3 RISK ASSESSMENT

44 CFR Requirement §201.6(c)(2): [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.

The risk assessment process identifies and profiles relevant hazards and assesses the exposure of lives, property, and infrastructure within Jackson County, Iowa to these hazards. The goal of the risk assessment is to estimate the potential loss in the planning area, including loss of life, personal injury, property damage, and economic loss, from a hazard event. The risk assessment process allows communities in the planning area to better understand their potential risk to the identified hazards and provides a framework for developing and prioritizing mitigation actions to reduce risk from future hazard events.

The risk assessment for Jackson County and participating jurisdictions followed the methodology described in the 2023 FEMA *Local Mitigation Planning Handbook*, which includes a five-step process:

Step 1 - Identify Hazards
Step 2 - Describe Hazards
Step 3 - Identify Community Assets
Step 4 - Analyze Risks
Step 5 - Summarize Vulnerability

This chapter is divided into six main parts:

- **Section 3.1 Hazard Identification** identifies the hazards that threaten the planning area and the methodology utilized to score or rank the hazards.

- **Section 3.2 Assets at Risk** provides the planning area's total exposure to natural hazards, considering critical facilities and other community assets at risk.

- **Section 3.3 Development Since 2019 Plan Update** discusses what changes in development have occurred since the previous Hazard Mitigation Plan.

- **Section 3.4 Future Land Use and Development** discusses areas of planned future development.

- **Section 3.5 Hazard Profiles and Vulnerability** for each hazard, this section is divided into two parts:

    1) **Hazard Profile** discusses the threat to the planning area, the geographic location/extent at risk, previous occurrences of hazard events, and probability of future occurrence; and

    2) **Vulnerability Assessment** discusses specific assets at risk as well as loss estimates. Specifically, where data is available, this section defines and quantifies populations, buildings, critical facilities, and other community assets at risk to hazards with estimates of potential losses to those assets, where possible.

- **Section 3.6 Hazard Analysis Summary** provides a tabular summary of the hazard ranking for each jurisdiction in the planning area.

3.1 Hazard Identification

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

The hazards identified for this plan update are listed below in alphabetical order

Animal/Crop/Plant Disease
Dam/Levee Failure
Drought
Excessive Heat
Flooding – Flash
Flooding -- River
Hail and Lightning from Thunderstorms
Hazardous Materials
Infrastructure Failure
Pandemic Human Disease
Radiological Incident
Severe Winter Storms
Terrorism
Tornado/Windstorm
Transportation Incident
Wildland or Grass Fire

Sections 3.1.1 through 3.1.3 describe how these hazards were identified for this plan update.

3.1.1 Review of Existing Mitigation Plans

Prior to 2012, Hazard Mitigation Planning in Jackson County was implemented on a jurisdictional basis. In 2012 the unincorporated county and incorporated municipalities came together to coordinate multi-jurisdictional mitigation planning for the entire Jackson County planning area. This coordinated effort resulted in the Jackson County, Iowa Multi-Jurisdictional Hazard Mitigation Plan, approved by FEMA on February 15, 2013 and subsequently updated in 2019. The updated Hazard Mitigation Plan was approved by FEMA on January 8, 2020. To identify hazards to include in the current Risk Assessment update, a comparison was performed between the hazard identification in the 2023 Iowa State Hazard Mitigation Plan, the 2019 Jackson County Multi-Jurisdictional Hazard Mitigation Plan, and the current plan update. **Table 3.1.** provides the details of the comparison.

Table 3.1. Hazard Comparison Chart for Jackson County

Natural Hazards	2023 Iowa	2019 Plan	2025 Plan - Updates
Dam/Levee Failure (relates to natural hazard of flooding)	√	√	√
Drought	√	√	√
Earthquake	√		
Excessive Heat	√	√	√
Expansive Soils	√		
Flooding - Flash	√	√	√
Flooding - River	√	√	√

Hail and Lightning from Thunderstorms	√	√	√
Landslides	√		
Severe Winter Storms	√	√	√
Sinkholes	√	√	√
Tornado/Windstorm (including derechos)	√	√	√
Wildland Fire or Grass Fire	√		√
Non-Natural Hazards			
Animal/Crop/Plant Disease	√	√	√
Hazardous Materials	√	√	√
Infrastructure Failure	√	√	√
Pandemic Human Disease	√	√	√
Radiological Incident	√	√	√
Terrorism	√	√	√
Transportation Incident	√	√	√

√ = indicates included

3.1.2 Review Disaster Declaration History

Information utilized to identify hazards relevant for Jackson County was obtained by examining events that triggered federal disaster declarations. Federal and/or state declarations may be granted when the severity and magnitude of an event surpasses the ability of the local government to respond and recover. Disaster assistance is supplemental and sequential. When the local government's capacity has been surpassed, a state disaster declaration may be issued, allowing for the provision of state assistance. If the disaster is so severe that both the local and state governments' capacities are exceeded; a federal emergency or disaster declaration may be issued allowing for the provision of federal assistance.

FEMA also issues emergency declarations, which are more limited in scope and do not include the long-term federal recovery programs of major disaster declarations. Determinations for declaration type are based on scale and type of damage and institutions or industrial sectors affected. **Table 3.2.** lists federal disaster declarations that included Jackson County for the period from 1965 to May 2024. There have been 2 Biological incidents, 8 Flood incidents, 1 Hurricane incident, and 9 severe storms incidents.

Table 3.2. FEMA Disaster Declarations that included Jackson County, 1965-May 2024

Disaster Number	Declaration Date	Incident Type	Title	Incident Begin Date	Incident End Date
DR-193	4/22/1965	Flood	Flooding	4/22/1965	4/22/1965
DR-259	4/25/1969	Flood	Flooding	4/25/1969	4/25/1969
DR-386	5/23/1973	Flood	Severe Storms and Flooding	5/23/1973	5/23/1973
DR-443	6/24/1974	Flood	Severe Storms and Flooding	6/24/1974	6/24/1974
DR-996	7/9/1993	Flood	Severe Storms and Flooding	4/13/1993	10/1/1993
DR-1367	5/2/2001	Severe Storm	Severe Storms, Tornadoes and Flooding	4/8/2001	5/29/2001
DR-1420	6/19/2002	Flood	Severe Storms and Flooding	6/3/2002	6/25/2002
DR-1518	5/25/2004	Severe Storm	Severe Storms, Tornadoes and Flooding	5/19/2004	6/24/2004
EM-3239	9/10/2005	Hurricane	Hurricane Katrina Evacuation	8/29/2005	10/1/2005
DR-1688	3/14/2007	Severe Storm	Severe Winter Storms	2/23/2007	3/2/2007

DR-1763	5/27/2008	Severe Storm	Severe Storms, Tornadoes and Flooding	5/25/2008	8/13/2008
DR-1930	7/29/2010	Severe Storm	Severe Storms, Flooding and Tornadoes	6/1/2010	8/31/2010
DR-4018	8/30/2011	Severe Storm	Severe Storms and Flooding	7/27/2011	7/29/2011
DR-4187	8/5/2014	Severe Storm	Severe Storms, Tornadoes, Straight-Line Winds and Flooding	6/26/2014	7/7/2014
DR-4421	3/23/2019	Flood	Severe Storms and Flooding	3/12/2019	6/15/2019
EM-3480	3/13/2020	Biological	COVID-19	1/1/2020	6/14/2023
DR-4483	3/23/2020	Biological	COVID-19 Pandemic	1/20/2020	5/11/2023
DR-4557	8/17/2020	Severe Storm	Severe Storms	8/10/2020	8/10/2020
DR-4732	8/23/2023	Flood	Flooding	4/24/2023	5/13/2024
DR-4784	05/24/2024	Severe Storm	Severe Storms, Tornadoes, and Flooding	5/20/2024	5/31/2024

Source: Federal Emergency Management Agency

The U.S. Department of Agriculture (USDA) Secretary of Agriculture is authorized to designate counties as disaster areas to make emergency loans (EM) to producers suffering losses in those counties, and in counties that are contiguous to a designated county. In addition to EM eligibility, other emergency assistance programs, such as Farm Service Agency (FSA) disaster assistance programs, have historically used disaster designations as an eligibility requirement trigger.

Table 3.3. provides the USDA Secretarial disaster declarations that included Jackson County from 2012 to 2023. Details on USDA declarations prior to 2012 are not available. There have been 1 Derecho incident; 4 Drought-Fast Track incidents; 1 Excessive Moisture, Flooding and Flash Flooding incident; 1 Excessive Rainfall and Flooding incident; and 1 Frosts, Freezes incident.

Table 3.3. USDA Disaster Declarations Including Jackson County, 2012-May 2024

Year	Designation Number	Drought	Flood -- Flash	Excessive Rain, Moisture, Humidity	Wind, High Winds	Fire, Wildfire	High Temp (Incl. Low Humidity)	Frost, Freeze	Insects	Begin Date	Description
2012	S3264	0	0	0	0	0	0	1	0	4/6/2012	Frosts, Freezes
2012	S3310	1	0	0	1	1	1	0	1	7/24/2012	Drought-Fast Track
2012	S3311	0	1	1	0	0	0	0	0	7/24/2012	Drought-Fast Track
2015	S3865	0	1	1	0	0	0	0	0	8/12/2015	Excessive Rainfall and Flooding
2019	S4508	0	1	1	0	0	0	0	0	8/7/2019	Excessive Moisture, Flooding and Flash Flooding
2020	S4786	0	0	0	1	0	0	0	0	8/10/2020	Derecho
2023	S5514	1	0	0	0	0	0	0	0	8/29/2023	Drought-Fast Track
2023	S5530	1	0	0	0	0	0	0	0	9/5/2023	Drought-Fast Track
2024	S5684	1	0	0	0	0	0	0	0	4/1/2024	Drought-Fast Track

Source: U.S. Department of Agriculture

3.1.3 Research Additional Sources

Additional data on locations and past impacts of hazards in the planning area was collected from the

following sources:

- Jackson County Flood Insurance Rate Map, FEMA
- Jackson County Emergency Management
- Jackson County Flood Insurance Study, FEMA
- *Jackson County Multi-jurisdictional Hazard Mitigation Plan*, 2019
- Data Collection Guides completed by each jurisdiction
- Environmental Protection Agency (EPA)
- Federal Emergency Management Agency (FEMA)
- Flood Insurance Administration
- Hazards US (HAZUS)
- Iowa Department of Agriculture and Land Stewardship (IDALS), Division of Soil Conservation
- Iowa Department of Education, Bureau of Information and Analysis Services
- Iowa Department of Natural Resources (DNR)
- Iowa Department of Public Safety
- Iowa Department of Transportation, Office of Traffic and Safety
- *Iowa State Hazard Mitigation Plan* (August 2023)
- Iowa Utilities Board
- National Drought Mitigation Center Drought Reporter
- National Oceanic and Atmospheric Administration's (NOAA) National Climatic Data Center
- Pipeline and Hazardous Materials Safety Administration
- SILVIS Lab, Department of Forest Ecology and Management, University of Wisconsin
- U.S. Army Corps of Engineers (USACE)
- U.S. Department of Agriculture's (USDA) Risk Management Agency Crop Insurance Statistics
- U.S. Department of Transportation
- United States Geological Survey
- Various articles and publications available on the internet (sources are indicated where data is cited)

3.1.4 Hazards Identified

Through the hazard identification review process, it was determined that the following natural and non-natural hazards have the potential to significantly affect the planning area and were chosen for further analysis in the risk assessment. The natural and human-caused/technological hazards identified for this plan update are listed below in alphabetical order:

Natural Hazards	Non-Natural Hazards
Dam/Levee Failure (relates to natural hazard of flooding)	Animal/Crop/Plant Disease
Drought	Hazardous Materials
Excessive Heat	Infrastructure Failure
Flooding - Flash	Pandemic Human Disease
Flooding - River	Radiological Incident
Hail and Lightning from Thunderstorms	Terrorism
Severe Winter Storms	Transportation Incident
Sinkholes	
Tornado/Windstorm (including derechos)	
Wildland Fire or Grass Fire	

Of the 20 hazards identified in the 2023 State Hazard Mitigation Plan, the following were eliminated from further review. Justification is provided for each eliminated hazard.

- Earthquake — The planning area is in a low-risk zone for earthquakes (Source: USGS; DNR). According to planning committee, no real impacts have been experienced or expected; this hazard was not included in the 2013 or the 2019 Jackson County Hazard Mitigation Plan.

- Expansive soils — According to USGS, most of the planning area has soils with either little or no swelling clay or slight to moderate swelling potential. The only areas in the county that have soil units with abundant clay are directly adjacent to the Mississippi River and is not developed land. Based on only one known damaging instance but no history otherwise; this hazard was not included in the 2013 or the 2019 Jackson County Hazard Mitigation Plan.

- Landslides — The only known areas that landslides occur are by the river; however, there is no development that is impacted, and this hazard was not included in the 2013 or the 2019 Jackson County Hazard Mitigation Plans.

In evaluating the hazards and occurrences, the HMPC decided to include Wildfire, including Grass Fire, in this plan update for the following reason:

- Wildland Fire or Grass Fire —Historically based on very small amounts of wildland urban interface or intermix areas, the planning committee indicated historically wildfire has not been a significant threat in the county; therefore, hazard was not included in the 2013 or 2019 Jackson County Hazard Mitigation Plan. It is being included in the plan update as the HMPC has seen an increase in grass fires across the county and with concern over rising temperatures and climate changes the HMPC determined that it would include the hazard in the updated mitigation plan.

Additionally, to maintain consistency and to facilitate the roll-up or summarization of hazards in the next State Plan Update, it was agreed that the hazard grouping/hazard naming for this update will be consistent with the 2023 State Plan.

3.1.5 Multi-Jurisdictional Risk Assessment

For this multi-jurisdictional plan, the risks are assessed for each jurisdiction where they deviate from the risks facing the entire planning area. The planning area is fairly uniform in terms of climate and topography as well as building construction characteristics. Accordingly, the geographic areas of occurrence for weather-related hazards do not vary greatly across the planning area for most hazards. The more urbanized areas within the planning area have more assets that are vulnerable to weather-related hazards and varied development trends impact the future vulnerability. Similarly, more rural areas have more assets (crops/livestock) that are vulnerable to drought. These differences are discussed in greater detail in the vulnerability sections of each hazard.

Although 16 hazards with the potential to significantly affect the planning area were identified and selected for additional analysis, not all hazards impact every jurisdiction. **Table 3.4.** provides a summary of the jurisdictions impacted by each hazard. An “x” indicates the jurisdiction is impacted by the hazard. A "N/A" indicates the hazard is not applicable to that jurisdiction.

Table 3.4. Hazards Identified for Each Jurisdiction

Jurisdiction	Animal/Plant/Crop Disease	Dam and Levee Failure	Drought	Excessive Heat	Flooding – Flash	Hazardous Materials	Pandemic Human Disease	Infrastructure Failure	Radiological Incident	Flooding -- River	Severe Winter Storms	Sinkholes	Terrorism	Hail and Lightning from Thunderstorms	Tornado/Windstorm	Transportation Incident	Wildland/Grass Fire
Unincorporated County	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Andrew	X	N/A	X	X	X	X	X	X	X	N/A	X	X	X	X	X	X	X
Baldwin	X	N/A	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Bellevue	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
LaMotte	X	N/A	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Maquoketa	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Miles	X	N/A	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Monmouth	X	N/A	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Preston	X	N/A	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Sabula	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Spragueville	X	N/A	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Springbrook	X	N/A	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
St. Donatus	X	N/A	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Andrew CSD	X	N/A	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Bellevue CSD	X	N/A	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Easton Valley CSD	X	N/A	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Maquoketa CSD	X	N/A	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

"N/A" indicates hazard not applicable to this jurisdiction.
Source: Data Collection Guide – 2024

3.1.6 Hazard Scoring Methodology

To maintain reporting format consistent with the 2019 Hazard Mitigation Plan, the Jackson County Hazard Mitigation Planning Committee (HMPC) used the same methodology to score and prioritize the hazards. This prioritization was based on a hazard scoring system that considers four elements of risk: probability, magnitude/severity, warning time, and duration. **Table 3.5.** provides definitions for each of the four elements along with associated rating levels.

Table 3.5. Hazard Score Element Definitions and Rating Scales

Element/Score	Definitions
Probability: Reflects the likelihood of the hazard occurring again in the future, considering both the hazard's historical occurrence and the projected likelihood of the hazard occurring in any given year.	
1—Unlikely	Less than 10% probability in any given year (up to 1 in 10 chance of occurring), history of events is less than 10% likely or the event is unlikely but there is a possibility of its occurrence.

2—Occasional	Between 10% and 20% probability in any given year (up to 1 in 5 chance of occurring), history of events is greater than 10% but less than 20% or the event could possibly occur.
3—Likely	Between 20% and 33% probability in any given year (up to 1 in 3 chance of occurring), history of events is greater than 20% but less than 33% or the event is likely to occur.
4—Highly Likely	More than 33% probability in any given year (event has up to a 1 in 1 chance of occurring), history of events is greater than 33% likely or the event is highly likely to occur.

Magnitude / Severity: Assessment of severity in terms of injuries and fatalities, personal property, and infrastructure and the degree and extent with which the hazard affects the jurisdiction.	
1—Negligible	Less than 10% of property severely damaged, shutdown of facilities and services for less than 24 hours, and/or injuries /illnesses treatable with first aid.
2—Limited	10% to 25% of property severely damaged, shutdown of facilities and services for more than a week, and/or injuries/illnesses that do not result in permanent disability.
3—Critical	25% to 50% of property severely damaged, shutdown of facilities and services for at least 2 weeks, and/or injuries/illnesses that result in permanent disability.
4—Catastrophic	More than 50% of property severely damaged, shutdown of facilities and services for more than 30 days, and/or multiple deaths.

Warning Time: Rating of the potential amount of warning time that is available before the hazard occurs. This should be taken as an average warning time.	
1	More than 24 hours warning time
2	More than 12 to 24 hours warning time
3	6 to 12 hours warning time
4	Minimal or no warning time (up to 6 hours warning)

Duration: A measure of the duration of time that the hazard will affect the jurisdiction.	
1	Less than 6 hours
2	Less than 1 day
3	Less than 1 week
4	More than one week

Using the rating scales described in the table above, the formula used to determine each hazard's score, including weighting factors, is provided below:

(Probability x .45) + (Magnitude/Severity x .30) + (Warning Time x .15) + (Duration x .10) = SCORE

Based on the hazard's overall weighted score, the hazards are categorized as follows: High (3.0-4.0), Moderate (2.0-2.9), and Low (1.0-1.9).

These terms relate to the level of planning analysis to be given to the hazard in the risk assessment process and are not meant to suggest that a hazard would have only limited impact. To focus on the most critical natural hazards, those assigned a level of high or moderate were given more extensive attention in the remainder of the risk assessment (e.g., quantitative analysis or loss estimation), while those with a low planning significance were addressed in more general or qualitative ways.

The HMPC determined the overview hazard ranking scores for the planning area as a whole. The

results of this overview are provided below in **Table 3.6.** Additionally, the hazard ranking overview is provided at the beginning of each hazard profile and vulnerability section. A detailed hazard summary by jurisdiction is provided at the conclusion of each hazard profile and vulnerability section to provide a summary of how the hazard varies by jurisdiction.

Table 3.6. Jackson County Planning Area Hazard Ranking Score Results

Natural Hazards	Probability	Magnitude	Warning Time	Duration	CPRI	Planning Significance
Tornado/Windstorm	3	3	3	4	3.1	High
Hail/Lightning/Thunderstorm	4	2	2	2	2.9	Moderate
Flooding – River	3	2	2	3	2.55	Moderate
Drought	3	2	1	4	2.5	Moderate
Excessive Heat	3	2	1	3	2.4	Moderate
Severe Winter Storm	3	2	1	3	2.4	Moderate
Wildland/Grass Fire	2	2	4	2	2.3	Moderate
Dam/Levee Failure	2	2	2	4	2.2	Moderate
Flooding – Flash	2	2	3	2	2.15	Moderate
Sinkholes	1	1	4	1	1.45	Low
Non-Natural Hazards						
Hazardous Materials	2	2	4	2	2.3	Moderate
Transportation Incident	2	2	4	2	2.3	Moderate
Infrastructure Failure	2	2	3	3	2.25	Moderate
Animal/Plant/Crop Disease	2	2	1	4	2.05	Moderate
Pandemic Human Disease	2	2	1	4	2.05	Moderate
Terrorism	1	1	4	4	1.75	Low
Radiological Incident	1	1	3	3	1.5	Low

Source: HMPC & Hazard Risk Assessment Survey - 2024

3.1.7 Climate Change

In accordance with FEMA Administrator Policy 2011-OPPA-01, where possible, this plan update has considered the potential impacts of climate change on the hazards profiled. Climate change can affect all aspects of life. In 2010, the Iowa Climate Change Advisory Council reported to the Governor and the Iowa General Assembly on climate change impacts in Iowa. The report summarized the following climate changes Iowa is already experiencing:

More Precipitation

- Increased frequency of precipitation extremes that lead to flooding.
- Increase of 8 percent more precipitation from 1873 to 2008.
- A larger increase in precipitation in eastern Iowa than in western Iowa.

Higher Temperatures

- Long-term winter temperatures have increased six times more than summer temperatures.
- Nighttime temperatures have increased more than daytime temperatures since 1970.
- Iowa's humidity has risen substantially, especially in summer, which now has 13 percent more atmospheric moisture than 35 years ago as indicated by a 3 - 5-degree F rise in dew- point temperature. This fuels convective thunderstorms that provide more summer precipitation.

Agricultural Challenges

- Climate extremes, not averages, have the greater impact on crop and livestock productivity.
- Increased soil erosion and water runoff.
- Increased challenges associated with manure applications.
- Favorable conditions for survival and spread of many unwanted pests and pathogens.

Habitat Changes

- Plants are leafing out and flowering sooner.
- Birds arrive earlier in the spring.
- Particular animals are now being sighted farther north than in the past.

Public Health Effects

- Increases in heart and lung programs from increasing air pollutants of ozone and fine particles enhanced by higher temperatures.
- Increases in infectious diseases transmitted by insects that require a warmer, wetter climate.
- An increase prevalence of asthma and allergies.

3.2 Assets at Risk

This section assesses the population, structures, critical facilities and infrastructure, and other important assets in the planning area that may be at risk to hazards.

3.2.1 Total Exposure of Population and Structures

Unincorporated County and Incorporated Cities

Table 3.7 shows the total population and building/improvement counts and values for the county and each city in the planning area broken down by usage type.

The methodology employed to extract the summary of building/improvement counts and values from the parcel data is provided below:

- Parcel values that had an associated dwelling or improvement value were used as the structure file. Since building footprints and/or building counts per parcel were not available, the parcels with dwelling or improvement value were counted as one building/improvement;
- Parcel polygons were converted to points; and
- Parcel points were spatially joined to the political area (jurisdiction).

Population data is based on the U.S. Census Bureau's 2020 Decennial Census. Building counts and building exposure values are based on parcel data provided by the Jackson County Assessor's Office on 4/3/2024. The contents exposure values were calculated by factoring a multiplier to the building exposure values based on usage type. The contents multipliers were derived from FEMA's HAZUS software. Results are shown in **Table 3.7.** Land values have been purposely excluded from the tables because land remains following disasters, and subsequent market devaluations are frequently short term and difficult to quantify. Additionally, state and federal disaster assistance programs generally do not address loss of land or its associated value (other than crop insurance).

Table 3.7. Population and Building Exposure by Jurisdiction

Property Class	Parcels	Improved Value	Content Value	Total Value
Andrew (pop. 380)				
Commercial	37	$ 4,158,400	$ 4,158,400	$ 8,316,800
Multi-Family Residential	5	$ 811,400	$ 405,700	$ 1,217,100
Residential	171	$ 13,954,000	$ 6,977,000	$ 20,931,000
Total	**220**	**$ 18,923,800**	**$ 11,541,100**	**$ 30,464,900**
Baldwin (pop. 99)				
Agricultural	10	$ 42,500	$ 42,500	$ 85,010
Commercial	28	$ 1,534,200	$ 1,534,200	$ 3,068,428
Residential	73	$ 3,102,300	$ 1,551,150	$ 4,653,523
Total	**111**	**$ 4,679,000**	**$ 3,127,850**	**$ 7,806,961**
Bellevue (pop. 2,363)				
Ag. Dwelling	1	$ 145,400	$ 72,700	$ 218,100
Agricultural	17	$ 17,400	$ 17,400	$ 34,800
Commercial	198	$ 47,192,100	$ 47,192,100	$ 94,384,200
Industrial	6	$ 1,681,100	$ 2,521,650	$ 4,202,750
Multi-Family Residential	15	$ 6,056,200	$ 3,028,100	$ 9,084,300
Residential	1,068	$ 186,216,100	$ 93,108,050	$ 279,324,150
Total	**1,305**	**$ 241,308,300**	**$145,940,000**	**$ 387,248,300**
LaMotte (pop. 237)				
Agricultural	12	$ 71,400	$ 71,400	$ 142,800
Commercial	43	$ 2,920,100	$ 2,920,100	$ 5,840,200

Table 3.7. Population and Building Exposure by Jurisdiction

Property Class	Parcels	Improved Value	Content Value	Total Value
Industrial	2	$ 1,471,000	$ 2,206,500	$ 3,677,500
Multi-Family Residential	2	$ 244,100	$ 122,050	$ 366,150
Residential	111	$ 14,656,800	$ 7,328,400	$ 21,985,200
Total	**170**	**$ 19,363,400**	**$ 12,648,450**	**$ 32,011,850**
Maquoketa (pop. 6,128)				
Agricultural	42	$ 203,400	$ 203,400	$ 406,800
Commercial	459	$ 157,156,348	$157,156,348	$ 314,312,696
Industrial	30	$ 15,522,600	$ 23,283,900	$ 38,806,500
Multi-Family Residential	43	$ 20,017,200	$ 10,008,600	$ 30,025,800
Residential	2,199	$ 252,192,300	$126,096,150	$ 378,288,450
Total	**2,773**	**$ 445,091,848**	**$316,748,398**	**$ 761,840,246**
Miles (pop. 408)				
Agricultural	31	$ 136,700	$ 136,700	$ 273,400
Commercial	51	$ 6,532,400	$ 6,532,400	$ 13,064,800
Industrial	2	$ 336,800	$ 505,200	$ 842,000
Multi-Family Residential	2	$ 241,200	$ 120,600	$ 361,800
Residential	201	$ 18,495,700	$ 9,247,850	$ 27,743,550
Total	**287**	**$ 25,742,800**	**$ 16,542,750**	**$ 42,285,550**
Monmouth (pop. 129)				
Ag. Dwelling	2	$ 94,900	$ 47,450	$ 142,350
Agricultural	30	$ 4,100	$ 4,100	$ 8,200
Commercial	19	$ 418,400	$ 418,400	$ 836,800
Residential	72	$ 2,923,000	$ 1,461,500	$ 4,384,500
Total	**123**	**$ 3,440,400**	**$ 1,931,450**	**$ 5,371,850**
Preston (pop. 949)				
Agricultural	22	$ 6,900	$ 6,900	$ 13,800
Commercial	112	$ 18,938,400	$ 18,938,400	$ 37,876,800
Industrial	9	$ 4,347,200	$ 6,520,800	$ 10,868,000
Multi-Family Residential	8	$ 1,022,000	$ 511,000	$ 1,533,000
Residential	433	$ 53,784,500	$ 26,892,250	$ 80,676,750
Total	**584**	**$ 78,099,000**	**$ 52,869,350**	**$ 130,968,350**
Sabula (pop. 506)				
Commercial	54	$ 3,576,500	$ 3,576,500	$ 7,153,000
Industrial	1	$ 588,000	$ 882,000	$ 1,470,000
Residential	345	$ 24,995,200	$ 24,995,200	$ 49,990,400
Total	**402**	**$ 29,159,700**	**$ 29,453,700**	**$ 58,613,400**
St. Donatus (pop. 120)				
Ag. Dwelling	2	$ 666,700	$ 333,350	$ 1,000,050
Agricultural	12	$ 17,000	$ 17,000	$ 34,000
Commercial	18	$ 1,213,300	$ 1,213,300	$ 2,426,600
Industrial	1	$ 102,700	$ 154,050	$ 256,750
Multi-Family Residential	1	$ 177,700	$ 88,850	$ 266,550

Table 3.7. Population and Building Exposure by Jurisdiction

Property Class	Parcels	Improved Value	Content Value	Total Value
Residential	74	$ 7,768,700	$ 3,884,350	$ 11,653,050
Total	**108**	**$ 9,279,400**	**$ 5,357,550**	**$ 14,636,950**
Spragueville (pop. 92)				
Ag. Dwelling	1	$ -	$ -	$ -
Agricultural	27	$ 13,200	$ 13,200	$ 26,400
Commercial	11	$ 971,900	$ 971,900	$ 1,943,800
Multi-Family Residential	1	$ 34,400	$ 17,200	$ 51,600
Residential	41	$ 2,772,300	$ 1,386,150	$ 4,158,450
Total	**81**	**$ 3,791,800**	**$ 2,388,450**	**$ 6,180,250**
Springbrook (pop. 143)				
Agricultural	20	$ 2,200	$ 2,200	$ 4,400
Commercial	18	$ 1,353,800	$ 1,353,800	$ 2,707,600
Industrial	2	$ 146,300	$ 219,450	$ 365,750
Residential	72	$ 7,903,600	$ 3,951,800	$ 11,855,400
Total	**112**	**$ 9,405,900**	**$ 5,527,250**	**$ 14,933,150**
Zwingle (pop. 21 in Jackson County)				
Residential	17	$ 1,393,400	$ 696,700	$ 2,090,100
Total	**17**	**$ 1,393,400**	**$ 696,700**	**$ 2,090,100**
Unincorporated (pop. est. 7,910)				
Ag. Dwelling	1,603	$ 313,534,800	$156,767,400	$ 470,302,200
Agricultural	11,207	$ 15,217,200	$ 15,217,200	$ 30,434,400
Commercial	397	$ 29,666,000	$ 29,666,000	$ 59,332,000
Industrial	12	$ 4,174,700	$ 6,262,050	$ 10,436,750
Multi-Family Residential	2	$ 310,400	$ 155,200	$ 465,600
Residential	2,892	$ 480,493,500	$240,246,750	$ 720,740,250
Total	**16,113**	**$ 843,396,600**	**$448,314,600**	**$1,291,711,200**
Total (pop. 19,485)				
Ag. Dwelling	1,609	$ 314,441,800	$157,220,900	$ 471,662,700
Agricultural	11,423	$ 15,268,900	$ 15,268,900	$ 30,537,800
Commercial	1,445	$ 79,461,700	$ 79,461,700	$ 158,923,400
Industrial	65	$ 8,915,900	$ 10,416,450	$ 19,332,350
Multi-Family Residential	79	$ 12,757,000	$ 6,589,750	$ 19,346,750
Residential	7,769	$ 678,277,000	$339,634,500	$1,017,911,500
Grand Total	**22,390**	**$1,109,122,300**	**$608,592,200**	**$1,717,714,500**

Source: U.S. Census Bureau's 2020 Decennial Census

Table 3.8. provides the number of structures built by time period by jurisdiction. Note: There are minor differences between the structure counts from the parcel data and the structure counts in the census data due to the types of structures included in the counts. For example, many parcels zoned as agricultural use also have a residential structure.

Table 3.8. Breakdown of Estimated Structures Built by Time Period by Jurisdiction

Jurisdiction	Total Structures	Year Built									
		2020 or later	2010-2019	2000-2009	1990-1999	1980-1989	1970-1979	1960-1969	1950-1959	1940-1949	1939 or earlier
Unincorporated	3,838	32	301	449	334	225	936	271	283	79	928
Andrew	174	0	0	1	25	16	20	16	18	8	70
Baldwin	92	0	0	2	5	15	2	0	5	4	59
Bellevue	1,048	8	73	102	42	57	133	87	103	69	374
LaMotte	118	0	0	0	11	4	22	10	1	2	68
Maquoketa	2,831	0	27	199	290	251	430	334	364	61	875
Miles	193	0	5	21	7	14	15	19	28	7	77
Monmouth	52	0	2	3	7	1	1	3	2	4	29
Preston	439	0	0	53	19	15	47	45	33	66	161
Sabula	288	0	9	24	25	5	31	38	13	3	140
St. Donatus	79	0	2	3	13	3	19	7	4	3	25
Spragueville	45	0	1	10	1	0	6	2	0	0	25
Springbrook	63	0	0	5	0	2	21	6	6	2	21
Total	**9,260**	**40**	**420**	**872**	**779**	**608**	**1,683**	**838**	**860**	**308**	**2,852**

Source: U.S. Census Bureau, 2018-2022 American Community Survey 5-Year Estimates

Public School Districts

The enrolled number of students at the participating public-school districts is provided in **Table 3.9.** as well as the number of buildings, building exposure values, and contents exposure values.

Table 3.9. Enrollment and Building Exposure by Jurisdiction - Public School Districts

School District	Enrollment	Building Count	Building Value	Contents Value	Total Value
Andrew CSD	148	1	$1,448,400	NR	$1,448,400
Bellevue CSD	804	3	$6,974,500	NR	$6,974,500
Easton Valley CSD	497	2	$5,077,600	NR	$5,077,600
Maquoketa CSD	1,318	6	$51,802,705	$4,579,374	$56,382,079
Total	**2,767**	**12**	**$65,303,205**	**$4,579,374**	**$69,882,579**

Source: Enrollments from Iowa Public School Pre K-12, Enrollments by District - Iowa Department of Education, Building Count and Exposures from Data Collection Guides 2024 and Jackson County Assessor

3.2.2 Critical and Essential Facilities and Infrastructure

As part of the update to the *Jackson County Multi-Jurisdictional Hazard Mitigation Plan*, participating jurisdictions assessed the vulnerability of the following types of facilities below:

- **Critical Facilities**: Those facilities that are essential in providing utility or direction either during the response to an emergency or during the recovery operation.
- **Essential Facilities**: Those facilities that if damaged, would have devastating impacts on disaster response and/or recovery.
- **High Potential Loss Facilities**: Those facilities that would have a high loss or impact on the community.
- **Transportation and Lifeline Facilities**: Those facilities and infrastructure that are critical to transportation, communications, and necessary utilities.

Table 3.10. is a summary of the inventory of critical and essential facilities and infrastructure in the planning area. This list was compiled from data layers provided by Jackson County. The full list of critical facilities is included in Appendix E. This is a non-public appendix and is maintained by Jackson County Emergency Management.

Table 3.10. Inventory of Critical/Essential Facilities and Infrastructure by Jurisdiction

Type of Facility	Andrew	Baldwin	Bellevue	LaMotte	Maquoketa	Miles	Monmouth	Preston	Sabula	Sprague ville	Springbrook	St. Donatus	Unincorporated	Total
Air Facility	0	0	0	0	0	0	0	0	0	0	0	0	1	**1**
Church	2	0	3	2	10	1	1	3	2	1	1	1	4	**31**
Communications	0	0	0	0	1	1	0	0	0	0	0	1	3	**6**
Community/Recreation Center	2	0	1	1	1	1	0	0	1	1	1	0	1	**10**
Convention Center	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Daycare	3	0	0	0	3	1	0	0	0	1	0	0	0	**8**
EHS Chemical Facility	1	0	1	0	1	3	0	0	0	0	0	0	4	**10**
Elder Care	0	0	1	0	0	0	0	0	0	0	0	0	0	**1**
Fire Station/EMS Station	1	1	1	1	1	2	0	1	1	0	1	0	0	**10**
Government Facility	0	0	1	1	2	1	0	1	1	1	0	1	1	**10**
Health or Medical Facility	1	0	1	0	1	0	0	1	0	0	0	0	0	**4**
Hospital/Medical Center	0	0	0	0	1	0	0	0	0	0	0	0	0	**1**
Local Emergency Operations Center	0	0	0	0	1	0	0	0	0	0	0	0	1	**2**
National Shelter System Facility	0	0	0	0	0	2	0	0	0	0	0	0	0	**2**
Nursing Home / Long Term Care	0	0	2	0	3	0	0	0	0	0	0	0	1	**6**
Outdoor Theater / Amphitheater	0	0	0	0	1	0	0	0	0	0	0	0	0	**1**
Outpatient Clinic	0	0	1	0	0	0	0	1	0	0	0	0	0	**2**
Police Station	0	0	1	0	1	0	0	1	1	0	0	0	0	**4**
Power Plant	0	0	1	0	1	0	0	1	0	0	0	0	0	**3**
Public Health Department	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
School K-12	1	0	1	0	4	1	0	1	0	0	0	0	0	**8**
Sheriff's Office	0	0	0	0	1	0	0	0	0	0	0	0	0	**1**
Sirens	2	0	1	1	4	2	0	3	2	1	0	0	0	**16**
Transportation Facility	0	0	0	0	1	0	0	0	0	0	1	0	0	**2**
Veterinary Hospital/Clinic	0	0	1	1	3	0	0	1	0	0	0	0	0	**6**
Wastewater Treatment Plant	0	0	1	1	1	1	0	1	1	1	0	1	0	**8**
Grand Total	**13**	**1**	**18**	**8**	**42**	**16**	**1**	**15**	**9**	**6**	**4**	**4**	**16**	**153**

Source: HMPC Data Collection Worksheets 2024

Other Assets

Assessing the vulnerability of the planning area to disaster also involves inventorying the natural, historic, cultural, and economic assets of the area. This is important for the following reasons:

- The plan participants may decide that these types of resources warrant a greater degree of

protection due to their unique and irreplaceable nature and contribution to the overall economy.

- If these resources are impacted by a disaster, knowing about them ahead of time allows for more prudent care in the immediate aftermath, when the potential for additional impacts is higher.
- The rules for reconstruction, restoration, rehabilitation, and/or replacement are often different for these types of designated resources.
- Natural resources can have beneficial functions that reduce the impacts of natural hazards, such as wetlands and riparian habitat, which help absorb and attenuate floodwaters.
- Losses to economic assets (e.g., major employers or primary economic sectors) could have severe impacts on a community and its ability to recover from disaster.

In the planning area, specific assets include the following:

Threatened and Endangered Species

Table 3.11. includes Federally Threatened and Endangered Species in Jackson County. The Iowa DNR's Natural Areas Inventory interactive website lists 78 threatened, endangered, special concern, and selected rare species for Jackson County (source: https://www.iowadnr.gov/Conservation/Iowas-Wildlife/Threatened-and-Endangered).

Table 3.11. Threatened and Endangered Species in Jackson County

Common Name	Scientific Name	Status
Higgins eye (pearly mussel)	Lampsilis higginsii	Endangered
Iowa Pleistocene snail	Discus macclintocki	Endangered
Rusty patched bumble bee	Bombus affinis	Endangered
Sheepnose Mussel	Plethobasus cyphyus	Endangered
Eastern prairie fringed orchid	Platanthera leucophaea	Threatened
Northern wild monkshood	Aconitum noveboracense	Threatened

Source: U.S. Fish and Wildlife Service

Natural Resources

The State of Iowa owns two parks in Jackson County: Bellevue State Park consisting of 225 acres overlooking the Mississippi River, and Maquoketa Cave State Park which covers 370 acres and has 13 caves. The Jackson County Conservation Department manages nine hunting areas and 38 individual parks, natural areas, timber preserves, historic sites, river accesses, and campgrounds: encompassing over 2,200 acres across the county. The County's recreation areas provide both primitive and modern facilities including the Hurstville Interpretive Center, two modern campgrounds, bike trail, marina, and historical structures such as one-room schoolhouse and the Hurstville Lime Kilns. For a list and map of these areas, please visit http://www.mycountyparks.com/county/Jackson/Parks.aspx.

Historic Resources

The National Register of Historic Places (NRHP) is the official list of the Nation's cultural resources worthy of preservation. Authorized under the National Historic Preservation Act of 1966, the NRHP is part of a national program to coordinate and support public and private efforts to identify, evaluate, and protect our historic and archeological resources. The NRHP is administered by the National Park Service under the Secretary of the Interior. Properties listed in the NRHP include districts, sites, buildings, structures, and objects that are significant in American history, architecture, archeology, engineering, and culture. **Table 3.12.** lists 70 properties and six districts in Jackson County that are listed on the NRHP with local significance. These assets are unique to the county and are, in many situations, irreplaceable. The NRHP is maintained by the National Park Service (NPS).

Table 3.12. Properties on the National Register of Historic Places, Jackson County

Jurisdiction	Resource	Address
Andrew	Butterworth, Nathaniel, House	E side of IA 62 N of Andrew
	DeFries House, Barn and Carpenter Shop	E side of Co. Rd. (232 Ave) W of jct. with IA 62
	Insane Asylum at the County Poor Farm	E side Co. Rd. Y61 (250th Ave.) N of Andrew
	Jackson County Jail	Emmet St.
	Slye, Thomas, House	S side of Co. Rd. (184 St.) E of jct. with IA 62
Baldwin	Lubben, Henry, House, Smokehouse and Springhouse	W side of Co. Rd. Y34 N of Baldwin
	Mill Rock School	W side of Co. Rd. (153 Ave.) S of Baldwin
	Sieben, Mrs. Margaret, House	.3 mi. E of Co. Rd. Y34, N of Baldwin
Bellevue	Lock and Dam No. 12 Historic District	401 N. Riverview St.
	Bellevue Commercial Historic District	100 North Riverview–318 South Riverview Dr., 100 North 2nd–307 South 2nd, 102 Market–203 West Market, 103–15 State Sts.
	Bellevue Herald Building	130 S. Riverview St.
	Big Mill Homestead	Paradise Valley Rd. W of Bellevue
	Building at 101 North Riverview Street	101 N. Riverview St.
	Building at 126 South Riverview Street	126 S. Riverview St.
	Building at 130-132 North Riverview St	130--132 N. Riverview St.
	Building at 306 South Second Street	306 S. Second St.
	Dyas Hexagonal Barn	US 52
	Dyas, George, House	Co. Rd. Z-15, SW of jct. with US 52
	Dyas, William, Barn	Co. Rd. Z-15, SW of jct. with US 52
	Fritz Chapel	Spruce Creek Rd. W of jct. with US 52
	House at 505 Court Street	505 Court St.
	Jackson County Courthouse	Bounded by Third, State, Fourth, and Court Sts.
	Kucheman Building	100 N. Second St.
	Niemann, Theodore, House and Spring House	Spruce Creek Rd. W of jct. with US 52
	Paradise Farm	W of Bellevue
	Potter's, E. G., Jasper Flour Mill	South and Second St.
	Robb House and Spring House	Paradise Valley Rd. W of Bellevue
	Roling, Henry, House	Spruce Creek Rd. W of jct. with US 52
	Spring Side	Jct. of US 52 and Ensign Rd.
	Upper Paradise	Paradise Valley Rd. W of Bellevue
Canton	Canton School	South St.
	Central School	Jct. of Bellevue--Canton and Dubuque--Canton Rds.
Garryowen	St. Patrick's Church-Garryowen	W. Bellevue--Cascade Rd. (Co. Rd. D61) W of Garryowen
LaMotte	Harris Wagon and Carriage Shop	Jct. of Main and Pine Streets

Table 3.12. Properties on the National Register of Historic Places, Jackson County

Jurisdiction	Resource	Address
Maquoketa	Anderson, D. H., Building	129 S. Main St.
	Anderson, D. H., House	315 E. Locust
	Bassnett-Nickerson House	116 S. Vermont
	Cooper, George, House	413 W. Platt St.
	Cundill Block	202 S. Main
	Decker House Hotel	128 N. Main St.
	First National Bank	120 S. Main
	Godard, Milton, House	S side Co. Rd. (7 St.) SW of Maquoketa
	Hotel Hurst	227 S. Main
	Hotel Hurst Garage	219 S. Main
	House at 111 E. Maple Street	111 E. Maple St.
	Hurst, A. A., House	513 W. Platt St.
	Hurstville Historic District	N of Maquoketa on U. S. 61
	IOOF Building	103 N. Main
	Johnson, Mrs. Lydia, House	209 E. Locust
	Lake, John, House	601 W. Platt St.
	Lyon Block	112--116 N. Main
	Maquoketa Caves State Park Historic District	Co. Rd. 428 NW of Maquoketa
	Maquoketa Commercial Historic District	Main St. between Quarry and Maple Sts., including Platt and Pleasant Sts. one block east and west of Main St.
	Maquoketa Company-Clinton Machine Company Administration Building	605 E. Maple St.
	Maquoketa Free Public Library	Second and Pleasant
	Martin, Dr. G. S., House	311 S. Second St.
	Merrero Building	111--115 S. Main
	Mitchell-Maskrey Mill	120 E. Pleasant
	New Era Building	115--117 E. Platt
	Organ, Alexander, House	607 W. Summit
	Perham House	213 E. Pleasant St.
	Sanborn, C. M., Building	203 S. Main
	Squiers, J. E., House	418 W. Pleasant St.
	Swigert, W. B., House	309 N. Main St.
	Taubman, Henry, House	303 E. Pleasant St.
	West Pleasant Street Historic District	Pleasant St. between Second & Prospect Sts.
	Williams, Seneca, Mill	E of Maquoketa on IA 64
	Wilson, Anson, House	S of Maquoketa off U.S. 61
Otter Creek	St. Lawrence Catholic Church	Bellevue--Cascade Rd. (Co. Rd. D61) W of jct. with US 61
Sabula	Dominy, John S., House	605 Pearl St.
	Savanna-Sabula Bridge	IA 64, US 52 over Mississippi River

Table 3.12. Properties on the National Register of Historic Places, Jackson County

Jurisdiction	Resource	Address
	Wood, Jeremiah, House	802 River St.
Springbrook	Kegler Gonner Store and Post Office	100 E. Main
St. Donatus	Gehlen House and Barn	U.S. 52
	Village of St. Donatus Historic District	Jct. of US 52/Main St. and First St.
Van Buren	Polygonal Barn, Van Buren Township	IA 64

Source: National Park Service, https://www.nps.gov/subjects/nationalregister/database-research.htm

Agriculture and the Economy

Agriculture plays an important role in the Jackson County economy. **Table 3.13.** details the findings of the 2022 Census of Agriculture for Jackson County.

Table 3.13. Census of Agriculture Statistics, Jackson County, IA - 2022

2022 Census of Agriculture	
Land in Farms (acres)	292,239
Number of Farms	1,131
Average Farm Size (acres)	258
Average Age of Farmers	58.1
Market Value of All Farm Products	$326,812,000
Market Value of All Crops	$176,285,000
Market Value of All Livestock	$150,527,000
Production Expenses	$241,388,000
Hogs and Pigs Inventory	62,925
Soybeans (acres)	46,101
Cattle as of January 1, 2022	
All Cattle and Calves (State Rank 6)	95,000
Crops - 2021 Acreage, Yield and Production Rank	
Corn for Grain (State Rank 61)	117,000 acres
Oats (acres, State Rank 6)	4,200 acres

Source: USDA National Agricultural Statistics Service, 2022 Census of Agriculture. Cattle and Crops data from 2022 Iowa Agricultural Statistics Report, USDA National Agricultural Statistical Service

3.3 Development Since 2019 Plan Update

This section provides information on developments that have occurred since the 2019 Jackson County Multi-Jurisdictional Hazard Mitigation Plan Update. According to the U.S. Census Bureau, the Jackson County population decreased 1.8 percent from 2010 to 2020. **Table 3.14.** provides the population growth statistics for all cities in Jackson County as well as the county. The unincorporated area population was determined by subtracting the cities' populations from the overall county population.

Table 3.14. Jackson County Population Growth, 2010-2020

Jurisdiction	2010 Population	2020 Population	# Change 2010-2022	% Change 2010-2022
Unincorporated	8,143	7,910	-233	-2.9%
Andrew	434	380	-54	-12.4%
Baldwin	109	99	-10	-9.2%
Bellevue	2,191	2,363	172	7.9%
LaMotte	260	237	-23	-8.8%
Maquoketa	6,141	6,128	-13	-0.2%
Miles	445	408	-37	-8.3%
Monmouth	153	129	-24	-15.7%
Preston	1,012	949	-63	-6.2%
Sabula	576	506	-70	-12.2%
St. Donatus	135	120	-15	-11.1%
Spragueville	81	92	11	13.6%
Springbrook	144	143	-1	-0.7%
Total	**19,848**	**19,485**	**-363**	**-1.8%**

Source: U.S. Census Bureau: Decennial Census, 2010 and 2020

Table 3.15. provides the change in numbers of housing units in the planning area from 2010 to 2020.

Table 3.15. Change in Housing Units, 2010-2020

Jurisdiction	2010 Housing Units	2020 Housing Units	# Change 2010-2020	% Change 2010-2020
Unincorporated	3,881	3,727	-154	-4.0%
Andrew	173	166	-7	-4.0%
Baldwin	80	56	-24	-30.0%
Bellevue	1,120	1,115	-5	-0.4%
LaMotte	109	106	-3	-2.8%
Maquoketa	2,856	2,888	32	1.1%
Miles	195	197	2	1.0%
Monmouth	69	63	-6	-8.7%
Preston	464	436	-28	-6.0%
Sabula	321	316	-5	-1.6%
St. Donatus	57	62	5	8.8%
Spragueville	46	44	-2	-4.3%
Springbrook	64	65	1	1.6%
Total	**9,415**	**9,241**	**-174**	**-1.8%**

Source: U.S. Census Bureau: Decennial Census, 2010 and 2020

3.4 Future Land Use and Development

The following sections provide details regarding future growth, land use and development. The information in this section was provided by each of the participating jurisdictions as well as other sources, cited throughout. Where available, maps are provided to facilitate consideration of hazard areas in future development plans as well as potential growth areas.

Jackson County

The land in Jackson County is primarily used for agricultural purposes, including but not limited to corn, soybeans, and pasture ground for grazing livestock. However, in contrast to other counties located farther west of the Mississippi River, Jackson County does not have the abundance of land suitable for widespread crop production. The closer one travels to the Mississippi River, the more variation in elevation one sees. This proves less advantageous for crop production and more advantageous for pastures and timber, as the land undulates and becomes rockier in the eastern parts of the county.

Residential development in Jackson County has increased in many of the scenic areas of Jackson County. Rural areas around Bellevue and Sabula are seen as desirable for large tract residential uses, due to the amount of scenic views and timbered areas that provide both uninhibited views of the landscape and seclusion respectively. The major concentrations of rural residential development in Jackson County are rural areas around the incorporated communities, in particular Maquoketa, Bellevue, and Preston. Unique to Jackson County is Leisure Lake, an unincorporated subdivision in northwest Jackson County that is residential in nature. Designed around a small lake, Leisure Lake was initially intended to provide weekend and vacation housing opportunities but has since provided more permanent housing for many of the residents.

The Jackson County does not have a Land Use Plan in place; but rather relies on a Land Use Policy Statement to guide development countywide. The County is in the process of establishing a comprehensive plan and adoption by the county is anticipated in 2024. Jackson County has adopted a Zoning Ordinance and Zoning Map and regulates the division of land through a Platting Ordinance. Jackson County also has adopted a Floodplain Management Ordinance based on minimum requirements mandated by FEMA.

Table 3.16. provides the 2010 decennial census population of Jackson County as well as the population projections through 2040. Overall, the population is not expected to change much over the next 24 years.

Table 3.16. Jackson County 2010 Population and Population Projections, 2020-2040

2010	2020	2025	2030	2035	2040
19,848	19,485	19,877	19,883	19,893	19,906

Source: U.S. Census Bureau 2020; Population projections from the 2010 Profile: Iowa, Woods & Poole Economics, Inc, State Library of Iowa, State Data Center Program

City of Andrew

The City of Andrew has no subdivisions and has had no land annexations and does not expect substantial changes in the near future.

City of Baldwin

The City of Baldwin does not have a zoning ordinance, a building code, or a comprehensive plan. There are no substantial changes expected in the size of the town in the near future.

City of Bellevue

The City of Bellevue reports having control over most of the floodplain and does not anticipate any growth in those areas. The City does hope to see continued residential growth to the north and west of town and expanded commercial growth on the south end of town. Several facilities are planned for

construction within the next five years. The City built a radium treatment facility for the water supply in 2018. The wastewater facility has already been upgraded along with wells for drinking water. The fire department added an addition to its facility. All utility infrastructure owned by the city has excess capacity to accommodate future growth.

City of LaMotte
The City of LaMotte has no current subdivision developments and has had no land annexations, nor is there any substantial change anticipated in the near future.

City of Maquoketa
Maquoketa has had public development including reconstruction of HWY 64 and the City Wastewater Treatment Plant. The City welcomed Meadow Park subdivision (30 residential parcels) and will be building new homes with the private developer. The City of Maquoketa has also welcomed multiple businesses into the City near Walmart and in the Industrial loop. City is seeking funds for a downtown community event space that will include public restrooms and shelter.

City of Miles
The City of Miles has no subdivisions and has had no land annexations. Since 2019 a new sewer plant was installed. One abandoned derelict commercial building was deconstructed downtown. No substantial changes are anticipated in the near future.

City of Monmouth
The City of Monmouth has no subdivisions and has had no land annexations. No substantial changes are anticipated in the near future.

City of Preston
The City of Preston has completed the development of Harvest Heights subdivision with the construction of one home. Westside Subdivision has been established and two lots sold. The City of Preston expects growth from housing in the Harvest Heights and Westside Subdivision areas. Five acres has been purchased for the construction of a 12-unit senior housing complex.

A City Comprehensive Plan was adopted. A walking path and Fit core obstacle course was added to Westside Park. Main Street Square was built near the entrance to downtown. A Downtown Incentive Program was created and has assisted two new startup businesses. Restoration of Old City Hall for Jump Start/Incubator Program for businesses was completed. The Preston Times had extensive restoration with the assistance of a Catalyst Grant. The Amos Street reconstruction project will be completed in summer 2024.

The City's Peppermint Park Playground project will be complete with equipment installed in 2024. The Historic building of the Treasure Trove has been purchased and plans for restoration are being made. The Post Office building has plans of adding upper story apartments with Catalyst Grant and Downtown Incentive Grant applications.

City of Sabula
The City of Sabula has no subdivisions and has had no land annexations. Development is heavily restricted based on the natural landscape of the area. A new housing development will begin in 2024. This will create approximately ten apartments.

City of St. Donatus
The City of St. Donatus does not anticipate any building or substantial changes in the near future.

City of Spragueville
The City of Spragueville has no subdivisions and has had no land annexations. One home built during

past five years. No other changes to report.

City of Springbrook
The City of Springbrook has no subdivision but has annexed two lots on the northeast corner for residential use. No other changes to report.

School Districts' Future Development
This section summarizes future development for the participating school districts:

Maquoketa Community School District
The school district does not have any specific construction planned over the next five years. However, all facilities are currently under review with hopes of a new building in the future. Enrollment is difficult to predict for the school district due to a high transient population. Projections show variable enrollment.

No other school districts reported any planned development or enrollment projections for the next five years.

Future Land Use Maps
The cities of Bellevue, Maquoketa, and Preston have adopted comprehensive plans that include future growth areas.

<u>City of Bellevue</u>
The Future Land Use Map in the City of Bellevue's 2022 Comprehensive Plan is shown in **Figure 3.1.**

The map provides a development concept for the entire area within two miles of the existing Bellevue city limits. But, because of the natural limitations on future growth, most of city's new growth will likely occur within the existing city limits or within the three Possible Growth Areas outlined in black to the south, west, and north.

Figure 3.1. City of Bellevue Future Land Use Map

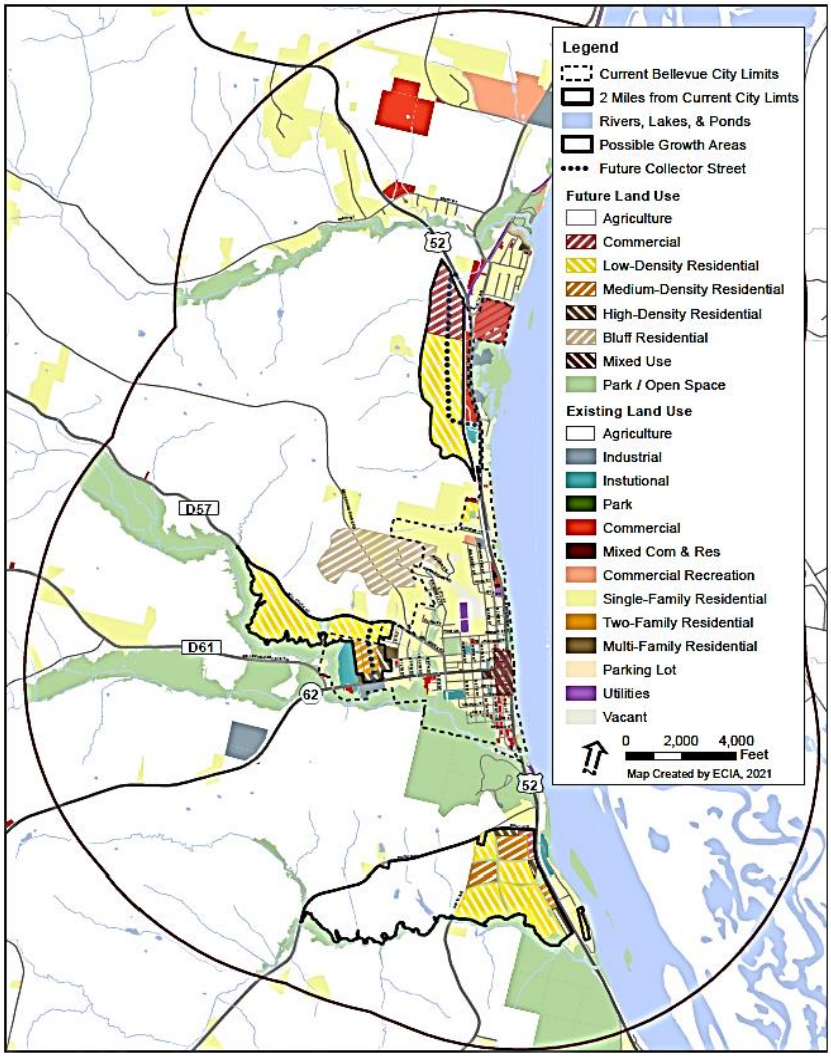
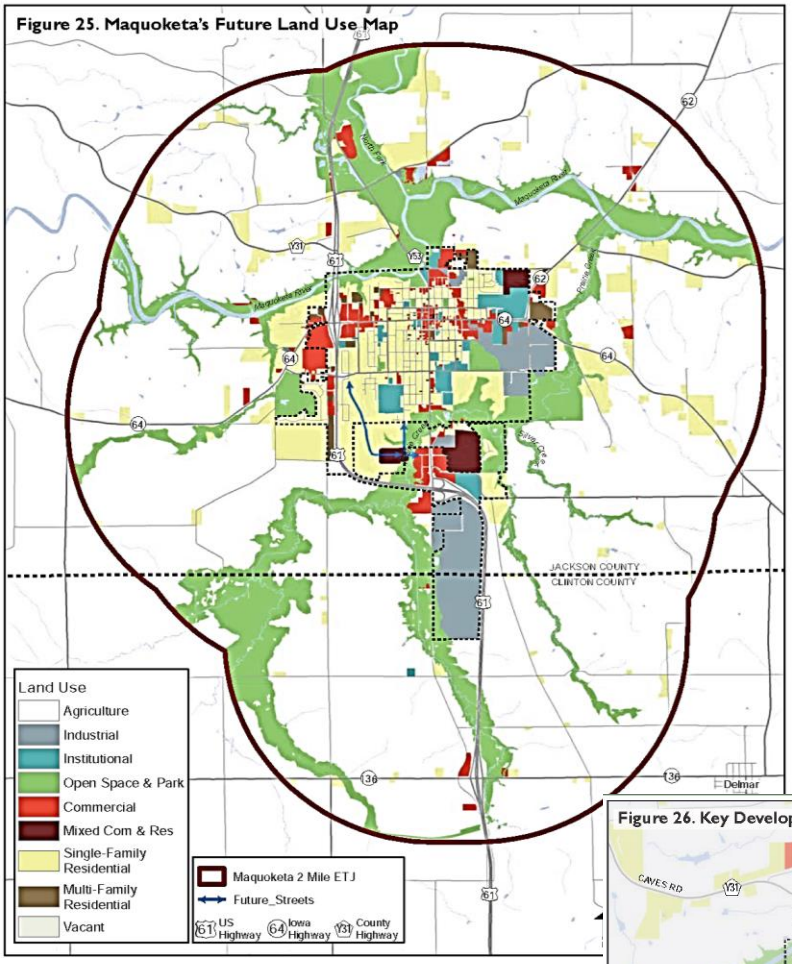


Figure 3.2. City of Maquoketa Future Land Use Map



<u>City of Maquoketa</u>

The Future Land Use Map in the City of Maquoketa's 2019 Comprehensive Plan is shown in **Figure 3.2.**

Figure 3.3. is a Future Land Use that shows the City of Maquoketa's Key Development Areas outlined in blue. The community has identified these 11 areas as the most important to the future development of the community and as the locations where development is most likely to occur.

Figure 3.3. City of Maquoketa Key Development Areas

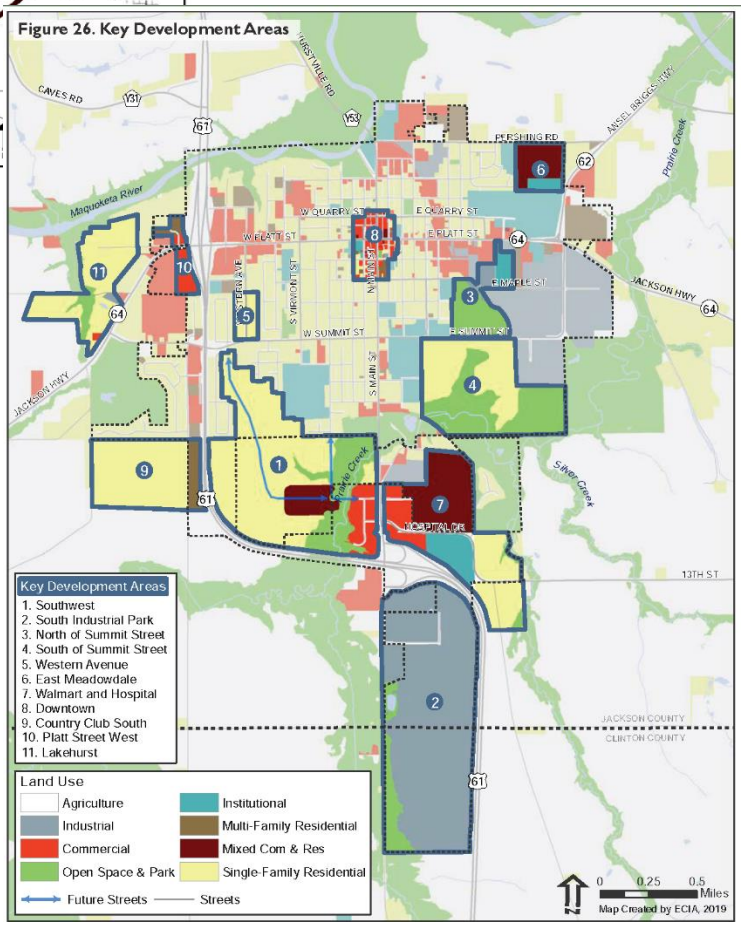
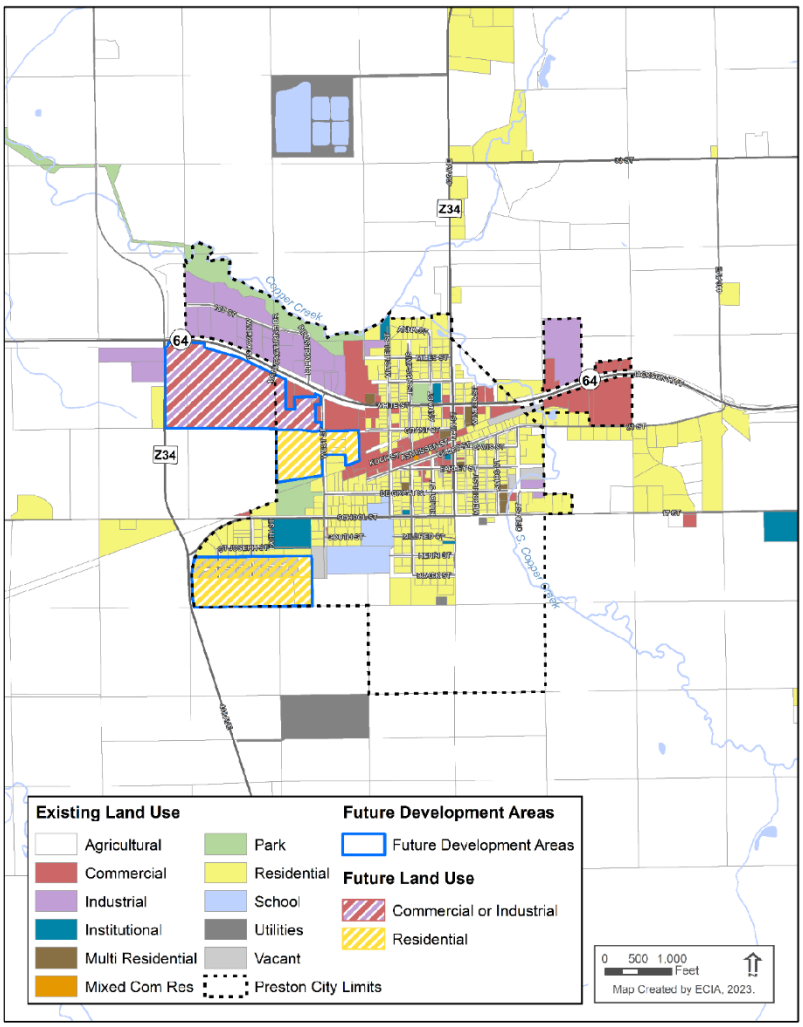


Figure 3.4. City of Preston Future Land Use Map



City of Preston

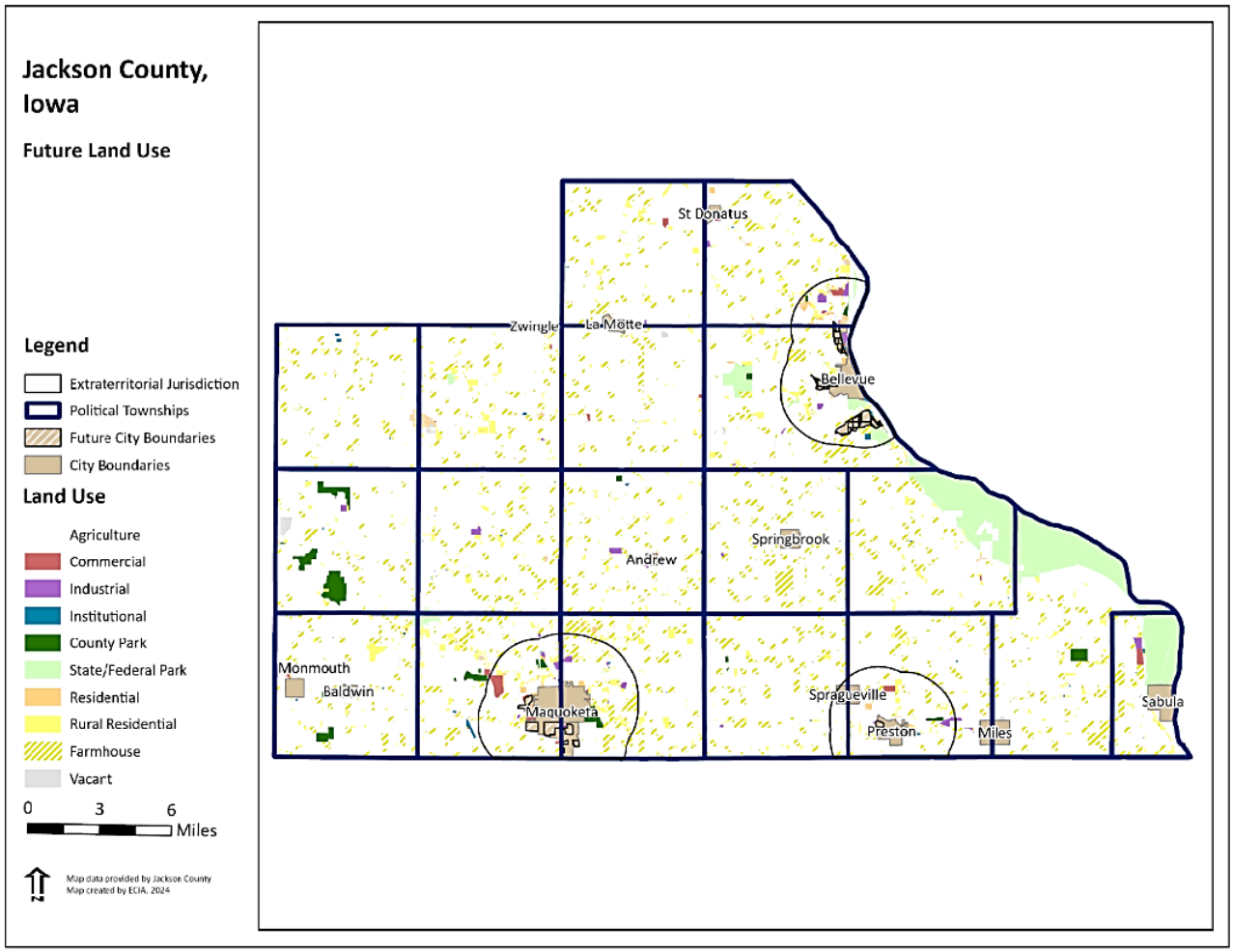
The Future Land Use Map in the City of Preston's 2023 Comprehensive Plan is shown in **Figure 3.4.** The map identifies several key areas for future development. Preston has identified three Key Development Areas outlined in blue as the most important to the future development of the community and as the locations where development is most likely to occur.

Jackson County

The proposed Future Land Use Map in the proposed Jackson County Comprehensive Plan is shown in **Figure 3.5.** As noted above, the cities of Bellevue, Maquoketa, and Preston have adopted comprehensive plans that include areas for future growth and development. The future city boundaries that are represented by these growth areas are identified with a light brown stripe outlined in black on the Future Land Use Map.

These cities also have adopted subdivision ordinances. Iowa Code gives cities that have adopted subdivision ordinances the option to review subdivision plats that are located within two miles of their city boundaries. If a property owner within two miles of the city plans to subdivide their land, they must apply to both Jackson County and that city for approval. The cities of Bellevue, Maquoketa, and Preston have adopted two-mile extraterritorial jurisdictions for subdivision review. Jackson County should coordinate with these cities when reviewing development proposals that are within the future growth areas. Jackson County coordinates with these three cities for subdivision review and approval within their extraterritorial jurisdictions. **Figure 3.5.** shows the two-mile extraterritorial jurisdictions of these cities.

Figure 3.5. Jackson County Future Land Use Map



3.5 Hazard Profiles and Vulnerability

Hazard Profiles

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.

Each hazard identified in Section **3.1.4** is profiled individually in this section in alphabetical order. The level of information presented in the profiles varies by hazard based on the information available. With each update of this plan, new information will be incorporated to provide for better evaluation and prioritization of the hazards that affect the planning area. Detailed profiles for each of the identified hazards include information categorized as follows:

Hazard Description
This section consists of a general description of the hazard and the types of impacts it may have on a community. It also includes the ratings assigned to the hazard relative to typical warning times and duration of hazard events as described in **Table 3.5**.

Geographic Location/Extent
This section describes the geographic location of the hazard in the planning area. Where available, maps are utilized to indicate the specific locations of the planning area that are vulnerable to the subject hazard. This section also provides information as to the extent of the hazard (i.e. the size or degree of impact).

Previous Occurrences
This section includes information on historic incidents and their impacts.

Probability of Future Occurrence
The frequency of past events is used to gauge the likelihood of future occurrences. Where possible, the probability or chance of occurrence was calculated based on historical data. Probability was determined by dividing the number of events observed by the number of years and multiplying by 100. This gives the percentage chance of the event happening in any given year. An example would be three droughts occurring over a 30-year period, which suggests a 10 percent chance of a drought occurring in any given year. For each hazard, the probability is assigned a rating as defined in **Table 3.5**.

Vulnerability Assessments

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)(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 areas.

Requirement §201.6(c)(2)(ii)(B): [The plan should describe vulnerability in terms of an] estimate of the potential dollar losses to vulnerable structures identified in paragraph (c)(2)(i)(A) of this section and a description of the methodology used to prepare the estimate.

Requirement §201.6(c)(2)(ii)(C): [The plan should describe vulnerability in terms of] providing a general description of land uses and development trends within the community so that mitigation options can be considered in future land use decisions.

Requirement §201.6(c)(2)(ii): (As of October 1, 2008) [The risk assessment] must also address National Flood Insurance Program (NFIP) insured structures that have been repetitively damaged in floods.

Following the hazard profile for each hazard is the vulnerability assessment. The vulnerability assessment further defines and quantifies populations, buildings, critical facilities, and other community assets at risk to natural hazards. The vulnerability assessments were conducted based on the best available data and the significance of the hazard. Data to support the vulnerability assessments was collected from the following sources:

- Available GIS data sets such as DFIRM, parcel data, critical facilities, etc. (all sourced when used);
- Homeland Security Infrastructure Program Freedom, 2015;
- Written descriptions of assets and risks provided by participating jurisdictions;
- Existing plans and reports;
- Personal interviews with planning committee members and other stakeholders; and
- Other sources as cited.

Detailed profiles for each of the identified hazards include information categorized as follows:

Vulnerability Overview

This section consists of a general overview narrative of the planning area's vulnerability to the hazard. Within this section, the magnitude/severity of the hazard is discussed. The magnitude of the impact of a hazard event (past and perceived) is related directly to the vulnerability of the people, property, and the environment it affects. This is a function of when the event occurs, the location affected, the resilience of the community, and the effectiveness of the emergency response and disaster recovery efforts.

For each hazard, the magnitude/severity is assigned a rating as defined in **Table 3.5**.

Potential Losses to Existing Development

This section provides the potential losses to existing development. Where data is available, provides estimated financial losses as well as the methodology used. For hazards with an overall "Low" rating, potential losses may not be discussed.

Future Development

This section provides information on how vulnerability to this hazard will be impacted by planned future development as well as information for jurisdictions to consider in planning future development.

Climate Change Impacts
This section will discuss any potential impacts to this hazard as a result of climate change.

Hazard Summary by Jurisdiction
For hazards that vary by jurisdiction, this section will provide an overview of how the hazard varies, followed by a table indicating the probability, magnitude, warning time, and duration rankings for each jurisdiction with the resulting hazard score and level.

The following Hazard Profiles and Vulnerability Assessments are arranged so that Natural Hazards are listed first, in alphabetical order, followed by Non-Natural Hazards, also listed in alphabetical order.

Natural Hazards
3.5.1. Dam/Levee Failure (relates to natural hazard of flooding)
3.5.2. Drought
3.5.3. Excessive Heat
3.5.4. Flooding - Flash
3.5.5. Flooding - River
3.5.6. Hail and Lightning from Thunderstorms
3.5.7. Severe Winter Storms
3.5.8. Sinkholes
3.5.9 Tornado/Windstorm (including derechos)
3.5.10.Wildland Fire or Grass Fire
Non-Natural Hazards
3.5.11. Animal/Crop/Plant Disease
3.5.12. Hazardous Materials
3.5.13. Infrastructure Failure
3.5.14. Pandemic Human Disease
3.5.15. Radiological Incident
3.5.16. Terrorism
3.5.17. Transportation Incident

3.5.1 Dam and Levee Failure (relates to natural hazard of flooding)

Hazard Score Calculation					
Probability	**Magnitude/Severity**	**Warning Time**	**Duration**	**Weighted Score**	**Level**
2	**2**	**2**	**4**	**2.2**	**Moderate**

Hazard Profile

Hazard Description

Many of Iowa's community settlements were founded along rivers and streams due to their reliance on water resources. Often, these streams or rivers later needed a dam or levee for flood control or a reservoir for a constant water source. This section discusses both dam and levee failure.

Dam Failure: A dam is defined as a barrier constructed across a watercourse for the purpose of storage, control, or diversion of water. Dams are typically constructed of earth, rock, concrete, or mine tailings. Dam failure is the uncontrolled release of impounded water resulting in downstream flooding, affecting both life and property.

Levee Failure is the uncontrolled release of water resulting from a structural failure.

Dam and Levee failure can be caused by any of the following: flooding, earthquakes, blockages, landslides, erosion, lack of maintenance, improper operation, poor construction, piping, saturation, under seepage, vandalism, or terrorism.

Warning Time Score: 2 - From 12 to 24 hours

Duration Score: 4 – More than 1 week

Geographic Location/Extent

The thresholds for when a dam falls under State regulation are outlined in Iowa Administrative Code 567-71.3 and are listed below. The thresholds are primarily based on both dam height and water storage volumes. State regulated dams are those dams that meet the following:

In rural areas:

a. *Any dam designed to provide a sum of permanent and temporary storage exceeding 50 acre-feet at the top of dam elevation, or 25 acre-feet if the dam does not have an emergency spillway, and which has a height of 5 feet or more.*
b. *Any dam designed to provide permanent storage in excess of 18 acre-feet and which has a height of 5 feet or more.*
c. *Any dam across a stream draining more than 10 square miles.*
d. *Any dam located within 1 mile of an incorporated municipality, if the dam has a height of 10 feet or more, stores 10 acre-feet or more at the top of dam elevation and is situated such that the discharge from the dam will flow through the incorporated area.*

In urban areas: *Any dam which exceeds the thresholds in 71.3 (1) "a", "b", or "d".*

Low head dams: Any low head dam on a stream draining 2 or more square miles in an urban area, or 10 or more square miles in a rural area.

Dams are classified by the State of Iowa into three categories based on the potential risk to people and property in the event of failure (see **Table 3.17.**). The classification can change over time due to changes in development downstream from the dam. In addition, older dams may not have been built to the standards of their updated classification when this occurs. The Iowa Department of Natural Resources (DNR) performs annual inspections on all high hazard dams in the State.

Table 3.17. Dam Hazard Classification Definitions

Hazard Class	Definition
High	A dam is classified as high hazard when it is located in an area where failure may create a serious threat of loss of human life or result in serious damage to residential, industrial, or commercial areas, important public utilities, public buildings, or major transportation facilities.
Moderate (Significant)*	A dam is classified as moderate hazard if located in an area where failure may damage isolated homes or cabins, industrial or commercial buildings, moderately traveled roads or railroads, interrupt major utility services, but without substantial risk of loss of human life. In addition, structures where the dam and its impoundment are of themselves of public importance, such as dams associated with public water supply systems, industrial water supply or public recreation, or which are an integral feature of a private development complex, shall be considered moderate hazard for design and regulatory purposes unless a higher hazard class is warranted by downstream conditions.
Low	A structure shall be classified as low hazard if located in an area where damages from a failure would be limited to loss of the dam, loss of livestock, damages to farm outbuildings, agricultural lands, and lesser used roads, and where loss of human live is considered unlikely.

Source: Iowa DNR; *the term “moderate” is used by the Iowa DNR. However, the National Inventory of Dams uses the term “significant” to identify the same general hazard classification.

Dams in Planning Area

For this plan update, both the National Inventory of Dams (NID) as well as the State-regulated dam inventory were consulted. The NID documents all known dams in the United States and its territories that meet certain criteria. It is designed to provide a variety of users the ability to search for specific data about dams in the United States and serves as a resource to support awareness of dams and actions to prepare for a dam-related emergency.

The Iowa DNR Dam Safety Program maintains a database of dams in the state that meet the thresholds for the National Inventory of Dams. **Table 3.18.** shows the Iowa DNR Dam Inventory for Jackson County in 2024. There are 12 regulated dams in Jackson County. Leisure Lake Dam is a High Hazard dam, Lake Homestead Dam and Maquoketa Milldam are Significant Hazard dams, and the remaining nine are Low Hazard dams. One of the low hazard dams is a federal dam; the Mississippi River Lock & Dam No. 12, is owned and operated by the U.S. Army Corps of Engineers (USACE). All dams are regulated by the Iowa DNR except for the dam at Mississippi River Lock & Dam No. 12.

Figure 3.6. is a map of dams in Jackson County prepared using the NID online database. It shows the dams by hazard level. The four principal dams considered in this plan are identified by name on this map: High Hazard - Leisure Lake Dam, Significant Hazard – Lake Homestead Dam and Maquoketa Milldam, and Low Hazard - Mississippi River Lock & Dam No. 12.

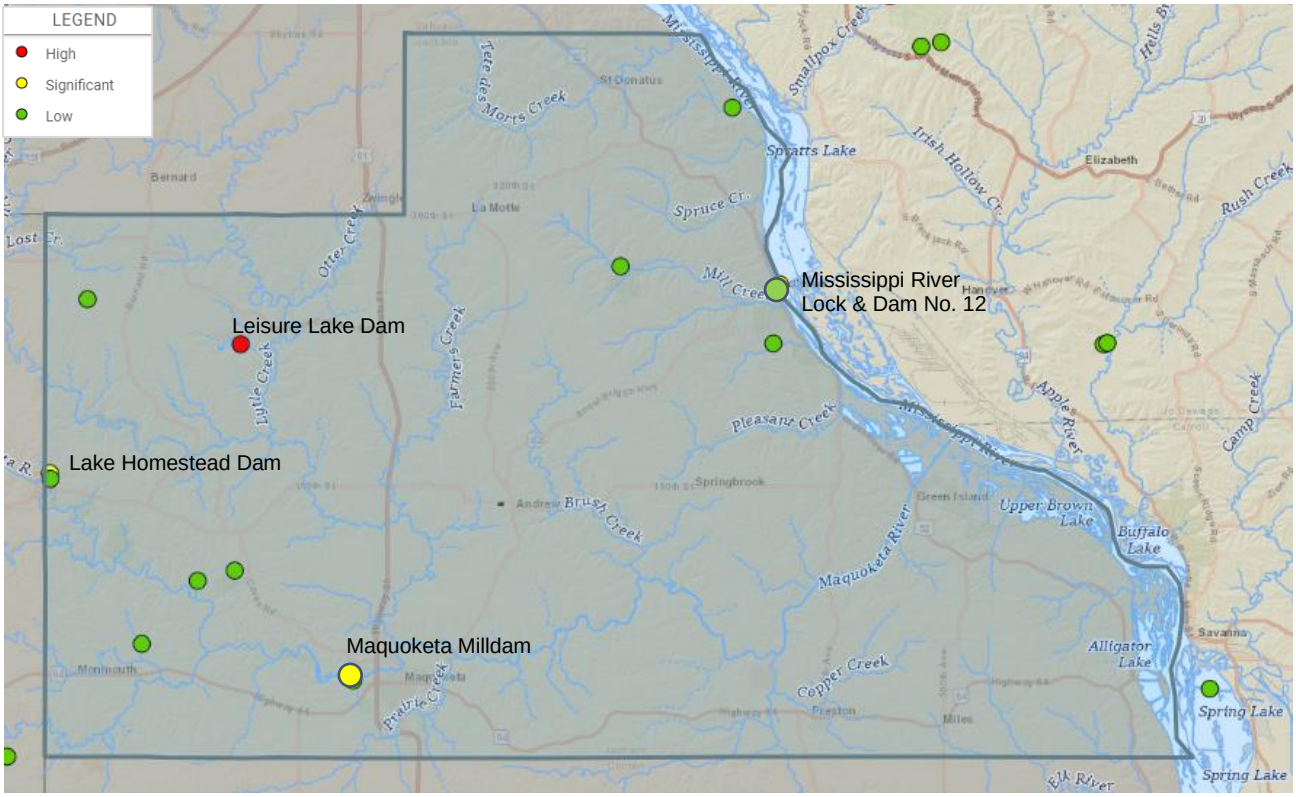
Figure 3.7. is a set of aerial maps prepared using the NID online database. The maps show the locations and surrounding land areas for the High Hazard - Leisure Lake Dam, Significant Hazard – Lake Homestead Dam, and Significant Hazard –Maquoketa Milldam.

Table 3.18. Iowa DNR Dam Inventory for Jackson County, 2024

Dam Name	NIDID	Owner Name	Hazard Class	Last Date Inspected	Condition Assessment	Year Built	EAP
Leisure Lake Dam	IA00522	Ron Kirchhoff	High	09/27/2022	Satisfactory	1958	N
Lake Homestead Dam	IA01973	Wildwood Acres Homeowners Assn	Significant	06/14/2019	Satisfactory	1978	NR
Maquoketa Milldam	IA01302	Renewable World Energies	Significant	09/17/2021	Satisfactory	1923	NR
Thomas Dam	IA00521	Don Thomas	Low	05/08/1980	Not Rated	1959	NR
Pfab Dam	IA02118	James Pfab	Low	09/09/1993	Not Rated	1979	NR
Big Mill Wetlands Dam	IA02201	Iowa DNR	Low		Not Rated	1981	NR
Stamp Dam	IA02369	Erwin Stamp	Low		Not Rated	1987	NR
Penrose Dam	IA02969	Harold Penrose	Low		Not Rated	1989	NR
Four D Partnership Dam	IA03311	Four D Partnership	Low		Not Rated	1999	NR
Lechtenberg Dam	IA03901	Joseph A Lechtenberg	Low		Not Rated	1999	NR
Von Maur Dam	IA04095	James VonMaur	Low		Not Rated	2012	NR
Mississippi River Lock & Dam No. 12	IA00004	US Army Corps of Engineers - MVR	Low		Not Rated	1938	NR

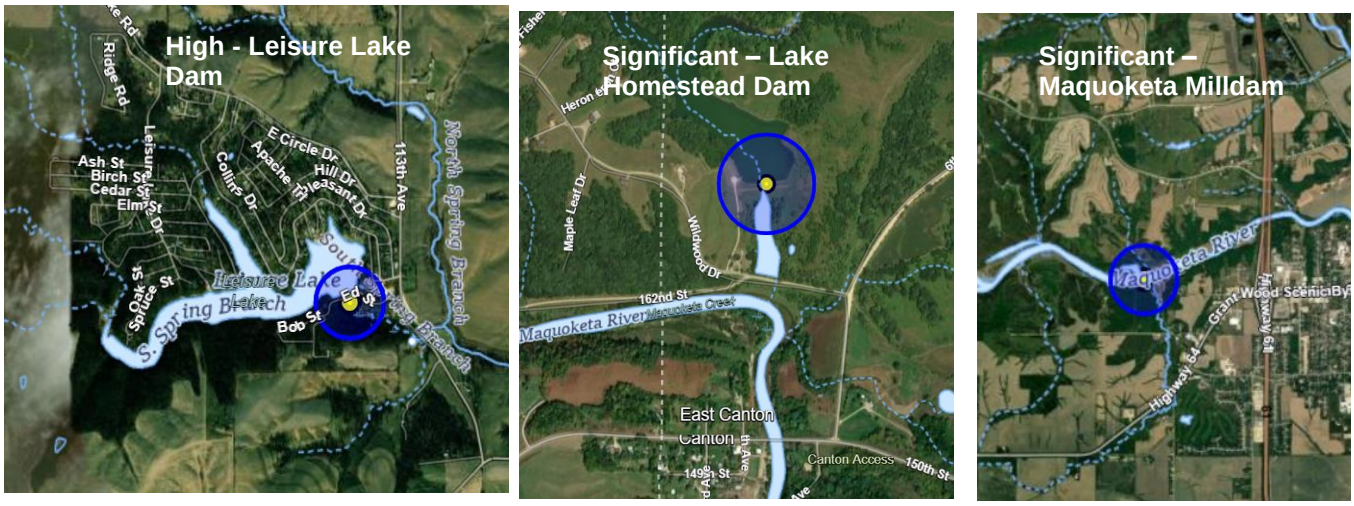
"NIDID" = National Inventory of Dams Identification number, "EAP" = Emergency Action Plan, "N" = No, and "NR" = Not Rated.
Source: Iowa DNR's Online Dam Inventory, https://www.iowadnr.gov/Environmental-Protection/Land-Quality/Dam-Safety accessed 5/24

Figure 3.6. Map of Dams in Jackson County, 2024



Source: National Inventory of Dams, https://nid.sec.usace.army.mil/#/ accessed May 2024

Figure 3.7. Aerial Maps of High Hazard and Significant Hazard Dams in Jackson County, 2024



Source: National Inventory of Dams (NID) https://nid.sec.usace.army.mil/#/ accessed May 2024

Flooding can occur near dams in a variety of scenarios. Inundation maps are a tool used to visualize impacts from flooding and prepare in advance. In 2024, flood inundation maps are not available from the NID for the 12 dams in the planning area.

Dams Upstream of Planning Area

According to the Iowa DNR, there are no known dams upstream of the planning area that would have a significant impact on Jackson County in the unlikely event of failure.

Levees in Planning Area
The National Levee Database and the FEMA National Flood Hazard Layer were consulted to identify levees in the planning area. There are two levee segments in Jackson County as follows:

- *Sabula Levee* – 2.34 miles long. This levee was federally constructed by USACE and then turned over to the public sponsor for operations and maintenance. The levee's sponsors are listed as the Canadian Pacific Railroad, the City of Sabula, the Iowa Department of Transportation, and a private landowner. The Sabula Levee is depicted on the FEMA National Flood Hazard Layer.

- *Green Island Levee* —17.73 miles long. This levee was locally constructed and is locally operated and maintained. The levee's sponsor is listed as the Green Island Levee and Drainage District No.1. The Green Island Levee is not depicted on the FEMA National Flood Hazard layer.

Figure 3.8. shows the locations of both levees in Jackson County. **Figure 3.9.** provides close-up images of the Green Island Levee and Sabula Levee respectively, including the areas protected.

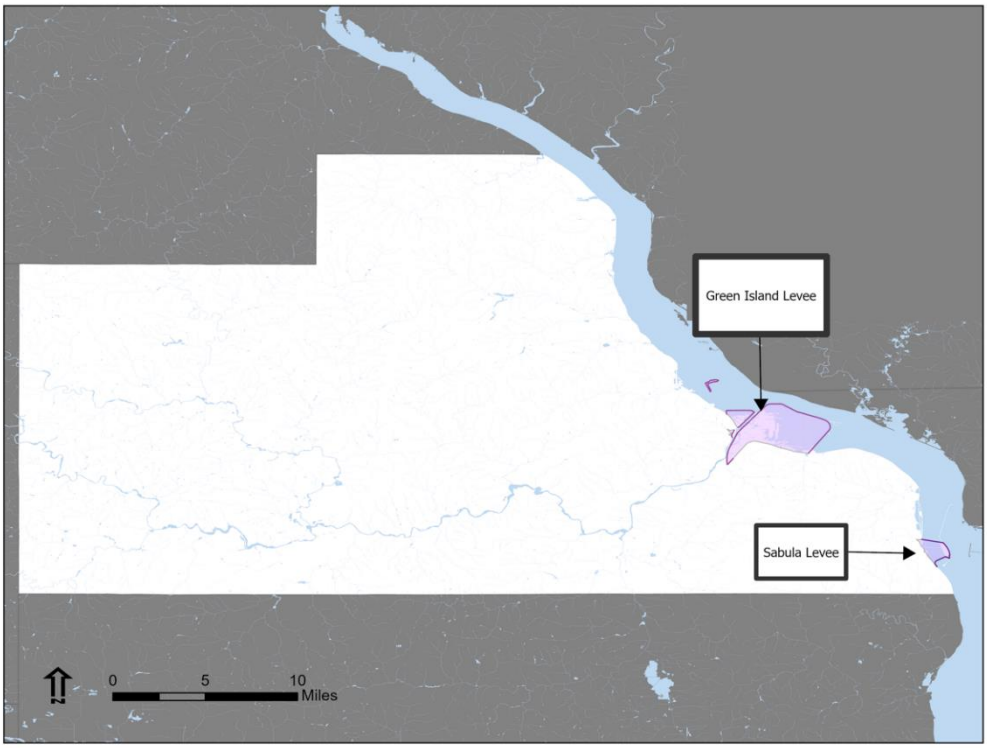


Figure 3.8.Jackson County Levees

Source: USACE National Levee Database

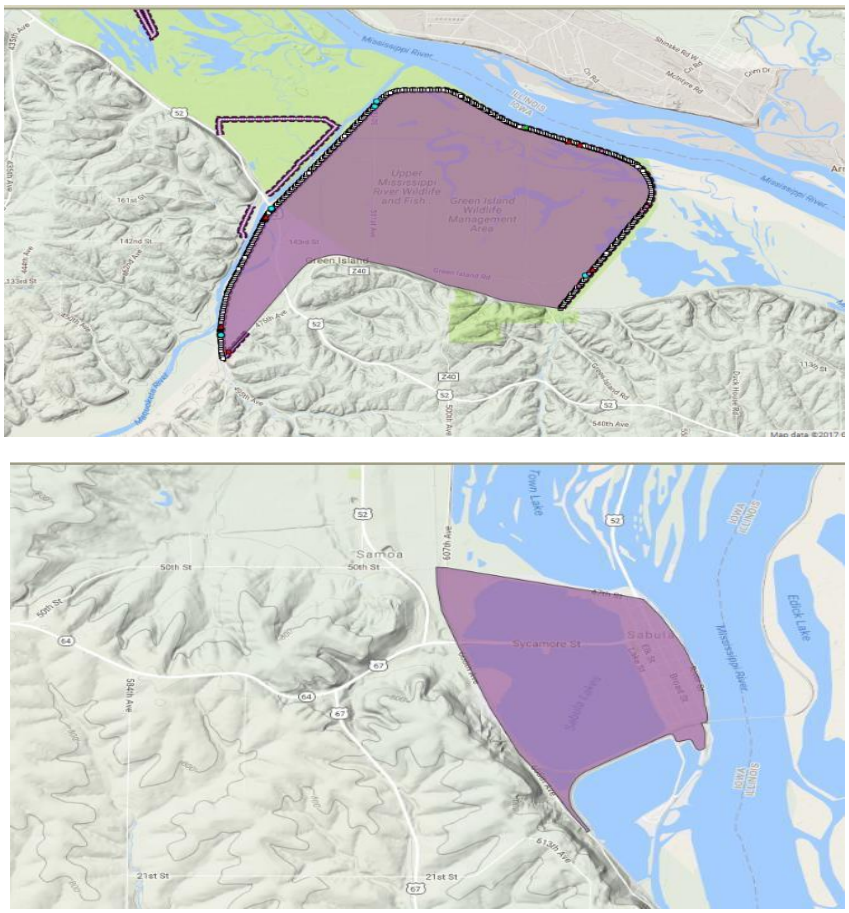


Figure 3.9.
Close-up Images of Green Island Levee and Sabula Levee showing areas of protection

Source: USACE National Levee Database

The City of Maquoketa has an earthen levee that runs along the Maquoketa River. This levee provides an unknown level of protection and has been overtopped in previous flooding. In 2010 when the Lake Delhi Dam upriver from Maquoketa in Delaware County failed, there was also significant flooding in the City of Maquoketa. It is noted that because of the dam being rebuilt at Lake Delhi, there remains risk for the City of Maquoketa since the potential for sudden release of impounded water may occur. On the south side of S. Main Street, between the sewage plant and Hurstville Road, the City extended this earthen levee to prevent back flow.

There also may exist various other agricultural or earthen levees in the planning area. However currently there is no inventory to catalogue these levees nor any inspection requirements.

Previous Occurrences

Dam Failure
To determine previous occurrences of dam failure within Jackson County, the 2013 Jackson County Multi-Jurisdictional Hazard Mitigation Plan, the Iowa State Hazard Mitigation Plan, and the Stanford University's National Performance of Dams Program (https://npdp.stanford.edu/) were reviewed for historical dam failures. No record of dam failure within Jackson County boundaries was found.

Levee Failure
The Green Island levee was breached by floodwaters from the Lake Delhi dam collapse in July 2010. The earthen levee at Green Island is more than 70 miles from Lake Delhi, but suffered the effects of the Maquoketa River flooding when Lake Delhi was drained after the dam breach there.

Probability of Future Occurrence

The flooding of 1993 and again in 2008 was so great that the limits of many levees were tested and sometimes exceeded. Of the 275 USACE levees affected by the 1993 flood, 85% held, of the 15% that failed, 31 overtopped (11 %), eight (8) eroded and ruptured (3%), and three (3) breached (1%). The performance of non-federal levees was much worse: only 43% withstood the trauma, and 800 of 1,400 failed. The rate of failure of a levee or floodwall is difficult to predict with sudden failure a possibility.

Probability Score: 2 - Occasional

Vulnerability Assessment

Vulnerability Overview

Dam or levee failure is typically an additional or secondary impact of another disaster such as flooding or earthquake.

Dam Failure

The Iowa DNR Dam Safety Program maintains a database of dams in the state that meet the thresholds for the National Inventory of Dams. High Hazard and Significant Hazard dams are routinely inspected by the Iowa DNR. In Jackson County, Leisure Lake Dam is a High Hazard dam, and Lake Homestead Dam and Maquoketa Milldam are Significant Hazard dams. On their most recent Iowa DNR inspections, all three dams received a rating of "Satisfactory." This means that "No existing or potential dam safety deficiencies recognized. Safe performance is expected under all anticipated loading conditions, including such events as infrequent hydrologic and/or seismic events." Additional details on the high hazard and significant hazard dams in Jackson County are provided below in **Table 3.19.**

Table 3.19. High Hazard and Significant Hazard Dams in Jackson County

Site	Leisure Lake Dam	Lake Homestead Dam	Maquoketa Milldam
National Inventory No.	IA00522	IA01973	IA01302
Hazard Classification	High	Significant	Significant
Structure Classification	Major	Major	Major
Year Completed	1958	1978	1923
Year Modified	n/a	1980	n/a
Last Inspection	9/27/2022	6/14/2019	9/17/2021
Condition	Satisfactory	Satisfactory	Satisfactory
Dam Height (ft)	58	36	26
Dam Length (ft)	470	580	700
Surface Area (acres)	55.0	33.5	340.0
Normal Storage (acre-ft)	670	419	4,419
Maximum Storage (acre-ft)	2,130	748	4,419
Drainage Area (sq miles)	4.20	0.88	953.00
Volume of Embankment Fill (cy)	108,400	0	0
Dam Owner	Ron Kirchhoff	Wildwood Acres Homeowners Assn	Renewable World Energies
Dam Purpose	Recreation	Recreation	Hydroelectric

Source: Iowa DNR Dam Inventory; http://iowadnr.knack.com/dams, National Inventory of Dams

Additional details also are provided for the federal low hazard dam in the county below:

Lock & Dam No. 12: This dam located on the Mississippi River adjacent to the City of Bellevue. In the event of failure of this low hazard Federal dam, ability to navigate that portion of the Mississippi River could be impacted. This could also impact industrial water intakes and other water intakes if the failure

caused the water level to go below the intake level. According to the Jackson County Emergency Management Agency, the only low-lying area that would be affected by failure of this dam may be a campground located south of the City of Bellevue where there are approximately 30 campsites.

Levee Failure
The USACE regularly inspects levees within its Levee Safety Program to monitor their overall condition, identify deficiencies, verify that needed maintenance is taking place, determine eligibility for federal rehabilitation assistance (in accordance with P.L. 84-99), and provide information about the levees on which the public relies. Inspection information also contributes to risk assessments and supports levee accreditation decisions for the National Flood Insurance Program administered by FEMA. USACE conducts two types of levee inspections:

- *Routine inspection* is a visual inspection to verify and rate levee system operation and maintenance. It is typically conducted each year for all levees in the Levee Safety Program.

- *Periodic inspection* is a comprehensive inspection conducted by a USACE multidisciplinary team that includes the levee sponsor and is led by a professional engineer. USACE typically conducts this inspection every five years on the federally authorized levees in the Levee Safety Program.

Both routine and periodic inspections result in a final inspection rating for operation and maintenance. The rating is based on the levee inspection checklist, which includes 125 specific items dealing with operation and maintenance of levee embankments, floodwalls, interior drainage, pump stations, and channels.

Each levee segment receives an overall segment inspection rating of acceptable, minimally acceptable, or unacceptable. If a levee system comprises one or more levee segments (if there are different levee sponsors for different parts of the levee) then the overall levee system rating is the lowest of the segment ratings. The USACE Levee Inspection Ratings are listed below:

- *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 inspection items are rated as Unacceptable and would prevent the segment/system from performing as intended, or a serious deficiency noted in past inspections (previous Unacceptable items in a Minimally Acceptable overall rating) has not been corrected within the established timeframe, not to exceed two years.

A levee sponsor must maintain the levee to at least the minimally acceptable standard to remain eligible for federal rehabilitation assistance through the USACE Rehabilitation and Inspection Program (PL 84-99). According to the December 2022 “Iowa Statewide Levee Districts Study” by the Iowa HSEMD, the most recent USACE inspection ratings were “Minimally Acceptable“ for the Sabula Levee and “Unacceptable” for the Green Island Levee and Drainage District No. 1.

Magnitude/Severity Score: 2 - Limited

Potential Losses to Existing Development
The jurisdictions that would be impacted in the event of failure of the high hazard or significant hazard dams or levees are discussed below relative to the applicable flood protection structure:

- Leisure Lake Dam (High Hazard) -- There are portions of the unincorporated county downstream of the dam. Fulton, Illinois is also 10 miles downstream of this dam. These areas would be impacted by a dam failure.

- Lake Homestead Dam (Significant Hazard) -- The unincorporated community of Canton is one mile downstream from the dam. There are also portions of the unincorporated county downstream of the dam. These areas would be impacted by a dam failure.

- Maquoketa Milldam (Significant Hazard) – The City of Maquoketa and portions of the unincorporated county downstream of the dam would be impacted by a dam failure.

- Sabula Levee -- A portion of the City of Sabula is in the levee protected area and would therefore be impacted if the levee were to fail.

- Green Island Levee -- The unincorporated county in the Green Island area would be impacted by failure of this levee.

- Maquoketa Earthen Levee -- Portions of the City of Maquoketa would be impacted by failure of this earthen levee. There is no designated protected area for this levee.

Dam Failure
Based on the definition of High Hazard dams, failure of the leisure Lake Dam could create a serious threat of loss of human life or result in serious damage to residential, industrial, or commercial areas, important public utilities, public buildings, or major transportation facilities.

In the 2023 Iowa DNR High Hazard Dam Assessments report, an in-depth evaluation was made of 39 of the 85 state-regulated high hazard dams -- including Leisure Lake Dam. The report assessed the three main potential failure modes (PFMs) per industry standards and FEMA's requirements:

- *Static PFM* refers to the risk of failure during normal operations of the dam. This is also referred to as a sunny-day failure.

- *Hydrologic PFM* refers to the risk of failure during a runoff event. This is also referred to as a rainy-day failure.

- *Seismic PFM* refers to the risk of failure due to seismic activity during normal operations of the dam.

For each category, dams were ranked from highest risk to lowest risk with a 1 being the highest risk and 39 being the lowest risk. The rankings for Leisure Lake Dam were: Static Rank – 3, Hydrologic Rank – 11, Seismic Rank – 2, overall Rank – 3, and Static + Hydrologic Rank – 3.

The report noted that downstream of Leisure Lake Dam are six critical facilities: five bridges and a wastewater treatment facility. The report also noted that Iowa Dam Safety regulations specify that Emergency Action Plans (EAP) are required for existing and future high hazard dams, but that the Leisure Lake Dam does not have an EAP. The report's recommendations for Leisure Lake Dam include maintenance items, preparation of a geotechnical report and an online inundation map, updates to meet design criteria for high hazard dams, and buy-out and removal of downstream property in the breach path. The complete report is available online at https://www.iowadnr.gov/Environmental-Protection/Land-Quality/Dam-Safety.

Based on the definition of Significant Hazard dams, failure of the Lake Homestead Dam or the Maquoketa Milldam may damage isolated homes or cabins, industrial or commercial buildings,

moderately traveled roads or railroads, interrupt major utility services, but without substantial risk of loss of human life. Inundation maps were not available from the Iowa DNR for these dams to determine potential loss estimates or analyze critical facilities and infrastructure at risk to dam failure.

Based on the definition, failure of the nine Low Hazard dams would be limited to loss of the dam, loss of livestock, damages to farm outbuildings, agricultural lands, and lesser used roads, and where loss of human life is considered unlikely. Inundation maps were not available from the Iowa DNR for these dams to determine potential loss estimates or analyze critical facilities and infrastructure at risk to dam failure.

Levee Failure

The most recent USACE inspection rating was “Minimally Acceptable“ for the Sabula Levee, which means that an engineering determination concludes that the Unacceptable inspection items would not prevent the segment/system from performing as intended during the next flood event.

The most recent USACE inspection rating was “Unacceptable” for the Green Island Levee, which means that one or more inspection items are rated as Unacceptable and would prevent the segment/system from performing as intended, or a serious deficiency noted in past Minimally Acceptable inspections has not been corrected within the established timeframe.

For the Sabula and Green Island levees, GIS data was available to identify the levee protected areas. Combined with the parcel data in a GIS format with assessed values, this allowed comparative analysis of these two layers to determine parcels and improvement values by type that fall within the boundaries of the levee protected areas. **Table 3.20.** provides the assets at risk of levee failure.

Table 3.20. Assets at Risk of Levee Failure in Jackson County

Jurisdiction	Property Type	Parcels	Improvements Value	Contents Value	Total Value
Sabula Levee					
City of Sabula	Agricultural land	1	$0	$0	$0
	Residential	318	$22,521,100	$11,260,550	$33,781,650
	Commercial	50	$3,303,768	$3,303,768	$6,607,536
	Industrial	1	$588,000	$882,000	$1,470,000
	Total	**370**	**$26,412,868**	**$15,446,318**	**$41,859,186**
Green Island Levee					
Unincorporated Jackson County	Agricultural dwelling	3	$332,900	$166,450	$499,350
	Agricultural land	118	$16,800	$0	$16,800
	Residential	12	$1,326,500	$663,250	$1,989,750
	Commercial	10	$0	$0	$0
	Total	**143**	**$1,676,200**	**$829,700**	**$2,505,900**
	Grand Total	**513**	**$28,089,068**	**$16,276,018**	**$44,365,086**

According to this analysis, there are $41,859,186 in improvements values and contents values in the area protected by the Sabula Levee and $2,505,900 in improvements values and contents values in the area protected by the Grenn Island Levee.

To determine the potential number of people that might be impacted by levee failure, the average family size of 2.88 persons in Jackson County from the 2022 American Community Survey 5-Year Estimates was multiplied by the number of dwellings in the levee protected area, which is 333. This analysis revealed approximately 959 people living in the levee protection areas; with 916 people in the Sabula Levee protected area and 43 people in the Green Island Levee protected area.

A comparison was made of the critical facilities and the levee protected areas to determine those facilities that could be impacted in the event of levee failure. This analysis revealed 7 critical facilities within levee protected areas.

Future Development
Future development located downstream from dams in floodplains or inundation zones and/or in levee protected areas would increase vulnerability to dam or levee failure.

Green Island Habitat Rehabilitation and Enhancement Project: The USACE and its Upper Mississippi River Restoration Program partners are planning a habitat rehabilitation project in Pool 13 of the Mississippi River near Green Island, Iowa. The project area is a 4,000-acre wetland complex that includes shallow lakes, emergent vegetation, managed moist soil areas, and braided channels surrounded by degrading riparian timber. The project boundaries lie within the Green Island Wildlife Management Area which is managed by the Iowa DNR. The project area also is within the Green Island Levee and Drainage District. However, project features will not affect the levee and drainage district operations.

Climate Change Impacts
Increased frequency of precipitation and precipitation extremes leading to flooding could cause additional stress on dam and levee structures.

Dam and Levee Failure Hazard Summary by Jurisdiction
The magnitude of "catastrophic" is assigned to jurisdictions downstream of the Leisure Lake Dam, a high hazard dam, and the Sabula Levee and Green Island Levee due to the potential for loss of life in the unlikely event of failure of the dam or levees. For jurisdictions downstream of the Lake Homestead Dam and Maquoketa Milldam, rated as significant hazard dams, or other known levee systems, the magnitude was determined to be "limited." For jurisdictions that would be impacted by failure of low hazard dams or no dams, this hazard was determined to be "not applicable."

Jurisdiction	Probability	Magnitude/ Severity	Warning Time	Duration	Weighted Score	Level
Unincorporated	2	4	2	4	2.8	Moderate
Andrew	N/A	N/A	N/A	N/A	N/A	N/A
Baldwin	N/A	N/A	N/A	N/A	N/A	N/A
Bellevue	2	2	2	4	2.2	Moderate
LaMotte	N/A	N/A	N/A	N/A	N/A	N/A
Maquoketa	2	2	2	4	2.2	Moderate
Miles	N/A	N/A	N/A	N/A	N/A	N/A
Monmouth	N/A	N/A	N/A	N/A	N/A	N/A
Preston	N/A	N/A	N/A	N/A	N/A	N/A
Sabula	2	4	2	4	2.8	Moderate
Spragueville	N/A	N/A	N/A	N/A	N/A	N/A
Springbrook	N/A	N/A	N/A	N/A	N/A	N/A
St. Donatus	N/A	N/A	N/A	N/A	N/A	N/A
Andrew CSD	N/A	N/A	N/A	N/A	N/A	N/A
Bellevue CSD	N/A	N/A	N/A	N/A	N/A	N/A
Easton Valley CSD	N/A	N/A	N/A	N/A	N/A	N/A
Maquoketa CSD	N/A	N/A	N/A	N/A	N/A	N/A

3.5.2. Drought

Hazard Score Calculation					
Probability	**Magnitude/Severity**	**Warning Time**	**Duration**	**Weighted Score**	**Level**
3	**2**	**1**	**4**	**2.5**	**Moderate**

Hazard Profile

Hazard Description

Drought is generally defined as a condition of moisture levels significantly below normal for an extended period of time over a large area that adversely affects plants, animal life, and humans. There are four types of drought conditions relevant to Iowa:

Meteorological drought is defined on the basis of the degree of dryness (in comparison to some "normal" or average amount) and the duration of the dry period. A meteorological drought must be considered as region-specific since the atmospheric conditions that result in deficiencies of precipitation are highly variable from region to region.

Hydrological drought is associated with the effects of periods of precipitation (including snowfall) shortfalls on surface or subsurface water supply (e.g., streamflow, reservoir and lake levels, ground water). The frequency and severity of hydrological drought is often defined on a watershed or river basin scale. Although all droughts originate with a deficiency of precipitation, hydrologists are more concerned with how this deficiency plays out through the hydrologic system. Hydrological droughts are usually out of phase with or lag the occurrence of meteorological and agricultural droughts. It takes longer for precipitation deficiencies to show up in components of the hydrological system such as soil moisture, streamflow, and ground water and reservoir levels. As a result, these impacts are out of phase with impacts in other economic sectors.

Agricultural drought focus is on soil moisture deficiencies, differences between actual and potential evaporation, reduced ground water or reservoir levels, and so forth. Plant water demand depends on prevailing weather conditions, biological characteristics of the specific plant, its stage of growth, and the physical and biological properties of the soil.

Socioeconomic drought refers to when physical water shortage begins to affect people.

The four different types of drought conditions can all occur in Iowa. A meteorological drought is the easiest to determine based on rainfall data and is an easier drought to monitor from rain gauges and reports. A hydrological drought means that stream and river levels are low, which also has an impact for surface water and ground water irrigators. In addition, in-stream discharges that fall below a pre-required level also place the State in regulatory difficulty with U.S. Fish and Wildlife and with neighboring states over cross-border flowage rights. An agricultural drought represents difficulty for Iowa's agricultural-based economy and is also relatively easy to monitor based on crop viabilities for different regions.

The National Drought Mitigation Center (NDMC) located at the University of Nebraska in Lincoln provides a clearinghouse for information on the effects of drought, based on reports from media, observers and other sources. NDMC's website is found at http://www.drought.unl.edu/. Specific drought impacts by county are recorded at http://droughtreporter.unl.edu/.

The NDMC categorizes impacts of drought as economic, environmental, or social. Many economic impacts occur in agriculture and related sectors, including forestry and fisheries, because of the reliance of these sectors on surface and subsurface water supplies. In addition to obvious losses in yields in both crop and livestock production, drought is associated with increases in insect infestations, plant disease and wind erosion. Droughts also bring increased problems with insects and disease to forests and reduce growth. The incidence of forest and range fires increases substantially during extended droughts, which in

turn places both human and wildlife populations at higher levels of risk. Income loss is another indicator used in assessing the impacts of drought because so many sectors are affected.

Although drought is not predictable, long-range outlooks may indicate an increased chance of drought, which can serve as a warning. A drought period can last for months, years, or even decades. It is rarely a direct cause of death, though the associated heat, dust and stress can all contribute to increased mortality.

Warning Time Score: 1 – More than 24 hours warning time

Duration: 4 - More than one week

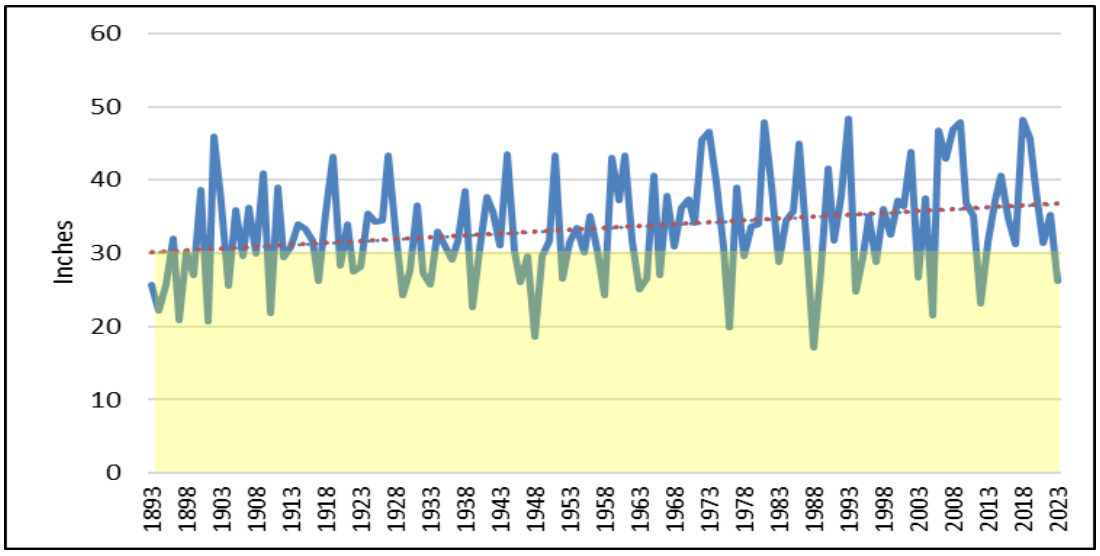
Geographic Location/Extent

According to the 2022 Census of Agriculture, of the 636 square miles (407,040 acres) of land area in Jackson County, 72 percent (292,239 acres) is utilized for agricultural purposes. There were 1,131 farms with an average size of 258 acres per farm. Although the entire planning area in Jackson County is at risk to drought, the agricultural areas are more vulnerable to the immediate effects of drought. The map in **Figure 3.55** in the Animal/Plant/Crop Disease **Section 3.5.11.** displays the locations of various cropland uses in Jackson County.

Previous Occurrences

According to the Iowa Environmental Mesonet, using the weather station in Maquoketa, the mean annual precipitation for Jackson County from 1893 to 2023 is 33.18 inches. This calculation uses monthly liquid precipitation totals in inches (snow is melted). In average years, this represents enough rainfall to prevent drought; however, successive years of below-average rainfall are the cause of drought impacts in the planning area. **Figure 3.10.** charts the annual liquid precipitation at the Maquoketa weather station from 1893 to 2023. The yellow box represents years in which annual liquid precipitation was less than 30 inches. The lowest annual precipitation on record occurred in 1988 with 16.98 inches.

Figure 3.10. Annual Liquid Precipitation in Jackson County, 1893 - 2023



Source: Iowa Environmental Mesonet, https://mesonet.agron.iastate.edu/climodat/

The U.S. Drought Monitor (USDM) identifies areas in drought and labels them by intensity. The USDM uses four categories of drought, from D1—the least intense—to D4, the most. It also highlights areas with no drought and uses the D0 category to indicate abnormally dry areas that could be entering or recovering from drought (see **Table 3.21.**).

Table 3.21. US Drought Monitor Descriptions of Drought Categories

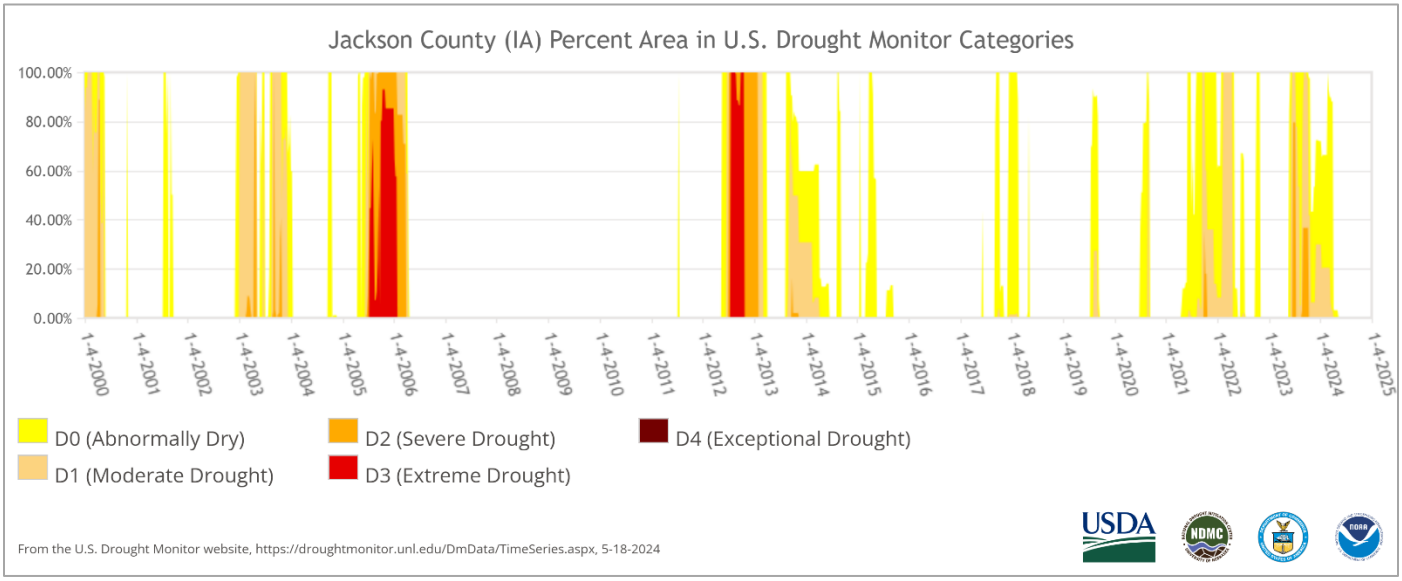
Category	Description	Example Percentile Range for Most Indicators	Values for Standard Precipitation Index and Standardized Precipitation-Evapotranspiration Index
None	Normal or wet conditions	30.01 or Above	-0.49 or above
D0	Abnormally Dry	20.01 to 30.00	-0.5 to -0.79
D1	Moderate Drought	10.01 to 20.00	-0.8 to -1.29
D2	Severe Drought	5.01 to 10.00	-1.3 to -1.59
D3	Extreme Drought	2.01 to 5.00	-1.6 to -1.99
D4	Exceptional Drought	0.00 to 2.00	-2.0 or less

Source: U.S. Drought Monitor, https://droughtmonitor.unl.edu/About/AbouttheData/DroughtClassification.aspx

The US Drought Monitor differentiates between short- and long-term drought. Short-term drought, typically less than 6 months, can have impacts on agriculture and grasslands, and the drought classification can rapidly change. Long-term drought, typically more than 6 months, has deeper impacts on hydrology and ecology and can persist even with short-term gains in precipitation. An area may contain both short- and long-term impacts.

Figure 3.11. shows the percent area of Jackson County in U.S. Drought Monitor Categories from 2000 to 2024. Drought conditions reached D3 (Extreme Drought) in 2005 and 2012.

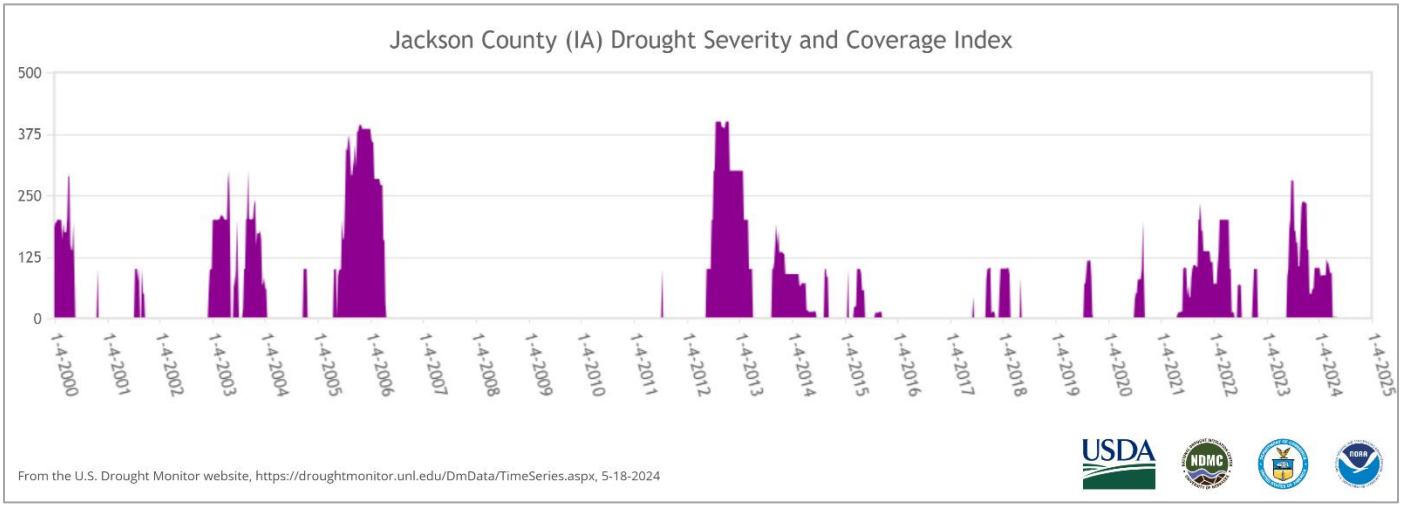
Figure 3.11. US Drought Monitor Categories for Jackson County, 2000-2024



Source: USDM, https://droughtmonitor.unl.edu/DmData/TimeSeries.aspx accessed 5-18-2024

USDM also provides data on the Drought Severity and Coverage Index (DSCI). The DSCI is a convenient, experimental method for converting categorical USDM data into a single continuous variable for each area of interest. Possible values of the DSCI are from 0 to 500. Zero means that none of the area is abnormally dry or in drought, and 500 means that all of the area is in D4, exceptional drought. **Figure 3.12.** shows Jackson County's Drought Severity and Coverage Index for 2000 to 2024.

Figure 3.12. Drought Severity and Coverage Index for Jackson County, 2000-2024



Source: USDM, https://droughtmonitor.unl.edu/DmData/TimeSeries.aspx accessed 5-18-2024

Since 2012, four USDA Secretarial disaster declarations that included Jackson County were issued for Drought – Fast Track: two in 2012 and two in 2023.

- Declaration S3310 began on 7/24/2012 for Drought-Fast Track with these hazards identified: Drought; Wind, High Winds; Fire, Wildfire; High Temperature (including Low Humidity); and Insects.
- Declaration S3311 began on 7/24/2012 for Drought-Fast Track with these hazards identified: Flood, Flash Flooding; and Excessive Rain, Moisture, Humidity.
- Declaration S5514 began on 8/29/2023 for Drought-Fast Track with this hazard identified: Drought.
- Declaration S5530 began on 9/5/2023 for Drought-Fast Track with this hazard identified: Drought.

Table 3.22. summarizes the historical drought conditions for Jackson County by intensity and percent area with annual averages from 2014 through 2023, and a ten-year average, for each drought category.

Table 3.22. Historic Drought Intensity (Percent Area) for Jackson County, 2014-2023

Drought Intensity	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	10-Year Average
None	73.93	82.36	100.00	84.20	83.20	87.10	85.66	45.25	53.74	47.98	74.34
D0 Abnormally Dry	26.07	17.64	0.00	15.80	16.80	12.90	14.34	54.75	46.26	52.03	25.66
D1 Moderate	5.18	0.00	0.00	0.19	0.20	2.13	1.91	14.51	20.73	31.52	7.64
D2 Severe	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.38	0.00	8.89	1.03
D3 Extreme	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00
D4 Exceptional	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Source: USDM, https://droughtmonitor.unl.edu/DmData/DataDownload/ComprehensiveStatistics.aspx accessed 5-18-2024

According to the USDA's Risk Management Agency, payments for insured crop losses in Jackson County as a result of drought conditions occurred in all ten years from 2014 to 2023 and totaled

$1,769,546.37 (see **Table 3.23.**). With the extensive drought conditions during 2023, 67% percent of the 10-year crop losses came from this year.

Table 3.23. Crop Insurance Claims Paid for Drought

Year	Insurance Paid
2014	$283,217.18
2015	$222.00
2016	$1,259.48
2017	$14,168.28
2018	$5,795.50
2019	$5,593.23
2020	$140,087.30
2021	$89,860.00
2022	$36,131.50
2023	$1,193,211.90
Grand Total Insurance Paid	**$1,769,546.37**

Source: USDA's Risk Management Agency

Potential Losses to Existing Development

Areas associated with agricultural use are vulnerable to drought conditions which could result in a decrease in crop production or a decrease in available grazing area for livestock. Drought has no real effect on houses and buildings. The impacts would be minimal in terms of landscaping. Rationing water supplies would most likely be the worst-case scenario impact.

According to the ten-year period from USDA's Risk Management Agency, the amount of claims paid for crop damage as a result of drought in Jackson County was $1,769,546.37. According to the 2015 Iowa Crop Insurance Profile from USDA's Risk Management Agency, 89 percent of the insurable crops in Iowa are insured with USDA Crop Insurance. To factor in estimated losses to insurable crops that are not insured, the 89 percent crop insurance coverage was factored in to provide an adjusted estimate of losses. According to this calculation, estimated annualized losses total $6,442,028.66 (see **Table 3.24.**).

Considering the value of crops from the 2022 Census of Agriculture as baseline crop exposure, the estimated annual losses from drought was determined minimal compared to the value of the insurable crops.

Table 3.24. Estimated Insurable Annual Crops Lost Resulting from Drought

10-Year Insurance Paid	Adjusted 10-Year Losses (considering 89% insured)	Estimated Annualized Losses	2022 Value of Crops	Annualized Crop Loss Ratio (Losses/Value)
$1,769,546.37	$64,420,286.65	$6,442,028.66	$176,285,000.00	3.65%

Source: U.S. Agriculture Department

Probability of Future Occurrence

NOAA's National Climatic Data Center (NCDC) uses the U.S. Palmer Drought Indices and the Standardized Precipitation Index to monitor and predict drought conditions. Lack of precipitation for a given area is the primary contributor to drought conditions. Since precipitation levels cannot be predicted in the long term, the following indices can be used to determine the probability of future occurrences of drought.

The following are the indices:

- **Palmer Z Index** monitors short-term monthly moisture conditions when depart from normal,
- **Palmer Drought Severity Index** measures the duration and intensity of the long-term (meteorological) drought patterns,
- **Palmer Hydrological Drought Index** measures long-term (hydrological) drought and wet conditions reflecting groundwater and reservoir levels.
- **Standardized Precipitation Index** is a probability index that considers only precipitation. This is important to farmers to estimate soil moisture.

In the past 10 years, there have been eight years with crop insurance claims as a result of drought in Jackson County. If this trend continues, this results in a probability of 80% of agricultural impacts as a result of drought in any given year. The probability rating for this hazard is "Likely."

Probability Score: 3 - Likely

Vulnerability Assessment

Vulnerability Overview

Jackson County jurisdictions are impacted by drought because it is an expensive weather disaster; it reduces agricultural productivity and causes a strain on urban water supplies. In Jackson County, farmers bear the most direct stress from drought as wells may run dry; crops wilt and die, and forage for livestock becomes scarce and costly.

According to the 2022 Census of Agriculture, Jackson County has 1,131 farms in the County that cover 292,239 acres of land. This translates to 70 percent of the 416,000 acres of land in the County being used for agriculture. Therefore, the planned area has a high exposure to this hazard. Aside from agricultural impacts, other losses related to drought include increased costs of fire suppression and damage to roads and structural foundations due to the shrink dynamic of expansive soils during excessively dry conditions. Drought also presents hazards to public health in extreme cases, where drinking water production cannot keep up with demand. Water wells become less productive during drought and a failure of remaining productive wells (due to power outage, etc.) can cause public drinking water supplies to become compromised.

According to the *2013 Iowa Hazard Mitigation Plan*, of the 8 hazards for which data was available to estimate annualized losses, drought ranked 2nd with $424 million in annualized losses based on data spanning an 18-year period. Losses associated with this hazard can be very high, particularly associated with agriculture. Crop insurance coverage mitigates the adverse economic impacts somewhat.

Magnitude/Severity Score: 2 - Limited

Future Development

Increases in acreage planted with crops would increase the exposure to drought-related agricultural losses. In addition, increases in population add additional strain on water supply systems to meet the growing demand for treated water.

Climate Change Impacts

For the most part, climate change studies have shown increases in precipitation, rather than decreases. However, drought cycles still continue. Climate change studies have also shown some increases in average temperatures. If this occurs during a drought cycle, the drought impacts will be exacerbated and increased agricultural losses will be sustained.

Drought Hazard Summary by Jurisdiction

As discussed in the drought previous occurrences and vulnerability sections, the majority of the damages seen historically as a result of drought are to crops and other agriculture-related activities. Therefore, the magnitude of the impacts is greater in the unincorporated areas. In the cities, the frequency of drought conditions would be the same, but the magnitude would be less with lawns and local gardens affected and leading to expansive soil problems around foundations. If drought conditions are severe and prolonged, water supplies could also be affected.

Jurisdiction	Probability	Magnitude/ Severity	Warning Time	Duration	Weighted Score	Level
Unincorporated	3	2	1	4	2.5	Moderate
Andrew	3	1	1	4	2.2	Moderate
Baldwin	3	1	1	4	2.2	Moderate
Bellevue	3	1	1	4	2.2	Moderate
LaMotte	3	1	1	4	2.2	Moderate
Maquoketa	3	1	1	4	2.2	Moderate
Miles	3	1	1	4	2.2	Moderate
Monmouth	3	1	1	4	2.2	Moderate
Preston	3	1	1	4	2.2	Moderate
Sabula	3	1	1	4	2.2	Moderate
Spragueville	3	1	1	4	2.2	Moderate
Springbrook	3	1	1	4	2.2	Moderate
St. Donatus	3	1	1	4	2.2	Moderate
Andrew CSD	3	1	1	4	2.2	Moderate
Bellevue CSD	3	1	1	4	2.2	Moderate
Easton Valley CSD	3	1	1	4	2.2	Moderate
Maquoketa CSD	3	1	1	4	2.2	Moderate

3.5.3. Excessive Heat

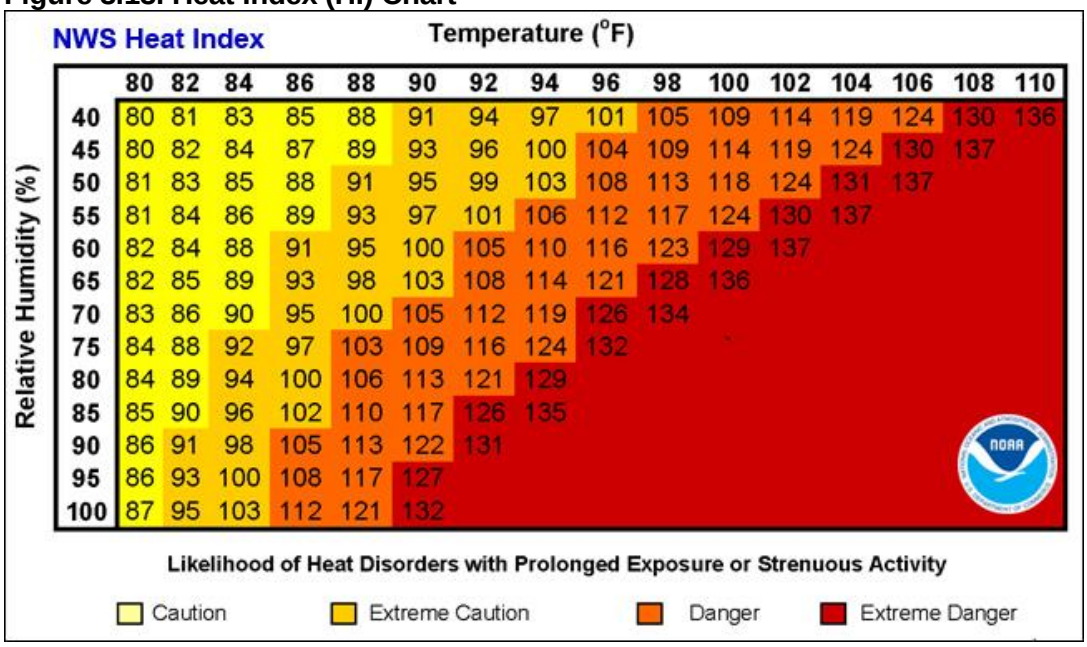
Hazard Score Calculation					
Probability	**Magnitude/Severity**	**Warning Time**	**Duration**	**Weighted Score**	**Level**
3	**2**	**1**	**3**	**2.4**	**Moderate**

Hazard Profile

Hazard Description

According to information provided by FEMA, Excessive Heat is defined as temperatures that hover 10 degrees or more above the average high temperature for the region and last for several weeks. Ambient air temperature is one component of heat conditions, with relative humidity being the other. The relationship of these factors creates what is known as the apparent temperature. The Heat Index Chart in **Figure 3.13.** uses both of these factors to produce a guide for the apparent temperature or relative intensity of heat conditions.

Figure 3.13. Heat Index (HI) Chart



Source: National Weather Service

During these conditions, the human body has difficulties cooling through the normal method of the evaporation of perspiration. Health risks rise when a person is over exposed to heat. The most dangerous place to be is in a permanent home, with little or no air conditioning. Those at greatest risk for heat-related illness include people 65 years of age and older, people who are overweight, and people who are ill or on certain medications. However, even young and healthy individuals are susceptible if they participate in strenuous physical activities during hot weather. In agricultural areas, the exposure of farm workers, as well as livestock, to excessive heat is a major concern. **Table 3.25.** lists typical symptoms and health impacts of exposure to excessive heat.

Table 3.25. Typical Health Impacts of Excessive Heat

Heat Index	Disorder
80-90° F	Fatigue possible with prolonged exposure and/or physical activity
90-105° F	Sunstroke, heat cramps, heat exhaustion possible with prolonged exposure and/or physical activity
105-130° F	Heatstroke/sunstroke highly likely with continued exposure

The National Weather Service has a system in place to initiate alert procedures (advisories or

warnings) when the Heat Index is expected to have a significant impact on public safety. The expected severity of the heat determines whether advisories or warnings are issued. A common guideline for issuing excessive heat alerts is when the maximum daytime Heat Index is expected to equal or exceed 105 degrees Fahrenheit (°F) and the nighttime minimum Heat Index is 80°F or above for two or more consecutive days. A heat advisory is issued when temperatures reach 105 degrees, and a warning is issued at 115 degrees.

Warning Time Score: 1 - More than 24 hours warning time

Duration Score: 3 - Less than one week

Geographic Location/Extent
The entire planning area is subject to excessive heat and all participating jurisdictions are affected.

Previous Occurrences
The National Climatic Data Center (NCDC) Storm Data are geographically categorized by County or by NWS Forecast Zone. Smaller (areal coverage) are collected by county (Tornado, Thunderstorm Winds, Flash Floods and Hail) while larger scale events are collected by forecast zone (Heat, Cold, Drought, Flood, Tropical & Winter Weather). (Source: https://www.ncdc.noaa.gov/stormevents)

According to the US Department of Health and Human Services, excessive summer heat is already increasing in the U.S. and climate projections indicate that excessive heat events will become more frequent and intense in coming decades. Heat-related deaths have been increasing in the U.S., with approximately 1,602 occurring in 2021, 1,722 in 2022, and 2,302 in 2023.

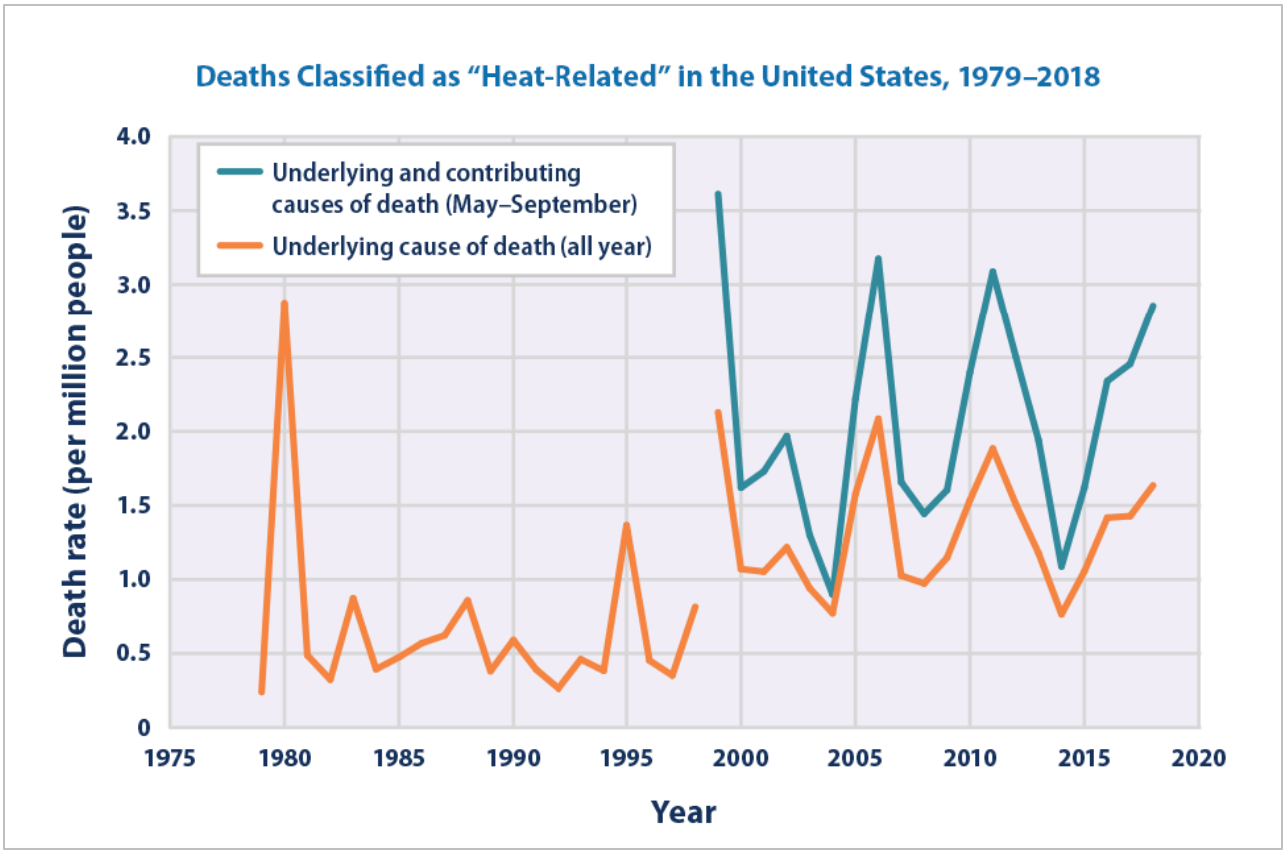
According to the NCDC Storm Events Data base, between 1993 and 2023, one Excessive Heat event was reported in 2012 and 3 Heat events were reported in 1997, 1999, and 2013 for the NWS Jackson County Zone. There were no reported deaths, injuries, or property damages.

According to the National Weather Service, only one heat-related death has been reported for Iowa between 2014-2023. In 2019, one person died in Iowa as a result of excessive heat. The previous death due to excessive heat in Iowa occurred in 2006. In 2023, there were 207 deaths nationally due to excessive heat. The ten-year average from 2014-2023 nationally is 188 deaths, and the 30-year average is 183 deaths. (Source: http://www.nws.noaa.gov/om/hazstats.shtml).

On average, the hottest months of the year are July and August. According to the High Plains Regional Climate Center, the average temperature in Jackson County for the month of July is 72.84 degrees Fahrenheit (ºF) with an average maximum temperature of 83.45 ºF; and the average temperature for the month of August is 70.91 ºF with an average maximum temperature of 81.65 ºF. (Source: http://www.hprcc.unl.edu/datasets.php?set=CountyData#)

Figure 3.14. shows the annual rates for deaths classified as “heat-related” by medical professionals in the 50 states and the District of Columbia. The orange line shows deaths for which heat was listed as the main (underlying) cause. The blue line shows deaths for which heat was listed as either the underlying or contributing cause of death during the months from May to September.

Figure 3.14. Heat-Related Deaths in the U.S., 1979-2018

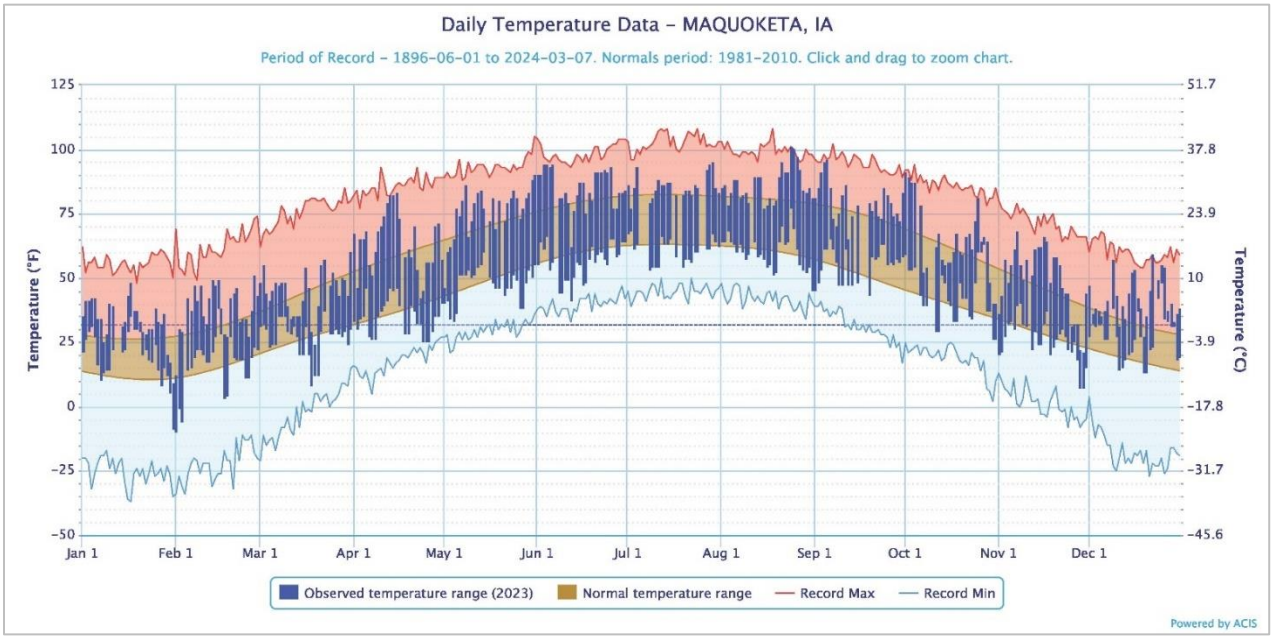


Source: https://www.epa.gov/climate-indicators/climate-change-indicators-heat-related-deaths

At the Maquoketa, Iowa weather station from 1993 to 2024, there were 29 days with temperatures 95 degrees Fahrenheit or above (at least 10 degrees above normal). When looking at only those events with a high temperature of 95 degrees Fahrenheit and higher that lasted for 3 consecutive days or more, there were two occurrences during the 24-year period from 1993 to 2016.

Figure 3.15. provides daily temperature data for Maquoketa from 1896 to 2023 from the High Plains Regional Climate Center. The graph also includes the observed temperature range for 2023, the temperature range for the normal period: 1981-2010, and the extremes for the Maquoketa, Iowa weather station for the period.

Figure 3.15. Daily Temperature Averages and Extremes, Maquoketa, Iowa, 1896 – 2024



According to the USDA's Risk Management Agency, the amount of claims paid for crop damage as a result of excessive heat in Jackson County from 2016-2023 was $59,783.14 (see **Table 3.26.**).

Table 3.26. Claims Paid in Jackson County for Crop Loss as a Result of Heat, 2016-2023

Year	Insurance Paid
2016	$9,445.24
2020	$8,863.90
2021	$18,253.00
2022	$4,299.00
2023	$18,922.00
Grand Total Insurance Paid	**$59,783.14**

Source: USDA's Risk Management Agency

Probability of Future Occurrence

The frequency of claims paid in Jackson County for crop damage as a result of excessive heat in 5 of 7 years from 2016 to 2023 is 71%. This translates to a probability rating of "Likely."

Probability Score: 3 – Likely

Vulnerability Assessment

Vulnerability Overview

Those at greatest risk for heat-related illness and deaths include people 65 years of age and older, people who are overweight, and people who are ill or on certain medications. To determine jurisdictions within the planning area with populations that may be more vulnerable to excessive heat, demographic data was obtained from the U.S. Census Bureau on numbers of people in each jurisdiction that are over the age of 65 are seen in **Table 3.27.** Data was not available for overweight individuals and those on certain medications.

Table 3.27. Jackson County Population 65 years and Over, 2020

Jurisdiction	Total Population	# 65 years and over	% 65 years and over
Jackson, Unincorporated	19,485	4,283	22%
Andrew	380	42	11.1%
Baldwin	99	24	24.2%
Bellevue	2363	581	24.6%
La Motte	237	46	19.4%
Maquoketa	6,128	1,284	21%
Miles	408	80	19.6%
Monmouth	129	28	21.7%
Preston	949	203	21.4%
Sabula	506	144	28.5%
St. Donatus	120	34	28.3%
Spragueville	92	17	18.5%
Springbrook	143	38	26.6%

Source: 2020 Decennial Census

Overall, Iowans are older than the country as a whole. About 15 percent of its population is over 65 years, compared with 13 percent nationally. Jackson County's population over 65 years is higher than the national and state average at 22 percent. The participating jurisdictions with a higher percentage of adults 65 and over than the county average of 22% are, in descending order, the cities of Sabula, St. Donatus, Springbrook, Bellevue, and Baldwin.

Potential Losses to Existing Development

According to the ten-year period from USDA's Risk Management Agency, the amount of claims paid for crop damages as a result of heat was $73,811.14. According to the 2015 Iowa Crop Insurance Profile Report issued by the USDA's Risk Management Agency, 89 percent of Iowa insurable crops were insured. To factor in estimated losses to insurable crops that are not insured, the 89 percent of crop insurance coverage was factored in to provide an adjusted estimate of losses. According to this calculation, estimated annualized losses total $73,811.14 (see **Table 3.28.**).

Considering the value of crops from the 2022 Census of Agriculture as baseline crop exposure, the estimated annual losses from heat was determined to be minimal (0.21%) compared to the value of the insurable crops.

Table 3.28. Estimated Insurable Annual Crops Lost Resulting from Heat

10-Year Insurance Paid	Adjusted 10-Year Losses (considering 89% insured)	Estimated Annualized Losses	2022 Value of Crops	Annualized Crop Loss Ratio (Losses/Value)
$73,811.14	$738,111.43	$73,811.14	$176,285,000.00	0.04%

Excessive heat can also cause a strain on electricity delivery infrastructure which can be overloaded during peak use of electricity to power air conditioning during excessive heat events. Another type of infrastructure damage that can occur as a result of excessive heat is road damage. When asphalt is exposed to prolonged excessive heat, it can cause buckling of asphalt- paved roads, driveways, and parking lots.

Future Development

Since Jackson County is not experiencing large population growth, the number of people vulnerable to

excessive heat is not increasing.

Climate Change Impacts

The following climate change impacts relative to Excessive Heat were included in the *2010 Climate Change Impacts on Iowa* report developed by the Iowa Climate Change Impacts Committee.

- Nighttime temperatures have increased more than daytime temperatures since 1970.
- Iowa's humidity has risen substantially, especially in summer, which now has 13 percent more atmospheric moisture than 35 years ago as indicated by a 3-to-5-degree F rise in dew- point temperature. This fuels convective thunderstorms that provide more summer precipitation.

Both of these impacts could increase the number excessive heat events in the planning area as well as the potential for negative impacts on people and agriculture.

Excessive Heat Hazard Summary by Jurisdiction

Excessive heat is a regional hazard and impacts all jurisdictions in the planning area.

Jurisdiction	Probability	Magnitude/ Severity	Warning Time	Duration	Weighted Score	Level
Unincorporated	3	2	1	3	2.4	Moderate
Andrew	3	2	1	3	2.4	Moderate
Baldwin	3	2	1	3	2.4	Moderate
Bellevue	3	2	1	3	2.4	Moderate
LaMotte	3	2	1	3	2.4	Moderate
Maquoketa	3	2	1	3	2.4	Moderate
Miles	3	2	1	3	2.4	Moderate
Monmouth	3	2	1	3	2.4	Moderate
Preston	3	2	1	3	2.4	Moderate
Sabula	3	2	1	3	2.4	Moderate
Spragueville	3	2	1	3	2.4	Moderate
Springbrook	3	2	1	3	2.4	Moderate
St. Donatus	3	2	1	3	2.4	Moderate
Andrew CSD	3	2	1	3	2.4	Moderate
Bellevue CSD	3	2	1	3	2.4	Moderate
Easton Valley CSD	3	2	1	3	2.4	Moderate
Maquoketa CSD	3	2	1	3	2.4	Moderate

3.5.4. Flooding -- Flash

Hazard Score Calculation					
Probability	**Magnitude/Severity**	**Warning Time**	**Duration**	**Weighted Score**	**Level**
2	**2**	**3**	**2**	**2.15**	**Moderate**

Hazard Profile

Hazard Description

A flash flood is an event that occurs when water levels rise at an extremely fast rate as a result of intense rainfall over a brief period, sometimes combined with rapid snowmelt, ice jam release, frozen ground, saturated soil or impermeable surfaces.

Ice jam flooding is a form of flash flooding that occurs when ice breaks up in moving waterways, and then stacks on itself where channels narrow. This creates a natural dam, often causing flooding within minutes of the dam formation.

River Flooding is discussed separately in **Section 3.5.5** and flooding caused by dam and levee failure is discussed in **Section 3.5.1**.

Most flash flooding is caused by slow-moving thunderstorms or thunderstorms repeatedly moving over the same area. Flash flooding is an extremely dangerous form of flooding which can reach full peak in only a few minutes and allows little or no time for protective measures to be taken by those in its path. Flash flood waters move at very fast speeds and can move boulders, tear out trees, scour channels, destroy buildings, and obliterate bridges. Flash flooding often results in higher loss of life, both human and animal, than slower developing river and stream 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 outstrips the ability of the drainage infrastructure to properly carry and disburse the water flow.

In certain areas, aging storm sewer systems are not designed to carry the capacity currently needed to handle the increased storm runoff. Typically, the result is water backing into basements, which damages mechanical systems and can create serious public health and safety concerns. This combined with rainfall trends and rainfall extremes all demonstrate the high probability, yet generally unpredictable nature of flash flooding in the planning area.

Although flash floods are somewhat unpredictable, there are factors that can point to the likelihood of flash floods occurring. Weather surveillance radar is being used to improve monitoring capabilities of intense rainfall. This, along with knowledge of the watershed characteristics, modeling techniques, monitoring, and advanced warning systems increases the warning time for flash floods.

Warning Time Score: 3 - 6 to 12 hours warning time. This refers to the period of time prior to the event with heightened awareness that a flash flood could occur, not the issuance of a “flash flood warning” by the National Weather Service.

Duration Score: 2 - Less than 1 day

Geographic Location/Extent
Jackson County is mainly on well dissected uplands. The landscape in all areas, except for the stream terraces and bottom land along the Mississippi River, is gently rolling to very steep. The landscape along the Mississippi and Maquoketa Rivers and their tributaries commonly is very steep and rugged. Limestone bedrock bluffs are common between the bottom land and the upland ridges.

Less rugged areas are in the southern part of the county near miles and south and west of Maquoketa. These areas are characterized by lower relief, fewer limestone outcrops, and undulating or gently rolling topography. The major bottom land region is along the Mississippi River, near Green Island. This area is characterized by nearly level slopes, sloughs, old river channels, and backwater lakes.

Approximately 75-percent of Jackson County is drained by the Maquoketa River and its tributaries. This river enters the county near the town of Canton and flows in a southeasterly direction until it reaches the town of Maquoketa. In an area directly north of this town, it is joined by the North Fork of the Maquoketa River. From this area, the Maquoketa River flows in an easterly direction until it reaches Spragueville. From Spragueville, it flows in a northeasterly direction and eventually empties into the Mississippi River directly north of Green Island.

Flash flooding occurs in those locations of the planning area that are low-lying and/or do not have adequate drainage to carry away the amount of water that falls during intense rainfall events. According to the National Climatic Data Center (NCDC) and specific reports from planning committee members, the following locations have a history of flash flooding events:

- *Unincorporated County*
  - Bridge on 308th Street between Sieverding Ridge Road and U.S. 52
  - 370th Street
  - Spruce Creek Park
  - Highway 52 just south of Green Island

- *City of Maquoketa*
  - South Fifth and Washington streets
  - Eddy and South Vermont streets
  - 200th Avenue and Family Dollar Parkway
  - Horseshoe Pond Park

- *City of Bellevue*
  - Highway 52 near Pleasant Creek
  - Second Avenue and Park Street

The National Weather Service has various flash flooding products that are issued to the public to provide information regarding upcoming and current flash flood threats (see **Table 3.29.**).

Table 3.29. National Weather Service Flash Flooding Products

Product	What It Means	You Should...
Hazardous Weather Outlook	Will there be any threat of flash flooding in the next several days?	If there is a threat of flash flooding, check back later for updated forecasts and possible watches and warnings. Latest Hazardous Weather Outlook

Flash Flood Watch	There is a threat of flash flooding within the next 48 hours, either as a result of heavy rain, ice jams, or the threat of a dam break.	Monitor weather conditions closely, especially if you live in an area prone to flash flooding.
Flash Flood Warning	There is an immediate threat for flash flooding in the warned area, especially in low-lying and poor drainage areas. These warnings are updated frequently with Flash Flood Statements.	If you live in an area susceptible to flash flooding, be prepared to evacuate and head to higher ground. Be very cautious when driving in the warned area, especially at night or while it is still raining. You may not be able to see a flooded road until it is too late!
Flash Flood Emergency	A *Flash Flood Emergency* may be declared when a severe threat to human life and catastrophic damage from a flash flood is imminent or ongoing. The declaration of a Flash Flood Emergency would typically be found in either a Flash Flood Warning or Flash Flood Statement.	People are strongly encouraged to avoid the geographic area of concern in a Flash Flood Emergency. The Flash Flood Emergency wording is used very rarely and is reserved for exceptionally rare and hazardous events.
Areal Flood Warning	The threat of flash flooding is over, but there is still significant standing water in the affected area.	Areal flood warnings will typically list locations and roads impacted by the flooding. Try to avoid these locations until the water has receded.

Source: National Weather Service

Previous Occurrences

Table 3.30. provides details regarding the flashflood and areal flood watches and warnings issued for Jackson County and the Jackson County forecast zone by National Weather Service. Areal flooding is a type of flash flooding that is generally over a large area usually due to the amount and duration of rainfall.

Table 3.30. Flash Flood-Related Advisories, Watches and Warnings, 1986-2023

Flood Type	Areal Flood				Flash Flood			
Product Issues	Advisory	Warning	Watch	Total	Advisory	Warning	Watch	Total
1986						4		**4**
1987						1		**1**
1990						2		**2**
1991						1		**1**
1993						12		**12**
1995						1		**1**
1997						2		**2**
1998						5		**5**
2000						1		**1**
2001						3		**3**
2004						1		**1**
2007			4	**4**		2	9	**11**
2008	7	11	2	**20**		10	15	**25**
2009	5		1	**6**		1	3	**4**

Table 3.30. Flash Flood-Related Advisories, Watches and Warnings, 1986-2023

Flood Type	Areal Flood				Flash Flood			
Product Issues	Advisory	Warning	Watch	Total	Advisory	Warning	Watch	Total
2010	6	3		**9**		11	21	**32**
2011						3	5	**8**
2012						1	1	**2**
2013		1		**1**		2	6	**8**
2014		2		**2**		4	7	**11**
2015		1	1	**2**		2	8	**10**
2016						1	4	**5**
2017		1		**1**			2	**2**
2018		1	1	**2**			10	**10**
2019			1	**1**			10	**10**
2020							4	**4**
2021							1	**1**
2022			2	**2**				
2023								
Total	**18**	**20**	**12**	**50**	**0**	**70**	**106**	**176**

Source: Iowa State University Department of Agronomy

As discussed in the Description Section, flash flooding can be caused by intense rainfall over a brief period. **Table 3.31.** provides the top 30 rainfall events at the Maquoketa Climate Station from 1893- 2023.

Table 3.31. Top 30 Rainfall Events in Jackson County, 1893-2023

Date	Amount (Inches)	Date	Amount (Inches)
1981-08-30	6.93	1949-06-14	3.57
1961-09-13	4.99	1955-08-05	3.51
2002-06-04	4.8	1943-10-21	3.5
1941-09-08	4.57	1986-09-23	3.5
1981-06-13	4.53	1980-09-13	3.35
1956-08-31	4.31	2020-09-06	3.25
2007-07-04	4.28	1986-09-25	3.2
1963-07-19	4.27	1984-10-19	3.2
1927-09-09	4.11	2009-07-22	3.2
1934-07-05	4.09	1979-06-10	3.18
1942-09-02	3.85	1937-08-20	3.15
1968-08-05	3.85	1952-11-17	3.12
1987-08-26	3.78	2002-10-02	3.1
2013-04-18	3.68	1931-10-10	3.05
1902-09-23	3.6	2006-07-22	3.04

Source: Iowa State University Department of Agronomy

Information from the NCDC was obtained from 1993 to 2023 to determine previous occurrences for

flash flood in the planning area. This search did not reveal any flash flood incidents recorded from 1993 to 1996. Between 1997 and 2016, there were 19 flash flood events and 3 heavy rain events. When counting only events that occurred on separate days, there were 15 events. During this timeframe, there were no injuries or deaths reported. Total property damages for these events were estimated to be $1,834,000. **Table 3.32.** provides a summary of the NCDC data.

Table 3.32. Jackson County Flash Flood Events, 1993-2023

Date	Property Loss	# of Events
Flash Floods		
2/20/1997	$0	1
6/4/2002	$0	4
7/4/2007	$25,000	1
7/18/2007	$5,000	1
6/19/2009	$50,000	1
7/27/2009	$250,000	1
8/13/2010	$0	1
7/27/2011	$1,500,000	1
6/30/2014	$0	1
6/11/2015	$0	1
7/26/2015	$2,000	2
6/14/2016	$0	1
7/22/2017	$1,000	1
6/9/2018	$0	2
Subtotal	**$1,833,000**	**19**
Heavy Rain		
7/7/2003	$2,000	1
7/17/2006	$0	1
7/21/2006	$0	1
Subtotal	**$2,000**	**3**
Grand Total	**$1,834,000**	**22**

Source: NCDC

Probability of Future Occurrence

The frequency of past events is used to gauge the likelihood of future occurrences. The events from NCDC that occurred on the same day were combined to determine the total number of 15 flash flooding events in the planning area over the 30-year period from 1993 to 2023.This translates to 50-percent likelihood of flash flooding somewhere in the planning area in any given year. Therefore, the probability rating is “Occasional.”

Probability Score: 2 - Occasional

Vulnerability Assessment

Vulnerability Overview

Water over low-lying roads and bridges is the most frequent impacts associated with flash flooding that has occurred in the planning area. This can cause wash out of bridge abutments and erosion/scour damage on roads. There is potential for loss of life if motorists drive into

moving water. However, public education campaigns have helped to educate citizens about not driving through moving water. Building damage is generally limited to water in basements where rain is too intense for drainage systems and natural drainage to carry water away from the structure. In addition, when combined storm/sanitary sewer systems are overloaded, this can result in sewer back-up. Generally, flash-flooding is short in duration and government services and business operations are not impacted.

Magnitude/Severity Score: 2 - Limited

Potential Losses to Existing Development

When roads and bridges are inundated by water, damage often occurs as the water scours materials around bridge abutments and gravel roads. (See **Figure 3.66.** for the Jackson County transportation map.) The water can also cause erosion, undermining roadbeds. In some instances, steep slopes that are saturated with water may cause mud or rockslides onto roadways. These damages can cause costly repairs for state, county, and city road/bridge maintenance departments. When sewer back-up occurs, this can result in costly clean-up for home and business owners as well as present a health hazard. Based on loss estimates reported by NCDC, property losses averaged $76,416 per year over the 24-year period from 1993 to 2016.

Future Development

In planning future development, jurisdictions in the planning area should avoid development in low-lying areas near rivers and streams or where interior drainage systems are not adequate to provide drainage during heavy rainfall events. Future development should also take into consideration the impact of additional impervious surfaces to water run-off and drainage capabilities during heavy rainfall events.

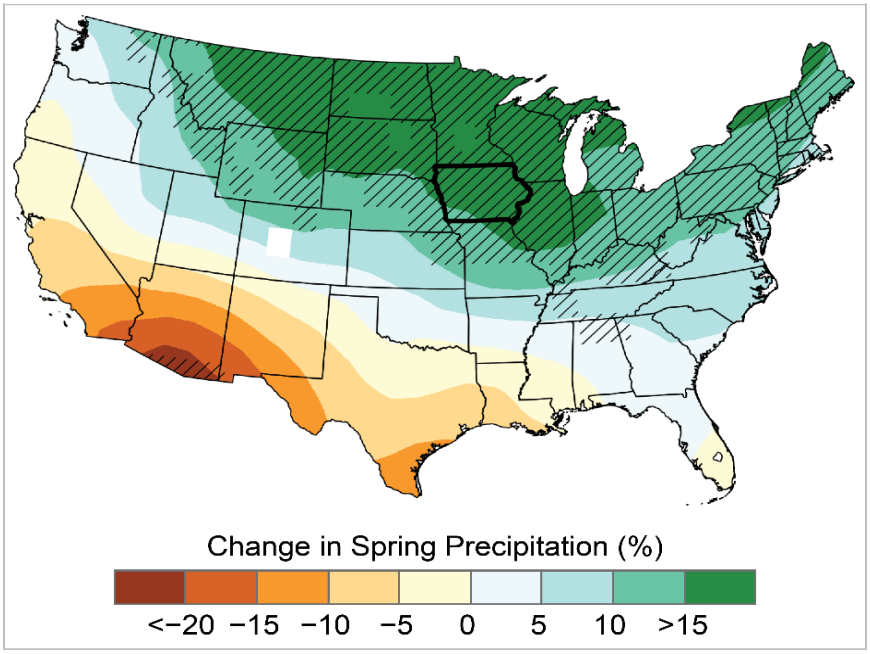
Climate Change Impacts

The 2010 Climate Change Impacts on Iowa report notes the increase in frequency of severe precipitation events.

Figure 3.16. shows projected changes in spring (March–May) precipitation (%) for the middle of the 21st century compared to the late 20th century under a higher emissions pathway. The whited-out area indicates that the climate models are uncertain about the direction of change. Hatching represents areas where the majority of climate models indicate a statistically significant change. Iowa is part of a large area of projected increases in the Northeast and Midwest.

For this study, very heavy precipitation was defined as the heaviest 1% of all events. If this trend increases, flash flooding events and their associated impacts will likely occur more often in the planning area.

Figure 3.16. Projected Change in Spring Precipitation



Source: https://statesummaries.ncics.org/chapter/ia/

Flooding - Flash Hazard Summary by Jurisdiction

For the jurisdictions indicated in previous flash flood events reported to NCDC or that indicated specific flash flooding previous events, the probability was determined to be “highly likely” (4). For the remaining jurisdictions and school districts, the probability was determined to be “occasional” (2). Although impacts were not mentioned for some cities or the school districts, flash flooding can still occur in the future if the amount of rainfall received in a given time exceeds the capability of drainage features and natural drainage to carry the water away.

Jurisdiction	Probability	Magnitude/ Severity	Warning Time	Duration	Weighted Score	Level
Unincorporated	4	2	3	2	3.05	High
Andrew	4	2	3	2	3.05	High
Baldwin	2	2	3	2	2.15	Moderate
Bellevue	4	2	3	2	3.05	High
LaMotte	4	2	3	2	3.05	High
Maquoketa	4	2	3	2	3.05	High
Miles	2	2	3	2	2.15	Moderate
Monmouth	4	2	3	2	3.05	High
Preston	2	2	3	2	2.15	Moderate
Sabula	2	2	3	2	2.15	Moderate
Spragueville	2	2	3	2	2.15	Moderate
Springbrook	4	2	3	2	3.05	High
St. Donatus	2	2	3	2	2.15	Moderate
Andrew CSD	2	2	3	2	2.15	Moderate
Bellevue CSD	2	2	3	2	2.15	Moderate
Easton Valley CSD	2	2	3	2	2.15	Moderate
Maquoketa CSD	2	2	3	2	2.15	Moderate

3.5.5. Flooding – River

Hazard Score Calculation					
Probability	**Magnitude/Severity**	**Warning Time**	**Duration**	**Weighted Score**	**Level**
3	**2**	**2**	**3**	**2.55**	**Moderate**

Hazard Profile

Hazard Description

The Mississippi River provides the eastern boundary for Jackson County. The Maquoketa River flows diagonally through Jackson County from the northwest to the southeast, emptying into the Mississippi River. Numerous small creeks, branches of rivers, and streams also flow through the County. Flooding from these rivers and their tributaries has been a significant problem for many of the communities in Jackson County. Many of the communities were settled and developed largely because of their proximity to water resources.

A flood is partial or complete inundation of normally dry land areas. Heavy precipitation can cause flooding either in the region of precipitation or in areas downstream. 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 two main types of flooding in the planning area: river flooding and flash flooding which includes ice jam flooding. Flash flooding is discussed separately in **Section 3.5.4.** A specific type of flash flooding can occur as a result of dam failure or levee failure. Flooding caused by dam or levee failure is discussed in **Section 3.5.1.**

River flooding 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 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, which is defined as all the land drained by a river and its branches.

Gauges along streams and rain gauges throughout the state provide for an early flood warning system. River flooding usually develops over the course of several hours or even days depending on the basin characteristics and the position of the particular reach of the stream.

The National Weather Service provides flood forecasts for Iowa. Flood warnings are issued over emergency radio and television messages as well as the NOAA Weather Radio. People in the paths of river floods may have time to take appropriate actions to limit harm to themselves and their property.

Warning Time Score: 2 -- More than 12 to 24 hours warning time

Duration Score: 3 -- Less than one week

Geographic Location/Extent

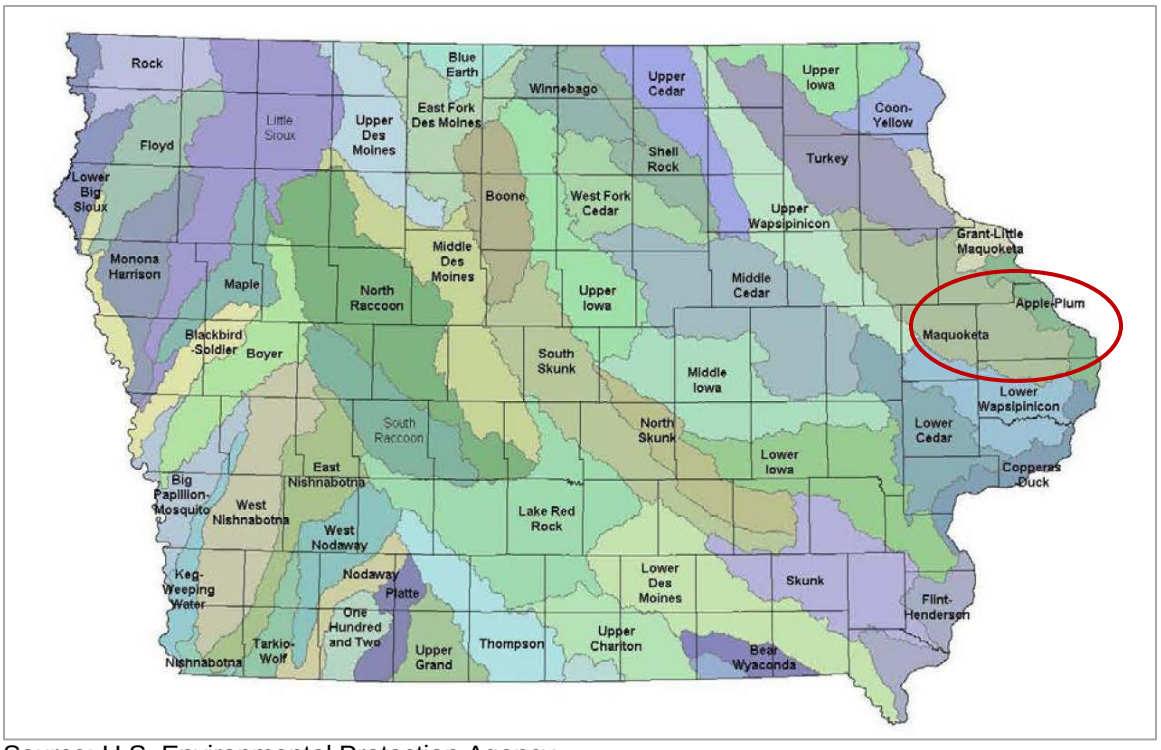
A watershed is an area of land that is drained by the same body of water. Within the watershed all rainwater eventually ends up in the same river, lake, or ocean. Like rivers, watersheds are also hierarchical systems with smaller watersheds nested inside larger watersheds. The

watersheds of small streams that flow into the same river combine to make up the river watershed. Then, the river watershed combines with watersheds from other rivers to make up a larger watershed.

Watershed boundaries show the extent of surface water drainage using a hierarchical system of nesting hydrologic units at various scales, each with an assigned hydrologic unit code (HUC). The hydrologic unit hierarchy is indicated by the number of digits in groups of two (such as HUC 2, HUC 4, and HUC 6) within the HUC code. HUC 8 maps the subbasin level, analogous to medium-sized river basins (about 2,200 nationwide).

Figure 3.17. is a map of the HUC 8 Watersheds in Iowa. There are two HUC 8 watersheds in Jackson County (circled in red). The Apple-Plum Watershed is located on the eastern side of the county along the Mississippi River. The Maquoketa River Watershed covers the rest of the county.

Figure 3.17. Map of Major Watersheds in Jackson County



Source: U.S. Environmental Protection Agency

For purposes of this hazard profile and vulnerability analysis, the geographic location/extent for river flooding will be considered as those areas at risk to the 100-year flood (also known as the 1-percent annual chance flood). The 1-percent annual chance flood has been adopted by FEMA as the base flood for floodplain management purposes.

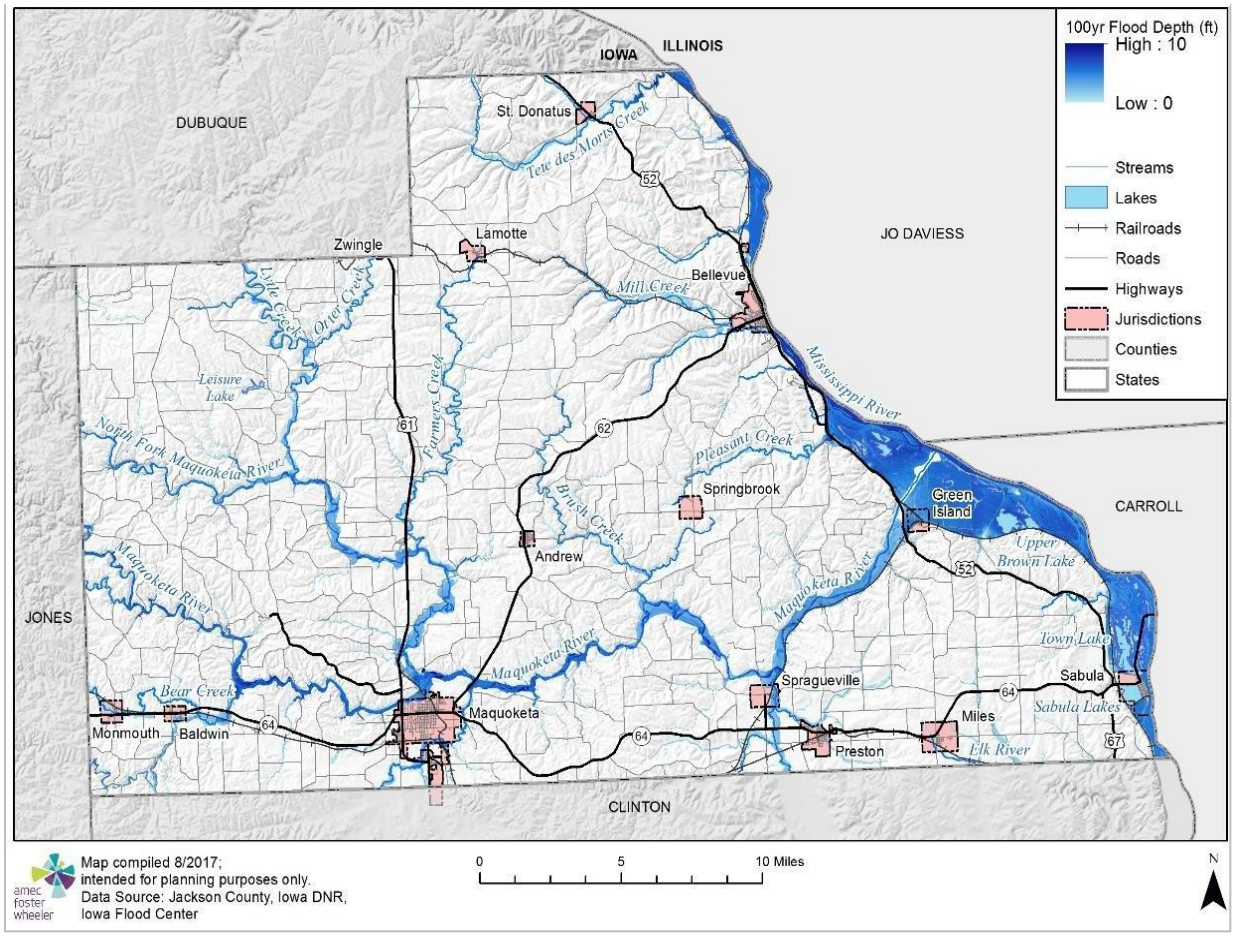
Jurisdictional Flood Hazard Maps

IFC Flood Depth Map

The 1-percent annual chance floodplain for all jurisdictions in the planning area according to the National Flood Hazard Layer (NFHL) is shown in **Figure 3.18**. This map provides extent of the 1-percent annual chance floodplain based on depth grids that were provided by the Iowa Flood

Center (IFC) from the University of Iowa. The flood risk assessment that was performed using FEMA's loss estimation software, HAZUS-MH, utilized the depth grids from the IFC as best available data for depth grids as this data was an essential piece of data to run an enhanced HAZUS Level 2 flood risk assessment.

Figure 3.18. Jackson County 1-Percent Annual Chance Floodplain (IFC Depth Grids)



FEMA Flood Hazard Maps

The Flood Insurance Rate Map (FIRM) produced by FEMA for Jackson County identifies all flood hazard areas within the 100-year flood boundary (see **Figure 3.19.**). There are multiple types of flood hazard zones present in Jackson County:

- The 1% annual chance flood zone has a 1% chance of its height being equaled or exceeded in a given year.
- The 0.2% annual chance flood zone has a 0.2% chance of its height being equaled or exceeded in a given year.
- A "Regulatory Floodway" means the channel of a river or other watercourse and the adjacent land areas that must be reserved in order to discharge the base flood without cumulatively increasing the water surface elevation more than a designated height.

- Areas with reduced risk due to levee indicate that the area is provided protection through a levee system that prevents overflow.

The Jackson County flood hazard areas map in **Figure 3.19.** provides an overview of the planning area as a whole. The jurisdictional maps for the incorporated cities and community school districts (**Figures 3.20 through 3.32**) depict the 1- percent annual chance floodplain based on the FEMA FIRM data. Appendix E provides locations of available critical facilities in relation to the FEMA FIRM data. This will be discussed in greater detail in the Vulnerability Assessment section.

Figure 3.19. Jackson County Flood Hazard Areas

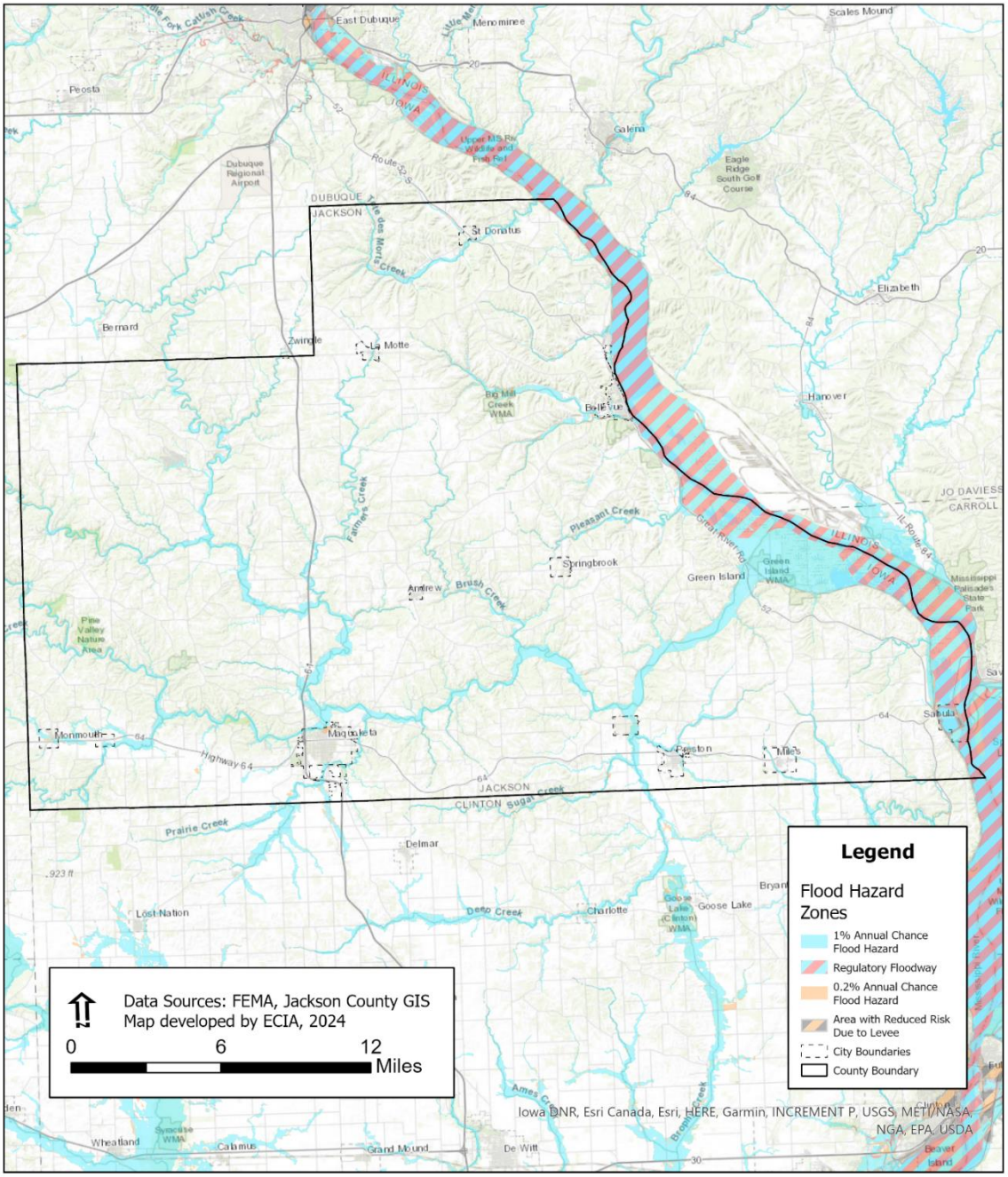


Figure 3.20. City of Andrew Flood Hazard Areas

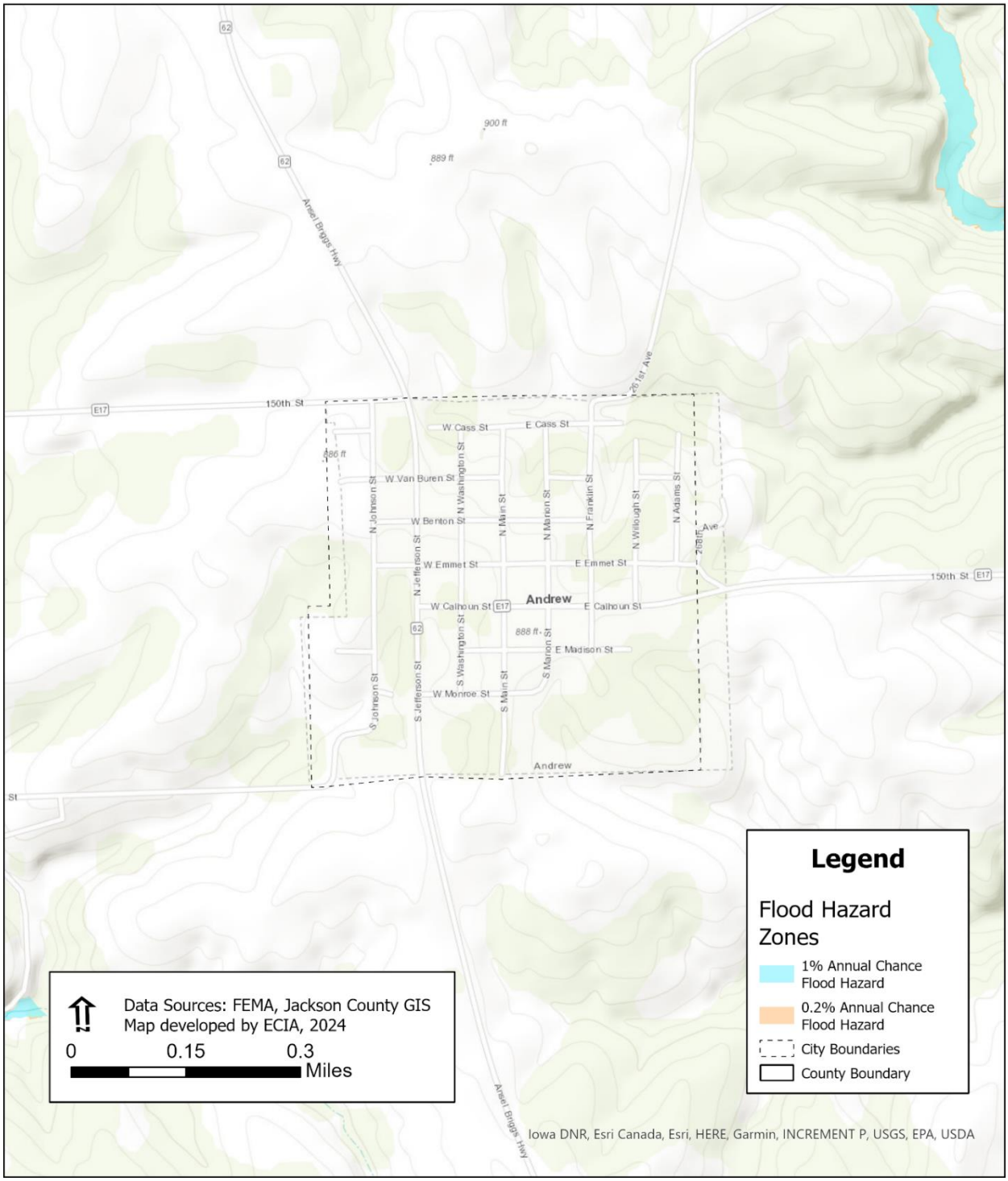


Figure 3.21. City of Baldwin Flood Hazard Areas

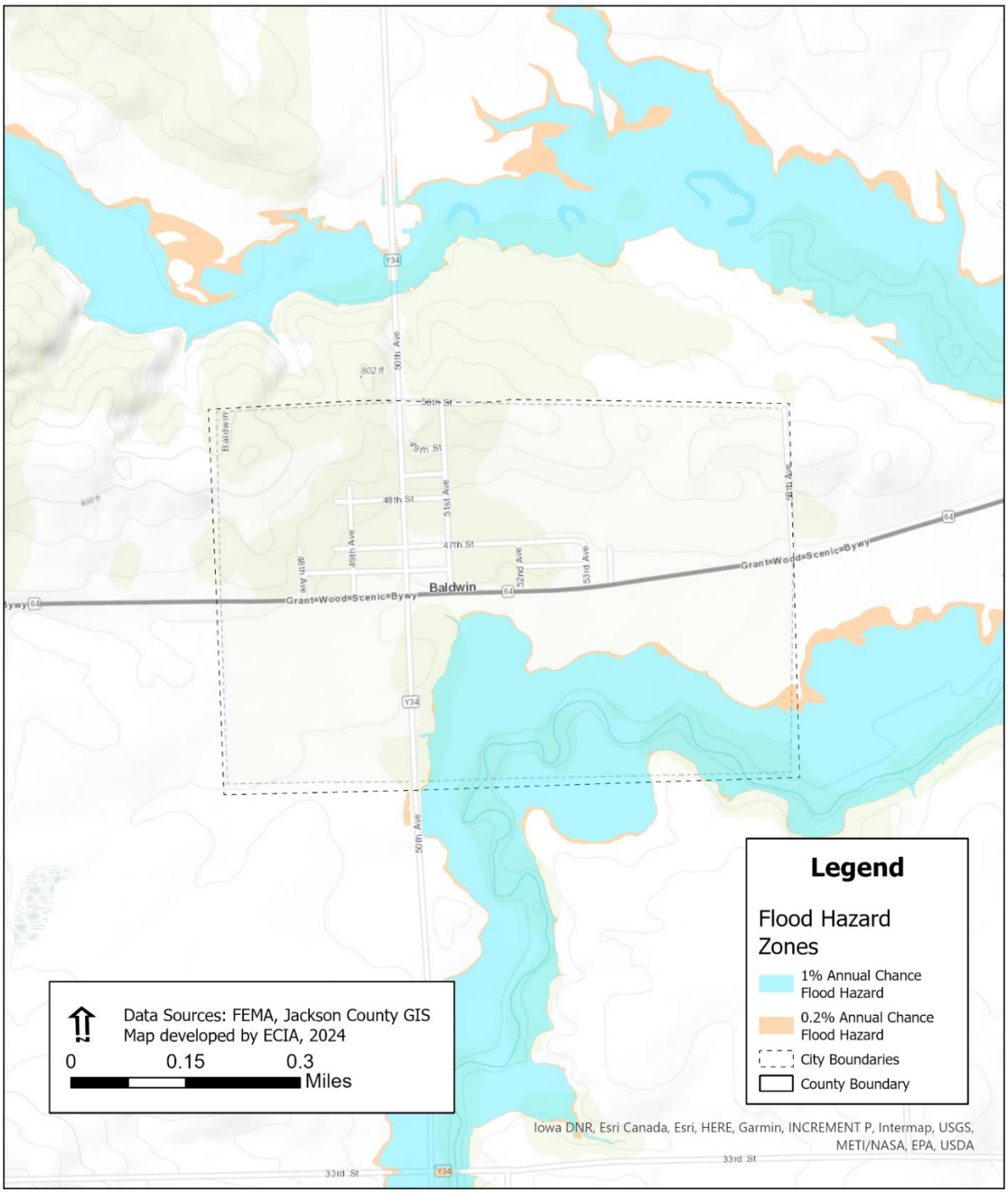


Figure 3.22. City of Bellevue Flood Hazard Areas

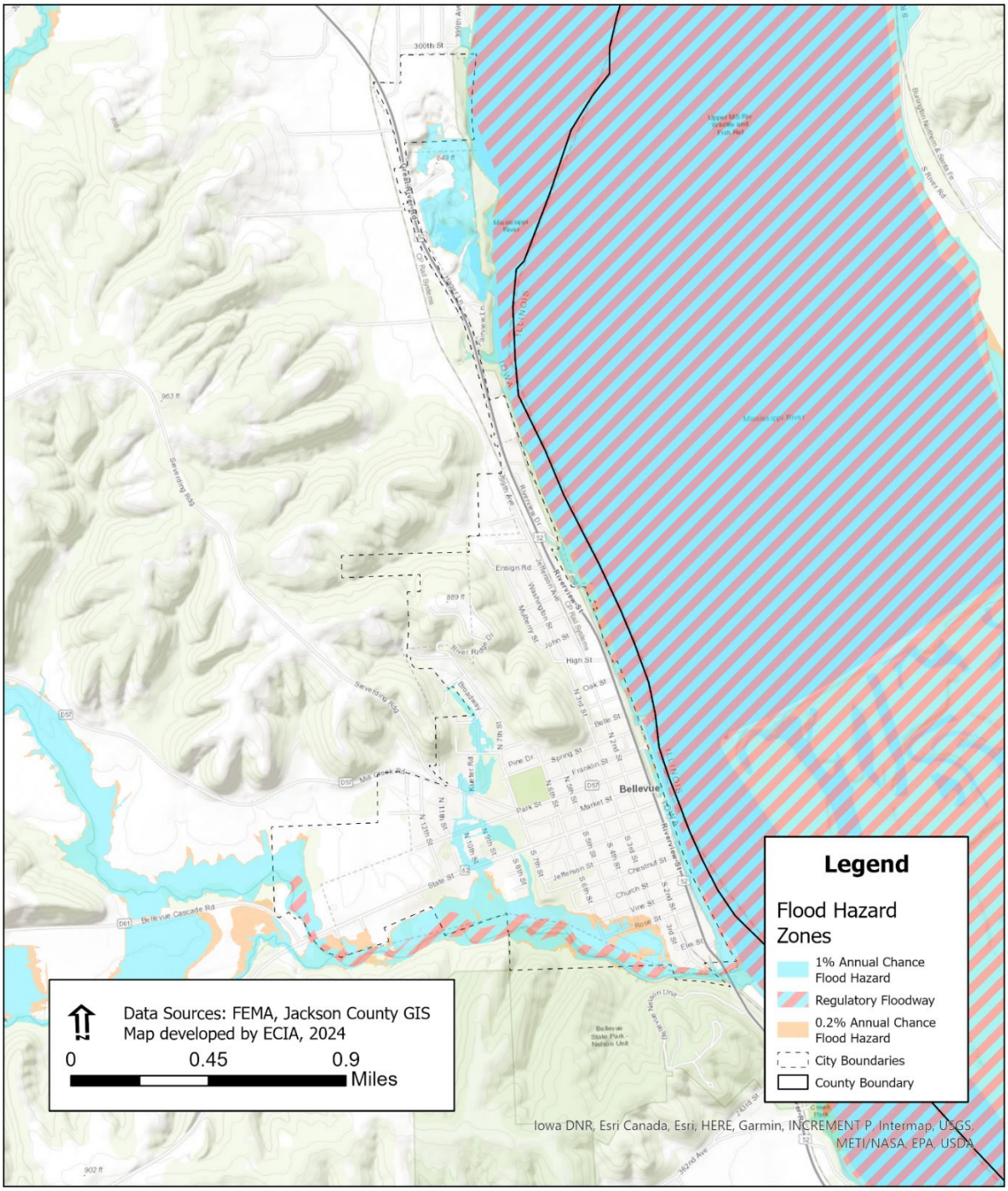


Figure 3.23. City of LaMotte Flood Hazard Areas

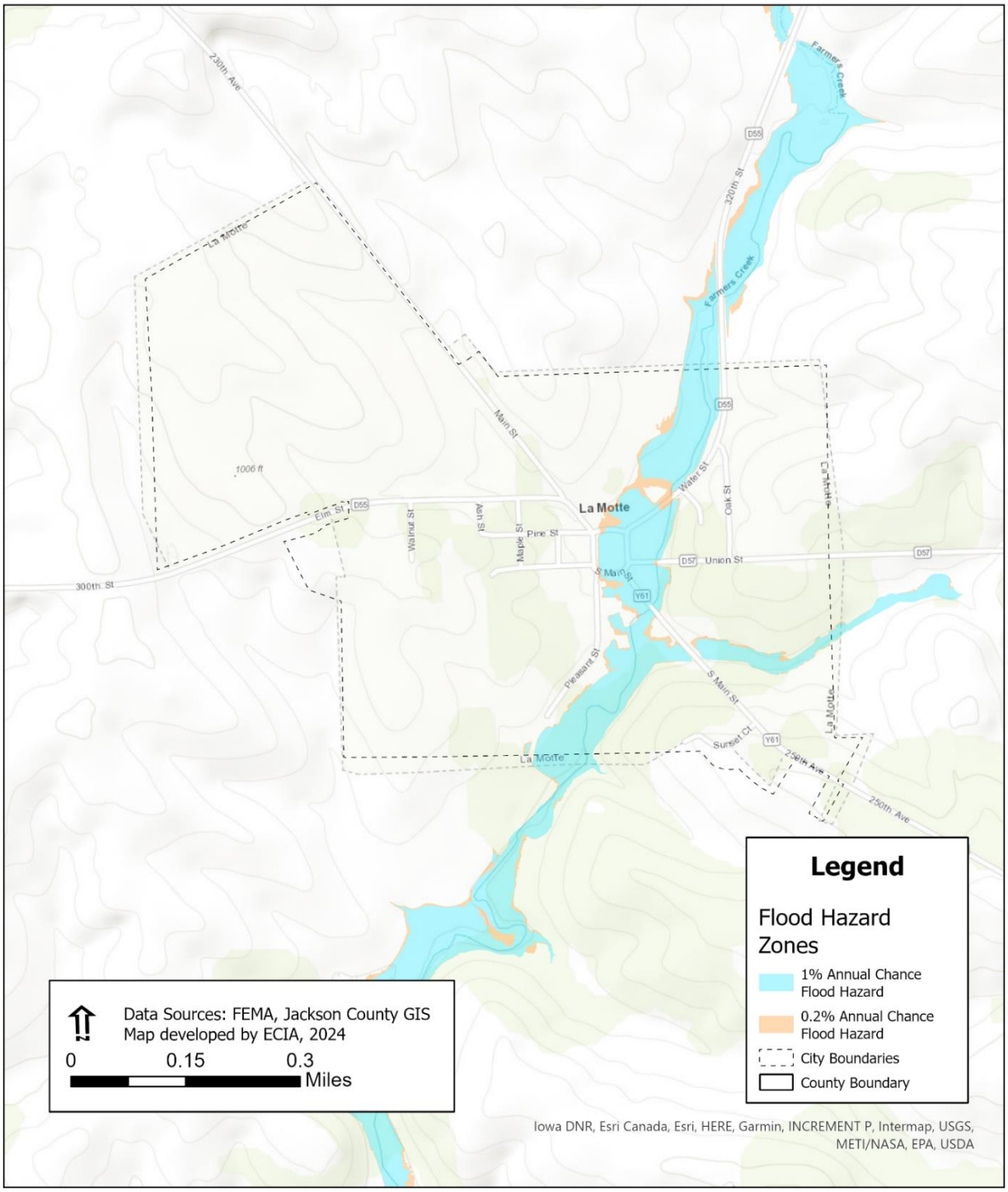


Figure 3.24. City of Maquoketa Flood Hazard Areas

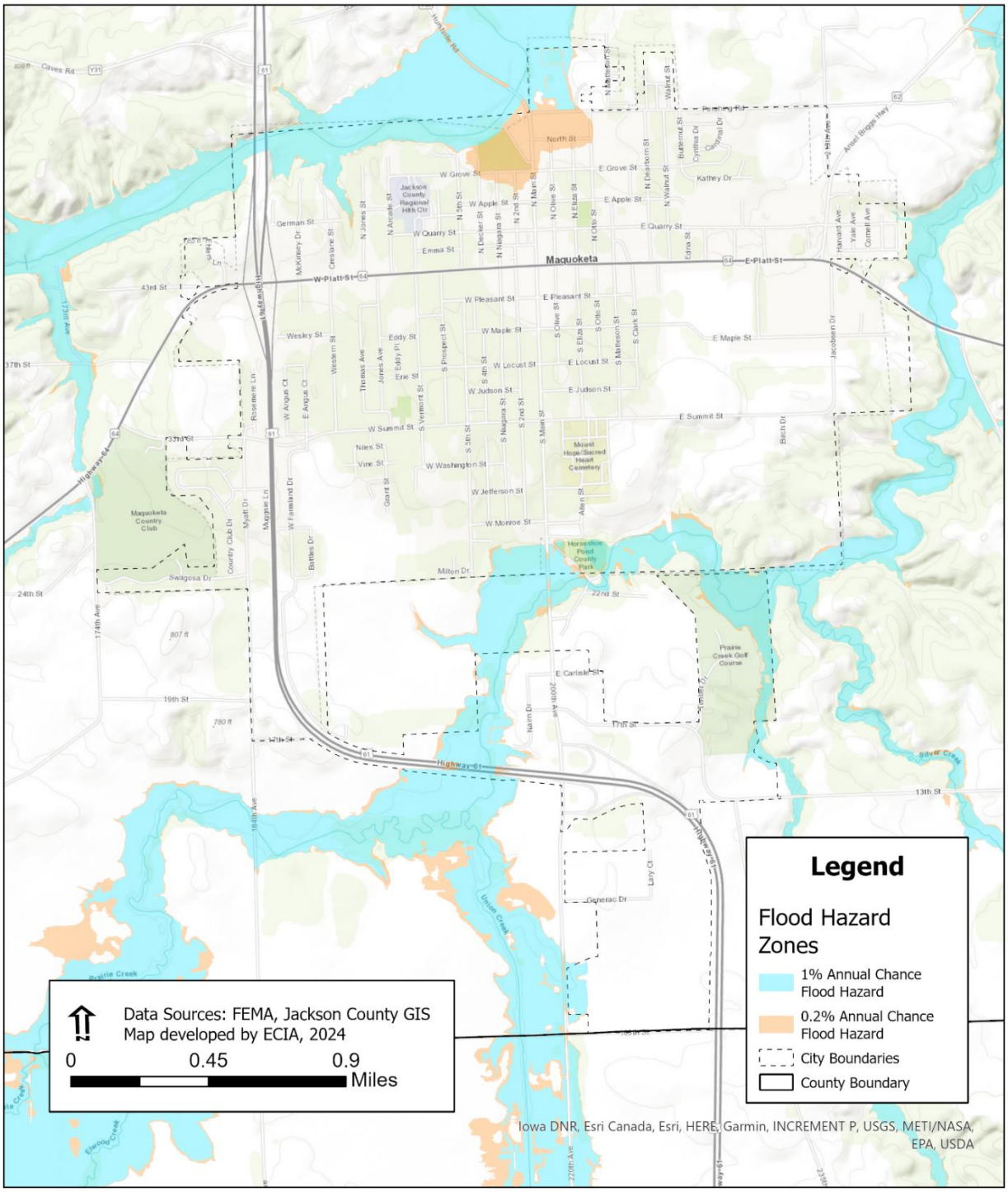


Figure 3.25. City of Miles Flood Hazard Areas

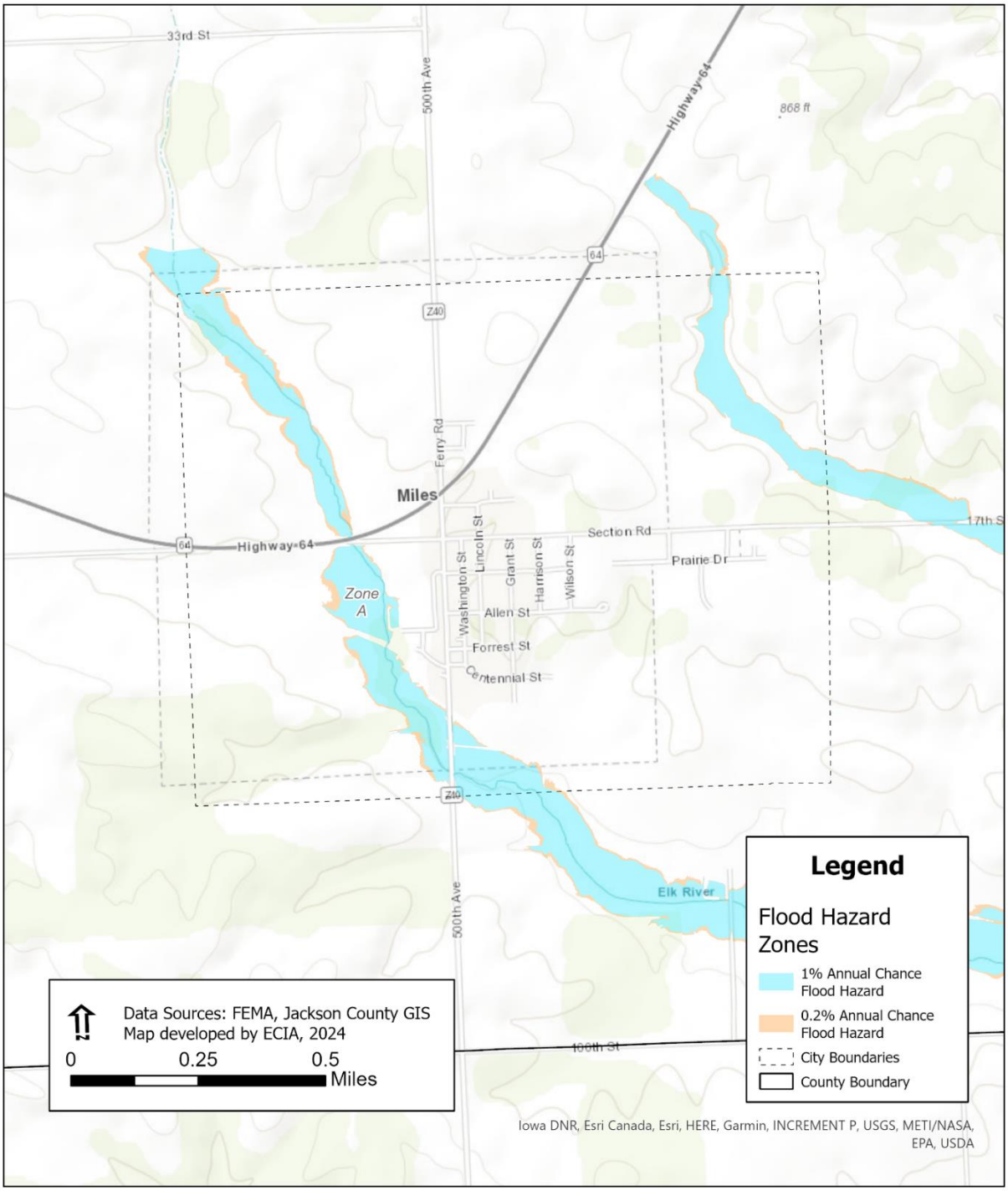


Figure 3.26. City of Monmouth Flood Hazard Areas

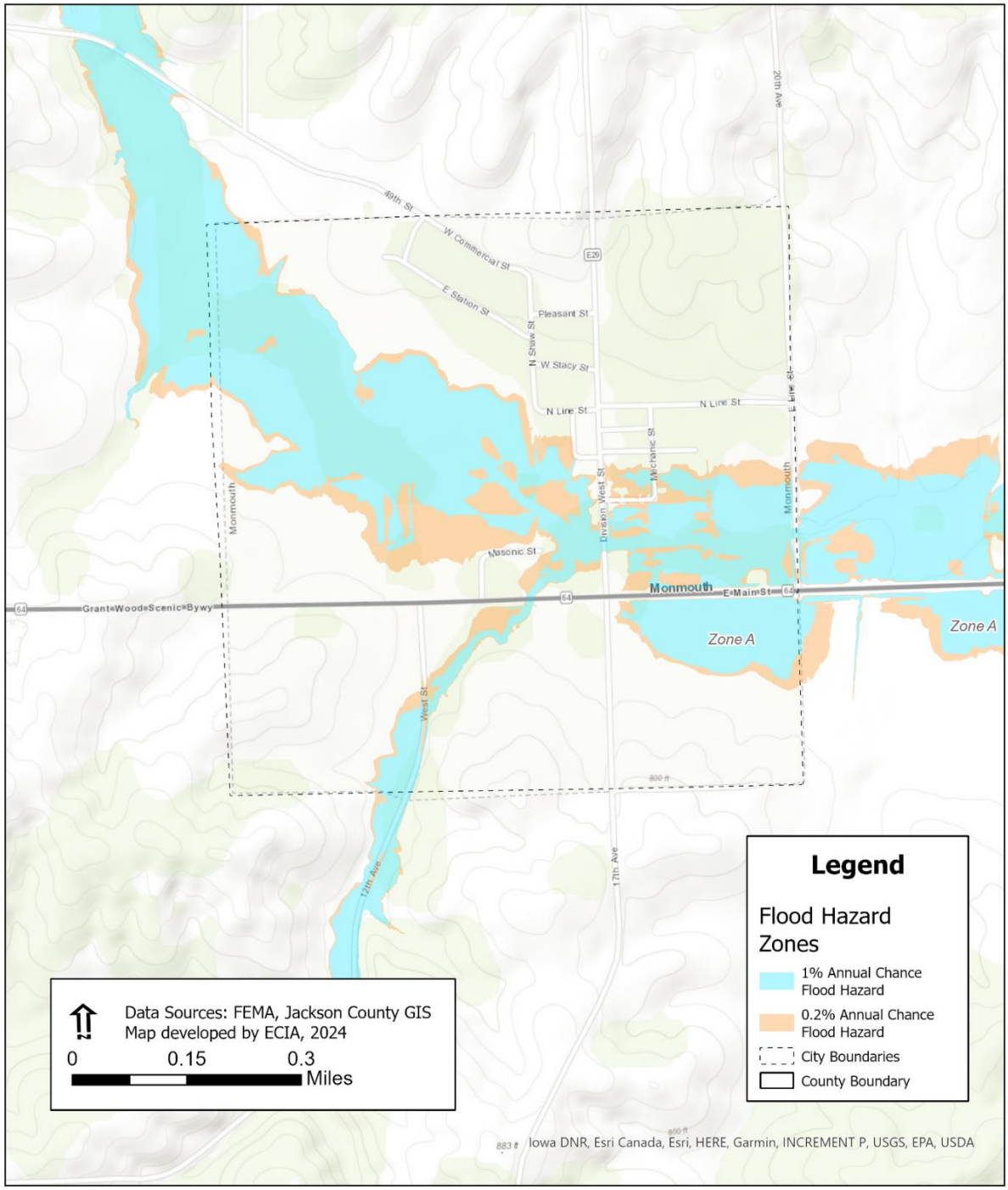


Figure 3.27. City of Preston Flood Hazard Areas

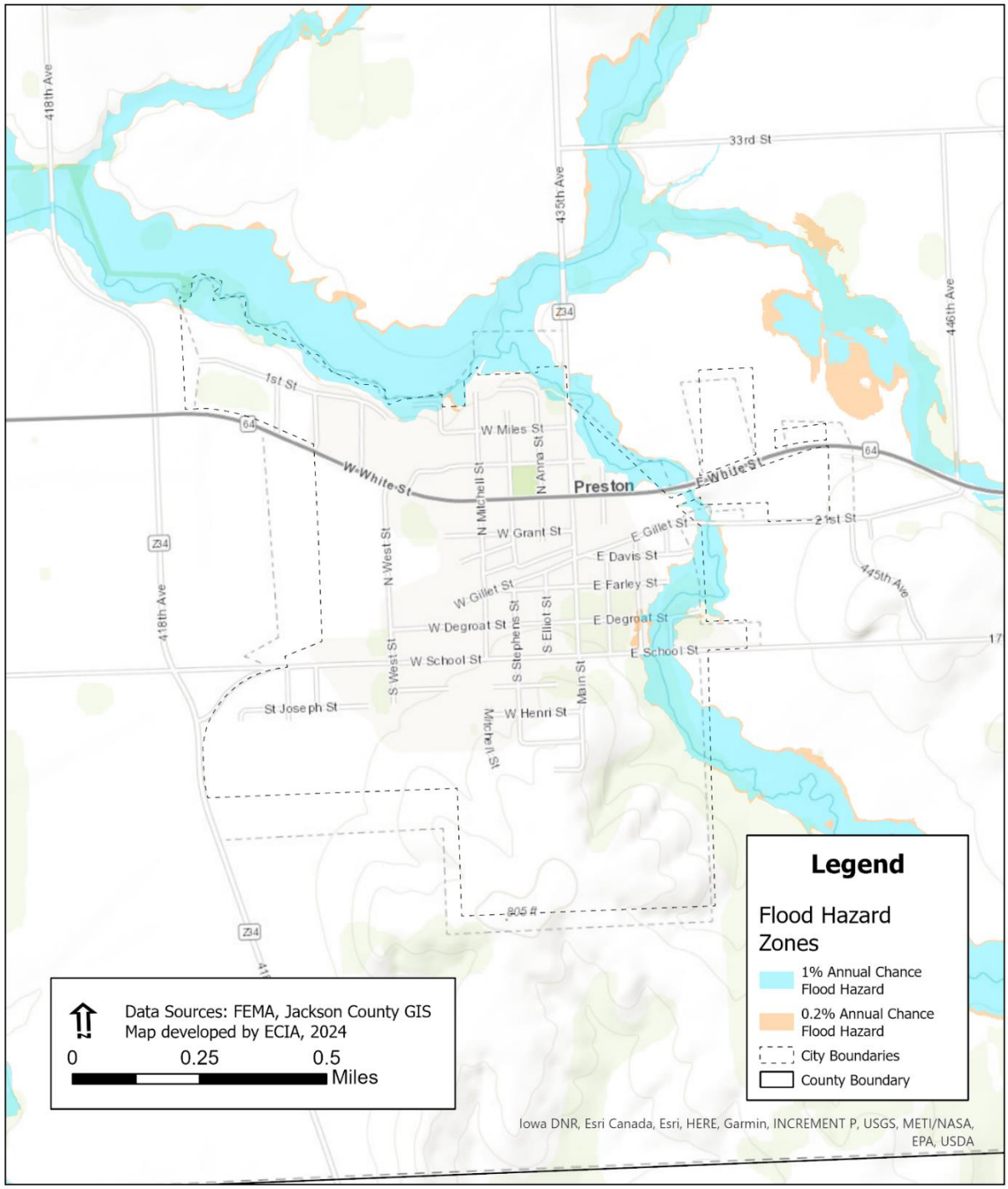


Figure 3.28. City of Sabula Flood Hazard Areas

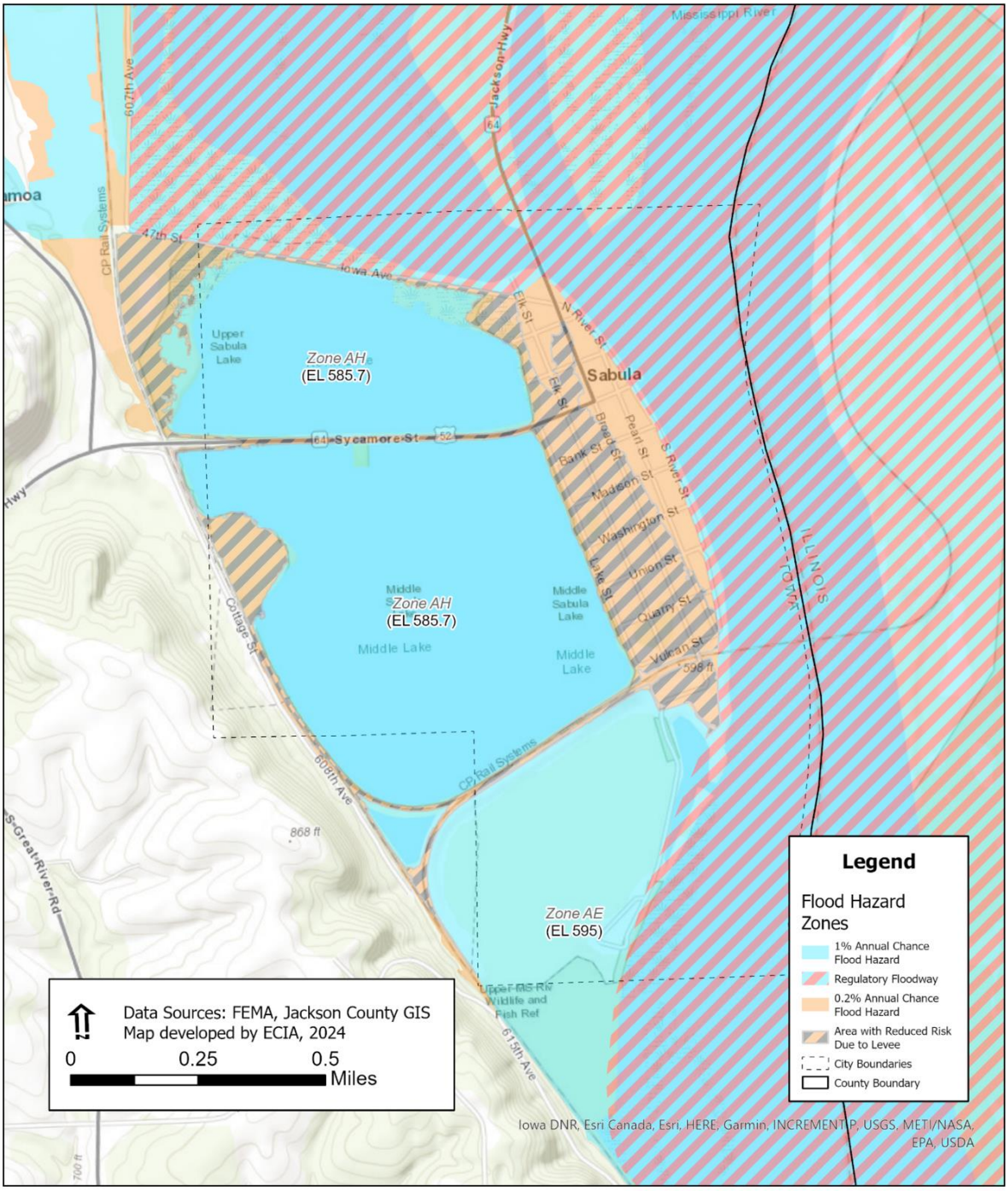


Figure 3.29. City of Spragueville Flood Hazard Areas

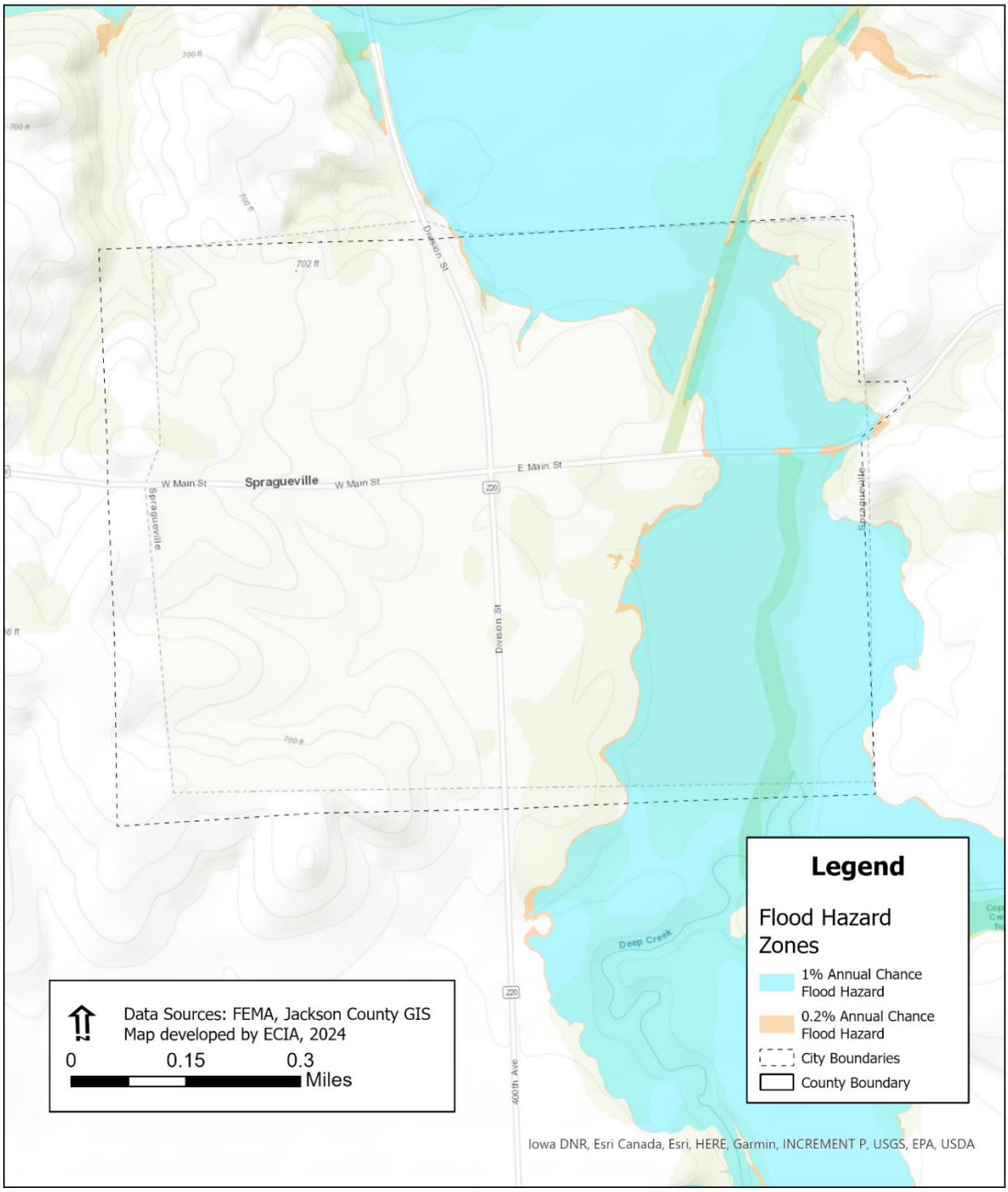


Figure 3.30. City of Springbrook Flood Hazard Areas

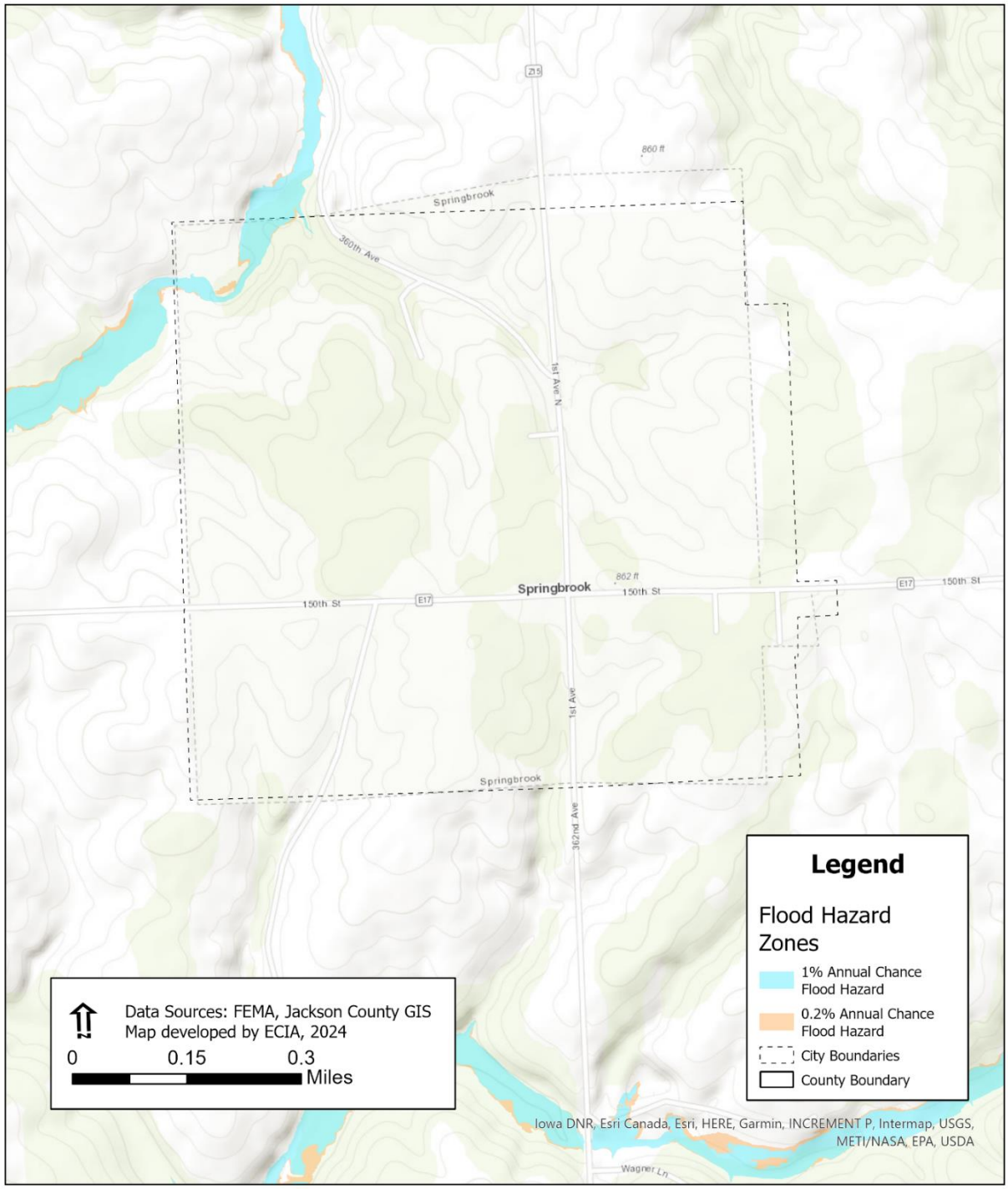


Figure 3.31. City of St. Donatus Flood Hazard Areas

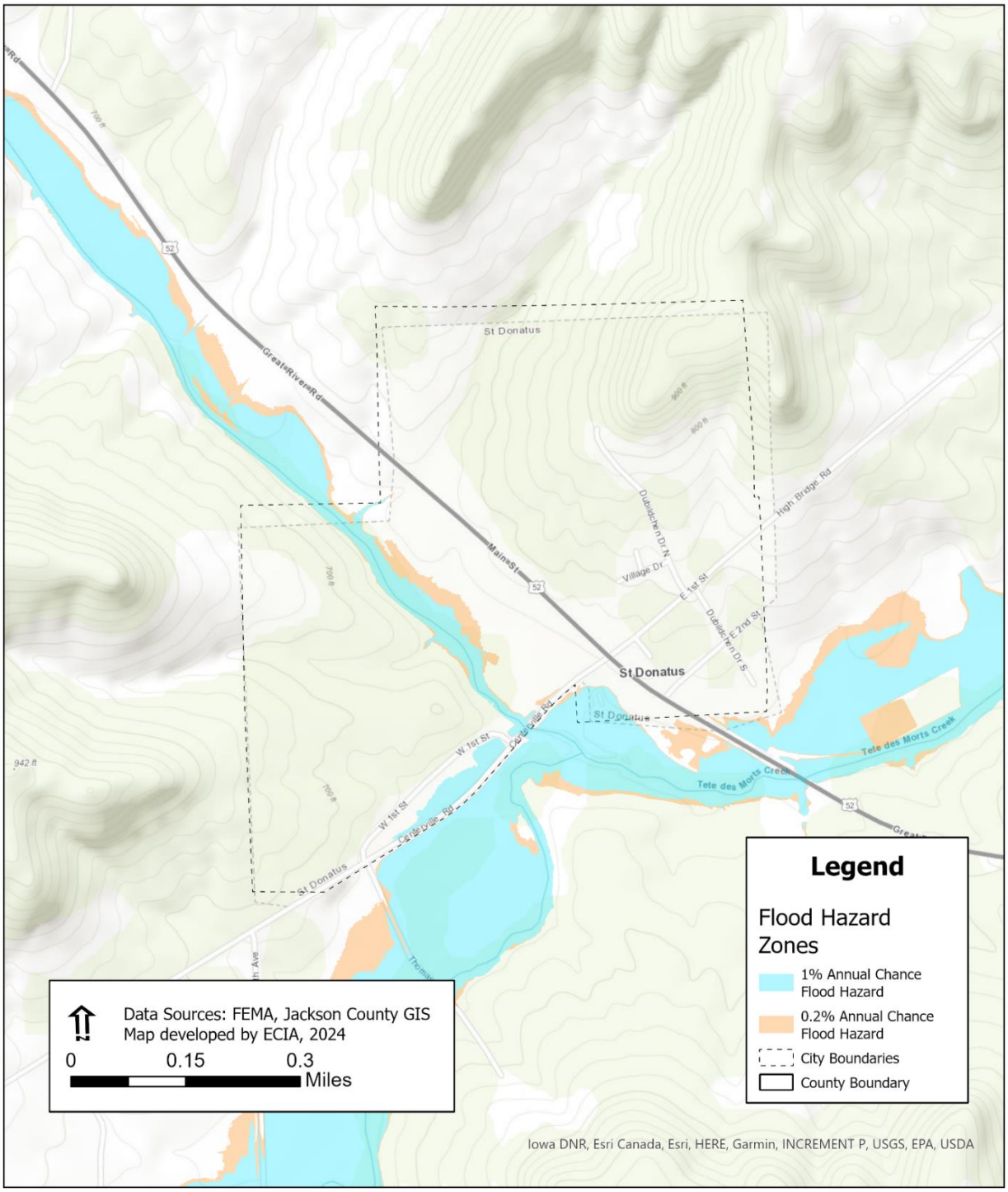
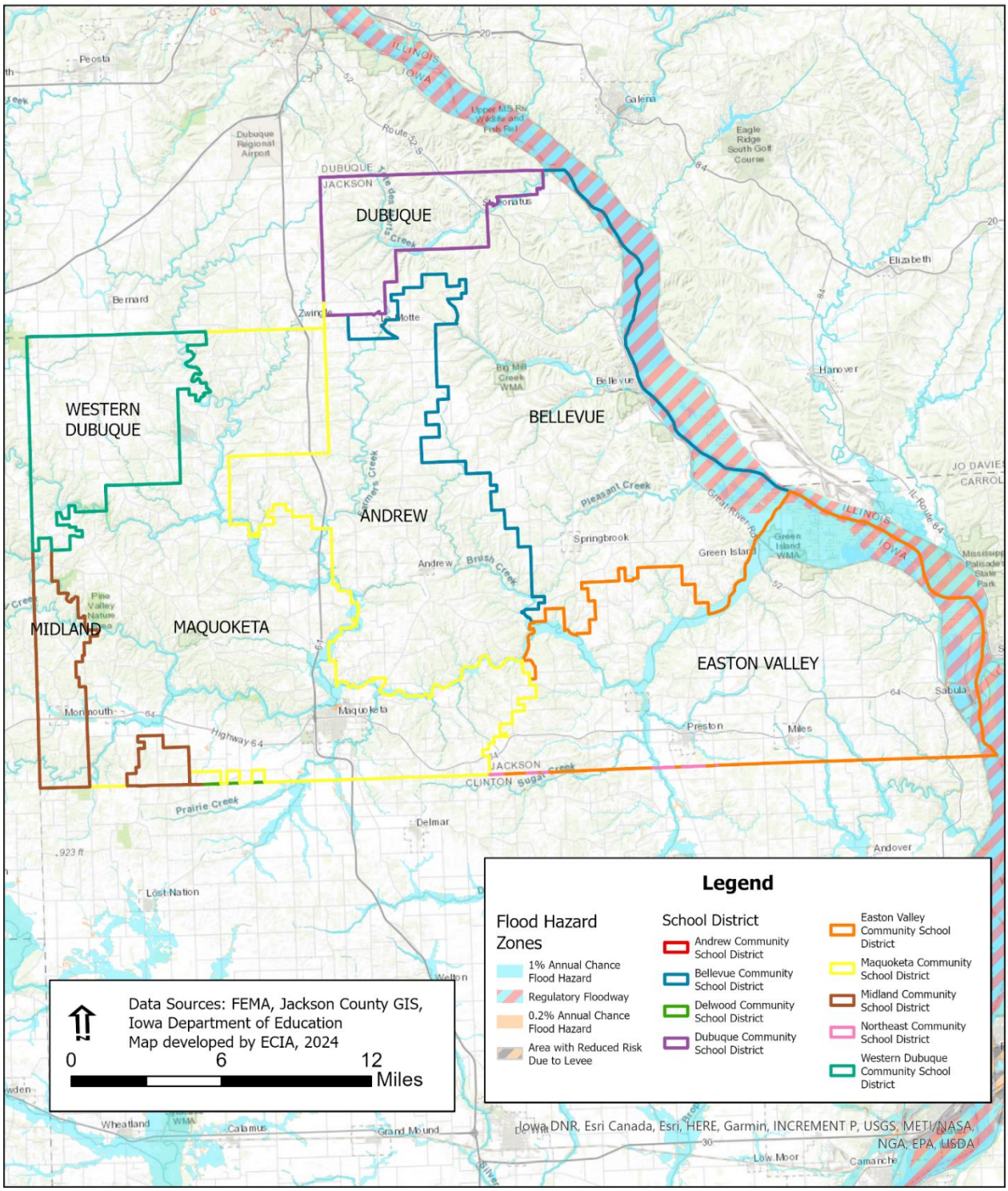


Figure 3.32. Jackson County School Districts -- Flood Hazard Areas



Previous Occurrences
This section provides information on previous occurrences of river flooding in the planning area.

Disaster Declarations for Flooding in Planning Area
From 1965 to 2023, there have been 8 Major Presidential FEMA Disaster Declarations for flooding that included Jackson County (see **Table 3.2.** in the Hazard Identification Section).

From 2012 to 2023, there have been 2 USDA Secretarial disaster declarations for flooding that included Jackson County (see **Table 3.3.** in the Hazard Identification Section).

Previous Agricultural Impacts
Flooding and excess moisture take a toll on crop production in the planning area. According to the USDA's Risk Management Agency, payments for insured crop losses in the planning area as a result of excess moisture and flood conditions from 2014-2023 totaled $7,997,552.94. This translates to an annual average of $799,755.29. According to USDA Risk Management Agency's 2015 Iowa Crop Insurance Profile, 89 percent of insurable crops in Iowa were insured. **Table 3.33.** summarizes the claims paid by year.

Table 3.33. Crop Insurance Claims Paid in Jackson County for Crop Loss as a result of Excess Moisture/Precipitation/Rain and Flood (2014-2023)

Damage Cause	Indemnity Amount	Determined Acres
Excess Moisture, Precipitation, Rain	**$7,196,668.90**	**73,681**
2014	$1,453,904.52	14,063
2015	$670,717.59	7,393
2016	$122,231.10	761
2017	$288,387.85	3,234
2018	$787,979.80	14,577
2019	$3,223,576.44	29,949
2020	$162,196.10	1,273
2021	$13,146.00	151
2022	$167,673.50	747
2023	$306,856.00	1,534
Flood	**$800,884.04**	**3,043**
2014	$608,246.39	2,071
2016	$4,595.00	152
2017	$6,853.15	75
2018	$89,331.60	346
2019	$23,694.00	156
2020	$44,141.40	183
2023	$24,022.50	60
Grand Total	**$7,997,552.94**	**76,725**

National Flood Insurance Program (NFIP) Participation
Table 3.34. provides details on NFIP participation for the communities in the planning area as well as the number of policies in force, amount of insurance in force, number of closed losses, and total payments for each jurisdiction, where applicable.

Table 3.34. NFIP Participation, Policy and Claim Statistics for Jackson County

Community Name	NFIP Participant (Yes/No)	Participant in CRS (Yes/No)	Current Effective Map Date	Regular-Emergency Program Entry Date	Policies in Force	Insurance in Force	Closed Losses	Total Payments
Jackson County	Yes	No	1/28/2022	5/1/1990	14	$1,946,000	4	$78,738
Andrew	No	No	N/A	N/A	N/A	N/A	N/A	n/a
Baldwin	Yes	No	1/28/2022	6/18/1987	0	$0	0	$0
Bellevue	Yes	No	1/28/2022	10/15/1982	15	$3,173,000	3	$65,224
La Motte	Yes	No	1/28/2022	4/26/2011	4	$649,000	6	$17,718
Maquoketa	Yes	No	1/28/2022	8/5/1986	5	$929,000	7	$13,856
Miles	Yes	No	1/28/2022	12/17/2010	0	$0	0	$0
Monmouth	Yes	No	1/28/2022	12/17/2010	1	$28,000	3	$67,227
Preston	Yes	No	1/28/2022	2/28/1994	1	$143,000	0	$0
Sabula	Yes	No	1/28/2022	11/19/1987	8	$1,455,000	19	$139,832
Spragueville	Yes	No	1/28/2022	11/28/2018	0	$0	0	$0
Springbrook	Sanctioned 12/17/2011	No	1/28/2022	N/A	N/A	N/A	N/A	n/a
St. Donatus	Yes	No	1/28/2022	3/21/2013	0	$0	0	$0

Source: FEMA

Repetitive Loss/Severe Repetitive Loss Properties

Repetitive Loss Properties are those properties with at least two flood insurance payments of $5,000 or more in a 10-year period.

Severe Repetitive Loss (SRL) properties are defined it as “a single family property” (consisting of one-to-four residences) that is covered under flood insurance by the NFIP and has incurred flood-related damage for which four or more separate claims payments have been paid under flood insurance coverage with the amount of each claim payment exceeding $5,000 and with cumulative amounts of such claims payments exceeding $20,000; or for which at least two separate claims payments have been made with the cumulative amount of such claims exceeding the reported value of the property. **Table 3.35.** provides additional details about the Repetitive and Severe Repetitive Loss Properties in Jackson County.

Table 3.35. Repetitive and Severe Repetitive Loss Properties in Jackson County

Total Repetitive Loss Properties				
State ID	**Repetitive Loss Properties**	**Total Losses**	**Total Building Payments**	**Total Contents Payments**
Jackson County	1	2	$65,332	$2,939
LaMotte	1	3	$17,783	$0
Sabula	3	7	$114,348	$11,676
County Totals	**5**	**12**	**$197,463**	**$14,615**

Source: FEMA PIVOT Database. Accessed by Iowa DNR on 4/12/2024. https://pivot.fema.gov/pivot/web-portal/

Probability of Future Occurrence

With the history of flooding in the planned area, it is likely that flooding of various levels will continue to occur.

Probability Score: 3 -- Likely

Vulnerability Assessment

Vulnerability Overview

To determine vulnerability of people and property to river flooding, an enhanced flood risk analysis was performed utilizing FEMA's HAZUS software. This analysis included Level 2 enhancements to both the hazard and inventory inputs to the HAZUS model to enhance the accuracy of flood risk modelling as follows:

- Depth Grids provided by University of Iowa's Iowa Flood Center (IFC)
- Parcel layer provided by Jackson County
- Assessor's data provided by Jackson County

The Depth Grids provided by the IFC were used as the best available data since older FEMA depth grids are difficult to obtain and using the IFC data complements the efforts that the Iowa Homeland Security and Emergency Management Department is doing for the State Plan. It should be noted that the Iowa Flood Center depth grids are very similar to the effective FEMA products however there are some differences in the detailed areas for the 1-percent annual chance floodplain.

Default HAZUS inventories for structures were replaced with data supplied by Jackson County using the parcel layer and additional structure attributes in the Assessor's data. GIS was used to create a centroid or point representing the center of the parcel polygon in the parcel layer to represent the location of the primary structure on each parcel. The structure inventory data set was formatted for use in HAZUS using the HAZUS Comprehensive Data Management System (CDMS) tool. This tool syncs data and attributes fields necessary for HAZUS analysis and imports the enhanced data set into the HAZUS study region.

After the hazard and inventory data was imported into HAZUS, analysis was completed to determine the potential losses as a result of a 1-percent annual chance flood. The results of this analysis are provided in the following sections on Potential Losses to Existing Development.

The following jurisdictions would have losses as a result of a 1-percent annual chance flood: Bellevue, LaMotte, Maquoketa, Miles, Monmouth, Preston, Sabula, St. Donatus, and Unincorporated Jackson County. Andrew, Baldwin, Sprague ville, Springbrook and the portion of Zwingle in Jackson does not have any estimated losses as a result of a 1-percent annual chance flood.

For the planning area ranking, the HMPC determined the magnitude of river flooding to be "Limited." Individual jurisdictional ratings are provided at the end of this hazard section.

Magnitude/Severity Score: 2 -- Limited

Potential Losses to Existing Development

The potential losses to existing development will be provided for the following categories:

- Building/Contents Losses;
- Estimated Population Displaced;
- Agricultural Impacts; and
- Critical Facilities and Infrastructure at Risk.

Building/Contents Losses

Table 3.36. provides the summary of potential flood loss estimates and impacted population for the 1-percent annual chance flood by jurisdiction based on the HAZUS Level 2 Analysis.

Table 3.36. Potential Flood Loss Estimates, 1-Percent Annual Chance Flood

Jurisdiction	Property Type	Parcels	Improved Value	Content Value	Improved Losses	Content Losses	Inventory Losses	Total Losses
Bellevue	Commercial	2	$218,000	$218,000	$8,169	$22,328	$28,933	$59,430
	Residential	24	$4,517,600	$2,258,800	$344,917	$120,143	$0	$465,060
	Total	**26**	**$4,735,600**	**$2,476,800**	**$353,086**	**$142,471**	**$28,933**	**$524,491**
Green Island	Commercial	1	$36,800	$36,800	$2,814	$8,075	$9,729	$20,619
	Residential	19	$547,600	$273,800	$53,759	$20,539	$0	$74,298
	Total	**20**	**$584,400**	**$310,600**	**$56,574**	**$28,614**	**$9,729**	**$94,916**
LaMotte	Commercial	2	$188,800	$188,800	$8,064	$22,303	$28,395	$58,762
	Residential	5	$388,600	$194,300	$8,798	$4,865	$0	$13,663
	Total	**7**	**$577,400**	**$383,100**	**$16,861**	**$27,168**	**$28,395**	**$72,425**
Maquoketa	Commercial	2	$25,200	$25,200	$2,663	$7,819	$9,237	$19,719
	Residential	5	$833,800	$416,900	$76,994	$25,097	$0	$102,091
	Total	**7**	**$859,000**	**$442,100**	**$79,657**	**$32,916**	**$9,237**	**$121,811**
Miles	Agriculture	2	$5,900	$5,900	$131	$660	$547	$1,339
	Total	**2**	**$5,900**	**$5,900**	**$131**	**$660**	**$547**	**$1,339**
Monmouth	Residential	3	$125,900	$62,950	$2,491	$883	$0	$3,375
	Total	**3**	**$125,900**	**$62,950**	**$2,491**	**$883**	**$0**	**$3,375**
Preston	Industrial	1	$11,000	$16,500	$625	$1,287	$1,083	$2,995
	Residential	1	$110,100	$55,050	$16,066	$4,926	$0	$20,992
	Total	**2**	**$121,100**	**$71,550**	**$16,691**	**$6,213**	**$1,083**	**$23,986**
Sabula	Commercial	1	$90,400	$90,400	$2,227	$5,778	$8,083	$16,088
	Industrial	1	$550,000	$825,000	$86,603	$291,270	$229,232	$607,105
	Residential	6	$323,900	$161,950	$22,446	$8,334	$0	$30,780
	Total	**8**	**$964,300**	**$1,077,350**	**$111,277**	**$305,383**	**$237,314**	**$653,974**
St. Donatus	Residential	6	$552,600	$276,300	$40,057	$15,634	$0	$55,690
	Total	**6**	**$552,600**	**$276,300**	**$40,057**	**$15,634**	**$0**	**$55,690**
Unincorporated	Agriculture	39	$258,700	$258,700	$10,942	$44,924	$48,551	$104,417
	Commercial	1	$19,400	$19,400	$1,866	$5,429	$6,447	$13,742
	Industrial	1	$274,300	$411,450	$44,557	$148,850	$117,398	$310,805
	Residential	88	$8,403,900	$4,201,950	$831,057	$332,171	$0	$1,163,228
	Total	**129**	**$8,956,300**	**$4,891,500**	**$888,422**	**$531,374**	**$172,396**	**$1,592,193**
	Grand Total	**210**	**$17,482,500**	**$9,998,150**	**$1,565,248**	**$1,091,317**	**$487,635**	**$3,144,199**

Source: Hazus MH 2.2; Jackson County Assessor's Office, Iowa Flood Center

Estimated Population Displaced

To estimate population displaced by a 1-percent annual chance flood, the number of residential structures impacted was multiplied by the average household size for each jurisdiction. According to the HAZUS Level 2 analysis, there would be a total of 157 residential structures impacted. **Table 3.37.** provides the estimated population impacted for each jurisdiction that

would have flood losses.

Table 3.37. Estimated Displaced Population

Jurisdiction	Residential Properties Impacted	Average Household Size	Estimated Displaced Population
Bellevue	24	2.19	53
LaMotte	5	2.34	12
Maquoketa	5	2.23	11
Miles	0	2.29	0
Monmouth	3	2.40	7
Preston	1	2.30	2
Sabula	6	2.04	12
St. Donatus	6	2.13	13
Green Island (Unincorporated.)	19	2.54	48
Unincorporated	88	2.54	224
Total	**157**		**382**

Source: Average Household Size, U.S. Census Bureau 2015 American Community Survey 5-year Estimates, Residential Properties Impacted, Hazus Analysis Results

Agricultural Impacts

Additionally, USDA crop insurance claims for excess moisture/precipitation/rain and flood conditions for the ten-year period from 2014-2023 totaled $7,997,552. Considering that 89 percent of insurable crops are insured in Iowa (2015 Iowa Crop Insurance Profile, USDA, RMA), the adjusted losses calculate to $8,986,015 for all insurable crops for the period. This results in an average annual loss estimate of $898,601 to insurable crops as a result of excess moisture/precipitation/rain and flood conditions affecting agriculture.

Critical Facilities and Infrastructure at Risk

To analyze critical facilities at risk in the planning area, the inventory of critical and essential facilities and infrastructure in the planning area was compiled from various sources including the Jackson County, HSIP Freedom 2015, and the Iowa Department of Natural Resources (NRGIS). A comparison was made of the 201 facilities in the NFHL layer to determine those facilities that would be damaged in the 1-percent and 0.2-percent annual chance flood events.

This analysis determined that 10 critical facilities are in the 1-percent annual chance floodplain. No critical facilities in the inventory are in the 0.2-percent annual chance floodplain.

Appendix E provides the list of critical facilities that were inventoried and analyzed. This Appendix is redacted from the public version of this plan. To obtain access for official use, contact the Jackson County Emergency Management Agency.

FEMA's HAZUS Average Annualized Loss

In 2010, FEMA conducted a Level 1 HAZUS MR4 flood analysis to estimate average annualized losses (AAL). This AAL study examined river and coastal flood hazards in the 48 contiguous states (including the District of Columbia) by county. Hawaii, Alaska, Puerto Rico, and US territories were not analyzed as part of this study. The AAL study estimated flood losses for the following storm events, which were then used to develop the annualized loss estimate: 10% annual chance (10-year), 2% annual chance (50-year), 1% annual chance (100-year), 0.5%

annual chance (200-year), and 0.2% annual chance (500-year).

The data from the AAL Study was calculated at the census block level, based on HAZUS' hydrology and hydraulic analysis of streams draining 10 square miles or greater and utilizing 30m Digital Elevation Model (DEM) data. It includes estimated replacement values and flood losses for both buildings and contents, based on 2000 census data, and is aggregated by structure type (residential, commercial, and other). For certain reaches of stream, the hydrology or hydraulics failed during the AAL study, and loss estimates were not able to be calculated. In some of the coastal areas, both river and coastal loss estimates were calculated, but may not be distinct in the AAL results. In spite of these known data gaps, the AAL study represents a baseline level of flood risk assessment results which can be used where more refined analyses are not conducted or available. The AAL Study estimates $3,900,000 in Average Annual Losses (AAL) for Jackson County, Iowa.

Future Development
Any future development in floodplains would increase risk in those areas. For those communities that participate in the National Flood Insurance Program, enforcement of the floodplain management regulations will ensure mitigation of future construction in those areas. With new regulatory flood maps in process of becoming effective, additional communities with designated Special Flood Hazard Areas are intending to join the National Flood Insurance Program, including regulation of development in their floodplains.

Climate Change Impacts
One of the climate change impacts noted in the *2010 Climate Change Impacts on Iowa* report by the Iowa Climate Change Impacts Committee is the increase in frequency of severe precipitation events. This climate change impact was also noted in the Flash Flood hazard analysis. Although very heavy precipitation does not always result in river flooding, it can if/when the very heavy precipitation occurs frequently without enough time for the watershed to drain away as much water is coming in due to precipitation in the watershed or upstream watersheds. For this study, very heavy precipitation was defined as the heaviest 1% of all events. If this trend increases, flash flooding events and their associated impacts will likely occur more often in the planning area.

In **Section 3.5.4.** Flash Flood hazard profile, **Figure 3.16.** shows projected changes in spring (March–May) precipitation (%) for the middle of the 21st century compared to the late 20th century under a higher emissions pathway. The whited-out area indicates that the climate models are uncertain about the direction of change. Hatching represents areas where the majority of climate models indicate a statistically significant change. Iowa is part of a large area of projected increases in the Northeast and Midwest.

Flooding – River Hazard Summary by Jurisdiction
To demonstrate how river flooding varies additionally by jurisdiction, all jurisdictions that had any structures at risk to the 1-percent annual chance flood received a rating of 3 for probability.

Magnitude for the county and incorporated cities was based on the loss estimates. Jurisdictions with less than $100,000 in estimated losses received a magnitude of negligible (1), a loss estimate between $100,000 and $500,000 magnitude of limited (2), and loss estimates over $500,000 received a magnitude of 3 -- Critical.

It should be noted that the HAZUS loss estimates quantify losses to tax-assessed structures only. Loss estimates, including losses to infrastructure and public buildings would be much

higher.

For those jurisdictions with no Special Flood Hazard Areas, all elements indicate Not Applicable (N/A) unless other specific infrastructure has been identified as vulnerable in the floodplain.

To determine the rankings for the school districts, the critical facility layer of school buildings was compared against the Flood Insurance Rate Map. This analysis revealed no public k-12 school buildings in the 1-percent or 0.2-percent annual chance floodplains.

The warning time and duration were considered to be 2 and 3 for all jurisdictions to which the flood hazard applies.

Jurisdiction	Probability	Magnitude/ Severity	Warning Time	Duration	Weighted Score	Level
Unincorporated	3	3	2	3	2.85	Moderate
Andrew	N/A	N/A	N/A	N/A	N/A	N/A
Baldwin	3	1	2	3	2.25	Moderate
Bellevue	3	3	2	3	2.85	Moderate
LaMotte	3	1	2	3	2.25	Moderate
Maquoketa	3	2	2	3	2.55	Moderate
Miles	3	1	2	3	2.25	Moderate
Monmouth	3	1	2	3	2.25	Moderate
Preston	3	1	2	3	2.25	Moderate
Sabula	3	3	2	3	2.85	Moderate
Spragueville	3	1	2	3	2.25	Moderate
Springbrook	3	1	2	3	2.25	Moderate
St. Donatus	3	1	2	3	2.25	Moderate
Andrew CSD	N/A	N/A	N/A	N/A	N/A	N/A
Bellevue CSD	N/A	N/A	N/A	N/A	N/A	N/A
Easton Valley CSD	N/A	N/A	N/A	N/A	N/A	N/A
Maquoketa CSD	N/A	N/A	N/A	N/A	N/A	N/A

3.5.6. Hail and Lightning from Thunderstorms

Hazard Score Calculation					
Probability	**Magnitude/Severity**	**Warning Time**	**Duration**	**Weighted Score**	**Level**
4	**2**	**2**	**2**	**2.9**	**Moderate**

Hazard Profile

Hazard Description

A thunderstorm is defined as a storm that contains lightning and thunder which is caused by unstable atmospheric conditions. When the colder upper air sinks and warm moist air rises, storm clouds or 'thunderheads' develop, resulting in thunderstorms. This can occur singularly, in clusters or in lines. Severe thunderstorms most often occur in Iowa in the spring and summer, during the afternoon and evenings, but can occur at any time. Other hazards associated with thunderstorms and lightning include heavy rains causing flash flooding (discussed separately in **Section 3.5.4.**) and tornadoes and windstorms (discussed further in **Section 3.5.9.**).

Lightning

All thunderstorms produce lightning, which often strikes outside of the area where it is raining and is known to fall more than 10 miles away from the rainfall area. Thunder is simply the sound that lightning makes. Lightning is a huge discharge of electricity. When lightning strikes, electricity shoots through the air and causes vibrations creating the sound of thunder. Nationwide, lightning kills 75 to 100 people each year. Lightning strikes can also start building fires, wildland fires, and damage electrical systems and equipment.

Hail

According to the National Oceanic and Atmospheric Administration (NOAA), hail is precipitation that is formed when updrafts in thunderstorms carry raindrops upward into extremely cold areas of the atmosphere causing them to freeze. The raindrops form into small frozen droplets and then continue to grow as they come into contact with super-cooled water which will freeze on contact with the frozen rain droplet. This frozen rain droplet can continue to grow and form hail. As long as the updraft forces can support or suspend the weight of the hailstone, hail can continue to grow.

At the time when the updraft can no longer support the hailstone, it will fall down to the earth. For example, a ¼" diameter or pea sized hail requires updrafts of 24 mph, while a 2 ¾" diameter or baseball sized hail requires an updraft of 81 mph. The largest hailstone recorded in the United States was found in Vivian, South Dakota on July 23, 2010, measuring eight inches in diameter, almost the size of a soccer ball. Soccer-ball-sized hail is the exception, but even small pea sized hail can do damage.

Hailstorms in Iowa cause damage to property, crops, and the environment and kill and injure livestock. In the United States, hail causes more than $1 billion in damage to property and crops each year. Much of the damage inflicted by hail is to crops. Even relatively small hail can shred plants to ribbons in a matter of minutes. Vehicles, roofs of buildings and homes, and landscaping are the other things most commonly damaged by hail. Hail has been known to cause injury to humans, occasionally, these injuries can be fatal.

Table 3.38. below describes typical damage impacts of the various sizes of hail.

Table 3.38. Tornado and Storm Research Organization Hailstorm Intensity Scale

Intensity Category	Diameter (mm)	Diameter (in)	Size Description	Typical Damage Impacts
Hard Hail	5-9	.2-.4	Pea	No damage
Potentially Damaging	5-15	.4-.6	Mothball	Slight general damage to plants, crops
Significant	10-20	.6-.8	Marble, Grape	Significant damage to fruit, crops, vegetation
Severe	20-30	.8-1.2	Walnut	Severe damage to fruit and crops, damage to glass and plastic structures, paint and wood scored
Severe	25-40	1.2-1.6	Pigeon's egg > Squash ball	Widespread glass damage, vehicle bodywork damage
Destructive	30-50	1.6-2.0	Golf ball > Pullet's egg	Wholesale destruction of glass, damage to tiled roofs, significant risk of injuries
Destructive	40-60	2.0-2.4	Hen's egg	Bodywork of grounded aircraft dented; brick walls pitted
Destructive	50-75	2.4-3.0	Tennis ball > cricket ball	Severe roof damage, risk of serious injuries
Destructive	60-90	3.0-3.5	Large orange > soft ball	Severe damage to aircraft bodywork
Super Hailstorms	75-100	3.6-3.9	Grapefruit	Extensive structural damage. Risk of severe or even fatal injuries to persons caught in the open
Super Hailstorms	>100	4.0+	Melon	Extensive structural damage. Risk of severe or even fatal injuries to persons caught in the open

The onset of thunderstorms with lightning and hail is generally rapid. However, advancements in meteorological forecasting allow for some advance warning.

Warning Time Score: 2 -- More than 12 to 24 hours warning time

Duration Score: 2-- Less than 1 day

Geographic Location/Extent
Thunderstorms and the associated hail and lightning impact the entire County with relatively similar frequency. Although, these events occur similarly throughout the planned area, they are more frequently reported in more urbanized areas. In addition, damages are more likely to occur in more densely developed urban areas as well as to cropland.

Figure 3.33. displays the annual mean of days with thunderstorms experienced throughout the U.S, from 1993-2028, showing Jackson County experienced between 18+ to 27 thunderstorms days per year.

Figure 3.34. shows the total lightning density in the U.S. for 2016-2022, showing that Jackson County experienced between 24-32 lightning events per square kilometer per year.

Figure 3.33. Distribution and Frequency of Thunderstorms

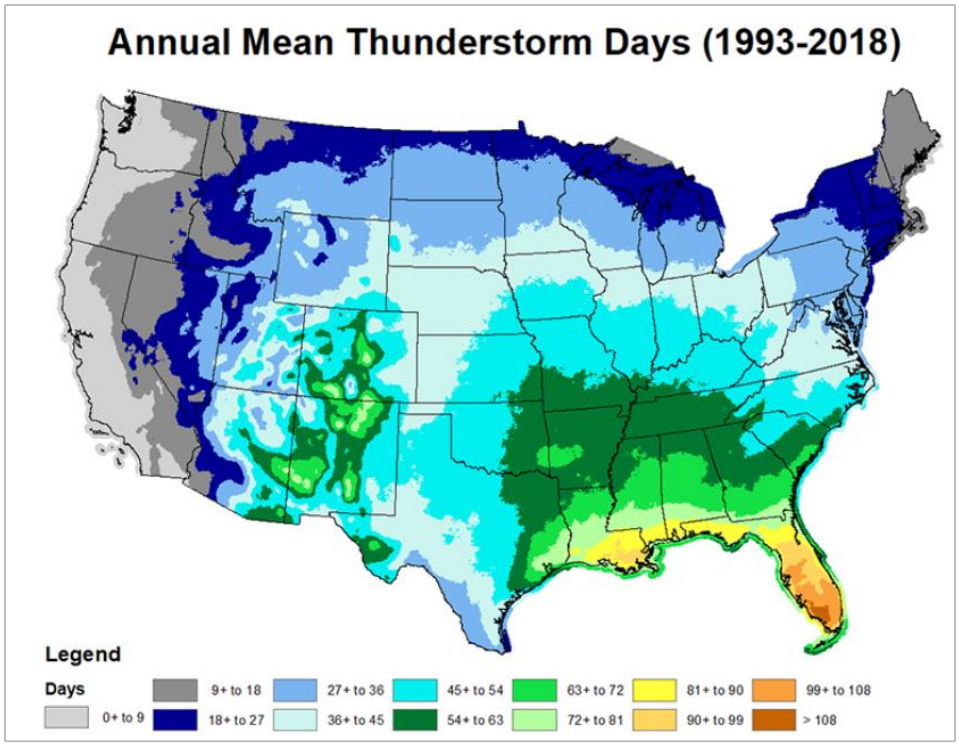
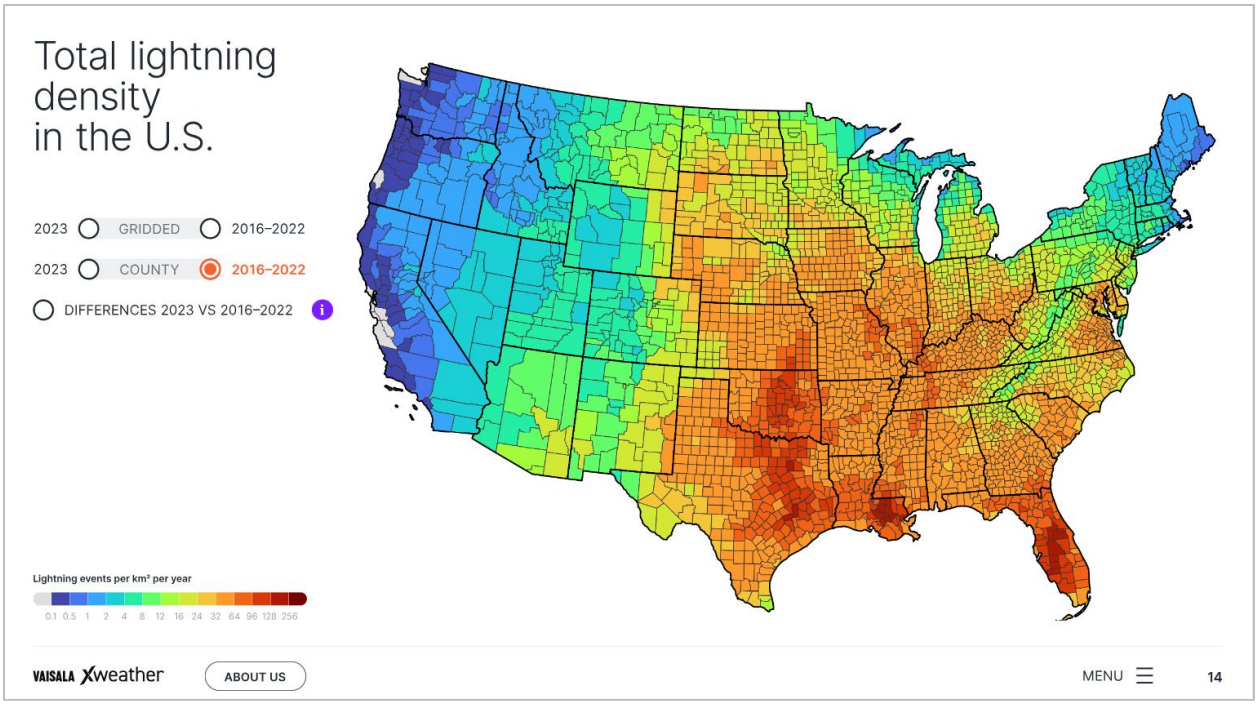


Figure 3.34. Lightning Density Map



Source: 023 Vaisala Xweather Annual Lightning Report https://www.vaisala.com

Previous Occurrences
Since 1965, Jackson County has been included in 13 presidential disaster declarations that included severe storms (see **Table 3.2** in the Hazard Identification Section). Some of the damages that resulted in the declarations were from tornadoes and flooding that accompanied the severe storms.

The National Climatic Data Center (NCDC) reported 197 total thunderstorm events for Jackson County from 1993 to 2023. Of the reported events, there was $27,032,200 in total property damage, one injury, and no fatalities (see **Table 3.39.**).

Table 3.39. Thunderstorm Summary for Jackson County, 1993-2023

Hazard Type	Total Events	Events with Damage	Property Damage	Injuries	Fatalities
Hail	63	19	$20,171,500	0	0
Lightning	0	0	$0	0	0
Thunderstorm Wind	134	55	$6,860,700	1	0
Totals	**197**	**74**	**$27,032,200**	**1**	**0**

Source: National Climate Data Center

Table 3.40. shows the number of hail events in Jackson County summarized by the size of the hail between 1993 to 2023.

Table 3.40. Hail Events by Hail Size, 1993-2023

Hail Size (inches)	# of Events
2.75	2
2.5	1
2	2
1.75	4
1.5	1
1.25	0
1	19
0.88	9
0.75	25
Grand Total	**63**

Thunderstorm Winds
Information concerning tornadoes and windstorms, separate from thunderstorms, can be found in **Section 3.5.9.**

The National Weather Service (NWS) will issue a Severe Thunderstorm Warning whenever a thunderstorm is forecasted to produce wind gusts to 58 miles per hour (50 knots) or greater and/or hail size one inch (quarter-size) diameter which can produce significant damage (source: http://www.nws.noaa.gov/oneinchhail/). The data is kept on Iowa Environmental Mesonet, Iowa State University Department of Agronomy website, http://mesonet.agron.iastate.edu/vtec/search.php.

From 1987 to 2023, there were 114 severe thunderstorm watches and 377 warnings. During this 36-year period, that calculates to an annual average of 3.1 and 10.5 respectively.

Although NCDC provides estimates of crop losses, crop insurance payment statistics are considered a more accurate resource for this data. According to the USDA Risk Management Agency, insured crop losses in Jackson County as a result of hail from 2014 to 2023 totaled $50,951.90 and $995,136.80 from windstorms. There was no crop damage reported from lightning. **Table 3.41.** shows the crop insurance claims paid in Jackson County from hailstorms and windstorms from 2014 – 2023.

Table 3.41. Crop Insurance Claims Paid for Hailstorms and Windstorms, 2014-2023

Year	Hail	Wind or Excess Wind	Insurance Paid
2014	$4,794.00	$243,242.80	$248,036.80
2015		$1,181.60	$1,181.60
2016		$6,288.00	$6,288.00
2017	$13,779.00	$4,227.00	$18,006.00
2018	$7,698.00	$11,700.00	$19,398.00
2019		$46,843.20	$46,843.20
2020	$7,536.50	$676,462.20	$683,998.70
2021		$1,293.00	$1,293.00
2022		$3,899.00	$3,899.00
2023	$17,144.40		$17,144.40
Total	**$50,951.90**	**$995,136.80**	**$1,046,088.70**

Source: USDA Risk Management Agency

Probability of Future Occurrence

NCDC reported no damaging lightning events from 1993 through 2023 for Jackson County. Since lightning accompanies thunderstorms, it can be assumed that lightning occurs more often than damages are reported. These rates of occurrence are expected to continue in the future.

Based on NCDC data, there have been 58 damaging hail events and 111 damaging thunderstorm wind events. This translates to an annual average of 2.4 and 4.6 damaging events per year, respectively. Based on this history, damaging hail and thunderstorm wind occur in the planning area multiple times each year making the probability for damaging events "Highly Likely" in any given year.

Probability Score: 4 -- Highly Likely

Vulnerability Assessment

Vulnerability Overview

In general, assets in Jackson County are vulnerable to thunderstorms, winds, lightning and hail including people, crops, vehicles, and built structures. According to the *2013 Iowa Hazard Mitigation Plan*, of the 8 hazards for which data was available to estimate annualized losses, thunderstorm with lightning and hail ranked 4th with $30 million in annualized losses based on data spanning a 17-year period. Although this hazard results in high annual losses, generally private property insurance and crop insurance cover the majority of losses. Considering insurance coverage as a recovery capability and therefore mitigation of devastating impacts to the economy, the overall impact on jurisdictions is reduced; therefore, this hazard's magnitude score to the planning area is "limited."

Magnitude Score: 2 – Limited

Potential Losses to Existing Development
Most lightning damages occur to electronic equipment located inside buildings. But structural damage can also occur when a lightning strike causes a building fire. In addition, lightning strikes can cause damages to crops if fields light on fire. Communications equipment and warning transmitters and receivers can also be knocked out by lightning strikes. There have not been any fatalities in Jackson County from lightning strikes. Thunderstorm winds and hail can cause damage to property, vehicles, trees, and crops.

Property and Crop Losses
Table 3.42. provides the NCDC estimated annualized property damages resulting from Thunderstorms, including lightning, hail and wind, for Jackson County from 1993-2023 .

Table 3.42. Estimated Annualized Property Damages from Hail, Lightning, and Wind

Severe Weather Event	Property Damages	Annualized Property Damages
Hail	$20,171,500	$2,017,150
Lightning	$0	$0
Thunderstorm Wind	$6,860,700	$686,070
Total	**$27,032,200**	**$2,703,220**

Source: National Climate Data Center

Table 3.43. provides the insured crop losses for resulting from hail and wind in Jackson County. The insured loss has been adjusted to estimate losses to all insurable crops by considering that 89 percent of insurable crops in the State were insured (2015 Iowa Crop Insurance Profile from USDA's Risk Management Agency).

Table 3.43. Estimated Insurable Annualized Crop Damages from Hail and Wind

10-Year Insurance Paid	Adjusted 10-Year Losses (considering 89% insured)	Estimated Annualized Losses	2022 Value of Crops	Annualized Crop Loss Ratio (Losses/Value)
$1,046,088.70	$7,777,256.55	$777,725.65	$176,285,000.00	0.44%

Source: USDA Risk Management Agency

Future Development
Any additional future development will result in more property being vulnerable to damages from severe thunderstorms, lightning and hail. To minimize vulnerability, protective measures could be implemented such as wind-resistant construction, lightning rods, surge protection, and use of materials less prone to hail/wind damage.

Climate Change Impacts
According to the 2010 *Climate Change Impacts on Iowa* report, growing evidence points to stronger summer storm systems in the Midwest. Studies have not been done to conclusively say that severe storms, including hail, lightning, and strong winds, are increasing. However, with summer temperatures becoming warmer and humidity levels increasing, an increase in the likelihood of these hazards is plausible.

Hail and Lightning from Thunderstorms Hazard Summary by Jurisdiction
The following hazard summary table shows that this hazard does not vary significantly by jurisdiction. Although structural property damages are higher in the urban areas, the rural areas have higher damages to agriculture.

Jurisdiction	Probability	Magnitude/ Severity	Warning Time	Duration	Weighted Score	Level
Unincorporated	4	2	2	2	2.9	Moderate
Andrew	4	2	2	2	2.9	Moderate
Baldwin	4	2	2	2	2.9	Moderate
Bellevue	4	2	2	2	2.9	Moderate
LaMotte	4	2	2	2	2.9	Moderate
Maquoketa	4	2	2	2	2.9	Moderate
Miles	4	2	2	2	2.9	Moderate
Monmouth	4	2	2	2	2.9	Moderate
Preston	4	2	2	2	2.9	Moderate
Sabula	4	2	2	2	2.9	Moderate
Spragueville	4	2	2	2	2.9	Moderate
Springbrook	4	2	2	2	2.9	Moderate
St. Donatus	4	2	2	2	2.9	Moderate
Andrew CSD	4	2	2	2	2.9	Moderate
Bellevue CSD	4	2	2	2	2.9	Moderate
Easton Valley CSD	4	2	2	2	2.9	Moderate
Maquoketa CSD	4	2	2	2	2.9	Moderate

3.5.7. Severe Winter Storm

Hazard Score Calculation					
Probability	**Magnitude/Severity**	**Warning Time**	**Duration**	**Weighted Score**	**Level**
3	**2**	**1**	**3**	**2.4**	**Moderate**

Hazard Profile

Hazard Description

Severe winter storms are an annual occurrence in Iowa. A major winter storm can last for several days and be accompanied by high winds, freezing rain or sleet, heavy snowfall, cold temperatures and drifting snow creating blizzards. The National Weather Service describes different types of winter storm events as follows:

- **Blizzard**—Winds of 35 mph or more with snow and blowing snow reducing visibility to less than ¼ mile for at least three hours.
- **Blowing Snow**—Wind-driven snow that reduces visibility. Blowing snow may be falling snow and/or snow on the ground picked up by the wind.
- **Snow Squalls**—Brief, intense snow showers accompanied by strong, gusty winds. Accumulation may be significant.
- **Snow Showers**—Snow falling at varying intensities for brief periods of time. Some accumulation is possible.
- **Freezing Rain**—Measurable rain that falls onto a surface with a temperature below freezing. This causes it to freeze to surfaces, such as trees, cars, and roads, forming a coating or glaze of ice. Most freezing-rain events are short lived and occur near sunrise between the months of December and March.
- **Sleet**—Rain drops that freeze into ice pellets before reaching the ground. Sleet usually bounces when hitting a surface and does not stick to objects.

Heavy accumulations of ice, often the result of freezing rain, can bring down trees, utility poles, and communications towers and disrupt communications and power for days. Even small accumulations of ice can be extremely dangerous to motorists and pedestrians.

Severe winter storms include extreme cold, heavy snowfall, ice, and strong winds which can push the wind chill well below zero degrees in the planning area. Heavy snow can bring a community to a standstill by inhibiting transportation (in whiteout conditions), weighing down utility lines, and by causing structural collapse in buildings not designed to withstand the weight of the snow. Repair and snow removal costs can be significant. Ice buildup can collapse utility lines and communication towers, as well as make transportation difficult and hazardous. Ice can also become a problem on roadways if the air temperature is high enough so that precipitation falls as freezing rain rather than snow.

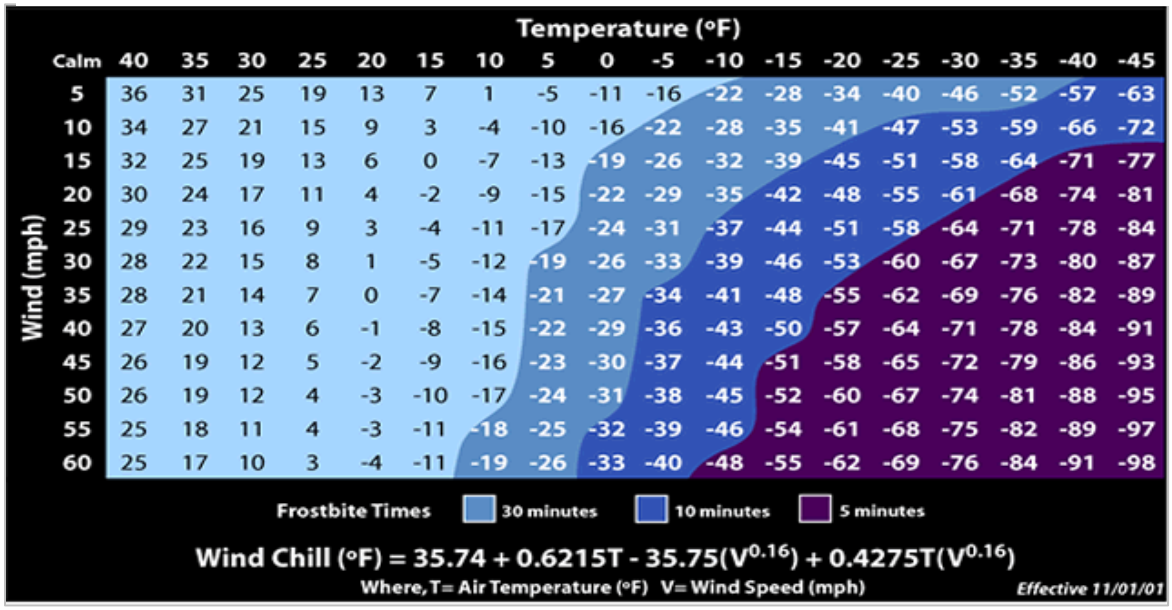
Extreme cold often accompanies severe winter storms and can lead to hypothermia and frostbite in people who are exposed to the weather without adequate clothing protection. Cold can cause fuel to congeal in storage tanks and supply lines, stopping electric generators. Cold

temperatures can also overpower a building's heating system and cause water and sewer pipes to freeze and rupture. When combined with high winds from winter storms, extreme cold becomes extreme wind chill, which is extremely hazardous to health and safety.

The National Institute on Aging estimates that more than 2.5 million Americans are especially vulnerable to hypothermia, with the isolated elderly being most at risk. About 10 percent of people over the age of 65 have some kind of temperature-regulating defect, and 3-4 percent of all hospital patients over 65 are hypothermic.

Also, at risk are those without shelter or who are stranded, or who live in a home that is poorly insulated or without heat. Other impacts of extreme cold include asphyxiation (unconsciousness or death from a lack of oxygen) from toxic fumes from emergency heaters; household fires, which can be caused by fireplaces and emergency heaters; and frozen/burst pipes.
Wind can greatly amplify the impact of cold ambient air temperatures. Provided by the National Weather Service**, Figure 3.35.** below shows the relationship of wind speed to apparent temperature and typical time periods for the onset of frostbite.

Figure 3.35. NOAA/NWS Wind Chill Chart

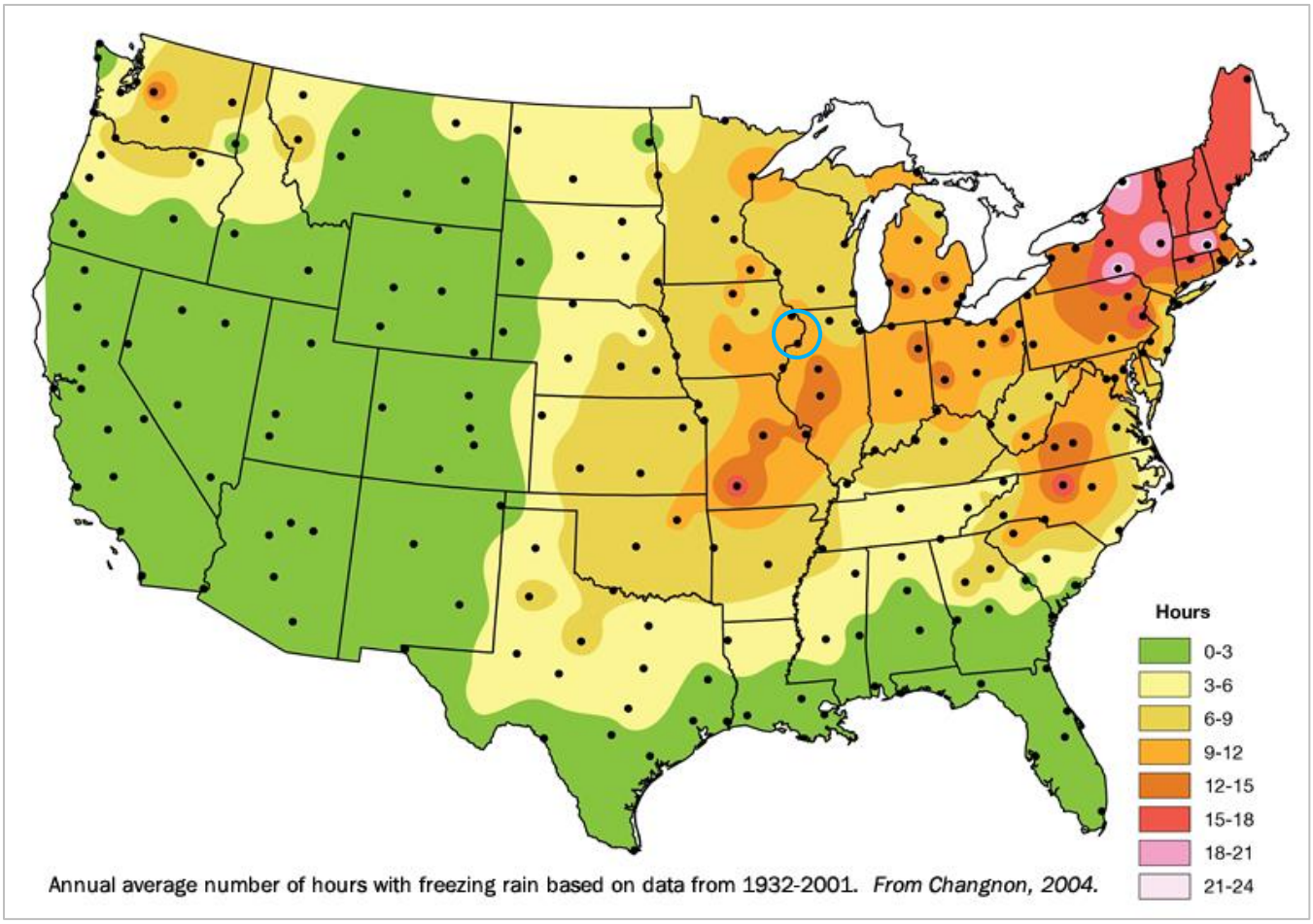


Warning Time Score: 1 -- More than 24 hours warning time

Duration Score: 3 -- Less than 1 week

Geographic Location/Extent
The entire state of Iowa is vulnerable to heavy snow, extreme cold temperatures and freezing rain. Generally, winter storms occur between the months of November and March but can occur as early as October and as late as April. **Figure 3.36.** shows that the planning area is in the orange-shaded area that receives 9-12 hours of freezing rain per year.

Figure 3.36. Average Number of Hours per Year with Freezing Rain



Previous Occurrences

According to the High Plains Regional Climate Center and based on the Maquoketa Weather Station, the planning area has an average maximum temperature of 31.85 ºF in December, 28.02 ºF in January, and 32.91 ºF in February. Average minimum temperatures for those same three months are 15.44 ºF, 10.48 ºF and 14.65 ºF. Average snowfall is highest in December, January, and February with an annual average of 29 inches. (Source: http://www.hprcc.unl.edu/datasets.php?set=CountyData#)

Historically, there has been one Presidential Disaster Declaration for Severe Winter Storms that included Jackson County since 1965 (See **Table 3.2** in the Hazard Identification Section).

From 1993 thru 2023, the NCDC reported 181 severe winter weather events in Jackson County as shown in **Table 3.44.** During this 30-year period, this translates to an average of 6 severe winter weather events each year. The total property damage for these 181 events was $96,000 due to heavy snow, winter storm, and winter weather events. Crop damage of $495,000 was reported for a frost/freeze event in 2005. There was one death reported due to a winter storm event in 1996. There were no injuries reported during this time period for any of these events.

Table 3.44. Severe Winter Weather Events in Jackson County, 1993-2023

Category	Number	Injuries	Deaths	Property Damage	Crop Damage
Blizzard	7	0	0	$0	$0
Cold/Wind Chill	6	0	0	$0	$0
Extreme Cold/Wind Chill	11	0	0	$0	$0
Freezing Fog	1	0	0	$0	$0
Frost/Freeze	7	0	0	$0	$495,000
Heavy Snow	17	0	0	$10,000	$0
Ice Storm	8	0	0	$0	$0
Winter Storm	64	0	1	$80,000	$0
Winter Weather	60	0	0	$6,000	$0
Total	**181**	**0**	**1**	**$96,000**	**$495,000**

Source: National Climate Data Center

NOAA's National Weather Service has issued 610 Advisory, Watch, and/or Warnings concerning winter weather phenomena in Jackson County from June 1, 1986 to January 26, 2024 (see **Table 3.45.**). The data is kept with Iowa Environmental Mesonet, Iowa State University Department of Agronomy website, (http://mesonet.agron.iastate.edu/vtec/search.php).

Table 3.45. National Weather Service Issuances for Winter Weather in Jackson County

Phenomenon/Significance	Advisory	Warning	Watch	Total
Blizzard		11	4	15
Blowing Snow	7			7
Freeze		46	12	58
Freezing Fog	2			2
Freezing Rain	12			12
Frost	49			49
Heavy Snow				0
Ice Storm		2		2
Snow	14			14
Snow and Blowing Snow	5			5
Wind Chill	98	22	5	125
Winter Storm		65	71	136
Winter Weather	185			185
Grand Total	**372**	**146**	**92**	**610**

Source: Iowa State University Department of Agronomy;
https://mesonet.agron.iastate.edu/vtec/search.php#byugc/IAZ054

Agricultural Impacts

Winter storms, cold, frost and freeze take a toll on crop production in the planning area. According to the USDA's Risk Management Agency, payments for insured crop losses in the planning area as a result of cold conditions and snow from 2014-2023 totaled $170,500 (see **Table 3.46.**).

Table 3.46. Crop Insurance Claims Paid in Jackson County as a Result of Cold Conditions and Snow (2014-2023)

Year	Cold Wet Weather	Cold Winter	Total Insurance Paid
2014	$112,990		$112,990
2016	$372		$372
2017	$673		$673
2019	$5,309		$5,309
2022	$21,197	$2,064	$23,261
2023	$27,895		$27,895
Total	**$168,436**	**$2,064**	**$170,500**

Source: USDA Risk Management Agency

Probability of Future Occurrence

From 1993 thru 2023, the NCDC reported 181 severe winter weather events as shown in **Table 3.44.** During this 30-year period, this translates to an average of 6 severe winter weather events each year. Therefore, the probability rating is "Likely."

Probability Score: 3 -- Likely

Vulnerability Assessment

Vulnerability Overview

The entire planning area is vulnerable to the effects of winter storm. Hazardous driving conditions due to snow and ice on highways and bridges lead to many traffic accidents and can impact the response of emergency vehicles. The leading cause of death during winter storms is transportation accidents. About 70 percent of winter-related deaths occur in automobiles due to traffic accidents and about 25 percent are from people caught outside in a storm. Emergency services such as police, fire, and ambulance are unable to respond due to road conditions.

Emergency needs of remote or isolated residents for food or fuel, as well as for feed, water and shelter for livestock are unable to be met. The probability of utility and infrastructure failure increases during winter storms due to freezing rain accumulation on utility poles and power lines. People, pets, and livestock are also susceptible to frostbite and hypothermia during winter storms. Those at risk are primarily either engaged in outdoor activity (shoveling snow, digging out vehicles, or assisting stranded motorists), or are the elderly. Schools often close during extreme cold or heavy snow conditions to protect the safety of children and bus drivers.

Citizens' use of kerosene heaters and other alternative forms of heating may create other hazards such as structural fires and carbon monoxide poisoning.

Magnitude/Severity Score: 2 -- Limited

Potential Losses to Existing Development

Vulnerable Buildings, Infrastructure, and Critical Facilities

Buildings with overhanging tree limbs are more vulnerable to damage during winter storms. Businesses experience loss of income as a result of closure during power outages. In general, heavy winter storms increase wear and tear on roadways though the cost of such damages is difficult to determine. Businesses can experience loss of income as a result of closure during winter storms.

Loss of Use

Overhead power lines and infrastructure are also vulnerable to damages from winter storms, in particular ice accumulation during winter storm events can cause damages to power lines due to the ice weight on the lines and equipment as well as damage caused to lines and equipment from falling trees and tree limbs weighted down by ice. Potential losses would include cost of repair or replacement of damaged facilities, and lost economic opportunities for businesses.

Secondary effects from loss of power could include burst water pipes in homes without electricity during winter storms. Public safety hazards include risk of electrocution from downed power lines. Specific amounts of estimated losses are not available due to the complexity and multiple variables associated with this hazard.

The electric power loss of use estimates provided in **Table 3.47.** below were calculated using FEMA's Standard Values for Loss of Service for Utilities published in the June 2009 *BCA Reference Guide*. These figures are used to provide estimated costs associated with the loss of power in relation to the populations in Jackson County's jurisdictions. The loss of use estimates for power failure associated with winter storms is provided as the loss of use cost per person, per day of loss. The estimated loss of use provided for each jurisdiction represents the loss of service of the indicated utility for one day for 10 percent of the population. It is understood that in rural areas, the typical loss of use may be for a larger percentage of the population for a longer time during weather extremes. These figures do not consider physical damages to utility equipment and infrastructure.

Table 3.47. Loss of Use Estimates for Power Failure (One Day)

Jurisdiction	2020 Population	Estimated Affected Population 10%	Electric Loss of Use Estimate ($126 per person per day)
Unincorporated	7,931	793	$99,930.60
Andrew	380	38	$4,788.00
Baldwin	99	10	$1,247.40
Bellevue	2,363	236	$29,773.80
La Motte	237	24	$2,986.20
Maquoketa	6,128	613	$77,212.80
Miles	408	41	$5,140.80
Monmouth	129	13	$1,625.40
Preston	949	95	$11,957.40
Sabula	506	51	$6,375.60
St. Donatus	120	12	$1,512.00
Spragueville	92	9	$1,159.20
Springbrook	143	14	$1,801.80
Total	**19,485**	**1,949**	**$245,511.00**

Property Losses

The total property damage for these 181 events was $96,000 due to heavy snow, winter storm, and winter weather events. Crop damage of $495,000 was reported for a frost/freeze event in 2005. Considering the $176,285,000 market value of crops from the 2022 Census of Agriculture as baseline crop exposure, the estimated annual losses from cold conditions and snow was determined minimal compared to the value of the insurable crops.

Increased Risk Populations
Elderly populations are considered to be at increased risk to Winter Storms and associated extreme cold events. **Table 3.27.** in **Section 3.5.2.** Excessive Heat hazard profile provides the population age 65 years and older in each jurisdiction in the planning area.

Future Development
Future development could potentially increase vulnerability to this hazard by increasing demand on the utilities and increasing the exposure of infrastructure networks.

Climate Change Impacts
According to the 2010 *Climate Change Impacts on Iowa* report, Iowa has experienced a long-term upward trend in temperature:

- Long-term winter temperatures have increased six times more than summer temperatures.
- Nighttime temperatures have increased more than daytime temperatures since 1970.
- Since 1970, daily minimum temperatures have increased in summer and winter; daily maximum temperatures have risen in winter but declined substantially in summer.

If this trend continues, future occurrences of the extreme cold/wind chill aspects of winter storms should decrease. In addition, higher winter temperatures bring higher probability of rain, rather than snow. As a result, the amount of precipitation falling as snow should decrease.

Severe Winter Storm Hazard Summary by Jurisdiction
Although crop loss as a result of winter storm occurs more in the unincorporated portions of the planning area, the losses are not high since corn and soybeans are not in the ground during winter months and only are affected by unusual weather events. The density of vulnerable populations is higher in the cities. Transportation incidents related to winter storm could impact all jurisdictions. With these vulnerabilities that apply to both urban and rural jurisdictions, the probability, magnitude, warning time, and duration are also equal across the planning area.

Jurisdiction	Probability	Magnitude/ Severity	Warning Time	Duration	Weighted Score	Level
Unincorporated	3	2	1	3	2.4	Moderate
Andrew	3	2	1	3	2.4	Moderate
Baldwin	3	2	1	3	2.4	Moderate
Bellevue	3	2	1	3	2.4	Moderate
LaMotte	3	2	1	3	2.4	Moderate
Maquoketa	3	2	1	3	2.4	Moderate
Miles	3	2	1	3	2.4	Moderate
Monmouth	3	2	1	3	2.4	Moderate
Preston	3	2	1	3	2.4	Moderate
Sabula	3	2	1	3	2.4	Moderate
Spragueville	3	2	1	3	2.4	Moderate
Springbrook	3	2	1	3	2.4	Moderate
St. Donatus	3	2	1	3	2.4	Moderate
Andrew CSD	3	2	1	3	2.4	Moderate
Bellevue CSD	3	2	1	3	2.4	Moderate
Easton Valley CSD	3	2	1	3	2.4	Moderate
Maquoketa CSD	3	2	1	3	2.4	Moderate

3.5.8. Sinkholes

Hazard Score Calculation					
Probability	**Magnitude/Severity**	**Warning Time**	**Duration**	**Weighted Score**	**Level**
1	**1**	**4**	**1**	**1.45**	**Low**

Hazard Profile

Hazard Description

Sinkholes are common where the rock below the land surface is limestone, carbonate rock, salt beds, or rocks that can naturally be dissolved by ground water circulating through them. As the rock dissolves, void spaces and caverns develop underground. The sudden collapse of the land surface can be dramatic and range in size from broad, regional lowering of the land surface to localized collapse. Although subsidence can be a naturally occurring hazard, the primary causes of most incidents of subsidence are human activities: underground mining of coal, groundwater or petroleum withdraw, and drainage of organic soils. Land subsidence occurs slowly and continuously over time or on occasion abruptly, as in the sudden formation of sinkholes. Sinkholes can be aggravated by flooding.

Karst is a landscape formed from the dissolution of soluble rocks including limestone, dolomite and gypsum. Sinkholes are a common indication of karst; caves and underground drainage systems are other indicators. With limestone commonly found in northeast Iowa, sinkholes have the potential to occur.

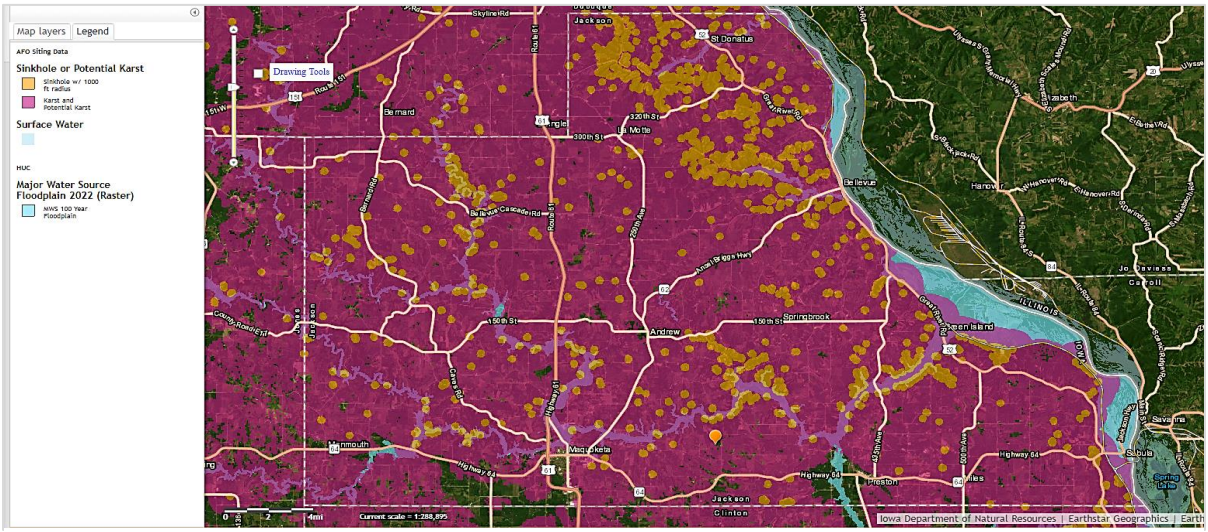
Warning Time Score: 4 – Minimal or no warning time

Duration Score: 1 -- Less than 6 hours

Geographic Location/Extent

Figure 3.37. shows sinkholes as well as karst and potential karst areas in Jackson County.

Figure 3.37. Karst Terrain (Sinkhole Location and Potential) in Jackson

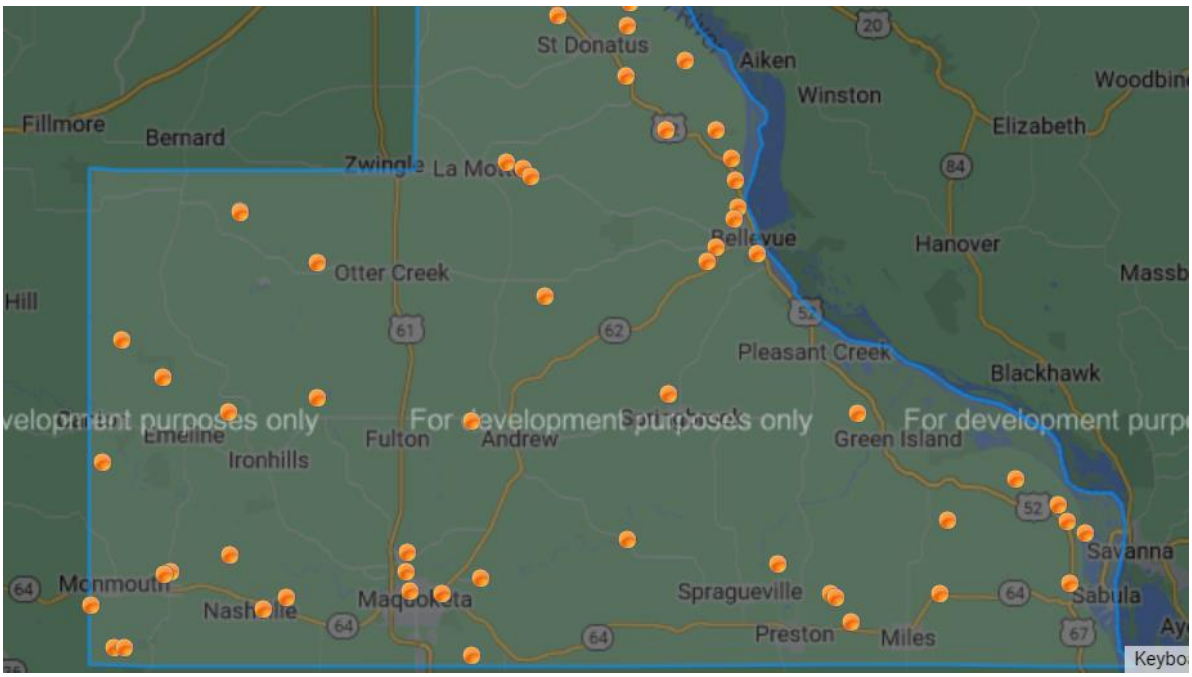


Source: https://www.iowadnr.gov/Environmental-Protection/Animal-Feeding-Operations/AFO-Online-Services

Mining activity within the planning area has been minimal. USMining.com maintains an interactive map and an inventory of mines, mine owners, and mine statistics for Jackson County (see **Figure**

3.38.). Sites include quarries producing crushed rock, stone, sand, and gravel; diggings; and pits.

Figure 3.38. Historic Mining Areas in Jackson County



Source: USMining.com http://www.us-mining.com/iowa/jackson-county

Previous Occurrences
Research did not reveal any reported previous occurrences of sinkholes in the planning area.

Probability of Future Occurrence
Based on no reports of sinkhole events, the probability of future occurrences is “Unlikely.”

Probability Score: 1 -- Unlikely

Vulnerability Assessment

Vulnerability Overview
If a sinkhole were to form, people and structures located on or near the sinkhole are the most at risk for injury, death, and property damage. However, most of Iowa’s sinkholes occur in rural areas where their main impact is rendering some land unsuitable for row-crop agriculture.

Magnitude/Severity Score: 1 -- Negligible

Potential Losses to Existing Development
Due to the lack of information regarding previous occurrences of this hazard, it is not possible to estimate potential losses.

Future Development
Future development will increase vulnerability to this hazard.

Climate Change Impacts
There are no noted trends in climate change that would not have a significant effect on the occurrence of sinkholes.

Sinkhole Hazard Summary by Jurisdiction

Since the potential for sinkhole occurrence is not significant in the planning area, all jurisdictions were determined to be similar in ratings for probability, magnitude, warning time, and duration.

Jurisdiction	Probability	Magnitude/ Severity	Warning Time	Duration	Weighted Score	Level
Unincorporated	1	1	4	1	1.45	Low
Andrew	1	1	4	1	1.45	Low
Baldwin	1	1	4	1	1.45	Low
Bellevue	1	1	4	1	1.45	Low
LaMotte	1	1	4	1	1.45	Low
Maquoketa	1	1	4	1	1.45	Low
Miles	1	1	4	1	1.45	Low
Monmouth	1	1	4	1	1.45	Low
Preston	1	1	4	1	1.45	Low
Sabula	1	1	4	1	1.45	Low
Spragueville	1	1	4	1	1.45	Low
Springbrook	1	1	4	1	1.45	Low
St. Donatus	1	1	4	1	1.45	Low
Andrew CSD	1	1	4	1	1.45	Low
Bellevue CSD	1	1	4	1	1.45	Low
Easton Valley CSD	1	1	4	1	1.45	Low
Maquoketa CSD	1	1	4	1	1.45	Low

3.5.9. Tornado/Windstorm

Hazard Score Calculation					
Probability	**Magnitude/Severity**	**Warning Time**	**Duration**	**Weighted Score**	**Level**
3	**3**	**3**	**4**	**3.1**	**High**

Hazard Profile

Hazard Description
This hazard section discusses both tornado and windstorm.

Tornado
The NWS defines a tornado as "a violently rotating column of air extending from a thunderstorm to the ground." It is usually spawned by a thunderstorm and produced when cool air overrides a layer of warm air, forcing the warm air to rise rapidly. Often, vortices remain suspended in the atmosphere as funnel clouds. When the lower tip of a vortex touches the ground, it becomes a tornado and a force of destruction.

Tornadoes are the most violent of all atmospheric storms and are capable of tremendous destruction. Wind speeds can exceed 250 miles per hour, and damage paths can be more than one mile wide and 50 miles long. Tornadoes have been known to lift and move objects weighing more than 300 tons a distance of 30 feet, toss homes more than 300 feet from their foundations, and siphon millions of tons of water from water bodies. Tornadoes also generate a tremendous amount of flying debris or "missiles," which often become airborne shrapnel that causes additional damage. If wind speeds are high enough, missiles can be thrown at a building with enough force to penetrate windows, roofs, and walls. However, the less spectacular damage is much more common.

Tornadoes are classified according to the Enhanced Fujita or "EF" Scale. The EF Scale attempts to rank tornadoes according to wind speed based on the damage caused. This update to the original F scale was implemented in the U.S. on February 1, 2007 (see **Table 3.48.**).

Table 3.48. Enhanced Fujita (EF) Scale for Tornado Damage

Fujita Scale			Derived EF Scale		Operational EF Scale	
F Number	**Fastest 1/4-mile (mph)**	**3 Second Gust (mph)**	**EF Number**	**3 Second Gust (mph)**	**EF Number**	**3 Second Gust (mph)**
1	73-112	79-117	1	86-109	1	86-110
2	113-157	118-161	2	110-137	2	111-135
3	158-207	162-209	3	138-167	3	136-165
4	208-260	210-261	4	168-199	4	166-200
5	261-318	262-317	5	200-234	5	Over 200

The wind speeds for the EF scale and damage descriptions are based on information on the NOAA Storm Prediction Center as listed in **Table 3.49.** The damage descriptions are summaries. For the actual EF scale, it is necessary to look up the damage indicator (type of structure damaged) and refer to the degrees of damage associated with that indicator. Information on the Enhanced Fujita Scale's damage indicators and degrees of damage is located online at www.spc.noaa.gov/efscale/ef-scale.html.

Table 3.49. Enhanced Fujita (EF) Scale with Potential Tornado Damage

Scale	Wind Speed (mph)	Relative Frequency	Potential Damage
EF0	65-85	53.5%	Light. Peels Surface off some roofs; some damage to gutters or siding; branches broken off trees; shallow rooted trees pushed over. Confirmed tornadoes with no reported damage (i.e. those that remain in open fields) are always rated EF0.
EF1	86-110	31.6%	Moderate. Roofs severely stripped; mobile homes overturned or badly damaged; loss of exterior doors; windows and other glass broken.
EF2	111-135	10.7%	Considerable. Roofs torn off well-constructed houses; foundations of frame homes shifted; mobile homes completely destroyed; large trees snapped or uprooted; light object missiles generated; cars lifted off ground.
EF3	136-165	3.4%	Severe. Entire stores of well-constructed houses destroyed; severe damage to large buildings such as shopping malls; trains overturned; trees debarked; heavy cars lifted off ground and thrown; structures with weak foundations blown away some distance.
EF4	166-200	0.7%	Devastating. Well-constructed houses and whole frame houses completely levelled; cars thrown, and small missiles generated.
EF5	> 200	< 0.1%	Explosive. Strong frame houses levelled off foundations and swept away; automobile-sized missiles fly in excess of 300 ft; steel reinforced concrete structure badly damaged; high rise buildings have significant structural deformation; incredible phenomena will occur.

The advancement in weather forecasting has provided for the ability to predict severe weather that is likely to produce tornadoes days in advance. Tornado watches can be delivered to those in the path of these storms several hours in advance. Lead time for actual tornado warnings is about 30 minutes. Tornadoes have been known to change paths very rapidly, thus limiting the time in which to take shelter. Tornadoes may not be visible on the ground if they occur after sundown or due to blowing dust or driving rain and hail.

Windstorm

A windstorm for purposes of this plan refers to other non-tornadic damaging winds of thunderstorms including downbursts, microbursts, and straight-line winds.

- *Downbursts* are localized currents of air blasting down from a thunderstorm, which induce an outward burst of damaging wind on or near the ground.

- *Microbursts* are minimized downbursts covering an area of less than 2.5 miles across. They include a strong wind shear (a rapid change in the direction of wind over a short distance) near the surface. Microbursts may or may not include precipitation and can produce winds at speeds of more than 150 miles per hour.

- *Straight-line winds* are generally any thunderstorm wind that is not associated with rotation. It is these winds, which can exceed 100 mph, which represent the most common type of severe weather and are responsible for most wind damage related to thunderstorms.

Since thunderstorms do not have narrow tracks like tornadoes, the associated wind damage can be extensive and affect entire (and multiple) counties. Objects like trees, barns,

outbuildings, high-profile vehicles, and power lines/poles can be toppled or destroyed, and roofs, windows, and homes can be damaged as wind speeds increase.

The NWS can issue High Wind Watch, High Wind Warning, and High Wind Advisory to the public. The following are the definitions of these issuances:

- *High Wind Watch*—This is issued when there is the potential of high wind speeds developing that may pose a hazard or is life-threatening.

- *High Wind Warning*—The 1-minute surface winds of 35 knots (40 mph) or greater lasting for one hour or longer, or winds gusting to 50 knots (58 mph) or greater, regardless of duration, that are either expected or observed over land.

- *High Wind Advisory*—This is issued when high wind speeds may pose a hazard. Sustained winds 25 to 39 mph and/or gusts to 57 mph.

Derecho
According to the National Weather Service at https://www.weather.gov/dmx/PastIowaDerechos:

A derecho produces a swath of particularly damaging thunderstorm winds (specifically, wind gusts of at least 58 mph along most of its length with several well-separated 75 mph or greater gusts) over an area at least 250 miles long.

Wind speeds in a derecho can exceed 100 mph, which is equivalent to that of an EF-1 tornado, but over a vastly larger area than a tornado would impact. Tornadoes can also be embedded within derechos and produce concentrated areas of even more intense damage.

Progressive derechos develop in an environment with very warm and moist air at the surface, colder air aloft, and moderate to strong winds at upper levels of the atmosphere. Serial derechos are caused by strong low pressure and associated strong low-level winds with a squall line containing embedded bow echoes.

Contrary to tornadoes, wind damage from derechos typically occurs in one direction along a relatively straight swath, hence the term “straight-line wind damage.” The origin of the term actually comes from the Spanish language, where “derecho” means "direct" or "straight ahead."

Finally, while the damage from a derecho can look like tornado damage, a key distinction between a derecho and a tornado is the widespread damage swath. A tornado's width is generally less than a mile with the widest tornado width around 2.5 miles. A derecho on the other hand produces damage over a much larger width of many miles.

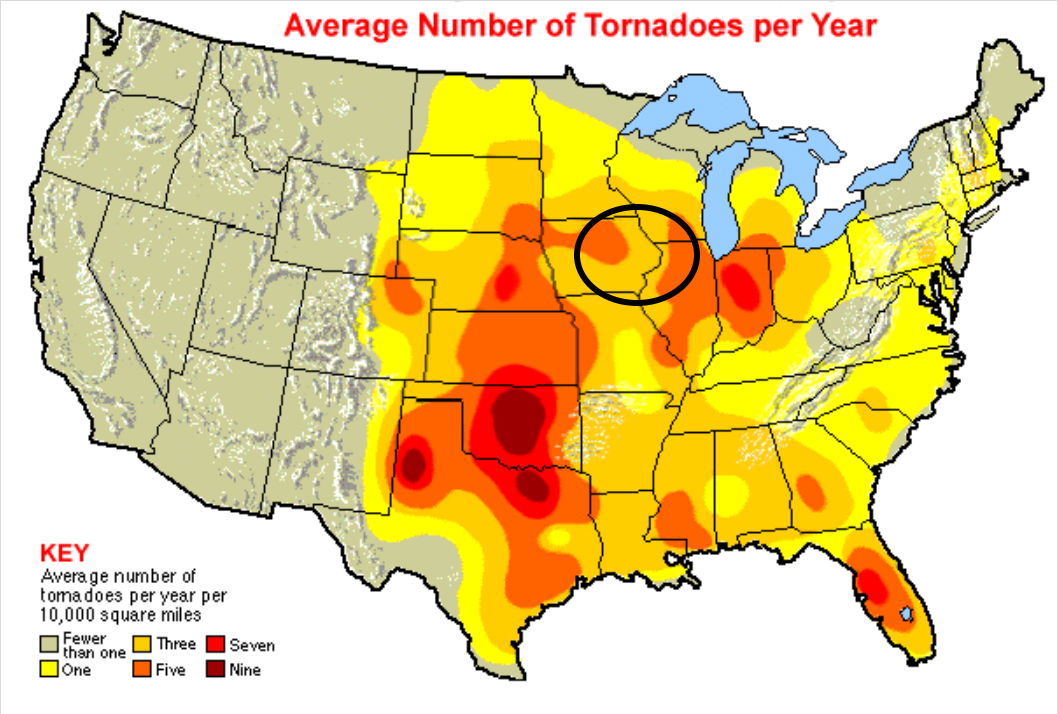
Warning Time Score: 3 -- 6 to 12 hours

Duration Score: 4 – More than one week

Geographic Location/Extent

Tornado
Tornadoes occur more frequently in the Midwest and Southeast, as illustrated in **Figure 3.39.** Jackson County is in the part of Iowa (black circle) with an average of three tornadoes per year.

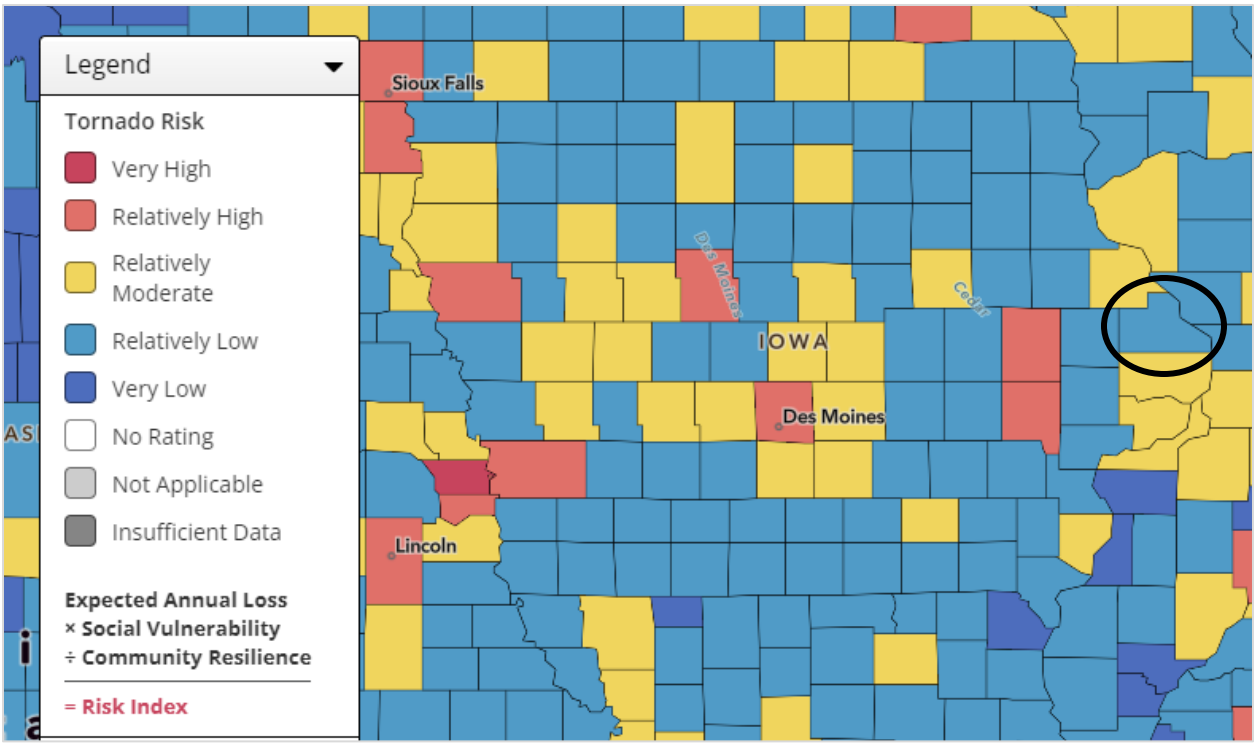
Figure 3.39. Frequency of Tornadoes in the United States



Iowa is located in a part of the United States where tornadoes are a common occurrence. Iowa has experienced 1,517 tornadoes from 1980 through 2011 (32-year period) with 86 percent of them being rated F0 and F1, 14 percent rated F2 through F5. Only one F5 rated tornado has occurred in Iowa during this timeframe (Parkersburg in 2008). Since 1980, there have been on average 47 tornadoes per year in Iowa. Most tornadoes occurred in May and June but can occur during any month. Also, mid-afternoon until around sunset is the peak time of day for tornado activity. There have been 763 injuries and 26 deaths attributable to tornadoes (source: National Weather Service, Iowa Tornado Climatology Report 1980-2011).

Tornadoes can occur in the entire planning area. **Figure 3.40.** illustrates the Tornado Risk throughout Iowa. The Tornado Risk Index = (Expected Annual Loss x Social Vulnerability) / Community Resilience. Jackson County (black circle) is classified as “Relatively Low.”

Figure 3.40. Tornado Risk for Iowa and Jackson County



Windstorm

Strong winds can occur year-round in Iowa. These winds typically develop with strong pressure gradients and gusty frontal passages. The closer and stronger two systems are, (one high pressure, one low pressure) the stronger the pressure gradient, and therefore, the stronger the winds are. Objects such as trees, barns, outbuildings, high-profile vehicles, and power line/poles can be toppled or destroyed, and roofs, windows, and homes can be damaged as wind speeds increase. Downbursts can be particularly dangerous to aviation.

Figure 3.41. shows the wind zones in the United States based on maximum wind speeds; the entire state of Iowa is located within Wind Zone IV, the highest inland category which is susceptible to winds up to 250 mph. All of Jackson County is susceptible to high wind events. All of the participating jurisdictions are vulnerable to this hazard.

Figure 3.42. shows the Strong Wind Risk throughout Iowa. The Strong Wind Risk Index = (Expected Annual Loss x Social Vulnerability) / Community Resilience. Jackson County (black circle) is classified as “Relatively High.”

Figure 3.41. Wind Zones in the United States

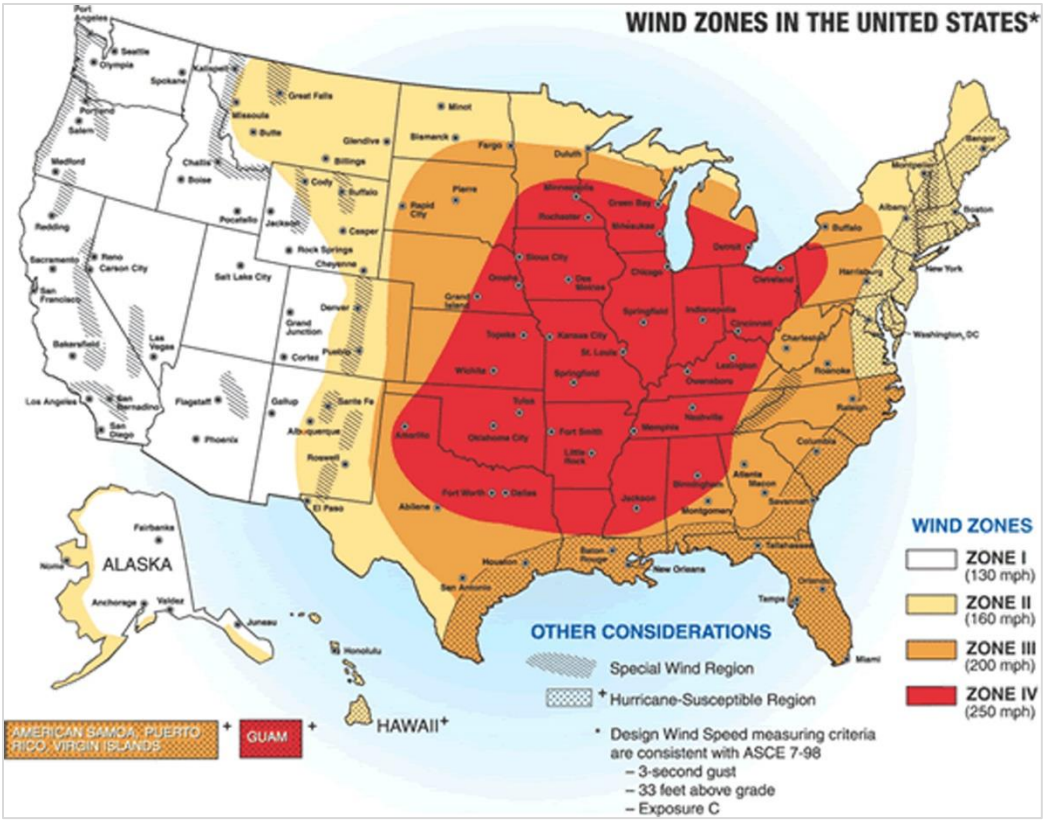
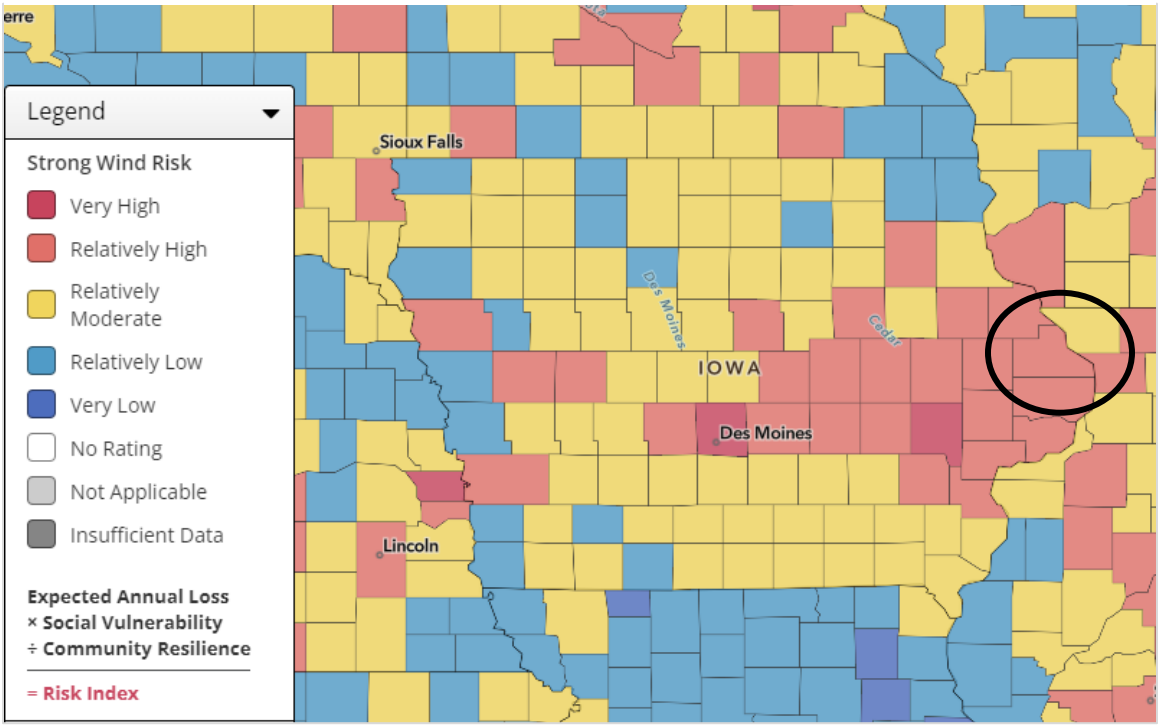


Figure 3.42. Strong Wind Risk for Iowa and Jackson County

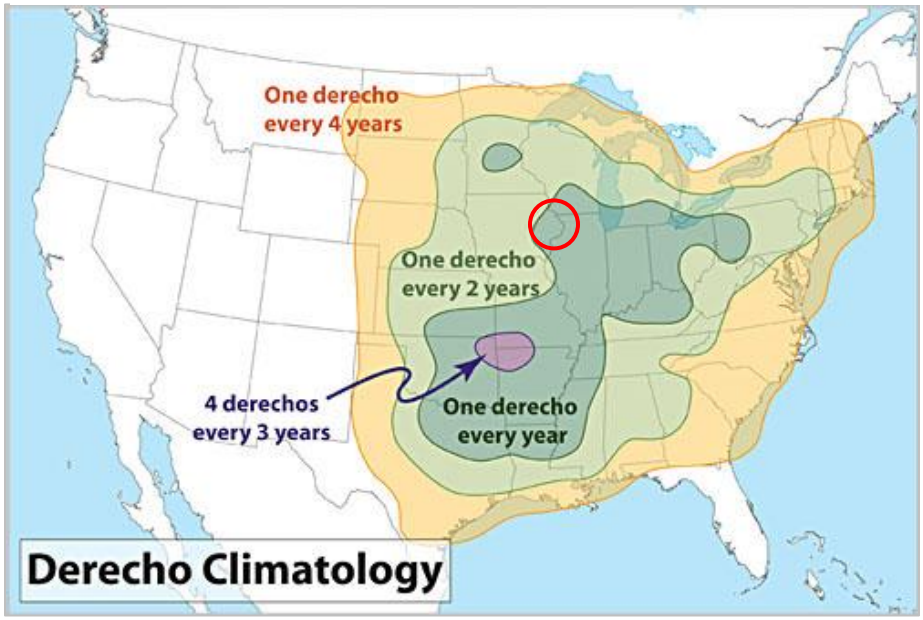


Derecho
According to the National Weather Service at https://www.spc.noaa.gov/misc/AbtDerechos/derechofacts.htm#climatology:

Derechos in the United States are most common in the late spring and summer (May through August), with more than 75% occurring between April and August (see graph below). As might be expected, the seasonal variation of derechos corresponds rather closely with the incidence of thunderstorms. In this country, derechos most commonly occur along two axes, as shown on **Figure 3.43.** One track is parallel to the "Corn Belt" from the upper Mississippi Valley southeast into the Ohio Valley; the other extends from the southern Plains northeast into the mid-Mississippi Valley. During the cool season (September through April), derechos are relatively infrequent but are most likely to occur from east Texas into the southeastern states.

Figure 3.43. is a map from the NOAA National Weather Service that shows derecho frequency in the United States. Jackson County (red circle) is in an area likely to have one derecho every year.

Figure 3.43. Map of Derecho Frequency in the United States



Source: NOAA National Weather Service,
https://www.spc.noaa.gov/misc/AbtDerechos/derechofacts.htm#climatology

According to Ready Iowa at https://ready.iowa.gov/derechos/: In Iowa, derechos occur every year or two on average. Winds above 85 mph like that of the August 10, 2020, derecho is quite unusual. While meteorologists can forecast potential severe weather outbreaks a few days in advance, predicting a derecho can be difficult. Meteorologists can look at a radar to better identify a derecho-type event, but this may only provide a few hours' notice.

Previous Occurrences

Tornado
Jackson County has been included in five Presidential Disaster Declarations that involved

tornadoes since 1965. See **Table 3.2** in the Hazard Identification Section for additional details.

According to NOAA statistics, Jackson County had 17 recorded tornado events from 1988 to 2023 (see **Table 3.50.**). Of these, two were an F2/EF2; eight were an F1/EF1; six were an F0/EF0; and one was an EFU. These tornadoes caused no fatalities, 4 injuries, and over $9 million in property damages. An EF1 tornado in July 2016 caused $5 million in damages.

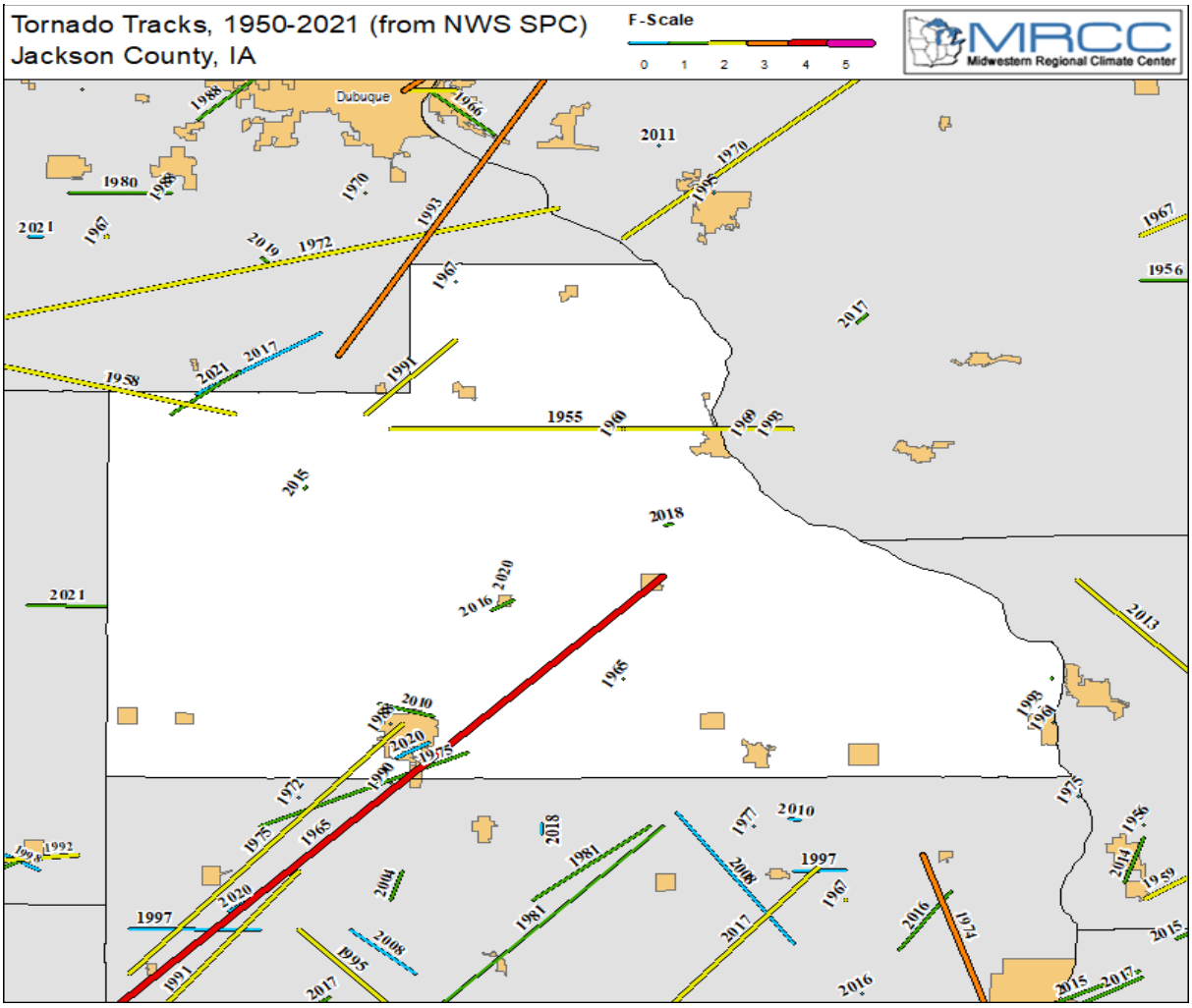
Table 3.50. NOAA Recorded Tornadoes in Jackson County, 1988-2023

Date	Magnitude	Deaths	Injuries	Property Damages	Crop Damages	Length (mi)	Width (yards)
3/25/1988	F0	0	0	$25,000	$0	0.2	20
6/2/1990	F1	0	0	$25,000	$0	1	40
3/27/1991	F2	0	0	$250,000	$0	0.5	100
4/19/1996	F0	0	0	$10,000	$0	0.1	10
4/30/1997	F0	0	0	$0	$0	0	10
6/1/2007	EF2	0	0	$3,250,000	$0	3.43	350
6/5/2010	EF1	0	1	$250,000	$0	2.2	150
5/26/2015	EF1	0	0	$0	$0	0.13	25
7/17/2016	EF1	0	0	$5,000,000	$0	1	50
3/6/2017	EF0	0	0	$0	$0	0.24	25
9/21/2018	EF1	0	0	$250,000	$0	0.3	20
5/23/2020	EF0	0	0	$0	$0	1.45	20
5/23/2020	EFU	0	0	$0	$0	0.04	20
6/20/2021	EF1	0	0	$0	$0	1.7	30
3/31/2023	EF1	0	0	$0	$0	1.24	50
3/31/2023	EF0	0	0	$0	$0	0.17	15
3/31/2023	EF1	0	3	$0	$0	0.85	100
Totals	**17**	**0**	**4**	**$9,060,000**	**$0**	**14.55**	**1,035**

Source: NOAA

The map in **Figure 3.44.** shows the paths of recorded tornado events from 1950 to 1921 for which latitude and longitude coordinates were available. As a result, not all events are shown.

Figure 3.44. Known Tornado Paths in Jackson County, 1950-2021



Windstorm

According to the NCDC database, there were 15 high wind events in Jackson County from 1993 to 2023. During this time period, there were no reported deaths or injuries. There was an estimated $253,000 in property damages and $50,000 in crop damage. Recorded wind gusts ranged from a high of 60 knots to a low of 39 knots (See **Table 3.51.**).

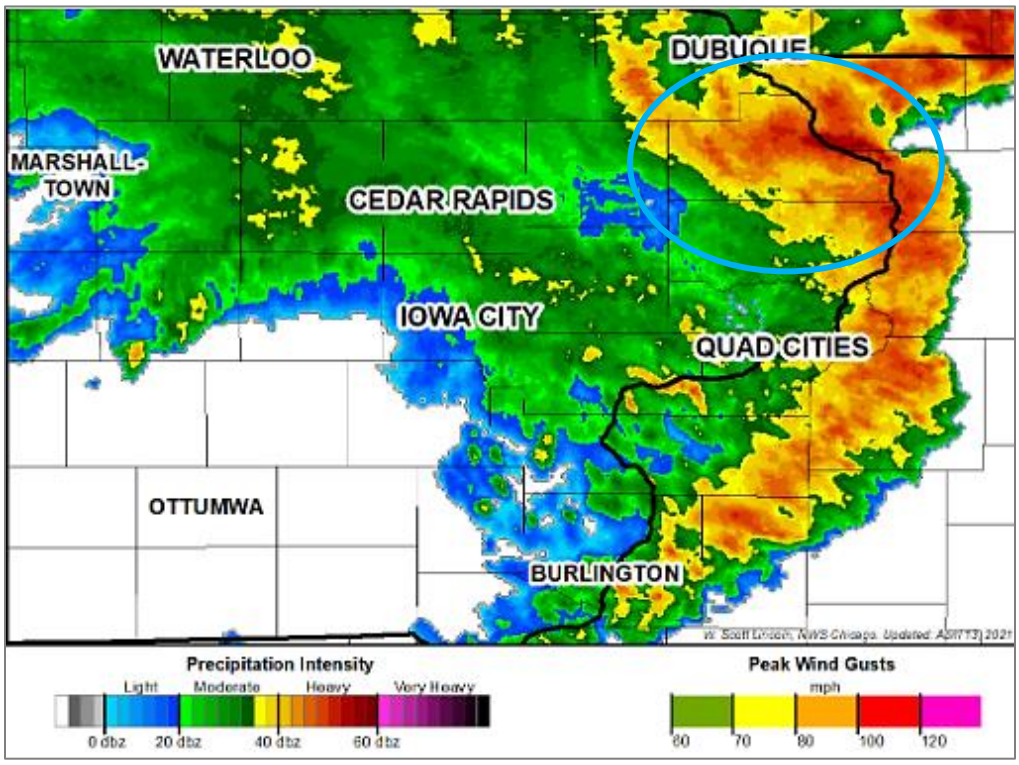
Table 3.51. Reported High Wind Speed Events, 1993-2023

Wind Speed	# of Events	Deaths	Injuries	Property Damage	Crop Damage
39 knots	1	0	0	$0	$0
49 knots	1	0	0	$0	$0
50 knots	6	0	0	$231,000	$50,000
52 knots	4	0	0	$0	$0
56 knots	2	0	0	$22,000	$0
60 knots	1	0	0	$0	$0
Total	**15**	**0**	**0**	**$253,000**	**$50,000**
Source: National Climate Data Center					

Derecho
According to the National Weather Service at https://www.weather.gov/dmx/PastIowaDerechos, 15 derechos have impacted at least some portion of Iowa since 1980.

A long-lived line of severe storms known as a "derecho" produced severe wind damage across portions of South Dakota, Nebraska, Iowa, Illinois, Wisconsin, Indiana, Michigan, and Ohio on Monday, August 10, 2020. A large area from central Iowa to north central Illinois experienced wind gusts of 70-80 mph, with maximum wind gusts of over 100 mph in a few isolated areas. The storm system also produced 26 weak tornadoes (rated EF-0 to EF-1 with wind speeds of 65 to 110 mph) in Iowa, Wisconsin, Illinois, and Indiana, although damage from the tornadoes was similar in magnitude to that caused by the straight-line winds covering a much larger area. **Figure 3.45.** is a radar reflectivity image from the NOAA National Weather Service that shows the August 10, 2020 derecho at 2:00 pm over Eastern Iowa. Jackson County is in the blue circle. Most derechos are less intense than the one that occurred on August 10, 2020. (Source: NOAA National Weather Service, August 6, 2021, https://jacksoncounty.iowa.gov/emergency-management/)

Figure 3.45. Radar Image of August 10, 2020 Derecho



Source: NOAA National Weather Service

Probability of Future Occurrence
NOAA reported 17 tornadoes in Jackson County in a 35-year time period, which calculates to 48-percent chance of a tornado in any given year. Therefore, it is a high probability that some portion of Jackson County will experience tornado activity in any given year. According to NCDC, there were 15 separate high wind events in a 30-year period from 1993 to 2023 in Jackson County. Based on this data there is a 50 percent annual probability of high wind events in any given year.

The National Weather Service indicates that Jackson County is in an area likely to have one derecho every year.

Therefore, the probability rating is “Likely.”

Probability Score: 3 -- Likely

Vulnerability Assessment

Vulnerability Overview

Jackson County is located in a region of the U.S. with a lower frequency of dangerous and destructive tornadoes (see **Figure 3.39.**) and is classified as “Relatively Low” for Tornado Risk (see **Figure 3.40.**).

Jackson County is located within Wind Zone IV, the highest inland category which is susceptible to winds up to 250 mph (see **Figure 3.41.**). Jackson County is classified as “Relatively High” for Strong Wind Risk” (see **Figure 3.42.**).

Light frame structures, such as mobile homes, outbuildings and sheds are considered especially vulnerable to damage from tornadoes. Those most at risk from tornadoes include people living in mobile homes, campgrounds, and other dwellings without secure foundations or basements. People in automobiles are also very vulnerable to twisters. **Table 3.52.** provides the number of mobile homes in each jurisdiction in Jackson County according to the U.S. Census Bureau’s 2022 American Community Survey (ACS) %-Year Estimates.

Table 3.52. Number of Mobile Homes per Jurisdiction

Jurisdiction	Number of Mobile Homes
Unincorporated County	755
Andrew	0
Baldwin	14
Bellevue	59
La Motte	0
Maquoketa	255
Miles	5
Monmouth	11
Preston	0
Sabula	23
St. Donatus	3
Spragueville	2
Springbrook	0
Total	**1,127**

Source: U.S. Census Bureau’s 2022 American Community Survey

The elderly (65 and older), young (less than 18 years old), and persons with physical and mental disabilities are most vulnerable because of the lack of mobility to escape the path of destruction. People who may not understand watches and warnings due to language barriers are also at risk.

According to the *2013 Iowa Hazard Mitigation Plan*, of the 8 hazards for which data was available to estimate annualized losses, tornadoes ranked 3rd with $36 million in annualized losses based on data spanning a 63-year period.

Due to the potential for damaging tornadoes in the planning area, the magnitude was determined to be a "Critical."

Magnitude/Severity Score: 3 -- Critical

Potential Losses to Existing Development
In Jackson County, the NCDC estimate for past property damages resulting from tornadoes from 1950 – 2016 (67 years) was $9,117,500. This translates to an annualized loss of over $136,000. For windstorms, NCDC loss estimates were $253,000 from 1993 to 2016 (24 years). This translates to an annualized loss of over $10,500.

Loss of Use
Overhead power lines and infrastructure are also vulnerable to damages from windstorms. Potential losses would include cost of repair or replacement of damaged facilities and lost economic opportunities for businesses. Public safety hazards include risk of electrocution from downed power lines. Specific amounts of estimated losses are not available due to the complexity and multiple variables associated with this hazard. Refer to the electric power loss of use estimates provided in **Table 3.47.** in the Winter Storm hazard section.

Crop Losses
Crop insurance payments for wind damage are discussed in **Section 3.5.6**, Hail and Lightning from Thunderstorms.

Future Development
Public buildings such as schools, government offices, as well as other buildings with a high occupancy and mobile home parks should consider inclusion of a tornado saferoom to shelter occupants in the event of a tornado.

Windstorm is primarily a public safety and economic concern, and the planning area is located in a region with very high frequency of occurrence. Windstorm can cause damage to structures and power lines which in turn create hazardous conditions for people. Debris flying from high wind events can shatter windows in structures and vehicles and can harm people that are not adequately sheltered.

Although windstorms occur frequently in the planning area and damages to property occurs, much of the damage is generally covered by private insurance. This results in less impact to individuals and the community since recovery is facilitated by insurance.

Climate Change Impacts
According to the 2010 *Climate Change Impacts on Iowa* report, growing evidence points to stronger summer storm systems in the Midwest. Studies have not been done to conclusively say that severe storms, including tornadoes, are increasing. However, with summer temperatures becoming warmer and humidity levels increasing, an increase in the likelihood of tornadic activity is plausible.

Tornado/Windstorm Hazard Summary by Jurisdiction

The magnitude was rated as a level 3 for all the participating jurisdictions, as they are all vulnerable to tornado and windstorm damage. The factors of probability, warning time, and duration are also equal across the planning area. This hazard does not substantially vary by jurisdiction.

Jurisdiction	Probability	Magnitude/ Severity	Warning Time	Duration	Weighted Score	Level
Unincorporated	3	3	3	3	3.1	High
Andrew	3	3	3	3	3.1	High
Baldwin	3	3	3	3	3.1	High
Bellevue	3	3	3	3	3.1	High
LaMotte	3	3	3	3	3.1	High
Maquoketa	3	3	3	3	3.1	High
Miles	3	3	3	3	3.1	High
Monmouth	3	3	3	3	3.1	High
Preston	3	3	3	3	3.1	High
Sabula	3	3	3	3	3.1	High
Spragueville	3	3	3	3	3.1	High
Springbrook	3	3	3	3	3.1	High
St. Donatus	3	3	3	3	3.1	High
Andrew CSD	3	3	3	3	3.1	High
Bellevue CSD	3	3	3	3	3.1	High
Easton Valley CSD	3	3	3	3	3.1	High
Maquoketa CSD	3	3	3	3	3.1	High

3.5.10. Wildfire, including Grass Fire

Hazard Score Calculation					
Probability	**Magnitude/Severity**	**Warning Time**	**Duration**	**Weighted Score**	**Level**
2	**2**	**4**	**2**	**2.3**	**Moderate**

Hazard Profile

Hazard Description

Iowa's urban/rural interface (areas where development occurs within or immediately adjacent to wildland, near fire-prone trees, brush, and/or other vegetation), is growing as metro areas expand into natural forest, prairies and agricultural areas that are in permanent vegetative cover through the Conservation Reserve Program (CRP). The State has the largest number of CRP contracts in the nation, totaling over 1.5 million acres. Most of this land is planted in cool and warm season grass plantings, tree plantings and riparian buffer strips. There is an additional 230,000 acres in federal ownership and conservation easements.

Wildfires are frequently associated with lightning and drought conditions, as dry conditions make vegetation more flammable. As new development encroaches into the wildland/urban interface more and more structures and people are at risk. On occasion, ranchers and farmers intentionally set fire to vegetation to restore soil nutrients or alter the existing vegetation growth. Also, individuals in rural areas frequently burn trash, leaves and other vegetation debris. These fires have the potential to get out of control and turn into wildfires.

The risk of wildfires is a real threat to landowners across the State. The NWS monitors the conditions supportive of wildfires in the State daily so that wildfires can be predicted, if not prevented. The risk factors considered are:

- High temperature
- High wind speed
- Fuel moisture (greenness of vegetation)
- Low humidity
- Little or no cloud cover

Grass and wildland fire can occur when conditions are favorable, such as during periods of drought when natural vegetation would be drier and more combustible. Most communities in Jackson County are surrounded by agricultural land. Parcels located on the outskirts of incorporated areas and parcels in unincorporated Jackson County are most likely to experience effects from this hazard.

Warning Time Score: 4 -- Minimal or no warning time.

Duration Score: 1 -- Less than 6 hours

Geographic Location/Extent

The USDA Forest Service developed a nationwide wildfire risk assessment. The Wildfire Risk to Communities study results were used to assess risk to Wildfire in Jackson County. Wildfire Risk to Communities uses the best available science data to identify risk and provide resources for communities to manage and mitigate risk. This is a national analysis for comparing risk that varies across a state, region, or county to help prioritize actions to mitigate risk. The following information is from the *Wildfire Risk to Communities* online at https://wildfirerisk.org/.

Wildfire Likelihood

Wildfire likelihood is the annual probability of wildfire burning in a specific location. At the community level, wildfire likelihood is averaged where housing units occur. Communities in all but the lowest classes need to prepare

Wildfire likelihood is based on fire behavior modeling across thousands of simulations of possible fire seasons. In each simulation, factors contributing to the probability of a fire occurring, including weather, topography, and ignitions are varied based on patterns derived from observations in recent decades. Wildfire likelihood is not predictive and does not reflect any currently forecasted weather or fire danger conditions.

Wildfire likelihood is simply a probability that any specific location (pixel) may experience wildfire in any given year. It does not say anything about the intensity of fire if it occurs.

Figure 3.46. shows the Wildfire Likelihood in Jackson County relative to the rest of Iowa's counties, with the placement of the circle indicating where the planning area is in relation to the other counties in Iowa. The size of the circles in the legend is a proportional representation of the county's population compared to other counties in the state. Populated areas in Jackson County have, on average, a lower wildfire likelihood than 86% of counties in Iowa.

Figure 3.47. below illustrates how wildfire likelihood is similar across Jackson County.

Figure 3.46. Jackson County Wildfire Likelihood Relative to Other Iowa Counties

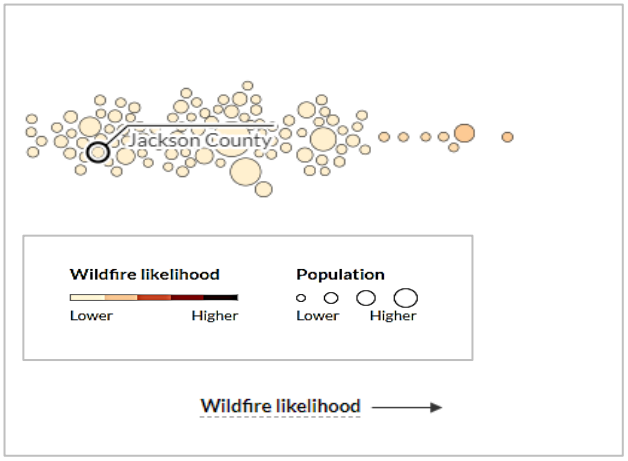
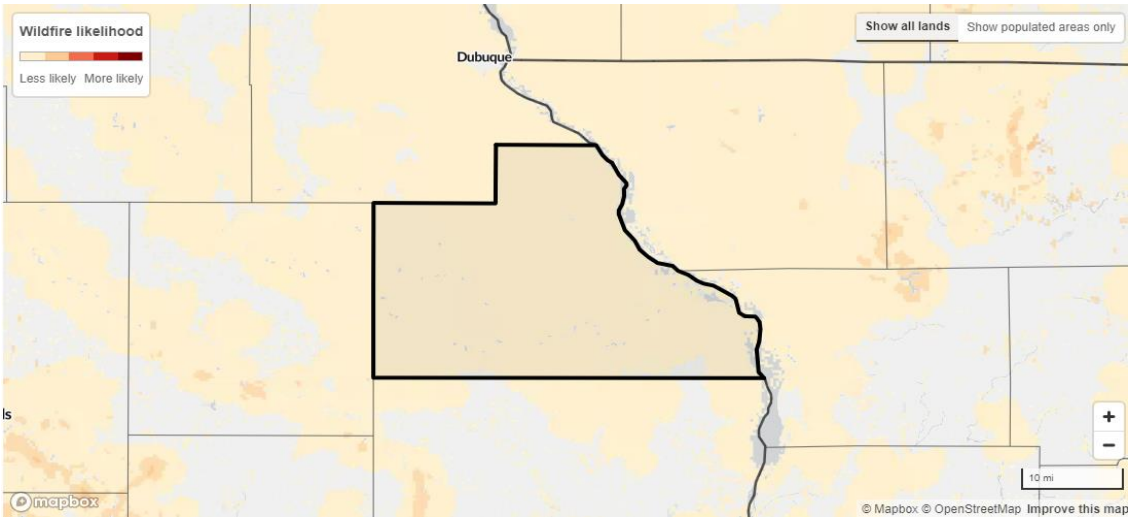


Figure 3.47. Wildfire Likelihood across Jackson County



Wildfire Intensity

Wildfire intensity is a measure of the energy expected from a wildfire. Intensity is largely a condition of the physical landscape (topography) and vegetative fuel available to burn. For example, a crown fire on a forested hillside can produce a greater wildfire intensity than grasses on flat ground. While wildfire intensity is technically measured in units of heat transfer per length of fire perimeter, it is more easily observed and expressed in terms of flame length.

Wildfire intensity is a component of "Risk to Homes." Risk to homes measures the relative consequence of wildfire to residential structures everywhere on the landscape, whether a home actually exists there or not. This allows us to consider wildfire risk in places with homes in addition to places where new construction is proposed.

Figure 3.48. shows the Risk to Homes within Jackson County relative to the rest of the state, with the placement of the circle indicating where the planning area is in relation to the other counties in Iowa. The size of the circles in the legend is a proportional representation of the county's population compared to other counties in the state. Populated areas in Jackson County have, on average, a lower wildfire likelihood than 82% of counties in Iowa.

Jackson County has a relatively low risk to Homes compared to other counties within the State. Risk to Homes combines wildfire likelihood and intensity with generalized results to a home within the planning area. The Risk to Homes data integrates wildfire likelihood and wildfire intensity from simulation modeling to represent wildfire hazard. Wildfire Risk to Communities uses a generalized concept of susceptibility that all homes that encounter wildfire will be damaged and the degree of damage is directly related to the fire's intensity. **Figure 3.49.** below illustrates how the risk to homes varies across Jackson County.

Figure 3.48. Wildfire Risk to Homes in Jackson County Relative to Other Iowa Counties

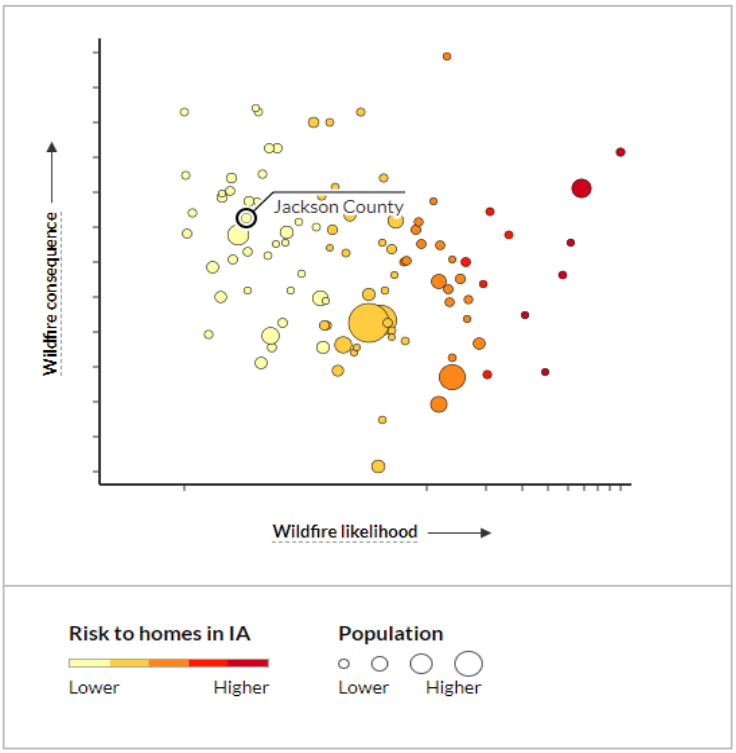
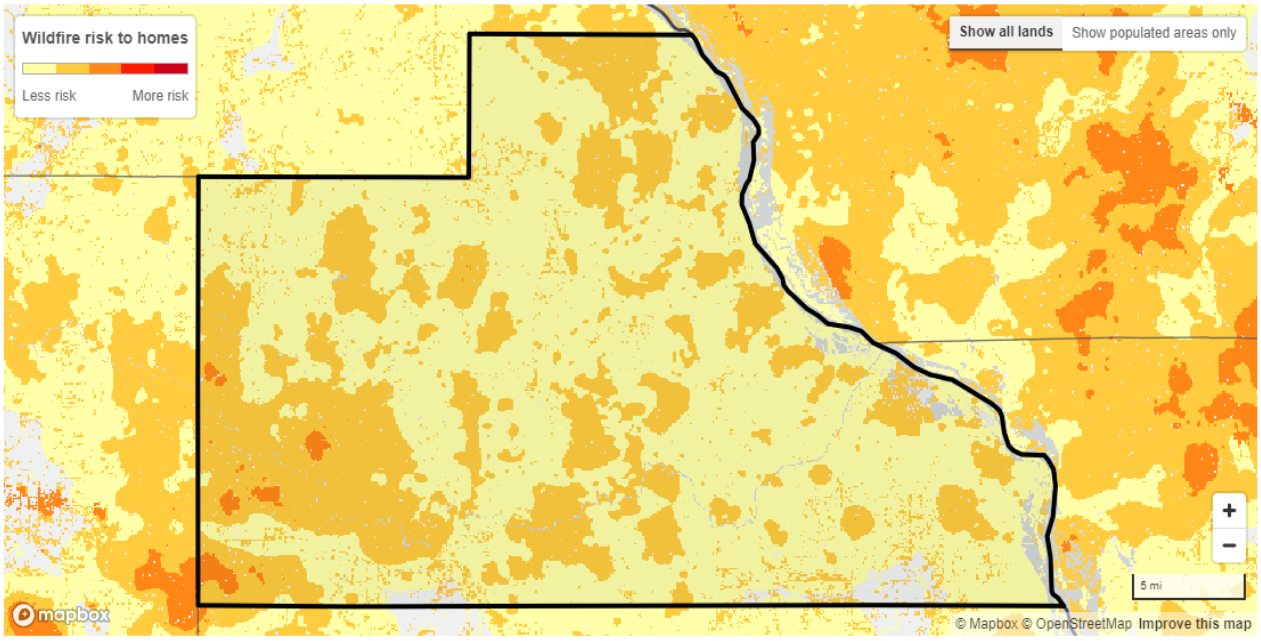


Figure 3.49. Jackson County Wildfire Risk to Homes Relative to Other Iowa Counties

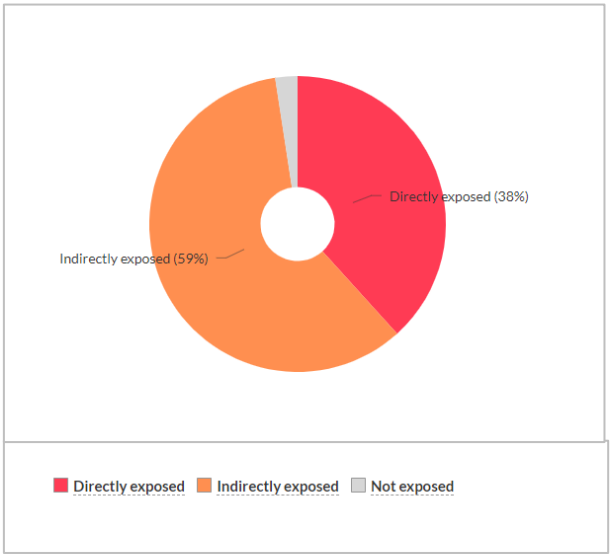


Exposure

Exposure is the spatial coincidence of wildfire likelihood and intensity with communities. Wildfire exposure is calculated based on wildfire likelihood and proximity to large areas of flammable wildland vegetation (at least two square miles). Any community that is located where wildfire likelihood is greater than zero (in other words, where there is a chance wildfire could occur) is exposed to wildfire. For example, a home in a flammable forest is exposed to wildfire. Communities can be directly exposed to wildfire from adjacent wildland vegetation, or indirectly exposed to wildfire from embers and home-to-home ignition.

Exposure is the intersection of wildfire likelihood and intensity with communities. Communities can be directly exposed to wildfire from adjacent wildland vegetation, or indirectly exposed to wildfire from embers and home-to-home ignition. Communities that are not exposed are not likely to be subjected to wildfire from either direct or indirect sources.

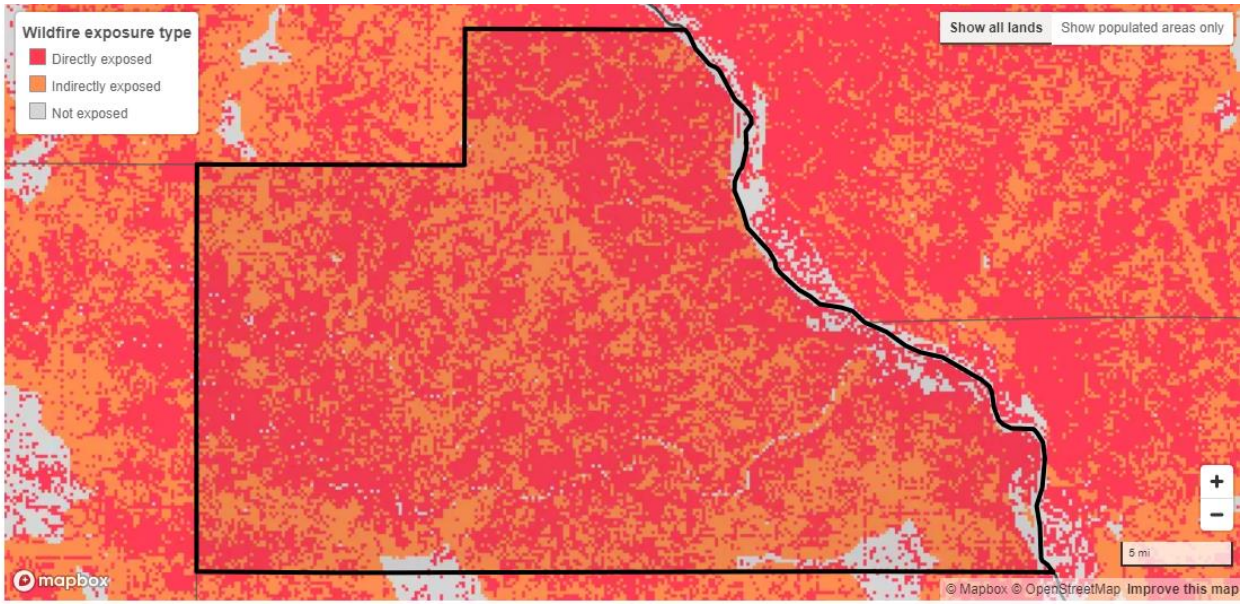
Figure 3.50. Exposure in Jackson County



Directly exposed homes are located in an area considered to be covered by flammable wildland vegetation. Indirectly exposed homes are located within one mile of a large area considered to be covered by flammable wildland vegetation. Nonexposed homes are located more than one mile from a large area considered to be covered by flammable wildland vegetation. Populated areas in Jackson County are exposed to wildfire predominantly from **indirect** sources, such as embers or home-to-home ignition (59%), as shown in **Figure 3.50.**

Figure 3.51 shows wildfire exposure types (directly exposed, indirectly exposed, and not exposed) across Jackson County.

Figure 3.51 Wildfire Exposure Types across Jackson County



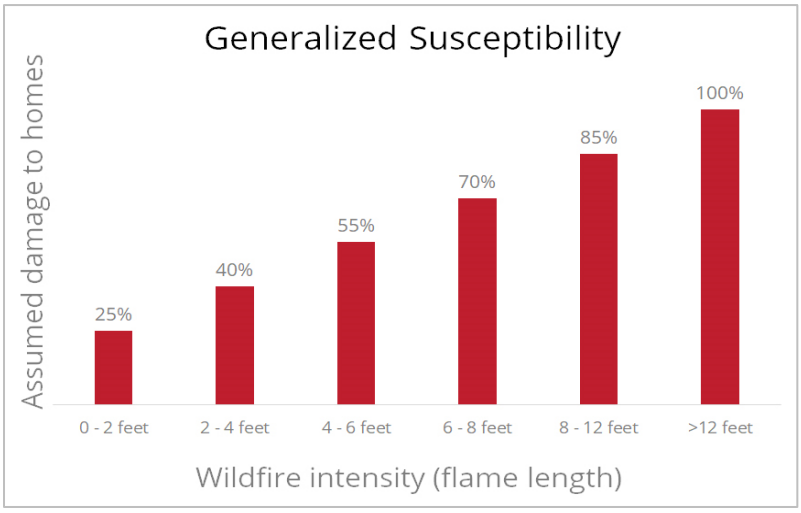
Susceptibility

Susceptibility is the propensity of a home or community to be damaged if a wildfire occurs.

Wildfire Risk to Communities uses a generalized concept of susceptibility for all homes (see **Figure 3.52.**). In other words, Wildfire Risk to Communities assumes all homes that encounter wildfire will be damaged, and the degree of damage is directly related to wildfire intensity.

Wildfire Risk to Communities does not account for homes that may have been mitigated and does not measure other important resources that may be damaged by a wildfire (such as infrastructure, watersheds, or forest health).

Figure 3.52 Generalized Susceptibility for Assumed Damage to Homes based on Wildfire Intensity



In reality, an individual home's ability to survive wildfire is driven primarily by local conditions (known as the "Home Ignition Zone"), including the construction materials and the vegetation in the immediate area. The only way to truly assess home susceptibility is through individual home assessments, which are well beyond the scope of Wildfire Risk to Communities.

Vulnerable Populations

Social and economic factors can make it more difficult for some people to prepare for, respond to, and recover from wildfire. Vulnerable populations may lack access to resources, experience cultural and institutional barriers, have limited mobility, or have medical conditions exacerbated by stress or smoke. Data about potentially vulnerable populations are shown for the census tracts that have values equal to or greater than the community median. The two variables that are most significant for Jackson County, Over 65 years and Under 5 years, are shown. Data are from the U.S. Census Bureau's American Community Survey. **Figure 3.53.** shows wildfire likelihood and **Figure 3.54.** shows risk to homes for theses vulnerable populations.

Figure 3.53. Vulnerable Population and Wildfire Likelihood in Jackson County

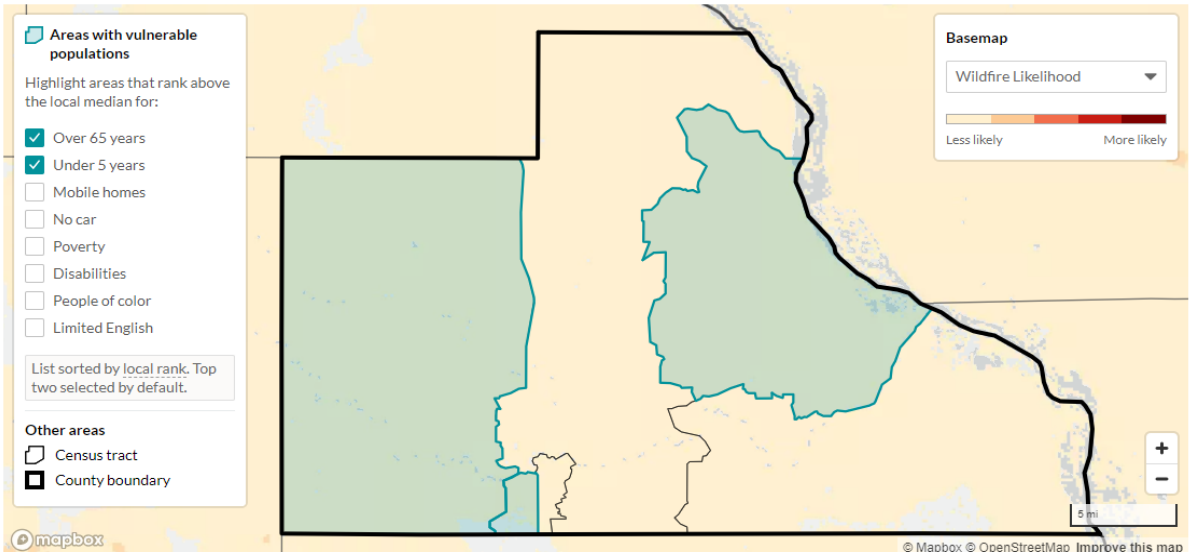
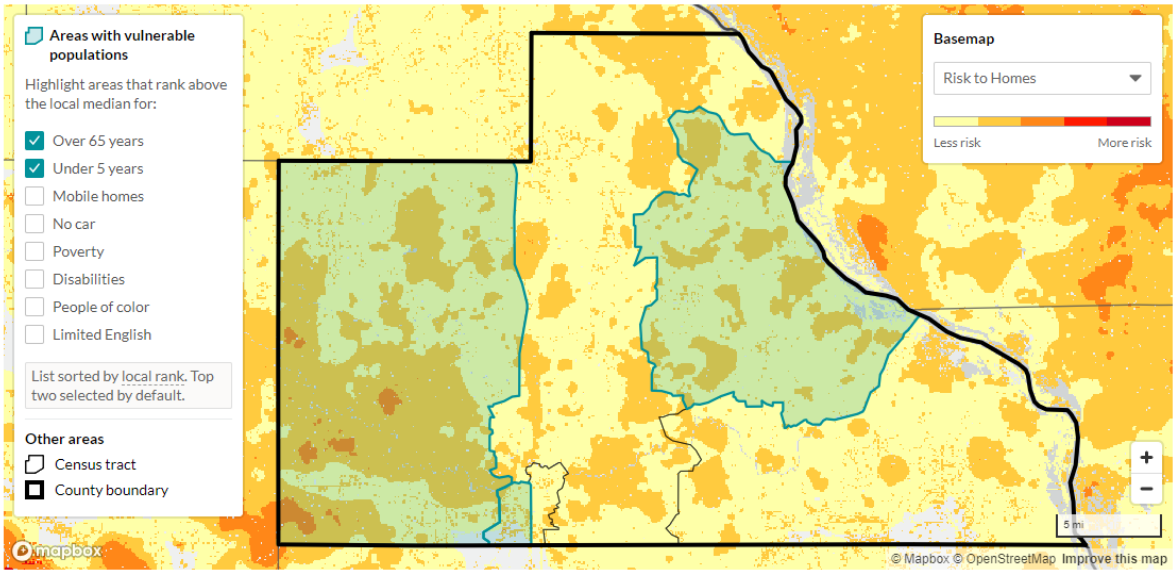


Figure 3.54. Vulnerable Population and Risk to Homes in Jackson County



Previous Occurrences
According to the NCEI database there were no wildland or forest fire events with significant impact that have been reported in Jackson County. This does not account for small or contained grass fires that may not have been reported. There is no available data to provide an accurate assessment of fires in the jurisdictions. While there is a lack of available data for the historical occurrences, it can be assumed that smaller brush fires which are regularly contained by the fire departments in the county occur annually throughout the planning area. These fires rarely result in any damage to property; however, cropland and open space areas are at a higher risk.

Probability of Future Occurrence
Historical data was not available to document the average number of wildland/grass fires per year. Since updated statistical data was unavailable to determine a quantitative probability, a qualitative probability is based on the anecdotal descriptions from the HMPC. Although grass/wildland fires do occur, the HMPC indicated that events that cause any notable damages occur less frequently. Based on this qualitative analysis, the probability is “Occasional”.

Probability Score: 2 -- Occasional

Vulnerability Assessment
Vulnerability Overview
Most grass fires are contained to highway right-of-way and rail right-of-way ditches and are less than a few acres in size. High winds can turn a small flame into a multi-acre grass fire within a matter of minutes, but the extent is dependent upon conditions such as land use/land cover, moisture, and wind. Grass fires are equally likely to affect Jackson County communities where there is dense or high vegetation. Rural areas are much more likely to experience grass or wildland fires. Grass fires are often more easily contained and extinguished before there is damage to people or developed property. It should be noted that all communities stressed that their vulnerability to damage from grass or wildland fires is extremely low due to the ability of fire departments throughout the county to respond to and put out fires before they spread.

Wildfire Likelihood found in **Figure 3.46.** is based on fire behavior modeling across thousands of simulations of possible fire seasons and annual probability of wildfire burning in a specific location. On average Jackson County has a greater likelihood of wildfire than 14% of other counties in the State. Wildfires can be reduced through fuel treatments and ignition prevention projects.

Jackson County Risk to Homes is low compared to other counties within the State found in **Figure 3.48.** Risk to Homes combines wildfire likelihood and intensity with generalized results to a home within the planning area. The Risk to Homes data integrates wildfire likelihood and wildfire intensity from simulation modeling to represent wildfire hazard. Wildfire Risk to Communities uses a generalized concept of susceptibility that all homes that encounter wildfire will be damaged and the degree of damage is directly related to the fire’s intensity. Based on this data, populated areas in Jackson County have, on average, greater risk than 18% of counties in Iowa.

Potential Losses to Existing Development
Wildfires can be responsible for extensive damage to crops, the environment and occasionally residential or business facilities. Homes built in rural areas are more vulnerable since they are in closer proximity to land that is burned, and homeowners are more likely to burn trash and debris in rural locations. The vulnerability of structures in rural areas is exacerbated due to the lack of

hydrants in these areas for firefighting and the distance required for firefighting vehicles and personnel to travel to respond. Potential losses to crops and rangeland are additional concerns.

Magnitude Score: 2 -- Limited

Future Development
Future development in the undeveloped areas would increase vulnerability to this hazard.

Climate Change Impacts
The 2010 *Iowa Climate Change Impacts* Report has highlighted many expected effects, many of which may impact the severity and frequency of grass or wildland fires in the coming years:

- Long-term winter temperatures have increased six times more than summer temperatures.
- Nighttime temperatures have increased more than daytime temperatures since 1970.
- Iowa's humidity has risen substantially, especially in summer, which now has 13 percent more atmospheric moisture than 35 years ago as indicated by a 3-to-5-degree F rise in dew-point temperature. This fuels convective thunderstorms that provide more summer precipitation.

The impacts of higher temperatures listed above could also impact the frequency and severity of drought, which in turn could help fuel more severe wildland fires. The complexities of the impacts of climate change related to wildland fires in Iowa will likely lead to many cascading hazards, such as increased erosion and flooding following fires.

Wildland/Grass Fires Hazard Summary by Jurisdiction
Smaller grass fires could occur in any area as a result of trash/leaf/shrub fires getting out of control. There is less potential for wildland/grass fires to impact schools. If a wildland/grass fire were to occur near school buildings, the magnitude would be lower due to close proximity to firefighting services.

Jurisdiction	Probability	Magnitude/ Severity	Warning Time	Duration	Weighted Score	Level
Unincorporated	2	2	4	2	2.3	Moderate
Andrew	1	1	4	2	1.45	Low
Baldwin	1	1	4	2	1.45	Low
Bellevue	1	1	4	2	1.45	Low
LaMotte	1	1	4	2	1.45	Low
Maquoketa	1	1	4	2	1.45	Low
Miles	1	1	4	2	1.45	Low
Monmouth	1	1	4	2	1.45	Low
Preston	1	1	4	2	1.45	Low
Sabula	1	1	4	2	1.45	Low
Spragueville	1	1	4	2	1.45	Low
Springbrook	1	1	4	2	1.45	Low
St. Donatus	1	1	4	2	1.45	Low
Andrew CSD	1	1	4	2	1.45	Low
Bellevue CSD	1	1	4	2	1.45	Low
Easton Valley CSD	1	1	4	2	1.45	Low
Maquoketa CSD	1	1	4	2	1.45	Low

3.5.11. Animal/Plant/Crop Disease

Hazard Score Calculation					
Probability	**Magnitude/Severity**	**Warning Time**	**Duration**	**Weighted Score**	**Level**
2	**2**	**1**	**4**	**2.05**	**Moderate**

Hazard Profile

Hazard Description

Agricultural infestation is the naturally occurring infection of vegetation, crops or livestock with insects, vermin, or diseases that render the crops or livestock unfit for consumption or use. Because of Iowa's overall substantial agricultural industry and related facilities and locations, the potential for infestation of crops or livestock poses a significant risk to the economy of the State. Iowa cropland is vulnerable to disease and other agricultural pests.

Some level of agricultural infestation is normal in Iowa. The concern is when the level of an infestation escalates suddenly, or a new infestation appears, overwhelming normal control efforts. The levels and types of agricultural infestation appear to vary by many factors, including cycles of heavy rains and drought.

Animal Disease

Agricultural incidents are naturally occurring infection of livestock with insects, vermin, or diseases that render the livestock unfit for consumption or use. The livestock inventory for the state of Iowa includes 3.65 million cattle and calves on farms January 1, 2023, down 210,000 head from January 1, 2022. According to the 2023 Iowa Agricultural Statistics, USDA National Agricultural Statistics Service, as of January 1, 2023, Jackson County ranked 6th in the state with 90,000 head of cattle and calves down from 95,000 head of cattle and calves on January 1, 2022. For beef cows, Jackson County is ranked 2nd with 22,000 head of cattle and calves. In 2021, Iowa's cattle industry contributed in excess of $7.32 billion in business activity to Iowa's economy. According to the 2022 Census of Agriculture, Iowa ranked first in hog inventory in the United States with 32 percent of the nation's inventory in 2022. There were 24.1 million head of hogs and pigs in Iowa, of which Jackson County inventory included 62,925 head of hogs and pigs. With this substantial agricultural industry and related facilities throughout the State, the potential for infestation of livestock poses a significant risk to the Iowa economy.

The Iowa Department of Agriculture and Land Stewardship (IDALS) monitors and reports on animal reportable diseases in Iowa. Producers are required by state law to report any of the reportable animal diseases to the IDALS's Bureau of Animal Industry. The IDALS's Bureau of The Center for Agriculture Security is the lead coordinating bureau for any emergency response for an agriculture incident.

Disease outbreaks can also occur in wild animal populations. The IDALS's Bureau of Animal Industry monitors wild animal species and game throughout the state as well as diseases that may impact them.

Crop Pests/Diseases

A plant disease outbreak or a pest infestation could negatively impact crop production and agriculturally dependent businesses. An extreme outbreak or infestation could potentially result in billions of dollars in production losses across the U.S. The cascading net negative economic effects could result in widespread business failures, reduction of tax revenues, harm to other state economies, and diminished capability for this country to compete in the global market.

Many factors influence disease development in plants, including hybrid/variety genetics, plant growth stage at the time of infection, weather (e.g., temperature, rain, wind, hail, etc.), single versus mixed infections, and genetics of the pathogen populations. The two elements of coordination and communication are essential when plant diseases or pest infestations occur. The United States Department of Agriculture/ Animal Plant Health Inspection Service, Iowa Department of Agriculture and Land Stewardship, local producers, local government, assessment teams and state government entities must work together to effectively diagnose the various plant hazards to determine if immediate crop quarantine and destruction is required.

Iowa State University, College of Agriculture and Life Sciences has the Plant and Insect Diagnosis Clinic that provides diagnosis of plant problems (plant diseases, insect damage, and assessment of herbicide damage) and the identification of insects and weeds from the field, garden, and home. Specific plant pests can vary from year to year.

Warning Time Score: 1 – More than 24 hours

Duration Score: 4 – More than 1 week

Geographic Location/Extent
All of Jackson County is subject to animal/livestock incidents and agricultural infestations. According to the USDA's 2022 Census of Agriculture, 292,239 acres of land area in Jackson County is used for farming. There were 1,131 farms with an average size of 258 acres per farm. **Table 3.53.** provides a summary of the value of agricultural products sold in Jackson County. Agricultural infestation of crops or livestock in the planning area would severely affect the economy.

Table 3.53. Market Value of Agricultural Products Sold in Jackson County

Market Value	Sales	Results
Agricultural Products Sold	$326,812,000	+ 24% since 2017
Crops	$176,285,000	Ranked 69th in Iowa
Livestock, poultry, and products	$150,527,000	Ranked 45th in Iowa
Average Per Farm	$288,959	+ 21% since 2017

Source: USDA National Agricultural Statistics Service, 2022 Census of Agriculture

Animal Location/Extent
In addition to the animal farm operations, there are also confined and open feeding operations in Jackson County. In Jackson County, there are 45 Animal Feeding Operations listed in the Iowa DNR Animal Feeding Operations Database in 2024. This includes 24 Confined Animal Feeding Operations and 28 Open Feedlots, and three combination Confined/Open Feedlot operations.

Crop Location/Extent
According to the National Agricultural Statistics Service, in 2022 Jackson County's top crop items included the following: Corn for Grain (State Rank 56) -114,500 acres harvested and Soybeans (State Rank 81) - 59,000 acres harvested.

As can be seen in the USDA Cropland Data Layer (CDL) in **Figure 3.55.**, the majority of land in Jackson County outside the incorporated areas is in agricultural use, with primary crops of corn and soybeans.

Figure 3.55. USDA Cropland Data Layer for Jackson County

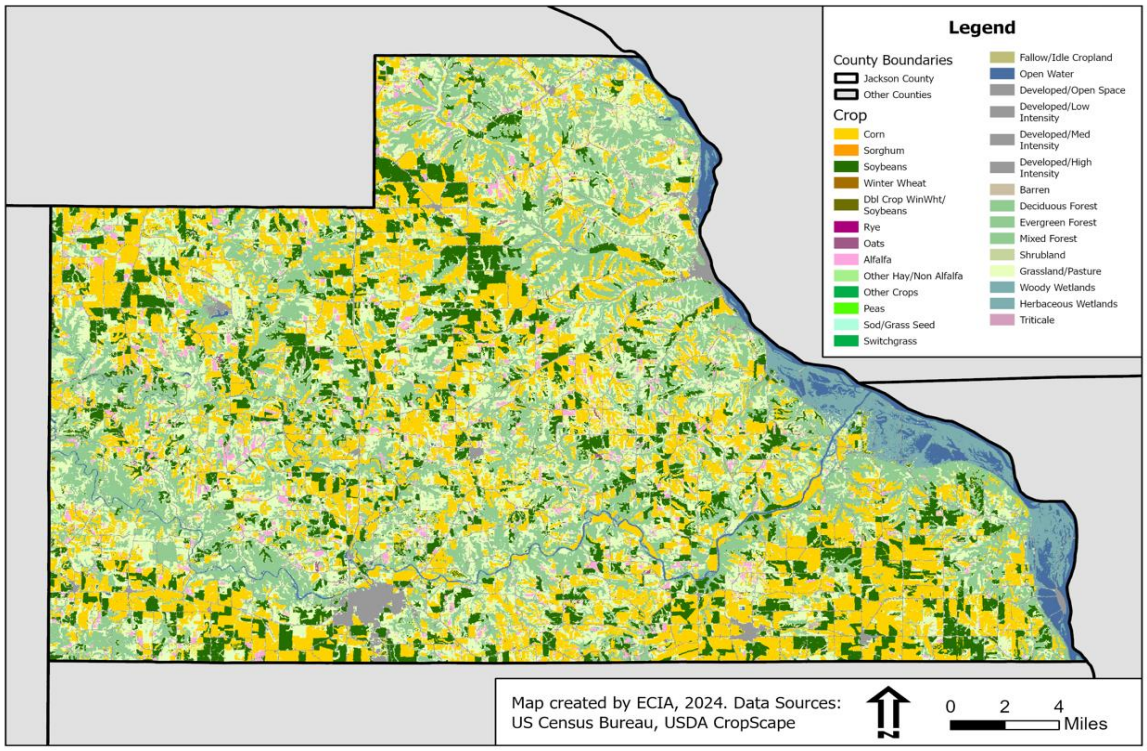
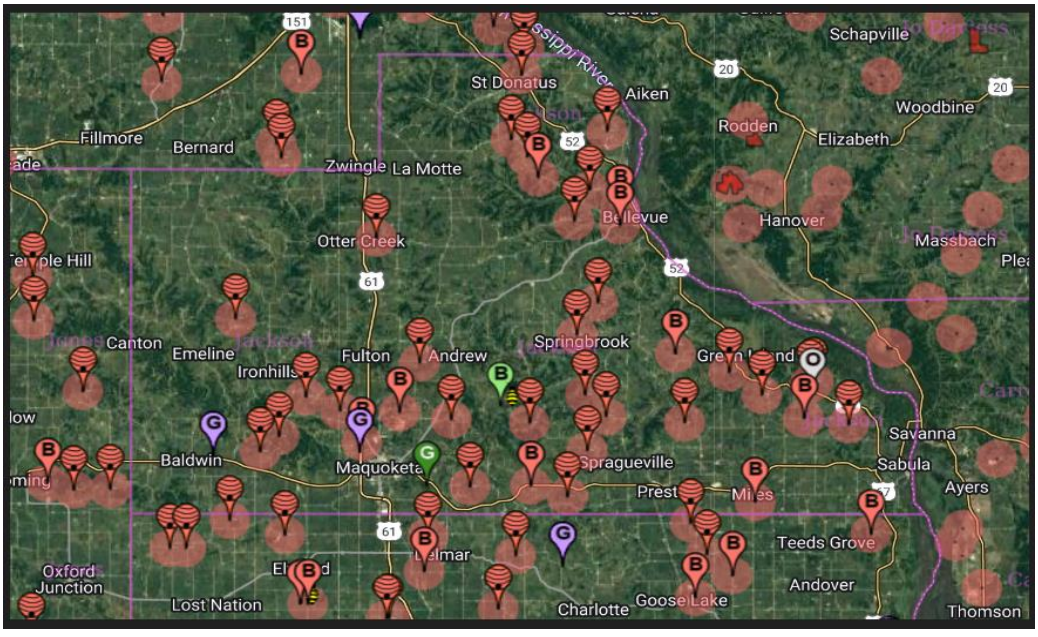


Figure 3.56. below provides the locations of the sites included on the Sensitive Crops Registry according to the IDALS, Pesticide Bureau. The red icons indicate beehives, purple icon indicates grapes and lime green icon indicates berries.

Figure 3.56. Sensitive Crops Registered Sites in Jackson County



Source: Iowa Department of Agriculture & Land Stewardship

Previous Occurrences - Animal Disease

Avian Influenza

In the beginning of April 2015, there were a significant number of confirmed diagnoses of avian influenza in the State of Iowa. As a result, on Friday May 1, 2015, Governor Branstad declared a state of emergency. The last positive flock was detected on June 16, 2015. Confirmed cases occurred in the following counties: Buena Vista, Calhoun, Cherokee, Clay, Hamilton, Kossuth, Lyon, Madison, O'Brien, Osceola, Palo Alto, Plymouth, Pocahontas, Sac, Sioux, Webster, and Wright. Infected flocks were depopulated and composted and cleanup and disinfection occurred. There were 77 total premises and 34 million birds affected. This included 35 commercial turkey flocks, 22 commercial egg production flocks, 13 pullet flocks, 1 breeding flock for a mail order hatchery, and 6 backyard flocks. More than 2,300 USDA staff and contractors were dispatched to Iowa to assist with the response to the avian influenza situation, including a USDA Incident Management Team (IMT). More than 300 state employees also participated in the disaster response.

As recently as November 27, 2023, another massive flock of egg-laying hens in Iowa was recently found to be infected by a very transmissible and deadly version of avian flu, which has pushed the total number of affected birds this fall beyond last year's deaths for the same period. There have been no reported infected flocks in Jackson County.

Chronic Wasting Disease

Chronic wasting disease, or CWD, is a neurological disease infecting wild white-tailed deer in Iowa and other members of the Cervidae family in North America including mule deer, elk, moose, and caribou. The first case of CWD in Iowa was found in 2012 on a hunting preserve in the southeastern part of the state. In that case, it was determined the CWD-positive mature buck had been transferred to the hunting preserve from a deer farm in north central Iowa. Subsequent testing found CWD at the deer farm. The farm was placed under quarantine, but the owners sued for compensation. The litigation prevented the farm from being depopulated of deer until August 2014. IDALS conducted testing. Results were released in early October 2014, stating that 284 of 356 deer (80 percent) from a captive herd in north-central Iowa tested positive for chronic wasting disease. This finding represents the highest number of CWD-positive animals detected at a facility, according to wildlife health officials (Milwaukee-Wisconsin Journal Sentinel, October 4, 2014). In 2014, the first case of CWD was found in a wild deer in Allamakee County. Then in 2015, two wild deer tested positive for CWD in Allamakee County.

Rabies

The Centers for Disease Control and Prevention (CDC) collect information about cases of animal and human rabies from state health departments and summarize the information in an annual report. The most recent report from Iowa Department of Public Health dates from 2018, however, Jackson County Animal Control provided statistics for the years 2018-2022. According to the report from Jackson County Animal Control there was one confirmed rabies case of a bat in 2018 and no other confirmed cases from 2017-2022.

Previous Occurrences – Crop Disease

According to the USDA Risk Management Agency, from 2017-2022 combined crop insurance payments for damages resulting from insects, plant disease and wildlife totaled $97,049.26 in Jackson County. The Iowa Statewide average for insurable crop acres with insurance is 89 percent. **Table 3.54.** provides a summary of insured crop losses because of crop infestations.

Table 3.54. Crop Insurance Payments for Crop Pests/Diseases 2017-2022

Damage Cause	Sum of Indemnity Amount	Sum of Determined Acres
Insects	**$792**	**25**
2017	$792	25
Plant Diseases	**$52,303.87**	**341.55**
2016	$10,185.87	112.57
2018	$19,725	104.39
2022	$22,393	124.59
Wildlife	**$43,953.39**	**308.82**
2014	$908.40	9.9
2016	$3,479.07	31.09
2017	$1,634.00	34.6
2018	$3,891.72	39.41
2019	$4,247.10	51.39
2020	$114.10	0.61
2022	$29,679.00	141.82
Grand Total	**$97,049.26**	**675.36**

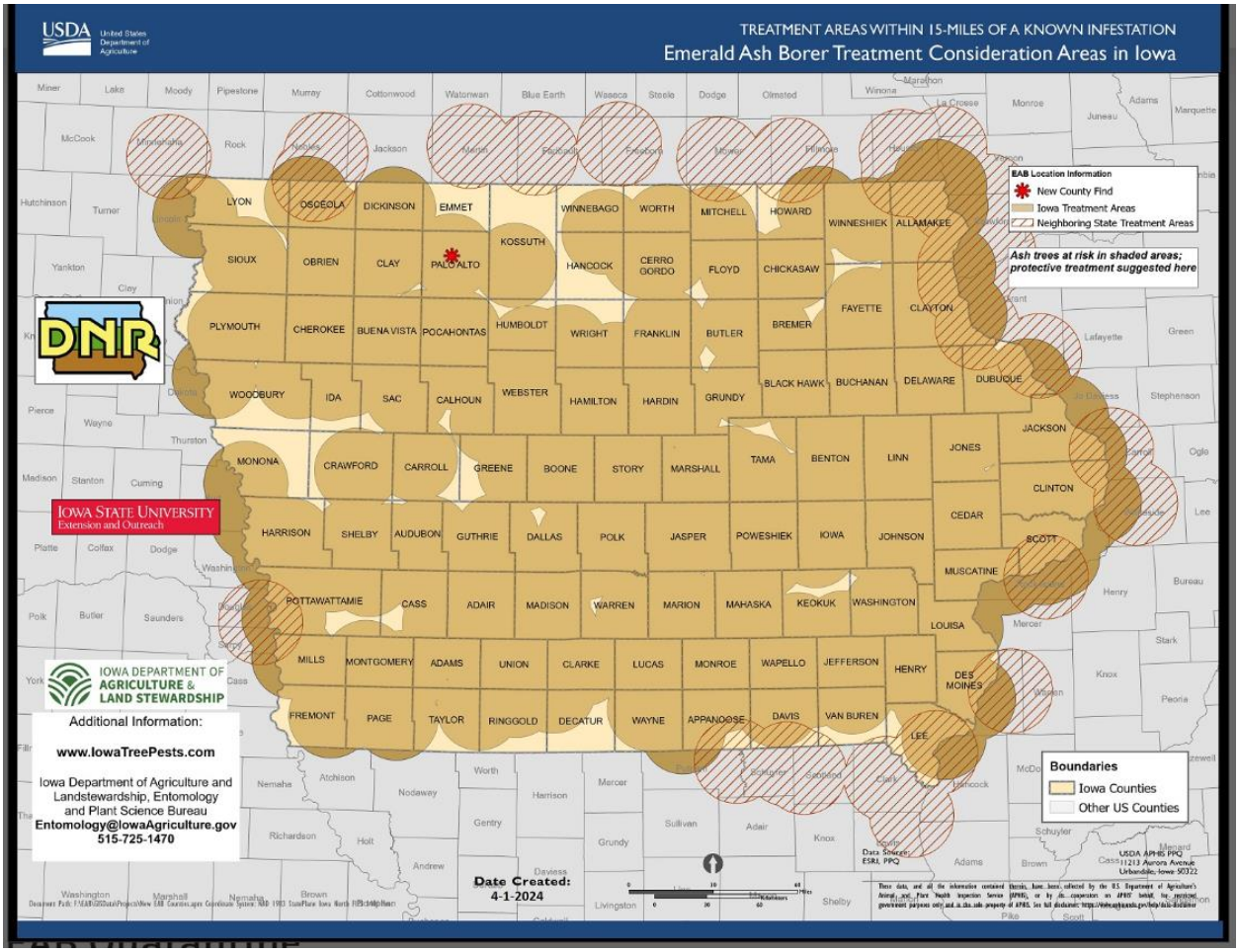
Source: USDA Risk Management Agency

Emerald Ash Borer

Emerald Ash Borer is a small, metallic-green, invasive wood-boring beetle native to east Asia that attacks and kills ash trees. According to Iowa Department of Natural Resources (DNR) it was first discovered in Iowa in 2010 and in Jackson County in 2015.

It is estimated by the Iowa DNR – Forestry Bureau that approximately 15-20 percent of public trees in Iowa cities are green ash. In some communities, ash comprises more than 60 percent of the public trees. Statewide, there are over 50 million ash trees (green, white and black) in bottomland and upland forests (2005 USDA Forest Service, Forest Inventory Data) and another 30 million urban ash trees (Iowa DNR – Forestry Bureau). **Figure 3.57.** reflects the locations of the emerald ash infestations as of August 2022. The brown circles represent a 15-mile radius around each infestation.

Figure 3.57. Locations of Emerald Ash Borer Infestations in Iowa (August 2022)



Source: USDA, IA DNR

Probability of Future Occurrence

The planning area experiences some level of agricultural loss every year as a result of naturally-occurring diseases that impact animals/livestock. The concern is when the level of an infestation escalates suddenly, or a new infestation appears, overwhelming normal control efforts. Normal control efforts include crop insurance and employment of various other agricultural practices that limit impact. For purposes of determining probability of future occurrence, the HMPC defined "occurrence" as an infestation occurring suddenly, a new infestation, or infestation that overwhelmed normal control efforts. Research did not reveal any infestations in Jackson County that have reached this level of defined "occurrence." Therefore, it was determined that the probability of this defined "occurrence" of agricultural infestation is "Occasional."

Probability Score: 2 – Occasional

Vulnerability Assessment

Vulnerability Overview

A widespread infestation of animals/livestock and crops could impact the economic base of the County. According to the 2017 USDA Census of Agriculture there are 2,037 jobs representing 20 percent of Jackson County's total workforce employed by agriculture or agriculture related industries. In 2022 the total market value of Jackson County's agricultural products sold was

$292,239,000. With this contribution of agriculture to the economy, a wide-scale agricultural infestation could impact the economic stability of the county.

Magnitude/Severity Score: 2 - Limited

Potential Losses to Existing Development
Buildings, infrastructure, and critical facilities are not vulnerable to this hazard. Its impacts are primarily economic and environmental, rather than structural effects.

Rough estimates of potential direct losses from a maximum threat event fall in a range of 1-75 percent of livestock receipts. The market value of all livestock in Jackson County according to USDA's 2022 Census of Agriculture was $150,527,000. Based on a worst-case scenario where 75 percent of livestock is lost in a given year due to agricultural infestations, the total direct costs could exceed $112 million.

Table 3.55. provides the annual crop losses for insurable crops. The insurable loss is adjusted to estimate losses to all insurable crops by considering that 89 percent of insurable crops in the State were insured (2022 Iowa Crop Insurance Profile from USDA's Risk Management Agency).

Table 3.55. Estimated Insurable Crop Losses from Disease, Infestation, and Wildlife

10-Year Insurance Paid	Adjusted 10-Year Losses (considering 89% insured)	Estimated Annualized Losses	2022 Value of Crops	Annualized Crop Loss Ratio (Losses/Value)
$97,049.26	$ 419,159.76	$41,915.98	$176,285,000	0.02%

Source: 2022 Iowa Crop Insurance Profile from USDA's Risk Management Agency

Rough estimates of potential direct losses from a maximum threat event fall in a range of 1-50 percent of annual crop receipts. The market value of all crops sold in Jackson County in 2022 was $176,285,000. Based on a worst-case scenario where 50 percent of crop production is lost in a given year due to agricultural infestations, the total direct costs could exceed $88 million.

The U.S. Forest Service estimates that Jackson County has up to 2.5 million ash trees in the County. Removal of debris infestation would be challenging and costly. If only 10 percent of the Ash trees were impacted in Jackson County that could translate to 250,000. It is estimated that it costs $682 to replace each Ash tree. In Jackson County, this translates to over $170 million in potential replacement costs.

Future Development
Future development is not expected to significantly impact the planning area's vulnerability to this hazard. However, if crop production and numbers of animals/livestock increases, the amount vulnerable to infestation also increases. Regarding the Emerald Ash Borer, the Iowa Department of Natural Resources recommends that other native tree species be planted in lieu of Ash trees to avoid increasing vulnerability to infestation of the Emerald Ash Borer.

Climate Change Impacts
The climate change impacts below are excerpted from the 2010 Report on *Climate Change Impacts on Iowa* developed by the Iowa Climate Change Impacts Committee.

<u>Crops</u>

Despite great improvements in yield potential over the last several years, crop production remains highly dependent on climate in conjunction with other variables. The overall effect of climate change on crop productivity in Iowa remains unclear, as positive climatic events could be overridden by the impacts of poor management or genetics, or favorable management and genetics could override negative climate events.

Regardless of these interactions, it is certain that climate changes will affect future crop production. Greenhouse and growth chamber studies suggest increases in atmospheric carbon dioxide (CO2) will generally have a substantial positive effect on crop yields by increasing plant photosynthesis and biomass accumulation.

Greater precipitation during the growing season, as we have been experiencing in Iowa, has been associated with increased yields; however, excessive precipitation early in the growing season adversely affects crop productivity. Waterlogged soil conditions during early plant growth often result in shallower root systems that are more prone to diseases, nutrient deficiencies, and drought stress later in the season.

An increase in temperature, especially during nighttime, reduces corn yield by shortening the time in which grain is accumulating dry matter (the grain fill period). According to research, Iowa's nighttime temperatures have been increasing more rapidly than daytime temperatures.

The current changes in precipitation, temperature, wind speeds, solar radiation, dew-point temperatures, and cloud cover imply less ventilation of crops and longer dew periods. Soybean plants in particular readily absorb moisture, making harvest problematic. One adaptive approach to these conditions involves farmers purchasing larger harvesting equipment to speed harvest, compensating for the reduced daily time suitable for soybean harvest.

The recent extreme weather events involving greater intensity and amount of rainfall have increased the erosive power of Iowa's precipitation, resulting in significant erosion of topsoil. The impact of climate change on the erosive force of precipitation in the U.S. is expected to increase by as much as 58%. These rates are expected to increase exponentially as precipitation continues to rise.
Plant disease can also increase as temperature, soil wetness, and humidity increase as these conditions favor the development of various plant diseases.

Animals
Despite the fact that Iowa ranks first in hog and sixth in cattle production nationwide, there is a lack of information about the effects of climate change on animal production in Iowa. Nevertheless, our general knowledge and principles pertaining to livestock and extreme weather events are applicable to Iowa's changing climate conditions.

High temperatures have been shown to reduce summer milk production, impair immunological and digestive functions of animals, and increase mortality rates among dairy cattle.
In general, domestic livestock can adapt to gradual changes in environmental conditions; however, extended periods of exposure to extreme conditions greatly reduce productivity and is potentially life threatening.

Animal/Crops/Plant Disease Hazard Summary by Jurisdiction
The magnitude determinations discussed in the vulnerability overview sections were factored into the following hazard summary table to show how this hazard varies by jurisdiction. It has been determined that the magnitude of animal/crop/plant disease would be slightly less in the

cities and for the school districts due to less agriculture within city limits. However, an infestation of the Emerald Ash Borer would likely have a larger impact in the incorporated areas and the economy of incorporated areas is heavily dependent on agriculture. As a result, the magnitude in the unincorporated area was determined to be a 2 and the magnitude in the incorporated areas was determined to be a 1. School districts and the community college would have limited Ash trees to dispose of in the event of infestation. Therefore, the magnitude was determined to be a 1.

Jurisdiction	Probability	Magnitude/ Severity	Warning Time	Duration	Weighted Score	Level
Unincorporated	2	2	1	4	2.05	Moderate
Andrew	2	1	1	4	1.75	Low
Baldwin	2	1	1	4	1.75	Low
Bellevue	2	1	1	4	1.75	Low
LaMotte	2	1	1	4	1.75	Low
Maquoketa	2	1	1	4	1.75	Low
Miles	2	1	1	4	1.75	Low
Monmouth	2	1	1	4	1.75	Low
Preston	2	1	1	4	1.75	Low
Sabula	2	1	1	4	1.75	Low
Spragueville	2	1	1	4	1.75	Low
Springbrook	2	1	1	4	1.75	Low
St. Donatus	2	1	1	4	1.75	Low
Andrew CSD	2	1	1	4	1.75	Low
Bellevue CSD	2	1	1	4	1.75	Low
Easton Valley CSD	2	1	1	4	1.75	Low
Maquoketa CSD	2	1	1	4	1.75	Low

3.5.12. Hazardous Materials

Hazard Score Calculation					
Probability	**Magnitude/Severity**	**Warning Time**	**Duration**	**Weighted Score**	**Level**
2	**2**	**4**	**2**	**2.3**	**Moderate**

Hazard Profile

Hazard Description

A hazardous substance is one that may cause damage to persons, property, or the environment when released to soil, water, or air. Chemicals are manufactured and used in increasing types and quantities. Each year over 1,000 new synthetic chemicals are introduced and as many as 500,000 products pose physical or health hazards and can be defined as "hazardous chemicals". Hazardous substances are categorized as toxic, corrosive, flammable, irritant, or explosive. Hazardous material incidents generally affect a localized area.

Fixed Hazardous Materials Incident

A fixed hazardous materials incident is the accidental release of chemical substances or mixtures during production or handling at a fixed facility.

Transportation Hazardous Materials Incident

A transportation hazardous materials incident is the accidental release of chemical substances or mixtures during transport. Transportation Hazardous Materials Incidents in Jackson County can occur during highway or air transport. Highway and rail accidents involving hazardous materials pose a great potential for public exposures. Both nearby populations and motorists can be impacted and become exposed by accidents and releases. Barge accidents involving hazardous material pose potential for exposure through contamination of the water as well as populations near the point of release. If airplanes carrying hazardous cargo crash, or otherwise leak contaminated cargo, populations and the environment in the impacted area can become exposed.

Pipeline Incident

A pipeline transportation incident occurs when a break in a pipeline creates the potential for an explosion or leak of a dangerous substance (oil, gas, etc.) possibly requiring evacuation. An underground pipeline incident can be caused by environmental disruption, accidental damage, or sabotage. Incidents can range from a small, slow leak to a large rupture where an explosion is possible. Inspection and maintenance of the pipeline system along with marked gas line locations and an early warning and response procedure can lessen the risk to those near the pipelines.

Warning Time Score: 4 - Less than six hours warning time

Duration Score: 2 - Less than 1 day

Geographic Location/Extent

This section provides geographic locations within Jackson County impacted by each type of potential hazardous materials incident.

Fixed Hazardous Materials Incident

According to the Iowa DNR, there are 28 sites in Jackson County that because of the volume or toxicity of the materials on site were designated as Tier II Facilities under the Superfund Amendments and Reauthorization Act. **Table 3.56.** provides the number of Tier II Facilities for

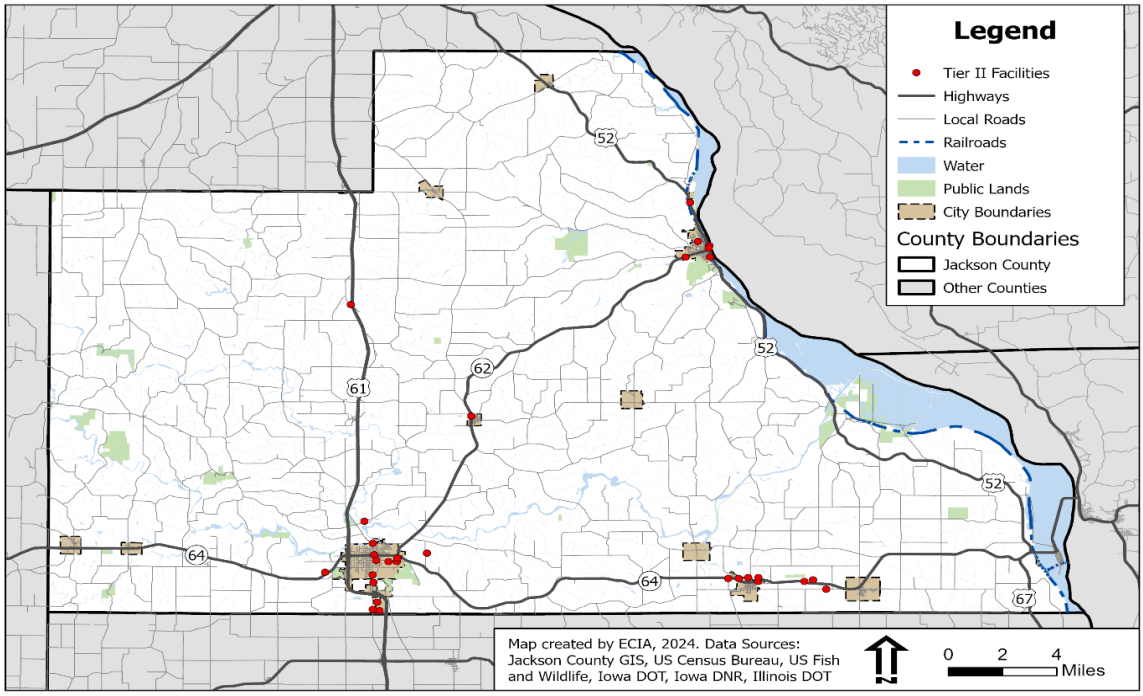
each jurisdiction in the planning area as well as the number of those facilities that store Extremely Hazardous Substances (EHS). Note: The jurisdiction is assigned from the address. Some facilities do fall within the unincorporated areas but are identified with the nearest city. **Figure 3.58** shows the locations of Tier II Facilities with Extremely Hazardous Substances.

Table 3.56. Number of Tier II Facilities by Jurisdiction

Jurisdiction	# of Facilities	# of EHS Facilities
Andrew	1	1
Baldwin	0	0
Bellevue	6	2
La Motte	1	1
Maquoketa	15	10
Miles	1	1
Monmouth	0	0
Preston	7	3
Sabula	0	0
St. Donatus	0	0
Spragueville	0	0
Springbrook	0	0
Zwingle	1	1
Grand Total	**32**	**19**

Source: Iowa DNR; Iowa Geospatial Data

Figure 3.58 Tier II Facilities in Jackson County



Transportation Hazardous Materials Incident

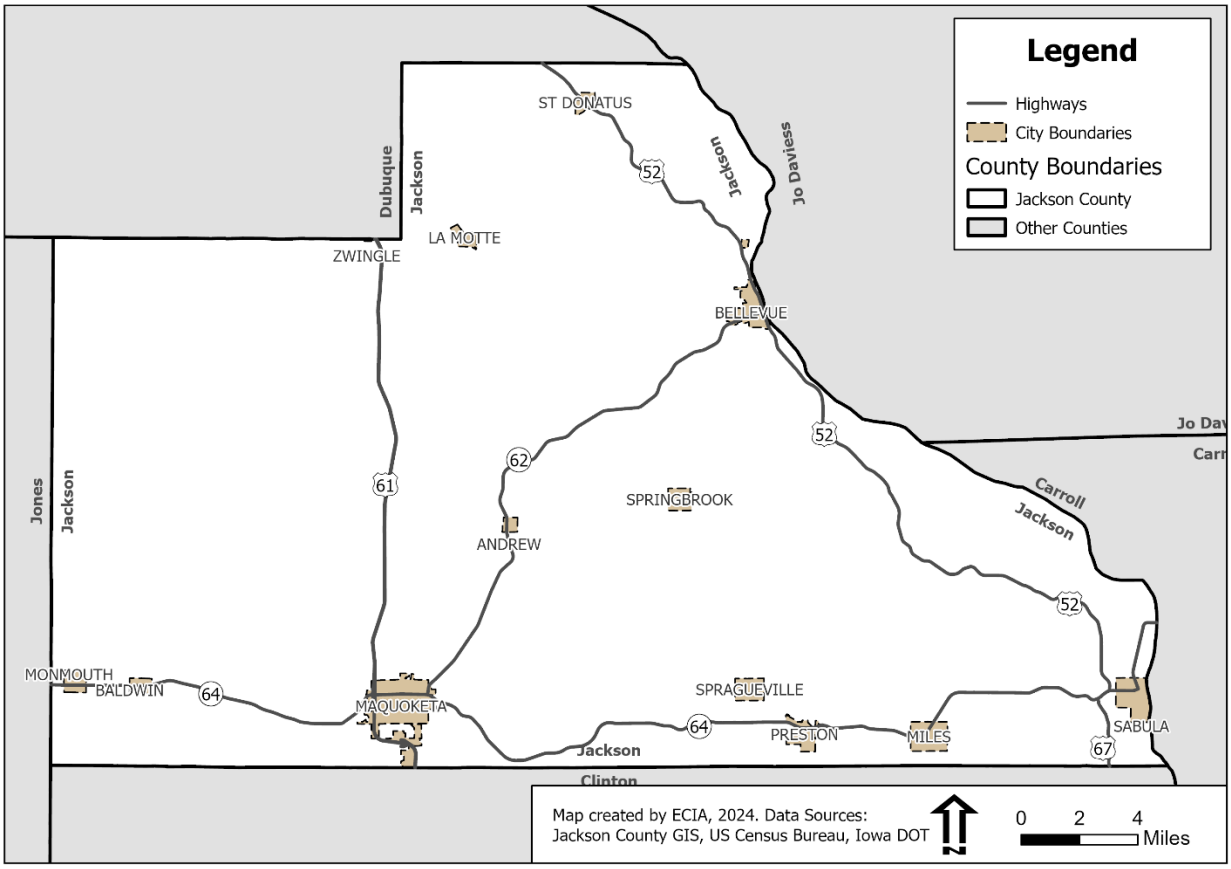
The transport of hazardous materials in Jackson County occurs via trucks on the

highways/roads and railways as well as via barge traffic on the Mississippi River and airplanes carrying hazardous cargo.

Truck Transport

Hazardous materials can be transported on any of the roads in Jackson County. U.S. Highway 61 crosses the county north to south, while US Highway 52 follows the eastern edge of the county and runs, generally, along the Mississippi River. State Highways 62 and 64 meander east to west through Jackson County, meeting in the city of Maquoketa (see **Figure 3.59.**). Numerous paved county roads connect all of the incorporated cities and unincorporated towns throughout the county. Agriculture is important to the economy of Jackson County. As a result, along with other chemicals, chemicals utilized in agriculture are frequently transported along county and local roadways.

Figure 3.59. Jackson County Highways



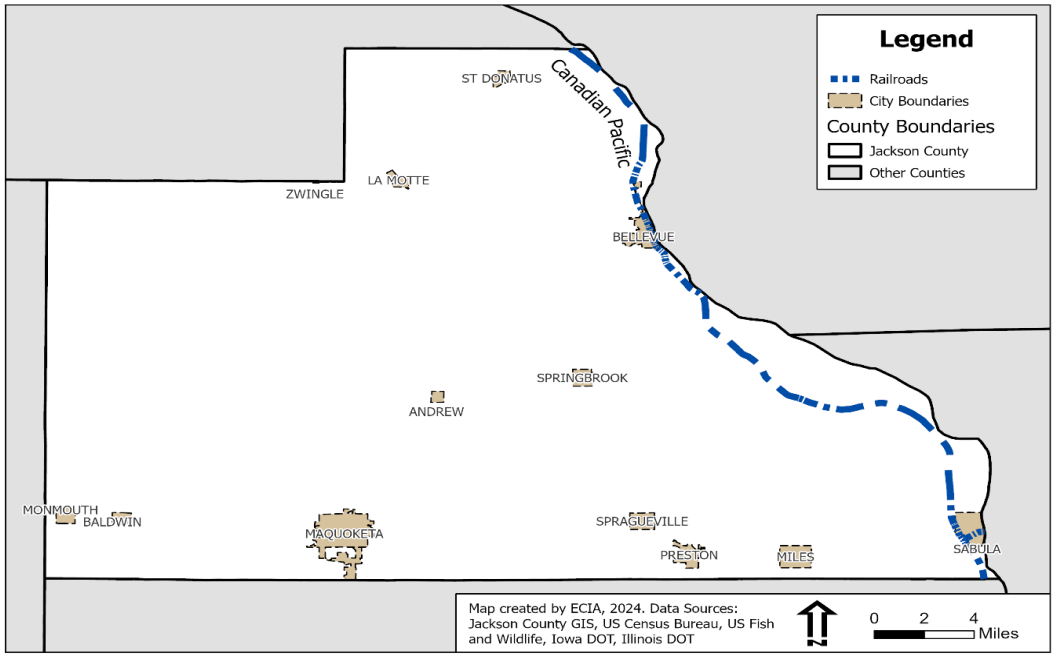
Rail Transport

The following railroads operate in Jackson County: Canadian Pacific Railroad (CP) and the Dakota, Minnesota and Eastern R.R. Company. Burlington Northern Sante Fe Railroad has a line that runs down the Illinois side of the Mississippi River adjacent to Jackson County. The merger between Canadian Pacific Railway and Kansas City Southern will likely increase freight transportation within Jackson County.

Figure 3.60. shows the railroads that operate in Jackson County with the annual gross tons per mile. The main line of the Canadian Pacific (CP) railroad, doing business as Dakota, Minnesota,

and Eastern (DME) runs along the Jackson County side of the Mississippi River. It carries 20 to 39.99 million tons per mile annually.

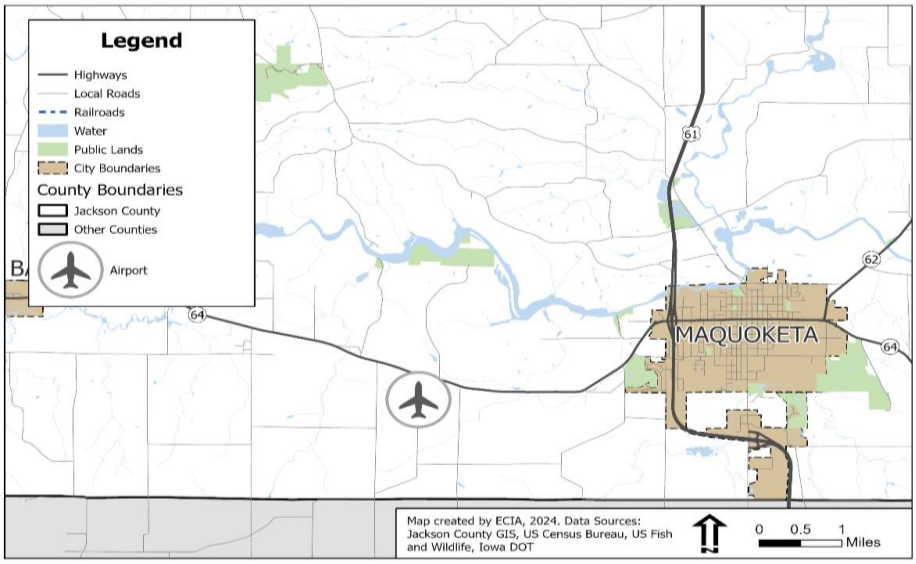
Figure 3.60. Jackson County Railroads



Air Freight

The only airport in Jackson County is the Maquoketa Municipal Airport (see **Figure 3.61.**). The Maquoketa Municipal Airport provides general aviation services in Jackson County for business, agriculture, personal recreation, air medical transport, and law enforcement.

Figure 3.61. Maquoketa Municipal Airport

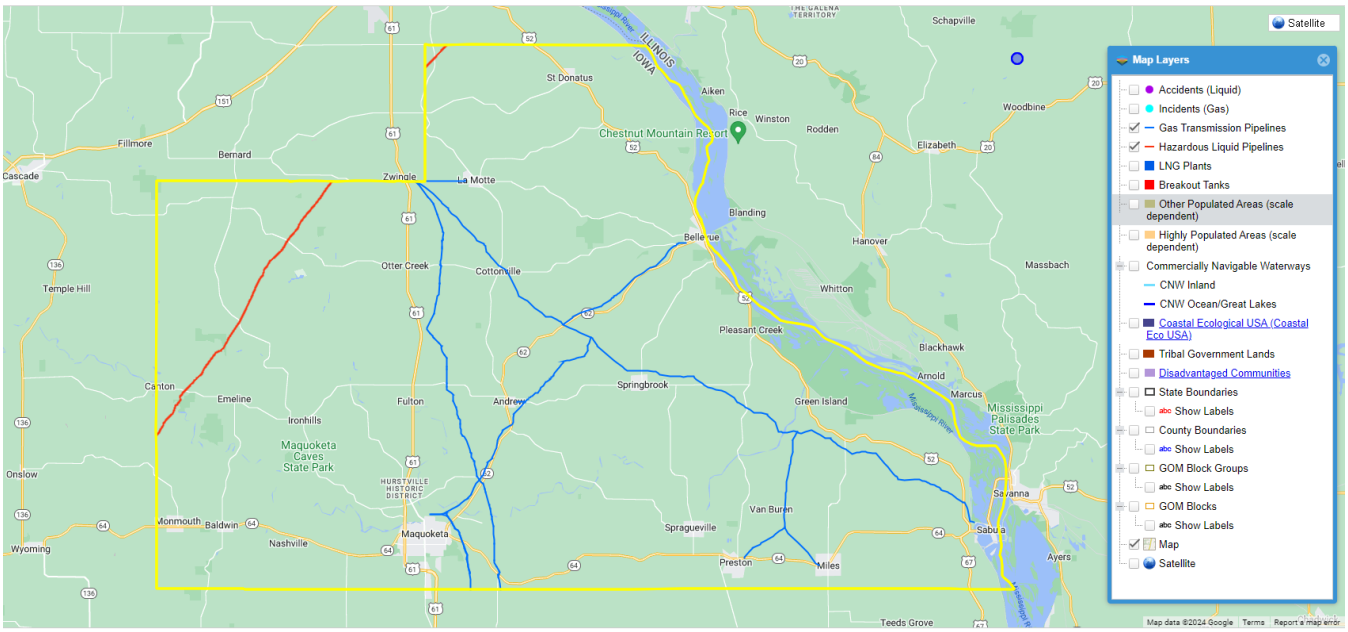


Pipeline Incident

Figure 3.62. provides the locations of pipelines in Jackson County. The data for this map

consists of gas transmission pipelines (blue) and hazardous liquid trunklines (red). It does not contain gathering or distribution pipelines, such as lines which deliver gas to a customer's home. Therefore, not all pipelines in the County will be visible.

Figure 3.62. Pipelines in Jackson County



Source: https://pvnpms.phmsa.dot.gov/PublicViewer/ accessed May 2024

Any type of hazardous materials incident within a city that includes a large release of hazardous materials could affect large areas of the city in the right conditions, possibly even the entire city. This could necessitate evacuation of large areas. In the rural unincorporated areas where population densities are low, even in the event of a large release the number of homes that may need to be evacuated would be significantly lower than in an urban environment.

Immediate dangers from hazardous materials include fires and explosions. The release of some toxic gases may cause immediate death, disablement, or sickness if absorbed through the skin, injected, ingested, or inhaled. Contaminated water resources may be unsafe and unusable, depending on the amount of contaminant. Some chemicals cause painful and damaging burns if they come in direct contact with skin. Contamination of air, ground, or water may result in harm to fish, wildlife, livestock, and crops. The release of hazardous materials into the environment may cause debilitation, disease, or birth defects over a long period of time.

Loss of livestock and crops may lead to economic hardships within the community. The occurrence of a hazmat incident many times shuts down transportation corridors for hours at a time while the scene is stabilized, the product is off-loaded, and reloaded on a replacement container.

Previous Occurrences

In Iowa, hazardous materials spills are reported to the Iowa DNR. According to Iowa Administrative Code Chapter 131, *Notification of Hazardous Conditions*, any person manufacturing, storing, handling, transporting, or disposing of a hazardous substance must notify the Iowa DNR and the local Police Department or the Sheriff's Office of the occurrence of a hazardous condition as soon as possible but not later than six hours after the onset of the

hazardous condition or the discovery of the hazardous condition. The Iowa DNR maintains a database of reported spills. According to that database, from 2000 to 2023, there have been 106 hazardous materials spills reported in Jackson County.

Table 3.57. provides a summary of the reported spills during this time period for each jurisdiction indicated in the database as well as the mode of the spill. According to this data, the most spills occurred in the City of Maquoketa (47) and most spills occurred during handling and storage (39).

Table 3.57. Reported Hazardous Materials Spills by Jurisdiction and Mode, 2000-2023

Jurisdiction	Fire	Handling and Storage	Manure	Other	Pipeline	Railroad	Theft	Transformer	Transportation	Not Reported	Grand Total
Andrew	0	1	0	0	0	0	0	2	0	0	**3**
Baldwin	0	4	0	0	0	0	0	1	0	0	**5**
Bellevue	0	7	1	1	0	0	0	4	1	0	**14**
Bernard	0	0	0	2	0	0	0	0	0	1	**3**
LaMotte	0	1	0	0	1	0	0	0	0	0	**2**
Maquoketa	1	18	2	0	0	0	0	8	16	2	**47**
Miles	0	4	0	0	0	0	1	1	1	0	**7**
Monmouth	3	0	0	0	0	0	0	1	1	0	**5**
Preston	0	2	1	0	0	0	0	0	2	0	**5**
Sabula	0	2	0	0	0	1	0	1	4	1	**9**
St. Donatus	0	0	0	0	0	0	0	0	1	0	**1**
Zwingle	0	0	3	0	0	0	0	0	2	0	**5**
Grand Total	**4**	**39**	**7**	**3**	**1**	**1**	**1**	**18**	**28**	**4**	**106**

Source: Iowa DNR; Hazardous Material Release Database; https://programs.iowadnr.gov/hazardousspills/introductory.aspx#&&BasicPageIndex=0

Table 3.58. that follows summarizes the spills by material type. Petroleum is the most common material type spilled (44).

Table 3.58. Reported Hazardous Materials Spills by Material Type, 2000-2023

Jurisdiction	Acids, Bases	Animal or Vegetable Product	Chlorine	Fertilize, Pesticide	Inorganic Chemical	Manure	Organic Chemical	Petroleum	Propane, LPG, Natural Gas	Transformer Oil, PCB	Not Reported	Grand Total
Andrew	0	0	0	0	0	0	0	0	0	2	1	**3**
Baldwin	0	0	0	2	0	0	0	2	0	1	0	**5**
Bellevue	0	0	0	1	0	1	0	7	1	4	0	**14**

Table 3.58. Reported Hazardous Materials Spills by Material Type, 2000-2023

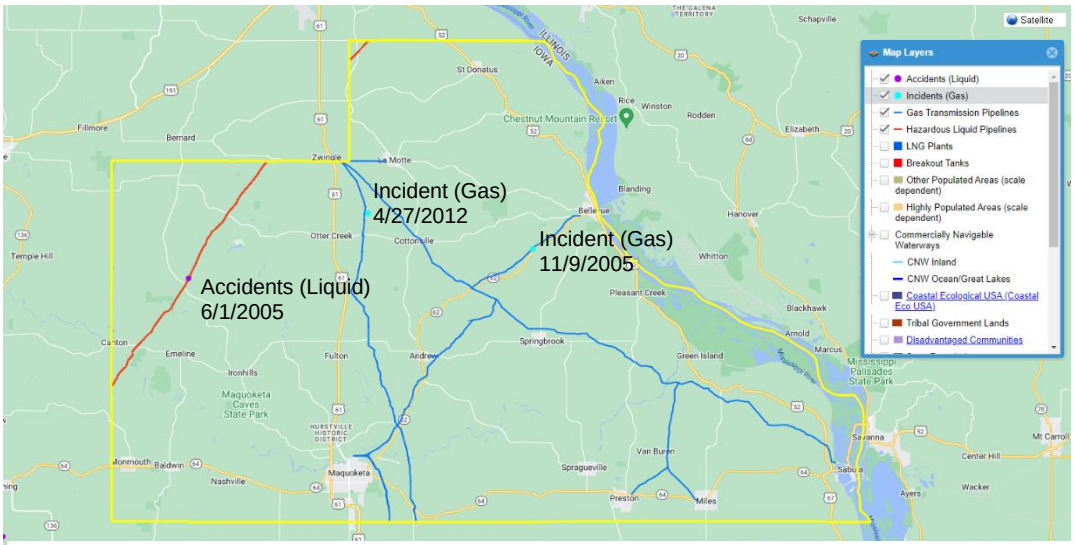
Jurisdiction	Acids, Bases	Animal or Vegetable Product	Chlorine	Fertilize, Pesticide	Inorganic Chemical	Manure	Organic Chemical	Petroleum	Propane, LPG, Natural Gas	Transformer Oil, PCB	Not Reported	Grand Total
Bernard	0	0	0	0	1	0	0	0	0	0	2	**3**
LaMotte	0	1	0	0	0	0	0	0	1	0	0	**2**
Maquoketa	2	3	2	4	0	0	2	23	0	4	7	**47**
Miles	0	0	0	2	0	0	0	1	0	1	3	**7**
Monmouth	0	0	0	3	0	0	0	0	0	1	1	**5**
Preston	0	0	0	3	0	1	0	1	0	0	0	**5**
Sabula	0	0	0	0	0	0	0	7	0	1	1	**9**
St. Donatus	0	1	0	0	0	0	0	0	0	0	0	**1**
Zwingle	0	0	0	2	0	0	0	3	0	0	0	**5**
Grand Total	**2**	**5**	**2**	**17**	**1**	**2**	**2**	**44**	**2**	**14**	**15**	**106**

Source: Iowa DNR; Hazardous Material Release Database
https://programs.iowadnr.gov/hazardousspills/introductory.aspx#&&BasicPageIndex=1

Pipelines

The U.S. Department of Transportation (DOT) Pipeline and Hazardous Materials Safety Administration maintains a database of pipeline incidents and mileage reports. From 2005-2024, there were two reported incidents and one reported accident in Jackson County (see **Figure 3.63.**). The 2005 natural gas incident was caused by excavation damage; there was one injury. The 2012 natural gas incident was caused by excavation damage; there were no injuries. The propane pipeline accident in 2005 was caused by failure of pipe or weld; there were no injuries.

Figure 3.63. Pipelines in Jackson County, noting Incidents and Accidents



Source: https://pvnpms.phmsa.dot.gov/PublicViewer/ accessed May 2024

Probability of Future Occurrence

From 2000 to 2023 (23 years), there have been 106 spills reported to the Iowa DNR in Jackson County. This computes to an annual average of 4.6 hazardous materials spills per year. Therefore, the probability of future occurrence of hazardous materials incidents is determined to be “Occasional.”

Probability Score: 2 - Occasional

Vulnerability Assessment

Vulnerability Overview

A hazardous materials incident can occur almost anywhere. So, all jurisdictions are considered to have at least some vulnerability to this hazard. People, pets, livestock, and vegetation in close proximity to facilities producing, storing, or transporting hazardous substances are at higher risk. Populations downstream, downwind, and downhill of a released substance are particularly vulnerable. Depending on the characteristics of the substance released, more people, in a larger area may be in danger from explosion, absorption, injection, ingestion, or inhalation.

Most of the hazardous materials incidents that have occurred in Jackson County are localized and are quickly contained or stabilized. Depending on the characteristic of the hazardous material or the volume of product involved, the affected area can be as small as a room in a building or as large as 5 square miles or more. Many times, additional regions outside the immediately affected area are evacuated for precautionary reasons. More widespread effects occur when the product contaminates the municipal water supply or water system such as river, lake, or aquifer. Spills can be costly to clean up due to the specialized equipment and training, and disposal sites that are necessary. Since the majority of spills in the county are small and quickly maintained within existing capabilities, the magnitude was determined to be “Limited.”

Magnitude/Severity Score: 2 – Limited

Potential Losses to Existing Development

The impact of this type of disaster will likely be localized to the immediate area surrounding the incident. The initial concern will be for people, then the environment. If contamination occurs, the spiller is responsible for the cleanup actions and will work closely with responders in the local jurisdiction, the Iowa DNR, and the USEPA to ensure that cleanup is done safely and in accordance with federal and state laws.

As mentioned, it is difficult to determine the potential losses to existing development because of the variable nature of a hazardous materials spill. For example, a spill of a toxic airborne chemical in a populated area could have greater potential for loss of life. By contrast a spill of a very small amount of a chemical in a remote rural area would be much less costly and possibly limited to remediation of soil.

Data provided by the Iowa DNR did not provide information relative to costs associated with cleaning up any of the spills or of any property damage that occurred. Without data on costs of previous events, it is not possible to determine potential costs associated with future spills.

To analyze critical facilities at risk in the planning area, the inventory of critical and essential facilities and infrastructure in the planning area was compiled from various sources including the Jackson County GIS Department, HSIP Freedom 2015, and the Iowa DNR GIS Repository. The compiled inventory consisted of 201 critical facilities. A comparison was made of the critical facilities with the locations of Tier II Facilities housing Extremely Hazardous Substances (EHS)

to determine those critical/essential facilities/functions (other than Tier II EHS facilities themselves) that are within a half mile of Tier II fixed EHS chemical facilities. This analysis revealed 69 critical or essential facilities within half mile of fixed EHS chemical facilities with the Tier II reporting requirement. Appendix E contains the results of analysis. This Appendix is redacted from the public version of this plan. To obtain access for official use, contact the Jackson County Emergency Manager.

Future Development

The number and types of hazardous chemicals stored and transported through Jackson County will likely continue to increase. Business growth along major transportation corridors could also increase the vulnerability to transportation hazardous materials spills.

Climate Change Impacts

There are no apparent climate change impacts related to the hazardous materials hazard.

Hazardous Materials Hazard Summary by Jurisdiction

It should be noted that all spills in the Iowa DNR database are associated with an incorporated area. Although spills do occur in the unincorporated area, they are recorded in the database associated with the nearest city. All jurisdictions with the exception of Sprague ville and Springbrook had at least one spill during the reporting period. The probability score was based on the number of spills for each jurisdiction during this period. The magnitude was determined to be “negligible” based on the general types and quantities of spills that have occurred. Probability and magnitude for the schools were determined unlikely and negligible as hazardous materials are not generally stored on site.

Jurisdiction	Probability	Magnitude/ Severity	Warning Time	Duration	Weighted Score	Level
Unincorporated	2	2	4	2	2.3	Moderate
Andrew	2	2	4	2	2.3	Moderate
Baldwin	3	2	4	2	2.75	Moderate
Bellevue	4	2	4	2	3.2	High
LaMotte	2	2	4	2	2.3	Moderate
Maquoketa	4	2	4	2	3.2	High
Miles	4	2	4	2	3.2	High
Monmouth	3	2	4	2	2.75	Moderate
Preston	3	2	4	2	2.75	Moderate
Sabula	4	2	4	2	3.2	High
Sprague ville	1	2	4	2	1.85	Low
Springbrook	1	2	4	2	1.85	Low
St. Donatus	2	2	4	2	2.3	Moderate
Andrew CSD	1	2	4	2	1.85	Low
Bellevue CSD	1	2	4	2	1.85	Low
Easton Valley CSD	1	2	4	2	1.85	Low
Maquoketa CSD	1	2	4	2	1.85	Low

3.5.13. Infrastructure Failure

Hazard Score Calculation					
Probability	**Magnitude/Severity**	**Warning Time**	**Duration**	**Weighted Score**	**Level**
2	**2**	**3**	**3**	**2.25**	**Moderate**

Hazard Profile

Hazard Description
Critical infrastructure involves several different types of facilities and systems including electric power, transportation routes, natural gas and oil pipelines, water and sewer systems, storage networks, and internet/telecommunications systems. Failure of utilities or other components of the infrastructure in the planning area can seriously impact public health, functioning of communities and the economy.

Disruption of any of these services could result from the majority of the natural, technological, and manmade hazards described in this plan, as well as space weather.

Coronal Mass Ejection (CME), Electromagnetic Pulse (EMP), and Geomagnetic Disturbance (GMD)
According to the National Weather Service at https://www.weather.gov/safety/space:
Coronal Mass Ejections (CMEs) are large clouds of plasma and magnetic fields hurled into space from the Sun. The ejected material can travel a million or more miles per hour (500 km/second). Luckily, Earth's magnetosphere, ionosphere, and atmosphere do a great job of protecting us from the most hazardous effects. In order to protect people and systems that might be at risk from space weather effects, we need to understand the causes. The sun is the main source of space weather. Eruptions of plasma and magnetic field structures from the sun's atmosphere (CMEs) and sudden bursts of radiation solar flares) can cause space weather effects at or near Earth.

If a CME arrives at Earth, it can produce a geomagnetic storm, which, in turn, can cause anomalies and disruptions to the modern conveniences we have come to rely on. For example, fluctuating magnetic fields associated with these storms induce currents in long wires like power lines, potentially leading to widespread blackouts in extreme cases. Power outages due to space weather are rare events, but evidence suggests that significant effects could occur. Significant power outages *may* have cascading effects, causing loss of:

- Water and wastewater distribution systems
- Perishable foods and medications
- Heating/air conditioning and electrical lighting systems
- Computer systems, telephone systems, and communications systems (including disruptions in airline flights, satellite networks and GPS services)
- Public transportation systems
- Fuel distribution systems and fuel pipelines
- All electrical systems that do not have back-up power

According to the U.S. Department of Homeland Security:
An *Electromagnetic Pulse (EMP)* is a burst of electromagnetic energy produced by a nuclear explosion in the atmosphere, considered capable of widespread damage to power lines, telecommunications, and electronic equipment.

A *Geomagnetic Disturbance (GMD)* is a temporary disturbance of the Earth's magnetosphere caused by a solar wind shock wave and/or cloud of magnetic field that interacts with the Earth's magnetic field.

Electromagnetic pulses, whether caused by an intentional EMP attack or a naturally occurring geomagnetic disturbance from severe space weather, could disrupt critical infrastructure such as the electrical grid, communications equipment, water and wastewater systems, and transportation modes. (Source: https://www.dhs.gov/science-and-technology/news/2022/09/06/dhs-releases-recommendations-protect-national-public-warning-system-emps)

In addition to a secondary or cascading impact from another primary hazard, utilities and infrastructure can fail as a result of faulty equipment, lack of maintenance, degradation over time, or accidental damage such as damage to buried lines or pipes during excavation. To maintain consistency with the state plan, this hazard encompasses a variety of different types of infrastructure failure, including communications failure, energy failure, structural failure, and structural fire.

According to NOAA, geomagnetic storms, also referred to as solar storms, disrupt Earth's magnetic field and can potentially affect power grids on Earth as well as radio signals and communications systems. They can also affect our satellite operations and GPS navigation capabilities. NOAA categorizes geomagnetic storms on a scale ranging from G1 to G5. A G5 storm, the most extreme level, can result in complete high frequency radio blackouts across the sunlit side of Earth, lasting for several hours.

From March 23–24, 2024, NOAA's GOES satellites, and others operated by international partners, observed numerous flares erupting from the sun, including a powerful X-class solar flare. Additionally, a surge of extremely hot plasma, known as a coronal mass ejection (CME), raced toward Earth resulting in a severe G4-class geomagnetic storm, marking the most potent solar storm since 2017. However, according to a Geomagnetic Storm Watch from NOAA's Space Weather Prediction Center, there was no reason for the public to be alarmed. (Source: https://www.nesdis.noaa.gov/news/noaa-satellites-detect-severe-solar-storm)

Communications Failure

Communications failure is the widespread breakdown or disruption of normal communication capabilities. This could include major telephone outages, internet interruption, loss of cellular telephone service, loss of local government radio facilities, long-term interruption of electronic broadcast services, or emergency 911. Law enforcement, fire, emergency medical services, public works, and emergency warning systems are just a few of the vital services which rely on communications systems to effectively protect citizens. In addition, business and industry rely heavily on various modes of communication. Mechanical failure, traffic accidents, power failure, line severance, and weather can all affect communications systems and disrupt service. Disruptions and failures can range from localized and temporary to widespread and long-term.

The types of hazards and impacts to internet and telecommunications infrastructure are very similar to electric power supply. Land line phone lines often utilize the same poles as electric lines. So, when weather events such as windstorm or winter weather cause lines to break, both electricity and telephone services experience outages. With the increasing utilization of cellular phones, hazard events such as tornado that can damage cellular repeaters can cause outages. In addition, during any hazard event, internet and telecommunications systems can become overwhelmed due to the surge in call/usage volume.

Energy Failure
Energy failure includes interruption of service to electric, petroleum, or natural gas. Disruption of electric power supply can be a cascading impact of several other hazards. Electric power is the type of energy failure that is most often a secondary impact of other hazard events. The most common hazards analyzed in this plan that disrupt power supply are flood, tornado, windstorm, and winter weather as these hazards can cause major damage to power infrastructure. To a lesser extent, extreme temperatures, dam failure, lightning, and terrorism can disrupt power. Excessive heat can disrupt power supply when air conditioning use spikes during heat waves which can cause brownouts. Dam failure is similar to flood in that infrastructure can be damaged or made inaccessible by water. Lightning strikes can damage substations and transformers but are usually isolated to small areas of outage. Many forms of terrorism could impact power supply either by direct damage to infrastructure or through cyber- terrorism targeting power supply networks. Primary hazards that can impact natural gas and oil pipelines are earthquake, expansive soils, land subsidence, landslide, and terrorism.

Other Utility Failure
Interruption of other utilities such as water and sewer systems can be a devastating, costly impact. The primary hazards that can impact water supply systems are drought, flood, hazardous materials, and terrorism. Winter storm can also impact water supply if low temperatures cause failure/breakage of water infrastructure. The primary hazard that impacts sewer systems is flood.

Structural Failure
The collapse (partial or total) of any structure including roads, bridges, towers, and buildings is considered a structural failure. A road, bridge, or building may collapse due to the failure of the structural components or because the structure was overloaded. Natural events such as heavy snow may also cause the roof of a building to collapse (under the weight of snow). In 1983 a KWWL television tower collapsed due to ice buildup. Heavy rains and flooding can undercut and washout a road or bridge. This occurred twice in 2008 when railway bridges failed in Waterloo and Cedar Rapids due to flooding. The age of the structure is sometimes independent of the cause of the failure.

Enforcement of building codes can better guarantee that structures are designed to hold-up under normal conditions. Routine inspection of older structures may alert inspectors to weak points. The level of damage and severity of the failure is dependent on factors such as the size of the building or bridge, the number of occupants of the building, the time of day, day of week, amount of traffic on the road or bridge, and the type, and amount of products stored in the structure. There have been structural failures across the state in the past as mentioned above. They have included homes, commercial structures, and communications towers. There is no central collection point for this information, but news articles document infrastructure failure.

Structure Fire
A structure fire is an uncontrolled fire in a populated area that threatens life and property and is beyond normal day-to-day response capability. Structural fires present a far greater threat to life and property and the potential for much larger economic losses. Modern fire codes and fire suppression requirements in new construction and building renovations, coupled with improved fire-fighting equipment, training, and techniques lessen the chance and impact of a major urban fire. Most structural fires occur in residential structures, but the occurrence of a fire in a commercial or industrial facility could affect more people and pose a greater threat to those near the fire or fighting the fire because of the volume or type of the material involved. Less severe structural fires are almost a common occurrence in some communities.

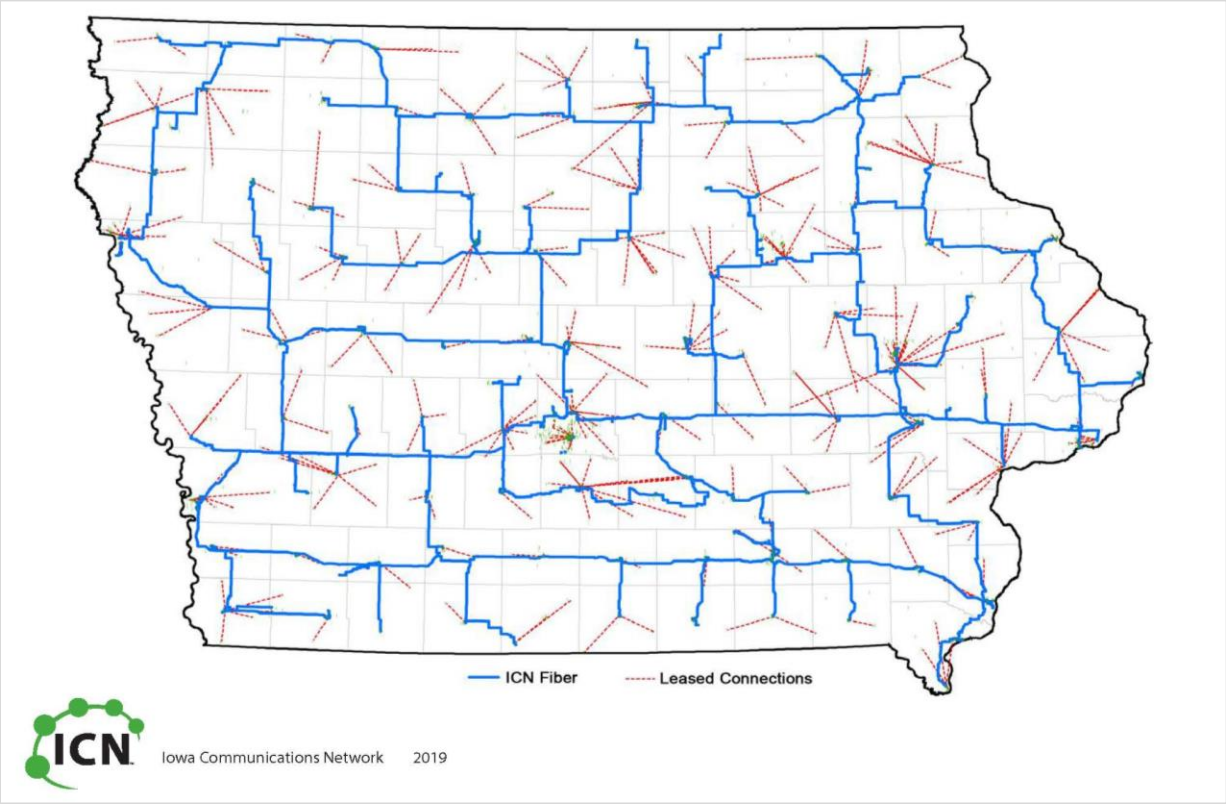
Warning Time Score: 3 -- 6 to 12 hours warning time

Duration Score: 3 -- Less than one week

Geographic Location/Extent
The entire planning area is at risk to all types of infrastructure failure included in the hazard description section, either from primary failure due to malfunction, degradation, or accidental or intentional damage or as a result of a secondary impact related to another hazard event.

Communications
Figure 3.64. shows the Iowa Communications Network (ICN) that administers Iowa's statewide fiber optic telecommunications network.

Figure 3.64. Map of Iowa Communication Network



Energy
Power outages can occur in outlying areas with more frequency than in more developed areas. A loss of electric power can also interrupt supply of water from a well. Food in freezers or refrigerators may also be lost. Power outages can cause problems with computers and other devices as well. **Figure 3.65. i**s the electrical service area map for Jackson County.

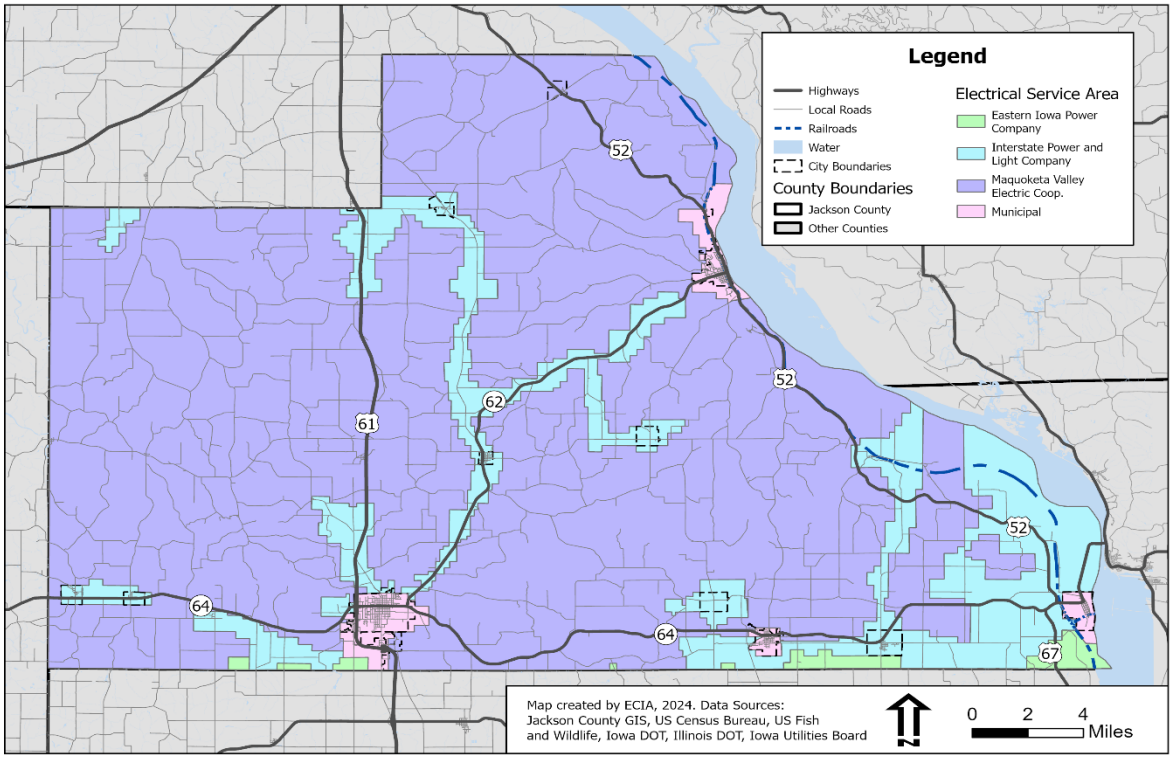
Other Utilities (Water/Sewer)
There are 10 Water Supply Systems in Jackson County, Iowa as follows:

- Maquoketa: Maquoketa Municipal Water—Serves 6,112 people
- Bellevue: Bellevue Municipal Utilities—Serves 2,350 people

- Preston: Preston Municipal Water Supply—Serves 949 people
- Sabula: Sabula Water Supply—Serves 670 people
- Miles: Miles Water Department—Serves 462 people
- Andrew: Andrew Water Supply—Serves 460 people
- La Motte: La Motte Water Supply—Serves 272 people
- Springbrook: Springbrook Water Dept—Serves 182 people
- Monmouth: Monmouth Water Supply—Serves 180 people
- Baldwin: Baldwin Water Supply—Serves 127 people

(Source: https://www.nytimes.com/interactive/projects/toxic-waters/contaminants/ia/jackson/index.html)

Figure 3.65. Map of Electrical Service Areas in Jackson County



There are 17 permitted wastewater treatment discharge sites in Jackson County, Iowa according to the Iowa DNR (see **Table 3.59.**).

Table 3.59. Iowa DNR Permitted Wastewater Sites in Jackson County

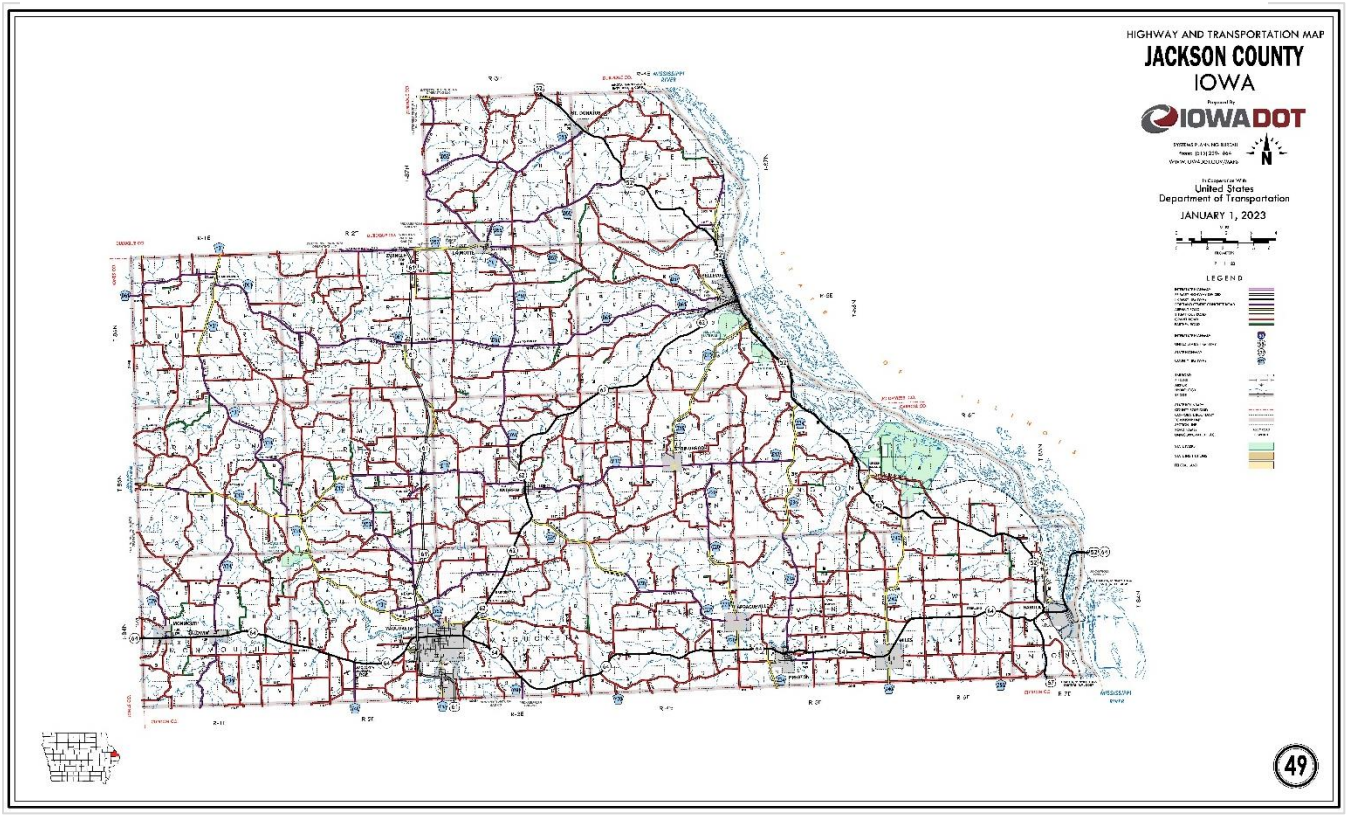
Facility Name	Facility City	Permit Type	Class	Treatment Type
City of Andrew STP	Andrew	Municipal	Minor	Waste Stabilization Lagoon
Baldwin-Monmouth WW Treatment Agency	Baldwin	Municipal	Minor	Waste Stabilization Lagoon
City of Bellevue STP	Bellevue	Municipal	Minor	Activated Sludge
DNR Bellevue State Park	Bellevue	Semi-Public	Minor	Waste Stabilization Lagoon
DNR Maquoketa Caves State Park	Maquoketa	Semi-Public	Minor	Waste Stabilization Lagoon
City of LaMotte STP	La Motte	Municipal	Minor	Waste Stabilization Lagoon
Community of Leisure Lake STP	Bernard	Municipal	Minor	Waste Stabilization Lagoon

City of Maquoketa STP	Maquoketa	Municipal	Major	Activated Sludge
City of Miles STP	Miles	Municipal	Minor	Waste Stabilization Lagoon
City of Preston STP	Preston	Municipal	Minor	Trickling Filter
City of Sabula STP	Sabula	Municipal	Minor	Sequencing Batch Reactor
City of Spragueville STP	Spragueville	Municipal	Minor	Activated Sludge
City of Springbrook STP	Springbrook	Municipal	Minor	Waste Stabilization Lagoon
City of St. Donatus STP	St. Donatus	Municipal	Minor	Waste Stabilization Lagoon
City of Zwingle STP	Zwingle	Municipal	Minor	Septic Tank Sand Filter
Notes: STP = Sewage Treatment Plant, WW = Wastewater				

Infrastructure/Structures

The Highway map for Jackson County is provided in **Figure 3.59.** in the Hazardous Materials Incident Section. The Iowa Department of Transportation (DOT) detailed Highway and Transportation Map that includes other transportation infrastructure in the county is provided in **Figure 3.66**.

Figure 3.66. Iowa DOT Jackson County Transportation Map



There are a total of 258 bridge structures in Jackson County as follows:

- 46 State-owned Bridges.
- 209 county-owned bridges
- 3 city-owned bridges

Previous Occurrences

As indicated in the Hazard Description section, Infrastructure Failure often occurs as a secondary impact to other hazard events. For specific descriptions, please see the Previous Occurrences section of the other hazards included in this plan. In addition to failure/impacts as a result of other hazard events, Infrastructure Failure can also occur as a result of lack of maintenance, human error, and age deterioration.

The structure fires that have occurred in Jackson County have been within the normal day-to-day response capability, including use of pre-arranged mutual aid and do not fall into the category of uncontrolled fires in a populated area that threatens life and property.

Probability of Future Occurrence

As discussed in other hazard sections in this plan, infrastructure failure occurs as a secondary or cascading impact from several primary hazards such as winter storm, windstorm, and tornado as well as lack of maintenance and age deterioration and other human-caused incidents such as human error, and various forms of terrorism. Structure fire events also occur annually. Therefore, the HMPC determined the probability of future occurrence of this hazard to be "Occasional."

Probability Score: 2 -- Occasional

Vulnerability Assessment

Vulnerability Overview

Iowa is almost entirely dependent on out-of-state resources for energy. Iowans purchase oil, coal, and natural gas from outside sources. As a result, world and regional fuel disruptions are felt in Iowa.

Every community in the planning area is at risk to some type of utility/infrastructure failure. Business and industry in the urban areas are reliant on electricity to power servers, computers, automated systems, etc. Rural areas of the County are vulnerable as well, as modern agricultural practices are reliant on energy, such as electric milking machines, and irrigation pivots.

Generally, the smaller utility suppliers such as small electrical suppliers have limited resources for mitigation. This could mean greater vulnerability in the event of a major, widespread disaster, such as a major flood, severe winter storm or ice storm. The municipal utilities that exist in the County purchase power on the wholesale market for resale to their customers. This may make them more vulnerable to regional shortages of power as well.

In the event of a large-scale event impacting water supply or wastewater treatment homes and businesses with well-supplied water and septic systems for waste treatment would be largely unaffected. However, these systems may be prone to individual failure and do not have back-up systems in place in the event of failure as larger systems might.

The Iowa DOT has conducted inspections of bridges in the state. **Table 3.60.** provides a summary of the condition of the 258 bridges in Jackson County.

Table 3.60. Jackson County Bridge Condition Ratings and Weight Restrictions

Condition Index Rating - State Owned Bridges		
Good	Fair	Poor
24	22	0

Condition Index Rating - County Owned Bridges		
Good	Fair	Poor
40	114	39
Condition Index Rating - All Bridges in Jackson County		
Good	Fair	Poor
64	137	41
Structurally Deficient/Functionally Obsolete (SDFO) Rating- All Bridges in Jackson County		
Not Deficient	Structurally Deficient	Functionally Obsolete
201	41	0
Weight Restrictions- All Bridges in Jackson County		
Unrestricted	Restricted	Closed
193	47	2

Source: IA Department of Transportation

Magnitude/Severity Score: 2 -- Limited

Potential Losses to Existing Development

Since Utility or Infrastructure Failure is generally a secondary or cascading impact of other hazards, it is not possible to quantify estimated potential losses specific to this hazard due to the variables associated with affected population, duration of outages, etc. Although the variables make it difficult to estimate specific future losses, FEMA has developed standard loss of use estimates in conjunction with their Benefit-Cost Analysis methodologies to estimate the cost of lost utilities on a per-person, per-use basis (See **Table 3.61.**).

Table 3.61. FEMA Standard Values for Loss of Service for Utilities and Roads/Bridges

Loss of Electric Power	Cost of Complete Loss of Service
Total Economic Impact	$126 per person per day
Loss of Potable Water Service	Cost of Complete Loss of Service
Total Economic Impact	$93 per person per day
Loss of Wastewater Service	Cost of Complete Loss of Service
Total Economic Impact	$41 per person per day
Loss of Road/Bridge Service	Cost of Complete Loss of Service
Vehicle Delay Detour Time	$38.15 per vehicle per hour
Vehicle Delay Mileage	$0.55 per mile (or current federal mileage rate)

Source: FEMA

Future Development

Increases in development and population growth would increase the demand for utilities and use of infrastructure as well as the level of impacts when the utilities or infrastructure fail. However, Jackson County has seen an overall population decrease of about 1.4 percent since the 2000 census. As technological advances are made and systems become more and more automated and dependent on power and communications infrastructure, the impacts of infrastructure failure could increase even though population is decreasing slightly.

Climate Change Impacts

Please refer to the Climate Change Impacts sections of the following primary hazards that can cause a cascading or secondary impact of infrastructure failure: River Flood, Severe Winter

Storm, Tornado/Windstorm, Thunderstorm/Lightning Hail, Excessive Heat, Flash Flood, and Terrorism.

Infrastructure Failure Hazard Summary by Jurisdiction
All jurisdictions within the planning area are at risk to infrastructure failure.

Jurisdiction	Probability	Magnitude/ Severity	Warning Time	Duration	Weighted Score	Level
Unincorporated	2	2	3	3	2.25	Moderate
Andrew	2	2	3	3	2.25	Moderate
Baldwin	2	2	3	3	2.25	Moderate
Bellevue	2	2	3	3	2.25	Moderate
LaMotte	2	2	3	3	2.25	Moderate
Maquoketa	2	2	3	3	2.25	Moderate
Miles	2	2	3	3	2.25	Moderate
Monmouth	2	2	3	3	2.25	Moderate
Preston	2	2	3	3	2.25	Moderate
Sabula	2	2	3	3	2.25	Moderate
Spragueville	2	2	3	3	2.25	Moderate
Springbrook	2	2	3	3	2.25	Moderate
St. Donatus	2	2	3	3	2.25	Moderate
Andrew CSD	2	2	3	3	2.25	Moderate
Bellevue CSD	2	2	3	3	2.25	Moderate
Easton Valley CSD	2	2	3	3	2.25	Moderate
Maquoketa CSD	2	2	3	3	2.25	Moderate

3.5.14. Pandemic Human Disease

Hazard Score Calculation					
Probability	**Magnitude/Severity**	**Warning Time**	**Duration**	**Weighted Score**	**Level**
2	**2**	**1**	**4**	**2.05**	**Moderate**

Hazard Profile

Hazard Description

A human disease outbreak is a medical, health or sanitation threat to the general public (such as contamination, epidemic, plague and insect infestation). The outbreak may be spread by direct contact with an infected person or animal, ingesting contaminated food or water, vectors such as mosquitoes or ticks, contact with contaminated surroundings such as animal droppings, infected droplets, or by aerosolization. A pandemic human disease outbreak is a global outbreak.

Iowa's public health and health care communities work to protect Iowans from infectious diseases and preserve the health and safety of Iowans by rapidly identifying and containing a wide range of biological agents. Local public health departments and the Iowa Department of Public Health, Center for Acute Epidemiology investigate disease "outbreaks" of routine illnesses. There are a number of biological diseases/agents that are of concern to the State of Iowa such as vaccine preventable disease, foodborne disease and community associated infections having significant impact on the morbidity of Iowans. The following descriptions are general, and it should be noted that individuals may experience more or less severe consequences.

Vaccine Preventable Disease

In the U.S., there are common infectious diseases that include polio, measles, diphtheria, pertussis, rubella, mumps, tetanus and *Haemophilus influenzae* type b that are now rare because of widespread use of vaccines. Routine childhood immunizations have helped protect both individuals and communities each year saving nearly $14 billion in direct medical costs and $69 billion in costs to society according to the U.S. Department of Health and Human Services, Centers for Disease Control and Prevention.

The immunization rates in Iowa are consistent with national average. Vaccine preventable diseases continue to threaten the health of Iowans when children, adolescents and adults are un-immunized or under-immunized.

Influenza

Influenza (flu) is a viral infection of the nose, throat, bronchial tubes, and lungs. There are two main types of viruses: A and B. Each type includes many different strains, which tend to change each year. In Iowa, influenza occurs most often in the winter months. Illnesses resembling influenza may occur in the summer months, but these are usually the result of other viruses that exhibit symptoms commonly referred to as influenza-like illness or ILI.

Influenza is highly contagious and is easily transmitted through contact with droplets from the nose and throat of an infected person during coughing and sneezing. Typical symptoms include headache, fever, chills, cough, and body aches. Although most people are ill for only a few days some may have secondary infections, such as pneumonia, and may need to be hospitalized. Anyone can get influenza, but it is typically more serious in the elderly and people with chronic illnesses such as cancer, emphysema, or diabetes or weak immune systems. It is estimated that thousands of people die each year in the United States from flu or related complications.

Pandemic Influenza
A pandemic is a global disease outbreak. A pandemic flu is a human flu that causes a global outbreak, or pandemic, of serious illness. A flu pandemic occurs when a new influenza virus emerges for which people have little or no immunity, and for which there is no vaccine.

This disease spreads easily person-to-person, causing serious illness, and can sweep across the country and around the world in a very short time. The Centers for Disease Control and Prevention (CDC) has been working closely with other countries and the World Health Organization to strengthen systems to detect outbreaks of influenza that might cause a pandemic and to assist with pandemic planning and preparation.

During 2009 and 2010, health professionals around the globe worked to combat the H1N1 influenza virus. This relatively mild and stable influenza virus circulated across the globe and caused one of the most robust worldwide vaccination campaigns since the 1970s. Health professionals continue to monitor the possibility of an avian (bird) flu pandemic associated with a highly pathogenic avian H5N1 virus. Since 2003, avian influenza has been spreading through Asia. A growing number of human H5N1 cases contracted directly from handling infected poultry have been reported in Asia, Europe, and Africa, and more than half the infected people have died. There has been no sustained human-to-human transmission of the disease, but the concern is that H5N1 will evolve into a virus capable of human-to-human transmission.

An especially severe influenza pandemic could lead to high levels of illness, death, social disruption, and economic loss. Impacts could range from school and business closings to the interruption of basic services such as public transportation, health care, and the delivery of food and essential medicines.

Pandemics are generally thought to be the result of novel strains of viruses. Because of the process utilized to prepare vaccines, it is impossible to have vaccine pre-prepared to combat pandemics. A portion of the human and financial cost of a pandemic is related to lag time to prepare a vaccine to prevent future spread of the novel virus. In some cases, current vaccines may have limited activity against novel strains.

Since March 2020 and during implementation of the *2019 Hazard Mitigation Plan*, Jackson County, the nation, and the world were dealing with the COVID-19 pandemic, confirming that pandemic is a key public health hazard in the county. Unlike seasonal flu, an influenza pandemic has much greater potential for loss of life and significant social disruption due to higher rates of transmission and more severe health impacts. The COVID-19 virus has a much higher rate of transmission than the seasonal flu, primarily by airborne transmission of droplets/bodily fluid. Common symptoms include fever, cough, fatigue, shortness of breath or breathing difficulties, and loss of smell and taste. While most people have mild symptoms, some people develop acute respiratory distress syndrome with roughly one in five requiring hospitalization and a fatality rate of approximately 1%. A key challenge in containing the spread has been the fact that it can be transmitted by people who are asymptomatic.

Foodborne Disease
There are several agents that can cause illness when consumers eat contaminated food, beverages or water. Foodborne illness (food poisoning) can also be spread person-to-person as well as from contact with animals. **Table 3.62.** is a list of common foodborne diseases,

Table 3.62. Common Foodborne Diseases

Organism	Onset of Symptoms	Associated Food(s)
Botulism	12-36 hours	canned fruits and vegetables
Campylobacter	2-5 days, range 1-10 days	undercooked chicken or pork, unpasteurized milk
Cholera	12-72 hours	undercooked or raw seafood, especially oysters
Cryptosporidium	7 days, range 1-12 days	unpasteurized beverages, contaminated food or water, person-to-person
E. coli (shiga-toxin)	3-4 days, range 1-12 days	undercooked ground meats, unpasteurized milk, contaminated fruits or vegetables, person-to-person
Giardia	7-10 days, range 3-25 days	contaminated water, person-to-person
Hepatitis A	28-30 days, range 15-50	raw produce, undercooked foods, person-to-person
Listeria	3 weeks, range 3-70 days	soft cheeses, unpasteurized milk, ready-to-eat deli meats, hot dogs, undercooked poultry, unwashed raw vegetables
Norovirus	24-48 hours, range 10-50 hours	contaminated ready-to-eat food, undercooked shellfish, person-to-person
Salmonella	12-36 hours, range 6-72 hours	contaminated eggs, poultry, beef, raw fruits and vegetables, unpasteurized milk or juice, cheese
Shigella	1-3 days, range 12-96 hours	contaminated food or water, person-to-person
Trichinosis	8-15 days, range 5-45 days	raw or undercooked pork or wild game meat

Source: Centers of Disease Control and Prevention (CDC)

Warning Time Score: 2 - More than 12 to 24 hours warning time

Duration Score: 4 - More than one week

Geographic Location/Extent

A Pandemic Human Disease outbreak has no geographic boundaries. Because of our highly mobile society, disease can move rapidly through a school, business and across the nation and around the word within days, weeks or months. Many of the infectious diseases that are designated as notifiable at the national level result in serious illness if not death. Some are treatable, for others only the symptoms are treatable.

The current COVID-19 pandemic affected all 99 Iowa counties. All communities in the county were impacted, either directly or indirectly. Some indirect consequences may be the diversion of resources that may be otherwise available. The COVID-19 vaccination rate for the 2023-2025 season was 12.2 percent for Jackson County and 15.2% for the State of Iowa.

The magnitude of a public health emergency will range significantly depending on the aggressiveness of the virus in question and the ease of transmission. Pandemic influenza is more easily transmitted from person-to-person but advances in medical technologies have greatly reduced the number of deaths caused by influenza over time.

Previous Occurrences

The World Health Organization tracks and reports on epidemics and other public health emergencies through the Global Alert and Response (see historic epidemics at www.who.int/en/). There have been five acknowledged pandemics in the past century:

- **2020-Ongoing COVID-19:** The COVID-19 or novel coronavirus pandemic began in December 2019 and was declared a pandemic in March of 2020. As of October 30th, 2020, 45 million cases were reported around the world with over 1 million deaths, including 9 million cases and 229,000 deaths in the U.S. As of September 1, 2021, this figure had increased to over 218 million cases and approximately 4.53 million deaths reported globally, including over 39.3 million cases and approximately 641,000 deaths in the U.S. -- more than double since October 2020. Several COVID-19 vaccines were given emergency approval by the FDA and in August 2021 the Pfizer vaccine was fully approved by the FDA. Vaccine hesitancy resulted in 52% of the US population to be fully vaccinated (as of August 2021). It took months for the majority of the population to receive a vaccine and achieve herd immunity. In addition, many other countries did not have access or the capabilities to disseminate vaccines as the U.S. does; thus, the pandemic is expected to continue for an indefinite period of time.

- **2009 H1N1 Influenza**—The 2009 H1N1 Pandemic Influenza caused 659 hospitalizations with lab confirmed H1N1 since 9/1/09 and resulting in 41 fatalities. Typically, people who became ill were the elderly, the very young and people with chronic medical conditions and high-risk behaviors.

- **1968–69 Hong Kong flu (H3N2)** —This strain caused approximately 34,000 deaths in the United States and more than 700,000 deaths worldwide. It was first detected in Hong Kong in early 1968 and spread to the United States later that year. Those over age 65 were most likely to suffer fatal consequences. This virus returned in 1970 and 1972 and still circulates today.

- **1957–58 Asian flu (H2N2)** —This virus was quickly identified because of advances in technology, and a vaccine was produced. Infection rates were highest among school children, young adults and pregnant women. The elderly had the highest rates of death. A second wave developed in 1958. In total, there were about 70,000 deaths in the United States. Worldwide deaths were estimated between one and two million.

- 1**918–19 Spanish flu (H1N1)** —This flu is estimated to have sickened 20-40 percent of the world's population. Over 20 million people lost their lives. Between September 1918 and April 1919, 500,000 Americans died. The flu spread rapidly; many died within a few days of infection, others from secondary complications. The attack rate and mortality were highest among adults 20-50 years old; the reasons for this are uncertain.

Other Reportable Diseases

Table 3.63. shows the 10-year historical reported deaths in Jackson County and in the State of Iowa from Influenza and Pneumonia, as well as Infective and Parasitic Disease for 2012-2022 .

Table 3.63. Deaths from Influenza/ Pneumonia and Infective/Parasitic Disease

Year	Influenza/Pneumonia Deaths		Infective/Parasitic Disease Deaths	
	Jackson County	State of Iowa	Jackson County	State of Iowa
2022	*	488	*	614
2021	*	361	*	580
2020	10	536	*	602
2019	*	583	8	634
2018	*	689	*	529

Table 3.63. Deaths from Influenza/ Pneumonia and Infective/Parasitic Disease

Year	Influenza/Pneumonia Deaths		Infective/Parasitic Disease Deaths	
	Jackson County	State of Iowa	Jackson County	State of Iowa
2017	*	567	8	554
2016	*	483	*	429
2015	*	592	*	488
2014	6	549	*	448
2013	*	755	*	511
2012	*	656	6	511

Table 3.64. provides the number of common reportable diseases in Jackson County from 2010 to 2017 from the Iowa Department of Public Health (IDPH), Center for Acute Epidemiology (CADE) Annual Reports. The spike in reportable diseases in 2012 is due to 36 cases of Pertussis that year; the drop in 2015 is due to some diseases being removed from the reportable list.

Table 3.64. Iowa Common Reportable Diseases by Year in Jackson County

2010	2011	2012	2013	2014	2015	2016	2017
71	**89**	**102**	**95**	**78**	**47**	**n/a**	**25**

Source: IDPH Annual Reports

Probability of Future Occurrence

For purposes of determining probability of future occurrence, the HMPC defined “occurrence” of human disease outbreak as a medical, health or sanitation threat to the general public (such as contamination, epidemic, or plague). In the last century, there have been five pandemic flu events. With the COVID-19 pandemic, the HMPC determined the possibility of a Pandemic Human Disease outbreak causing a threat to the general public to be “Occasional”, with between 10% and 20% probability of occurring.

Probability Score: 2 - Occasional

Vulnerability Assessment

Vulnerability Overview

Although infectious diseases do not respect geographic boundaries, several populations in Jackson County are at specific risk to infectious diseases. Communicable diseases are most likely to spread quickly in institutional settings such as nursing home facilities, day care facilities, and schools. There are 7 facilities that are classified as nursing homes or elder care. There are also 13 public school facilities and 7 licensed group day care facilities in the county.

Immunizations

Immunization data can be used to identify trends and patterns in immunization coverage over time and in different geographic areas. Vaccines are the best way to protect children and communities from vaccine-preventable diseases. With time, immunity from childhood vaccines can wear off, leaving adults at risk for disease. Adult vaccines not only provide protection against the disease itself but also prevents serious illness and complications from the disease. Vaccines are the best way to protect adults and communities from vaccine-preventable diseases.

Iowa's Immunization Registry Information System (IRIS) provides computerized tracking of immunizations for children, adolescents and adults who are seen in a variety of public and private health care provider sites throughout the state. The IRIS program is able to document individual immunizations, track vaccine usage and vaccine distribution. IRIS information is available from the Iowa Public Health Tracking Portal at https://hhs.iowa.gov/public-health/data.

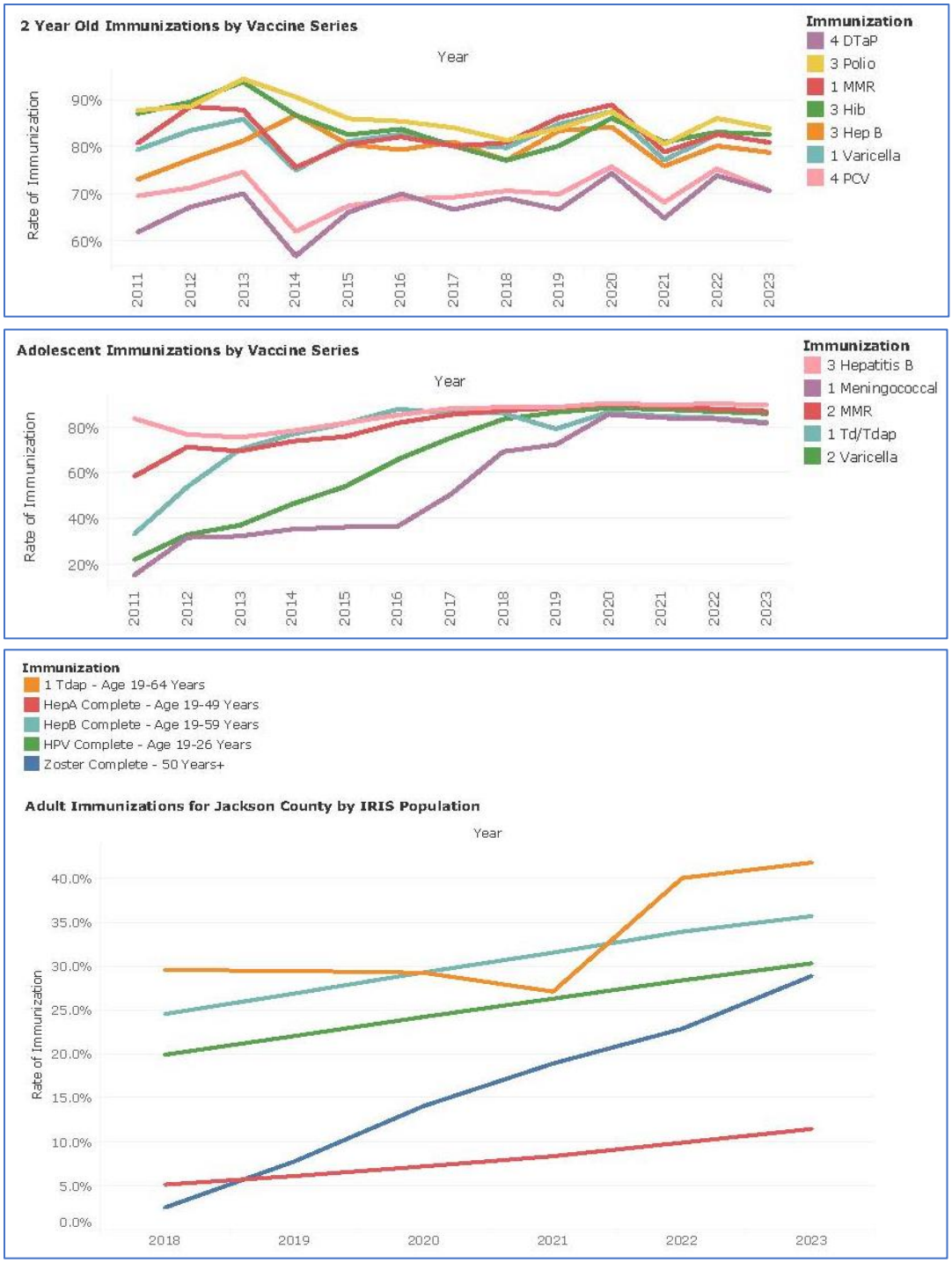
Child immunization data includes the percent of children that received the recommended doses of 4 DTaP, 3 Polio, 1 MMR, 3 Hib, 3 Hepatitis B, 1 Varicella and 4 PCV vaccines by age 24 months. In 2023, the population estimate based on IRIS records for 2-year-olds in Jackson County was 233.

Adolescent immunization data includes the percent of adolescents 13-15 years of age that received the recommended doses of 3 Hepatitis B, 1 Meningococcal, 2 MMR, 1 Td/Tdap, and 2 Varicella vaccines. The HPV vaccination coverage for adolescents aged 13-15 years Vaccination Rates includes series initiation (series has not been completed) and series completion. In 2023, the population estimate based on IRIS records for adolescents 13-15 years of age in Jackson County was 760.

Adult immunization data includes the percent of Iowa residents that received the recommended doses of Tdap, HPV, Pneumococcal, Hepatitis A, and Zoster vaccine, based on recommended age groups. In 2023, the population estimate based on IRIS records for adults in Jackson County was 760.

Figure 3.67. shows the rate of immunization for Jackson County by IRIS population. The time trend for 2-year-olds and adolescents 13 to 15 years old is 2011-2023. The time trend for adults is 2018-2023.

Figure 3.67. Rate of Immunization for Jackson County by IRIS Population

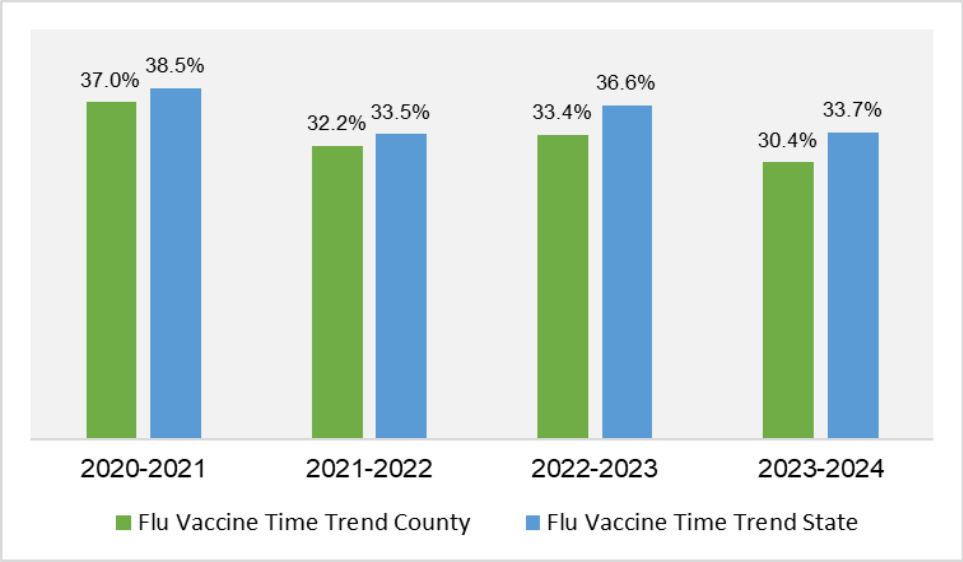


Source: Iowa Public Health Tracking Portal accessed May 2024

Flu vaccine is the best way to protect against the flu. The flu vaccine causes antibodies to develop in the body approximately two weeks after vaccination. These antibodies provide protection against infection when the viruses are circulating. The flu vaccine can protect against influenza and its potentially serious complications. Vaccination of high-risk persons is especially

important to decrease their risk of severe flu illness. The typical influenza season lasts from August to May. **Figure 3.68.** shows the flu vaccine time trend for Jackson County and the State of Iowa by flu season.

Figure 3.68. Flu Vaccine Time Trend for Jackson County



Source: Iowa Public Health Tracking Portal accessed May 2024

Potential Losses to Existing Development

The HMPC ranked Pandemic Human Disease outbreak as critical based on a widespread scenario. The magnitude of an infectious disease outbreak is related to the ability of the public health and medical communities to stop the spread of the disease. Most disease outbreaks that cause critical numbers of deaths are communicable in nature, meaning that they are spread from person to person. The key to reducing the critical nature of the event is to stop the spread of disease. This is generally done in three ways:

1. identification and isolation of the ill,
2. quarantine of those exposed to the illness to prevent further spread, and
3. education of the public about methods to prevent transmission.

The public health and health care providers in Jackson County routinely utilize all three methods to reduce morbidity and mortality from infectious disease.

Magnitude/Severity Score: 2 - Limited

Future Development

The population in Jackson County is declining slightly. But 19.6 percent of the population is over 65 years old. Those over 65 are more susceptible to health complications as a result of disease.

Climate Change Impacts

The following is an excerpt from the *2010 Climate Change Impacts on Iowa* Report.

Investigations of the past two decades indicate that the health effects of climate change can be

serious. The World Health Organization estimated that in 2002, 2.4% of worldwide diarrhea cases, 6% of malaria cases, 7% of dengue fever cases, and 170,000 deaths (0.3% of worldwide deaths) were attributed to climate change (Beggs and Bambrick 2005, WHO 2002). A major 2010 study included a range of diseases in its listing of potential effects of climate change, ranging from obvious illnesses such as asthma and vector-borne disease to less obvious cancer and neurological disease (Portier 2010).
The report details the following as climate change contributors to negative consequences for public health in Iowa:

- Extreme Precipitation Events, Rising Humidity, and Associated Disease
- Illness and Death Associated with Excessive Heat and Heat Waves
- Warming, Air Quality and Respiratory Problems
- Pollen Production and Allergies
- Diseases Transferred by Food, Water, and Insects

Pandemic Human Disease Hazard Summary by Jurisdiction
Due to disease spreading more quickly in areas with higher population density, the cities with a population over 2,000 were given a magnitude of 3. School districts were also given a magnitude of three since disease tends to spread rapidly in school settings. The unincorporated county and cities with smaller populations were given a magnitude of 2. The rest of the elements are not varied across jurisdictions.

Jurisdiction	Probability	Magnitude/ Severity	Warning Time	Duration	Weighted Score	Level
Unincorporated	2	2	1	4	2.05	Moderate
Andrew	2	2	1	4	2.05	Moderate
Baldwin	2	2	1	4	2.05	Moderate
Bellevue	2	3	1	4	2.35	Moderate
LaMotte	2	2	1	4	2.05	Moderate
Maquoketa	2	3	1	4	2.35	Moderate
Miles	2	2	1	4	2.05	Moderate
Monmouth	2	2	1	4	2.05	Moderate
Preston	2	2	1	4	2.05	Moderate
Sabula	2	2	1	4	2.05	Moderate
Spragueville	2	2	1	4	2.05	Moderate
Springbrook	2	2	1	4	2.05	Moderate
St. Donatus	2	2	1	4	2.05	Moderate
Andrew CSD	2	3	1	4	2.35	Moderate
Bellevue CSD	2	3	1	4	2.35	Moderate
Easton Valley CSD	2	3	1	4	2.35	Moderate
Maquoketa CSD	2	3	1	4	2.35	Moderate

3.5.15 Radiological Incident

Hazard Score Calculation					
Probability	**Magnitude/Severity**	**Warning Time**	**Duration**	**Weighted Score**	**Level**
1	**1**	**3**	**3**	**1.5**	**Low**

Hazard Profile

Hazard Description

A radiological incident is an occurrence resulting in the release of radiological material at a fixed facility (such as power plants, hospitals, laboratories, etc.) or in transit. Radiological incidents related to transportation are described as an incident resulting in a release of radioactive material during transportation. Transportation of radioactive materials through Iowa over the interstate highway system is considered a radiological hazard. The transportation of radioactive material by any means of transport is licensed and regulated by the federal government. As a rule, there are two categories of radioactive materials shipped over the interstate highways:

1. Low level waste consists of primarily of materials that have been contaminated by low level radioactive substances but pose no serious threat except through long-term exposure. These materials are shipped in sealed drums within placarded trailers. The danger to the public is no more than a wide array of other hazardous materials.

2. High level waste, usually in the form of spent fuel from nuclear power plants, is transported in specially constructed casks that are built to withstand a direct hit from a locomotive.

Warning Time Score: 3 -- 6 to 12 hours warning time

Duration Score: 3 -- Less than one week

Geographic Location/Extent

The most significant fixed facility radiological incident would be a release of radioactive materials from an accident at a nuclear power plant. All of Jackson County is in the 50-mile planning buffer of the Quad Cities Nuclear Power Plant in Cordova, Illinois (see **Figure 3.69.**).

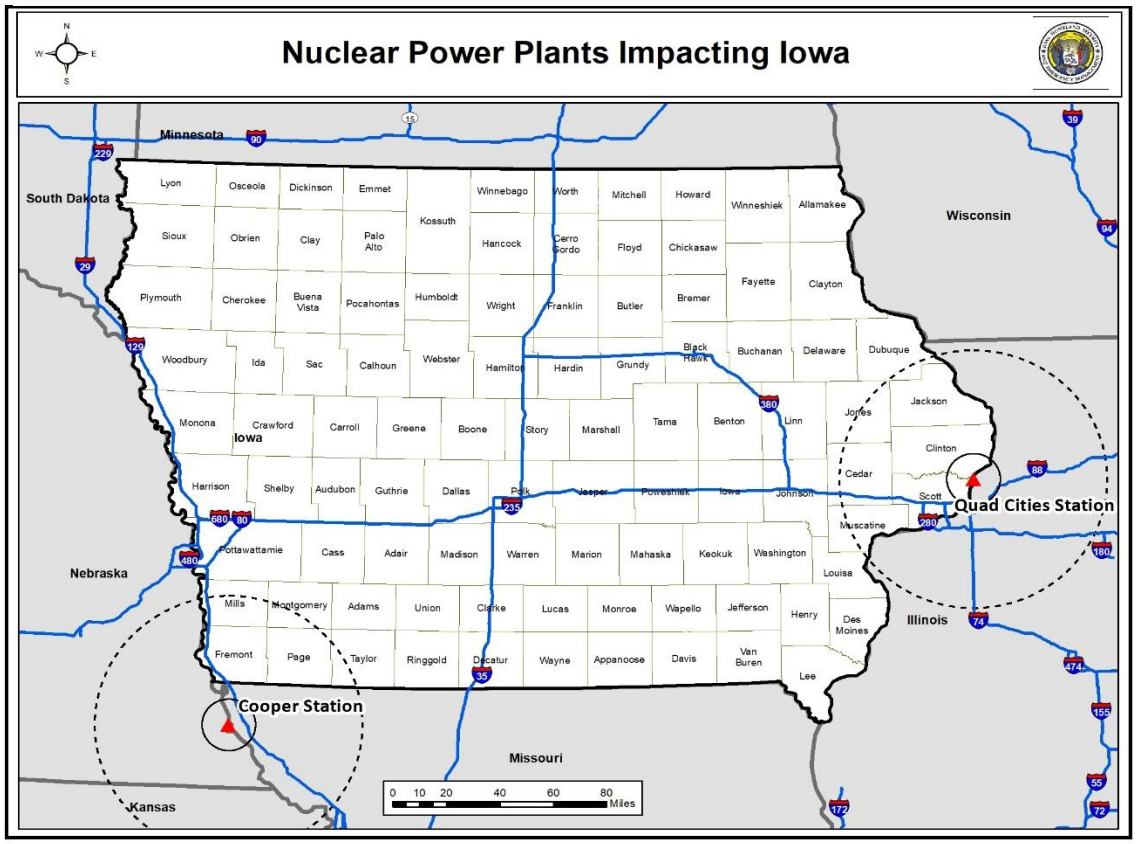
The Duane Arnold Energy Center in Linn County, Iowa's only nuclear power plant, shut down in 2020. Spent nuclear fuel is still stored on the site, but an accident involving spent fuel rods would be unlikely to affect Jackson County.

There is potential for the transport of radioactive waste within Jackson County, primarily along major highways.

Previous Occurrences

The U.S. Nuclear Regulatory Commission (NRC) has emergency classifications divided into four categories. Each level has a certain response requirement from the plant and government. The following are the emergency classifications from least to most severe: Unusual Event, Alert, Site Area Emergency, and General Emergency. From 1990 to 2013, the Quad Cities Nuclear Power Plant had 18 Unusual Events, 7 Alerts, and no Site Area Emergencies or General Emergencies. According to the 2013 Iowa State Hazard Mitigation Plan, there have been no occurrences of a radiological transportation incident in Iowa since 1990.

Figure 3.69. Map of Nuclear Power Plants Impacting Iowa



Probability of Future Occurrence

The NRC regulates commercial nuclear power plants and other uses of nuclear materials through licensing, inspection, and enforcement of requirements. Within the NRC, several Offices and Divisions have various responsibilities to ensure nuclear power plant safety. The Office of Nuclear Reactor Regulation (NRR) is responsible for accomplishing key components of the NRC's nuclear reactor safety mission. As such, NRR conducts a broad range of regulatory activities in the four primary program areas of rulemaking, licensing, oversight, and incident response for commercial nuclear power reactors, and test and research reactors to protect the public health, safety, and the environment. NRR works with the regions and other offices to accomplish its mission and contribute to the agency mission.

Additionally, the Radiological Emergency Preparedness (REP) Program within FEMA coordinates the national effort to provide state, local, and tribal governments with relevant and executable planning, training, and exercise guidance and policies necessary to ensure that adequate capabilities exist to prevent, protect against, mitigate the effects of, respond to, and recover from incidents involving commercial nuclear power plants. Jackson County Emergency Management works closely with the REP program to ensure preparedness for any incidents involving the nuclear power plant.

Considering the regulatory and preparedness programs in place and based on the lack of any Site Area or General Emergency previous occurrences for this hazard, the probability of future occurrences of radiological incidents is “Unlikely.”

Probability Score: 1 -- Unlikely

Vulnerability Assessment

Vulnerability Overview

In general, danger to the public in the planning area is less than a wide array of other hazardous materials. Those working with or near sources of radiation are at a greater risk than the general citizens in the planning area. Those responding to a radiological incident should be trained in recognizing a radiological incident and minimize exposure to radioactive materials. Although the probability of occurrence is low, if a release of radiation from the nuclear power plants did occur, this could have serious consequences in Jackson County.

Magnitude/Severity Score: 1 -- Negligible

Potential Losses to Existing Development

Responding to the effects of a radiological incident in the planning area would be extensive and would require resources and assistance from several state and federal agencies to determine and evaluate the threat to life and the environment. Due to the variable nature of this hazard, it is not possible to quantify potential losses.

Future Development

Increased development in the planning buffer zones and along transportation corridors would increase the number of people vulnerable to this hazard in the planning area.

Climate Change Impacts

Drought can impact water levels for intake pipes that carry water from the Mississippi River to cool the reactor. See **Section 3.5.3** for discussion of Climate Change Impacts for Drought

Radiological Incident Hazard Summary by Jurisdiction

Jackson County is within the planning buffer zone of the Quad Cities Nuclear Power Plant. Although an incident is unlikely, all jurisdictions within the county are at risk to this hazard.

Jurisdiction	Probability	Magnitude/ Severity	Warning Time	Duration	Weighted Score	Level
Unincorporated	2.35	2.35	2.35	2.35	2.35	2.35
Andrew	2.35	2.35	2.35	2.35	2.35	2.35
Baldwin	2.35	2.35	2.35	2.35	2.35	2.35
Bellevue	2.35	2.35	2.35	2.35	2.35	2.35
LaMotte	2.35	2.35	2.35	2.35	2.35	2.35
Maquoketa	2.35	2.35	2.35	2.35	2.35	2.35
Miles	2.35	2.35	2.35	2.35	2.35	2.35
Monmouth	2.35	2.35	2.35	2.35	2.35	2.35
Preston	2.35	2.35	2.35	2.35	2.35	2.35
Sabula	2.35	2.35	2.35	2.35	2.35	2.35
Spragueville	2.35	2.35	2.35	2.35	2.35	2.35
Springbrook	2.35	2.35	2.35	2.35	2.35	2.35
St. Donatus	2.35	2.35	2.35	2.35	2.35	2.35
Andrew CSD	2.35	2.35	2.35	2.35	2.35	2.35
Bellevue CSD	2.35	2.35	2.35	2.35	2.35	2.35
Easton Valley CSD	2.35	2.35	2.35	2.35	2.35	2.35
Maquoketa CSD	2.35	2.35	2.35	2.35	2.35	2.35

3.5.16. Terrorism

Hazard Score Calculation					
Probability	**Magnitude/Severity**	**Warning Time**	**Duration**	**Weighted Score**	**Level**
1	**1**	**4**	**4**	**1.75**	**Low**

Hazard Profile

Hazard Description

This hazard encompasses the following sub-hazards: enemy attack, biological terrorism, agro-terrorism, chemical terrorism, conventional terrorism, cyber terrorism, radiological terrorism, electromagnetic pulse, public disorder, and hate crimes. These hazards can occur anywhere and demonstrate unlawful force, violence, and/or threat against persons or property causing intentional harm for purposes of intimidation, coercion or ransom in violation of the criminal laws of the United States. These actions may cause massive destruction and/or extensive casualties. The threat of terrorism, both international and domestic, is ever present, and an attack can occur when least expected.

Enemy Attack

Enemy attack is an incident that could cause massive destruction and extensive casualties throughout the world. Some areas could experience direct weapons' effects: blast and heat; others could experience indirect weapons' effect. International political and military activities of other nations are closely monitored by our federal government and the State of Iowa would be notified of any escalating military threats.

Biological Terrorism

The use of biological agents against persons or property in violation of the criminal laws of the United States for purposes of intimidation, coercion or ransom can be described as biological terrorism. Liquid or solid contaminants can be dispersed using sprayers/aerosol generators or by point of line sources such as munitions, covert deposits and moving sprayers. Biological agents vary in the amount of time they pose a threat. They can be a threat for hours to years depending upon the agent and the conditions in which it exists.

Agro-Terrorism

Agro-terrorism consists of acts to intentionally contaminate, ruin, or otherwise make agricultural products unfit or dangerous for consumption or further use. Agriculture is an important industry in Iowa and Jackson County. The introduction of a biological agent into the population of 49,000 cattle and calves, or the 115,777 hogs and pigs, or the 121,000 acres of corn in Jackson County would be financially devastating and would have a major impact on the food supply of the state and the nation. A major attack involving the nation's food supply could be launched in a rural area that has little capacity to respond. Potential terrorists' targets for livestock disease introduction would be concentration points, such as the County's licensed feedlots or livestock markets discussed later in the Geographic Location section.

Chemical Terrorism

Chemical terrorism involves the use or threat of chemical agents against persons or property in violation of the criminal laws of the United States for purposes of intimidation, coercion or ransom. Effects of chemical contaminants are similar to biological agents.

Conventional Terrorism

Use of conventional weapons and explosives against persons or property in violation of the criminal laws of the United States for purposes of intimidations, coercion, or ransom is

conventional terrorism. Hazard affects are instantaneous; additional secondary devices may be used, lengthening the time duration of the hazard until the attack site is determined to be clear.

The extent of damage is determined by the type and quantity of explosive. Effects are generally static other than cascading consequences and incremental structural failures. Conventional terrorism can also include tactical assault or sniping from remote locations.

Cyber Terrorism
Electronic attack using one computer system against another in order to intimidate people or disrupt other systems is a cyber-attack. All governments, businesses and citizens that conduct business utilizing computers face these threats. Cyber-security and critical infrastructure protection are among the most important national security issues facing our country today. As such, the Iowa Division of Criminal Investigation has a Cyber Crime Unit tasked with analysis and retrieval of digital information for investigations.

Radiological terrorism
Radiological terrorism is the use of radiological materials against persons or property in violation of the criminal laws of the United States for purposes of intimidation, coercion or ransom. Radioactive contaminants can be dispersed using sprayers/aerosol generators, or by point of line sources such as munitions, covert deposits and moving sprayers or by the detonation of a nuclear device underground, at the surface, in the air or at high altitude.

Electromagnetic Pulse (EMP)
“Electromagnetic pulses, whether caused by an intentional EMP attack or a naturally occurring geomagnetic disturbance from severe space weather, could disrupt critical infrastructure such as the electrical grid, communications equipment, water and wastewater systems, and transportation modes.” (Source: U.S. Department of Homeland Security, https://www.dhs.gov/science-and-technology/news/2022/09/06/dhs-releases-recommendations-protect-national-public-warning-system-emps.) EMP is discussed in **Section 3.5.13.** Infrastructure Failure.

Public Disorder
Mass demonstrations, or direct conflict by large groups of citizens, as in marches, protect rallies, riots, and non-peaceful strikes are examples of public disorder. These are assembling of people together in a manner to substantially interfere with public peace to constitute a threat, and with use of unlawful force or violence against another person, or causing property damage or attempting to interfere with, disrupting, or destroying the government, political subdivision, or group of people. Labor strikes and work stoppages are not considered in this hazard unless they escalate into a threat to the community. Vandalism is usually initiated by a small number of individuals and limited to a small target or institution. Most events are within the capacity of local law enforcement.

Hate Crime
According to the U.S. Department of Justice, a hate crime, at the federal level, is a crime motivated by bias against race, color, religion, national origin, sexual orientation, gender, gender identity, or disability. In 2022, there were 77 hate crimes in Iowa; 45 (58.4%) were crimes against persons and 32 (41.6%) were crimes against property. There were no crimes against society. (Source: https://www.justice.gov/hatecrimes/state-data/iowa)

The Southern Poverty Law Center (SPLC) reported in 2014 there were five active hate groups in Iowa: one racist skinhead group (Aryan Strike force), three Ku Klux Klan groups (Fraternal

White Knights of the KKK, Loyal White Knights of the KKK, and New Empire Knights of the KKK) and one Neo-Nazi group (National Socialist Movement). In 2022, Iowa was home to 12 hate and anti-government groups; six were statewide groups. The SPLC notes: “Extremist ideas that mobilize these groups now operate more openly in the political mainstream.” (Source: https://www.splcenter.org/states/iowa)

Warning Time Score: 4 – Minimal or no warning time (up to 6 hours warning)

Duration Score: 4 -- More than 1 week

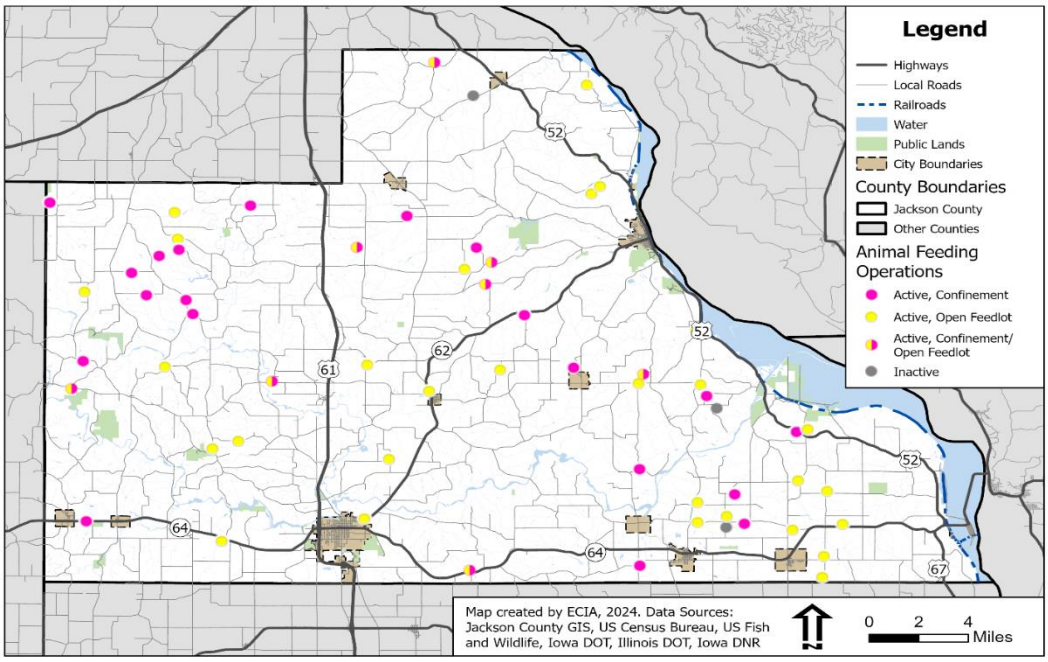
Geographic Location/Extent

The entire planning area has a low potential for terrorist activity. However, any venue with a large gathering of people could be a potential target for terrorists. The most likely targets of a conventional terrorism attack in Jackson County include public school system facilities, the Jackson County Courthouse and law enforcement centers within Jackson County.

In terms of cyber-terrorism, our society is highly networked and interconnected. An attack could be launched from anywhere on earth and could range in impacts from small and localized to a far-reaching global scale. Depending on the attack vector and parameters, a cyber-attack could impact all of Jackson County and its associated municipal jurisdictions.

For agro-terrorism planning, **Figure 3.70.** shows the locations of animal feeding operations in Jackson County. Additional agricultural assets are discussed in **Section 3.5.11**, Animal/Plant/Crop Disease.

Figure 3.70. Animal Feeding Operations in Jackson County



Previous Occurrences

There have not been any large-scale enemy attacks or acts of radiological terrorism in Iowa. There have been biological and chemical agent threats, animal rights activists’ vandalism and many bomb threats. In 2002, pipe bombs were found in 18 states including Iowa and six people

were injured in the bombings in Iowa and Illinois. In 2005 and 2006, pipe bombs were used in attempted murder cases in two Iowa cities.

According to ADL, the ADL H.E.A.T. Map™ (Hate, Extremism, Antisemitism, Terrorism) is the first-of-its-kind interactive and customizable map detailing specific incidents of hate, extremism, antisemitism and terrorism by state and nationwide. Using this map, from 2014 to 2024 there were 307 hate crimes in Iowa; 219 (71%) were for White Supremacist Propaganda. In Jackson County, there were four hate crimes during that time frame, all for White Supremacist Propaganda. There were three in Maquoketa: one in 2020 and two in 2023, and one in Zwingle in 2023. (Source: https://www.adl.org/resources/tools-to-track-hate/heat-map)

Probability of Future Occurrence
While difficult to estimate, the probability for a terrorist event is "Unlikely" within the next 10 years in Jackson County.

Probability Score: 1-- Unlikely

Vulnerability Assessment

Vulnerability Overview
A terrorism event could occur in either limited area of a jurisdiction or over the entire jurisdiction at once. This hazard has the ability to directly cause substantial structural losses and potentially loss of life.

Magnitude/Severity Score: 1 -- Negligible

Potential Losses to Existing Development
Potential losses from Terrorism include all infrastructure, critical facilities, crops, humans and animals. The degree of impact would be directly related to the type of incident and the target. Potential losses could include cost of repair or replacement of damaged facilities, lost economic opportunities for businesses, loss of human life, injuries to persons, loss of food supplies, disruption of the food supply chain, and immediate damage to the surrounding environment.

Secondary effects of infrastructure failure could include public safety hazards, spread of disease, increased morbidity and mortality among the local and distant populations, public panic and long-lasting damage to the environment. Terrorism events are rare occurrences and specific amounts of estimated losses for previous occurrences are not available due to the complexity and multiple variables associated with these types of hazards. In some instances, information about these events is secure and unavailable to the public in order to maintain national security and prevent future attacks.

As discussed previously, it is difficult to quantify potential losses in terms of the jurisdictions most threatened by CBRNE (chemical, biological, radiological, nuclear, and high yield explosive) attack events due to the many variables and human element. Therefore, for the purposes of this plan, the loss estimates will consider a hypothetical scenario. The attack scenario is staged at a Friday night high school football game. The hypothetical football stadium has approximately 500 persons in the stadium and concession areas on any home football game nights during the fall.

Analysis of vulnerable populations is aided by a program developed by Johns Hopkins University in 2006 called Electronic Mass Casualty Assessment and Planning Scenarios (EMCAPS) http://www.hopkins-cepar.org/EMCAPS/EMCAPS.html which utilizes scenarios

developed by the Department of Homeland Security.

****THE FOLLOWING HYPOTHETICAL SCENARIOS ARE FOR INSTRUCTIONAL AND ILLUSTRATIVE PURPOSES ONLY****

Chemical Attack – Toxic Gas – Chlorine Release
Scenario Overview: A bomb is attached to a truck trailer tanker carrying compressed chlorine and enters the high school football stadium parking lot. The entire contents of the tank escape to the atmosphere and the plume spreads to the stadium and the immediate surrounding parking lot area. This particular type of attack would cause harm to humans and could render portions of the stadium unusable for a short time period in order to allow for a costly clean-up. There might also be a fear by the public of long-term contamination of the stadium and the high school subsequent closing the high school.

Assumptions: (1) The population density is approximately 500 persons around the high school stadium, (2) Chlorine is toxic and may damage eyes, skin and respiratory tract, (3) The rate of "worried well" is equal to 9 times the number of infected cases or the full exposed population, whichever is least. **Table 3.65.** describes losses from a chemical attack – chlorine scenario.

Table 3.65. Described Losses from a Chemical Attack – Chlorine Scenario

Impacts	Costs
Eye pain & swelling, headache, restricted airflow - difficulty breathing, possible chemical burns	22 persons
Eye pain & swelling, headache, rapid breathing, skin irritation	42 persons
Eye pain & swelling, headache, rapid breathing, coughing, chest pain, skin irritation	86 persons
Eye irritation, headache, throat irritation, coughing, skin irritation	119 persons
Eye irritation, headache, coughing, skin irritation	82 persons
Total "Worried Well" Cases (total exposed population)	500 persons
Deaths	16 persons
Cost of Decontamination @ $12/person (assumes all persons with skin injuries will require decontamination and approximately 1/10 of the worried well will demand to be decontaminated) - total persons = 417	$5,004

Improvised Explosive Device Attack – ANFO
Scenario Overview: An Improvised Explosive Device (IED) utilizing an ammonium nitrate/fuel oil (ANFO) mixture is carried in a panel van to a high school parking area at the beginning of a home football game when people are leaving their cars and entering the stadium. Potential losses with this type of scenario include both human and structural assets.

Assumptions: (1) The population density in the parking lot during the beginning and ending of the game is high, at least 1 person /1 square feet; (2) The quantity of ANFO used is 500 lbs. **Table 3.66.** described losses from an improvised explosive device attack – ANFO scenario.

Table 3.66. Described Losses from an Improvised Explosive Device Attack - ANFO

Impacts	Costs
Total Dead	86 persons
Total Traumatic Injuries	151 persons
Total Urgent Care Injuries	745 persons

Injuries not Requiring Hospitalization	279 persons
Structures and Other Physical Assets (Damages would certainly occur to vehicles and depending on the proximity of other structures, damages would occur to the stadium complex itself. The exact amount of these damages is difficult to predict because of the large number of factors, including the type of structures nearby and the amount of insurance held by vehicle owners.)	Vehicle - Replacement cost of approximately 350 vehicles @ $10,000 per vehicle inside the 200 ft. BATF described Lethal Air Blast Range = $3,500,000. Repair / repainting cost for approximately 70 vehicles @ $4,000 per vehicle inside the BATF described Falling Debris Hazard = $280,000

Future Development

As public events are held at various venues in the County, the potential may exist for these locations to become targets of attack. With human-caused hazards such as this that can have multiple variables involved, increases in development is not always a factor in determining risk, although the physical damages of the event may increase with the increased or newly developed areas.

Climate Change Impacts

There are no known climate change impacts relevant to this hazard.

Terrorism Hazard Summary by Jurisdiction

The overall rating applies to all jurisdictions in the planning area due to the variables and unknowns involved in terrorism events. If a wide scale event occurred in any jurisdiction, it could have devastating consequences.

Jurisdiction	Probability	Magnitude/ Severity	Warning Time	Duration	Weighted Score	Level
Unincorporated	1	1	1	4	4	Low
Andrew	1	1	1	4	4	Low
Baldwin	1	1	1	4	4	Low
Bellevue	1	1	1	4	4	Low
LaMotte	1	1	1	4	4	Low
Maquoketa	1	1	1	4	4	Low
Miles	1	1	1	4	4	Low
Monmouth	1	1	1	4	4	Low
Preston	1	1	1	4	4	Low
Sabula	1	1	1	4	4	Low
Spragueville	1	1	1	4	4	Low
Springbrook	1	1	1	4	4	Low
St. Donatus	1	1	1	4	4	Low
Andrew CSD	1	1	1	4	4	Low
Bellevue CSD	1	1	1	4	4	Low
Easton Valley CSD	1	1	1	4	4	Low
Maquoketa CSD	1	1	1	4	4	Low

3.4.17. Transportation Incident

Hazard Score Calculation					
Probability	**Magnitude/Severity**	**Warning Time**	**Duration**	**Weighted Score**	**Level**
2	**2**	**4**	**2**	**2.3**	**Moderate**

Hazard Profile

Hazard Description

This hazard encompasses the following: air transportation, highway transportation, railway transportation, and waterway transportation. The transportation incidents can involve any mode of transportation that directly threatens life, and which results in property damage and/or death(s)/injury(s) and/or adversely impact a community's capabilities to provide emergency services. Incidents involving buses and other high occupancy vehicles could trigger a response that exceeds the normal day-to-day capabilities of response agencies.

Air Transportation

An air transportation incident may involve a military, commercial or private aircraft. Air transportation is playing a more prominent role in transportation as a whole. Airplanes and helicopters are used to transport passengers for business and recreation as well as thousands of tons of cargo. A variety of circumstances can result in an air transportation incident; mechanical failure, pilot error, enemy attack, terrorism, weather conditions and on-board fire can all lead to an air transportation incident.

Highway Transportation

Highway transportation incidents are very complex. Contributing factors can include a roadway's design and/or pavement conditions (e.g. rain, snow and ice), a vehicle's mechanical condition (e.g. tires, brakes, lights), a driver's behavior (e.g. speeding, inattentiveness and seat belt usage), the driver's condition (e.g. alcohol use, age-related conditions, physical impairment) and driver inattention by using a wireless device. In fact, the driver's behavior and condition factors are the primary cause in an estimated 67 percent of highway crashes and a contributing factor in an estimated 95 percent of all crashes.

Railway Transportation

A railway transportation incident is a train accident that directly threatens life and/or property, or adversely impacts a community's capabilities to provide emergency services. Railway incidents may include derailments, collisions, and highway/rail crossing accidents. Train incidents can result from a variety of causes; human error, mechanical failure, faulty signals, and/or problems with the track. Results of an incident can range from minor "track hops" to catastrophic hazardous material incidents and even human/animal casualties. With so many miles of track in Iowa, vehicles must cross the railroad tracks at numerous at-grade crossings.

Waterway Transportation

A waterway transportation incident could include a collision between two vessels or between a vessel and a stationary object, for both commercial barges and recreational boating.

Warning Time Score: 4 -- Minimal or no warning

Duration Score: 2 -- Less than 1 day

Geographic Location/Extent

Air Transportation
Maquoketa Municipal Airport is the airport in Jackson County (see **Figure 3.61.** in the Hazardous Materials **Section 3.5.12.**). The Maquoketa Municipal Airport is owned and operated by the City of Maquoketa. The Iowa Aviation System plan identifies Maquoketa Municipal Airport as a Local Service airport. Local Service airports have runways less than 3,000 feet or have turf runways as the primary runway. Local Service airports generally have limited, if any, airport services that support limited local aviation activity. The Maquoketa Municipal Airport provides general aviation services in Jackson County for business, agriculture, personal recreation, air medical transport, and law enforcement.

Highway Transportation
U.S. Highway 61 crosses the county north to south, while US Highway 52 follows the eastern edge of the county and runs, generally, along the Mississippi River. State Highways 62 and 64 meander east to west through Jackson County, meeting in the city of Maquoketa. Numerous paved county roads connect all of the incorporated cities and unincorporated towns throughout the county. **Figure 3.59.** in the Hazardous Materials **Section 3.5.12.** shows the major highways in Jackson County. According to the Iowa DOT, the total daily traffic in Jackson County is 153,040 and the total daily truck traffic is 17,690. (Source: http://iowadot.maps.arcgis.com/apps/MapSeries/index.html?appid=db6cb43313354a4f85505089ab317e7a)

Rail Transportation
The following railroads operate in Jackson County: Canadian Pacific Railroad (CP) and the Dakota, Minnesota and Eastern R.R. Company. Burlington Northern Sante Fe Railroad has a line that runs down the Illinois side of the Mississippi River adjacent to Jackson County. **Figure 3.60.** in the Hazardous Materials **Section 3.5.12.** shows the railroads that operate in Jackson County.

Waterway Transportation
The Mississippi River flows for 93 miles through the center of the eight-county region, providing a direct waterways connection to the Gulf of Mexico and international markets. The river's flow is controlled by three locks and dams in the region, which maintain a nine-foot river channel depth needed to support barge traffic. Lock and Dam 12 is located near Bellevue on the Mississippi River. The lock normally operates from early March thru early December and is open 24 hours, seven days a week. It serves commercial barges and towboats as well as motorized and non-motorized recreational vessels. Recreational boating also occurs on the Maquoketa River and North Fork of the Maquoketa River.

Previous Occurrences

Air Transportation Incidents
The National Transportation Safety Board (NTSB) provides details of air transportation incidents. There have been no incidents reported since 2003 for Jackson County.

Highway Transportation Incidents
The Iowa DOT Office of Traffic and Safety maintains traffic crash statistics and location maps by county and cities in Iowa. **Table 3.67.** shows the reportable crash history for urban and rural crashes in Jackson County Iowa from 2014-2023. **Table 3.60.** in the Infrastructure Failure

Section 3.5.13. provides a summary of the condition of the 258 bridges in Jackson County inspected by the Iowa DOT.

Table 3.67. Urban Crashes in Jackson County, 2014-2023

Year	Crashes	Fatal	Major	Minor	Possible/ Unknown	Injuries	Fatalities	Major	Minor	Possible	Unknown
Urban Crashes											
2014	67	0	0	4	5	12	0	0	4	5	3
2015	52	0	0	4	9	14	0	0	4	10	0
2016	65	0	1	4	12	31	0	1	4	15	1
2017	73	1	2	10	11	43	1	2	15	13	2
2018	73	0	1	4	13	42	0	1	7	16	0
2019	63	0	0	1	12	30	0	0	1	11	2
2020	52	1	0	3	11	26	1	0	3	12	0
2021	67	2	0	5	4	29	2	2	6	6	1
2022	67	0	2	3	9	36	0	2	5	12	1
2023	70	0	2	7	4	27	0	2	7	2	2
Total	**649**	**4**	**8**	**45**	**90**	**290**	**4**	**10**	**56**	**102**	**12**
Rural Crashes											
2014	122	3	8	15	23	68	3	9	21	34	1
2015	98	3	10	15	16	66	4	11	23	28	0
2016	118	4	6	15	33	92	4	7	21	48	1
2017	121	3	14	13	22	77	3	17	16	31	1
2018	102	2	7	13	21	67	2	11	17	28	2
2019	92	2	7	13	17	59	2	7	13	27	1
2020	94	2	8	12	11	51	2	11	14	19	1
2021	109	2	4	16	19	74	3	6	21	28	0
2022	147	3	6	10	16	95	3	8	14	16	2
2023	188	1	7	24	23	142	1	9	29	35	2
Total	**1,191**	**25**	**77**	**146**	**201**	**791**	**27**	**96**	**189**	**294**	**11**

Source IA DOT

Railway Transportation Incidents

Throughout Iowa, railcar traffic has increased but the number of derailments in relation to the traffic is trending downward according to the Iowa DOT. The US DOT Federal Railroad Administration monitors safety at 19 public, at grade railway crossings in Jackson County. Three are equipped with active warning devices like gates, flashing lights, or bells, while the remaining uncontrolled crossings are only protected by a static sign such as a stop sign or cross bucks. All are used by the DME Railroad. From 1993-2023, the NTSB has reported no rail accidents.

Waterway Transportation Incidents

The 2018 Eight County Freight Plan notes that: In 2016, commercial traffic at Lock and Dam No. 12 included: 3,299 commercial lockages; 2,169 commercial flotillas; and 18,746 barges (empty and loaded). From 1993 to 2023, the NTSB has reported no marine (waterway) accidents in

Jackson County.

Probability of Future Occurrence
A major transportation incident can occur at any time, even though traffic engineering, inspection of traffic facilities, and land use management of areas adjacent to roads and highways has increased, incidents continue to occur. Current population trends indicate a slight decrease in population in Jackson County. If the volume of traffic on the county roads, highways and interstates decreases with population decreases, the number of traffic accidents will likely also decrease. The combination of cars and trucks, farm equipment, wildlife, unpredictable weather conditions, potential mechanical problems and human error always leaves the potential for a transportation accident.

Based on the information available, the probability of an air, rail, or waterway transportation is very low. Based on the available information, the probability of a highway transportation incident that directly threatens life and which results in property damage and/or death(s)/injury(s) and/or adversely impact a community's capabilities to provide emergency services is "Occasional."

Probability Score: 2 -- Occasional

Vulnerability Assessment

Vulnerability Overview
Transportation incidents can almost always be expected to occur in specific areas, on or near airports, roadways or other transportation infrastructure. The exception is air transportation incidents, which can occur anywhere. However, it is difficult to predict the magnitude of any specific event because these types of events are accidental and the circumstances surrounding these events will impact the extent of damage or injuries that occur.

The number of urban and rural highway/roadway transportation accidents from 2014 to 2023 was a total of 1,840 crashes during this 10-year time period (average 184 per year). Thirty-one (33) fatalities occurred during this time period (averaging more than three per year).

Transportation incident has resulted in the most deaths historically in the county compared to other hazards. Due to the potential for fatalities to occur, the magnitude rating is "Limited."

Magnitude Score: 2 -- Limited

Potential Losses to Existing Development
The U.S. Department of Transportation Federal Highway Administration issued a technical advisory in 1994 providing suggested estimates of the cost of traffic crashes to be used for planning purposes. These figures were converted from 1994 dollars to 2016 dollars using an annual inflation rate of 2.85 percent. The costs are listed below in **Table 3.68.** Estimated losses as a result of air, rail, and waterway transportation are not available for this analysis.

Table 3.68. Costs of a Traffic Crash

Severity	Cost per Injury
Fatal	$5,428,842
Evident Injury	$75,169
Possible Injury	$39,672
Property Damage Only	$4,176

Source: U.S. Department of Transportation

Using the traffic crash costs per type of severity from **Table 3.68.**, and combining major and minor injuries as “evident injury” and possible and unknown as “possible injury” the total costs of traffic crashes is calculated in **Table 3.69.** for Jackson County based on previous events. Based on the 10 years of data, with a total cost of $215,583,477, the annual average cost of transportation accidents is $21,558,347.70.

Table 3.69. Costs of Traffic Crashes in Jackson County, 2014-2023

Location	Fatalities	Evident Injury	Possible Injury	Property Damage
Urban	4	66	102	502
Rural	27	285	294	742
Total	31	351	396	1244
Estimated Cost	$168,294,102	$26,384,319	$15,710,112	$5,194,944

Future Development

Overall, Jackson County has seen a slight decrease in population. With decreased population, comes decreased traffic volume on Jackson County Roads, which could in turn translate to a decrease in traffic accidents.

Climate Change Impacts

If projections regarding milder winters come to fruition, climate change impacts may reduce the number of transportation incidents associated with some severe weather. However, if ice occurs, rather than snow, this could result in higher incidents of weather-related accidents.

Transportation Hazard Summary by Jurisdiction

All jurisdictions within the planning area are at risk to some kind of transportation incident.

Jurisdiction	Probability	Magnitude/ Severity	Warning Time	Duration	Weighted Score	Level
Unincorporated	2	2	4	2	2.3	Moderate
Andrew	2	2	4	2	2.3	Moderate
Baldwin	2	2	4	2	2.3	Moderate
Bellevue	2	2	4	2	2.3	Moderate
LaMotte	2	2	4	2	2.3	Moderate
Maquoketa	2	2	4	2	2.3	Moderate
Miles	2	2	4	2	2.3	Moderate
Monmouth	2	2	4	2	2.3	Moderate
Preston	2	2	4	2	2.3	Moderate
Sabula	2	2	4	2	2.3	Moderate
Spragueville	2	2	4	2	2.3	Moderate
Springbrook	2	2	4	2	2.3	Moderate
St. Donatus	2	2	4	2	2.3	Moderate
Andrew CSD	2	2	4	2	2.3	Moderate
Bellevue CSD	2	2	4	2	2.3	Moderate
Easton Valley CSD	2	2	4	2	2.3	Moderate
Maquoketa CSD	2	2	4	2	2.3	Moderate