clerk and Floodplain Administrator	City of Auburn
Vaughn Severs	Fire Chief	Auburn Volunteer Fire Department
*Becky Appleford	Project Manager	JEO Consulting Group
*Karl Dietrich	Planner	JEO Consulting Group
*Kayla Vondracek	Hazard Mitigation Intern	JEO Consulting Group
Syracuse – Thursday, January 23, 2020		
Bill Thomas	Board Member	Village of Palmyra
Bob Hilske	General Manager	Nemaha NRD
Bruce Neemann	Floodplain Administrator and Fire Chief	City of Syracuse/Syracuse Volunteer Fire Department
Deb Dettmer	City Council	City of Syracuse
Dr. Tom Sharp	Superintendent	Sterling Public Schools
Greg Conz	Fire Chief	Talmage Rural Fire Department
Gregg Goebel	Emergency Manager	Otoe County
Joe Miller	Fire Chief	Village of Douglas/Douglas Volunteer Fire Department
John Groathouse	Board Member	Village of Otoe
Ralph Edwards	Board Chairperson	Village of Otoe
Scott Hincker	Village Trustee	Village of Unadilla
Steven Vodicka	Fire Chief	Unadilla Volunteer Fire & Rescue
*Becky Appleford	Project Manager	JEO Consulting Group
*Karl Dietrich	Planner	JEO Consulting Group
*John Callen	Senior Project Engineer	JEO Consulting Group
Tecumseh – Tuesday, February 4, 2020		
Adam Badberg	Fire Chief	Cook Fire District
Ben Laun	Board Chairperson	Village of Table Rock
Bob Hilske	General Manager	Nemaha NRD

NAME	TITLE	JURISDICTION
Bob Steinauer		Village of Steinauer
Charlie Hatfield	Mayor	Pawnee City
Donald Schmit	Board Chair and Floodplain Administrator	Village of Burr
Eileen Rexroth	Clerk and Treasurer	Village of DuBois
Glen Plager	Board Member	Village of Elk Creek
Jason Ebbers	Assistant Fire Chief	Sterling Volunteer Fire Department
Jill Rogman	Administrative Assistant	Nemaha NRD
John Keizer	Board Chairperson	Village of Sterling
Kenny Edwards	Board Member	Village of Table Rock
Kirk Bartels	Board Member and Fire Chief	Village of Elk Creek/ Elk Creek Volunteer Fire Department
Lisa Kuhl	Nurse	Johnson County Central Public Schools
Mark Junker	Tribal Response Coordinator	Sac and Fox Nation of Missouri in Nebraska & Kansas
Rick Lester	Highschool Principal	Johnson County Central Public Schools
Ron Seitz	Clerk	Village of Burchard
Russ Waring	Maintenance	Johnson County Central Public Schools
Samantha Gordon	Clerk	Village of Sterling
Spencer Cumley	Foreman	Pawnee City
Steven Eickhoff	Fire Chief	Sterling Volunteer Fire Department
Travis Effken	Board Chairperson	Village of Cook
*Jessica Scharf	Hazard Mitigation Specialist	NEMA
*McKenzie Slack	Hazard Mitigation Specialist	NEMA
*Becky Appleford	Project Manager	JEO Consulting Group
*Karl Dietrich	Planner	JEO Consulting Group
*John Callen	Senior Project Engineer	JEO Consulting Group

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

NAME	TITLE	JURISDICTION
Nebraska City – Thursday, January 23, 2020		
Rex Pfeil	Superintendent	Nebraska City Public Schools
*Becky Appleford	Project Manager	JEO Consulting Group
*Karl Dietrich	Planner	JEO Consulting Group
Nebraska City – Friday, January 24, 2020		
Bryan Turner	Gas and Water Superintendent	Nebraska City Utilities
Dan Patton	Operations Superintendent	Nebraska City Utilities
Gregg Goebel	Emergency Manager	Otoe County
Jeff Kohrs	General Manager	Nebraska City Utilities
Jerry Whitehead	Wastewater Treatment Superintendent	Nebraska City Utilities
Keith Morrison	Building Inspector	Nebraska City

NAME	TITLE	JURISDICTION
Mark Lant	Wastewater Treatment Plant Superintendent	Nebraska City Utilities
Marty Stovall	Construction/Facility Manager and Floodplain Administrator	Nebraska City
Steve Cody	Deputy Emergency Manager	Otoe County
*Becky Appleford	Project Manager	JEO Consulting Group
*Karl Dietrich	Planner	JEO Consulting Group
*Ross Lawrence	Project Engineer	JEO Consulting Group
Tecumseh – Friday, February 21, 2020		
Amanda Burki	Emergency Manager	Johnson and Pawnee Counties
Doug Goracke	City Utility Foreman	City of Tecumseh
Matt Schaardt	Highway Superintendent	Johnson County
*Becky Appleford	Project Manager	JEO Consulting Group
*Karl Dietrich	Planner	JEO Consulting Group
Palmyra – Friday, February 21, 2020		
Heath Johnson	Principal	Palmyra District OR1
*Becky Appleford	Project Manager	JEO Consulting Group
*Karl Dietrich	Planner	JEO Consulting Group
Shubert – Tuesday, March 10, 2020		
Jennifer Buchner	Clerk	Village of Shubert
Kim Dunn	Board Member	Village of Shubert
*Becky Appleford	Project Manager	JEO Consulting Group
*Karl Dietrich	Planner	JEO Consulting Group
Humboldt – Tuesday, March 10, 2020		
Darla Hulsebus	City Clerk	City of Humboldt
Dustin White	Board Member	City of Humboldt
Larry Stauffer	Board Member	City of Humboldt
*Becky Appleford	Project Manager	JEO Consulting Group
*Karl Dietrich	Planner	JEO Consulting Group
Salem – Tuesday, March 10, 2020		
Carolyn Glathar	Clerk/Treasurer	Village of Salem
Jon Kean	Village Board Member	Village of Salem
Kenneth Strauch	Board Chairperson	Village of Salem
Lindie Catlin	Village Board Member	Village of Salem
*Becky Appleford	Project Manager	JEO Consulting Group
*Karl Dietrich	Planner	JEO Consulting Group

MITIGATION PLAN DEVELOPMENT

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 2015 HMP and provide copies or descriptions of current community 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 include, but was not limited to local hazard prioritization results, identified critical facilities and their location within the community, future development areas, and expected growth trends (refer to *Appendix B*).

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. Round 2 public meetings are traditionally held in person. However, due to the prevalence of and the state's directed health measures surrounding the coronavirus disease 2019 (COVID-19) pandemic, in-person meetings were restructured as online web conference meetings and materials and information were shared via online formats. All participating jurisdictions were provided Round 2 materials to review and complete. Regular email updates were provided to planning team members as changes to the schedule were determined to suit the COVID-19 response. As with Round 1 meetings, any jurisdictions unable to attend the scheduled web conference meetings were given the opportunity to have a one-on-one web or phone conference with the consultant in order to meet plan participation requirements and complete required information.

The following table lists the dates and times of web conference meetings for the Mitigation Strategies phase of this project. Meeting attendees are identified in Table 15 and Table 16.

Table 14: Round 2 Meeting Dates

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**
Zoom Virtual Meeting, 2:00PM	Tuesday, April 28, 2020
Zoom Virtual Meeting, 7:00PM	Wednesday, April 29, 2020
Zoom Virtual Meeting, 10:00AM	Tuesday, May 5, 2020

Table 15: Round 2 Meeting Attendees

NAME	TITLE	JURISDICTION
Zoom Virtual Meeting – Tuesday, April 28, 2020		
Amanda Burki	Johnson and Pawnee Counties Emergency Manager	Johnson and Pawnee County
Bob Hilske	General Manager	Nemaha NRD
Brian Kirkendall	Emergency Manager and Floodplain Administrator	Richardson County
Bruce Delluge	Attorney/City Zoning	City of Tecumseh
Bruce Neemann	Floodplain Administrator and Fire Chief	City of Syracuse/Syracuse Volunteer Fire Department
Byford Schmit		Village of Steinauer
Chris Rauner	Highway Superintendent/Fireman	Table Rock Volunteer Fire Department
Dan Patton	Operations Superintendent	Nebraska City Utilities
Dan White	Mayor	City of Auburn

NAME	TITLE	JURISDICTION
Dave Hunter, Jr	General Manager - Auburn Board of Public Works	City of Auburn
Denise Koso	Board Chairperson	Village of Verdon
Dr. Tom Sharp	Superintendent	Sterling Public Schools
Eileen Rexroth	Clerk and Treasurer	Village of DuBois
Gary Jorn	City Administrator	Falls City
Gregg Goebel	Emergency Manager	Otoe County
Jeff Kohrs	General Manager	Nebraska City Utilities
Jeff Rowell	Deputy Director	Nemaha County
Jennifer Buchner	Clerk	Village of Shubert
Jerry Joy	Board Chairperson	Village of Stella
Jerry Whitehead	Wastewater Treatment Superintendent	Nebraska City Utilities
Jessica Meyer	City Administrator	City of Syracuse
John Keizer	Board Chairperson	Village of Sterling
Johnathan Bailey	Pawnee County Assessor/Flood Plan Manager	Pawnee County
Kari Lottman	Assistant Principal	Humboldt-Table Rock-Steinauer School District
Keith Morrison	Building Inspector	Nebraska City
Kim Dunn	Board Member	Village of Shubert
Marty Stovall	Construction/Facility Manager and Floodplain Administrator	Nebraska City
Renee Crister	Emergency Manager	Nemaha County
Rex Pfeil	Ex-Superintendent	Nebraska City Public Schools
Ron Seitz	Clerk	Village of Burchard
Samantha Gordon	Clerk	Village of Sterling
Sherri Edmundson	Superintendent	Humboldt-Table Rock-Steinauer School District
Sherry Heskett	Clerk and Floodplain Administrator	City of Auburn
Steve Cody	Deputy Emergency Manager	Otoe County
Steven Vodicka	Fire Chief	Unadilla Volunteer Fire & Rescue
Suzanne Borcher	Clerk	Village of Steinauer
Joe Green	Hazard Mitigation Specialist	NEMA
*Becky Appleford	Project Manager	JEO Consulting Group
*Karl Dietrich	Planner	JEO Consulting Group
Zoom Virtual Meeting – Wednesday, April 29, 2020		
Carolyn Glathar	Clerk/Treasurer	Village of Salem
Charlie Hatfield	Mayor	Pawnee City
Danny Crownover	Board Chairperson	Village of Unadilla
Deana Bennett	Clerk and Floodplain Administrator	Village of Otoe
Glen Plager	Board Member	Village of Elk Creek
Grant Brueggemann	Director	Southeast District Health Department
Greg Conz	Fire Chief	Talmage Rural Fire Department

NAME	TITLE	JURISDICTION
Gregg Goebel	Emergency Manager	Otoe County
Jason Ebbers	Assistant Fire Chief	Sterling Volunteer Fire Department
Jon McQueen	Public Information Officer	Falls City Volunteer Fire Department
Kenny Edwards	Board Member	Village of Table Rock
Kirk Bartels	Board Member/ Fire Chief	Village of Elk Creek/Elk Creek Volunteer Fire Department
Matt Khulmann		Pawnee City
Scott Hincker	Village Trustee	Village of Unadilla
Spencer Cumley	Foreman	Pawnee City
Terry Frank	County Commissioner	Richardson County
Vaughn Severs	Fire Chief	Auburn Volunteer Fire Department
*Becky Appleford	Project Manager	JEO Consulting Group
*Karl Dietrich	Planner	JEO Consulting Group
Zoom Virtual Meeting – Tuesday, May 5, 2020		
Carol Woerlen	Clerk	Village of Julian
Charlotte Carpenter	Clerk	City of Peru
Dave Hunter, Jr	General Manager - Auburn Board of Public Works	City of Auburn
Dustin White	Board Member	City of Humboldt
Jan Richardson	Clerk	Village of Dawson/Dawson Rural Fire Protection District
Jill Rogman	Administrative Assistant	Nemaha NRD
Jonathan Brinkman	Highway Department	Otoe County
Larry Stauffer	Board Member	City of Humboldt
Patricia Petersen	Clerk and Floodplain Administrator	Village of Dunbar
Rachael Brook	Brock Clerk and Johnson Clerk and Floodplain Administrator	Village of Brock/Village of Johnson/Village of Talmage
Rick Lester	High School Principal	Johnson County Central Public Schools
Stephanie DeGroot	Clerk	Village of Lorton
Joe Green	Hazard Mitigation Specialist	NEMA
John Gassmann	SHMO	NEMA
McKenzie Slack	Hazard Mitigation Specialist	NEMA
*Becky Appleford	Project Manager	JEO Consulting Group
*Karl Dietrich	Planner	JEO Consulting Group

Table 16: Round 2 One-on-One Meeting Attendees

NAME	TITLE	JURISDICTION
Zoom Virtual Meeting – Wednesday, May 6, 2020		
Joe Moller	Fire Chief	Village of Douglas/Douglas Volunteer Fire Department
Vicki Focken	Clerk and Floodplain Administrator	Village of Douglas
*Becky Appleford	Project Manager	JEO Consulting Group
*Karl Dietrich	Planner	JEO Consulting Group
Zoom Virtual Meeting – Thursday, May 14, 2020		
Janice Boden	Clerk	Village of Nemaha
Donald Schmit	Board Chair and Floodplain Administrator	Village of Burr
Brent Lottman	Fire Chief and Nemaha County Sheriff	Peru Rural Fire Department
*Becky Appleford	Project Manager	JEO Consulting Group
*Karl Dietrich	Planner	JEO Consulting Group
Conference Call – Thursday, July 23, 2020		
Gary Stuchal	Board Member	Village of Brownville
Paul Fish	Board Member	Village of Brownville
*Karl Dietrich	Planner	JEO Consulting Group

DATA SOURCES AND INFORMATION

Effective hazard mitigation planning requires the review and inclusion of a wide range of data, documents, plans, and studies. The following table identifies many of the sources utilized during this planning process. Specific references are included as footnotes when used as applicable. The following table is not exhaustive as many studies, plans, and data resources at the local level are not publicly available. Individual examples of plan integration are identified in *Section Seven: Community Profiles.*

Table 17: General Plans, Documents, and Information

DOCUMENTS	
Disaster Mitigation Act of 2000 DMA https://www.fema.gov/media-library-data/20130726-1524-20490-1678/dma2000.txt	Mitigation Ideas: A Resource for Reducing Risk to Natural Hazards (2013) https://www.fema.gov/sites/default/files/2020-06/fema-mitigation-ideas_02-13-2013.pdf
Final Rule (2007) https://www.fema.gov/emergency-managers/risk/hazard-mitigation/regulations-guidance/archive	National Flood Insurance Program Community Status Book (2020) https://www.fema.gov/flood-insurance/work-with-nfip/community-status-book
Hazard Mitigation Assistance Unified Guidance (2015) https://www.fema.gov/sites/default/files/2020-07/fy15_HMA_Guidance.pdf	National Response Framework (2019) https://www.fema.gov/emergency-managers/national-preparedness/frameworks/response
Hazard Mitigation Assistance Guidance and Addendum (2015) https://www.fema.gov/sites/default/files/2020-07/fy15_hma_addendum.pdf	Robert T. Stafford Disaster Relief and Emergency Assistance Act (2019) https://www.fema.gov/disasters/stafford-act
Local Mitigation Plan Review Guide (2011) https://www.fema.gov/sites/default/files/2020-06/fema-local-mitigation-plan-review-guide_09_30_2011.pdf	The Census of Agriculture (2017) https://www.nass.usda.gov/Publications/AgCensus/2017/Full_Report/Census_by_State/Nebraska/
Local Mitigation Planning Handbook (2013) https://www.fema.gov/sites/default/files/2020-06/fema-local-mitigation-planning-handbook_03-2013.pdf	What is a Benefit: Guidance on Benefit-Cost Analysis on Hazard Mitigation Projects https://www.fema.gov/grants/guidance-tools/benefit-cost-analysis

DOCUMENTS PLANS AND STUDIES	
Nemaha NRD Hazard Mitigation Plan (2015) https://jeo.com/nnrd-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) 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 (NFS) 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 https://data.census.gov/cedsci/

DOCUMENTS	
National Historic Registry https://www.nps.gov/subjects/nationalregister/index.htm	United States Department of Agriculture http://www.usda.gov
National Oceanic Atmospheric Administration (NOAA) http://www.noaa.gov/	United States Department of Agriculture – Risk Management Agency http://www.rma.usda.gov
National Weather Service http://www.weather.gov/	United States Department of Agriculture – Web Soil Survey https://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx
Natural Resources Conservation Service www.ne.nrcs.usda.gov	United States Department of Commerce http://www.commerce.gov/
Nebraska Association of Resources Districts http://www.nrdnet.org	United States Department of Transportation – Pipeline and Hazardous Materials Safety Administration https://www.phmsa.dot.gov/
Nebraska Climate Assessment Response Committee http://carc.agr.ne.gov	United States Geological Survey http://www.usgs.gov/
Nebraska Department of Education http://nep.education.ne.gov/	United States National Response Center https://nrc.uscg.mil/
Nebraska Department of Education http://educdirsrc.education.ne.gov/	United States Small Business Administration http://www.sba.gov
Nebraska Department of Environment and Energy http://www.deq.state.ne.us/	UNL – College of Agricultural Sciences and Natural Resources – Schools of Natural Resources http://casnr.unl.edu
Nebraska Department of Health and Human Services http://dhhs.ne.gov/Pages/default.aspx	

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 July 13, 2020, through August 14, 2020. 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/nnrd-hmp) to download the document.

Comments and revisions of the HMP were received and incorporated from many participating jurisdictions including: Johnson County, Village of Elk Creek, City of Auburn, Village of Julian, Otoe County, Village of Douglas, Pawnee County, Humboldt-Table Rock-Steinauer School District, and City of Falls City. The NeDNR also reviewed the plan, providing comments on dam failure and drought.

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 need to be living documents. Once an HMP has been adopted locally, participants are responsible for implementing identified projects, maintaining the plan with relevant information, and fully updating the plan every five years. The plan must be monitored, evaluated, and updated on a five-year or less cycle. Those who participated directly in the planning process would be logical champions during the annual reviews and five-year cycle update of the plan. It is critical the plan be reviewed and updated annually or when a hazard event occurs that significantly affects the area or individual participants. These annual reviews are the responsibility of each jurisdiction's local planning team, and should be documented and reflected in the plan via amendments. However, participants are encouraged to work alongside the plan sponsor, NNRD, 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 NNRD HMP have established to monitor the plan; provides a description of how, when, and by whom the HMP process and mitigation actions will be evaluated; presents the criteria used to evaluate the plan; and explains how the plan will be maintained and updated.

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SECTION THREE
PLANNING AREA PROFILE

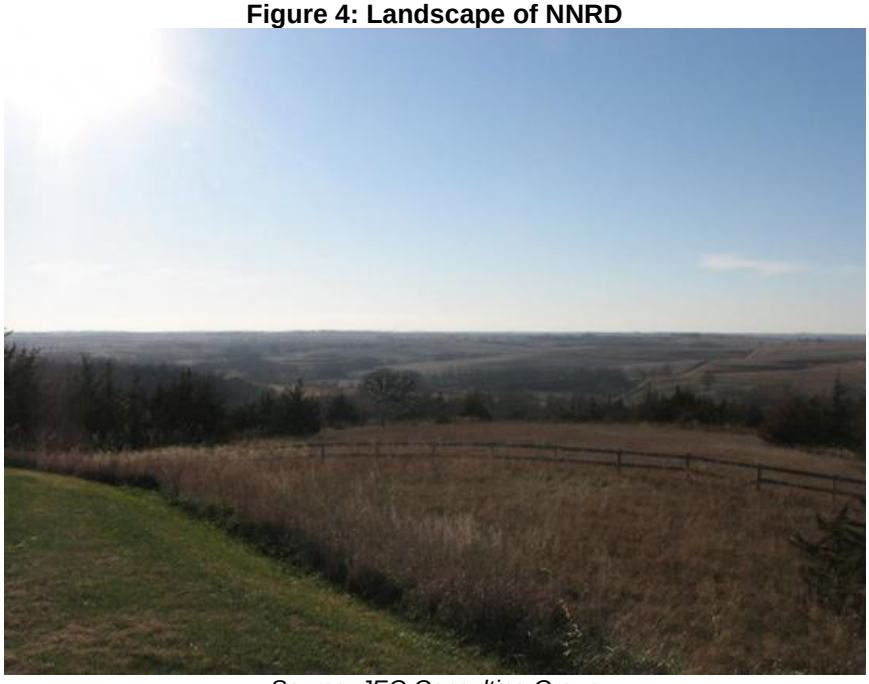
INTRODUCTION

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

PLANNING AREA GEOGRAPHIC SUMMARY

The Nemaha NRD is located in southeastern Nebraska and covers 2,402 square miles. It includes all of Johnson, Nemaha, and Richardson Counties and portions of Cass, Gage, Lancaster, Otoe, and Pawnee Counties. However, for the purposes of this HMP update, the planning area is defined as including all of Johnson, Nemaha, Otoe, Pawnee, and Richardson Counties. Much of the 1.5 million acres of land in the NRD lies within rolling hill regions, with some areas of bluffs and escarpments and valleys along the waterways (Figure 5). Rolling hills are hilly lands with moderate to steep slopes and rounded ridge crests; valleys are flat-lying land along major streams and include stream-deposited silt, clay, sand, and gravel materials; and bluffs and escarpments are rugged areas with very steep and irregular slopes.[13] This region has been proven to have ideal soil for crop agriculture.

Figure 4: Landscape of NNRD

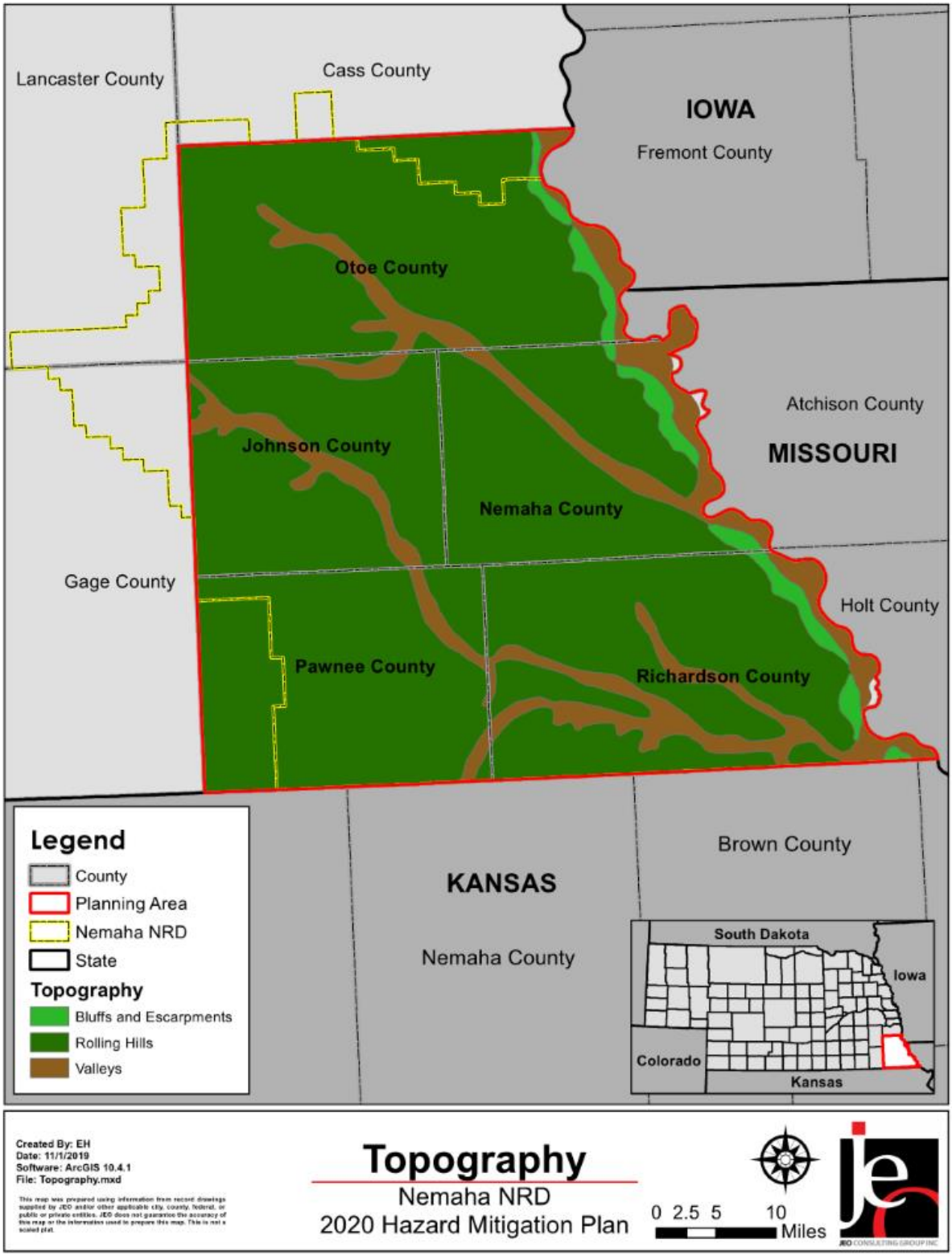


Source: JEO Consulting Group

The main rivers in the planning area are the Missouri River, Big Nemaha River, and Little Nemaha River. The Missouri River runs along the eastern border of the NNRD and Otoe, Nemaha, and Richardson Counties. The Big Nemaha River Basin bisects Johnson, Pawnee, and Richardson Counties from northwest to southeast, and the Little Nemaha River Basin is farther north, bisecting Otoe and Nemaha Counties.

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

Figure 5: Planning Area Topography



DEMOGRAPHICS AND AT-RISK POPULATIONS

As noted above, the planning area includes five counties: Johnson, Nemaha, Otoe, Pawnee, and Richardson Counties. While neither the NRD nor U.S. Census Bureau collects specific demographic information for the region, it serves an estimated population of 44,560[14]. This population includes a range of demographics and persons at risk to natural and human-made disasters.

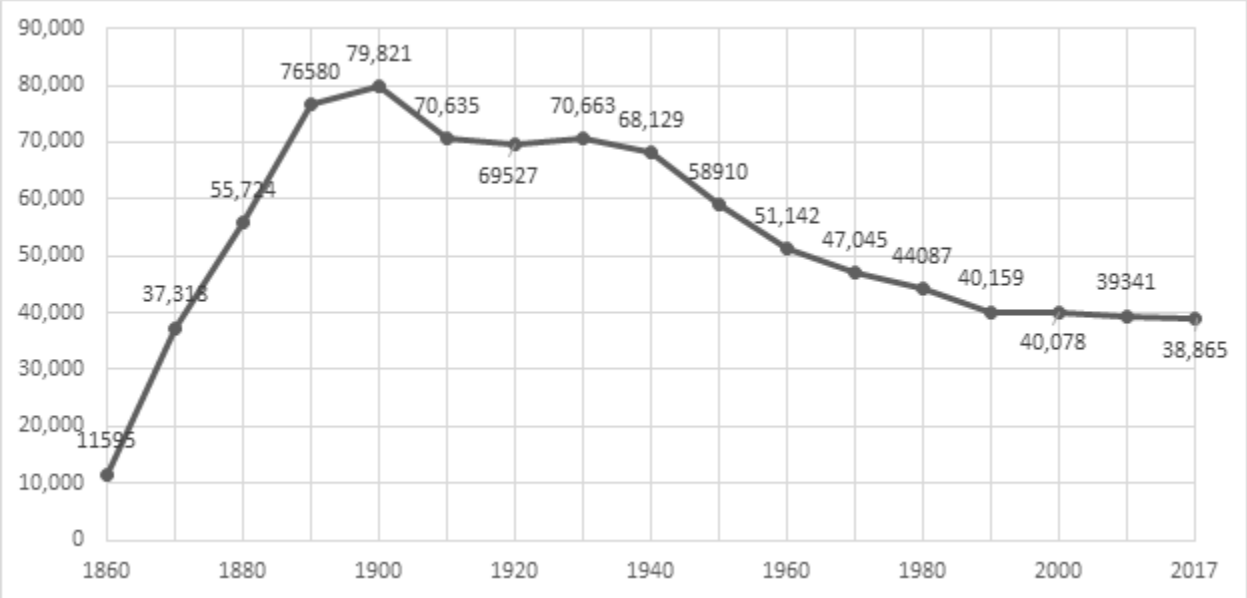
Table 18: Estimated Population for Planning Area

AGE	PLANNING AREA	STATE OF NEBRASKA
<5	5.3%	6.9%
5-18	15.7%	20.7%
19-64	57.7%	57.6%
>64	21.3%	14.8%
Median	44.7	36.3

Source: U.S. Census Bureau

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

Figure 6: Planning Area Population, 1860-2017



Source: US Census[15]

The planning area has displayed an overall decline in total population since the 1930s with population decline slowing since 1990. While the U.S. Census Bureau conducts a formal census every ten years, the estimated population of the five-county planning area in 2017 was 38,865. Subsequent updates to this HMP should include updated census data from the 2020 census to determine if the trend is continuing.

[14] Nemaha Natural Resources District. 2020. Nemaha About. https://www.nemahanrd.org/about
[15] United States Census Bureau. "2017 American Fact Finder: S0101: Age and Sex." [database file]. https://factfinder.census.gov.

AT-RISK POPULATIONS

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

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

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."[16]

Dependent children under 19 years old are one of the populations most vulnerable to disasters.[17] The majority of people in this age group do not have access to independent financial resources, transportation, or cellular telephones. 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 over 20% of the planning area's population younger than 19, children are a key vulnerable group to address in the planning process.

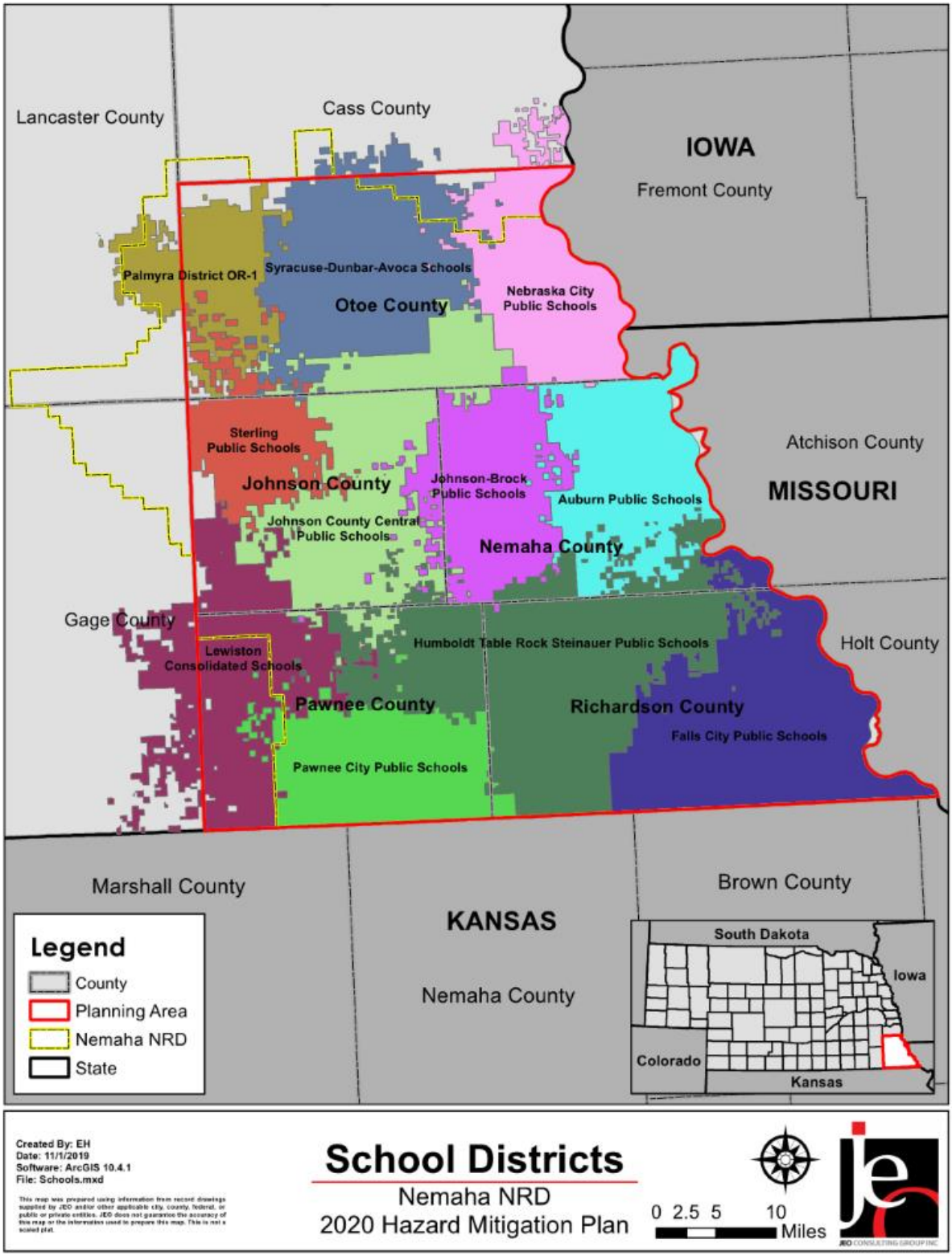
Schools house a high number of children and adults within the planning area during the daytime hours of weekdays, as well as during special events on evenings and weekends. The following table identifies the various school districts located within the planning area, and the following figure is a map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

Table 19: School Inventory

SCHOOL DISTRICT	TOTAL ENROLLMENT (2018-2019)	TOTAL TEACHERS
Auburn Public Schools	937	66
Falls City Public Schools	896	67
Humboldt-Table Rock-Steinauer Public Schools	360	49
Johnson-Brock Public Schools	355	24
Johnson County Central Public Schools	526	51
Lewiston Consolidated Schools	194	23
Nebraska City Public Schools	1,458	107
Palmyra District OR-1	591	46
Pawnee City Public Schools	293	26
Sterling Public Schools	216	23
Syracuse-Dunbar-Avoca Public Schools	756	58

[16] United States Department of Homeland Security. June 2016. National Response Framework Third Edition. https://www.fema.gov/media-library-data/1466014682982-9bcf8245ba4c60c120aa915abe74e15d/National_Response_Framework3rd.pdf.
[17] Flanagan, Gregory, Hallisey, Heitgerd, & Lewis. 2011. "A Social Vulnerability Index for Disaster Management." Journal of Homeland Security and Emergency Management, 8(11): Article 3.

Figure 7: Regional School Districts



Like minors, seniors (age 65 and older) are often more significantly impacted by temperature extremes. During prolonged heat waves or periods of extreme cold, seniors may lack resources to effectively address hazard conditions and as a result may incur injury or potentially death. Prolonged power outages (either standalone events or as the result of other contributing factors) can have significant impacts on any citizen relying on medical devices 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. Males over the age of 55 are 4.25 times more likely to experience cardiac symptoms during snow removal.

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

Table 20: Inventory of Care Facilities

JURISDICTION	HOSPITALS	HOSPITAL BEDS	HEALTH CLINICS	ADULT CARE HOMES	ADULT CARE BEDS	ASSISTED LIVING HOMES	ASSISTED LIVING BEDS
Johnson	1	18	1	2	77	1	36
Nemaha	1	16	0	1	102	1	30
Otoe	2	28	2	3	223	4	125
Pawnee	1	11	1	1	64	1	24
Richardson	1	137	2	3	233	2	47
PLANNING AREA	6	210	6	10	699	9	262

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

In addition to residents being classified as at-risk by age, there are other specific groups within the planning area that experience vulnerabilities related to their ability to communicate or their economic status. Table 22 provide statistics per county regarding households with English as a second language (ESL) and population reported as in poverty within the past 12 months.

Table 21: ESL and Poverty At-Risk Populations

COUNTY	PERCENT THAT SPEAKS ENGLISH AS SECOND LANGUAGE	FAMILIES BELOW POVERTY LEVEL
Johnson	9.1%	10.1%
Nemaha	2.6%	11.5%
Otoe	6.9%	10.0%
Pawnee	9.2%	20.5%
Richardson	1.3%	16.3%
PLANNING AREA	5.8%	13.7%

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

[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. July 2020. "Assisted Living Facilities." http://dhhs.ne.gov/licensure/Documents/ALF%20Roster.pdf.
[20] Department of Health and Human Services. July 2020. "Hospitals." http://dhhs.ne.gov/licensure/Documents/Hospital%20Roster.pdf
[21] Department of Health and Human Services. July 2020. "Long Term Care Facilities." http://dhhs.ne.gov/licensure/Documents/LTCRoster.pdf.
[22] Department of Health and Human Services. July 2020. "Rural Health Clinic." http://dhhs.ne.gov/licensure/Documents/RHC_Roster.pdf.
[23] U.S. Census Bureau. 2019. "Language Spoken at Home: 2017 American Community Survey (ACS) 5-year estimates." https://factfinder.census.gov/faces/nav/jsf/pages/searchresults.xhtml?refresh=t#.
[24] U.S. Census Bureau. 2019. "Selected Economic Characteristics: 2017 ACS 5-year estimate." https://factfinder.census.gov/faces/nav/jsf/pages/searchresults.xhtml?refresh=t#.

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

Residents who speak English as a second language may struggle with a range of issues before, during, and after hazard events. General vulnerabilities revolve around what could be an inability to effectively communicate with others or an inability to comprehend materials aimed at notification and/or education. When presented with a hazardous situation it is important that all community members be able to receive, decipher, and act on relevant information. An inability to understand warnings and notifications may prevent non-native English speakers from reacting in a timely manner. Further, educational materials related to regional hazards are most often developed in the dominant language for the area, for the planning 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. While the planning area is primarily White, not Hispanic, diversity has increased since 2010. However, these small changes in racial inequity will likely not significantly affect the community's vulnerability to hazards (Table 22).

Table 22: Racial Composition Trends

RACE	2010		2017		
	NUMBER	% OF TOTAL	NUMBER	% OF TOTAL	% CHANGE
White, Not Hispanic	26,645	95.8%	35,067	93.7%	-2.1%
Black	407	1.1%	513	1.4%	0.3%
American Indian and Alaskan Native	203	0.5%	416	1.1%	0.6%
Asian	53	0.1%	191	0.5%	0.4%
Native Hawaiian and Other Pacific Islander	0	0%	1	0%	0%
Other Races	268	0.7%	439	1.2%	0.5%
Two or More Races	657	1.8%	791	2.1%	0.3%
TOTAL POPULATION	**38,233**	**-**	**37,418**	**-**	**-**

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

BUILT ENVIRONMENT AND STRUCTURAL INVENTORY

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

Of the occupied housing units in the planning area, nearly 25 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.

[25] U.S. Census Bureau. 2019. "Race: 2010 ACS 5-year estimate." https://factfinder.census.gov/faces/nav/jsf/pages/searchresults.xhtml?refresh=t#.

[26] U.S. Census Bureau. 2019. "Race: 2017 ACS 5-year estimate." https://factfinder.census.gov/faces/nav/jsf/pages/searchresults.xhtml?refresh=t#.

Pawnee County has the highest percentage of vacant housing units compared to the other four counties. Unoccupied homes may not be maintained as well as occupied housing, thus adding to their vulnerability. During disaster events like high winds or tornadoes, these structures may collapse and result in debris which can impact other structures as well as humans, resulting in higher damage totals and injuries or fatalities. Some of the participating communities in this planning process have already identified the concern related to older building stock and revitalization efforts. Some of the participating jurisdictions have completed housing or blight studies to help define their needs and an approach to address the concerns.

Table 23: Housing Characteristics

JURISDICTION	TOTAL HOUSING UNITS				OCCUPIED HOUSING UNITS			
	Occupied		Vacant		Owner		Renter	
	#	%	#	%	#	%	#	%
Johnson County	1,869	86.5	291	13.5	1,382	73.9	487	26.1
Cook	149	84.7	27	15.3	108	72.5	41	27.5
Crab Orchard	29	100	0	0	26	89.7	3	10.3
Elk Creek	71	93.4	5	6.6	43	60.6	28	39.41
Sterling	256	81.5	58	18.5	202	78.9	54	21.1
Tecumseh	737	87.3	107	12.7	470	63.8	267	36.2
Nemaha County	2,814	80.1	699	19.9	2,023	71.9	791	28.1
Auburn	1,369	78	387	22	865	63.2	504	36.8
Brock	57	77	17	23	46	80.7	11	19.3
Brownville	61	48	66	52	57	93.4	4	6.6
Johnson	149	82.3	32	17.7	131	87.9	18	12.1
Julian	27	64.3	15	35.7	25	92.6	2	7.4
Nemaha	77	74.8	26	25.2	45	58.4	32	41.6
Peru	230	83.9	44	16.1	143	62.2	87	37.8
Otoe County	6,439	90.2	700	9.8	4,665	72.4	1,774	27.6
Burr	20	58.8	14	41.2	17	85	3	15
Douglas	80	68.4	37	31.6	65	81.3	15	18.8
Dunbar	78	89.7	9	10.3	54	69.2	24	30.8
Lorton	8	66.7	4	33.3	7	87.5	1	12.5
Nebraska City	3,013	74.8	26	25.2	1,976	65.6	1,032	34.4
Otoe	74	9.8	32	30.2	55	74.3	19	25.7
Palmyra	253	92.3	21	7.7	204	80.6	49	19.4
Syracuse	891	92.6	71	7.4	603	67.7	288	32.3
Talmage	95	89.6	11	10.4	66	69.5	29	30.5
Unadilla	114	91.2	11	8.8	91	79.8	23	20.2
Pawnee County	1,238	76.8	373	23.2	994	80.3	244	19.7
Burchard	27	67.5	13	32.5	17	63	10	37
DuBois	54	88.5	7	11.5	49	90.7	5	9.3
Lewiston	29	78.4	8	21.6	22	75.9	7	24.1
Pawnee City	471	83.5	93	16.5	336	71.3	135	28.7
Steinauer	33	82.5	7	17.5	32	97	1	3

Table Rock	159	87.4	23	12.6	139	87.4	20	12.6
Richardson County	3,798	86.3	602	13.7	2,938	77.4	860	22.6
Barada	4	57.1	3	42.9	4	100	0	0
Dawson	90	78.3	25	21.7	70	77.8	20	22.2
Falls City	1,909	89.9	214	10.1	1,481	77.6	428	22.4
Humboldt	420	76.6	128	23.4	295	70.2	125	29.8
Rulo	99	77.3	29	22.7	94	94.9	5	5.1
Salem	56	61.5	35	38.5	43	76.8	13	23.2
Shubert	93	71.5	37	28.5	84	90.3	9	9.7
Stella	102	83.6	20	16.4	90	88.2	12	11.8
Verdon	79	86.8	12	13.2	75	94.9	4	5.1
Planning Area	**16,158**	**85.8**	**2,665**	**16.5**	**12,002**	**74.3**	**4,156**	**24.8**

Source: U.S. Census Bureau[27]

The US Census provides information related to housing units and potential areas of vulnerability. The selected characteristics examined in Table 25 include: lacking complete plumbing facilities; lacking complete kitchen facilities; no telephone service available; housing units with no vehicles; and housing units that are mobile homes.

Table 24: Selected Housing Characteristics

	JOHNSON	NEMAHA	OTOE	PAWNEE	RICHARDSON	TOTAL
Occupied housing units	1,869 (86.5%)	2,814 (80.1%)	6,439 (90.2%)	1,238 (76.8%)	3,798 (86.3%)	16,158 (85.8%)
Lacking complete plumbing facilities	0.5%	1.6%	0.3%	1.5%	0.9%	97 (0.6%)
Lacking complete kitchen facilities	1.3%	1.6%	1.4%	1.2%	1.1%	220 (1.4%)
No telephone service available	3.0%	1.6%	1.8%	4.4%	1.9%	344 (2.2%)
No vehicles available	7.1%	4.3%	6.2%	9.8%	4.0%	923 (5.7%)
Mobile Homes	7.1%	2.8%	2.6%	7.4%	2.7%	423 (2.6%)

Source: U.S. Census Bureau

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 (IPAWS) to send emergency

[27] U.S. Census Bureau. 2019. "Selected Housing Characteristics: 2017 ACS 5-year estimate." https://factfinder.census.gov/faces/nav/jsf/pages/searchresults.xhtml?refresh=t#.

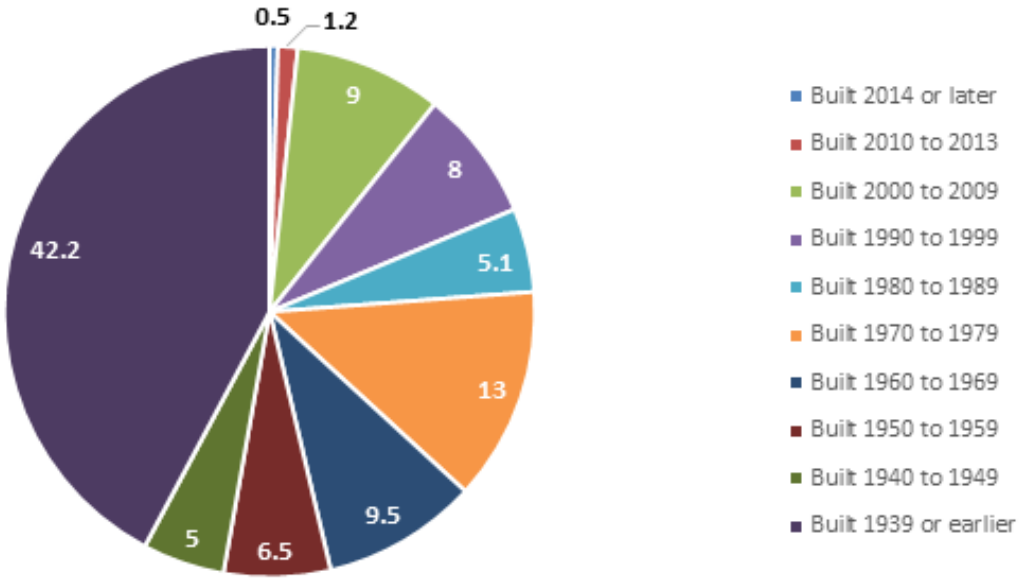
alerts and weather warnings to cellphones within a designated area. While like CodeRed, notifications are sent to all cellphone users within specific geographical areas without needing to opt-in.

Over two percent of housing units in the planning area are mobile homes. Pawnee and Johnson Counties have the highest rate of mobile homes in its housing stock at over seven 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.

Also, nearly six percent of homes do not have access to a vehicle with the highest percentage located in Pawnee County at nearly ten percent. Those without access to a vehicle will have difficulties evacuating during an emergency or may not head evacuation orders when issued, putting themselves and others in the home at risk to hazards like flooding and chemical or radiological releases.

The majority of homes within the planning area were built prior to 1980 (76%), with 42% of homes built prior to 1939 (Figure 8). Housing age can serve as an indicator of risk, as structures built prior to the development of state building codes may be more vulnerable. Residents living in these homes maybe at higher risk to the impacts of high winds, tornadoes, severe winter storms, and thunderstorms.

Figure 8: Housing Age in Planning Area



State and Federally-Owned Properties

The following table provides an inventory of state and federally-owned properties within the planning area by county. These are properties that are not under the jurisdiction of the NNRD but are still a source of vulnerability in the region. 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 25: State and Federally-Owned Facilities

FACILITY/AREA	COUNTY OR NEAREST COMMUNITY
Johnson County	
Hickory Ridge Wildlife Management Area	Crab Orchard, NE
Osage Wildlife Management Area	Northwest of Tecumseh, NE
Twin Oaks State Wildlife Management Area	North of Elk Creek, NE
Tecumseh State Correctional Institution	Tecumseh, NE
Nemaha County	
Aspinwall Bend Wildlife Management Area	Nemaha, NE
Peru State College	Peru, NE
Peru Bottoms Wildlife Management Area	Northeast of Peru, NE
Cooper Nuclear Station – Nebraska Public Power District	Brownville, NE
Lewis and Clark Camp Site	Brownville, NE
Kansas Bend (USACE)	North of Peru, NE
Sonora Bend (USACE)	Brownville, NE
Brownville Bend (USACE)	Brownville, NE
Langdon Bend (USACE)	Nemaha, NE
Otoe County	
Arbor Lodge State Historical Park	Nebraska City, NE
Riverview Marian State Recreation Area	Two miles north of Nebraska City, NE
Hamburg Bend Wildlife Management Area	Southeast of Nebraska City, NE
Wilson Creek Wildlife Management Area	Southeast of Otoe, NE
Pawnee County	
Bowwood Wildlife Management Area	East of Burchard, NE
Burchard Wildlife Management Area	Burchard, NE
Four Mile Creek State Wildlife Management Area	DuBois, NE
Mayberry Wildlife Management Area	Lewiston, NE
Pawnee Prairie Wildlife Management Area	South of Burchard, NE
Prairie Knoll Wildlife Management Area	Northwest of DuBois, NE
Table Rock State Wildlife Management Area	Table Rock, NE
Taylor's Branch Wildlife Management Area	Pawnee City, NE
Mayberry Wildlife Management Area	Lewiston, NE
Richardson County	
Cottier Bend (USACE)	North of Rulo, NE
Kinter's Ford State Wildlife Management Area	East of DuBois, NE
Indian Cave State Park	Northeast of Barada, NE
Margrave Wildlife Management Area	Southwest of Rulo, NE
South Fork Wildlife Management Area	West of Salem, NE
Thomas C. Matter Wildlife Management Area	West of Salem, NE
Verdon Lake State Recreation Area	Verdon, NE

Source: Nebraska Game and Parks[28][29]

Peru State College is a four-year public liberal arts college located on the southern edge of the City of Peru. The college was founded in 1867 as Nebraska's first college and was established by the state's legislature. The 104-acre campus has 25 major buildings and is a prominent feature of Peru.

[28] Nebraska Game and Parks. July 2020. https://maps.outdoornebraska.gov/Parks/

[29] Nebraska Game and Parks. July 2020. https://maps.outdoornebraska.gov/PublicAccessAtlas/

The college has an annual enrollment of approximately 3,500 students and employs approximately 188 fulltime staff. Many majors are offered, but the college specializes in education. The following figure displays the location of the campus facilities. Much of the college sits on top of a hill keeping the majority of it out of the one percent annual chance floodplain. A small portion of the practice football field is in the floodplain. The college is located in the 10-mile evacuation radius of Cooper Nuclear Station. If an evacuation occurs, the students in the City of Peru are to go to the Nebraska City Middle School. Additional information about the college can be found in the City of Peru's Community Profile in *Section Seven*.

Figure 9: Peru State College Map

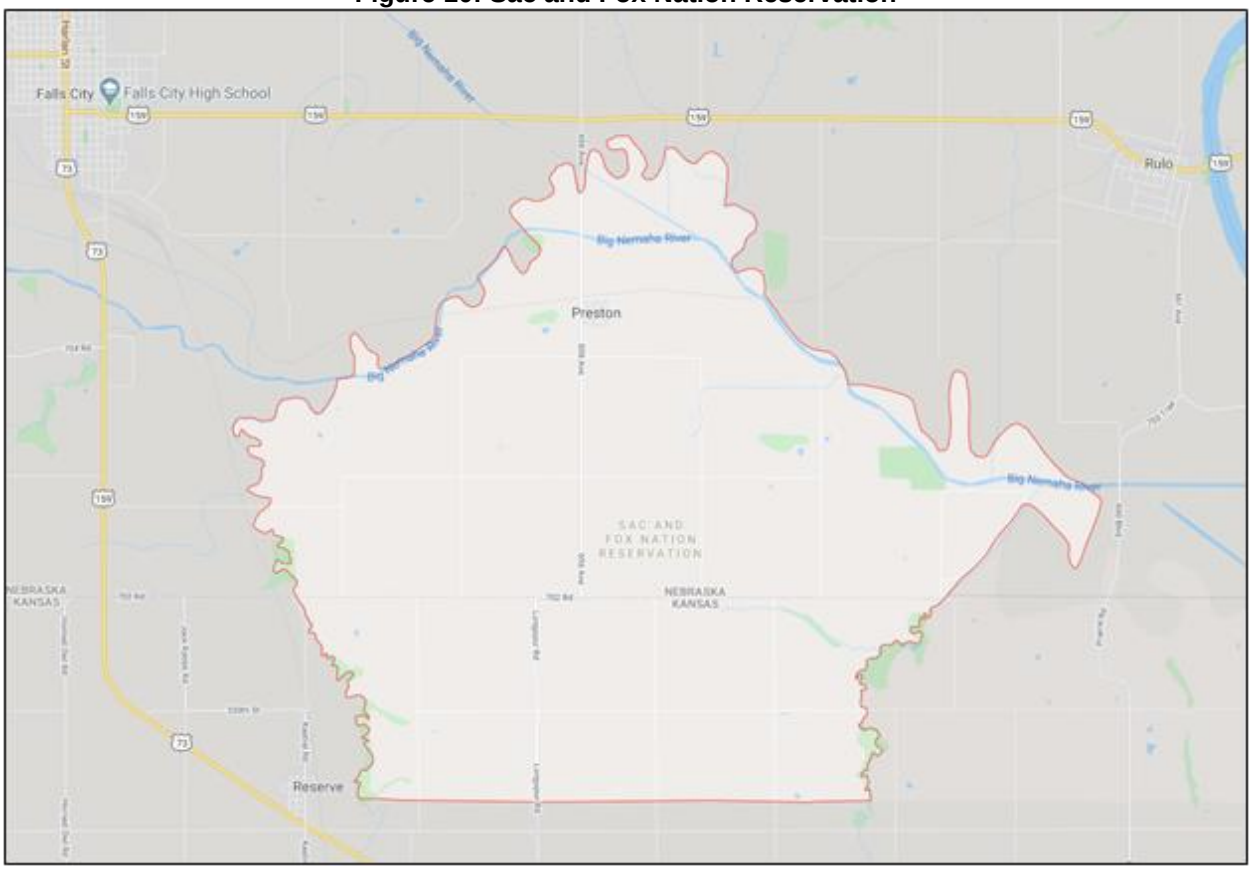
Source: Peru State College[30]

Tecumseh State Correctional Institution is also located in the planning area. The facility is located two miles north of Tecumseh on Highway 50. The facility began accepting inmates in December 2001, and it houses maximum and medium security inmates and any inmate on death row. The prison's capacity is 1,058 inmates. The number of inmates housed in the prison changes on a daily basis, so it is hard to get an accurate number. The facility also has a small medical unit that includes a 10-bed skilled nursing facility, clinic exam rooms, on-site x-ray, medical laboratory, optometry, and dental. There are also some behavioral services such as psychiatric services, crisis intervention, and residential and non-residential substance abuse treatment. The prison is located out of the one percent annual chance floodplain and does have back-up power generators in place.

The Sac and Fox Nation Reservation is located in Richardson County primarily south of the Big Nemaha River between Falls City and Rulo along the Nebraska border and it continues into Kansas as well (Figure 9). While the reservation extends into Nebraska, their facilities are located in Kansas. The Tribal Response Coordinator attended a Round 1 Meeting and provided information for this plan update, which was incorporated into the Richardson County Profile in *Section Seven*.

[30] Peru State College. July 2020. https://www.peru.edu/about/map

Figure 10: Sac and Fox Nation Reservation



Source: Google Maps, 2020

HISTORICAL SITES

According to the National Register of Historic Places for Nebraska by the National Park Service (NPS), there are 70 historic sites located in the planning area (Table 26). Twelve of the historic sites are in the one percent annual chance floodplain.

Table 26: Historical Sites

SITE NAME	DATE LISTED	NEAREST COMMUNITY	COUNTY	IN FLOODPLAIN?
Johnson County Courthouse	1/10/1990	Tecumseh	Johnson County	No
Keim Stone Arch Bridge	6/29/1992	Tecumseh	Johnson County	Yes
Tecumseh Historic District	6/20/1975	Tecumseh	Johnson County	No
Tecumseh Opera House	9/28/1988	Tecumseh	Johnson County	No
Townsend, George, House	11/2/2006	Tecumseh	Johnson County	No
Auburn Historic District	7/14/2014	Auburn	Nemaha County	No
First United Presbyterian Church of Auburn	7/15/1982	Auburn	Nemaha County	No
Legion Memorial Park	12/29/2004	Auburn	Nemaha County	No
Nemaha County Courthouse	1/10/1990	Auburn	Nemaha County	No

SITE NAME	DATE LISTED	NEAREST COMMUNITY	COUNTY	IN FLOODPLAIN?
New Opera House	9/28/1988	Auburn	Nemaha County	No
St. John's Lutheran Church Complex	1/25/1979	Auburn	Nemaha County	No
US Post Office—Auburn	5/11/1992	Auburn	Nemaha County	No
Wilber T. Reed House	3/24/1980	Auburn	Nemaha County	No
Bennett, John W., House	9/16/1983	Brownville	Nemaha County	No
Brownville Bridge	6/17/1993	Brownville	Nemaha County	Yes
Brownville Historic District	5/19/1970	Brownville	Nemaha County	No
Captain Meriwether Lewis (dredge)	10/28/1977	Brownville	Nemaha County	Yes
Majors, Thomas J., Farmstead	6/15/1978	Peru	Nemaha County	No
Little Nemaha River Bridge	6/29/1992	Dunbar	Otoe County	Yes
Massow, Joachim--Schultz, Charles and Annie, House	8/28/2012	Dunbar	Otoe County	No
Wolf Creek Bridge	6/29/1992	Dunbar	Otoe County	Yes
Wyoming Bridge	6/29/1992	Dunbar	Otoe County	Yes
[No Name] Bridge	6/29/1992	Lorton	Otoe County	Yes
Arbor Lodge	4/16/1969	Nebraska City	Otoe County	No
Boscobel	6/17/1976	Nebraska City	Otoe County	No
[No Name #2] Bridge	6/29/1992	Nebraska City	Otoe County	Yes
Camp Creek Cemetery and Chapel	3/21/2011	Nebraska City	Otoe County	No
Camp Creek School, Otoe County District No. 54	6/5/1980	Nebraska City	Otoe County	No
Grand Army of the Republic (G.A.R.) Memorial Hall	2/25/1994	Nebraska City	Otoe County	No
Harmony School, School District #53	7/22/2005	Nebraska City	Otoe County	Address Restricted
Kregel Wind Mill Company	2/25/1993	Nebraska City	Otoe County	No
Lee, George F., Octagon Houses	11/23/1977	Nebraska City	Otoe County	No
Mayhew Cabin	2/11/2011	Nebraska City	Otoe County	No
McCartney School District 17	11/15/2000	Nebraska City	Otoe County	No
Morton-James Public Library	5/28/1976	Nebraska City	Otoe County	No
Nebraska City Burlington Depot	8/8/1997	Nebraska City	Otoe County	No
Nebraska City Historic District	10/29/1976	Nebraska City	Otoe County	No
Otoe County Courthouse	6/18/1976	Nebraska City	Otoe County	No
South 13th Street Historic District	10/29/1976	Nebraska City	Otoe County	No
South Nebraska City Historic District	10/22/1976	Nebraska City	Otoe County	No
St. Benedict's Catholic Church	1/27/1983	Nebraska City	Otoe County	No
U.S. Post Office	9/3/1971	Nebraska City	Otoe County	No
Ware, Jasper A., House	7/16/1973	Nebraska City	Otoe County	No
Little Nemaha River Bridge	6/29/1992	Syracuse	Otoe County	Yes
Unadilla Main Street Historic District	2/17/1995	Unadilla	Otoe County	No

SITE NAME	DATE LISTED	NEAREST COMMUNITY	COUNTY	IN FLOODPLAIN?
Lloyd, Harold, Birthplace	12/22/1993	Burchard	Pawnee County	No
Cincinnati Bridge	6/29/1992	DuBois	Pawnee County	Yes
Farwell Archeological District	3/4/1997	DuBois	Pawnee County	Address Restricted
Rad Jan Kollar cis 101 Z. C. B. J.	4/5/1990	DuBois	Pawnee County	Address Restricted
Hempstead, E. F., House	10/19/1982	Pawnee City	Pawnee County	No
Pawnee City Carnegie Library	12/10/2010	Pawnee City	Pawnee County	No
Pawnee City Historic Business District	2/25/1994	Pawnee City	Pawnee County	No
Pawnee County Courthouse	1/10/1990	Pawnee City	Pawnee County	No
US Post Office--Pawnee City	5/11/1992	Pawnee City	Pawnee County	No
Steinauer Opera House	7/7/1988	Steinauer	Pawnee County	Yes
Lindsley House	3/25/1999	Table Rock	Pawnee County	No
Table Rock Archeological Site	7/12/1974	Table Rock	Pawnee County	Address Restricted
Table Rock Opera House	9/28/1988	Table Rock	Pawnee County	No
Table Rock Public Square Historic District	7/8/1994	Table Rock	Pawnee County	No
Mount Zion Brick Church	12/1/1988	Barada	Richardson County	Address Restricted
Miles Ranch	12/19/2012	Dawson	Richardson County	No
Schmid, Alfred and Magdalena, Farmstead	11/16/2005	Dawson	Richardson County	No
Falls City Commercial Historic District	12/31/2013	Falls City	Richardson County	No
Gehling's Theatre	9/28/1988	Falls City	Richardson County	No
Richardson County Courthouse	7/5/1990	Falls City	Richardson County	No
Weaver, Gov. Arthur J., House	4/27/2005	Falls City	Richardson County	No
Holman, John, House	4/25/1972	Humboldt	Richardson County	No
Humboldt Commercial Historic District	9/7/2005	Humboldt	Richardson County	No
Leary Site	10/15/1966	Rulo	Richardson County	Address Restricted
Rulo Bridge	1/4/1993	Rulo	Richardson County	Yes

Source: National Park Service[31]

[31] National Park Service. June 2019. "National Register of Historic Places NPGallery Database." https://npgallery.nps.gov/nrhp.

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SECTION FOUR
RISK ASSESSMENT

INTRODUCTION

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

Table 27: Term Definitions

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

METHODOLOGY

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

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.

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.

AVERAGE ANNUAL DAMAGES AND FREQUENCY

FEMA ***Requirement §201.6(c)(2)(ii) (B)*** suggests that when the appropriate data are available, hazard mitigation plans should also provide an estimate of potential dollar losses for structures in vulnerable areas. This risk assessment methodology includes an overview of assets at risk and provides historic average annual dollar losses for all hazards for which historic event data are available. Additional loss estimates are provided separately for those hazards for which sufficient data are 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 September 2019. 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 2018.
- **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:

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

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

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

HAZARD IDENTIFICATION

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

Table 28: Hazards Addressed in the Plan

HAZARDS ADDRESSED IN THE PLAN		
Agricultural Disease (Animal and Plant)	Earthquake	Terrorism
Chemical & Radiological Spills – Fixed Site	Flooding	Tornado & High Wind
Chemical & Radiological Spills - Transportation	Levee Failure	Wildfire
Dam Failure	Severe Thunderstorm & Hail	
Drought & Extreme Heat	Severe Winter Storm	

HAZARD ELIMINATION

Given the location and history of the planning area, several hazards from the 2015 Nemaha NRD HMP were eliminated from further review. These hazards are listed below with a brief explanation of their elimination.

Eliminated Hazards from 2015 Nemaha NRD Hazard Mitigation Plan:

- **Civil Disorder –** Civil disorder events have reportedly occurred in large metropolitan areas outside of the planning area and have primarily stemmed from racial tensions, political movements, or economic and labor disputes. No state emergencies related to civil disorder have occurred. Given that no civil disorder events have been recorded in the planning area, this hazard will not be profiled further in this plan. Additionally, local law enforcement has developed planning mechanisms to specifically respond to civil disorder events. Terrorism is profiled in this plan with an emphasis on local concerns and capabilities and brief overview of civil disorder. This approach is consistent with the 2019 Nebraska HMP.

- **Landslides –** While there are data available related to landslides across the state, the last known landslide in the planning area occurred in 1987. The following table outlines the number of recorded landslide events that have occurred in the planning area and no damages were reported. Landslides across the state have been highly localized and did not exceed local capabilities to respond. This approach is consistent with the 2019 Nebraska HMP.

Table 29: Known Landslides in the Planning Area by County

COUNTY	NUMBER OF LANDSLIDES	TOTAL ESTIMATED DAMAGES
Johnson	1	$0
Nemaha	3	$0
Otoe	9	$0
Pawnee	4	$0
Richardson	10	$0

Source: Nebraska Hazard Mitigation Plan, 2014[32]; University of Nebraska-Lincoln, 2018[33]

[32] Nebraska Emergency Management Agency. 2014. "State of Nebraska Hazard Mitigation Plan."
[33] University of Nebraska-Lincoln. 2018. "Database of Nebraska Landslides." http://snr.unl.edu/data/geologysoils/landslides/landslidedatabase.aspx.

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

It should be noted that based on discussions with the Regional Planning Team, no additional hazards were added during the update of this plan. By the time COVID-19 affected the planning area in March 2020, the planning process was too far along to add Public Health Emergency to the plan. However, in future updates, the Regional Planning Team should consider including Public Health Emergency in this plan.

HAZARD IDENTIFICATION CHANGES

Additionally, several hazards from the 2015 NNRD HMP have been modified and combined to provide a more robust and interconnected discussion. The following hazards from the previous HMP have combined hazard profiles in the following section:

- Drought and Extreme Heat
- Severe Thunderstorms and Hail
- Tornadoes and High Wind

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.

Table 30: Regional Risk Assessment

HAZARD	PREVIOUS OCCURRENCE EVENTS/YEARS	APPROXIMATE ANNUAL PROBABILITY	LIKELY EXTENT
Agricultural Animal Disease	69/6	100%	~36 animals per event
Agricultural Plant Disease	76/20	100%	Unavailable
Chemical & Radiological Fixed Site Spills	33/30	Chemical: 100% Radiological: <1%	0 – 25,000 Gallons 0 – 9,000 lbs
Chemical & Radiological Transportation Spills	24/49	Chemical: 49% Radiological: <1%	0 – 145 Gallons 0 – 115 lbs
Dam Failure	2/130	2%	Varies by Structure
Drought & Extreme Heat	493/1,500 months of drought Avg 6 days per year >100°F	33% 100%	D1-D2 >100°F
Earthquakes	3/120	3%	<5.0 Magnitude
Flooding	210/24	100%	Some inundation of structures (<1% of structures) and roads near streams. Some evacuations of people may be necessary (<1% of population)
High Winds & Tornadoes	107/24	100%	Avg: EF0 Range EF0-EF2 Avg 48mph; Range 35-62 EG
Levee Failure	7/120	6%	Varies by extent
Severe Thunderstorms	815/24	100%	≥1” rainfall Avg 54 mph winds; Hail range 0.75-2.75” (H2-H4); average 1.1”
Severe Winter Storms	281/24	100%	0.25 – 0.5” Ice 20°-40° below zero (wind chill) 1-5” snow 25-35 mph winds
Terrorism & Civil Disorder	0/49	<1%	Varies by event
Wildfire	1,225/19	100%	<35 acres Some homes and structures threatened or at risk

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

Table 31: Loss Estimation for the Planning Area

HAZARD TYPE		COUNT	PROPERTY	CROP[2]
Agricultural Disease	Animal Disease[1]	69	2,469 animals	N/A
	Plant Disease[2]	76	N/A	$623,210
Chemical & Radiological Fixed Site Spills[3] *2 injuries*		33	$0	N/A
Chemical & Radiological Transportation Spills[4] *1 fatality, 3 injuries*		24	$159,399	N/A
Dam Failure[5]		2	N/A	N/A
Drought[6] **& Extreme Heat**[7,8]		432/1,496 months of drought Avg 6 days per year >100°F	N/A	$171,110,842
Earthquakes[13]		3	$0	N/A
Flooding[8] *1 injury*	Flash Flood	60	$1,880,000	$19,094,862
	Flood	150	$4,196,000	
High Winds & Tornadoes[8] *1 fatality, 1 injury*	High Winds	65	$100,000	$2,088,445
	Tornadoes	42	$20,709,000	
Levee Failure[10,11]		7	N/A	N/A
Severe Thunderstorms[8]	Hail	517	$30,000	$64,430,823
	Heavy Rain	24	$0	
	Lightning	8	$368,000	
	Thunderstorm Wind	264	$634,000	
Severe Winter Storms[8] *1 fatality*	Blizzard	26	$0	$1,973,350
	Extreme Cold/Wind Chill	20	$0	
	Heavy Snow	30	$5,000,000	
	Ice Storm	17	$2,600,000	
	Winter Storm	162	$0	
	Winter Weather	26	$0	
Terrorism & Civil Disorder[12]		0	$0	N/A
Wildfire[9] *1fatality, 2 injuries*		1,225	23,841 acres	$30,054
Total		**2,854**	**$35,676,399**	**$259,351,586**

N/A: Data not available
1 NDA (2014-2019)
2 USDA RMA (2000-2019)
3 NRC (1990-2019)
4 PHMSA (1971-2019)
5 Stanford NPDP (1890-2019)
6 NOAA (1895-2019)
7 HPRCC (1897-2019)
8 NCEI (1996-2019)
9 NFS (2010-2018)
10 USAC NLD (1900-2019)
11 USACE (2019)
12 University of Maryland (1970-2018)
13 USGS (1900-2019)

HISTORICAL DISASTER DECLARATIONS

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

FARM SERVICE AGENCY SMALL BUSINESS ADMINISTRATION DISASTERS

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

Table 32: SBA Declarations

DISASTER DECLARATION NUMBER	DECLARATION DATE	DESCRIPTION	PRIMARY COUNTIES	CONTINUOUS COUNTIES
NE-00008	9/27/2006	High Temperatures, High Winds, Excessive Heat, Hail, Tornadoes, and Ongoing Drought	Johnson, Nemaha, Pawnee, Richardson	Otoe
NE-00018	1/11/2008	Severe Winter Storm	Johnson, Nemaha, Otoe, Pawnee, Richardson	-
NE-00019	5/30/2008	Severe Storms, Tornadoes, and Flooding	Johnson, Nemaha, Pawnee	-
NE-00020	6/20/2008	Severe Storms, Tornadoes, and Flooding	Richardson	Johnson, Nemaha, Otoe, Pawnee
NE-00021	6/20/2008	Severe storms, Tornadoes, and Flooding	Otoe, Richardson	-
NE-00024	9/20/2008	Excessive Rain, Flooding, Flash Flooding, High Winds, Hail, Lightning, Tornadoes	Otoe	Nemaha, Johnson
NE-00033	2/25/2010	Severe Winter storms and Snowstorm	Johnson, Nemaha, Otoe, Pawnee, Richardson	-
NE-00035	4/21/2010	Severe storms, Ice Jams, and Flooding	Johnson, Nemaha, Otoe, Pawnee, Richardson	-
NE-00040	10/21/2010	Severe Storms, Tornadoes, Straight-line Winds, and Flooding	Johnson, Nemaha, Otoe, Pawnee, Richardson	-
NE-00041	9/7/2011 8/12/2011 11/18/2011	Flooding	Nemaha, Richardson	Johnson, Pawnee
NE-00043	8/12/2011 12/12/2011	Flooding	Otoe, Nemaha, Richardson	-
NE-00052	8/22/2012	Drought, Excessive Heat, High Winds	Johnson, Nemaha, Pawnee, Richardson	Otoe
NE-00063	7/28/2014	Severe Storms, Tornadoes, High Winds, and Flooding	Nemaha, Pawnee	-

DISASTER DECLARATION NUMBER	DECLARATION DATE	DESCRIPTION	PRIMARY COUNTIES	CONTINUOUS COUNTIES
NE-00073	3/21/2019	Severe Winter Storm, Straight-line Winds, and Flooding	Johnson, Nemaha, Otoe, Pawnee, Richardson	-

Source: Small Business Administration, 2005-2019[34]

PRESIDENTIAL DISASTER DECLARATIONS

The presidential disaster declarations involving the planning area from 1953 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.

Table 33: Presidential Disaster Declarations

DISASTER DECLARATION NUMBER	DECLARATION DATE	DISASTER TYPE	AFFECTED COUNTIES	TOTAL PUBLIC ASSISTANCE	TOTAL INDIVIDUAL ASSISTANCE
228	7/18/1967	Severe Storms and Flooding	Johnson, Pawnee, Richardson	-	-
406	10/20/1973	Severe Storms and Flooding	Johnson, Nemaha, Otoe, Pawnee, Richardson	-	-
716	7/3/1984	Tornadoes and Flooding	Nemaha, Otoe, Richardson	-	-
954	8/19/1992	Severe Storms and Flooding	Johnson, Nemaha, Otoe, Pawnee, Richardson	-	-
998	7/19/1993	Severe Storms and Flooding	Johnson, Nemaha, Otoe, Pawnee, Richardson	-	-
1123	6/25/1996	Severe Storms and Tornadoes	Johnson, Nemaha, Otoe		
1190	11/1/1997	Severe Snow Storms, Rain, and Strong Winds	Otoe	-	-
1373	5/16/2001	Severe Storms	Johnson	$2,982,075	$0
1517	5/25/2004	Severe Storms, Tornadoes, and Flooding	Johnson, Otoe, Pawnee	$13,351,657	$829,908
1706	6/6/2007	Severe Storms, Flooding, and Tornadoes	Johnson, Nemaha, Otoe, Pawnee, Richardson	$6,109,252	$0
1739	1/11/2008	Severe Winter Storms	Johnson, Nemaha, Otoe, Pawnee, Richardson	$2,895,288	$0
1765	5/30/2008	Severe Storms, Tornadoes, and Flooding	Johnson, Nemaha, Pawnee	$499,319	$0

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

DISASTER DECLARATION NUMBER	DECLARATION DATE	DISASTER TYPE	AFFECTED COUNTIES	TOTAL PUBLIC ASSISTANCE	TOTAL INDIVIDUAL ASSISTANCE
1770	6/20/2008	Severe Storms, Tornadoes, and Flooding	Richardson	$36,258,650	$1,560,229
1853	7/31/2009	Severe Storms, Tornadoes, and Flooding	Pawnee, Richardson	$4,491,366	$0
1864	12/16/2009	Severe Winter storms	Johnson, Nemaha, Pawnee, Richardson	$5,125,446	$0
1878	2/25/2010	Severe Winter Storms and Snowstorm	Johnson, Nemaha, Otoe, Pawnee	$6,577,021	$0
1902	4/21/2010	Severe Storms, Ice Jams, and Flooding	Johnson, Nemaha, Otoe, Pawnee, Richardson	$3,112,392	$0
1924	7/15/2010	Severe Storms, Tornadoes, and Flooding	Nemaha, Otoe, Richardson	$49,926,355	$0
1945	10/21/2010	Severe Storms, Tornadoes, Straight-line Winds, and Flooding	Johnson, Nemaha, Otoe, Pawnee, Richardson	$2,138,552	$0
3245	9/13/2005	Hurricane Katrina Evacuees	Johnson, Nemaha, Otoe, Pawnee, Richardson	$393,813	$0
4013	8/12/2011	Flooding	Nemaha, Otoe, Richardson	$62,808,331	$4,310,797
4185	7/28/2014	Severe Storms, Tornadoes, Straight-line Winds, and Flooding	Nemaha, Pawnee	$54,271	$0
4225	6/25/2015	Severe Storms, Tornadoes, Straight-line Winds, and Flooding	Johnson, Nemaha, Otoe, Pawnee, Richardson	$14,492,814	$0
4420	3/21/2019	Severe Winter Storm, Straight-line Winds, and Flooding	Johnson, Nemaha, Otoe, Pawnee, Richardson	$85,227,842	$27,196,619

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

[35] Federal Emergency Management Agency. 2019. "Disaster Declarations." Accessed January 2020. https://www.fema.gov/openfema-dataset-disaster-declarations-summaries-v1.

CLIMATE ADAPTATION

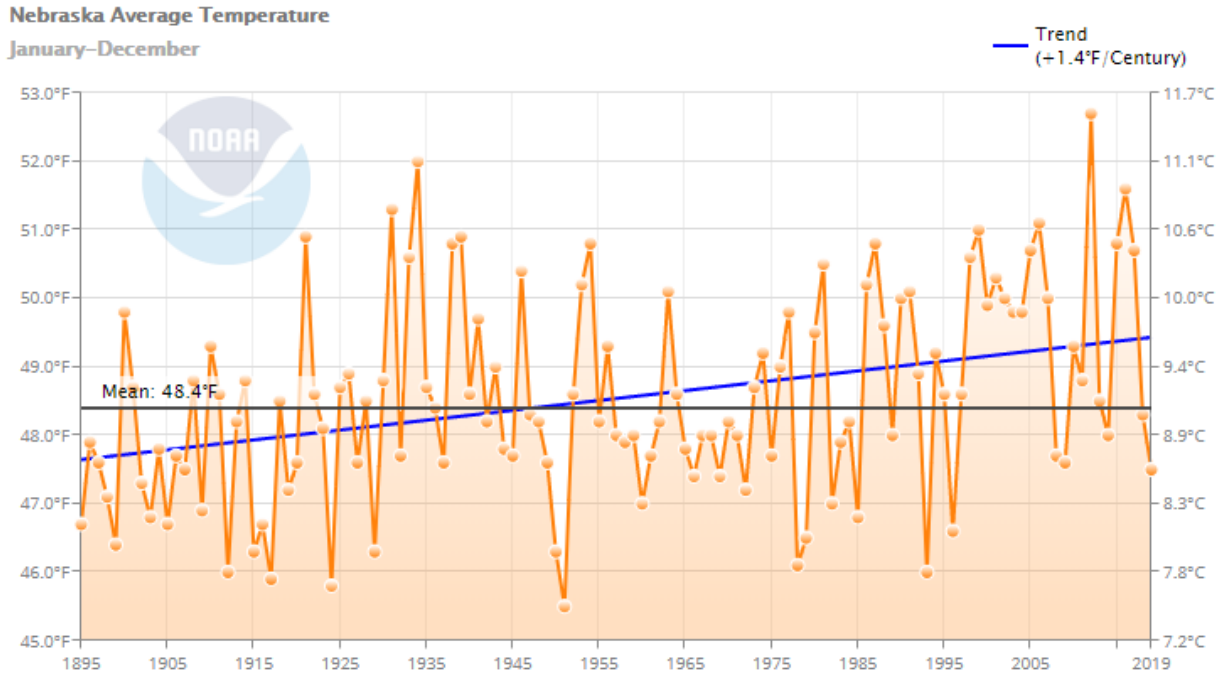
Long term climate trends have increased and will continue to increase the planning area's vulnerability to hazards. Since 1895, Nebraska's overall average temperature has increased by almost 2°F (Figure 11). This trend will likely contribute to increase in the frequency and intensity of hazardous events, which will cause significant economic, social, and environmental impacts on Nebraskans.

As seen in Figure 12 and Figure 13, the United States is experiencing an increase in the number of billion-dollar natural disasters. Regardless of whether this trend is due to a change in weather patterns or due to increased development, the trend exists.

According to a recent University of Nebraska report (*Understanding and Assessing Climate Change: Implications for Nebraska,* 2014),[36] Nebraskans can expect the following from the future climate:

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

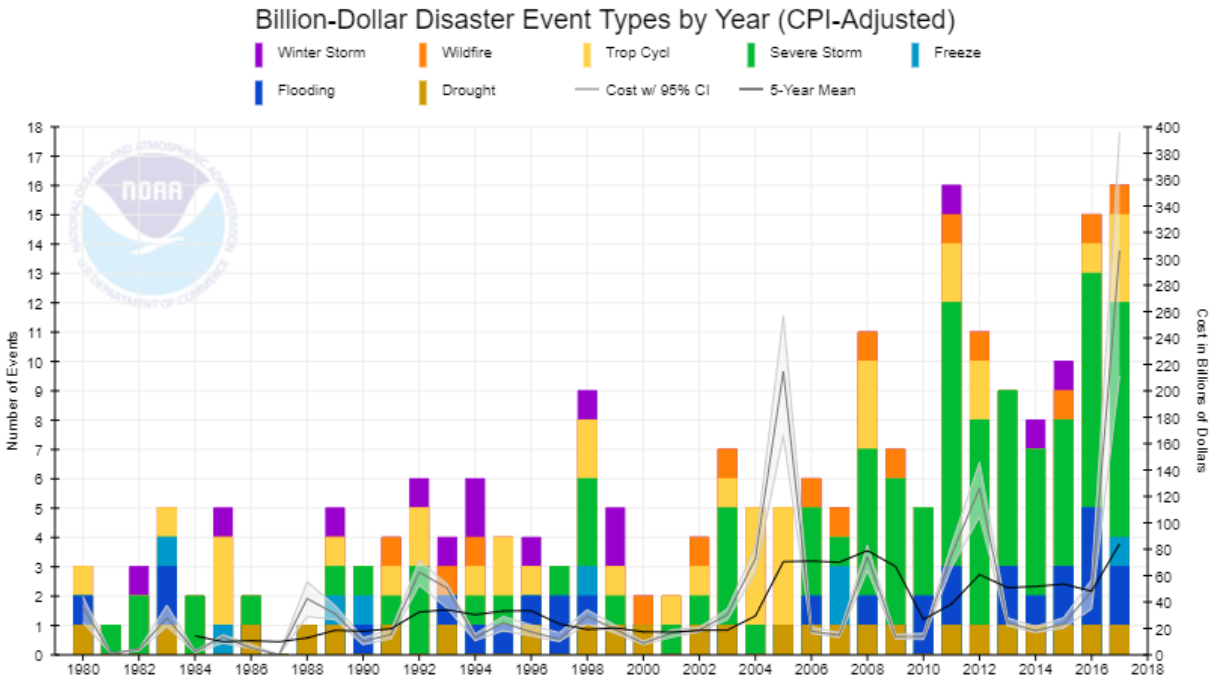
Figure 11: Average Temperature (1895-2019)



Source: NOAA/NCEI, 2020[37]

[36] Rowe, C.M., Bathke, D.J., Wilhite, D.A., & Oglesby, R.J. 2014. "Understanding and Assessing Climate Change: Implications for Nebraska."
[37] National Oceanic and Atmospheric Administration NCEI. 2020. "Climate at a Glance". Accessed July 2020. https://www.ncdc.noaa.gov/cag/statewide/time-series

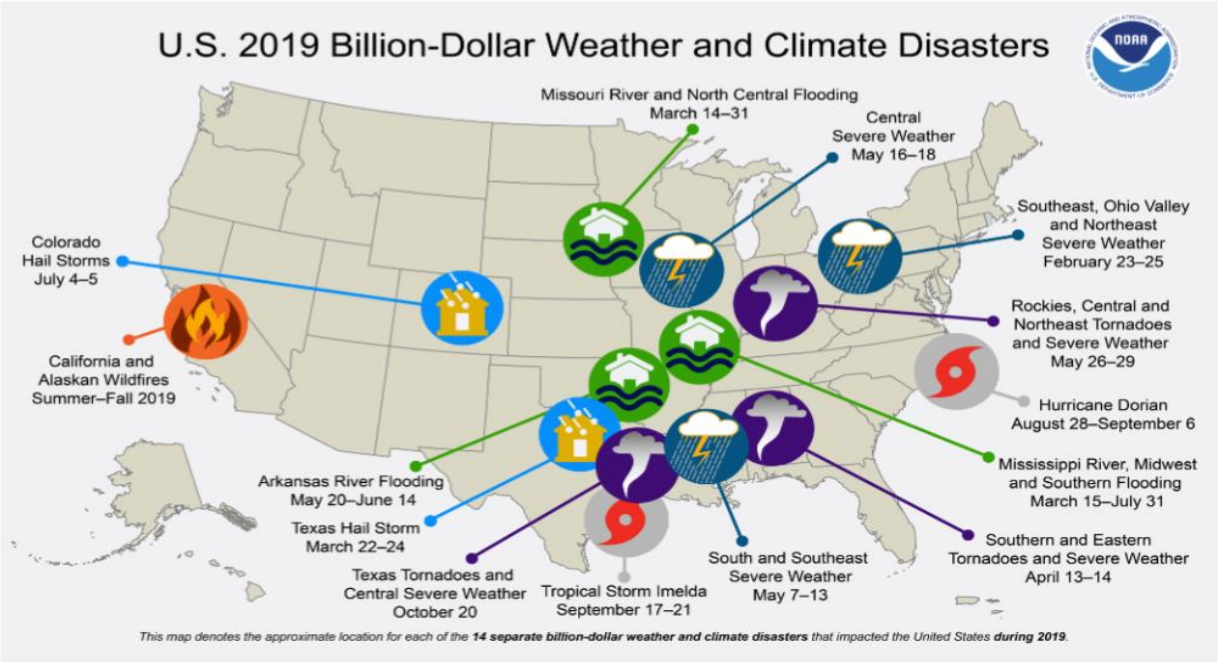
Figure 12: Billion Dollar Disasters



Source: NOAA, 2018

Figure 13: Billion Dollar Weather and Climate Disasters

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

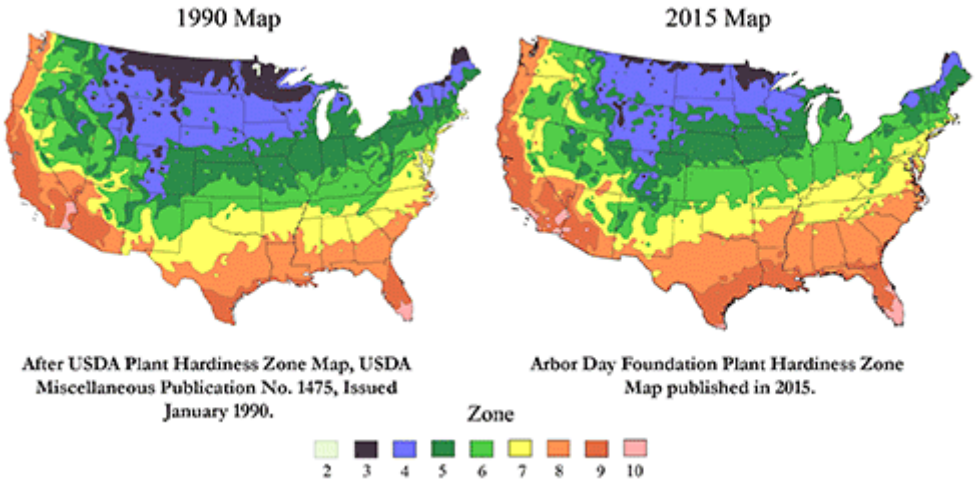


2019 is the fifth consecutive year (2015-2019) in which 10 or more billion-dollar weather and climate disaster events have impacted the United States. Over the last 40 years (1980-2019), the **years with 10 or more** separate billion-dollar disaster events include **1998, 2008,** 2011-2012, and 2015-2019.

Source: NOAA, 2020

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

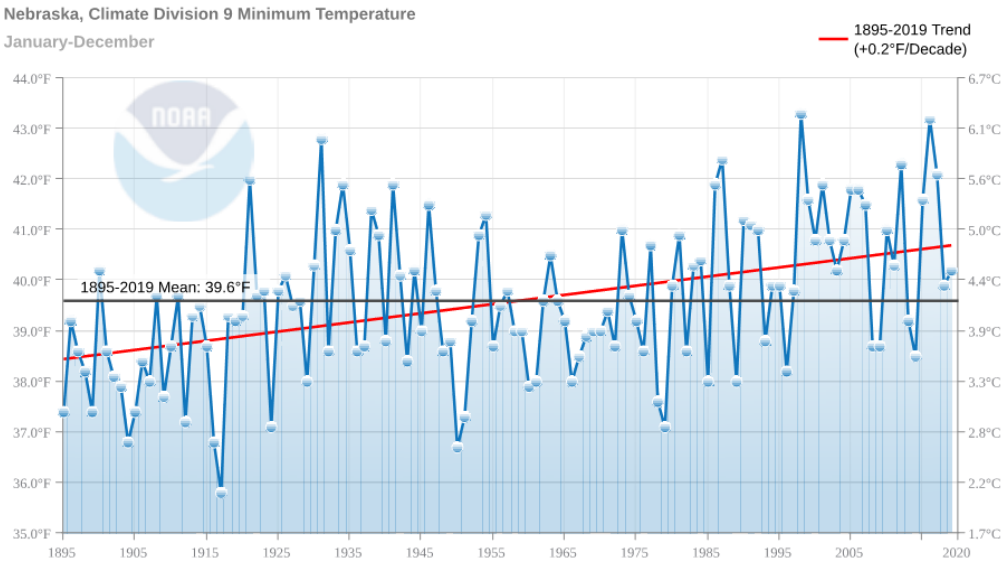
Figure 14: Plant Hardiness Zone Change



Source: Arbor Day Foundation, 2018[38]

Figure 15 shows a trend of increasing minimum temperatures in Climate Division 9, which includes the planning area. High nighttime temperatures can reduce grain yields, increase stress on animals, and lead to an increase in heat-related deaths.

Figure 15: Climate Division 9, Minimum Temperature 1895 – 2019



Source: NOAA/NCEI, 2020

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

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

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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: Prioritized Hazards by Jurisdictions

JURISDICTION	AGRICULTURAL DISEASE	CHEMICAL & RADIOLOGICAL - FIXED SITE	CHEMICAL & RADIOLOGICAL – TRANSPORTATION	DAM FAILURE	DROUGHT & EXTREME HEAT	EARTHQUAKE	FLOODING	LEVEE FAILURE	SEVERE THUNDERSTORMS	WINTER STORMS	TERRORISM	TORNADO & HIGH WIND	WILDFIRE
Nemaha NRD				X	X		X	X	X			X	
Southeast District Health Department	X						X	X	X			X	
Johnson County	X		X	X	X		X		X	X		X	
Village of Cook									X	X		X	
Village of Elk Creek		X	X						X	X		X	
Village of Sterling			X				X		X	X		X	
City of Tecumseh				X	X				X	X		X	
Cook Fire District				X	X					X		X	X
Elk Creek Volunteer Fire Dept.		X	X						X	X		X	
Johnson County Central Public Schools		X							X	X	X	X	
Sterling Rural Fire District		X	X						X	X		X	
Nemaha County							X	X	X	X		X	
City of Auburn		X	X		X		X		X	X		X	

JURISDICTION	AGRICULTURAL DISEASE	CHEMICAL & RADIOLOGICAL - FIXED SITE	CHEMICAL & RADIOLOGICAL – TRANSPORTATION	DAM FAILURE	DROUGHT & EXTREME HEAT	EARTHQUAKE	FLOODING	LEVEE FAILURE	SEVERE THUNDERSTORMS	WINTER STORMS	TERRORISM	TORNADO & HIGH WIND	WILDFIRE
Village of Brock							X		X	X		X	
Village of Brownville		X					X				X	X	
Village of Johnson							X			X		X	
Village of Julian									X	X		X	
Village of Nemaha		X	X				X	X		X			
City of Peru							X	X	X	X		X	
Auburn Volunteer Fire Dept.		X	X							X		X	
Peru Rural Fire District			X				X	X				X	X
Otoe County	X	X	X	X			X	X	X	X		X	
Village of Burr		X	X						X			X	X
Village of Douglas					X		X		X	X		X	
Village of Dunbar							X		X	X			
Village of Lorton	X						X		X	X		X	
City of Nebraska City			X				X		X	X		X	
Village of Otoe			X	X			X			X		X	
Village of Palmyra							X		X	X		X	
City of Syracuse							X		X	X		X	
Village of Talmage							X		X	X		X	
Village of Unadilla									X	X		X	
Nebraska City Public Schools									X	X	X	X	
Palmyra District OR-1			X						X	X	X	X	
Palmyra Rural Fire District					X		X		X	X		X	X

JURISDICTION	AGRICULTURAL DISEASE	CHEMICAL & RADIOLOGICAL - FIXED SITE	CHEMICAL & RADIOLOGICAL – TRANSPORTATION	DAM FAILURE	DROUGHT & EXTREME HEAT	EARTHQUAKE	FLOODING	LEVEE FAILURE	SEVERE THUNDERSTORMS	WINTER STORMS	TERRORISM	TORNADO & HIGH WIND	WILDFIRE
Syracuse Volunteer Fire Dept.		X	X						X			X	
Talmage Rural Fire Dept.	X		X				X			X		X	
Unadilla Volunteer Fire and Rescue	X		X		X				X			X	
Pawnee County				X	X		X		X	X		X	
Village of Burchard					X				X	X		X	
Village of DuBois			X						X	X		X	
City of Pawnee City		X	X		X				X	X		X	
Village of Steinauer					X		X		X	X		X	
Village of Table Rock	X				X				X	X		X	
Humboldt Table Rock Steinauer Schools							X		X	X		X	
Table Rock Fire District					X				X	X			X
Richardson County	X		X	X	X		X	X				X	
Village of Dawson			X							X		X	
City of Falls City			X				X		X	X		X	
City of Humboldt		X	X	X	X				X	X		X	X
Village of Rulo				X			X	X				X	
Village of Salem			X		X					X		X	X
Village of Shubert					X				X	X		X	X
Village of Stella					X				X			X	
Village of Verdon					X				X	X		X	
Dawson Rural Fire Department			X		X					X		X	

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AGRICULTURAL ANIMAL & 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 vested 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 more than $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 $781 million.[39]

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	SHEEP AND LAMBS	POULTRY EGG LAYERS
Johnson	$219,119,000	$214,360,000	$4,271,000	$2,227,000	D
Nemaha	$7,693,000	$6,187,000	$1,453,000	$27,000	D
Otoe	$25,077,000	$6,882,000	$17,734,000	$42,000	$41,000
Pawnee	$22,101,000	$19,790,000	$2,063,000	$118,000	D
Richardson	$32,060,000	$19,066,000	$9,555,000	$191,000	D
Total	$306,050,000	$266,285,000	$35,076,000	$2,605,000	$41,000

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. However, the majority of the planning area is comprised of pasture/grassland and cropland (primarily corn and soybeans). The following tables provide the value and acres of land in farms for the planning area. Otoe County has the highest number of farms and land in farms in the planning area as well as the highest crop sales, which account for over 30 percent of sales in the five-county area. Soybeans are the most prevalent crop type in the region followed by corn.

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
Johnson	374	119,488	$49,187,000
Nemaha	303	216,157	$106,734,000
Otoe	617	315,519	$145,447,000
Pawnee	355	165,417	$56,768,000
Richardson	511	251,097	$117,288,000
Total	2,160	1,067,678	$475,424,000

Source: U.S. Census of Agriculture, 2017

[39] US Department of Agriculture, National Agricultural Statistics Server. 2019. "2017 Census of Agriculture – County Data."

Table 37: Crop Values

COUNTY	CORN		SOYBEANS		WHEAT	
	Acres Planted	Value (2017)	Acres Planted	Value (2017)	Acres Planted	Value (2017)
Johnson	53,776	$27,917,000	49,938	$19,417,000	1,871	$353,000
Nemaha	102,782	$58,107,000	107,752	$47,761,000	1,533	$357,000
Otoe	151,746	$78,736,000	151,512	$64,599,00	1,185	$280,000
Pawnee	68,323	$28,471,000	75,714	$26,358,000	1,521	$322,000
Richardson	122,207	$64,784,000	116,364	$50,725,000	2,354	$492,000
Total	498,834	$258,015,000	504,280	$208,860,000	8,464	$1,804,000

Source: U.S. Census of Agriculture, 2017

LOCATION

Given the strong agricultural presence in the planning area, animal and plant diseases have the potential to occur across the planning area. If a major outbreak were to occur, the entire planning area's economy 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 69 instances of animal diseases reported between January 2014 and October 2019 by the NDA (Table 38). These outbreaks affected 2,469 animals.

Table 38: Livestock Diseases Reported in the Planning Area

YEAR	COUNTY	DISEASE	POPULATION IMPACTED
2014	Johnson, Nemaha, Richardson	Anaplasmosis	7
	Richardson	Bluetongue	1
	Johnson	Bovine Viral Diarrhea	2
	Johnson, Richardson	Enzootic Bovine Leukosis	14
	Nemaha, Richardson	Leptospirosis	2
	Johnson, Richardson	Paratuberculosis	3
	Nemaha, Otoe	Porcine Reproductive and Respiratory Syndrome	2
2015	Johnson, Nemaha	Bovine Viral Diarrhea	175
	Johnson	Enzootic Bovine Leukosis	25
2016	Johnson, Nemaha, Otoe, Richardson	Anaplasmosis	17
	Richardson	Bluetongue	1
	Johnson, Nemaha, Otoe, Richardson	Enzootic Bovine Leukosis	27
	Nemaha, Richardson	Leptospirosis	3
	Nemaha, Otoe, Richardson	Paratuberculosis	5
	Nemaha	Porcine Epidemic Diarrhea	1
	Nemaha, Richardson	Trichomoniasis	2
2017	Johnson, Otoe, Richardson	Anaplasmosis	3
	Johnson, Otoe	Bovine Viral Diarrhea	2

YEAR	COUNTY	DISEASE	POPULATION IMPACTED
	Johnson, Otoe	Enzootic Bovine Leukosis	8
	Johnson, Nemaha	Johnson, Nemaha	202
	Nemaha	Porcine Circovirus	1
	Nemaha	Porcine Circovirus Type 2	500
	Nemaha, Otoe	Seneca Valley Virus	2
2018	Johnson, Otoe, Richardson	Anaplasmosis	27
	Pawnee	Enzootic Abortion of Ewes	2
	Johnson, Nemaha, Richardson	Enzootic Bovine, Leukosis	9
	Richardson	Paratuberculosis	4
	Richardson	Porcine Circovirus	100
	Richardson	Porcine Circovirus Type 2	100
	Otoe, Richardson	Porcine Reproductive and Respiratory Syndrome	3
	Richardson	Scabies	1,200
	Johnson	West Nile Virus	1
2019	Johnson, Richardson	Anaplasmosis	2
	Richardson	Bluetongue	1
	Pawnee	Bovine Viral Diarrhea	5
	Johnson, Richardson	Enzootic Bovine Leukosis	7
	Richardson	Leptospirosis	1
	Richardson	Paratuberculosis	1
	Pawnee	Porcine Reproductive and Respiratory Syndrome	1

Source: Nebraska Department of Agriculture, Jan 2014 - Oct 2019[40]

The most prevalent agricultural diseases seen across the planning area and the state include: Chronic Wasting Disease, Vesicular Stomatitis, Epizootic Hemorrhagic Disease, and Bovine Tuberculosis. 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	Physoderma
	Maize Chlorotic Mottle Virus	
SOYBEANS	Anthracnose	Pod and Stem Blight

[40] Nebraska Department of Agriculture. 2018. "Livestock Disease Reporting." http://www.nda.nebraska.gov/animal/reporting/index.html.

CROP DISEASES		
	Bacterial Blight	Purple Seed Stain
	Bean Pod Mottle	Rhizoctonia Root Rot
	Brown Spot	Sclerotinia Stem Rot
	Brown Stem Rot	Soybean Mosaic Virus
	Charcoal Rot	Soybean Rust
	Frogeye Leaf Spot	Stem Canker
	Phytophthora Root and Stem Rot	Sudden Death Syndrome
WHEAT	Barley Yellow Dwarf	Leaf Rust
	Black Chaff	Tan Spot
	Crown and Root Rot	Wheat Soy-borne Mosaic
	Fusarium Head Blight	Wheat Streak Mosaic
SORGHUM	Ergot	Zonate Leaf Spot
	Sooty Stripe	
OTHER PESTS	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	

EMERALD ASH BORER

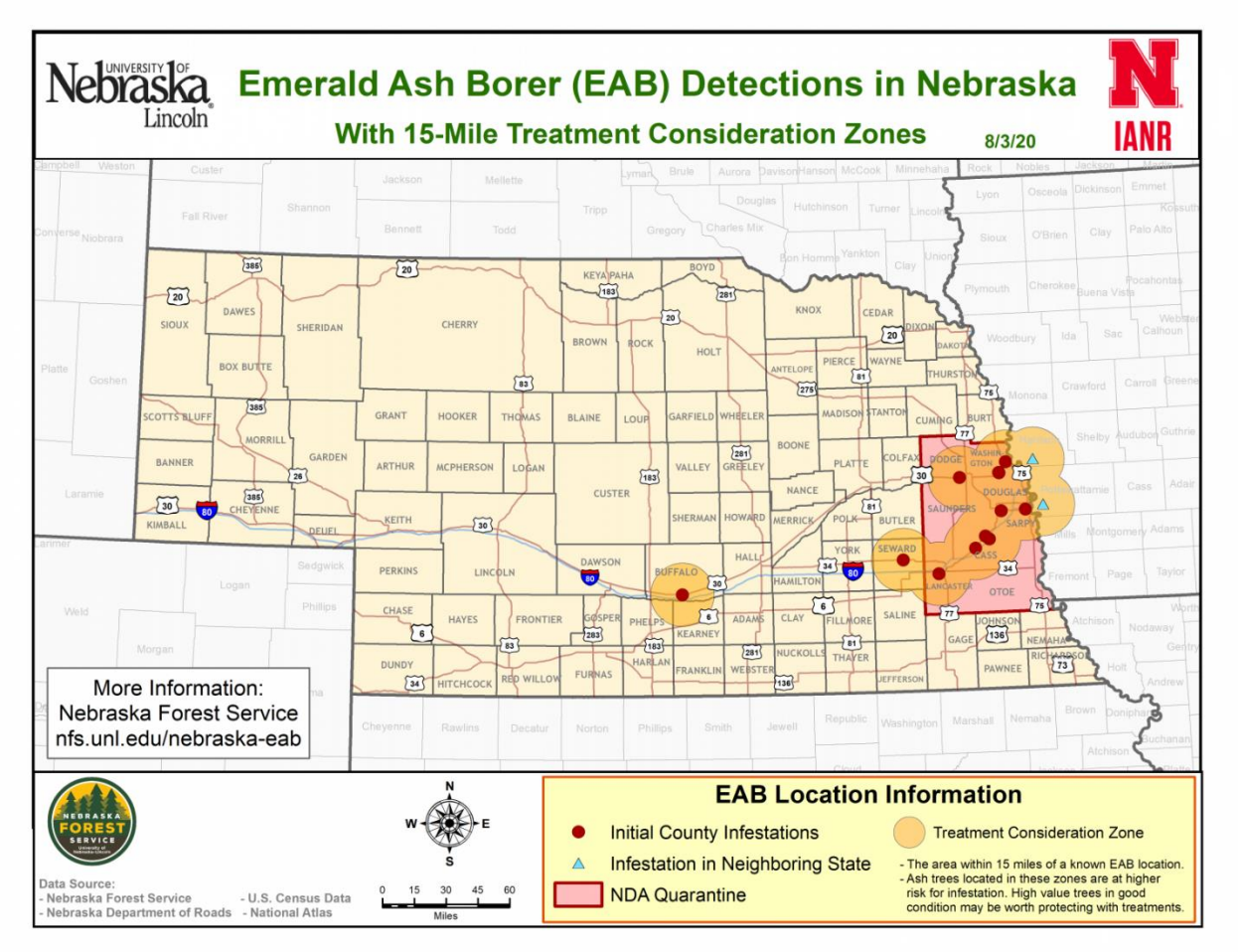
The spread and presence of the Emerald Ash Borer (EAB) have become a rising concern for many Nebraskan communities in recent years. The beetle spreads through transport of infected ash trees, lumber, and firewood. All species of North American ash trees are vulnerable to infestation. Confirmed cases 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 and Lancaster County in 2018.[41] Figure 16 shows the locations of Nebraska's confirmed EAB cases as of August 2020. Additional confirmed cases have likely occurred and many communities across the state are prioritizing the removal of ash trees to help curb potential infestations and tree mortality.

While adult beetles cause little damage, larvae damage trees by feeding on the inner bark of mature and growing trees, causing tunnels. Effects of EAB infestation include: extensive damage to trees by birds, canopy dieback, bark splitting, and water sprout growth at the tree base, and eventual tree mortality. EAB has impacted millions of trees across North America, killing young trees one to two years after infestation and mature trees three to four years after infestation.[42] Estimated economic impacts to Nebraska's 44 million ash trees exceed $961 million.[43] 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.

Because of the Nebraska infestations, a quarantine has been established in Cass, Dodge, Douglas, Otoe, Sarpy, Saunders, Washington, and Lancaster Counties that restricts the movement of ash trees and lumber to further mitigate the spread of EAB. The Nebraska Department of Agriculture regulates and monitors the sale and distribution of firewood in the state to restrict the flow of firewood from outside the state.

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

Figure 16: EAB Confirmation in Nebraska



Source: NDA, 2019[44]

AVERAGE ANNUAL LOSSES

According to the USDA RMA (2000-2019) 76 plant disease events occurred in the planning area. While the RMA does not track losses for livestock, annual crop losses from plant disease can be estimated. Agricultural livestock disease losses are determined from the Nebraska Department of Agriculture.

Table 40: Agricultural Plant Disease Losses

HAZARD TYPE	NUMBER OF EVENTS	EVENTS PER YEAR	TOTAL PLANT LOSSES	AVERAGE ANNUAL CROP LOSS
Plant Disease	76	3.8	$623,210	$31,161

Source: RMA, 2000-2019

Table 41: Agricultural Livestock Disease Losses

HAZARD TYPE	NUMBER OF EVENTS	EVENTS PER YEAR	TOTAL ANIMAL LOSSES	AVERAGE ANIMAL LOSSES PER EVENT
Animal Disease	69	11.5	2,469	36

Source: NDA, 2014-2019

[44] Nebraska Department of Agriculture. 2019. "Emerald Ash Borer." https://nda.nebraska.gov/plant/entomology/eab/index.html.

EXTENT

There is no standard for measuring the magnitude of agricultural disease. Historical events have impacted a relatively small number of livestock and/or crops. 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

Given the historic record of occurrence for agricultural disease events (69 animal disease outbreaks reported in six years, 76 plant disease outbreaks in 20 years), for the purposes of this plan, the annual probability of agricultural disease occurrence is 100 percent.

REGIONAL VULNERABILITIES

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

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

CHEMICAL & RADIOLOGICAL FIXED SITES

The following description for hazardous materials is provided by FEMA:

> Chemicals are found everywhere. They purify drinking water, increase crop production and simplify household chores. But chemicals also can be hazardous to humans or the environment if used or released improperly. Hazards can occur during production, storage, transportation, use or disposal. You and your community are at risk if a chemical is used unsafely or released in harmful amounts into the environment where you live, work or play.[45]

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

Chemical manufacturers are one source of hazardous materials, but there are many others, including service stations, hospitals, and hazardous materials waste sites.

Varying quantities of hazardous materials are manufactured, used, or stored in an estimated 4.5 million facilities in the United States—from major industrial plants to local dry-cleaning establishments or gardening supply stores.

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

The Environmental Protection Agency (EPA) requires the submission of the types and locations of hazardous chemicals being stored at any facility within the state over the previous calendar year. This is completed by submitting a Tier II form to the EPA as a requirement of the Emergency Planning and Community Right-to-Know Act of 1986.[46]

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

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

Table 42: Hazardous Material Classes

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

Source: Emergency Response Guidebook, 2016[47]

LOCATION

Chemical Fixed Sites

There are 112 locations across the planning area that house hazardous materials, according to the Tier II reports submitted to the Nebraska Department of Environment and Energy (NDEE) in 2019. A list of chemical storage sites can be found in *Section Seven: Community Profiles* for each jurisdiction.

Radiological Fixed Site – Cooper Nuclear Station

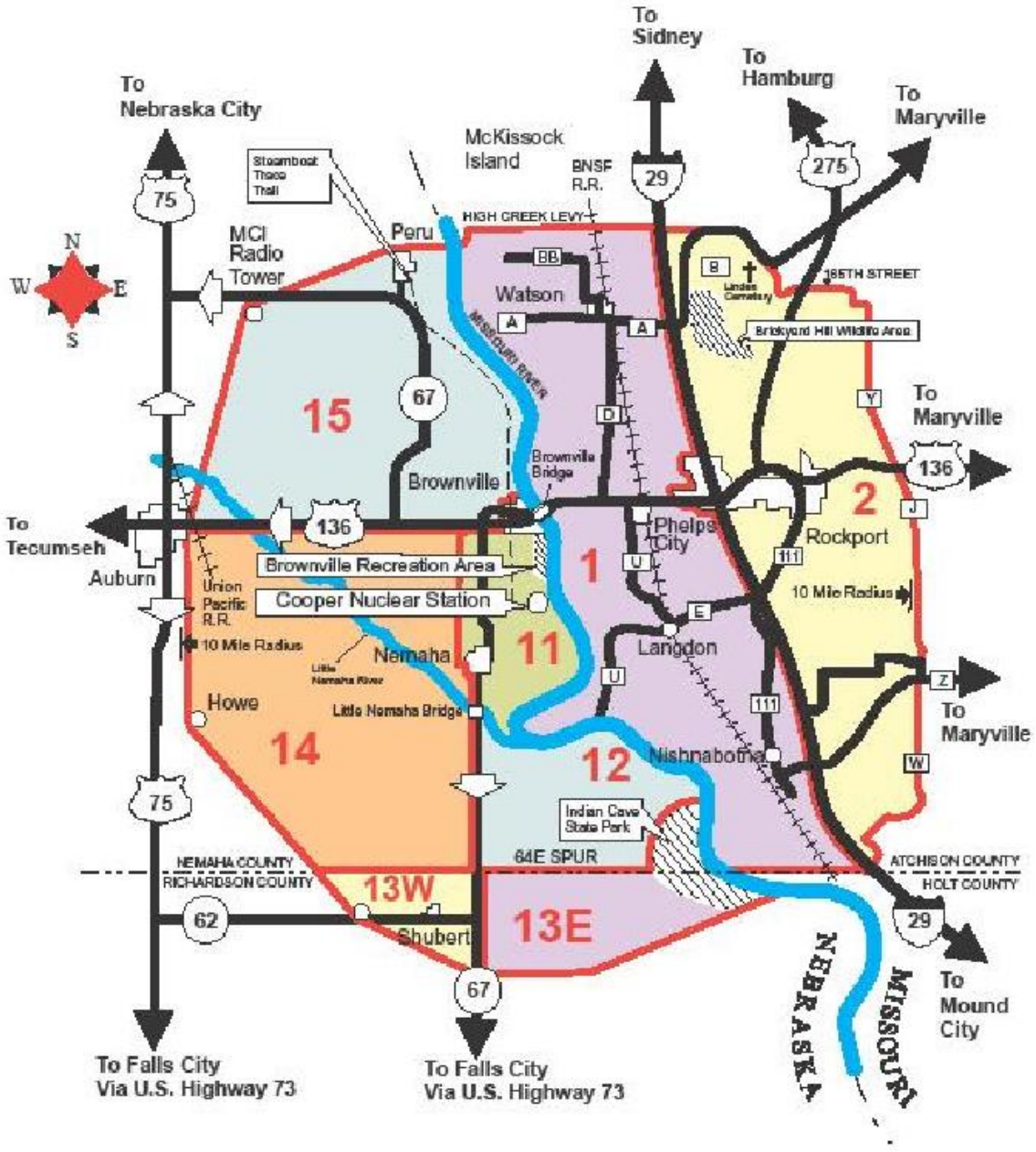
There is one radiological fixed site in the planning area. Cooper Nuclear Station is located just south of Brownville on 1,121 acres adjacent to the Missouri River. Commissioned on July 1, 1974, it is owned and operated by the Nebraska Public Power District. The plume emergency planning zone (EPZ) is a ten-mile

[47] 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.

radius around the plant and is shared by the states of Nebraska and Missouri. Counties falling within the Nebraska plume EPZ are Nemaha and Richardson Counties. The Brownville Recreational area, Indian Cave State Park, and Steamboat Trace Trail are within the ten-mile EPZ. The ingestion EPZ is a 50-mile radius around the plant. Counties falling within the ingestion EPZ in Nebraska are Cass, Gage, Johnson, Lancaster, Nemaha, Pawnee, Otoe, Richardson, and Sarpy Counties.

In the event of an evacuation, those needing shelter would go to either the Falls City High School or the Nebraska City Middle School. A map of evacuation routes is provided below.

Figure 17: Evacuation Routes for Cooper Nuclear Station



Source: NEMA

HISTORICAL OCCURRENCES

Chemical Fixed Sites

According to the U.S. Coast Guard's National Response Center (NRC) database, there have been 33 fixed site chemical spills from 1990 through November 2019 in the planning area. There were no reported property damages or evacuations from these chemical spills. The following table lists only those events with the largest quantity of material released or incidents with injuries.

Table 43: Chemical Fixed Site Incidents

YEAR OF EVENT	LOCATION OF RELEASE	QUANTITY SPILLED	MATERIAL INVOLVED	NUMBER OF INJURIES
1995	Nebraska City	9,000 Pounds	Anhydrous Ammonia	0
1999	Nebraska city	25,000 Gallons	Untreated Wastewater	0
2014	Tecumseh	Unknown	Anhydrous Ammonia	2

Source: National Response Center, 1990-Nov 2019[48]

Radiological Fixed Site – Cooper Nuclear Station

Two known low-grade incidents have occurred at Cooper Nuclear Station. The first Unusual Event (see definition below under *Extent*) began in June of 2011 as the Missouri River reached 899.1 feet above sea level. The emergency action plan for the plant states that the plant must notify the Nuclear Regulatory Commission when the Missouri River reaches an elevation of 899 feet above sea level. On June 23, 2011, the river reached 900.6 feet, while the elevation of the plant to move to the Alert status level is 902 feet, but this level was not reached. The plant left emergency status on July 12, 2011, when the river dropped to 895.8 feet, and operated safely during the Unusual Event emergency status.

The second incident was also an Unusual Event due to rising flood waters on the Missouri River, which began on March 15, 2020. It remained in this emergency status for nine days until the river levels had fallen to 896 feet above sea level, which ended on March 24, 2020. The plant operated safely while under the Unusual Event emergency status.

EXTENT

Chemical Fixed Sites

The extent of chemical spills at fixed sites varies and depends on the type of chemical that is released, with most events localized to the facility. Thirty-three releases have occurred in the planning area, and the total amount spilled ranged from 0.25 to 25,000 gallons or 50 to 9,000 pounds of pollutant. Of the 33 chemical spills, one event in 2014 led to two injuries from an unknown amount of anhydrous ammonia released in Tecumseh. Anhydrous ammonia and oil were most commonly spilled.

Radiological Fixed Site – Cooper Nuclear Station

The Nuclear Regulatory Commission has a classification scale for nuclear power plant events to ensure consistency in the communications and emergency response. Cooper Nuclear Station has only reported Unusual Events. The other event types are possible if the station were to not maintain the radioactive material in the proper way.

[48] U.S. Coast Guard National Response Center. 2019. "Chemical Pollution and Railroad Incidents, 1990-November 2019." [datafile]. https://nrc.uscg.mil/.

Table 44: Nuclear Power Plant Emergency Event Phases

EVENT TYPE	DESCRIPTION
Unusual Event	This is the lowest of the four emergency classifications. This classification indicates that a small problem has occurred. No release of radioactive material is expected and federal, state, and county officials are notified.
Alert	Events are in process or have occurred which involve an actual or potential substantial degradation in the level of safety of the plant. Any releases of radioactive material from the plant are expected to be limited to a small fraction of the EPA Protective Action Guide for Nuclear Incidents.
Site Area Emergency	Involves events in process or which have occurred that result in actual or likely major failures of plant functions needed for protection of the public. Any releases of radioactive material are not expected to exceed levels established by the EPA Protective Action Guide for Nuclear incidents except near the site boundary.
General Emergency	The most serious emergency classification and indicates a serious problem. A general emergency involves actual or imminent substantial core damage or melting of reactor fuel with the potential for loss of containment integrity. Emergency sirens will be sounded and federal, state, and county officials will act to ensure public safety. Radioactive releases during a general emergency can reasonably be expected to exceed EPA Protective Action Guide for Nuclear Incidents for more than the immediate site area.

Source: NRC

AVERAGE ANNUAL LOSSES

The following table estimates the average number of events per year and annual damages.

Table 45: Chemical Fixed Site Average Annual Losses

HAZARD TYPE	NUMBER OF EVENTS	EVENTS PER YEAR	TOTAL DAMAGES	AVERAGE ANNUAL CHEMICAL SPILL LOSS
Chemical Spills – Fixed	33	1.1	$0	$0

Source: NRC, 1990 – Nov. 2019

PROBABILITY

Chemical Fixed Sites

Chemical releases at fixed site storage areas are likely to occur in the future but unlikely to lead to evacuations in surrounding areas. Given the historic record of occurrence (33 chemical fixed site spills reported in 30 years), the probability of occurrence for chemical fixed site spills is 100 percent annually.

Radiological Fixed Site – Cooper Nuclear Station

Two Unusual Events have occurred since 1974, but no releases or General Emergency events have been reported. In the unlikely event of a General Emergency, the 10-mile radius EPZ would be instituted, which would include the communities of Brownville, Nemaha, Peru, and Shubert. Furthermore, if an event were to occur at the station, the entire 10-mile radius may not be affected depending on the type of accident and

the weather conditions. Since the station has not had a General Emergency, the probability for a radiological event will be stated at less than 1 percent annually for this plan.

REGIONAL VULNERABILITIES

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

Table 46: Regional Chemical and Radiological Fixed Site Vulnerabilities

SECTOR	VULNERABILITY
People	-Those in close proximity could have minor to severe health impacts -Possible evacuation -Hospitals, nursing homes, and the elderly at greater risk due to low mobility
Economic	-A chemical plant shutdown in smaller communities would have significant impacts to the local economy -A long-term evacuation of the emergency planning zone (EPZ) would have a negative effect on the economy in the area
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

CHEMICAL & RADIOLOGICAL TRANSPORTATION

The transportation of hazardous materials is defined by the U.S. Pipeline and Hazardous Materials Safety Administration (PHMSA) as "…a substance that has been determined to be capable of posing an unreasonable risk to health, safety, and property when transported in commerce…"[49] According to PHMSA, hazardous materials traffic in the U.S. now exceeds 1,000,000 shipments per day.[50]

Nationally, the U.S. has had 116 fatalities associated with the transport of hazardous materials between 2007 through 2017.[51] While such fatalities are a low probability risk, even one event can harm many people. For example, a train derailment in Crete, Nebraska, in 1969 allowed anhydrous ammonia to leak from a ruptured tanker. The resulting poisonous fog killed nine people and injured 53.

LOCATION

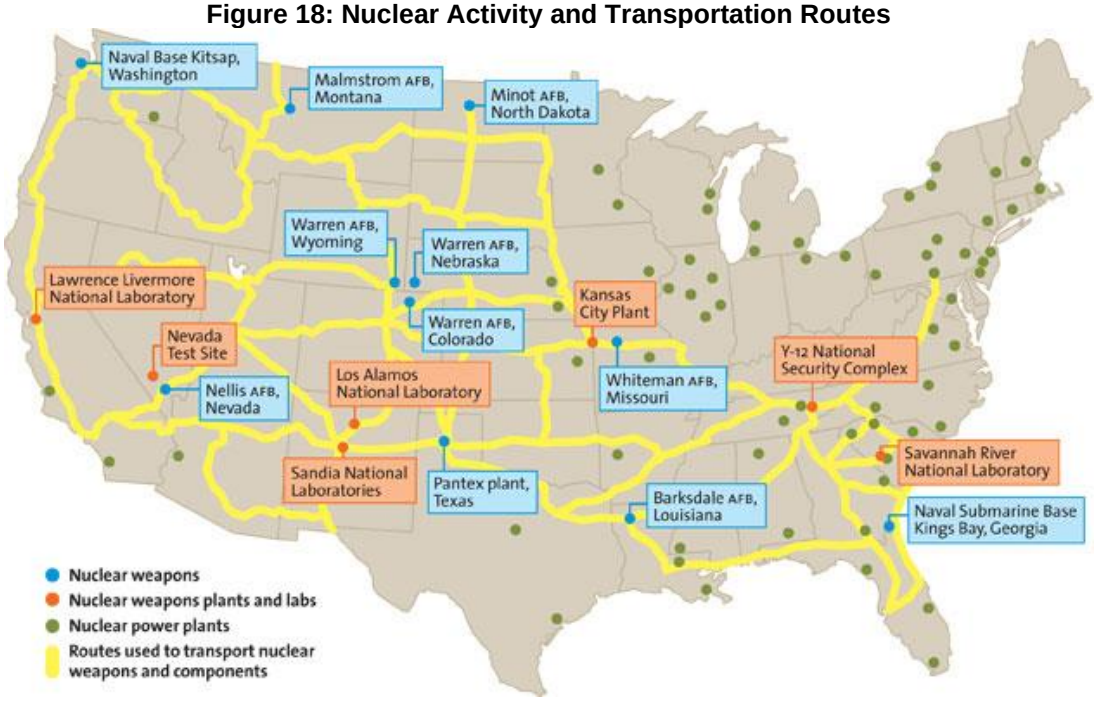
Chemical Transportation

Chemical releases can occur during transportation, primarily on major transportation routes as identified in Figure 18 and Figure 19. A large number of spills also typically occur during the loading and unloading of chemicals. According to PHMSA there are several gas transmission and hazardous liquid pipelines located in the planning area.[52]

Radiological Transportation

Participating communities specifically reported transportation along railroads as having the potential to impact communities. It was also reported, however, that railroads providing service through the planning area have already developed plans to respond to chemical releases along rail routes.

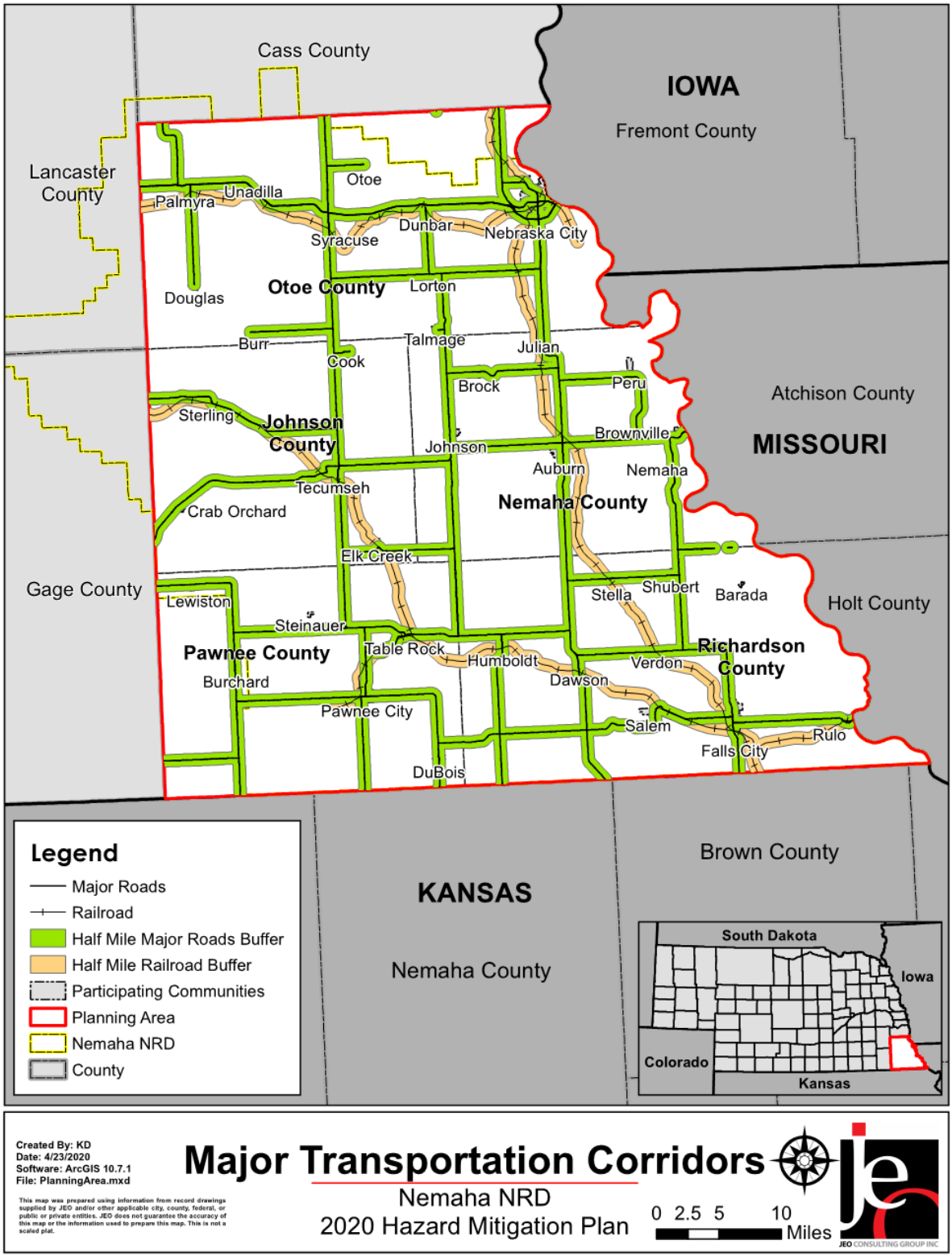
Figure 18: Nuclear Activity and Transportation Routes



Source: Jeff Berlin

[49] Pipeline and Hazardous Materials Safety Administration. 2018. "Hazmat Safety Community FAQ." https://phmsa.dot.gov/regulations.
[50] U.S. Department of Transportation. 2015. "2012 Economic Census: Transportation." https://www.census.gov/library/publications/2015/econ/ec12tcf-us.html.
[51] Pipeline and Hazardous Materials Safety Administration. 2017. "10 Year Incident Summary Reports." https://www.phmsa.dot.gov/hazmat/library/data-stats/incidents.
[52] Pipeline and Hazardous Materials Safety Administration. 2019. "National Pipeline Mapping System." https://www.npms.phmsa.dot.gov/.

Figure 19: Major Transportation Routes with Half Mile Buffer



HISTORICAL OCCURRENCES

Chemical Transportation

PHMSA reports that 24 chemical spills have occurred during transportation in the planning area between 1971 and November 2019. During these events, there was one fatality, three injuries, and $159,399 in damages.

Radiological Transportation

There have been no reports of radiological incidents during transportation in the planning area.

The following table provides a list of those chemical transportation events that have caused some of the most significant damages, injuries, or death.

Table 47: Historical Chemical Spills 1971-2019

DATE OF EVENT	LOCATION OF RELEASE	FAILURE DESCRIPTION	MATERIAL INVOLVED	TRANSPORTATION METHOD	INJURIES OR FATALITIES	TOTAL DAMAGE
6/20/1990	Auburn	Punctured	15 LGA Paint	Highway	0	$195
3/16/1992	Nebraska City	Defective Component	0.06 LGA Liquid N.O.S.	Highway	1 injury	14,260
8/9/1994	Pawnee	Loose Components	0.03 LGA Sulfuric Acid	Highway	0	$125
1/8/2003	Falls City	Loose Closure Component	20 LGA Flammable Liquid	Rail	0	$570
3/30/2011	Dunbar	Vehicle Accident	1,731 LGA Gasoline	Highway	0	$133,212
11/12/2013	Syracuse	Vehicle Accident	113.6 GCF Anhydrous Ammonia	Highway	0	$2,000
3/20/2014	Tecumseh	Human Error	8.355 GCF Anhydrous Ammonia	Highway	1 fatality, 2 injuries	$0
7/25/2019	Syracuse	Equipment Accident	10 LGA Paint Related Material	Highway	0	$9,000

Source: PHMSA, 1971-Nov 2019[53]

EXTENT

Chemical Transportation

The probable extent of chemical spills during transportation is difficult to anticipate and depends on the type and quantity of chemical released. Releases that have occurred during transportation in the planning area ranged from zero to 25,000 liquid gallons (LGA) and zero to 9,000 pounds. None of the events led to an evacuation. Based on historic records, it is likely that any spill involving hazardous materials that occurs will not affect an area larger than a tenth of a mile from the spill location.

Radiological Transportation

No known radiological incidents have occurred. If an event did occur, it is likely that it will be going to or leaving Cooper Nuclear Station.

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

AVERAGE ANNUAL LOSSES

The average damage per event estimate was determined based upon PHMSA's Incidents Reports since 1971 and the number of historical occurrences. This does not include losses from displacement, functional downtime, economic loss, injury, or loss of life. This hazard causes, on average, over $3,253 per year in property damages.

Table 48: Chemical Transportation Losses

HAZARD TYPE	NUMBER OF EVENTS	EVENTS PER YEAR	TOTAL PROPERTY LOSS	AVERAGE ANNUAL PROPERTY LOSS
Chemical Transportation Spills	24	0.5	$159,399	$3,253
Radiological Transportation	0	n/a	n/a	n/a

Source: PHMSA 1971 – November 2019

PROBABILITY

Chemical Transportation

The historical record indicates that chemical releases during transport have a 49 percent chance of occurring annually in the planning area or approximately every other year.

Radiological Transportation

Since the planning area has no reported radiological transportation incidents, the probability for a radiological event will be stated at less than 1 percent annually for this plan.

REGIONAL VULNERABILITIES

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

Table 49: Regional Chemical and Radiological Transportation Vulnerabilities

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

DAM FAILURE

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

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

Dams do not include:

- an obstruction in a canal used to raise or lower water;
- a fill or structure for highway or railroad use, but if such structure serves, either primarily or secondarily, additional purposes commonly associated with dams it shall be subject to review by the department;
- canals, including the diversion structure, and levees; or
- water storage or evaporation ponds regulated by the United States Nuclear Regulatory Commission."[54]

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 50: Dam Size Classification

SIZE	EFFECTIVE HEIGHT (FEET) X EFFECTIVE STORAGE (ACRE FEET)	EFFECTIVE HEIGHT
Small	≤ 3,000 acre-feet	and ≤ 35 feet
Intermediate	> 3,000 acre-feet to < 30,000 acre-feet	or > 35 feet
Large	≥ 30,000 acre-feet	Regardless of Height

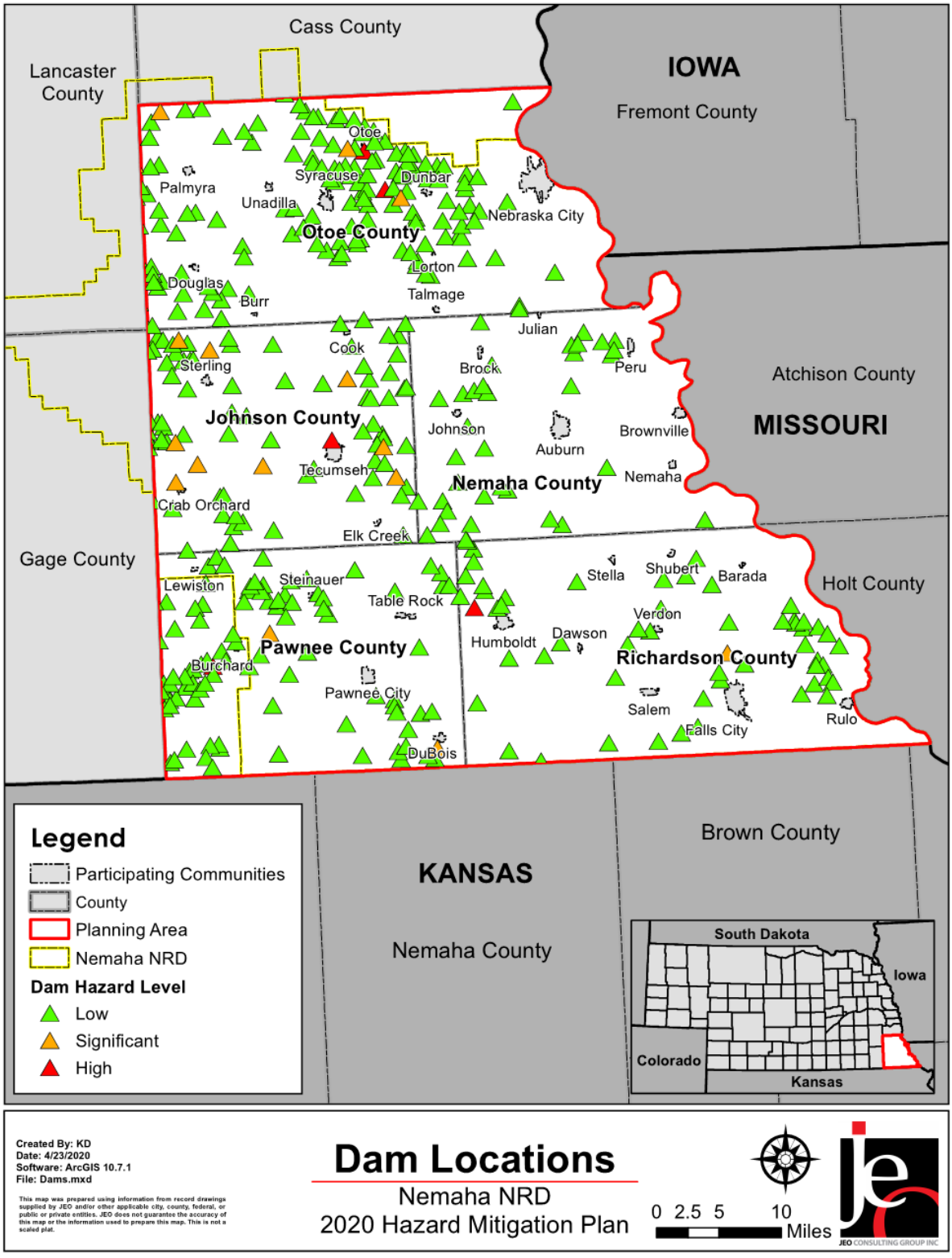
Source: NeDNR, 2013[55]

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.

[54] 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.

[55] 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.

Figure 20: Dam Locations



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

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

The NeDNR and USACE regulate dam safety in Nebraska and across the country. 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 Inventory of Dams, there are a total of 398 dams located within the five-county planning area, with classifications ranging from low to high hazard. Figure 20 maps the location of these dams.

Table 51: Dam Classification in the Planning Area

COUNTY	LOW HAZARD	SIGNIFICANT HAZARD	HIGH HAZARD
Johnson	67	9	1
Nemaha	35	0	0
Otoe	137	3	2
Pawnee	87	2	1
Richardson	52	1	1
Total	**378**	**15**	**5**

Source: USACE, 2020[56]

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

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

emergency situation can occur at any time; however, emergencies are more likely to happen when extreme conditions are present. There are five high hazard dams located within the planning area.

Table 52: High Hazard Dams in the Planning Area

COUNTY	DAM NAME	NID ID	PURPOSE	DAM HEIGHT (FEET)	MAX STORAGE (ACRE-FEET)	LAST INSPECTION DATE
Johnson	Middle Big Nemaha 96	NE02374	Flood Control	60	1,452	6/15/2020
Otoe	Wilson Creek 2-N	NE00865	Flood Control	38	36	3/24/2020
Otoe	Wilson Creek 8-H	NE00892	Flood Control	43.2	697	3/24/2020
Pawnee	Plum Creek 4-F	NE00775	Flood Control	50	2,185	6/15/2020
Richardson	Long Branch 21	NE02216	Flood Control	69	5,841	6/15/2020

Source: USACE, 2020

Upstream Dams Outside the Planning Area

Several dams and reservoirs are located upstream from the NNRD boundary in the Missouri River basin. Of these dams and reservoirs, six are located on the main stem of the Missouri River and provide the majority of the flood peak discharge reduction along Otoe, Nemaha, and Richardson Counties' eastern border from the Missouri River. Data on these dams are provided in the following table.

Table 53: Upstream Missouri River Dams

DAM NAME	LOCATION	YEAR OPERATIONAL	HAZARD POTENTIAL
Big Bend	Fort Thompson, South Dakota	1964	High
Fort Peck	Fort Peck, Montana	1940	High
Fort Randall	Pickstown, South Dakota	1953	High
Garrison	Riverdale, North Dakota	1955	High
Gavins Point	Yankton, South Dakota	1955	High
Oahe	Pierre, South Dakota	1962	High

During significant flood events, heightened releases from upstream dams may contribute to flooding impacts in the planning area. Of the dams listed above, four are designed for significant flood control: Fort Peck, Garrison, Oahe, and Fort Randall. Notably during the 2011 flood events, heightened dam release rates, including from Gavins Point, contributed to flooding impacts.

HISTORICAL OCCURRENCES

According to the Stanford University National Performance of Dams Program, there have been two dam failure events within the planning area.[57] The following table lists information about these failure events. No events resulted in reported damages, injuries, or fatalities.

[57] Stanford University. 1890-2019. "National Performance of Dams Program Dam Incident Database." Accessed December 2019. http://npdp.stanford.edu/dam_incidents.

Table 54: Dam Failure Events

DAM NAME	COUNTY	INCIDENT DATE	INCIDENT TYPE	HAZARD POTENTIAL
Nebraska City	Otoe County	4/10/1890	Not Known	Unknown
Johnson Dam	Otoe County	1/1/1945*	Not Known	Low

Source: Stanford University, 2019
**Exact date not known but year is accurate*

EXTENT

While a breach of a high hazard dam would certainly impact inundation areas, the total number of people and property exposed to this threat would vary based on the dam location. Since inundation maps are not made publicly available for security reasons, the following is provided as a description of areas affected in the inundation area from the County's Local Emergency Operations Plan (LEOP) where available for specific high hazard dams. Note that not all of the high hazard dams in each county are given extended descriptions, and two of the dams' impact descriptions were supplemented with information from their respective Emergency Action Plan.

Johnson County
Middle Big Nemaha Watershed-Site 96 – Owner, Nemaha NRD – Flow would overtop Highway 136 and inundate many properties and streets within the vicinity of central Tecumseh. Numerous private residences, businesses, streets, and public properties within central Tecumseh would be impacted. Major public facilities at risk include the football field and track at Johnson County Central High School, Tecumseh City Park, Tecumseh Utilities Department, and Tecumseh Public Library.

Approximately ten percent of the population of Johnson County could be affected by the failure of one or another of these dams.

Otoe County
Wilson Creek Dam 2-N – Owner, Nemaha NRD – This would affect the North Fork of the Little Nemaha River and the Village of Otoe. In Otoe County, the area affected would be slightly greater than the 100-year floodplain with the greatest effect on the Village of Otoe, which would approach 100 percent inundation.

Site 8-H Wilson Creek Watershed – Owner, Nemaha NRD – Nebraska State Highway 2, County Road I and County Road 40 located just south of County Road I could be impacted if the dam were to fail. Flow would likely overtop Highway 2 at a location ½ mile west of the intersection of County Road 40 and Highway 2. Shallow flooding could also occur at various locations along County Road I between County Roads 40 and 46. Flooding would continue to the east and end where flow crosses under Highway 2 just west of County Road 46 and Highway 67.[58]

Approximately two percent of the population of Otoe County could be affected by the failure of one or another of these dams.

Pawnee County
Plum Creek Watershed Dam 4-F (Southwest of Burchard) – Owner, Lower Big Blue NRD – Three homes immediately downstream of the dam are at risk of flooding. Furthermore, this would affect Tripps Creek and Plum Creek as far as Liberty in Gage County, Nebraska, and south into rural Kansas. The area affected would be slightly greater than the 100-year floodplain.

Less than five percent of the population of Pawnee County could be affected by the failure of the dam.

Richardson County
Long Branch Dam 21 – Owner, Nemaha NRD – Two rural residences just downstream of the dam near Kirkham Creek and several residences east of the Humboldt Cemetery along Long Branch Creek will be

[58] Nebraska Department of Natural Resources. Tim Gokie. October 15, 2020. [personal correspondence].

flooded. In addition, the Humboldt City Park and several businesses including the COOP grain elevator and Burlington Railroad need to be immediately evacuated.[58]

AVERAGE ANNUAL LOSSES

Due to a lack of data and the sensitive nature of this hazard, potential losses are not calculated for this hazard. In general, dam failure events would be confined to damage in the inundation area including buildings, agricultural land, and roads. Community members in the planning area that wish to quantify the threat of dam failure should contact their County Emergency Management, NNRD, or the NeDNR to view EAPs and breach inundation area maps.

PROBABILITY

There have been two reported dam failures since 1890, so the probability of dam failure will be stated as two percent annually.

REGIONAL VULNERABILITIES

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

Table 55: Regional Dam Failure Vulnerabilities

SECTOR	VULNERABILITY
People	-Those living downstream of high hazard dams -Evacuation likely with high hazard dams -Hospitals, nursing homes, and the elderly at greater risk due to low mobility
Economic	-Businesses located in the inundation areas would be impacted and closed for an extended period of time -Employees working in the inundation area may be out of work for an extended period of time
Built Environment	-Damage to homes and buildings
Infrastructure	-Transportation routes could be closed for extended period of time
Critical Facilities	-Critical facilities in inundation areas are vulnerable to damages
Climate	-Increased annual precipitation contributes to sustained stress on systems -Changes in water availability and supply can constrain energy production and reservoir stores

DROUGHT & EXTREME HEAT

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.

Extreme heat 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 while drought conditions can significantly and negatively impact the agricultural economic base.

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

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

- **Meteorological Drought** is defined based on the degree of dryness and the duration of the dry period. Meteorological drought is often the first type of drought to be identified and should be defined regionally as precipitation rates and frequencies (norms) vary.

- **Agricultural Drought** occurs when there is deficient moisture that hinders planting germination, leading to low plant population per hectare and a reduction of final yield. Agricultural drought is closely linked with meteorological and hydrological drought as agricultural water supplies are contingent upon the two sectors.

- **Hydrological 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.[59]

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

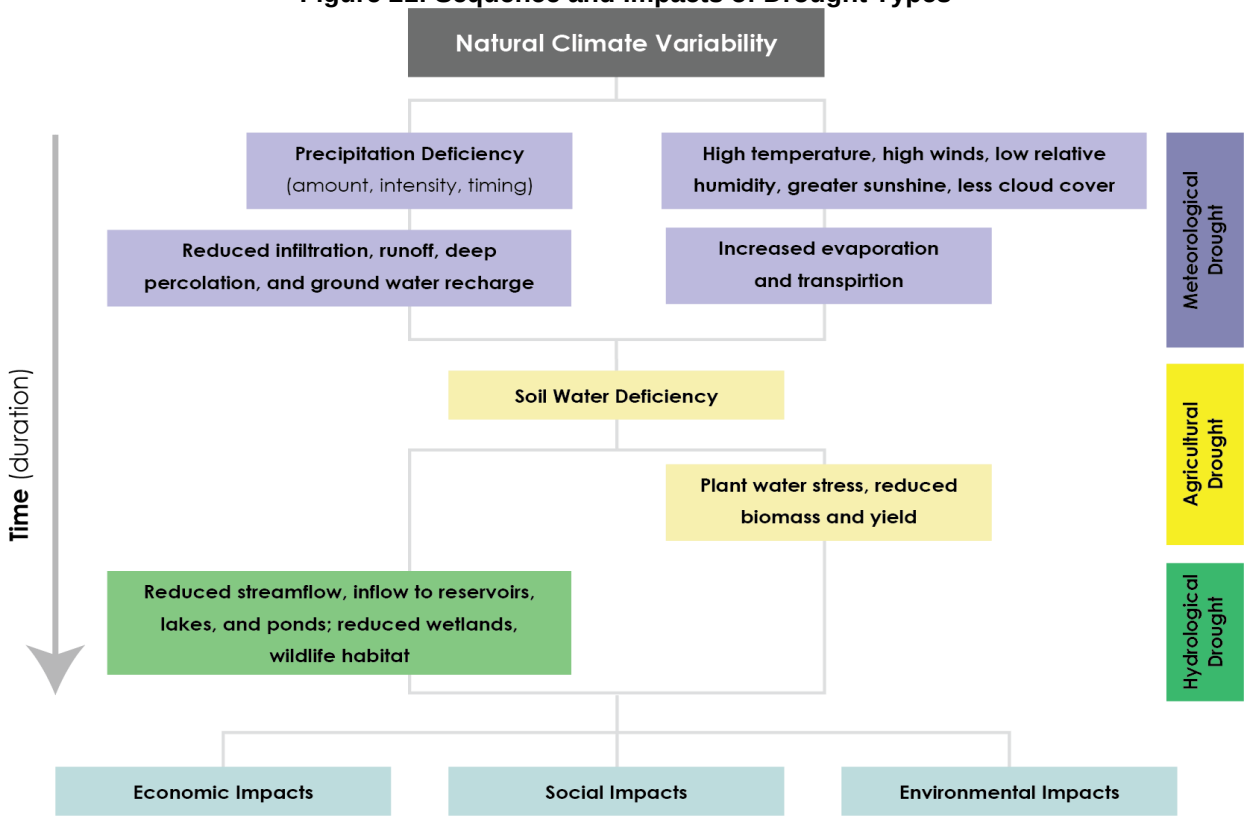
[59] National Drought Mitigation Center. 2017. "Drought Basics." http://drought.unl.edu/DroughtBasics.aspx.

- **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 staff, emergency managers, and public health officials to plan for extreme heat events.
- **Excessive heat watches** are issues 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 very high probability of occurring.[60]

Along with humans, animals also can be affected by high temperatures and humidity. For instance, cattle and other farm animals respond to heat by reducing feed intake, increasing their respiration rate, and increasing their body temperature. These responses assist the animal in cooling itself, but this is usually not sufficient. When animals overheat, they will begin to shut down body processes not vital to survival, such as milk production, reproduction, or muscle building. Additionally, government authorities from across the U.S. report that civil disturbances and riots are more likely to occur during heat waves or when water supplies are threatened. Municipal water supplies are a concern throughout the planning area, but particularly in Auburn and Peru.

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

Figure 21: Sequence and Impacts of Drought Types



Source: National Drought Mitigation Center, University of Nebraska-Lincoln, 2017[61]

LOCATION

The entire planning area is susceptible to drought impacts and extreme heat.

[60] National Weather Service. 2020. "Heat Watch vs. Warning." https://www.weather.gov/safety/heat-ww
[61] National Drought Mitigation Center. 2017. "Types of Drought." http://drought.unl.edu/DroughtBasics/TypesofDrought.aspx.

HISTORICAL OCCURRENCES

According to the historic record since 1895 as shown in Table 56, it is reasonable to expect extreme drought to occur in 5.4 percent of months for the planning area (81 extreme drought months in 1,500 months). Severe drought occurred in 95 months of the 1,500 months of record (6.3 percent of months). Moderate drought occurred in 108 of the 1,500 months of record or 7.2 percent of the time, and mild drought occurred in 13.9 percent of the time. Non-drought conditions (i.e. incipient dry spell, near normal, or incipient wet spell conditions) occurred in 387 months, or 25.8 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 32.5 inches according to the NCEI.[62]

Table 56: Historic Droughts

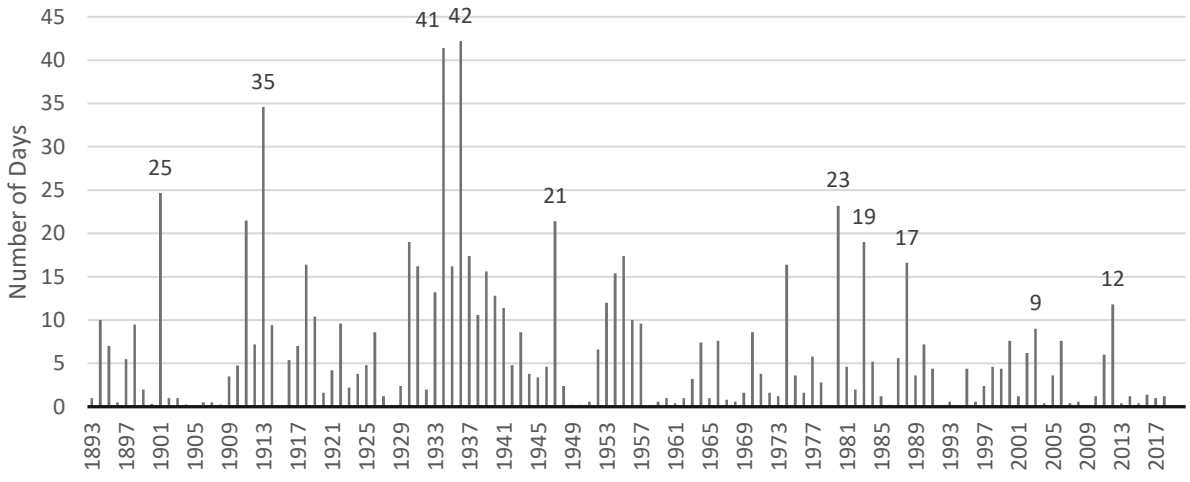
DROUGHT MAGNITUDE	MONTHS IN DROUGHT	PERCENT CHANCE
-1 Magnitude (Mild)	209/1,500	13.9%
-2 Magnitude (Moderate)	108/1,500	7.2%
-3 Magnitude (Severe)	95/1,500	6.3%
-4 Magnitude or Greater (Extreme)	81/1,500	5.4%

Source: NCEI, Jan 1895-Dec 2019[63]

The 2012 drought is the most recent event that reached severe drought in the planning area; however, the overall event did not warrant a presidential disaster declaration within Nebraska. The whole State of Nebraska was in severe drought conditions from the middle of July 2012 to the end of May 2013 and over 70% of the state was in exceptional drought conditions for over eight months. Water restrictions, mandatory and voluntary, were implemented in many communities in the planning area during the drought.

According to the High Plains Regional Climate Center (HPRCC), on average, the planning area experiences six days above 100°F per year. The planning area experienced the most days on record above 100°F in 1936 with 42 days and in 1934 with 41 days. More recently, 2012 had 12 days above 100°F. Conversely, 2019 was the most recent "coolest" year on record, with zero days above 100°F. Based on general climatic conditions in the planning area, it is reasonable to assume at least one 100+°F day occurs annually.

Figure 22: Number of Days Above 100°F



Source: HPRCC, 1893-2019

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

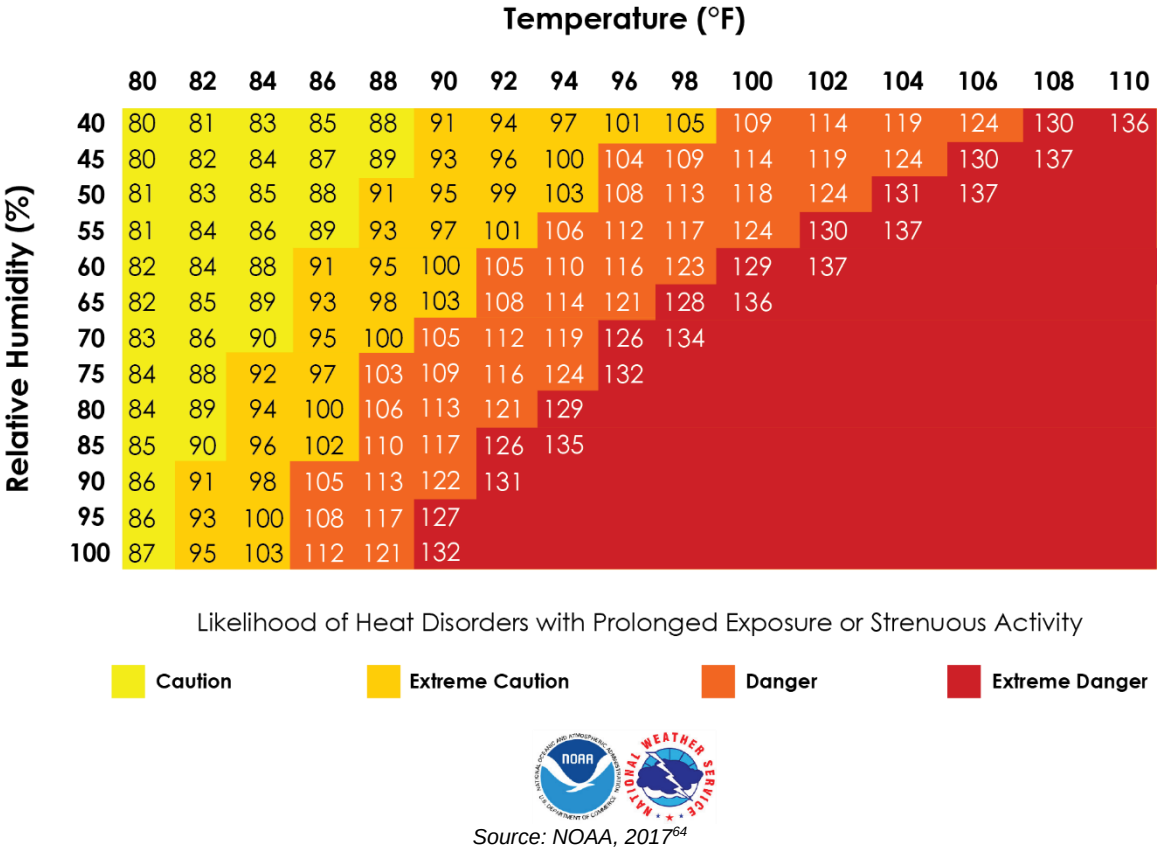
[63] National Centers for Environmental Information. 1895-2019. Accessed October 2, 2019. https://www7.ncdc.noaa.gov/CDO/CDODivisionalSelect.jsp.

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 percent Relative Humidity, dangerous levels of heat begin at 86°F whereas a Relative Humidity of 50 percent, require 94°F. The combination of Relative Humidity and Temperature result in a Heat Index as demonstrated below:

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

Figure 23: NOAA Heat Index



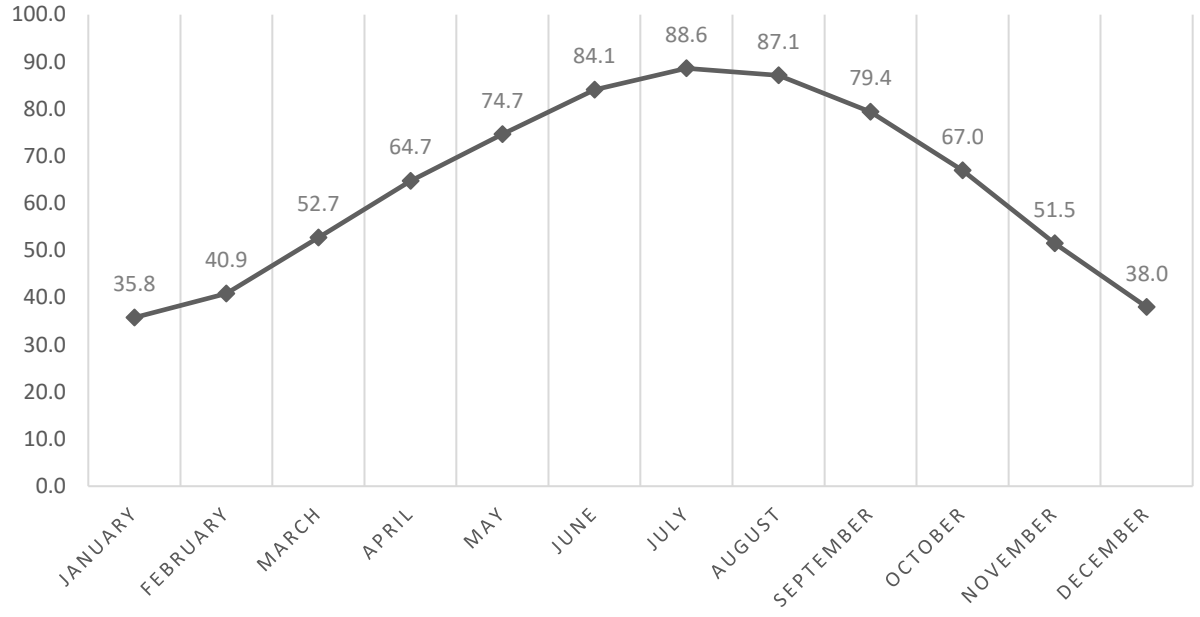
Source: NOAA, 2017[64]

The figure above 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 defined as temperatures of 100°F or greater.

For the planning area, the months with the highest temperatures are June, July, and August.

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

Figure 24: Normal Monthly Max Temperature (1981-2010)



Source: NCEI, 2020

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 9 (southeast Nebraska), which includes the entire planning area. This particular station's period of record started in 1895. Table 57 shows the details of the Palmer classifications. Figure 25 shows drought data from this time period. The negative Y axis represents the extent of a drought, for which '-2' indicates a moderate drought, '-3' a severe drought, and '-4' an extreme drought. The planning area has experienced several 'extreme' droughts and future droughts ranging in extent are likely in the future.

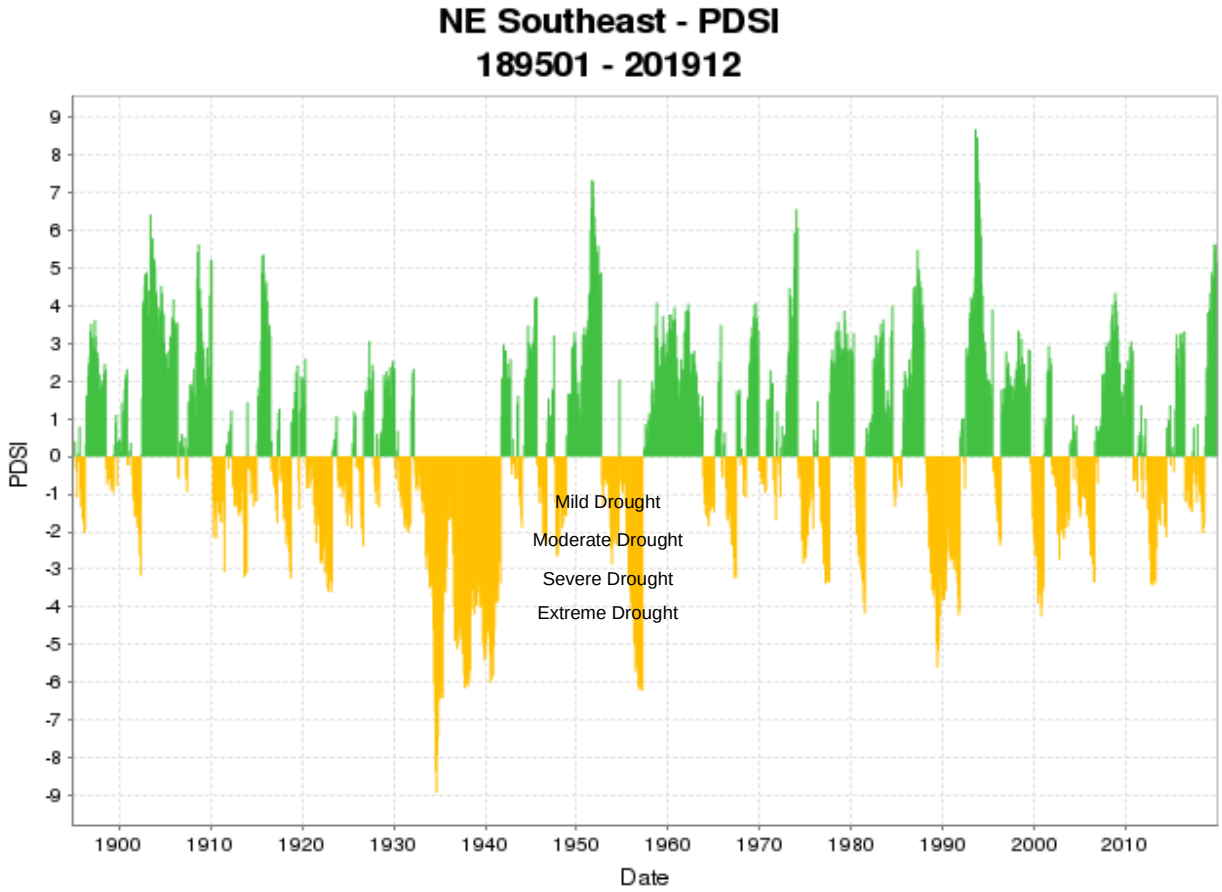
Table 57: Palmer Drought Severity Index Classification

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

Source: Climate Prediction Center[65]

[65] National Weather Service. 2017. "Climate Prediction Center." http://www.cpc.noaa.gov/.

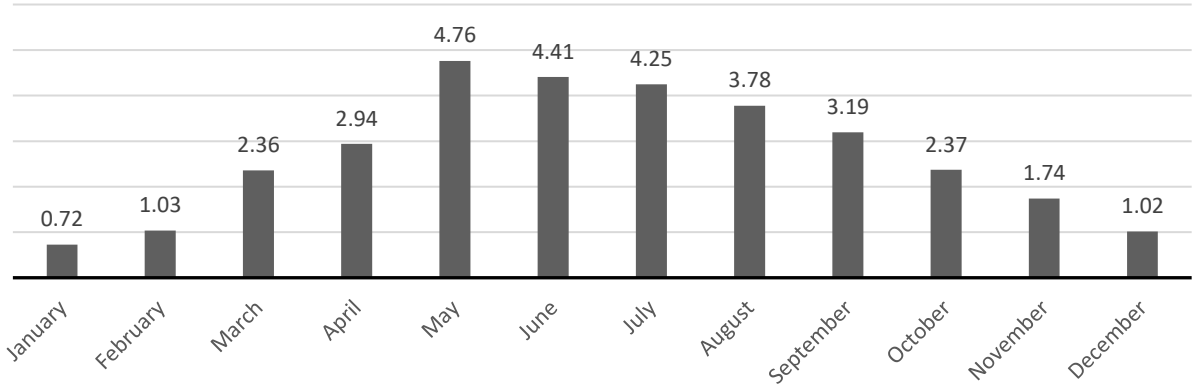
Figure 25: Palmer Drought Severity Index



Source: NCEI, Jan 1895-Dec 2019

On average, the planning area receives 32.5 inches of precipitation annually. The following figure shows the average precipitation per month in the planning area. Prolonged deviations from the norm showcase drought conditions and influence growing conditions for farmers.

Figure 26: Nemaha NRD Average Monthly Precipitation



Source: NCEI, 2020[66]

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

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 and 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 cause damages to infrastructure. The NCEI database did not report any direct property damage due to extreme heat or drought events.

Table 58: Loss Estimate for Drought

HAZARD TYPE	TOTAL PROPERTY LOSS[1]	AVERAGE ANNUAL PROPERTY LOSS[1]	TOTAL CROP LOSS[2]	AVERAGE ANNUAL CROP LOSS[2]
Drought and Extreme Heat	$0	$0	$171,110,842	$8,555,542.10

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

Estimate Loss of Electricity

According to the FEMA Benefit Cost Analysis (BCA) Reference Guide, if an extreme heat event occurred within the planning area, the following table assumes the event could potentially cause a loss of electricity for 10 percent of the population at a cost of $126 per person per day.[67] In rural areas, the percent of population affected and duration may increase during extreme events. The assumed damages do not consider physical damages to utility equipment and infrastructure.

Table 59: Loss of Electricity - Assumed Damage by Jurisdiction

COUNTY	(EST.) 2017 POPULATION	POPULATION AFFECTED (ASSUMED)	ELECTRIC LOSS OF USE ASSUMED DAMAGE PER DAY
Johnson	5,200	520	$65,520
Nemaha	7,041	704	$88,704
Otoe	15,875	1,588	$200,088
Pawnee	2,704	270	$34,020
Richardson	8,045	805	$101,430
Total	**38,865**	**3,887**	**$489,762**

PROBABILITY

Extreme heat is a regular part of the climate for the planning area; there is a 100 percent probability that temperatures greater than 100°F will occur annually. Drought conditions are also likely to occur regularly in the planning area. The following table summarizes the magnitude of drought and monthly probability of occurrence.

Table 60: Period of Record in Drought

PDSI VALUE	MAGNITUDE	DROUGHT OCCURRENCES BY MONTH	MONTHLY PROBABILITY
4 or more to -0.99	No Drought	1,007/1,500	67.2%
-1.0 to -1.99	Mild Drought	209/1,500	13.9%
-2.0 to -2.99	Moderate Drought	108/1,500	7.2%
-3.0 to -3.99	Severe Drought	95/1,500	6.3%
-4.0 or less	Extreme Drought	81/1,500	5.4%

Source: NCEI, Jan 1895-Dec 2019

[67] Federal Emergency Management Agency. June 2009. "BCA Reference Guide."

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*[68] 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. Note that while UCS indicated the historical average of days over 100°F was higher than six days as noted previously, locally available data through the High Plains Regional Climate Center was used in this hazard risk assessment. The table below indicates that by the middle of the century, the number of days over 100°F will be between 40 and 50 days and approaching 70 days or more by the end of the century.

Table 61: Extreme Heat Predictions for Days over 100°F

COUNTY	HISTORICAL AVERAGE 1971-2000 (DAYS PER YEAR)	MIDCENTURY PREDICTION 2036-2065 (DAYS PER YEAR)	LATE CENTURY 2070-2099 (DAYS PER YEAR)
Johnson	8	43	69
Nemaha	9	46	72
Otoe	8	42	68
Pawnee	9	45	72
Richardson	11	49	76

Source: Union of Concerned Scientists, 1971-2019[69]

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 26 drought-related impacts throughout the five-county area. This is not a comprehensive list of droughts which may have impacted the planning area. These impacts are summarized in the following table.

Table 62: Drought Impacts in Planning Area

CATEGORY	DATE	AFFECTED COUNTIES	TITLE
Water Supply & Quality	12/18/2000	Nemaha, Otoe, Richardson	Water Supply & Quality impact from Media submitted on 12/12/2005
Water Supply & Quality	6/18/2001	Nemaha, Otoe, Richardson	Water Supply & Quality impact from Media submitted on 12/2/2005
Relief, Response & Restrictions	6/1/2002	Nemaha, Otoe	Relief, Response & Restrictions impact from Government submitted on 10/28/2005
Relief, Response & Restrictions	7/1/2002	Johnson, Pawnee, Richardson	Relief, Response & Restrictions impact from Government submitted on 10/28/2005
Relief, Response & Restrictions	1/1/2003	Johnson, Nemaha, Otoe, Pawnee, Richardson	Relief, Response & Restrictions impact from Media submitted on 3/1/2006
Relief, Response & Restrictions	10/6/2003	Johnson, Richardson	Relief, Response & Restrictions impact from Media submitted on 11/3/2005
Relief, Response & Restrictions	12/9/2003	Nemaha, Otoe, Richardson	Relief, Response & Restrictions impact from Media submitted on 10/28/2005
Relief, Response & Restrictions	1/1/2004	Johnson, Nemaha, Pawnee	Relief, Response & Restrictions impact from Media submitted on 9/30/2005
Water Supply & Quality	4/12/2005	Nemaha, Otoe, Richardson	Water Supply & Quality impact from Media submitted on 7/29/2005

[68] 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.

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

CATEGORY	DATE	AFFECTED COUNTIES	TITLE
Water Supply & Quality	5/1/2005	Nemaha, Otoe, Richardson	Water Supply & Quality impact from Media submitted on 7/25/2005
Water Supply & Quality	5/2/2005	Nemaha, Otoe, Richardson	Water Supply & Quality impact from Media submitted on 8/3/2005
Water Supply & Quality	7/26/2005	Nemaha, Otoe, Richardson	Water Supply & Quality impact from Media submitted on 7/26/2005
Water Supply & Quality	10/5/2005	Nemaha, Otoe, Richardson	Water Supply & Quality impact from Media submitted on 10/21/2005
Relief, Response & Restrictions	3/24/2006	Richardson	Relief, Response & Restrictions impact from Media submitted on 3/24/2008
Relief, Response & Restrictions	9/28/2006	Johnson, Nemaha, Otoe, Pawnee, Richardson	Relief, Response & Restrictions impact from Media submitted on 9/28/2006
Water Supply & Quality	10/1/2006	Nemaha, Otoe, Richardson	Water Supply & Quality impact from Media submitted on 7/14/2006
Water Supply & Quality	7/18/2007	Otoe	Water Supply & Quality impact from Media submitted on 7/19/2007
Agriculture, Relief, Response & Restrictions	4/1/2012	Nemaha, Otoe, Richardson	USDA Designates 97 Counties in Missouri as Primary Natural Disaster Areas with Assistance to Producers in Surrounding States
Plants & Wildlife	5/1/2012	Nemaha, Otoe, Richardson	Grass planted on new levees along the Missouri River in eastern Nebraska was slow to grow
Fire, Relief, Response & Restrictions	6/28/2012	Johnson, Nemaha, Otoe, Pawnee, Richardson	Nebraskans urged to leave the fireworks to the professionals
Agriculture	8/7/2012	Johnson, Nemaha, Otoe, Pawnee, Richardson	Corn chopped for silage in eastern Nebraska
Agriculture, Water Supply & Quality	8/7/2012	Johnson, Nemaha, Otoe, Pawnee, Richardson	Nebraska ranchers hauling water to livestock
Agriculture	9/16/2012	Otoe	Smaller apples in Nebraska City, Nebraska
Agriculture, Relief, Response & Restrictions	1/9/2013	Johnson, Nemaha, Otoe, Pawnee, Richardson	Drought-related USDA disaster declarations in 2013
Agriculture, Relief, Response & Restrictions, Water Supply & Quality	11/27/2013	Pawnee	The Lower Big Blue Natural Resources District in southeastern Nebraska announced a moratorium on new wells for 180 days
Fire, Society & Public Health	3/15/2018	Johnson, Nemaha, Otoe, Pawnee, Richardson	Drought prevented agricultural burning in Kansas, Oklahoma in 2018

Source: NDMC, 2000-2019[70]

[70] National Drought Mitigation Center. 2019. "U.S. Drought Impact Reporter." Accessed January 2020. http://droughtreporter.unl.edu/map/.

As part of the HMP process, a qualitative analysis of the NRD's vulnerability to drought was conducted. A GIS model was developed to compare the vulnerability of different aquifers to prolonged drought conditions. The model was developed taking into consideration the following three primary conditions:

1. Assumes the NNRD is under prolonged drought conditions.
2. Assumes a significant precipitation event (inches of rain) may occur during the prolonged drought conditions.
3. The resulting qualitative drought vulnerability is based on current conditions including: 1) number of existing public water systems and high-capacity wells across the NNRD boundary, 2) permitted rates for public water systems and high-capacity wells, and 3) current groundwater levels across the NNRD plan boundary.

There are many variables that can affect how drought will impact an aquifer. The three variables that were determined to best model drought impacts on the NNRD were:

1. Total Saturated Sand Thickness (Figure 27);
2. High-Capacity Well Density with Permitted Pumping Rate per Square Mile (Figure 28); and
3. Total Clay Thickness Above Top of Aquifer (Figure 29).

The results for the GIS model are shown in Figure 30. Note that the model provides a qualitative ranking system, and does not definitively say how much groundwater would be available during drought conditions. The GIS model should be used in combination with other drought management tools to determine if additional wells are needed and where best to locate them.

Figure 27: Total Saturated Sand Thickness

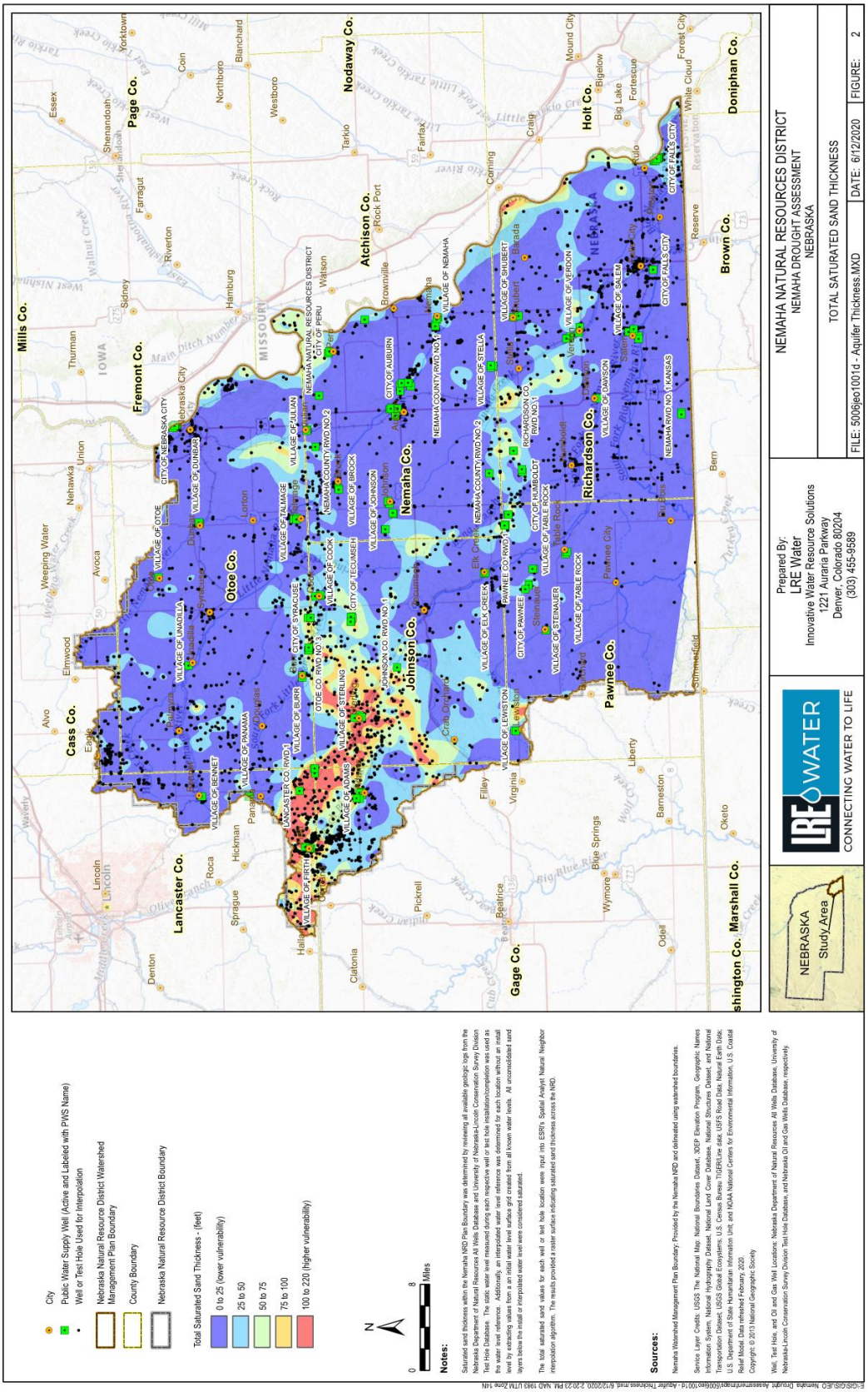


Figure 28: High-Capacity Well Density with Permitted Pumping Rate per Square Mile

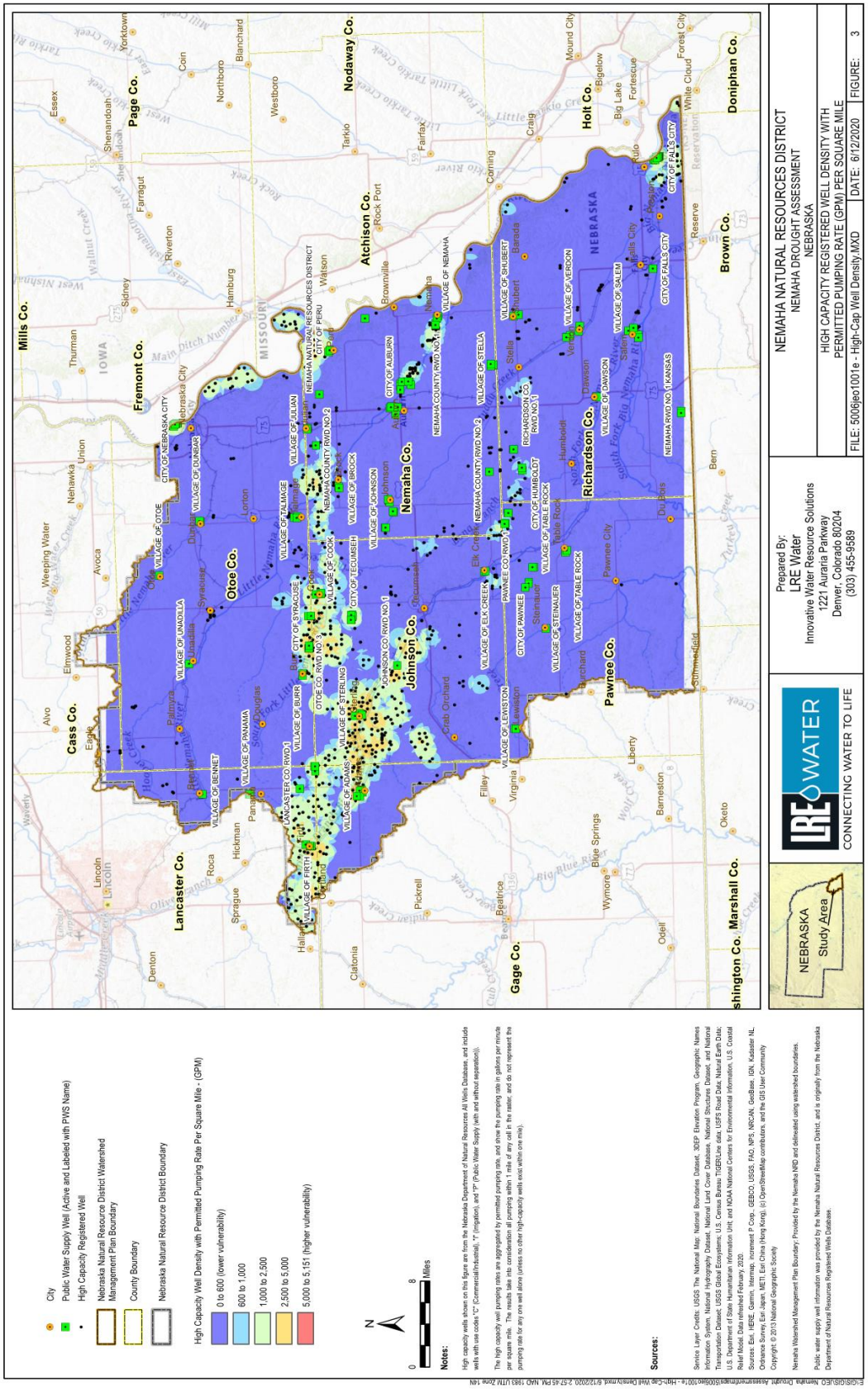


Figure 29: Total Clay Thickness Above Top of Aquifer

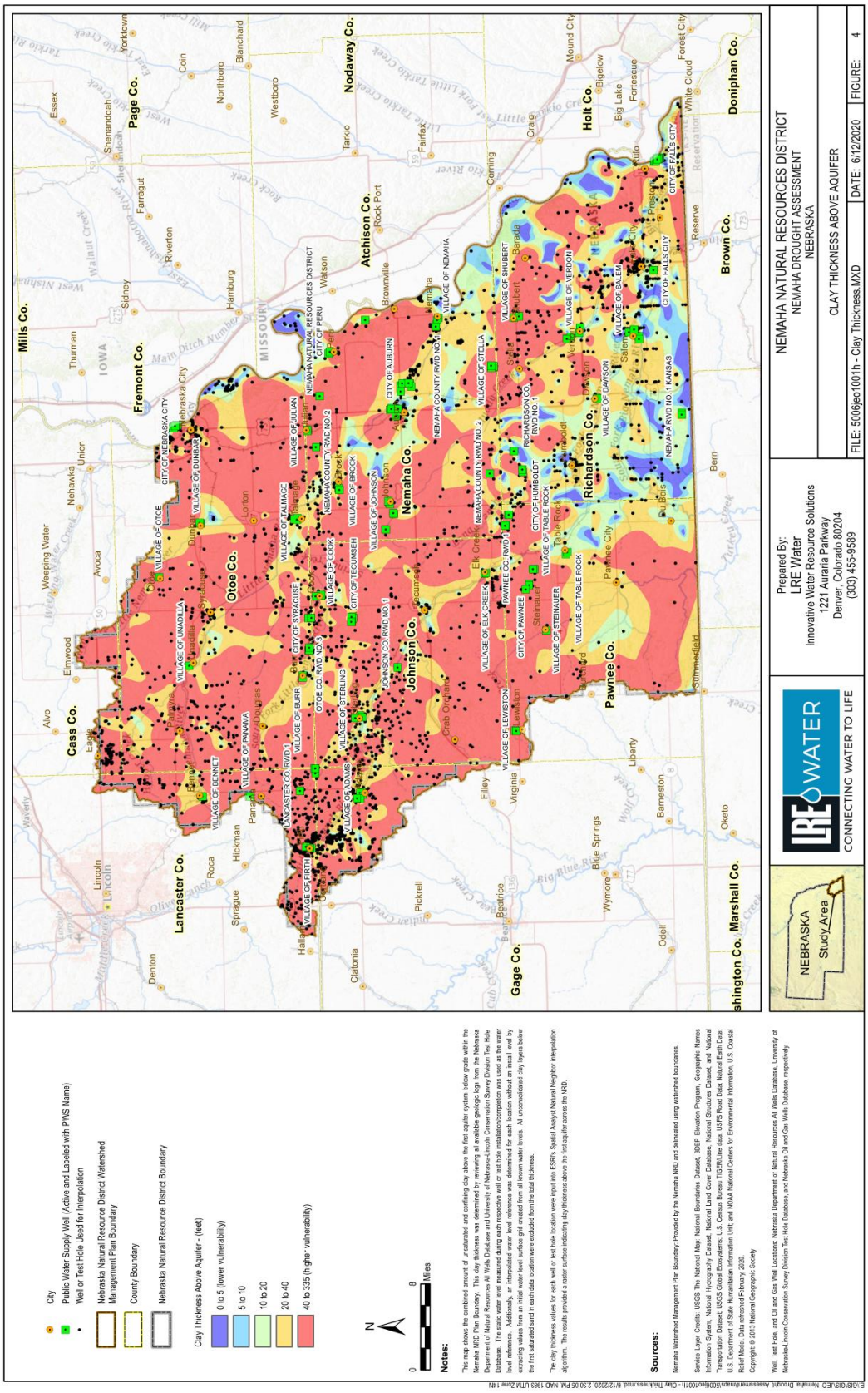
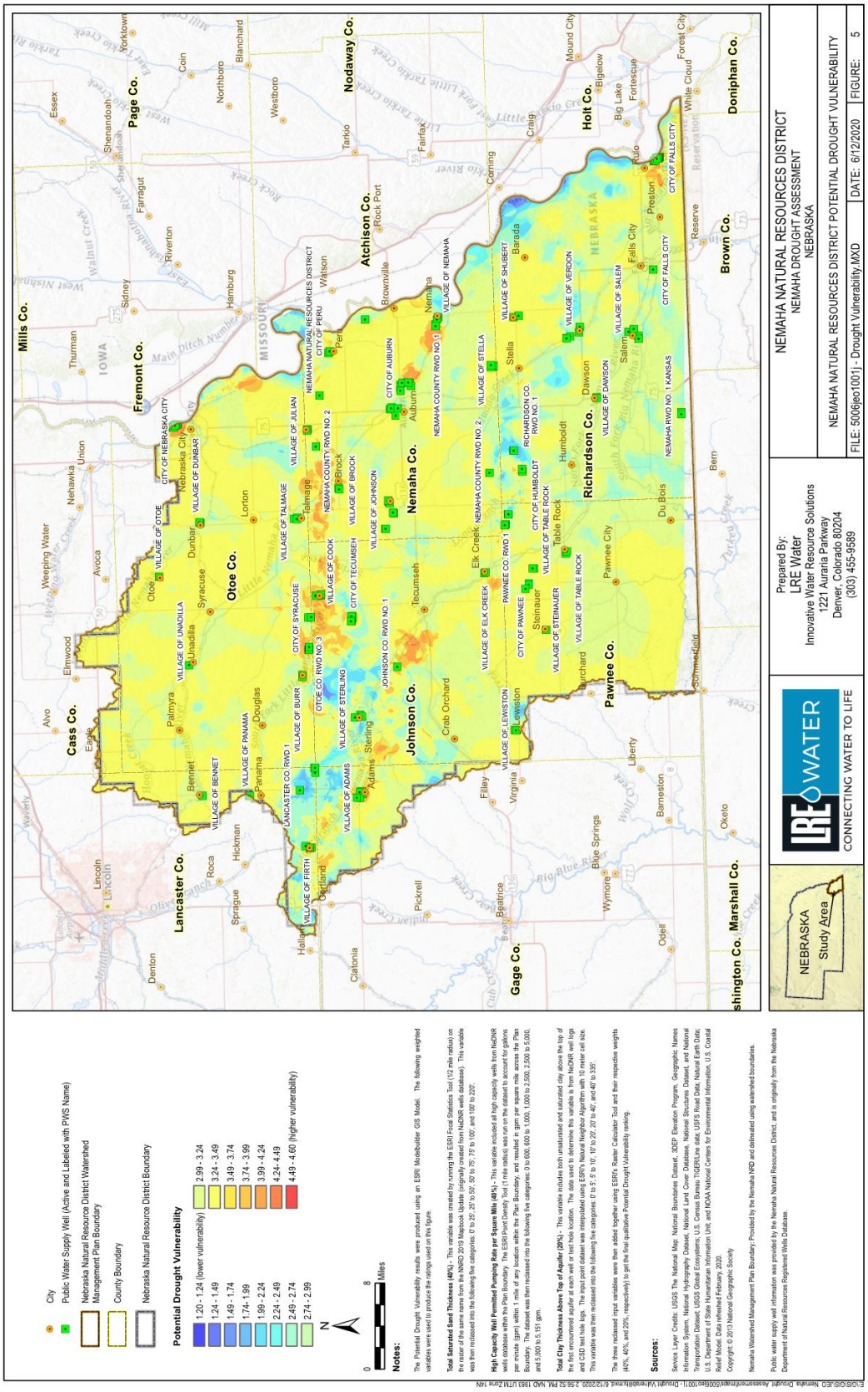


Figure 30: Drought Vulnerability



Zoomed in results of the GIS model are also provided for all public water systems within the NNRD boundary. Table 63 provides vulnerability ranges (1.2 lower vulnerability and 4.6 higher vulnerability) and primary vulnerability drivers for each public water system. The full drought vulnerability report can be found in *Appendix E.*

Table 63: Public Water System Drought Vulnerability Range

PUBLIC WATER SYSTEM	VULNERABILITY RATING (RANGE)	PRIMARY VULNERABILITY DRIVER(S) (IN ORDER OF AFFECT)
City of Auburn	2.6-4.0	High-capacity Wells, Saturated Sand Thickness
City of Falls City	2.2-4.0	High-capacity Wells, Clay Thickness
City of Falls City	2.6-3.4	Saturated Sand Thickness, Clay Thickness
City of Humboldt	2.2-3.8	High-capacity Wells, Clay Thickness
City of Humboldt	1.8-3.8	Saturated Sand Thickness, Clay Thickness
City of Nebraska City	2.4-4.2	High-capacity Wells, Clay Thickness
City of Pawnee	3.0-3.4	Saturated Sand Thickness, Clay Thickness
City of Peru	2.3-3.8	High-capacity Wells, Clay Thickness
City of Syracuse	2.4-4.4	High-capacity Wells, Clay Thickness
City of Tecumseh	2.2-3.8	High-capacity Wells, Clay Thickness
Johnson County Rural Water District No.1	2.0-4.6	High-capacity Wells, Clay Thickness
Lancaster County Rural Water District No.1	1.8-3.4	Clay Thickness, High-capacity Wells
Nemaha County Rural Water District No.1	2.6-3.4	Saturated Sand Thickness, Clay Thickness
Nemaha County Rural Water District No.1	2.2-4.0	Saturated Sand Thickness, High-capacity Wells
Otoe County Rural Water District No.3	2.2-4.2	High-capacity Wells, Clay Thickness
Nemaha County Rural Water District No.2	3.0-3.4	Saturated Sand Thickness, Clay Thickness
Nemaha County Rural Water District No.2	1.8-3.4	Saturated Sand Thickness, Clay Thickness
Nemaha Natural Resources District	2.2-3.8	Saturated Sand Thickness, Clay Thickness
Nemaha Rural Water District No.1 Kansas	2.6-3.0	Saturated Sand Thickness
Pawnee County Rural Water District No.1	2.2-3.8	High-capacity Wells, Clay Thickness
Richardson County Rural Water District No.1	1.8-3.8	Saturated Sand Thickness
Village of Adams	1.8-4.2	Saturated Sand Thickness, High-capacity Wells
Village of Bennet	2.6-3.4	Saturated Sand Thickness, Clay Thickness
Village of Brock	2.6-4.2	Saturated Sand Thickness, High-capacity Wells
Village of Burr	1.4-4.2	High-capacity Wells, Saturated Sand Thickness
Village of Cook	2.8-4.6	High-capacity Wells, Clay Thickness
Nemaha County Rural Water District No.2	2.8-4.0	High-capacity Wells, Clay Thickness
Village of Dawson	3.0-3.4	Saturated Sand Thickness, Clay Thickness
Village of Panama	2.8-3.4	Saturated Sand Thickness, Clay Thickness
Village of Salem	2.6-3.4	Saturated Sand Thickness, Clay Thickness
Village of Elk Creek	2.8-4.2	Saturated Sand Thickness
Village of Firth	2.2-4.2	High-capacity Wells
Village of Johnson	3.0-3.4	Saturated Sand Thickness, Clay Thickness
Village of Julian	2.6-3.8	Saturated Sand Thickness, Clay Thickness
Village of Lewiston	1.8-3.4	Saturated Sand thickness, Clay Thickness
Village of Nemaha	2.2-4.2	High-capacity Wells, Saturated Sand Thickness

PUBLIC WATER SYSTEM	VULNERABILITY RATING (RANGE)	PRIMARY VULNERABILITY DRIVER(S) (IN ORDER OF AFFECT)
Village of Otoe	2.8-3.4	Saturated Sand Thickness
Village of Dunbar	2.6-3.4	Saturated Sand Thickness, Clay Thickness
Village of Shubert	2.6-3.4	Saturated Sand Thickness, Clay Thickness
Village of Steinauer	3.2-3.4	Saturated Sand Thickness, Clay Thickness
Village of Stella	2.6-3.4	Saturated Sand Thickness, Clay Thickness
Village of Sterling	2.2-3.8	High-capacity Wells
Village of Table Rock	2.6-3.4	Saturated Sand Thickness, Clay Thickness
Village of Table Rock	2.6-3.4	Saturated Sand Thickness
Village of Talmage	2.6-4.2	Saturated Sand Thickness, Clay Thickness
Village of Unadilla	3.2-3.4	Saturated Sand Thickness, Clay Thickness
Village of Verdon	2.2-3.4	Saturated Sand Thickness

Furthermore, the NNRD began in late summer 2020 a survey of aquifers across their district. Instruments mounted below a low-flying helicopter collected and recorded geologic measurements to learn more about buried aquifer materials. The flights improve the NRD's understanding of available groundwater resource and potential groundwater/surface water connections in an area of the state made more complex by the presence of glacial deposits.

This scientific program is designed to study the area's water resources such as sand and gravel aquifers using an airborne perspective. It is part of a program to identify physical occurrences such as changes in geologic materials and sediment types in the subsurface across the region. Sixty percent of the funding for the project was obtained through a grant from the Nebraska Department of Natural Resources Water Sustainability Fund.

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

Table 64: 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 -Health impacts: heat exhaustion; heat stroke; those working outdoors; people without air conditioning; young children/elderly outside or without air conditioning
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→ jeopardizes educational funds
Built Environment	-Cracking of foundations (residential and commercial structures) -Damages to landscapes -Damage to air conditioning/HVAC systems if overworked
Infrastructure	-Damages to waterlines below ground -Damages to roadways (prolonged extreme events) -Stressing of electrical systems (brownouts during peak usage)
Critical Facilities	-Loss of power and impact on infrastructure
Climate	-Increased risk of wildfire events, damaging buildings and agricultural land -Increases in extreme heat conditions are likely, adding stress on livestock, crops, people, and infrastructure -Changes in annual precipitation can be detrimental to agriculture and energy production sectors

EARTHQUAKES

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

Table 65: Richter Scale

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

Source: FEMA, 2016[71]

Table 66: 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

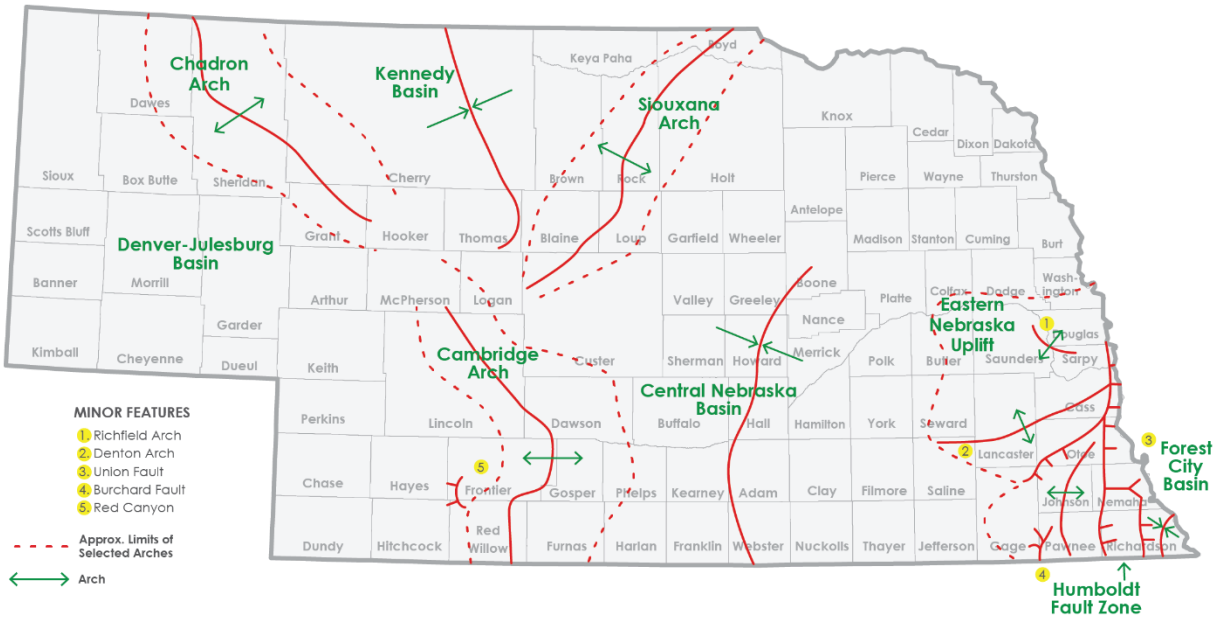
Source: FEMA, 2016

[71] Federal Emergency Management Agency. 2016. "Earthquake." https://www.fema.gov/earthquake.

LOCATION

The planning area has a few fault lines crossing it. The Union and Burchard Faults are minor features that occur in the planning area. The Forest City Basin and Humboldt Fault Zone are also active in the planning area. The Humboldt Fault Zone is the largest and most active feature. The Forest City Basin is also still active. Most of the earthquakes associated with these features occur in Kansas. The Union and Burchard faults are still active, but do not have a lot of movement associated with them. The following figure shows the fault lines in Nebraska.

Figure 31: Fault Lines in Nebraska



Source: Nebraska Department of Natural Resources

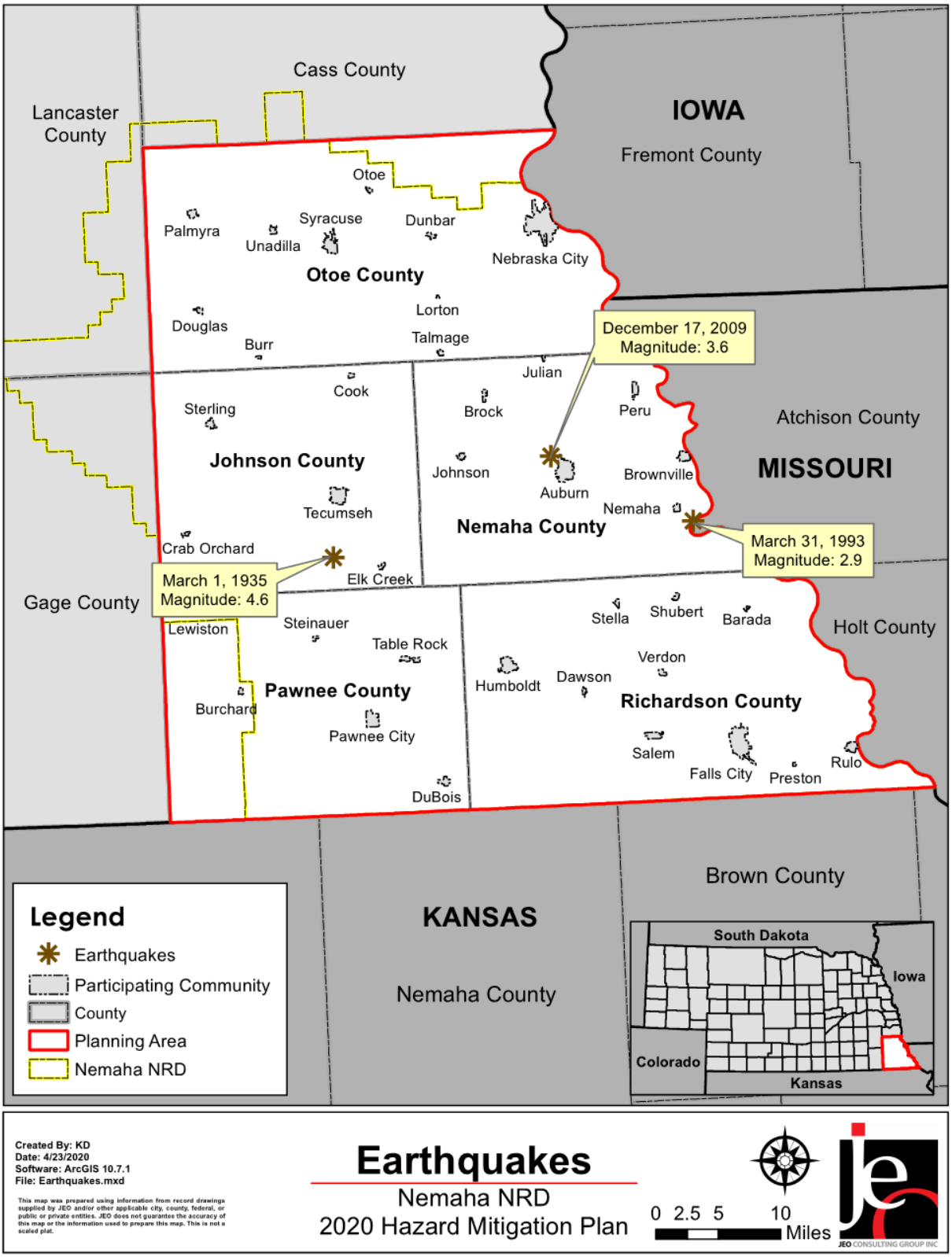
HISTORICAL OCCURRENCES

Figure 32 displays historical occurrences of earthquakes in and around the planning area since 1900. Three earthquakes have occurred. The strongest earthquake was a 4.6 in March 1935 that occurred in Johnson County west of Elk Creek. The second strongest earthquake was a 3.6 in December 2009 near Auburn in Nemaha County. The final recorded earthquake was a 2.9 along the Missouri River just south of the Village of Nemaha in March 1993. None of the earthquakes caused any known damage.

EXTENT

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

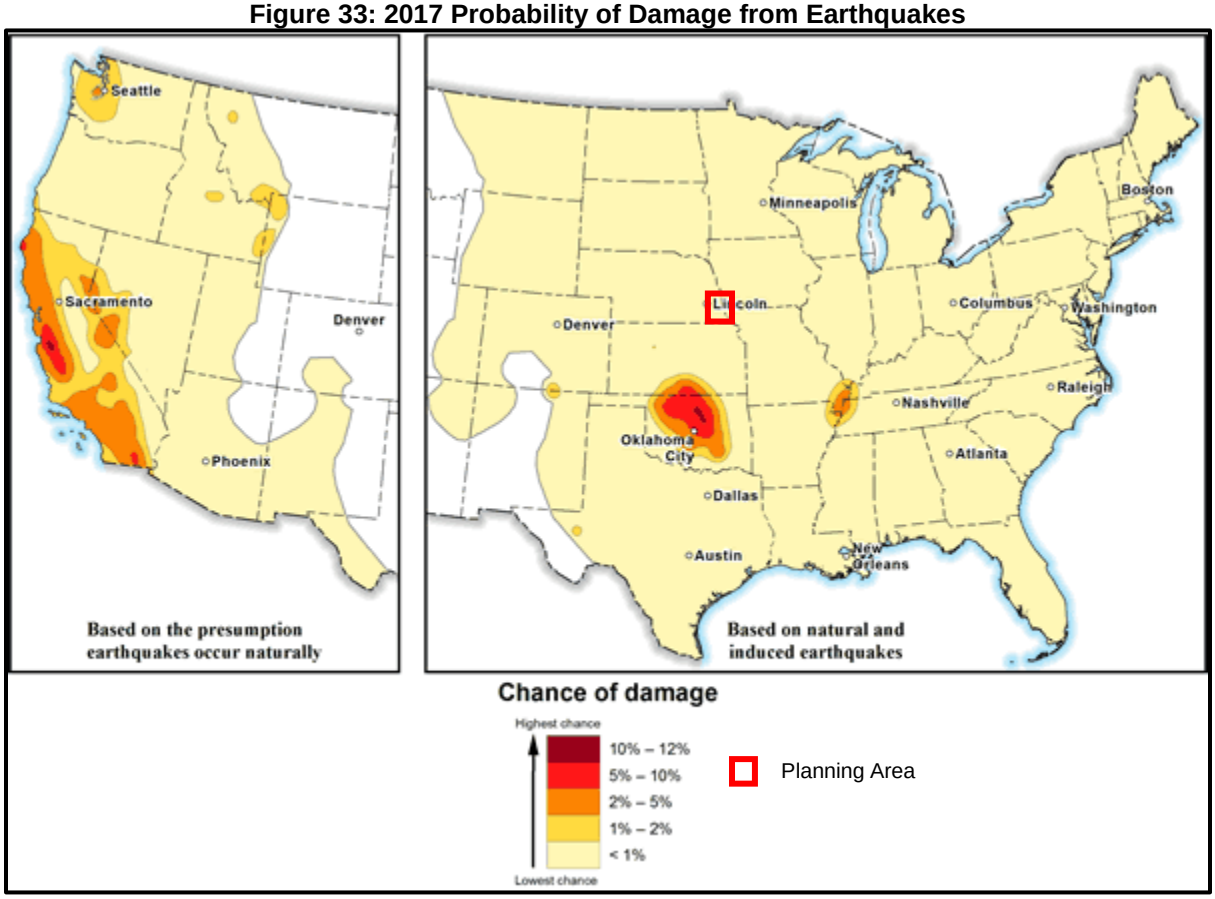
Figure 32: Earthquakes in the NNRD



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 33 shows the probability of damage from earthquakes, according to the United States Geological Survey (USGS). The figure shows that the planning area has a less than one percent chance of damages from earthquakes.

Figure 33: 2017 Probability of Damage from Earthquakes



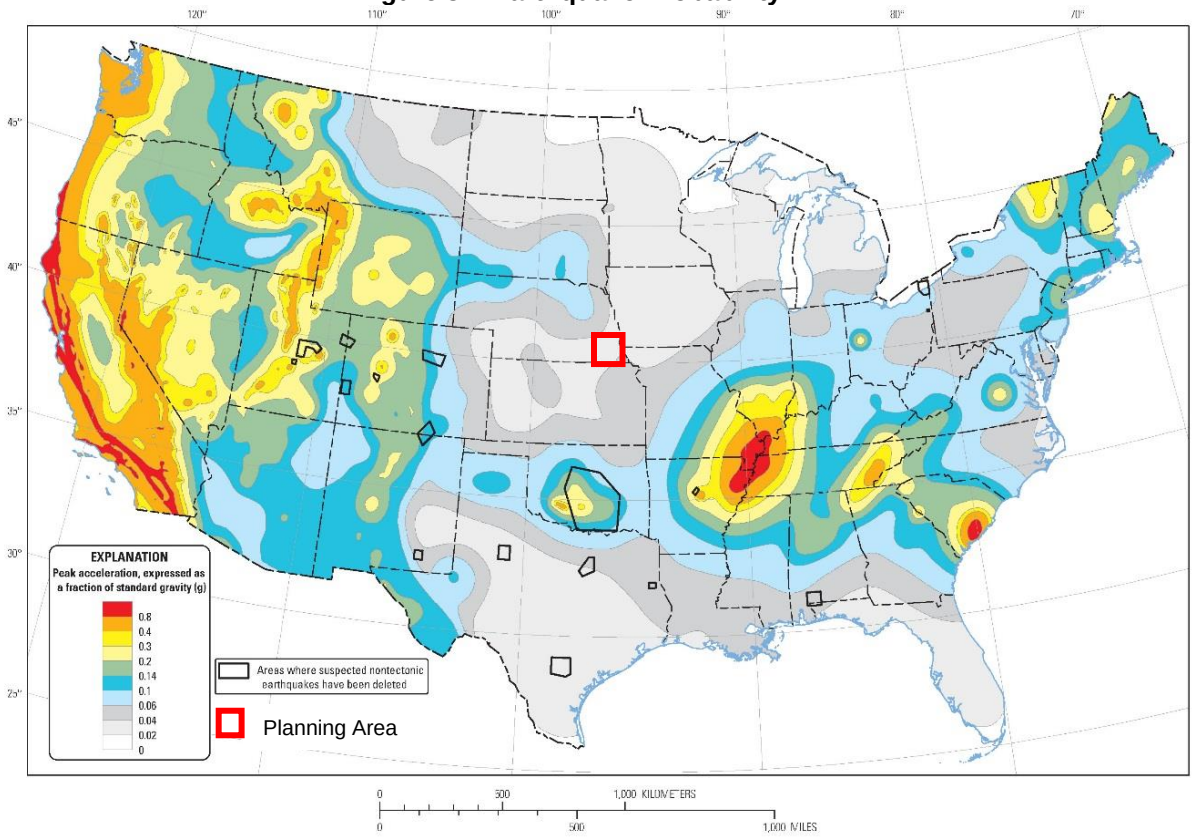
Source: USGS, 2017[72]

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 three recorded occurrences of earthquakes over 120-year period, the probability of an earthquake in the five-county region in any given year is three percent.

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

Figure 34: 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 67: 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

FLOODING

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

RIVERINE FLOODING

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

FLASH FLOODING

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

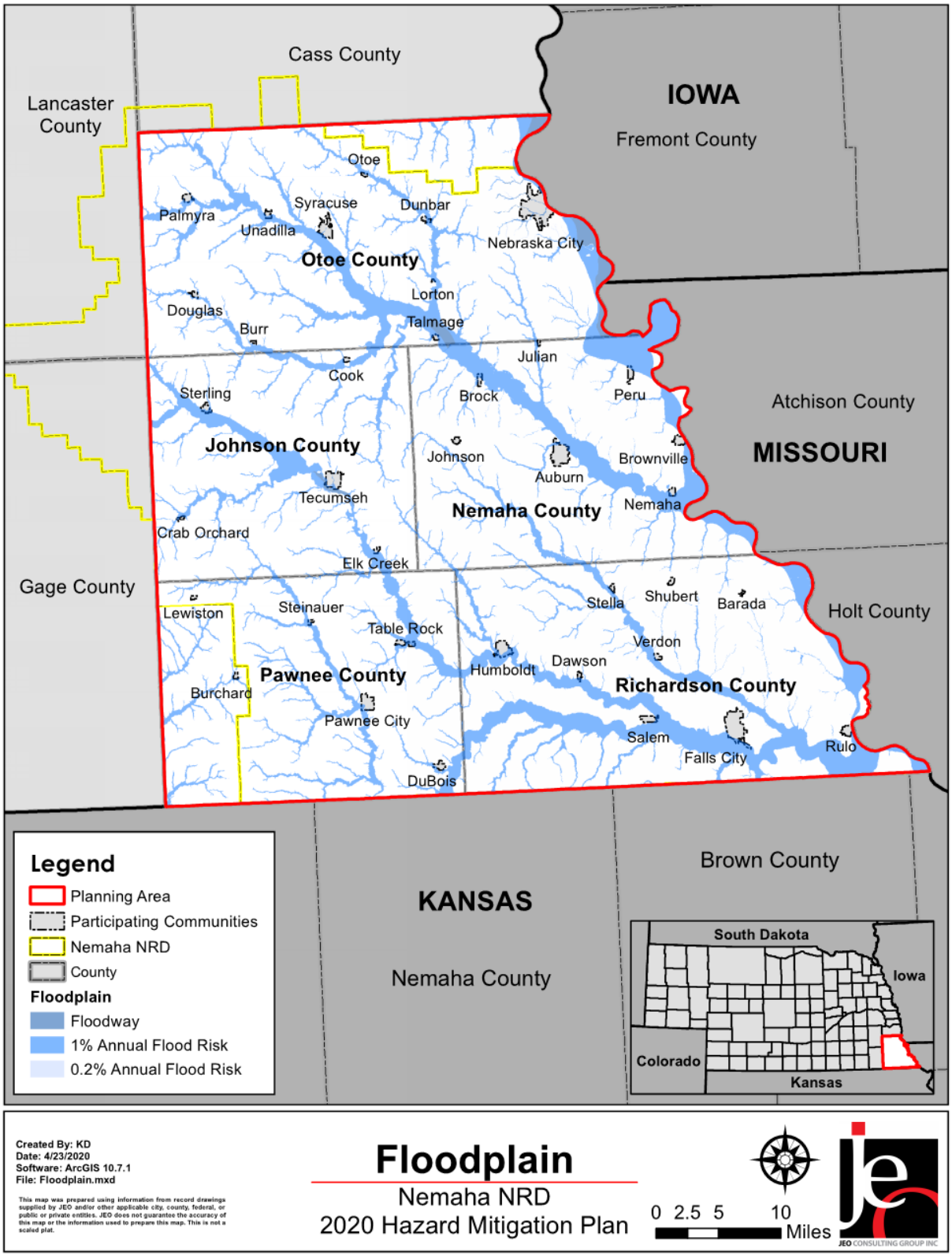
SHEET FLOODING

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

ICE JAM FLOODING

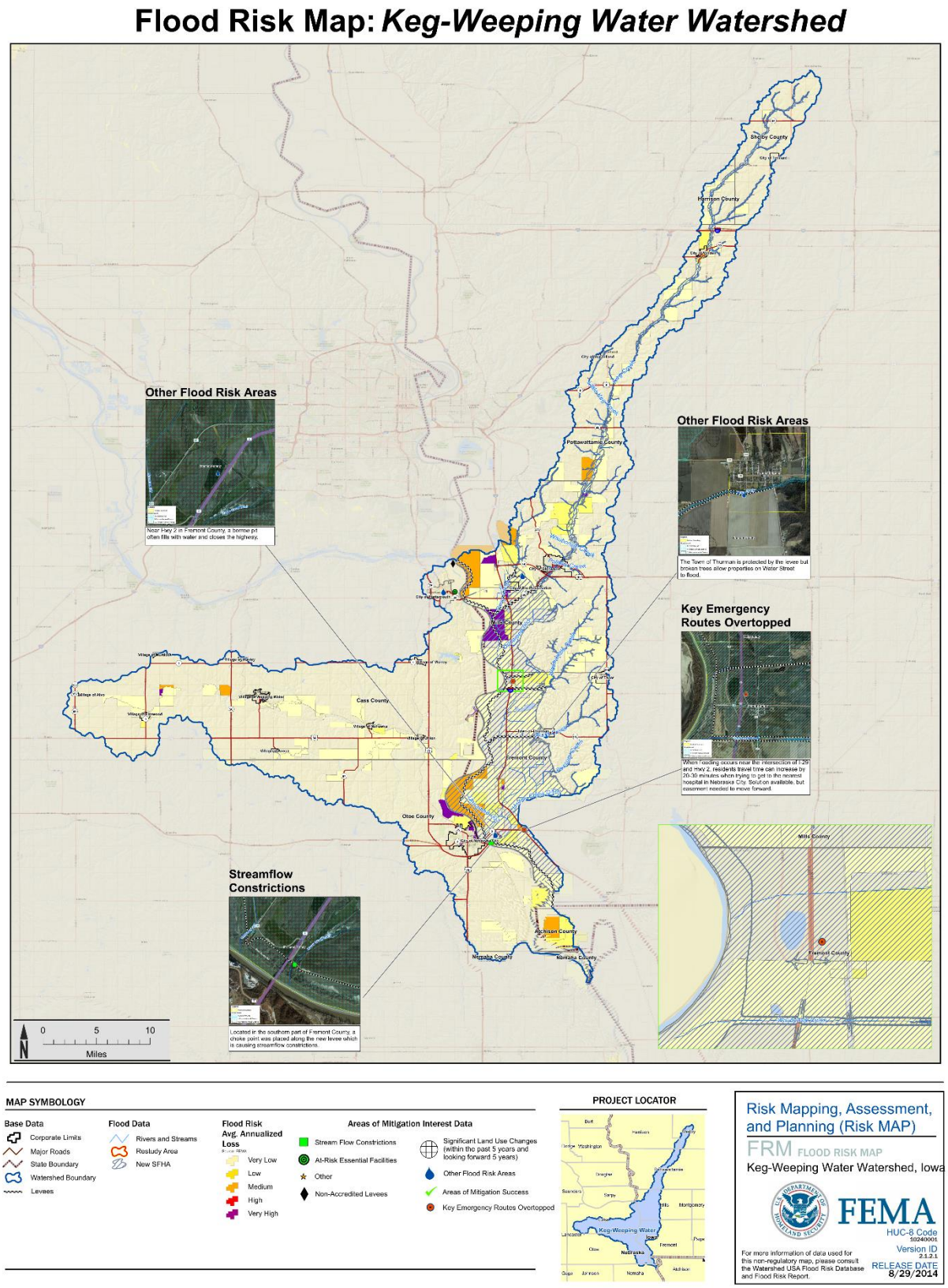
Ice jams occur when ice breaks up in moving waterways, and then stacks on itself where channels narrow, or human-made obstructions constrict the channel. This creates an ice dam, often causing flooding within minutes of the dam formation. Ice formation in streams occurs during periods of cold weather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

Figure 35: 1% Annual Flood Risk Hazard Area



**Nemaha County and Richardson County floodplain data are preliminary DFIRM data.*

Figure 36: Flood Risk MAP for Portions of Otoe County



LOCATION

There are three primary rivers that flow through the planning area: Missouri River, Little Nemaha River, and Big Nemaha River.

The Missouri River flows along the eastern boundary of Otoe, Nemaha, and Richardson Counties, flowing from the north to the south. This river and numerous creeks that flow through the counties cause flood problems. Since the construction of six main stem dams were completed by the USACE in the 1940s to 1960s, the threat of flooding has been reduced, but not eliminated completely, as was seen in 2011 and 2019. According to the stream gauge at Nebraska City, the historic crest on the Missouri River was 30.12 feet in March 2019, and the second highest crest occurred just eight years prior in June 2011 at 28.27 feet.

The Little Nemaha River flows from northwest to southeast through Otoe and Nemaha Counties and joins the Missouri River south of the Village of Nemaha. Flooding tends to occur most frequently in the spring or early summer as a result of heavy rainfall and/or snowmelt. However, locally heavy thunderstorms in late summer or autumn have also caused flooding problems. The worst flood on the Little Nemaha River occurred in May 1950 with an estimated discharge of 192,000 cfs. The recorded crest was 27.65 feet at Auburn.

The Big Nemaha River also flows from northwest to southeast through Johnson, Pawnee, and Richardson Counties. It joins the Missouri River south of Rulo just before the Nebraska-Kansas border. Flooding is normally caused by long periods of continuous rainfall or by a combination of rainfall and snowmelt. The major factors that aggravate flooding on the North Fork Big Nemaha River in Johnson County are constrictive bridges and fills of State Highway 50, the BNSF Railway, and US Highway 136. The largest flood on record at Tecumseh occurred in June 1941, with floodwaters reaching eight feet in depth in some parts of the city.

Table 68 shows the current status of Flood Insurance Rate Map (FIRM) panels. Many of the jurisdictions throughout the planning area also have FIRMs at the municipal level. Figure 35 shows the floodplain map for the Nemaha NRD planning area. For jurisdictional-specific vulnerabilities and available maps, refer to *Section Seven: Community Profiles*.

Table 68: FEMA FIRM Panel Status

JURISDICTION	PANEL NUMBER	EFFECTIVE DATE
Johnson County	31097CIND0A, 31097C0025C, 31097C0050C, 31097C0070C, 31097C0075C, 31097C0100C, 31097C0110C, 31097C0125C, 31097C0130C, 31097C0150, 31097C0164C, 31097C0173C, 31097C0174C, 31097C0175, 31097C0200C, 31097C0210C, 31097C0225C, 31097C0250C, 31097C0252C, 31097C0255C, 31097C0256C, 31097C0257C, 31097C0260C, 31097C0265C, 31097C0270C, 31097C0290C, 31097C0300C	04/17/2006
Cook	31097CIND0A, 31097C0070C	04/17/2006
Elk Creek	31097CIND0A, 31097C0270C, 31097C0290C	04/17/2006
Sterling	31097CIND0A, 31097C0110C, 31097C0130C	04/17/2006
Tecumseh	31097CIND0A, 31097C0164C, 31097C0173C, 31097C0174C, 31097C0252C, 31097C0256C, 31097C0257C	04/17/2006
Nemaha County	310460IND0, 3104600025A, 3104600050A, 3104600075A, 3104600100A, 3104600125A	04/02/1992
Auburn	Unmapped	n/a
Brock	3101550005B	08/19/1987
Brownville	Unmapped	n/a

JURISDICTION	PANEL NUMBER	EFFECTIVE DATE
Johnson	Unmapped	n/a
Julian	Unmapped	n/a
Nemaha	Unmapped	n/a
Peru	3101579999B, 310157B	09/01/1990
Otoe County (1)	31131C0025C, 31131C0050C, 31131C0075C, 31131C0100C, 31131C0125C, 31131C0160C, 31131C0175C, 31131C0200C, 31131C0210C, 31131C0215C, 31131C0220C, 31131C0230C, 31131C0235C, 31131C0240C, 31131C0245C, 31131C0275C, 31131C0310C, 31131C0325C, 31131C0345C, 31131C0350C, 31131C0375C, 31131C0400C	08/04/2004
Otoe County (2)	31131CIND0B, 31131C0120D, 31131C0140D, 31131C0256D, 31131C0257D, 31131C0258D, 31131C0259D, 31131C0266D, 31131C0268D, 31131C0269D, 31131C0288D, 31131C0289D, 31131C0291D, 31131C0293D, 31131C0295D, 31131C0385D, 31131C0391D, 31131C0392D, 31131C0393D, 31131C0394D, 31131C0425D, 31131C0435D, 31131C0445D, 31131C0450D, 31131C0455D, 31131C0465D	02/18/2011
Burr	31131C0345C 31131CIND0B	08/04/2004 02/18/2011
Douglas	31131C0310C 31131CIND0B	08/04/2004 02/18/2011
Dunbar	31131C0245C 31131CIND0B	08/04/2004 02/18/2011
Lorton	31131C0385D 31131CIND0B	02/18/2011
Nebraska City	31131CIND0B, 31131C0258D, 31131C0259D, 31131C0266D, 31131C0267D, 31131C0268D, 31131C0269D, 31131C0278D, 31131C0286D, 31131C0287D, 31131C0288D, 31131C0289D, 31131C0291D, 31131C0293D	02/18/2011
Otoe	31131C0210C, 31131C0230C 31131CIND0B	08/04/2004 02/18/2011
Palmyra	31131C0160C 31131CIND0B	08/04/2004 02/18/2011
Syracuse	31131C0215C, 31131C0220C 31131CIND0B	08/04/2004 02/18/2011
Talmage	31131CIND0B, 31131C0391D, 31131C0392D, 31131C0393D, 31131C0394D	02/18/2011
Unadilla	31131C0195C, 31131C0200C 31131CIND0B	08/04/2004 02/18/2011
Pawnee County	31133CIND0A, 31133C0025D, 31133C0050D, 31133C0075D, 31133C0100D, 31133C0125D, 31133C0150D, 31133C0175D, 31133C0200D, 31133C0225D, 31133C0250D, 31133C0275D, 31133C0300D	07/05/2005
Burchard	31133CIND0A, 31133C0150D	07/05/2005
DuBois	31133CIND0A, 31133C0300D	07/05/2005

JURISDICTION	PANEL NUMBER	EFFECTIVE DATE
Pawnee City	31133CIND0A, 31133C0175D, 31133C0275D, 31133C0300D	07/05/2005
Steinauer	31133CIND0A, 31133C0175D	07/05/2005
Table Rock	31133CIND0A, 31133C0200D	07/05/2005
Richardson County	3104709999B, 310470B	05/01/1990
Dawson	Unmapped	n/a
Falls City	Unmapped	n/a
Humboldt	3101830005B	08/19/1987
Rulo	310184IND0, 3101840001B, 3101840002B	09/29/1986
Salem	310185B	04/08/1977
Shubert	Unmapped	n/a
Stella	Unmapped	n/a
Verdon	Unmapped	n/a

Source: FEMA[73]

Nemaha and Richardson Counties are currently undergoing a floodplain mapping update. Effective FIRM maps are anticipated to be available in 2021. The FIRM panels listed above are the effective FIRM panels as of 2020. Floodplain maps used throughout this plan are based on preliminary FIRM maps provided by FEMA. Future updates of the HMP will include the newly effective FIRM maps. The most recent floodplain maps and panels can be found on the FEMA Flood Map Service Center.

Risk Map Products

Risk Mapping, Assessment, and Planning (Risk MAP) is a FEMA program that provides communities with flood information and tools (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. Eastern Otoe County and a sliver of extreme northeastern Nemaha County completed the Risk Map process and has products available as shown in Figure 36. Nemaha and Richardson Counties are currently going through the discovery mapping process with NeDNR, so they will have Risk MAP products available in the near future. NeDNR hosts the Risk MAP products on an interactive web map, which can be viewed here: https://prodmaps2.ne.gov/Html5DNR/index.html?viewer=outreach.

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, 60 flash flooding events resulted in $1,880,000 in property damage, while 150 riverine flooding events caused $4,196,000 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 $19,094,862. Descriptions of the most damaging flood events from the NCEI are below:

- **May 23, 1996 – Flash Flood – Johnson, Nemaha, and Otoe Counties:** Heavy rainfall throughout the month resulted in flash flooding and flooding along the Little Nemaha River and across the three counties. Damages reported to bridges, culverts, and other public structures ranged from $404,000 in Johnson County to $682,000 in Nemaha County. Crops were also heavily damaged with estimates around $9.6 million across the three counties.
- **May 12, 2005 – Flash Flood – Otoe County:** Heavy rain caused flash flooding across parts of Otoe County impacting mainly rural county roads around the Dunbar, Syracuse, Unadilla, and Douglas areas. A Weeping Water man driving a pickup truck was swept off of County Road 62 in extreme southern Otoe County by flood waters. He managed to free himself and swim to safety

[73] Federal Emergency Management Agency. 2020. "FEMA Flood Map Service Center." http://msc.fema.gov/portal/advanceSearch

suffering only minor injuries. Part of Highway 67 just north of Dunbar was washed out and water was reported over a bridge near minimum maintenance County Road F and County Road 36. Rainfall of two to six inches was reported across the county with much of it falling in an hour.

- **May 6, 2007 – Flash Flood – Johnson County:** Flash flooding washed out a county road bridge northwest of Sterling according to Emergency Management. A few county roads were also flooded in the area. Damages were estimated around $100,000.
- **April 25, 2008 – Riverine Flood – Johnson and Pawnee Counties:** Rainfall of two to six inches in a few hours' time caused flooding along Sampson Creek and Turkey Creek, which washed out three bridges and caused county road damage southwest of Tecumseh. Damage in Johnson County to roads and bridges was estimated at $1 million. The flooding continued into Pawnee County, and the flood waters also affected agricultural lowlands.
- **June 1, 2008 – Riverine Flood – Richardson County:** This flooding event carried over from May when heavy rain producing thunderstorms during the last week of May occurred along the Missouri River basin. The heavy rains caused the Missouri River to flood from near its confluence with the Platte River near Plattsmouth downstream through Rulo which is in extreme southeast Richardson County. Heavy rain which continued over sections of the Missouri River basin during the first week of June caused the flooding to continue along the Missouri River in Richardson County until mid-evening on June 21. The flooding from this event along the Missouri River in Richardson County began during the midafternoon hours of May 30. The river at Rulo crested just above 25 feet early in the evening of June 14 (flood stage is 17 feet). Rulo sustained damage to a few streets, park buildings and one of its boat ramps. It was estimated that around 30 homes and a few businesses sustained some damage from flood waters. The flooding also affected agricultural lowlands and flooded county roads in the area.
- **March 11, 2010 – Riverine Flood – Richardson County:** Melting snow, along with several rain events, brought a prolonged period of lowland flooding along the Missouri River, especially downstream of its confluence with the Platte River near Plattsmouth. The river at Rulo first crossed flood stage, 17 feet, during the evening of March 11 and remained above flood stage until the morning of March 31. The river at Rulo crested around 22 feet during the morning of March 25. Agricultural lowlands and a few county roads near the river flooded in Richardson county and some cabins and recreational areas near Rulo also experienced flood waters. Damages were estimated at $250,000.
- **June 11, 2010 – Riverine Flood –- Nemaha, Otoe, and Richardson Counties:** Heavy rain over much of eastern Nebraska and western Iowa during most of June caused a prolonged period of flooding along the Missouri River, especially downstream of Omaha through Rulo. The river at Rulo reached a record crest of around 26.6 feet during the evening of June 23 (flood stage is 17 feet). An earlier crest of around 25 feet was measured on June 17. The river remained in flood stage into and through July. Highway 159 near Rulo was closed for a time and substantial flooding of lowlands along the river occurred including cabins, homes and recreation areas. At least 30 to 40 people were evacuated from 20 homes that were damaged by flood waters. At Nebraska City, industrial roads near the river were flooded along with some cabins, boat ramps, and recreation areas. In Nemaha County, several roads were flooded including one that leads to the Cooper Nuclear Power Plant.
- **July 1, 2011 – Riverine Flood – Richardson County:** Flooding along the Missouri River gradually worsened during June as record releases from Gavins Point Dam brought widespread flooding along the river. The river at Rulo rose to a record crest around 27 feet by the end of the June before falling slightly as levees were breached and widened by the flood waters. The flooding persisted into August. The high water flooded farmland along the river, along with roads, cabins, recreation areas and a few businesses. Highway 159 in Holt County, Missouri flooded by the middle of the June prompting the closure of the Rulo, Nebraska bridge over the Missouri River for the summer. Over $100,000 had already been spent by early July shoring up pump houses and wells in the Falls City area to protect the water supply.
- **June 4, 2015 – Riverine Flood – Richardson County:** Significant flooding was observed along the Big Nemaha River near Falls City. The flooding closed many gravel and county roads, as well as State Highway 8. The flooding also impacted agricultural lowlands along the river. Damages were estimated at $125,000.

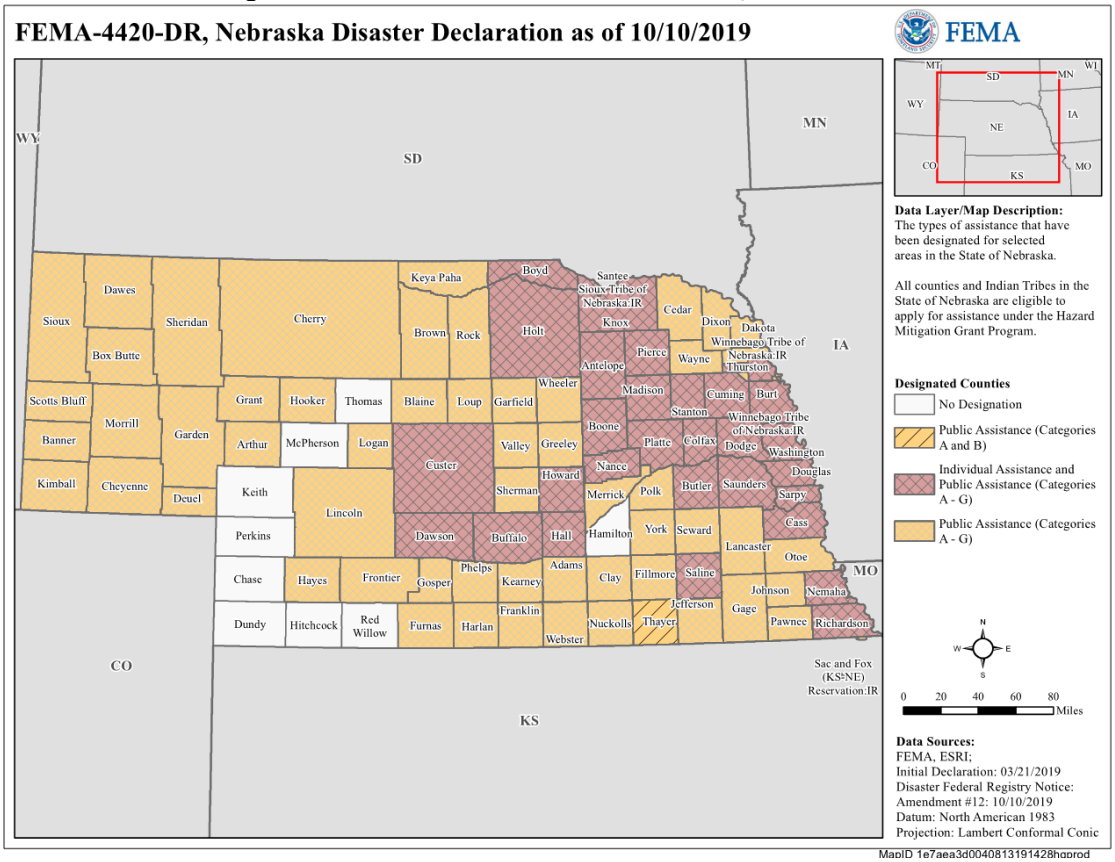
MARCH 2019 FLOOD EVENT

The March 2019 flood event significantly impacted the planning area, primarily Otoe, Nemaha, and Richardson Counties along the Missouri River. Winter Storm Ulmer developed on March 12 and slowly moved across the Midwest including Nebraska. Due to heavy precipitation on frozen ground and melting snowpack, numerous water systems were overwhelmed and failed. In other areas upstream from the Nemaha NRD, released ice jams destroyed roads, bridges, and levees. Several stream gauges in the planning area reached all-time record levels including the Missouri River at Nebraska City, Brownville, and Rulo. The Missouri River at Nebraska City recorded a crest of 30.12 feet of water, nearly two feet above the previous record set in June 2011. Flooding along the Missouri River lasted well into the next month. In total, 104 cities, 81 counties (including all five counties in the planning area), and five tribal nations in Nebraska received State or Federal Disaster Declarations due to the flood events, as seen in Figure 37.

The NeDNR has collected and reviewed extensive data records from the flood event. An event-wide ArcGIS StoryMap has been developed and provides an excellent resource to understand the cause, duration, impacts, and recovery efforts from this event. The ArcGIS StoryMap can be viewed at: https://storymaps.arcgis.com/stories/9ce70c78f5a44813a326d20035cab95a.

Figure 38 and Figure 39 show the stream gauge graphical information on the Missouri River at Nebraska City and Rulo. As indicated, both stream gauges reported record flood crests, which were 30.12 ft at Nebraska City on March 16, 2019 and 28.13 ft at Rulo on March 20, 2019. Previous records were 28.27 ft and 27.26 ft, respectively and occurred during the 2011 floods, which peaked in June that year.[74][75]

Figure 37: Nebraska Disaster Declaration, March 2019

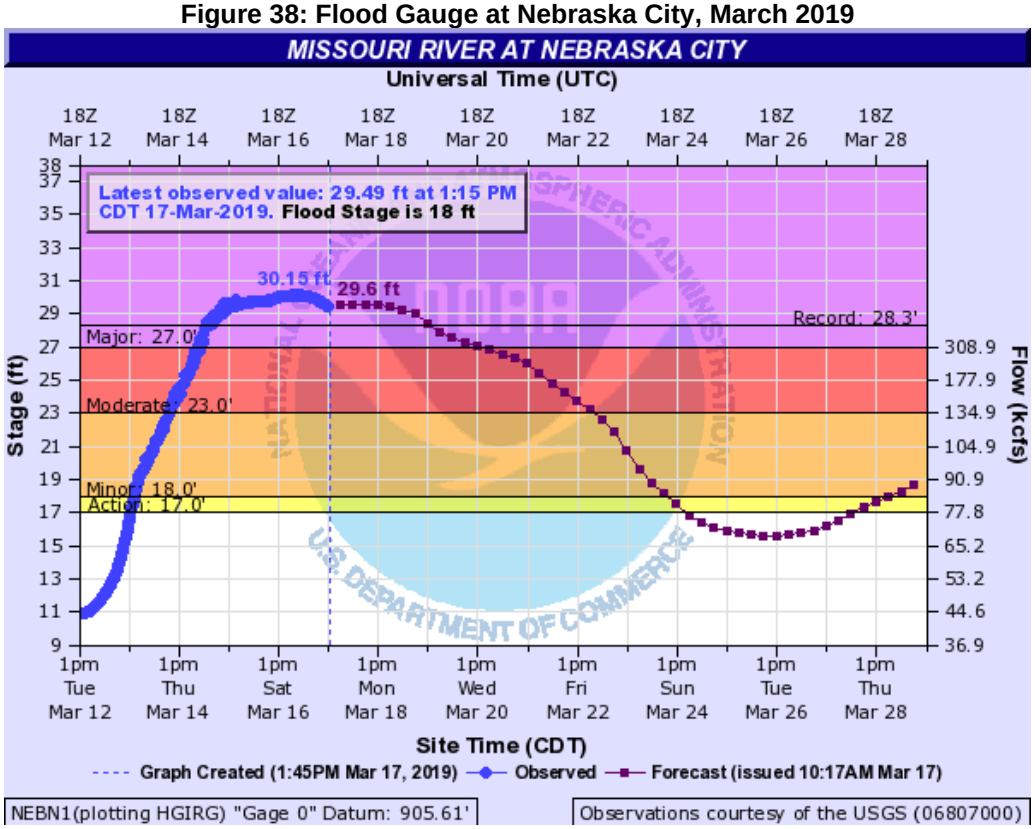


Source: FEMA, 2020

[74] NOAA National Weather Service. 2020. "Advanced Hydrologic Prediction Service." Missouri River at Nebraska City. https://water.weather.gov/ahps2/hydrograph.php?wfo=oax&gage=nebn1

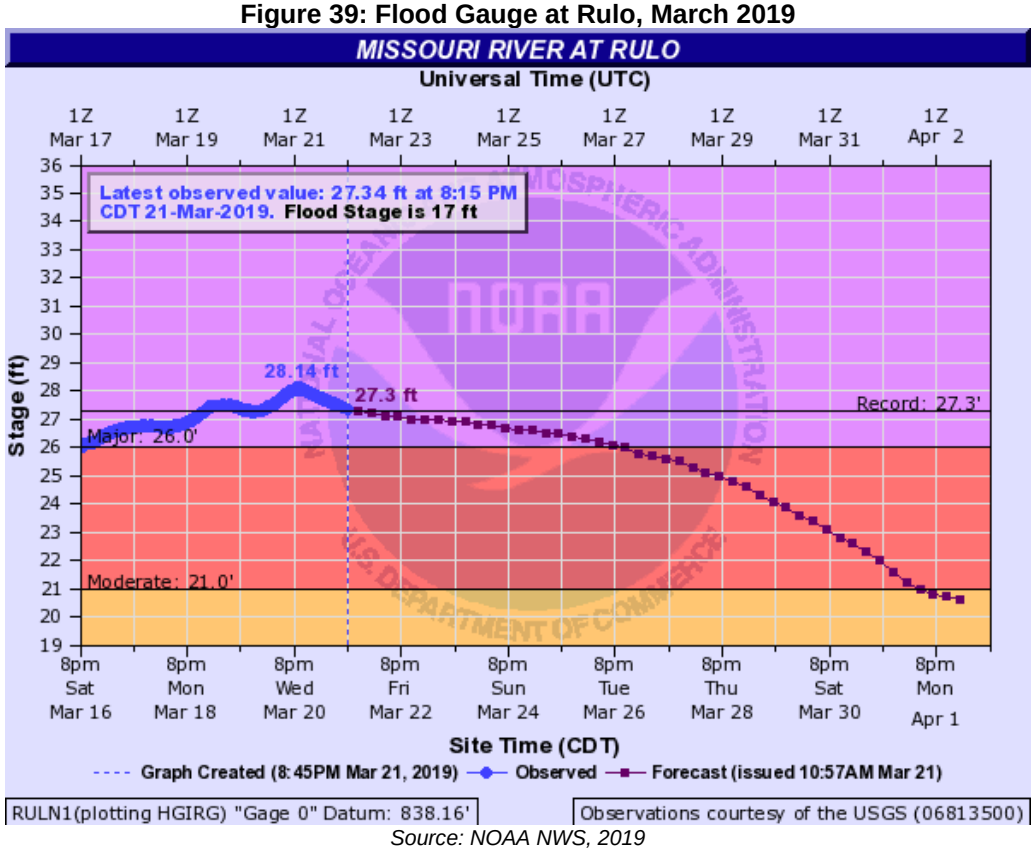
[75] NOAA National Weather Service. 2020. "Advanced Hydrologic Prediction Service." Missouri River at Rulo. https://water.weather.gov/ahps2/hydrograph.php?wfo=oax&gage=ruln1

Figure 38: Flood Gauge at Nebraska City, March 2019



Source: NOAA NWS, 2019

Figure 39: Flood Gauge at Rulo, March 2019



Source: NOAA NWS, 2019

While no fatalities were reported from this flood in the five-county area, there were numerous impacts, many of which lasted several months. Communities along the Missouri River were particularly affected. Below is a brief summary of impacts provided by local planning teams. Refer to the *Community Profiles* in *Section Seven* for additional details.

Table 69: Select Community March 2019 Flood Impacts

JURISDICTION	MARCH 2019 FLOOD IMPACTS
City of Auburn	- Flooding cut off access to water wells but remained operational - Overloaded sewer lines
Village of Brownville	- Highway 136 bridge to Iowa was closed for nine months - Riverside Park and landing area flooded - Picnic tables, camping areas, and trees washed away - Estimated foot and a half of debris in most flooded areas - No homes or businesses were damaged
Village of Dunbar	- One home damaged by sewer backup - Village sewage pump unable to keep up during flood - Bridge over Little Nemaha River a concern for maintenance and critical infrastructure that crosses with it - Stream bank erosion a concern
Village of Johnson	- Floodwaters overloaded the lift station and several sewer lines
Nebraska City	- Highway 2 closed going east into Iowa for over 100 days, which impacted businesses, industries, communities, and emergency services - Wastewater treatment plant was shut down from March 15 to July 23 - Four wellhouses were taken out of service due to standing water - Access road to well fields were flooded from March to November; access possible by boat only - Minimal damages along 1st Street to commercial buildings - Railroad over South Table Creek collapsed and had to be replaced - Considerable bank erosion along South Table Creek and North Table Creek - Water into basements due to seepage was the most reported damage by residential owners
Nemaha County	- Numerous roads closed - Missouri River bridge to Iowa on Highway 136 was closed for many months disrupting transportation and impacting businesses Concern regarding levee systems in county are not enrolled in USACE rehabilitation program and are not eligible for repairs and improvements putting communities, roads, and agriculture at continued risk of flooding
Village of Nemaha	- Local levee overtopped, allowing floodwaters to encroach on the village - Highway 67 closed for one day - Community volunteers and fire department sandbagged a trailer in the floodplain and the lift station, keeping floodwaters out - Lagoons and lift station were almost flooded by the Little Nemaha River, but sandbagging provided protection
City of Peru	- Levee north of the community breached, allowing floodwaters to impact the northern part of the community - Levee not enrolled in USACE rehabilitation program and is not eligible for complete repairs or improvements - Seven homes, water treatment plant, and both wells destroyed - Alternative water supply being explored - Wastewater lagoons damaged - Majority of stormwater drains damaged and in need of repair
Richardson County	- Crops were delayed or not planted due to flooded fields greatly affecting the local economy - Roads and bridges heavily damaged across the county - Few residential homes were damaged, but generally was minimal

JURISDICTION	MARCH 2019 FLOOD IMPACTS
Village of Rulo	- Several feet of water flowed down Commercial Street and standing water lasted 272 days - 25 homes were completed damaged and 20 residents have permanently left the community because of the flood - Village cutoff for several days due to roads and bridges washed out - Businesses were not damaged but suffered economic losses - Surrounding farmland suffered due to floodwaters and several feet of sand deposited

The Regional Planning Team also noted that orphaned tanks (e.g. propane tanks) floated downstream with many ending up along the Missouri River across the three counties. Debris management was a significant problem following the flood which included cornstalks, propane tanks, tree branches, silted sand, etc.

EXTENT

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

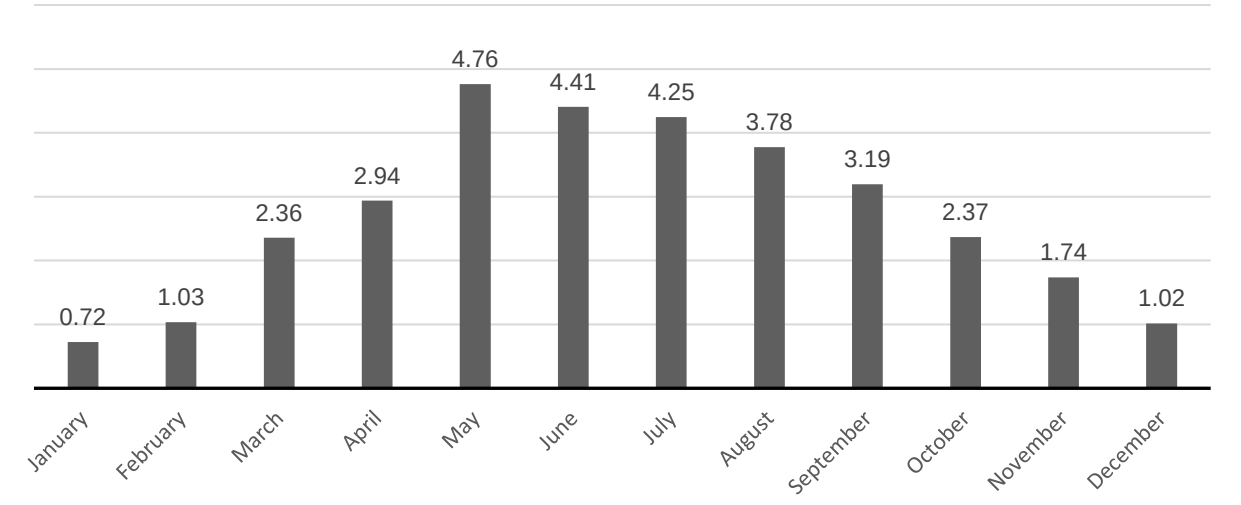
Table 70: Flooding Stages

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, 2019[76]

Figure 40 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 41, the most common month for flooding within the planning area is in May, followed closely by June. While it is possible that major flood events will occur, the likely extent of flood events within the planning area is classified as moderate.

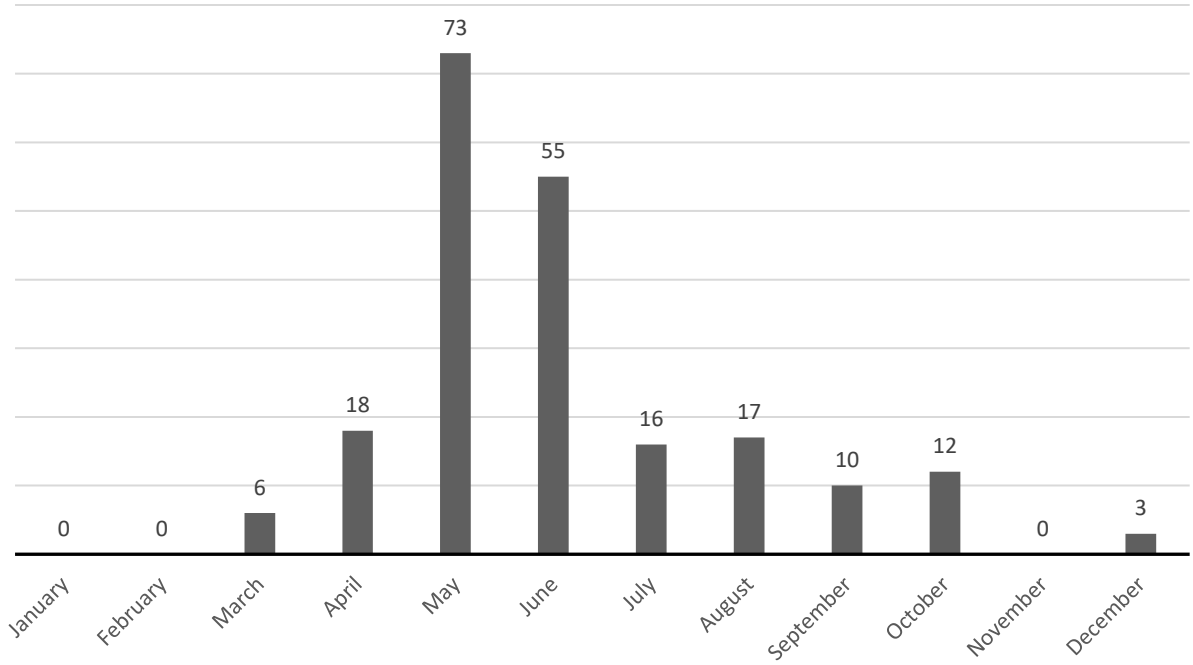
Figure 40: Average Monthly Precipitation



Source: NCEI, 2020

[76] National Weather Service. 2020. "Severe Weather 101- Floods." https://www.nssl.noaa.gov/education/svrwx101/floods/faq/.

Figure 41: Monthly Events for Floods/Flash Flood



Source: NCEI, 1996-2019

NATIONAL FLOOD INSURANCE PROGRAM (NFIP)

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

In return for availability of federally-backed flood insurance, jurisdictions participating in the NFIP must agree to adopt and enforce floodplain management standards to regulate development in special flood hazard areas (SFHA) as defined by FEMA's flood maps.

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

Table 71: NFIP Participants

JURISDICTION	PARTICIPATION IN NFIP	ELIGIBLE-REGULAR PROGRAM	DATE CURRENT MAP	SANCTION	SUSPENSION	RESCINDED
Johnson County	Yes	06/06/2006	04/17/2006	-	-	-
Cook	No	-	04/17/2006	10/18/75	-	-
Elk Creek	No	-	04/17/2006	12/05/89	12/05/1989	-
Sterling	Yes	09/01/1987	04/17/06(L)	-	-	-
Tecumseh	Yes	12/04/1979	04/17/2004	-	-	-
Nemaha County	Yes	04/02/1992	04/2/92(M)	-	-	-
Auburn	Yes	09/10/1984	NSFHA	-	-	9/10/1984
Brock	Yes	08/19/1987	8/19/87(M)	-	-	-
Brownville	No	-	-	-	-	-
Johnson	Yes	03/3/09(E)	-	-	-	-

JURISDICTION	PARTICIPATION IN NFIP	ELIGIBLE-REGULAR PROGRAM	DATE CURRENT MAP	SANCTION	SUSPENSION	RESCINDED
Julian	No	-	-	-	-	-
Nemaha	Yes	08/24/2012	NSFHA	-	-	-
Peru	Yes	09/01/1990	09/01/90(L)	-	-	-
Otoe County	Yes	03/02/1998	02/18/2011	-	-	-
Burr	No	-	-	-	-	-
Douglas	Yes	09/24/1984	NSFHA	-	-	09/24/1984
Dunbar	Yes	08/19/1985	08/4/04(M)	-	-	-
Lorton	No	-	02/18/2011	08/04/05	-	-
Nebraska City	Yes	09/16/1982	02/18/2011	-	-	-
Otoe	Yes	08/19/1985	08/4/04(M)	-	-	-
Palmyra	Yes	10/04/2004	08/04/2004	-	-	03/31/1977
Syracuse	Yes	07/01/1988	08/04/04(L)	-	-	-
Talmage	Yes	06/01/1982	02/18/2011	-	-	-
Unadilla	Yes	09/04/1985	08/4/04(M)	-	-	-
Pawnee County	Yes	06/06/2006	07/05/2005	-	-	-
Burchard	No	-	07/05/2005	11/08/75	-	-
DuBois	No	-	07/05/2005	07/05/06	-	-
Pawnee City	Yes	08/01/1986	07/05/2005	-	-	-
Steinauer	Yes	04/14/2010	07/05/2005	-	-	01/29/1981
Table Rock	Yes	06/02/2003	07/05/2005	-	-	-
Richardson County	Yes	05/01/1990	05/01/90(L)	-	-	-
Dawson	No	-	-	-	-	03/30/1979
Falls City	No	09/24/1984	NSFHA	-	-	09/24/1984
Humboldt	Yes	08/19/1987	8/19/87(M)	-	-	-
Rulo	Yes	09/29/1986	09/29/1986	-	-	-
Salem	Yes	04/08/1977	04/8/77(M)	-	-	-
Shubert	No	-	-	-	-	-
Stella	No	-	-	-	-	03/30/1979
Verdon	No	-	-	-	-	-

Source: Federal Emergency Management Agency, National Flood Insurance Program, 2020
(L) indicates Original FIRM by Letter – All Zone A, C, and X.
(M) indicates No Elevation Determined – All Zone A, C, and X.
NSFHA indicates No Special Flood Hazard Area – All Zone C
(E) indicates Entry in Emergency Program

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

Table 72: NFIP Policies in Force and Total Payments

JURISDICTION	POLICIES IN-FORCE	TOTAL PREMIUMS	TOTAL COVERAGE	TOTAL LOSSES	TOTAL PAYMENTS
Johnson County	4	$2,803	$283,000	0	$0
Cook	N/P	N/A	N/A	N/A	N/A

JURISDICTION	POLICIES IN-FORCE	TOTAL PREMIUMS	TOTAL COVERAGE	TOTAL LOSSES	TOTAL PAYMENTS
Elk Creek	N/P	N/A	N/A	N/A	N/A
Sterling	8	$4,891	$526,000	0	$0
Tecumseh	5	$3,127	$392,000	3	$7,614
Nemaha County	3	$7,804	$1,000,000	47	$545,993
Auburn	0	$0	$0	2	$1,670
Brock	0	$0	$0	0	$0
Brownville	N/P	N/A	N/A	N/A	N/A
Johnson	0	$0	$0	0	$0
Julian	N/P	N/A	N/A	N/A	N/A
Nemaha	0	$0	$0	0	$0
Peru	8	$5,458	$550,000	1	$0
Otoe County	6	$4,873	$1,133,000	0	$0
Burr	N/P	N/A	N/A	N/A	N/A
Douglas	1	$4,071	$136,000	0	$0
Dunbar	6	$3,542	$252	4	$15,178
Lorton	N/P	N/A	N/A	N/A	N/A
Nebraska City	8	$6,821	$1,652,000	7	$349,985
Otoe	1	$1,647	$145,000	1	$972
Palmyra	0	$0	$0	0	$0
Syracuse	9	$6,135	$631,000	4	$9,736
Talmage	0	$0	$0	0	$0
Unadilla	0	$0	$0	0	$0
Pawnee County	3	$1,150	$64,000	0	$0
Burchard	N/P	N/A	N/A	N/A	N/A
DuBois	N/P	N/A	N/A	N/A	N/A
Pawnee City	0	$0	$0	0	$0
Steinauer	1	$275	$13,000	0	$0
Table Rock	5	$2,865	$106,000	0	$0
Richardson County	6	$7,778	$667	36	$1,179,006
Dawson	N/P	N/A	N/A	N/A	N/A
Falls City	N/P	N/A	N/A	N/A	N/A
Humboldt	5	$7,894	$371,000	2	$8,444
Rulo	4	$996	$188,000	44	$896,102
Salem	0	$0	$0	0	$0
Shubert	N/P	N/A	N/A	N/A	N/A
Stella	N/P	N/A	N/A	N/A	N/A
Verdon	N/P	N/A	N/A	N/A	N/A

N/A: Not Applicable; N/P: Not Participate
Source: Federal Emergency Management Agency, National Flood Insurance Program, NFIP Community Status Book, 2019[77]

[77] Federal Emergency Management Agency: National Flood Insurance Program. December 2019. "Policy & Claim Statistics for Flood Insurance." Accessed December 2019. https://www.fema.gov/policy-claim-statistics-flood-insurance.

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, regardless of whether or not a flooding hazard area map has been delineated for the jurisdiction. 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).[78] 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. There are 28 NFIP repetitive loss (RL) properties, eight Hazard Mitigation Assistance (HMA) RL properties, and six HMA severe repetitive loss (SRL) properties located in the planning area.

Table 73: Repetitive Loss and Severe Repetitive Loss Properties

JURISDICTION	NFIP REPETITIVE LOSS (RL)	HMA RL	HMA RL TYPES	HMA SEVERE RL (SRL)	HMA SRL TYPES
Humboldt	1	-	-	-	-
Nebraska City	3	-	-	-	-
Nehawka	5	-	-	-	-
Nemaha County	1	-	-	-	-
Richardson County	10	6	Single Family	4	Single Family
Rulo	8	2	Single Family	2	Single Family

Source: NeDNR, February 2020

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

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

(1) That have incurred flood-related damage for which four or more separate claims payments have been made, with the amount of each claim (including building and contents payments) exceeding $5,000, and with the cumulative amount of such claim payments exceeding $20,000; or
(2) For which at least two separate claims payments (building payments only) have been made under such coverage, with cumulative amount of such claims exceeding the market value of the building.
(3) In both instances, at least two of the claims must be within 10 years of each other, and claims made within 10 days of each other will be counted as one claim.

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

(a) Has incurred flood-related damage on two occasions, in which the cost of the repair, on the average, equaled or exceeded 25 percent of the market value of the structure at the time of each such food event; and
(b) At the time of the second incidence of flood-related damage, the contract for flood insurance contains increased cost of compliance coverage.

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

(a) Is covered under a contract for flood insurance made available under the NFIP
(b) Has incurred flood related damage –

[78] Federal Emergency Management Agency. May 2017. "National Flood Insurance Program Community Rating System: Coordinator's Manual FIA-15/2017." Accessed August 2017. https://www.fema.gov/media-library/assets/documents/8768.

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

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

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

AVERAGE ANNUAL LOSSES

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 caused an average of $255,832 in property damages and $954,743 in crop losses per year for the planning area.

Table 74: Flood Loss Estimate

HAZARD TYPE	NUMBER OF EVENTS[1]	AVERAGE EVENTS PER YEAR	TOTAL PROPERTY LOSS[1]	AVERAGE ANNUAL PROPERTY LOSS[1]	TOTAL CROP LOSS[2]	AVERAGE ANNUAL CROP LOSS[2]
Flash Flood	60	2.5	$1,880,000	$79,158	$19,094,862	$954,743
Flood	150	6.3	$4,196,000	$176,674		
Total	**210**	**8.8**	**$6,076,000**	**$255,832**	**$19,094,862**	**$954,743**

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

PROBABILITY

The NCEI reports 150 flood and 60 flash flood events for a total of 210 events from January 1996 to September 2019. Based on the historic record and reported incidents by participating communities, there is a 100 percent probability that flooding will occur annually in the planning area.

REGIONAL VULNERABILITIES

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

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

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

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

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 structure son each parcel. A summary of the results of this analysis for the five-county planning area is provided in the following table. Specific jurisdictional parcel improvements in the floodplain can be found in the corresponding *Community Profile* in *Section Seven*.

Table 75: Planning Area Parcel Improvements and Value in the Floodplain

COUNTY	NUMBER OF IMPROVEMENTS	TOTAL IMPROVEMENT VALUE	NUMBER OF IMPROVEMENTS IN FLOODPLAIN	VALUE OF IMPROVEMENTS IN FLOODPLAIN	PERCENTAGE OF IMPROVEMENTS IN FLOODPLAIN
Johnson	3,416	$185,844,021	887	$41,771,853	25.96%
Nemaha	4,506	$260,445,337	706	$33,704,677	15.66%
Otoe	9,348	$817,514,570	1,521	$116,801,490	16.27%
Pawnee	2,776	$104,550,305	782	$29,074,205	28.17%
Richardson	5,770	$265,672,860	892	$40,928,198	15.45%
Planning Area Total	**25,816**	**$1,634,027,093**	**4,788**	**$262,280,423**	**18.55%**

Source: County Assessors, 2019

Pawnee County closely followed by Johnson County has the largest percentage of parcel improvements located in the floodplain at 28 percent and 26 percent respectively. This indicates that these counties, particularly along waterways, have the greatest flood vulnerability to people and infrastructure. However, Otoe County has the highest value of improvements in the floodplain, which may be at risk to damage during flood events.

Critical access between Iowa and Nebraska across the Missouri River is a continued vulnerability as these roadways were flooded for several weeks or months during the 2011 and 2019 floods. It appears the primary vulnerability is on the Iowa side of the Missouri River, and the Iowa Department of Transportation is currently investing $34 million to reduce the risk of flooding to Highway 2. This investment is critical to the economies on both sides of the river.

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

Table 76: Regional Flooding Vulnerabilities

SECTOR	VULNERABILITY
People	-Low income and minority populations may lack the resources needed for evacuation, response, or to mitigate the potential for flooding -Elderly or residents with decreased mobility may have trouble evacuating -Residents in low-lying areas, especially campgrounds, are vulnerable during flash flood events -Residents living in the floodplain may need to evacuate for extended periods
Economic	-Business closures or damages may have significant impacts -Agricultural losses from flooded fields or cattle loss -Closed roads and railways would impact commercial transportation of goods
Built Environment	-Building may be damaged
Infrastructure	-Damages to roadways and railways
Critical Facilities	-Wastewater facilities are at risk, particularly those in the floodplain -Critical facilities, especially those in the floodplain, are at risk to damage (critical facilities are noted within individual community profiles)

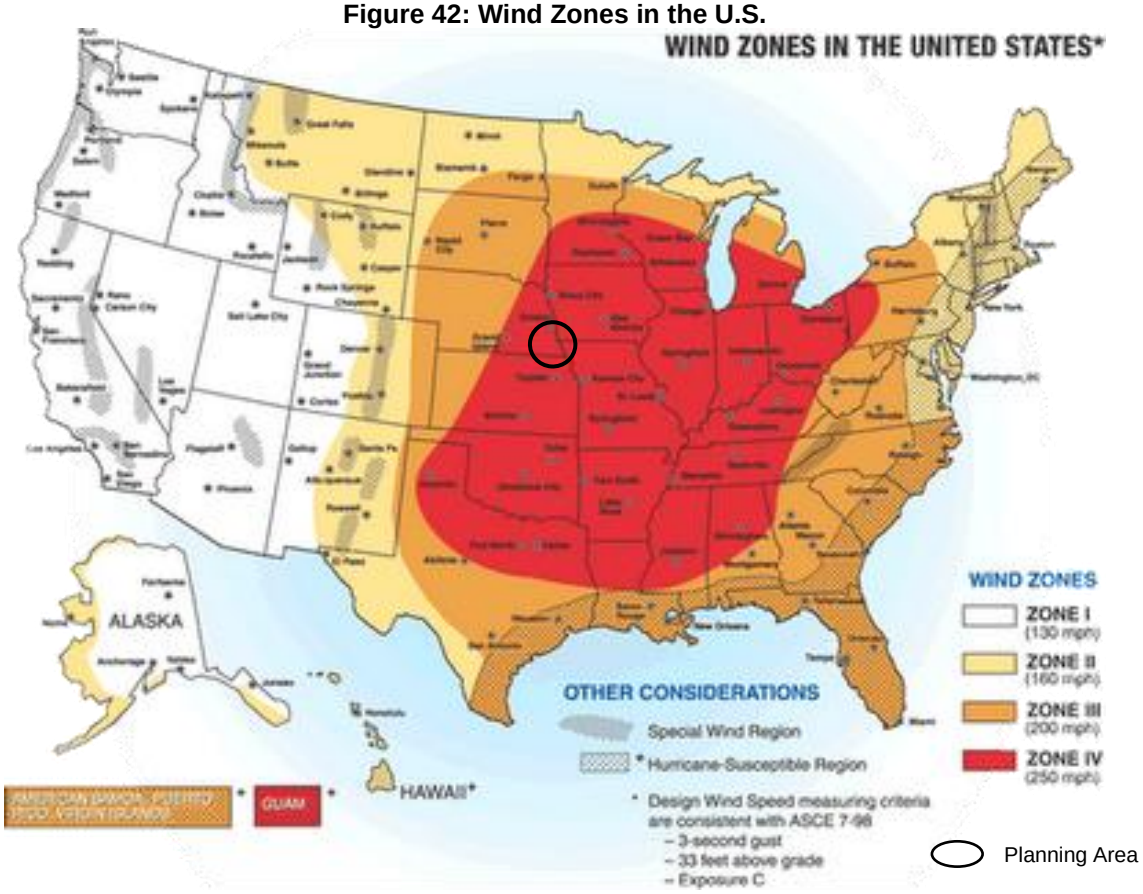
SECTOR	VULNERABILITY
Climate	-Changes in seasonal and annual precipitation normals will likely increase frequency and magnitude of flood events

HIGH WINDS & TORNADOES

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

The NWS defines high winds as sustained wind speeds of 40 mph or greater lasting for 1 hour or longer, or winds of 58 mph or greater for any duration.[79] The NWS issues High Wind Advisories when there are sustained winds of 25 to 39 miles per hour and/or gusts to 57 mph. Figure 42 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/IV which has maximum winds of 250 mph equivalent to an EF5 tornado.

Figure 42: Wind Zones in the U.S.



Source: FEMA, 2016

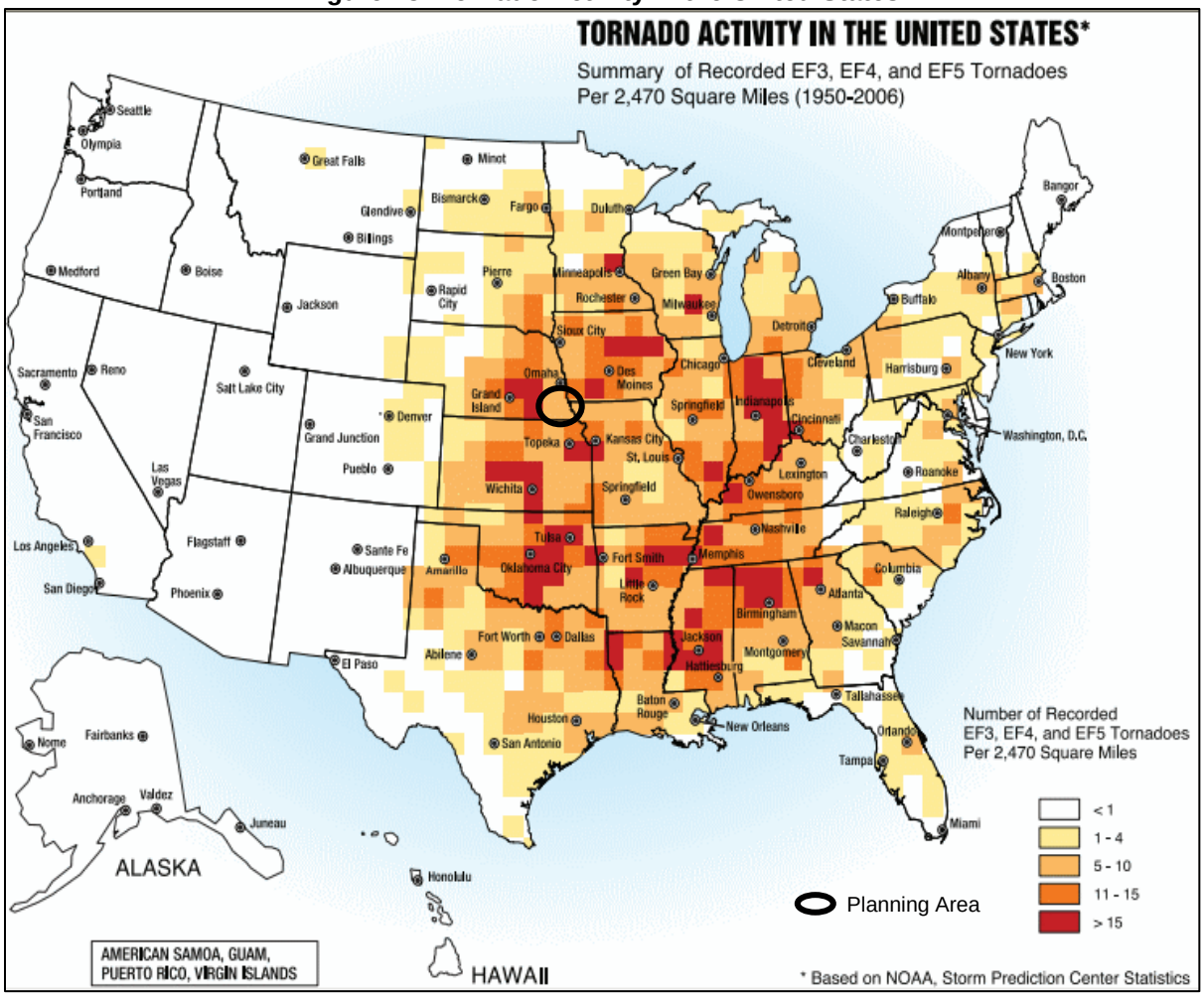
High winds are a critical component of tornado formation. A tornado is typically associated with a supercell thunderstorm. For a rotation to be classified as a tornado, three characteristics must be met:

- 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; and
- The spinning vortex of air must have caused enough damage to be classified by the Fujita Scale as a tornado.

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

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 longer 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.

Figure 43: Tornado Activity in the United States



Source: FEMA, 2008[80]

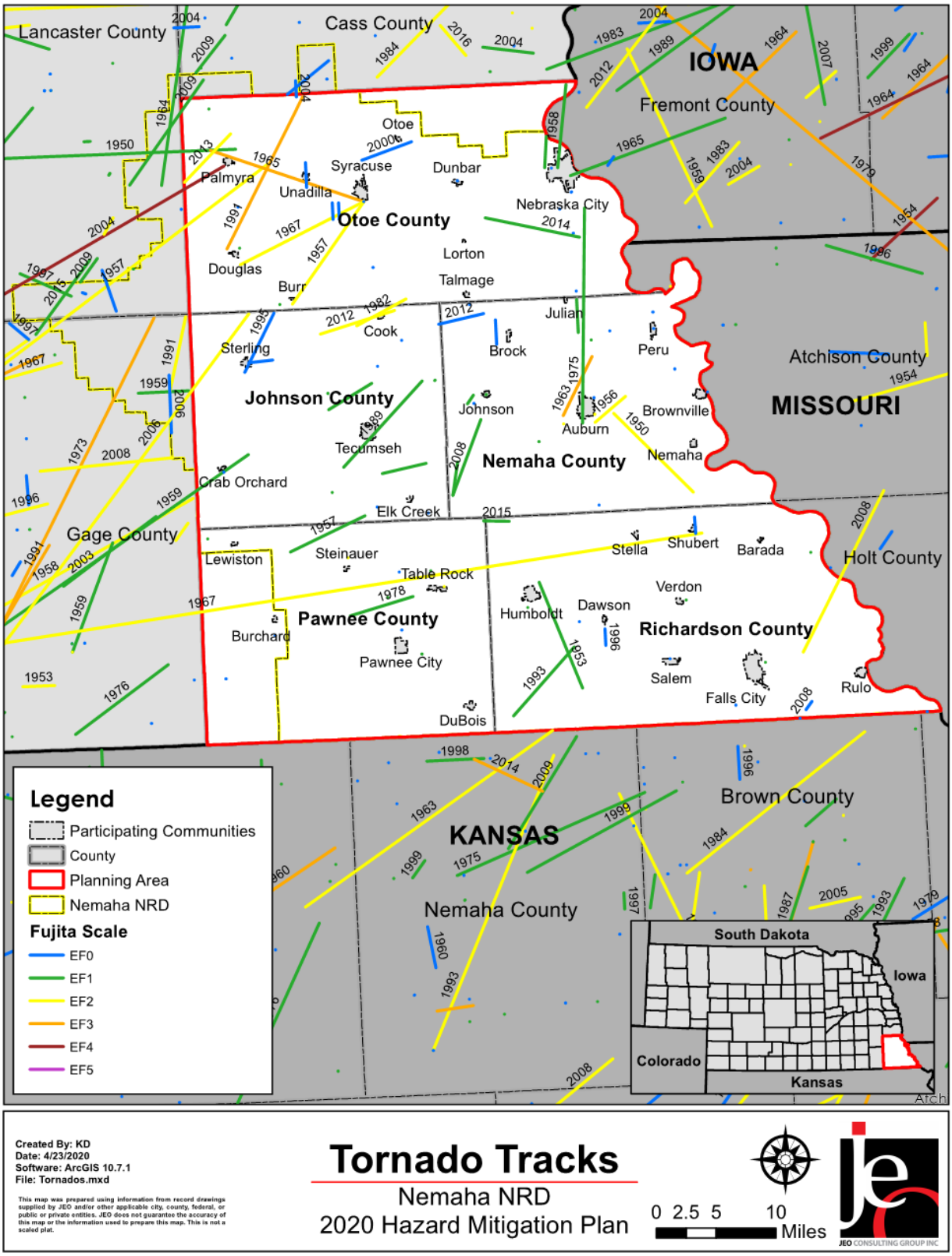
Nebraska is ranked fifth in the nation for tornado frequency with an annual average of 57 tornadoes between 1991 to 2010.[81] The following figure shows the tornado activity in the United States as a summary of recorded EF3, EF4, and EF5 tornadoes per 2,470 square miles from 1950 through 2006.

LOCATION

High winds and tornadoes commonly occur throughout the planning area. The impacts would likely be greater in more densely populated areas. The following map shows the historical track locations across the region from 1950 to 2018 according to the Midwestern Regional Climate Center.

[80] Federal Emergency Management Agency. August 2008. "Taking Shelter from the Storm: Building a Safe Room for Your Home or Small Business, 3rd edition."
[81] National Centers for Environmental Information. 2013. "U.S. Tornado Climatology." https://www.ncdc.noaa.gov/climate-information/extreme-events/us-tornado-climatology.

Figure 44: Historic Tornado Tracks



HISTORICAL OCCURRENCES

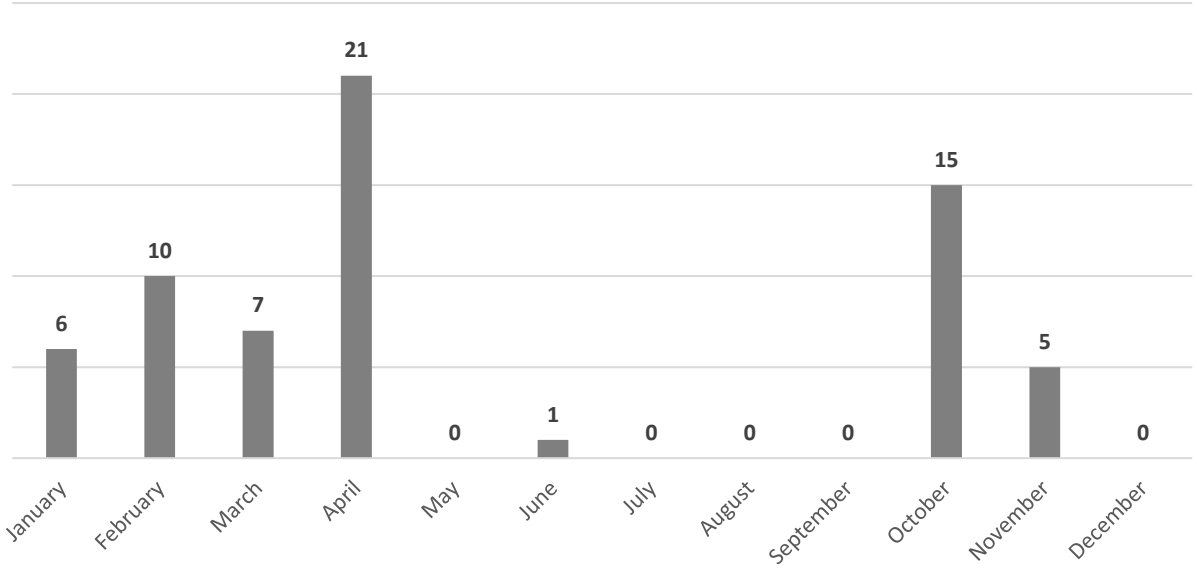
Due to the regional scale of high winds, the NCEI reports events as they occur in each county. While a single event can affect two or more counties at a time, the NCEI reports them as separate events. There were 65 high wind events that occurred between January 1996 and September 2019 and 42 tornadic events ranging from magnitude of EF0 to EF2. These events were responsible for $20,809,000 in property damages and $2,088,445 in crop damages.

One death and one fatality were reported, both of which occurred in the same high wind event in April 2002. A large area of strong, damaging winds developed following the dissipation of showers and thunderstorms late in the night of April 18, 2002. The Falls City airport measured wind speeds at 72 mph, which blew over a mobile home and destroyed a barn and lawn care equipment north of Falls City. In addition, there was widespread roof and tree damage in and out of Falls City and an insurance agency estimated that claims for damage alone in Falls City came to around $100,000. In Johnson and Pawnee Counties, the winds were estimated at around 70 mph by Emergency Management, and both counties reported extensive tree damage. Considerable damage was reported in the Village of Cook to barns, sheds, and other outbuildings in addition to several windows blown out. The winds were also responsible for a five-vehicle pileup because of blinding dust, which killed a 54-year old man.

Over $20.8 million in damages occurred from the 42 tornadic events since 1996. One tornado on May 22, 2004, caused the majority of the $20 million in damages. This tornado is known as the Hallam tornado, as it first struck Hallam in neighboring Lancaster County. It traveled for a total of 54 miles from Lancaster County into Otoe County before it dissipated near Palmyra in Otoe County. No deaths or injuries were reported in Otoe County from this tornado, and the majority of the $20 million in damages actually occurred in neighboring Lancaster County, but it is not possible to separate the Otoe County damages.

As seen in Figure 45, most high wind events occur in the spring, late fall, and winter months.

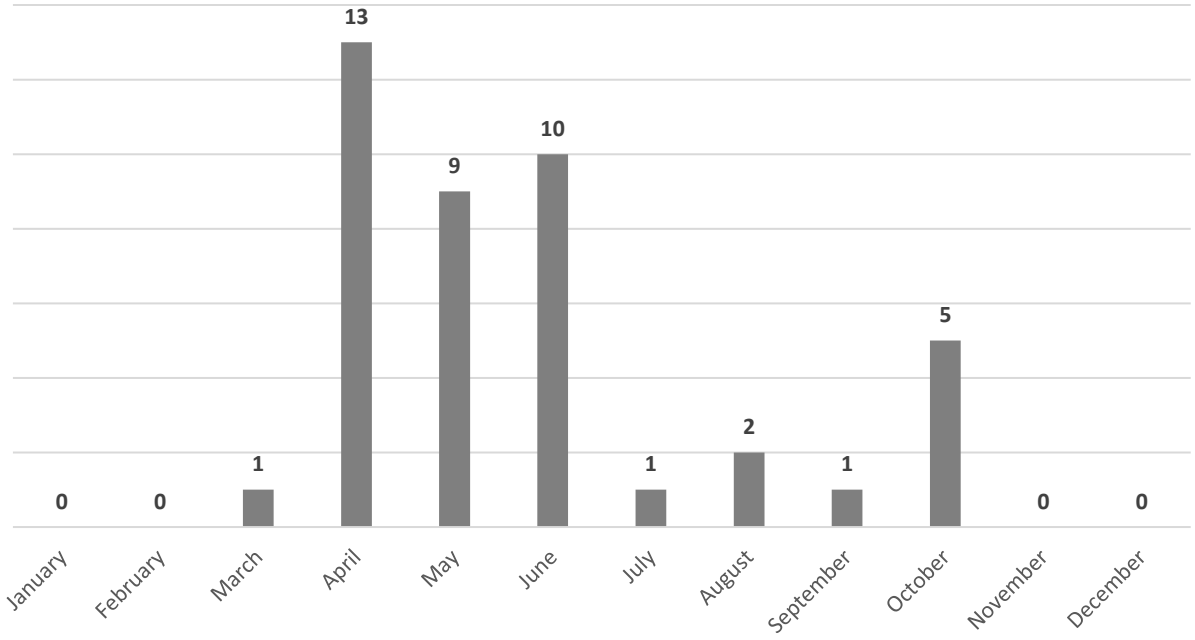
Figure 45: High Wind Events by Month



Source: NCEI, 1996-2019

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

Figure 46: Tornadoes by Month in the Planning Area



Source: NCEI, 1996-2019

EXTENT

The Beaufort Wind Scale can be used to classify wind strength, and the Enhanced Fujita Scale measures the magnitude of tornadoes. Table 77 outlines the Beaufort Scale, provides wind speed ranking, range of wind speeds per ranking, and a brief description of conditions for each ranking.

Table 77: Beaufort Wind Ranking

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

Source: Storm Prediction Center, 2017[82]

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

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

Table 78: Enhanced Fujita Scale

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

Source: NOAA; FEMA

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

Table 79: Enhanced Fujita Scale Damage Indicator

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

Source: NOAA; FEMA

Using the NCEI reported events, the most common high wind event is ranked a level 9 on the Beaufort Wind Force Scale. The reported high wind events had an average of 48 mph winds. Based on the historic record, it is most likely that tornadoes that occur within the planning area will be of EF0 strength. Of the 42 reported tornado events, nine were EF1 and three were EF2. High wind and tornadoes are likely to occur annually in the planning area.

Average Annual Losses

The average damage per event estimated was determined based upon NCEI Storm Events Database since 1996 and number of historical occurrences. This does not include losses from displacement, functional downtime, economic loss, injury, or loss of life. It is estimated that high wind events can cause an average of $4,167 per year in property damage, and an average of $104,422 per year in crop damage for the planning area. Tornadoes cause an average of $862,875 per year in property damage. The RMA did not report crop damages due to tornadic events, but damage to crops from tornadoes is still a concern for the planning area.

Table 80: High Wind and Tornado Loss Estimate

HAZARD TYPE	NUMBER OF EVENTS[1]	AVERAGE EVENTS PER YEAR	TOTAL PROPERTY LOSS[1]	AVERAGE ANNUAL PROPERTY LOSS[1]	TOTAL CROP LOSS[2]	AVERAGE ANNUAL CROP LOSS[2]
High Winds	65	2.7	$100,000	$4,167	$2,088,445	$104,422
Tornadoes	42	1.8	$20,709,000	$862,875	-	-
Total	**107**	**4.5**	**$20,809,000**	**$867,042**	**$2,088,445**	**$104,422**

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

PROBABILITY

Based on historical records and reported events, it is likely that high winds and tornadic events will occur within the planning area annually. For the 24 years examined, there were 65 high wind events and 42 tornadoes.

REGIONAL VULNERABILITIES

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

Table 81: Regional High Winds and Tornadoes Vulnerabilities

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

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.

LOCATION

There are 13 federal levees and four non-federal levees located within the five-county planning area as reported in USACE's National Levee Database. See Figure 48, Table 82, and Table 83 for information on the location of these levees and their respective levee protected 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.

HISTORICAL OCCURRENCES

As there is no formal database of historical levee failures, the following sources were consulted: members of the Planning Team, local newspapers and media outlets, and USACE. After the March 2019 flood event, USACE reported 41 breaches and numerous damages to federal and non-federal levees across the State of Nebraska. The failure of these structures significantly impacted subsequent flooding in neighboring communities. For a complete event narrative, refer to the Flooding hazard profile.

The following levee failure events were reported in the previous plan.

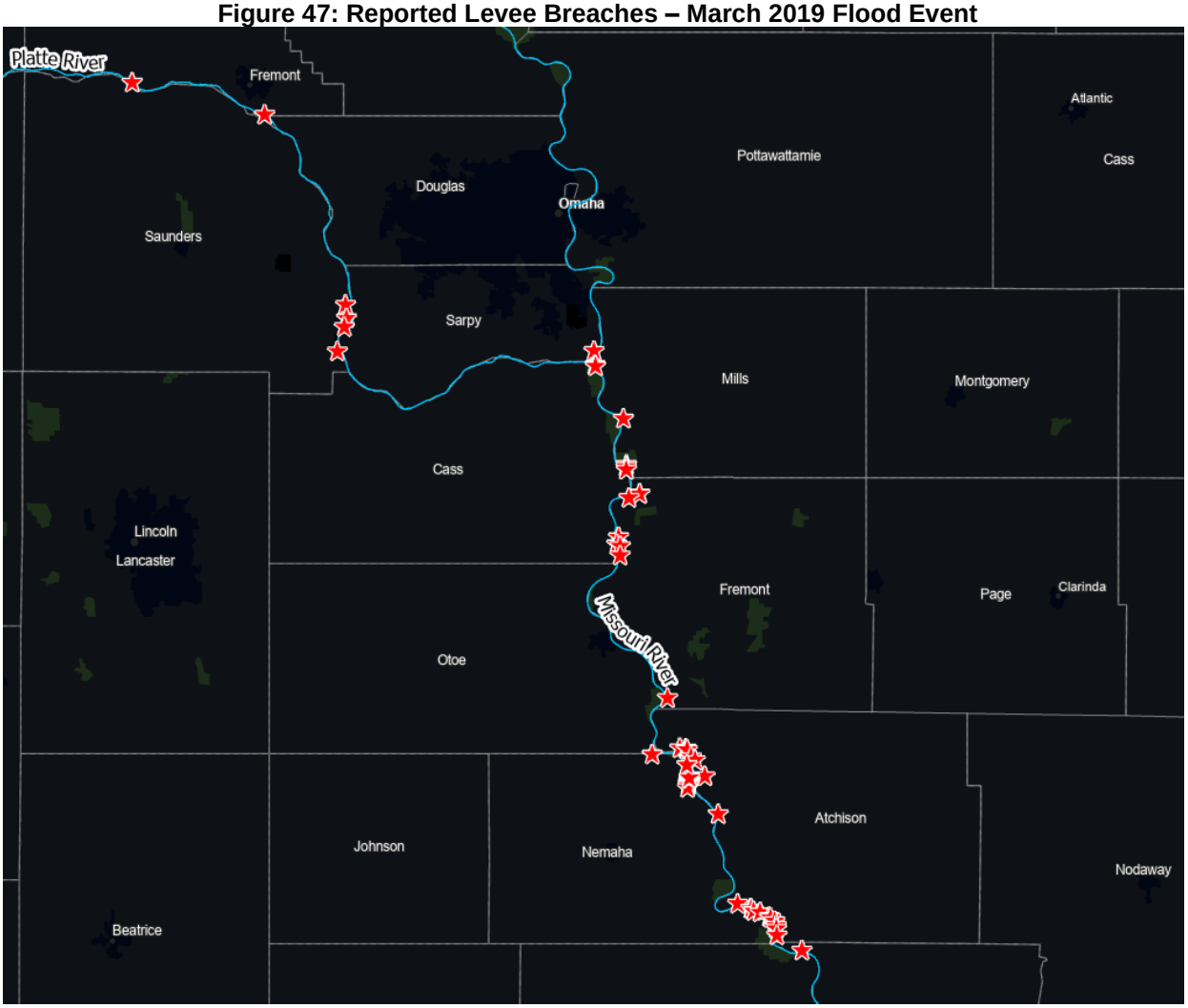
- In the spring and summer of 1993, federal and private levees breached, water supply was contaminated, and the Missouri River Bridge was closed that resulted in loss of business retailers. The loss of the bridge additionally eliminated the eastern evacuation route. (Brownville)
- In June of 1993, fifteen inches of rain fell over the Little Nemaha River, which overtopped the levee and flooded 800 acres. Additionally, the Nemaha River flooded from Brock to the mouth of the Missouri River. (Little Nemaha Levee District)
- In July 1993, the Little Nemaha River overtopped its banks and a levee broke causing extensive lowland flooding. Sand bagging guarded the lift station and water plant. Nearby farming communities were affected, negatively impacting the economy. (Nemaha)
- On June 16, 1998, the Missouri River overtopped the levee. Lots of water was in the community. (McKissick Island)
- On April 20, 2007 the Missouri River overtopped the levee. Lots of water was in the community. (McKissick Island)

- In July of 2008, severe flooding of the Missouri River broke the levee. Water stood from the river to the lower parts of town, including the area around the water plant. (Peru)

There were no breaches of any federal levees on the Nebraska side of the Missouri River during the 2011 Missouri River flood, but sandboils were a problem on three of the levee systems.

As reported by USACE and the Planning Team, one levee in Nemaha County was breached during the March 2019 flood event (Figure 47). Levee R-562 – Peru – Missouri River RB breached in several locations. The breaches allowed floodwaters to impact the north end of Peru. Flooding damaged both city wells, the water treatment facility, wastewater lagoons, and destroyed several homes. Since the levee is inactive in the USACE Rehabilitation Program, the levee system is ineligible for funds to repair it.[84]

Figure 47: Reported Levee Breaches – March 2019 Flood Event



Source: USACE

[84] U.S. Army Corps of Engineers. 2019. "Omaha District System Restoration Team: Levee System Status as of October 3, 2019." https://www.nwo.usace.army.mil/Omaha-District-System-Restoration-Team/.

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Table 82: Nemaha NRD USACE Levees

NAME	SPONSOR	LOCATION	YEAR	LENGTH (MILES)	PROTECTED AREA (SQ. MILES)	RISK LEVEL	FEMA ACCREDITED	USACE STATUS
R-562 Peru – Missouri River RB	Peru Dike and Drainage District	Nemaha, Otoe Counties	1949	7.55	10.58	Low	Non-Accredited	Inactive
R-573 Missouri River RB	SID #1, Otoe County	Nebraska City, Otoe County	1950	5.88	3.25	Moderate	Non-Accredited	Inactive
L-575 (BW-McKissock-Buchanan-Atchison-Hamburg)	Multiple	Nemaha County	1949	42.3	109.76	Low	Accredited	Active
R-548 Missouri River & Little Nemaha	Multiple	Nemaha, Nemaha County	1952	7.19	4.42	Low	Non-Accredited	Inactive
R-548 LN-Little Nemaha LB & Happy Hollow RB	Little Nemaha Valley Levee District #3	Nemaha, Nemaha County	1952	2.21	0.53	Low	Non-Accredited	Active
R-548 LN-Little Nemaha LB & Moores RB	Little Nemaha Valley Levee District #3	Nemaha, Nemaha County	1952	2.94	0.66	Low	Non-Accredited	Active
R-548 LN-Little Nemaha RB & Jarvis Creek LB	Little Nemaha Valley Levee District #3	Nemaha, Nemaha County	1952	3.25	0.64	Low	Non-Accredited	Active
R-548 LN-Little Nemaha RB & Whiskey Run LB	Little Nemaha Valley Levee District #3	Nemaha, Nemaha County	1952	1.6	0.36	Low	Non-Accredited	Active
R-548 LN-Little Nemaha RB & Whiskey Run RB	Little Nemaha Valley Levee District #3	Nemaha, Nemaha County	1952	1.66	0.21	Low	Non-Accredited	Active
MRLS 512-513-R North	Richardson County Drainage District #7	Rulo, Richardson County	1952	11.65	5.73	Low	Non-Accredited	Active
MRLS 512-513-R SE	Richardson County Drainage District #7	Rulo, Richardson County	1952	5.76	3.57	Low	Non-Accredited	Active
MRLS 512-513-R SW	Richardson County Drainage District #7	Rulo, Richardson County	1952	2.01	0.50	Low	Accredited	Active
R-520 Missouri River RB	Drainage District #8	Richardson County	1960	5.57	2.59	Low	Accredited	Inactive

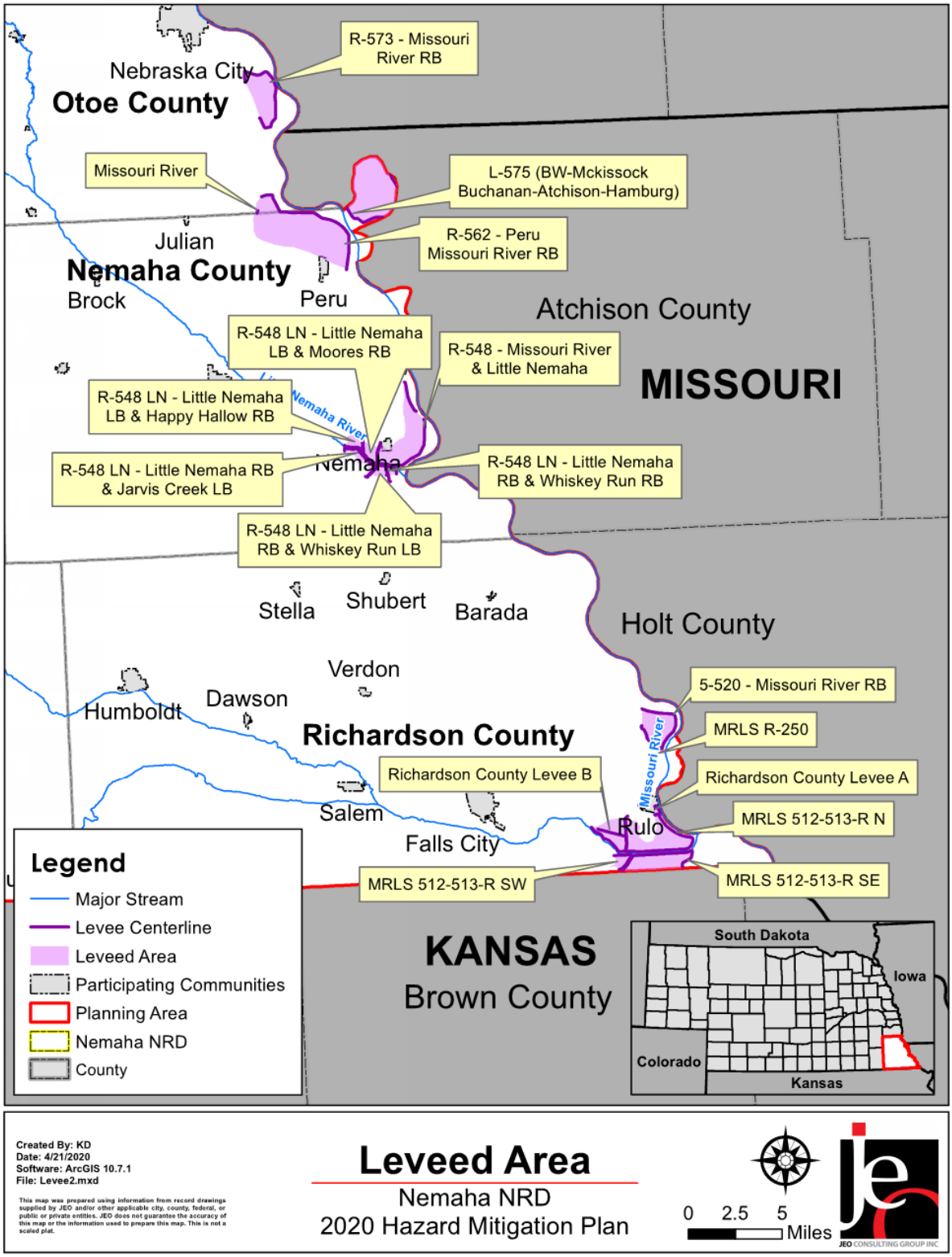
Source: USACE Levee Database

Table 83: Nemaha NRD Non-USACE Levees

NAME	SPONSOR	LOCATION	YEAR	LENGTH (MILES)	PROTECTED AREA (SQ. MILES)	RISK LEVEL	FIRM STATUS	REHAB STATUS
Missouri River	N/A	Nemaha, Otoe Counties	n/a	0.17	0.0019	Not Screened	Non-Accredited	Inactive
MRLS R-520	Undefined	Rulo, Richardson County	n/a	0.31	0.08	Not Screened	Non-Accredited	Not Enrolled
Richardson County Levee A	Undefined	Rulo, Richardson County	n/a	0.93	0.11	Not Screened	Non-Accredited	Not Enrolled
Richardson County Levee B	Undefined	Rulo, Richardson County	1952	2.36	0.95	Not Screened	No Info	Not Enrolled

Source: USACE Levee Database

Figure 48: Leveed Areas



EXTENT

The USACE, who is responsible for federal levee oversight and inspection of levees, has three ratings for levee inspections. Any levee failure events in the planning area will fall within USACE's rating system; however, it is not currently possible to determine what level of damage each levee system will experience.

Table 84: 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

POTENTIAL LOSSES

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 986 structures are at risk within the leveed areas, which are valued at $1,576,991,600. Additionally, an estimated 1,317 people are at risk of injury or death if these levees were to fail.

Table 85: Potential Losses in Levee Breach Area

NAME	STRUCTURES AT RISK	PROPERTY VALUE	PEOPLE AT RISK
R-562 Peru – Missouri River RB	14	$1,080,000	30
R-573 Missouri River RB	4	$1,400,000,000	124
L-575 (BW-McKissock-Buchanan-Atchison-Hamburg)	916	$165,000,000	984
R-548 Missouri River & Little Nemaha	27	$6,990,000	216
R-548 LN-Little Nemaha LB & Happy Hollow RB	0	$0	0
R-548 LN-Little Nemaha LB & Moores RB	0	$0	0
R-548 LN-Little Nemaha RB & Jarvis Creek LB	0	$0	0
R-548 LN-Little Nemaha RB & Whiskey Run LB	5	$268,000	2

NAME	STRUCTURES AT RISK	PROPERTY VALUE	PEOPLE AT RISK
R-548 LN-Little Nemaha RB & Whiskey Run RB	0	$0	0
MRLS 512-513-R North	18	$2,890,000	12
MRLS 512-513-R SE	2	$205,000	2
MRLS 512-513-R SW	0	$52,600	1
R-520 Missouri River RB	0	$506,000	0
Missouri River	0	$0	0
MRLS R-520	0	$0	0
Richardson County Levee A	0	$0	0
Richardson County Levee B	0	$0	0
Total	**986**	**$1,576,991,600**	**1,371**

Source: National Levee Database

PROBABILITY

Seven levee failure incidents have been reported in 120 years in the planning area, which is a probability of six percent. It should be noted that until permanent repairs are made to the levee systems, specifically levee R-562-Peru, there is an increased risk of failure. At this time, funding has not been identified to repair the levee beyond any emergency repairs that were completed immediately following the flood.

REGIONAL VULNERABILITIES

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

Areas within the Peru leveed area are still vulnerable to flooding due to breaches that have not been repaired.

Table 86: Regional Levee Failure Vulnerabilities

SECTOR	VULNERABILITY
People	-Those living in federal levee protected areas -Residents with low mobility or with no access to a vehicle are more vulnerable during a levee failure
Economic	-Businesses and industries protected by levees are at risk during failures
Built Environment	-All buildings within leveed areas are at risk to damages
Infrastructure	-Major transportation corridors and bridges at risk during levee failures
Critical Facilities	-Critical facilities in levee protected areas are at risk
Climate	-Changes in seasonal precipitation and temperature normals can increase strain on infrastructure

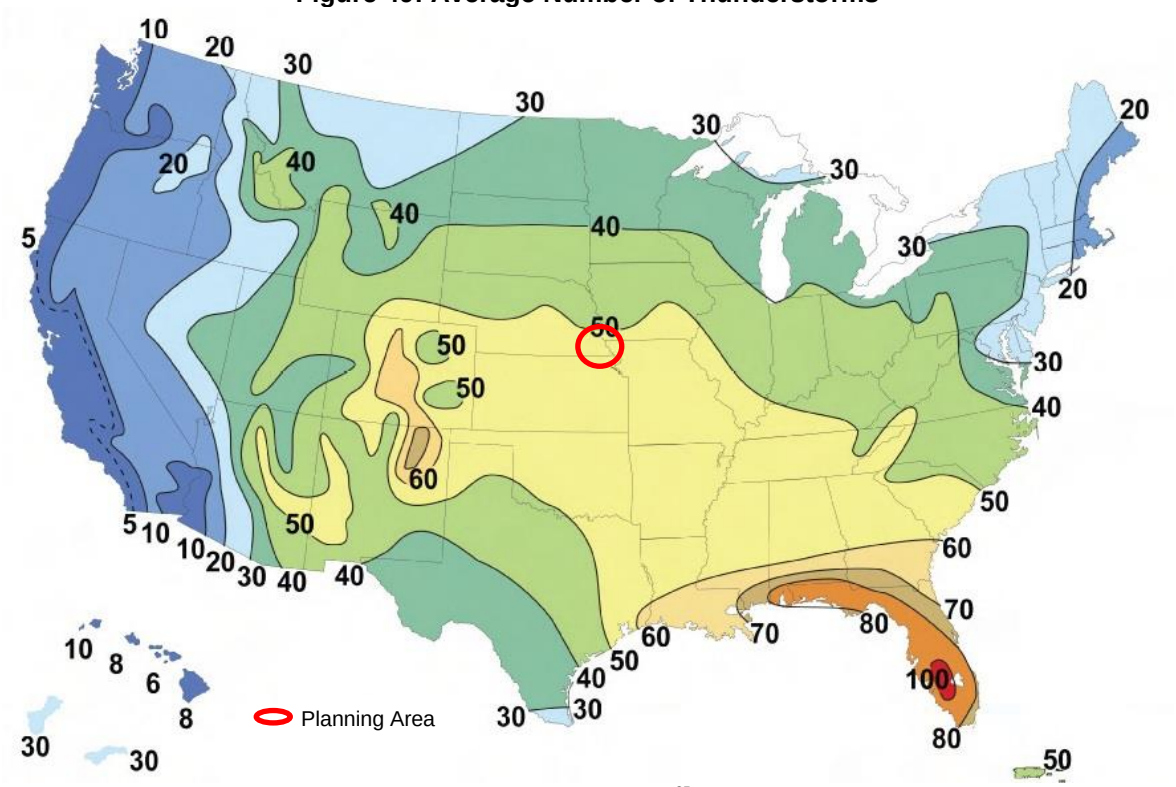
SEVERE THUNDERSTORMS

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. Additionally, hail is a common component of thunderstorms and often occur in series, with one area having the potential to be hit multiple times in one day. Severe thunderstorms usually occur in the evening during the spring and summer months. Hail can destroy property and crops with sheer force, as some hail stones can fall at speeds up to 100 mph.

Economically, thunderstorms are generally beneficial in that they provide moisture necessary to support Nebraska's largest industry, agriculture. The majority of thunderstorms do not cause damage, but when they escalate to severe storms, the potential for damages increases. Damages can include: crop losses from wind and hail; property losses due to building and automobile damages from hail; high wind; flash flooding; and death or injury to humans and animals from lightning, drowning, or getting struck by falling or flying debris. Figure 49 displays the average number of days with thunderstorms across the country each year. The planning area experiences an average of 40 to 50 thunderstorms over the course of one year.

Figure 49: Average Number of Thunderstorms



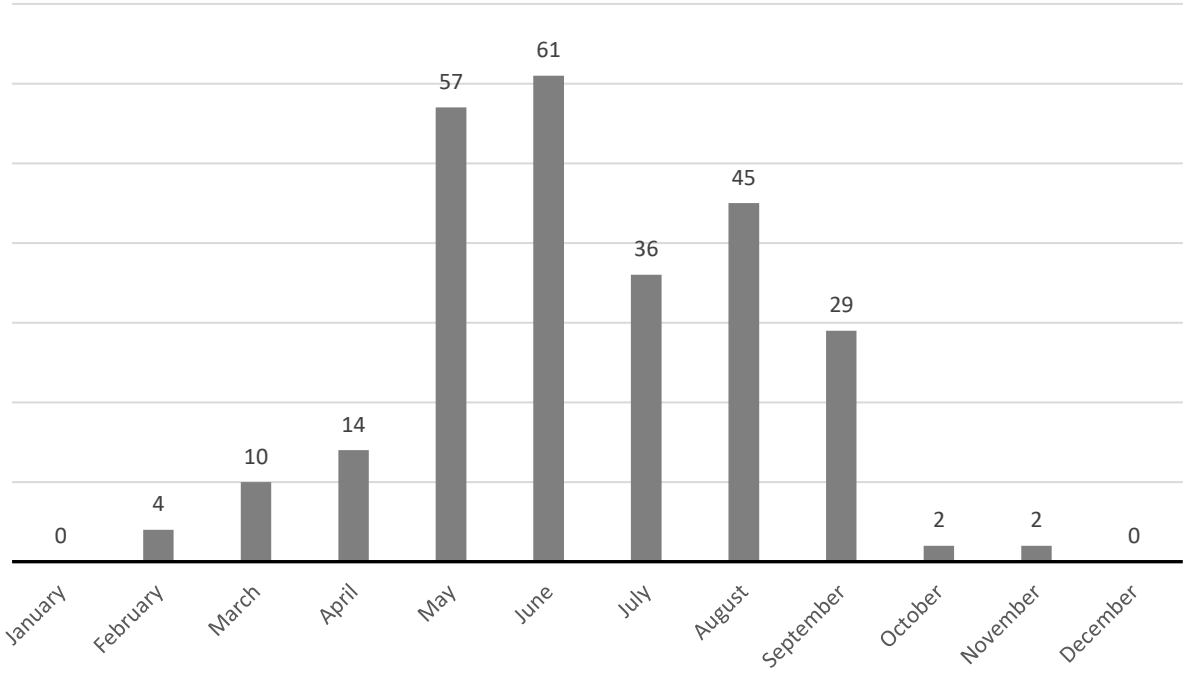
Source: NWS, 2017[85]

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

LOCATION
The entire planning area is at risk of severe thunderstorms, hail, and lightning.

HISTORICAL OCCURRENCES
Severe thunderstorms in the planning area usually occur in the afternoon and evening during the summer months (Figure 50).

Figure 50: Thunderstorm Wind 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 264 thunderstorm wind, 24 heavy rain, eight lightning, and 517 hail events in the planning area from January 1996 to October 2019. In total, these events were responsible for $1,032,000 in property damages. The USDA RMA data does not specify severe thunderstorms as a cause of loss, however heavy rains which may be associated with severe thunderstorms caused $64,430,823 in crop damages. There were no reported injuries or fatalities.

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 87 outlines the TORRO Hail Scale.

Table 87: TORRO Hail Scale

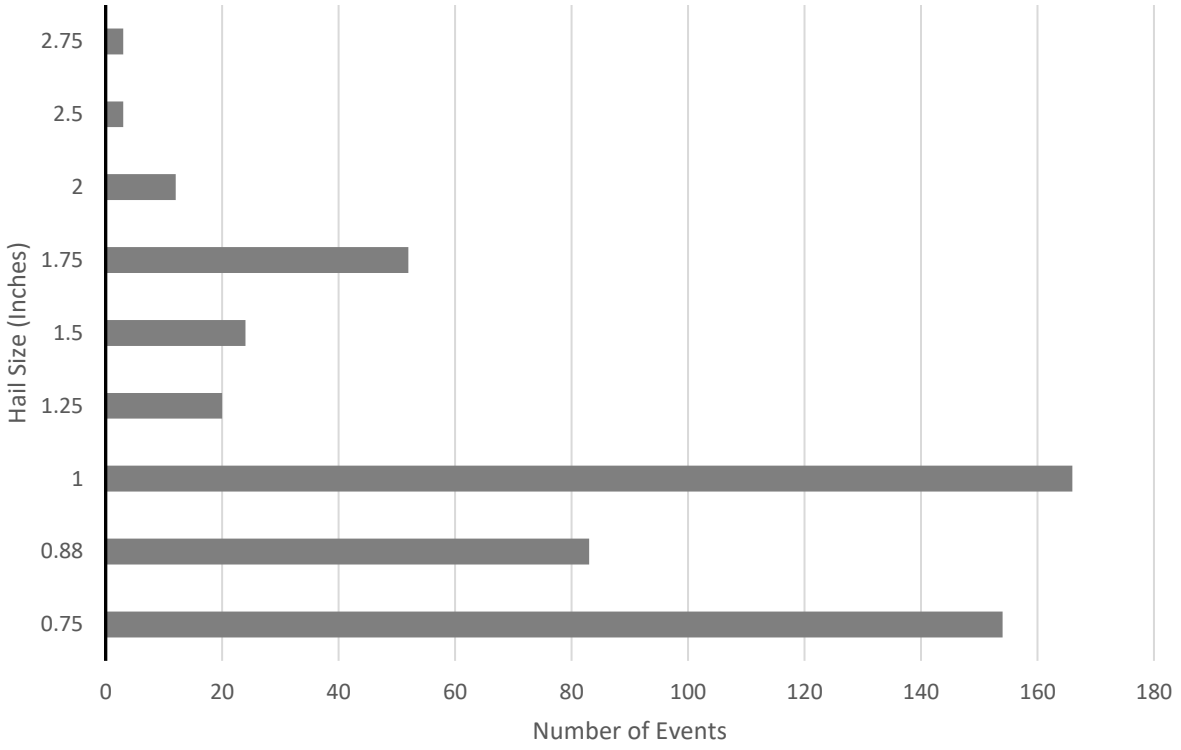
CLASS	TYPE OF MATERIAL	DIVISIONS
H0: Hard Hail	5 mm; (Pea size); 0.2 in	No damage
H1: Potentially Damaging	5 -15 mm (Marble); 0.2 – 0.6 in	Slight general damage to plants and crops
H2: Significant	10 -20 mm (Grape); 0.4 – 0.8 in.	Significant damage to fruit, crops, and vegetation
H3: Severe	20 -30 mm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

Source: TORRO, 2017[86]

The NCEI reported 517 individual hail events across the planning area. As the NCEI reports events per county, this value overestimates the total amount of thunderstorm events. The average hail size was 1.08 inches. Events of this magnitude correlate to an H3 Severe classification. It is reasonable to expect H3 class events to occur several times a year throughout the planning area. In addition, it is reasonable, based on the number of occurrences, to expect larger hail to occur in the planning area annually. The planning area has endured three events where the hail size was 2.75 inches, which is a H7 classification.

[86] Tornado and Storm Research Organization. 2017. "Hail Scale." http://www.torro.org.uk/hscale.php.

Figure 51: Hail Events by Magnitude



Source: NCEI, 1996-2019

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 $43,000 per year in property damages.

Table 88: Severe Thunderstorms Loss Estimate

HAZARD TYPE	NUMBER OF EVENTS[1]	AVERAGE EVENTS PER YEAR	TOTAL PROPERTY LOSS[1]	AVERAGE ANNUAL PROPERTY LOSS	TOTAL CROP LOSS[2]	AVERAGE ANNUAL CROP LOSS
Hail	517	21.5	$30,000	$1,250	$64,430,823	$3,221,541
Heavy Rain	24	1.0	$0	$0		
Lightning	8	0.3	$368,000	$15,333		
Thunderstorm Wind	264	11.0	$634,000	$26,417		
Total	**813**	**33.8**	**$1,032,000**	**$43,000**	**$64,430,823**	**$3,221,541**

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

PROBABILITY

Based on historical records and reported events, severe thunderstorm events and storms with hail are likely to occur on an annual basis. The NCEI reported a total of 813 severe thunderstorms events between 1996 and 2019; resulting in 100 percent chance annually for thunderstorms.

REGIONAL VULNERABILITIES

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

Table 89: Regional Severe Thunderstorm Vulnerabilities

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

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 average low temperature. For the planning area, the coldest months of the year are December, January, and February. The average low temperatures for these months are all below freezing (average low for the three months is 15.3°F). The average high temperatures for the months of January, February, and December are near 38°F.[87]

FREEZING RAIN

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

BLIZZARDS

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

LOCATION

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

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 281 severe winter storm events for the planning area from January 1996 to October 2019. These recorded events caused a total of $7,600,000 in property damages and $1,973,350 in crop damages.

According to the NCEI, 30 heavy snow events were reported since January 1996 causing $5,000,000 in property damage. The most damaging event occurred in late October 1997 when an early snowstorm dropped between six to 14 inches of wet snow on trees that were still fully or partially leafed and caused extensive damage. Tens of thousands of people were without power after the storm, and many of the outages lasted for several days.

Additional information from these events from NCEI and reported by each community are listed in *Section Seven: Community Profiles*.

[87] High Plains Regional Climate Center. 2019. “Monthly Climate Normals 1981-2010.” http://climod.unl.edu/.

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 52 shows the SPIA index.

Figure 52: SPIA Index

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

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

Source: SPIA-Index, 2017[88]

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 bit as it gets lower. Figure 53 shows the Wind Chill Index used by the NWS.

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

Figure 53: Wind Chill Index Chart

Temperature (°F)

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

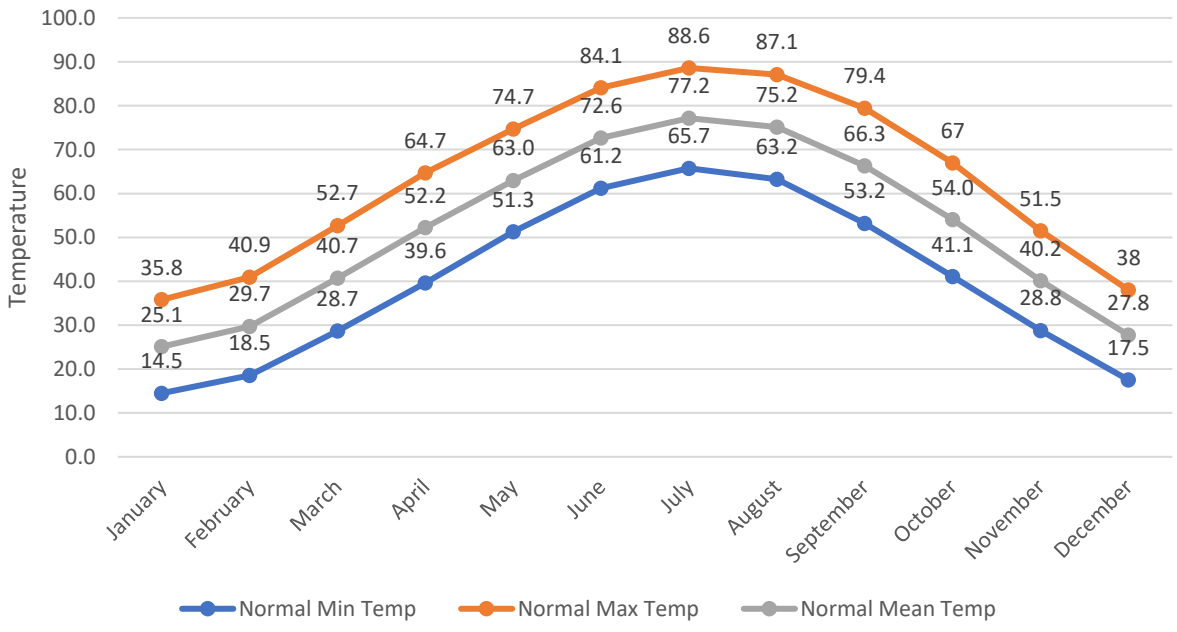
Frostbite Times: 30 Minutes | 10 Minutes | 5 Minutes

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

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

Source: NWS, 2017[89]

Figure 54: Monthly Climate Normals Temperature (1981-2010)



Source: NCEI, 2019

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

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 $316,666 per year in property damage and $98,668 per year in crop damages for the planning area.

Table 90: Severe Winter Storm Loss Estimate

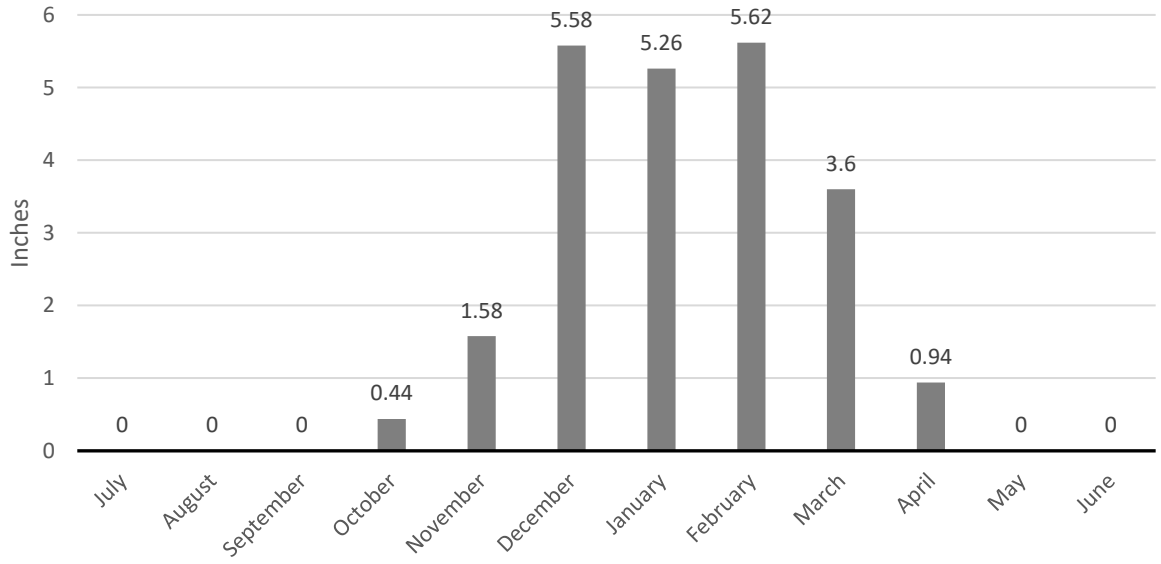
HAZARD TYPE	NUMBER OF EVENTS[1]	AVERAGE EVENTS PER YEAR	TOTAL PROPERTY LOSS[1]	AVERAGE ANNUAL PROPERTY LOSS	TOTAL CROP LOSS[2]	AVERAGE ANNUAL CROP LOSS
Blizzard	26	1.1	$0	$0		
Heavy Snow	30	1.3	$5,000,000	$208,333		
Ice Storm	17	0.7	$2,600,000	$108,333		
Winter Storm	162	6.8	$0	$0	$1,973,350	$98,668
Winter Weather	26	1.1	$0	$0		
Extreme Cold/Wind Chill	20	0.8	$0	$0		
Total	**281**	**11.7**	**$7,600,000**	**$316,666**	**$1,973,350**	**$98,668**

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

PROBABILITY

Average monthly snowfall for the planning area is shown in Figure 55, which shows the snowiest months are between November and April. A common snow event (likely to occur annually) will result in accumulation totals between one and five inches. Often these snow events are accompanied by high winds. It is reasonable to expect wind speeds of 25 to 35 mph with gusts reaching 50 mph or higher. Strong winds and low temperatures can combine to produce extreme wind chills of 20°F to 40°F below zero.

Figure 55: Monthly Normal (1981-2010) Snowfall in Inches



Source: High Plains Regional Climate Center, 2020

REGIONAL VULNERABILITIES

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

Table 91: 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 & CIVIL DISORDER

Terrorism and civil disorder are broad terms typically used by law enforcement to describe groups of people protesting major socio-political problems by choosing not to observe a law or regulation or 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. 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). Terrorist activities are also classified based on motivation behind the event (such as ideology: i.e. religious fundamentalism, national separatist movements, and social revolutionary movements). Terrorism can also be random with no ties to ideological reasoning.

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

- Domestic terrorism is the unlawful use, or threatened use, of force or violence by a group or individual based and operating entirely within the United States or Puerto Rico without foreign direction committed against persons or property to intimidate or coerce a government, the civilian population, or any segment thereof in furtherance of political or social objectives.
- International terrorism involves violent acts or acts dangerous to human life that are a violation of the criminal laws of the United States or any state, or that would be a criminal violation if committed within the jurisdiction of the United States or any state. These acts appear to be intended to intimidate or coerce a civilian population, influence the policy of a government by intimidation or coercion, or affect the conduct of a government by assassination or kidnapping. International terrorist acts occur outside the United States or transcend national boundaries in terms of the means by which they are accomplished, the persons they appear intended to coerce or intimidate, or the locale in which their perpetrators operate or seek asylum.

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

- Political Terrorism
- Bio-Terrorism
- Cyber-Terrorism
- Eco-Terrorism
- Nuclear Terrorism
- Narco-Terrorism

Though peaceful public demonstrations are allowed under US Federal law, any domestic situations such as a strike or riot involving three or more people could be considered a civil disorder event if the demonstration has devolved into having a potential for causing injuries, casualties, or property damage.[90] [91] However, civil disorder events are not common and have not occurred in the five-county planning area. Thus, this type of disturbance is not fully profiled in this HMP update but may be addressed in future updates if deemed a hazard of top concern by the regional and/or local planning teams.

Threat assessment, mitigation, and response to terrorism or civil disorder 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.

LOCATION

Terrorist activity within the planning area is possible throughout the region. Urban areas are more likely to see protestors, while rural areas may experience environmental justice protestors. Local concerns centered around vulnerability of water systems located throughout the planning area; the tampering of water supplies; protests occurring on campus at Peru State College by students, faculty, or residents; or active shooters in

[90] Civil Disorders, 18 U.S. Code Section 231-233 (1992)
[91] Terrorism, 28 U.S. Code Section 0.85

local schools. Cooper Nuclear Station is what many would consider a high value target in the planning area. As with most nuclear power plants, security around the plant is very tight to prevent any type of terrorist incident.

HISTORICAL OCCURRENCES

To identify any incidence of terroristic events, the University of Illinois Social, Political, and Economic Event Database Project (SPEED), maintained since the end of World War II (1946-2018), was consulted.[92] For any identified events, details of the incidents were found in the Global Terrorism Database between 1970-2018, as maintained by the University of Maryland and National Consortium for the Study of Terrorism and Responses to Terrorism (START) database and archival newspaper reports.[93] According to these sources, no terrorism events have been reported in the planning area.

EXTENT

Terrorist attacks can vary greatly in scale and magnitude, depending on the location of the attack, number of protestors, and reason for unrest.

AVERAGE ANNUAL LOSSES

The START Global Terrorism Database (1970-2018) and the SPEED database (1946-2018) reported no events or damages from events.

PROBABILITY

Due to the lack of reported events in a 49-year period, the annual probability will be stated as less than 1 percent for the purposes of this plan.

REGIONAL VULNERABILITIES

Local concerns regarding terrorism primarily include water supplies, water infrastructure, Cooper Nuclear Station, protests at Peru State College, and active shooters in local schools.

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

Table 92: Regional Terrorism & Civil Disorder 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 -Public property may be at risk of damage
Infrastructure	-Water supply, power plants, utilities all at risk of damage
Critical Facilities	-Police stations and governmental offices are at higher risk
Climate	-Activism pertaining to climate can place first responders and residents at risk

[92] The Social, Political and Economic Event Database Project (SPEED). 2018. Event Data File [Data file]. Retrieved from https://clinecenter.illinois.edu/project/human-loop-event-data-projects/SPEED.

[93] National Consortium for the Study of Terrorism and Responses to Terrorism (START). 2016. Global Terrorism Database [Data file]. Retrieved from https://www.start. umd.edu/gtd.

WILDFIRE

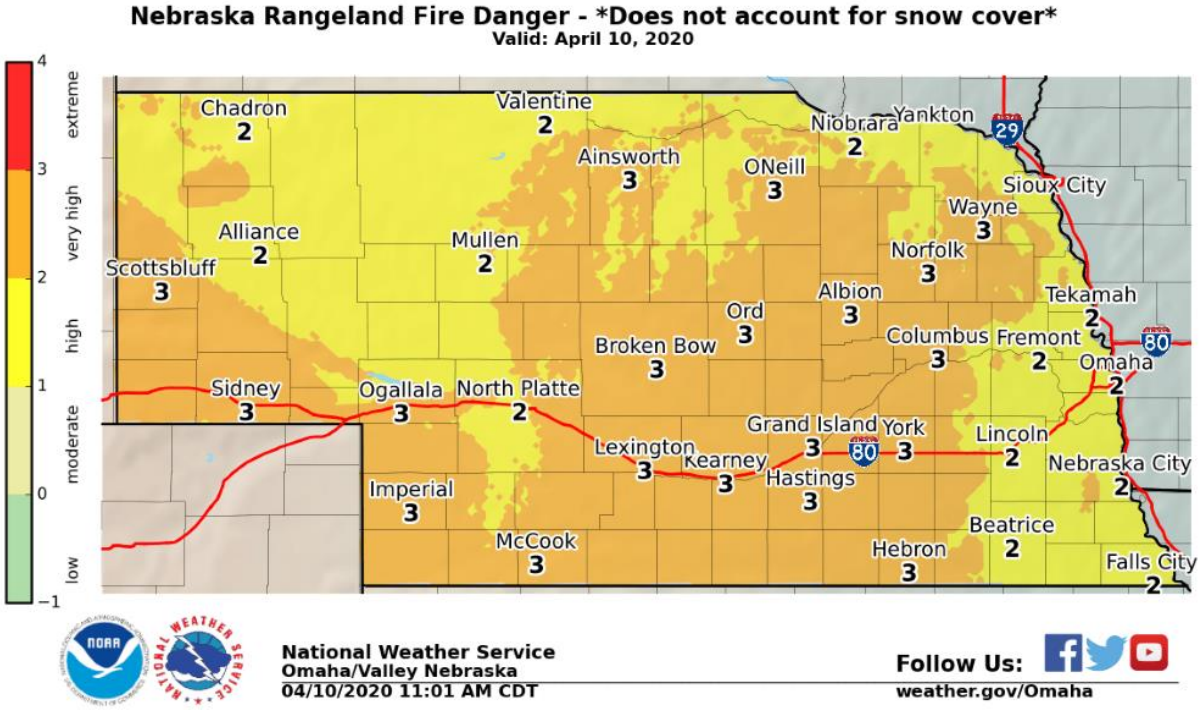
Wildfires, also known as brushfires, forest fires, or wildland fires, are any uncontrolled fire that occurs in the countryside or wildland. Wildland areas may include, but are not limited to grasslands, forests, woodlands, agricultural fields, pastures, and other vegetated areas. Wildfires differ from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

> Lightning starts approximately 10,000 forest fires each year, yet ninety percent of forest fires are started by humans.
>
> ~National Park Service

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

Wildfires are characterized in terms of their physical properties including topography, weather, and fuels. Wildfire behavior is often complex and variably dependent on factors such as fuel type, moisture content in the fuel, humidity, wind speed, topography, geographic location, ambient temperature, the effect of weather on the fire, and the cause of ignition. Fuel is the only physical property humans can control and is the target of most mitigation efforts. The NWS monitors the risk factors including high temperature, high wind speed, fuel moisture (greenness of vegetation), low humidity, and cloud cover in the state on a daily basis (Figure 56).

Figure 56: Rangeland Fire Danger



Source: NWS, 2020[94]

[94] National Weather Service. April 2020. "Nebraska Fire Danger Map." https://www.weather.gov/oax/fire. Accessed April 2020.

LOCATION

As the number of reported wildfires by the county indicates, Otoe County had the greatest number of fires, but Richardson County had the greatest amount of acres burned at nearly 7,000 acres.

Table 93: Reported Wildfires by County

COUNTY	REPORTED WILDFIRES	ACRES BURNED
Johnson County	127	2,978
Nemaha County	285	3,565
Otoe County	397	4,135
Pawnee County	176	6,191
Richardson County	240	6,973
Total	**1,225**	**23,841**

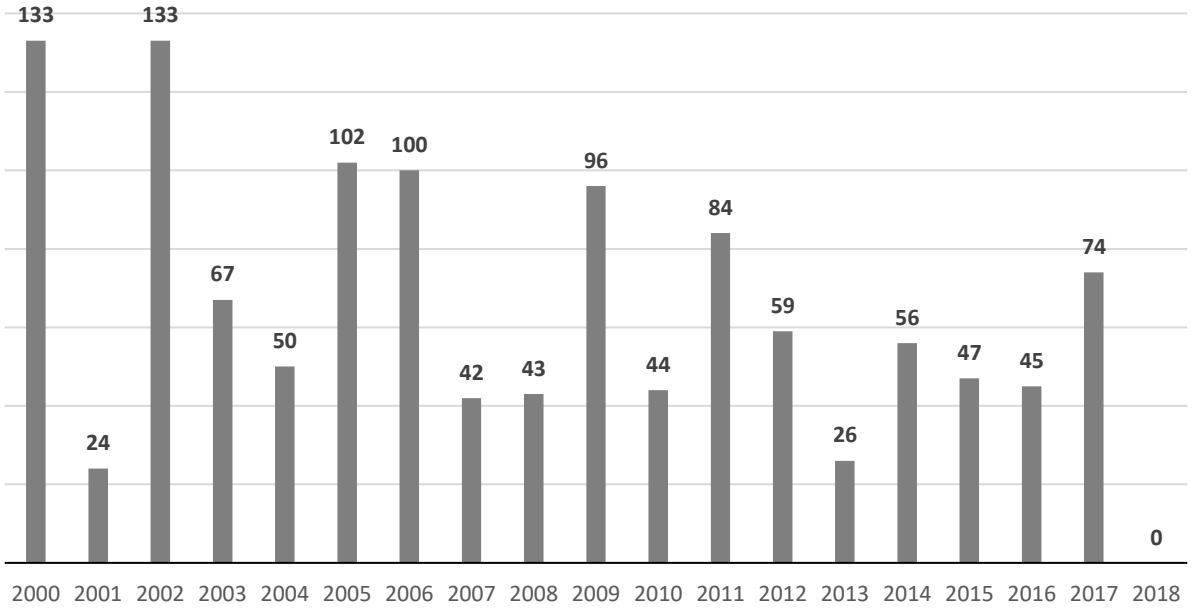
Source: Nebraska Forest Service, 2000-2018[95]

HISTORICAL OCCURRENCES

For the planning area, 33 different fire departments reported a total of 1,225 wildfires, according to the National Forest Service (NFS), from January 2000 to January 2018. Most fires occurred in 2000 and 2002 (Figure 57). The reported events burned 23,841 acres. While the RMA lists no damages from fire in the planning area, the NFS reported $30,054 in crop loss.

The majority of wildfires in the planning area were caused by debris burning (Figure 58). Wildfires in the planning area have ranged from zero to 1,200 acres, with an average event burning 20 acres.

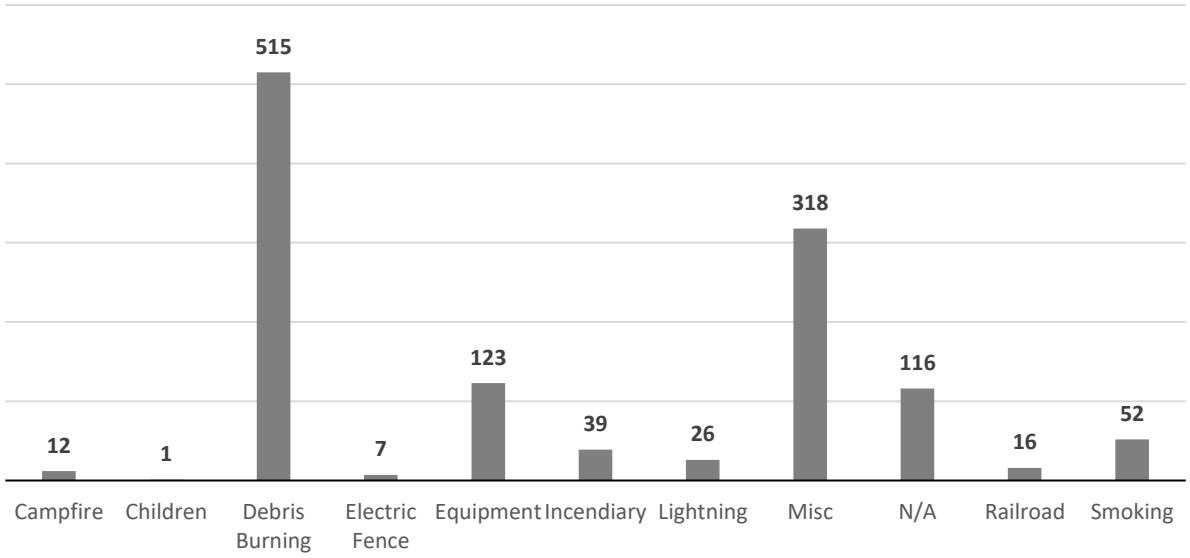
Figure 57: Number of Wildfires by Year in the Planning Area



Source: Nebraska Forest Service, Jan 2000-Jan 2018

[95] Nebraska Forest Service. 2018. "NFS All Fires by Year: 2000-2018." [datafile].

Figure 58: Wildfires by Cause in the Planning Area



Source: Nebraska Forest Service, Jan 2000-Jan 2018

EXTENT

Figure 58 illustrates the number of wildfires by cause in the planning area from January 2000 to January 2018, which burned 23,841 acres in total. Overall, 1,225 wildfires were reported in the planning area. Of these, 55 fires burned 100 acres or more, with the largest wildfire burning 1,200 acres in Nemaha County in March 2014.

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 59 shows the USGS's 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 occur in each area under natural conditions.

Figure 59: Mean Fire Return Interval

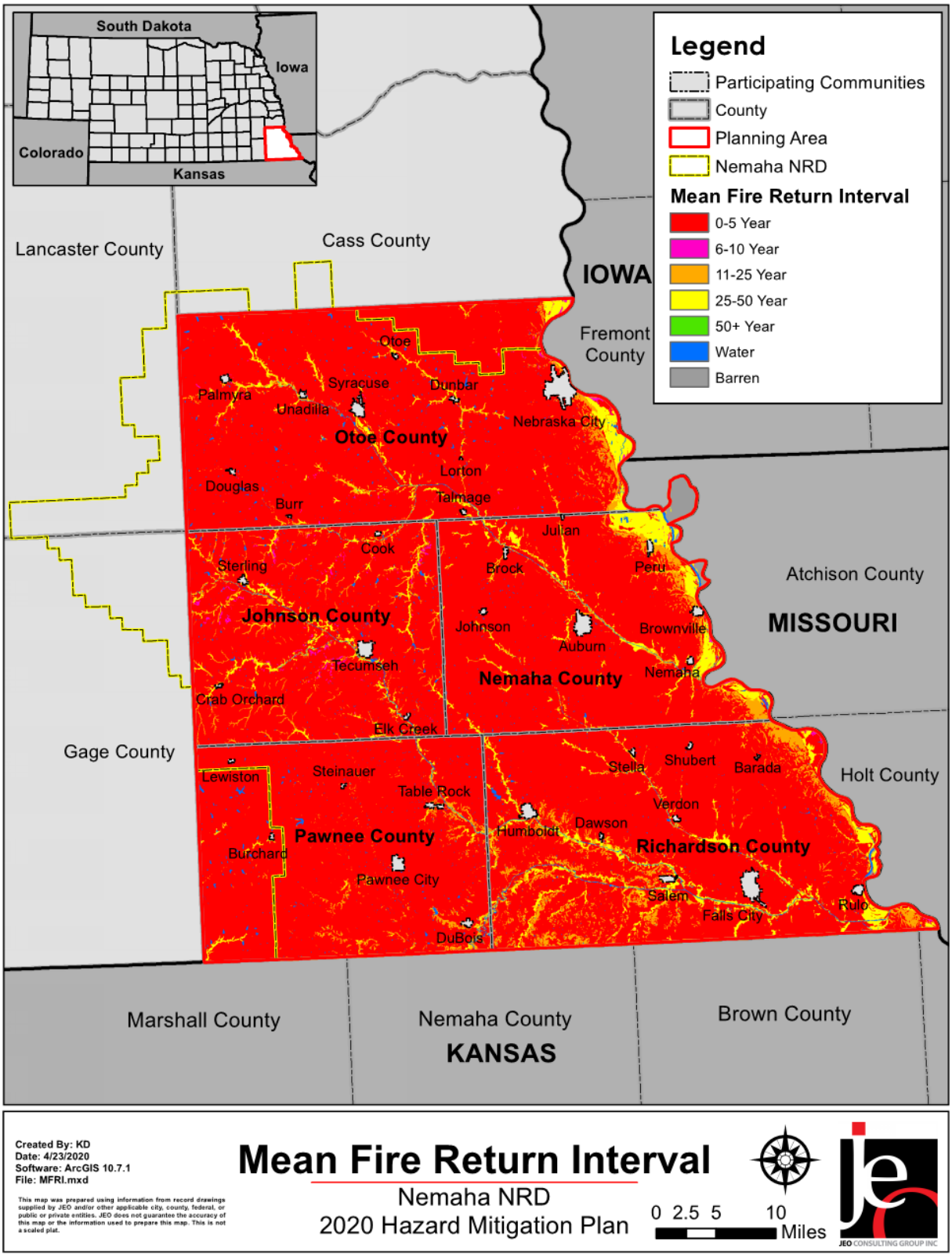
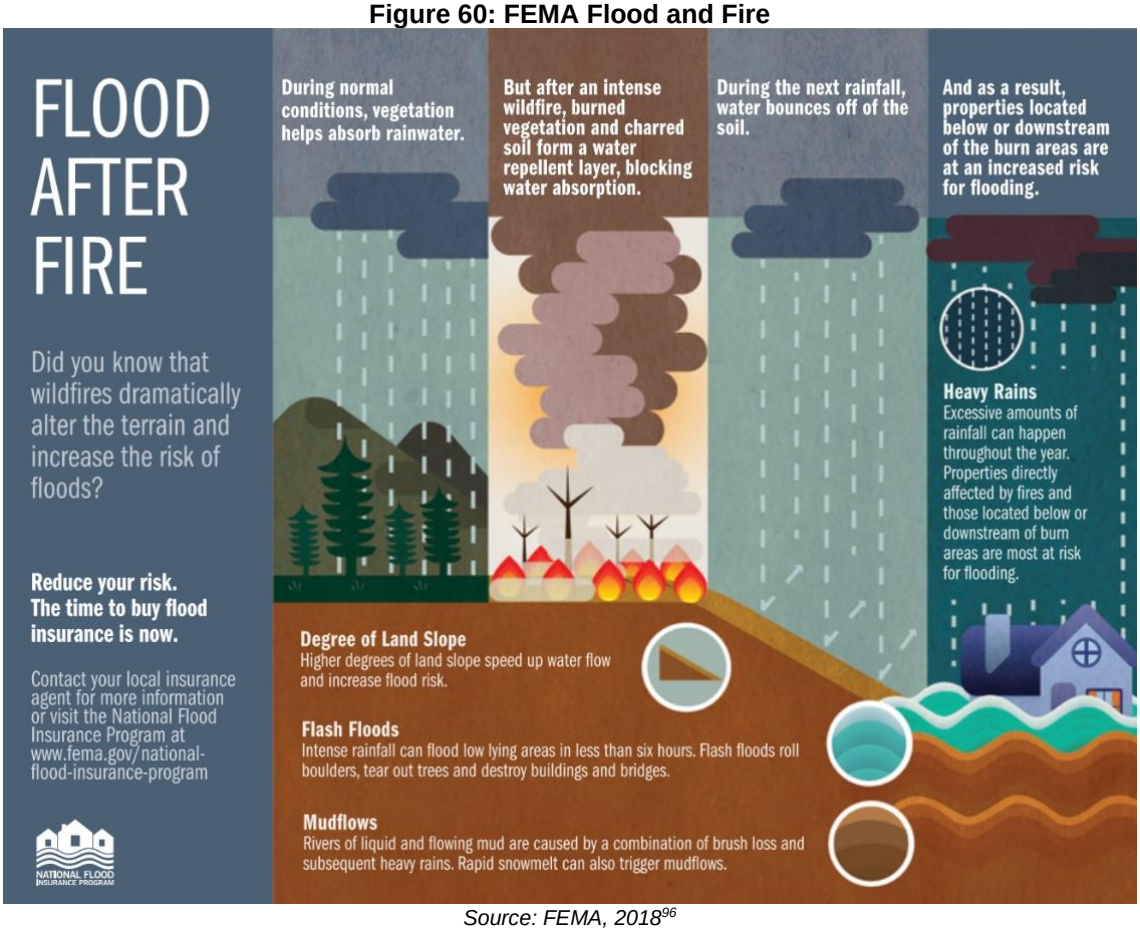


Figure 60: FEMA Flood and Fire



Source: FEMA, 2018[96]

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 January 2018 and number of historical occurrences. This does not include losses from displacement, functional downtime, economic loss, injury, or loss of life. During the 19-year period, 1,225 wildfires burned 23,841 acres and caused $30,054 in crop damage in the planning area.

Table 94: 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
Wildfire	1,225	65	20	23,841 acres	$30,054	$1,582

Source: Nebraska Forest Service, Jan 2000-Jan 2018

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

Table 95: Wildfire Threats

HAZARD TYPE	INJURIES	FATALITIES	HOMES THREATENED OR DESTROYED	OTHER STRUCTURES THREATENED OR DESTROYED
Wildfire	2	1	43	40

Source: Nebraska Forest Service, Jan 2000-Jan 2018

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, there is a 100 percent annual probability of wildfires occurring in the planning area each year.

REGIONAL VULNERABILITIES

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

Table 96: 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
Other	-Increase chance of landslides and erosion -May lead to poor water quality -Post-fire, flash flooding events may be exacerbated

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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 2015 HMP and discussed recommended additions and modifications. The intent of each goal and set of objectives is to develop strategies to account for risks associated with hazards and identify ways to reduce or eliminate those risks.

The Regional Planning Team voted to maintain the same list of goals from the 2015 HMP with minor modifications. Objective 3.2 was a new addition for this process and was in response to post-flood cleanup following the March 2019 flooding. These goals and objectives were then shared with all planning team members at the Round 1 public meetings.

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

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

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

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

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

SUMMARY OF CHANGES

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

GOALS

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

- **Goal 1: Protect Health and Safety of Residents**
- **Goal 2: Reduce Future Losses from Hazard Events**
- **Goal 3: Increase Public Awareness and Education on Vulnerability to Hazards**
- **Goal 4: Improve Emergency Management Capabilities**
- **Goal 5: Pursue Multi-Objective Opportunities (whenever possible)**
- **Goal 6: Enhance Overall Resilience and Promote Sustainability**

SELECTED MITIGATION ACTIONS

After establishing the goals, local planning teams evaluated and prioritized mitigation alternatives. These actions included: the mitigation actions identified per community/jurisdiction in the previous plan; additional

mitigation actions discussed during the planning process; and recommendations from JEO for additional mitigation actions based on identified needs. JEO provided each participant a preliminary list of mitigation alternatives to be used as a starting point. This list of alternatives helped participants determine which actions would best assist their respective jurisdiction in alleviating damages in the event of a disaster. The listed priority 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.

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

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 JEO.

It is important to note that not all of the mitigation actions identified by a community may ultimately be implemented due to limited capabilities, prohibitive costs, low benefit-cost ratio, or other concerns. These factors may not be identified during the planning process. Participants have not committed to undertaking identified mitigation actions in the plan. The cost estimates, priority ranking, potential funding, and identified agencies are used to give communities an idea of what actions may be 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 ALTERNATIVES

Mitigation alternatives identified by participants of the Nemaha NRD HMP are found in the Mitigation Alternative 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 – a general cost estimate for implementing the mitigation action for the appropriate jurisdiction
- Potential funding – a list of any potential funding mechanisms to fund the action
- Timeline – a general timeline as established by planning participants
- Priority –a 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. Establishment of 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 continued or new mitigation alternatives for each participating jurisdiction can be found in *Section Seven: Community Profiles*.

MITIGATION ALTERNATIVE PROJECT MATRIX

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

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Table 97: Mitigation Alternatives Selected by Each Jurisdiction

MITIGATION ALTERNATIVES	GOAL	NEMAHA NRD	JOHNSON COUNTY	COOK	ELK CREEK	STERLING	TECUMSEH	NEMAHA COUNTY	AUBURN	BROCK	BROWNVILLE	JOHNSON	JULIAN	NEMAHA	PERU
		NNRD	Johnson County					Nemaha County							
Above Ground Stormwater System and Drainage Improvements	2.1, 2.4, 5.2	x		x			x								
Acquire Identification Resources	3.1						x								
Alert/Warning Sirens	1.1, 4.3, 5.2	x	x			x		x							
Backup and Emergency Generators	1.1	x	x					x	x	x	x	x	x	x	x
Backup Records	2.1			x			x								
Bank Stabilization	2.1, 2.4, 5.2	x	x		x		x	x	x						
Bridge and Street Improvements	1.1, 4.1, 5.2														x
Bury Power and Service Lines	1.1, 2.1, 2.4, 5.2						x		x						
Civil Service Improvements	1.1, 2.1, 2.4, 4.3, 5.2		x					x	x			x	x		
Channel and Bridge Improvements	2.1, 2.4, 5.2						x								
Communication System	4.3		x					x	x						
Community Education and Awareness	1.1, 3.1, 3.2, 5.2	x	x					x	x			x	x		x
Community Rating System	1.1, 2.1, 5.2						x								
Dam Engineering and Analysis/Reports and Reinforcement	2.1, 2.2, 2.4, 5.2	x													
Designated Snow Routes	1.1, 2.4, 5.2						x								

MITIGATION ALTERNATIVES	GOAL	NEMAHA NRD	JOHNSON COUNTY	COOK	ELK CREEK	STERLING	TECUMSEH	NEMAHA COUNTY	AUBURN	BROCK	BROWNVILLE	JOHNSON	JULIAN	NEMAHA	PERU
		NNRD	Johnson County					Nemaha County							
Develop a Regional Water System	6.1								x						
Drainage Study /Stormwater Master Plan	2.2		x				x								x
Education Program for Chemical Releases	1.1, 3.1, 5.2						x								
Elevate Wells	1.1, 2.1, 2.4, 5.2								x						
Emergency Exercise: Hazardous Spill	1.1, 3.1, 5.2						x								
Ensure Adequate Water Supply for Health and Safety	1.1, 2.4, 5.2							x							
Fencing Around Lagoon	2.1										x				
Fire Alarm System	1.1, 2.1, 2.4, 5.2								x						
First Aid Training	1.1, 3.1, 5.2							x				x			
Flood-Prone Property Acquisition	1.1, 2.1, 2.4, 5.2	x	x												x
Flood-Prone Property Mitigation	1.1, 2.1, 2.4, 5.2	x	x												x
Groundwater Recharge	1.1								x						
Hazardous Tree Removal	1.1, 2.1, 2.4, 5.2	x	x			x		x	x	x	x	x	x	x	x
Hail-Resistant Building Materials	1.1, 2.1, 2.4, 5.2							x							
Improve and Revise Snow/Ice Removal Program	1.1, 2.4, 5.2						x								
Install Vehicular Barriers	1.1, 2.1, 2.4, 5.2							x							

MITIGATION ALTERNATIVES	GOAL	NEMAHA NRD	JOHNSON COUNTY	COOK	ELK CREEK	STERLING	TECUMSEH	NEMAHA COUNTY	AUBURN	BROCK	BROWNVILLE	JOHNSON	JULIAN	NEMAHA	PERU
		NNRD	Johnson County					Nemaha County							
Irrigation/Groundwater Management Plan	2.2	x													
Land-Use Regulations (Chemical and Radiological Spills)	2.3						x								
Levee/Floodwall Construction and/or Improvements	1.1, 2.1, 2.4, 5.2	x						x	x						
Long-term Sustainable Water Supply	1.1, 6.1														x
Longs Creek Wetland Restoration and Stream Assessment	2.2								x						
New Community Building	1.1													x	x
New Fire and Rescue Building	1.1								x						
New Municipal Well	1.1								x			x		x	x
New Salt and Sand Storage Building	1.1								x						
Parcel Level Evaluation of Floodprone Properties	2.2						x								
Participate in the National Flood Insurance Program (NFIP)	1.1, 5.1, 5.2												x		
Power and Service Lines	1.1, 2.1, 2.4, 5.2		x					x	x						
Recreational Trail Improvements	2.1, 2.4, 5.2	x													
Safe Rooms and Storm Shelters	1.1	x	x				x	x	x			x			
Shelter In Place	1.1, 3.1, 5.2						x								

MITIGATION ALTERNATIVES	GOAL	NEMAHA NRD	JOHNSON COUNTY	COOK	ELK CREEK	STERLING	TECUMSEH	NEMAHA COUNTY	AUBURN	BROCK	BROWNVILLE	JOHNSON	JULIAN	NEMAHA	PERU
		NNRD	Johnson County					Nemaha County							
Source Water Protection Plan	2.2	x	x												
Storm Shelter Identification	3.1						x								
Stormwater System and Drainage Improvements	2.1, 2.4, 5.2		x					x	x						x
Transformer Check and Replacement	1.1, 2.1, 2.4, 5.2					x									
Transportation Drainage Improvements	2.1						x								
Tree City USA	2.1, 2.4, 5.2											x		x	
Underground Stormwater System and Drainage Improvements	2.1, 2.4, 5.2			x											
Warning Systems	1.1, 4.3, 5.2		x										x		
Water System Improvements	1.1														
Weather Radios	4.3		x						x			x			x
Wildfire Education	3.1														

MITIGATION ALTERNATIVES	GOAL	OTOE COUNTY	BURR	DOUGLAS	DUNBAR	LORTON	NEBRASKA CITY	OTOE	PALMYRA	SYRACUSE	TALMAGE	UNADILLA	PAWNEE COUNTY	BURCHARD	DUBOIS	PAWNEE CITY	STEINAUER	TABLE ROCK
		Otoe County											Pawnee County					
Above Ground Stormwater System and Drainage Improvements	2.1, 2.4, 5.2														x		x	
Alert/Warning Sirens	1.1, 4.3, 5.2	x	x			x	x				x	x	x	x				x
Backup and Emergency Generators	1.1	x			x		x	x		x	x	x	x	x		x		
Bank Stabilization	2.1, 2.4, 5.2	x			x					x			x					
Bury Power and Service Lines	1.1, 2.1, 2.4, 5.2										x							
Civil Service Improvements	1.1, 2.1, 2.4, 4.3, 5.2	x		x				x	x		x		x					
Channel and Bridge Improvements	2.1, 2.4, 5.2						x											
Communication System	4.3	x											x					
Community Education and Awareness	1.1, 3.1, 3.2, 5.2	x											x					
Drainage Study /Stormwater Master Plan	2.2	x					x				x							
Drought Monitoring Plan and Procedures	2.2									x				x				
Elevate Wells	1.1, 2.1, 2.4, 5.2						x											
Evacuation Plan	2.2, 4.1, 4.2, 5.2	x								x								
Expand Water Storage Capacity	1.1, 2.4, 5.2									x						x		

MITIGATION ALTERNATIVES	GOAL	OTOE COUNTY	BURR	DOUGLAS	DUNBAR	LORTON	NEBRASKA CITY	OTOE	PALMYRA	SYRACUSE	TALMAGE	UNADILLA	PAWNEE COUNTY	BURCHARD	DUBOIS	PAWNEE CITY	STEINAUER	TABLE ROCK
		Otoe County											Pawnee County					
First Aid Training	1.1, 3.1, 5.2									x						x		
Flood-Prone Property Acquisition	1.1, 2.1, 2.4, 5.2						x						x					
Flood-Prone Property Mitigation	1.1, 2.1, 2.4, 5.2						x						x					
Flood Resiliency Plan	2.2						x											
Floodplain Management	1.1, 2.1, 2.4, 5.2									x								
Hazardous Tree Removal	1.1, 2.1, 2.4, 5.2						x		x		x	x	x	x				
Hail-Resistant Building Materials	1.1, 2.1, 2.4, 5.2									x								
Infrastructure Hardening	1.1, 2.1, 2.4, 5.2							x										x
Lagoon Improvements	1.1				x			x										
Lift Station Pump Replacement	1.1							x										
Low Impact Development	2.3									x								
New Community Building	1.1				x													
New Municipal Well	1.1									x								
No Adverse Impact	2.3									x								
Power and Service Lines	1.1, 2.1, 2.4, 5.2						x											
Relocate Chemical Storage	1.1, 2.1, 2.4, 5.2		x															
Roadway Repairs	2.1																x	

MITIGATION ALTERNATIVES	GOAL	OTOE COUNTY	BURR	DOUGLAS	DUNBAR	LORTON	NEBRASKA CITY	OTOE	PALMYRA	SYRACUSE	TALMAGE	UNADILLA	PAWNEE COUNTY	BURCHARD	DUBOIS	PAWNEE CITY	STEINAUER	TABLE ROCK
		Otoe County											Pawnee County					
Safe Rooms and Storm Shelters	1.1	x		x			x		x	x			x		x	x		
Stormwater System and Drainage Improvements	2.1, 2.4, 5.2	x					x		x	x	x		x					
Surge Protection/Computer Battery Backup	2.1, 2.4, 5.2			x														
Transportation Drainage Improvements	2.1				x										x			
Tree City USA	2.1, 2.4, 5.2									x	x							
Water System Improvements	1.1											x						
Weather Radios	4.3	x		x						x			x					
Wildfire Education	3.1																	
Wildfire Hazard Identification and Mitigation System	1.1, 2.1, 2.4, 3.1, 5.2														x		x	

MITIGATION ALTERNATIVES	GOAL	RICHARDSON COUNTY	DAWSON	FALLS CITY	HUMBOLDT	PRESTON	RULO	SALEM	SHUBERT	STELLA	VERDON	AUBURN FIRE DEPARTMENT	COOK FIRE DISTRICT	DAWSON RURAL FIRE DEPARTMENT	PALMYRA DISTRICT OR-1	ELK CREEK VOLUNTEER FIRE DEPARTMENT	HUMBOLDT TABLE ROCK STEINAUER SCHOOLS	JOHNSON COUNTY CENTRAL SCHOOLS
		Richardson County										Special Districts						
Above Ground Stormwater System and Drainage Improvements	2.1, 2.4, 5.2								x		x							x
Backup and Emergency Generators	1.1		x		x					x			x		x	x	x	x
Bank Stabilization	2.1, 2.4, 5.2	x					x			x								
Bury Power and Service Lines	1.1, 2.1, 2.4, 5.2			x														
Civil Service Improvements	1.1, 2.1, 2.4, 4.3, 5.2			x								x	x	x		x		
Classroom Door Security System	1.1, 2.1, 5.2																	x
Communication System	4.3											x						x
Community Education and Awareness	1.1, 3.1, 3.2, 5.2	x			x					x								
Community Rating System	1.1, 2.1, 5.2																x	
Comprehensive Disaster/Emergency Response Plan/ Rescue Plan	2.2, 4.1, 4.2, 5.1, 6.1	x								x								
Drainage Study /Stormwater Master Plan	2.2		x	x														
Drought Monitoring Plan and Procedures	2.2	x		x														

MITIGATION ALTERNATIVES	GOAL	RICHARDSON COUNTY	DAWSON	FALLS CITY	HUMBOLDT	PRESTON	RULO	SALEM	SHUBERT	STELLA	VERDON	AUBURN FIRE DEPARTMENT	COOK FIRE DISTRICT	DAWSON RURAL FIRE DEPARTMENT	PALMYRA DISTRICT OR-1	ELK CREEK VOLUNTEER FIRE DEPARTMENT	HUMBOLDT TABLE ROCK STEINAUER SCHOOLS	JOHNSON COUNTY CENTRAL SCHOOLS
		Richardson County										Special Districts						
Enroll in the National Flood Insurance Program (NFIP)	1.1		x															
Evacuation Plan	2.2, 4.1, 4.2, 5.2		x															
Fire Station Expansion	1.1													x				
Hail Insurance	1.1																	
Hazardous Tree Removal	1.1, 2.1, 2.4, 5.2		x							x								
Improve and Revise Snow/Ice Removal Program	1.1, 2.4, 5.2				x													
Irrigation/Groundwater Management Plan	2.2		x	x														
Lagoon Improvements	1.1										x							
Monitor Water Supply	1.1									x								
New Community Building	1.1						x											
New Fire and Rescue Building	1.1											x						
Remote Read Water Meter System	1.1						x											
Safe Rooms and Storm Shelters	1.1	x	x				x			x							x	
Sprinkler System	1.1, 2.1, 2.2, 2.4																	x
Storm Shelter Identification	3.1				x													

MITIGATION ALTERNATIVES	GOAL	RICHARDSON COUNTY	DAWSON	FALLS CITY	HUMBOLDT	PRESTON	RULO	SALEM	SHUBERT	STELLA	VERDON	AUBURN FIRE DEPARTMENT	COOK FIRE DISTRICT	DAWSON RURAL FIRE DEPARTMENT	PALMYRA DISTRICT OR-1	ELK CREEK VOLUNTEER FIRE DEPARTMENT	HUMBOLDT TABLE ROCK STEINAUER SCHOOLS	JOHNSON COUNTY CENTRAL SCHOOLS
		Richardson County										Special Districts						
Stormwater System and Drainage Improvements	2.1, 2.4, 5.2	x	x	x			x			x								
Surge Protection/Computer Batter Backup	2.1, 2.4, 5.2									x								
Tree Assistance	2.1, 2.4, 5.2									x								
Transportation Drainage Improvements	2.1										x							
Update Village Code Book	2.3, 5.1, 5.2						x											
Warning Systems	1.1, 4.3, 5.2	x								x								
Water System Improvements	1.1									x								
Weather Radios	4.3	x	x															

MITIGATION ALTERNATIVES	GOAL	NEBRASKA CITY PUBLIC SCHOOLS	PALMYRA RURAL FIRE DISTRICT	PERU RURAL FIRE DISTRICT	SOUTHEAST DISTRICT HEALTH DEPARTMENT	STERLING RURAL FIRE DISTRICT	SYRACUSE VOLUNTEER FIRE DEPARTMENT	TALMAGE RURAL FIRE DEPARTMENT	UNADILLA VOLUNTEER FIRE AND RESCUE
		Special Districts							
Alert/Warning Sirens	1.1, 4.3, 5.2							x	x
Backup and Emergency Generators	1.1	x			x			x	
Bury Power and Service Lines	1.1, 2.1, 2.4, 5.2								
Civil Service Improvements	1.1, 2.1, 2.4, 4.3, 5.2		x	x	x	x			
Communication System	4.3	x			x				
Community Education and Awareness	1.1, 3.1, 3.2, 5.2	x	x						
Continuity Planning	2.2, 4.3, 5.2	x							
Emergency Exercise: Hazardous Spill	1.1, 3.1, 5.2								x
Emergency Exercise: Radiological Incident	1.1, 3.1, 5.2								x
Fire Station Expansion	1.1								x
First Aid Training	1.1, 3.1, 5.2	x							
Hazardous Tree Removal	1.1, 2.1, 2.4, 5.2	x							
Hazardous Waste Remediation	1.1, 3.2, 5.2								x
Install Vehicular Barriers	1.1, 2.1, 2.4, 5.2	x							
Resource Tracking	4.1, 5.1, 5.2								x

MITIGATION ALTERNATIVES	GOAL	NEBRASKA CITY PUBLIC SCHOOLS	PALMYRA RURAL FIRE DISTRICT	PERU RURAL FIRE DISTRICT	SOUTHEAST DISTRICT HEALTH DEPARTMENT	STERLING RURAL FIRE DISTRICT	SYRACUSE VOLUNTEER FIRE DEPARTMENT	TALMAGE RURAL FIRE DEPARTMENT	UNADILLA VOLUNTEER FIRE AND RESCUE
		Special Districts							
Safe Rooms and Storm Shelters	1.1	x					x		
Shelter In Place	1.1, 3.1, 5.2								x
Tornado Safety	3.1	x							
Warning Systems	1.1, 4.3, 5.2	x							
Water System Improvements	1.1			x					
Wildfire Education	3.1								x
Wildfire Hazard Identification and Mitigation System	1.1, 2.1, 2.4, 3.1, 5.2								x

SECTION SIX: PLAN IMPLEMENTATION AND MAINTENANCE

MONITORING, EVALUATING, AND UPDATING THE PLAN

Each participating jurisdiction in the Nemaha NRD 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 governing body, 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.

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.

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

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

In addition, the governing body will be responsible for ensuring that the HMP's goals are incorporated into applicable revisions of other planning mechanisms per community. These plans may include: Comprehensive Plan, Capital Improvement Plans, Zoning Ordinances, Floodplain Ordinances, Building

Codes, and/or Watershed Management Plans. Future updates of this HMP will review and update discussions of plan integration per community as appropriate.

CONTINUED PUBLIC INVOLVEMENT

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

- 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 as 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 (SHMO) 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 program also oversees the 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 communities 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 (EOC), Mass Critical Shelters, Emergency Alert Systems (EAS) 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, which may include vital life saving measures. 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. The 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 the completion of BCA.

For more information regarding NeDNR's responsibilities as well as their ongoing projects, please go to http://dnr.nebraska.gov/.

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. At this time the Silver Jackets do not have any projects taking place in the Nemaha NRD planning area.

Nebraska Forest Service
The NFS is responsible for the care of existing forests within the state. The state agency is responsible for ensuring the health of state forests, ensuring that the forests are managed so they can provide logs for lumber, and protection of wildland from fire.

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 focuses on fire prevention.

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. Nemaha NRD, as the plan sponsor, provides an opportunity for jurisdictions to compile proposed amendments annually and send them to NEMA 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 Planning Team utilized a variety of plan integration tools to help communities determine how their existing planning mechanisms were related to the Nemaha NRD Hazard Mitigation Plan. Utilizing FEMA's *Integrating the Local Natural Hazard Mitigation Plan into a Community's Comprehensive Plan*[97] guidance, as well as FEMA's *2015 Plan Integration*[98] guide, each community engaged in a plan integration discussion. This discussion was facilitated by a Plan Integration Worksheet, created by the Planning Team. This document offered an easy way for participants to notify the Planning Team of existing planning mechanisms, and if they interface with the HMP.

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

[97] 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.

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

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

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

The hazard prioritization information, as provided by individual participants, 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*.