Unit 3: Local Plan Review – Risk Assessment

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Risk Assessment

What is the purpose of this portion of the Plan Review Requirements?

DMA 2000 places a strong emphasis on a sound and comprehensive risk assessment as the foundation for a coherent hazard mitigation plan.

The intent is to ensure that the community is focusing available resources where they will be most effective in reducing exposure and risk.

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Risk Assessment

IFR Requirement: § 201.6 (c) (2) (i) Identifying Hazards (1 of 7)

A. Does the plan include a description of the types of all natural hazards that affect the jurisdiction?

Key Words and Issues

"**descriptions**" vary in terms of what constitutes a hazard – e.g., are "hurricanes" a hazard?
= water (= coastal erosion; coastal flooding; and inland flooding) and
= wind (= wind borne debris; structural failures)

how will the reviewer know what constitutes "**all natural hazards**"?

"**manmade**" versus "**natural hazards**" = not required by DMA 2000
= official FEMA language), aka human-caused
= accidental and/or intentional technological events, terrorism, etc.

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Risk Assessment

IFR Requirement: § 201.6 (c) (2) (i) Identifying Hazards (1 of 7 continued)

What if?

What if a hazard is not mentioned at all but the rest of the plan is basically satisfactory?

What does that mean for subsequent reviews of the plan?

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Risk Assessment

IFR Requirement: § 201.6 (c) (2) (i) Profiling Hazards (2 of 7)

Does the risk assessment identify the

***A. location** (e.g., hazard area)*

***B. extent** (e.g., magnitude, severity)*

C. previous occurrences

D. probability of future events** (e.g., "high/medium/low" at a minimum of each hazard addressed in the plan)**?

Key Words and Issues

how can the communities (and the reviewers) handle "**data deficiencies**" (in this and subsequent requirements)?

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Risk Assessment

IFR Requirement: § 201.6 (c) (2) (i) Profiling Hazards (2 of 7 continued)

What if?

What if the plan identifies that the best available data (b.a.d.!?) was used but adequate information is not currently available (aka data deficiencies)…

…and is specific about the data that is needed but not present…

…but subsequent sections of the plan do not outline steps for gathering data and completing the assessment over the next planning cycle as a mitigation action?

Should this requirement be scored as satisfactory?

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Risk Assessment

IFR Requirement: § 201.6 (c) (2) (ii) Assessing Vulnerability: Overview (3/7)

A. Does the plan include an overall summary description of the jurisdiction's vulnerability to each hazard?

What if?

*Would an "**overall summary description**" of vulnerable assets that only mentions generalized land use zones (residential, commercial, industrial) satisfy this Element?*

Would the same description with quantities (buildings, people, etc.) derived from "global" data such as the U.S. Census satisfy this Element?

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Risk Assessment

IFR Requirement: § 201.6 (c) (2) (ii) Assessing Vulnerability: Overview (3/7 cont'd)

B. Does the plan address the impact of each hazard on the jurisdiction?

What if?

*would expressing the "**impact**" only in terms of the areas within the community that would be affected without the number of vulnerable assets by hazard and without addressing the value and/or percentage of damage anticipated for those assets, and/or the number of the population at risk (per Understanding Your Risk (FEMA 386-2) meet this element?*

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Risk Assessment

IFR Requirement ["should"]:
§ 201.6 (c) (2) (ii) (A) Assessing Vulnerability: Identifying Assets (4 of 7)

A. ***Does the plan describe vulnerability in terms of the types and numbers of existing buildings, infrastructure and critical facilities located in the identified hazard areas?***

B. ***Does the plan describe vulnerability in terms of the types and numbers of future buildings, infrastructure and critical facilities located in the identified hazard areas?***

Key Words and Issues

"**future**" buildings, etc. cannot be reliably predicted in the absence of a community master plan, comprehensive plan or some type of development projections

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Risk Assessment

IFR Requirement ["should"]:
§ 201.6 (c) (2) (ii) (B) Assessing Vulnerability: Estimating Potential Loss (5 of 7)

A. ***Does the plan estimate potential dollar losses to vulnerable structures?***

B. ***Does the plan describe the methodology used to prepare the loss estimate?***

Key Words and Issues

it is not unusual to see "**potential dollar losses**" expressed in terms of total property value, i.e., a building in a flood zone that is assumed to be a 100% loss

descriptions of "**methodology**" may not be very "satisfying" but may still clear the bar - refinements may only be identifiable as recommended revisions

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Risk Assessment

IFR Requirement ["should"]:
§ 201.6 (c) (2) (ii) (B) Assessing Vulnerability: Estimating Potential Loss (5/7 cont'd)

What if?

What if the results are inherently flawed due to low quality data inputs but the methodology is "scientifically based"?

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Risk Assessment

IFR Requirement ["should"]:
§ 201.6 (c)(2)(ii)(C) Assessing Vulnerability: Analyzing Development Trends (6 of 7)

A. Does the plan describe land uses and development trends?

What if?

If the plan only includes a description of existing land use and an anecdotal assessment of growth trends (ala "we got houses and businesses and factories and we expect to get some more someday"), would this meet the requirement?

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Risk Assessment

IFR Requirement:
§ 201.6 (c)(2)(iii) Multi-Jurisdictional Risk Assessment (7 of 7)

A. Does the plan include a risk assessment for each participating jurisdiction as needed to reflect unique or varied risks?

Key Words and Issues

"unique and varied risks" is open to interpretation – it is important to focus on making sure that multi-jurisdictional plans do not paint the risks with too broad a brush – it is also important to note that as a reviewer, you will only know what they tell you in most cases - if there is a risk assessment in the plan, how will you know if it is or is not reflecting **"unique"** conditions?

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Small Group Working Session – Risk Assessment

This session covers pages 5, 6 and the top half of page 7 of the Crosswalk.

The end product is a completed plan review of the Risk Assessment for the City of Darwin, Iowa plan.

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Small Group Results

Risk Assessment

Element	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	Group 7	Group 8	Group 9	Group 10
§ 201.6 (c) (2) (i) Identifying Hazards										
A. Description of all natural hazards that affect										
§ 201.6 (c) (2) (i) Profiling Hazards										
A. Location of hazards										
B. Extent of hazards										
C. Information on previous occurrences										
D. Probability of future hazard events included										
§ 201.6 (c) (2) (iii) Assessing Vulnerability: Overview										
A. Overall summary of jurisdiction's vulnerability to each hazard										
B. Impact of each hazard on jurisdiction addressed										

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Small Group Results

Risk Assessment (continued)

Element	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	Group 7	Group 8	Group 9	Group 10
§ 201.6 (c) (2) (ii) (A) Assessing Vulnerability: Identifying Structures										
A. Description of types and number of existing buildings et al										
B. Description of types and number of future buildings et al										
§ 201.6 (c) (2) (ii) (B) Assessing Vulnerability: Estimating Potential Loss										
A. Estimate of potential dollar losses to vulnerable structures										
B. Description of methodology used to prepare loss estimate										
§ 201.6 (c) (2) (ii) (C) Assessing Vulnerability: Analyzing Development Trends										
A. Description of land uses and development trends										

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HAZARD ANALYSIS – RISK ASSESSMENT
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HAZARD ANALYSIS AND RISK ASSESSMENT

Before a community can assess ongoing mitigation activities, evaluate mitigation measures that should be undertaken or outline a strategy for implementing mitigation projects; it must be aware of those hazards which, if they occur, could harm the community.

The hazard analysis identifies potential hazards that could affect the City of Darwin for the purposes of mitigation planning. It is important to note that the focus of mitigation is on reducing long-term risks of damage or threats to public health and safety caused by hazards and their effects. Thus, in some cases the hazards identified for mitigation will not include all of or the same hazards identified for preparedness, response or recovery.

The potential hazards identified for the City of Darwin are:

- Flooding
- Tornado/High Wind Events
- Severe Thunderstorms
- Winter Storms
- Earthquake
- Drought
- Hazardous Materials

The risk assessment identifies how people, properties, and structures will be damaged by the event. If the hazard can harm people or damage their homes and other structures, they are vulnerable. Finding the weak points in the system, for example, identifying building types that are vulnerable to damage and anticipating the loss in high risk areas, will help the community decide what mitigation measure should be undertaken and how to implement the activities they select.

In making their hazard analysis and risk assessment, the Darwin Planning Committee considered the following

- Historical Occurrence
- Probability
- Vulnerability
- Maximum Threat
- Severity of Impact
- Speed of Onset

The following tables define each factor and the rating scale the Planning Committee used to assess the hazards risk to the community.

Historical Occurrence – Number of times that a hazard has occurred in the community in the past

Rating	Number of Historical Occurrences
1-3	Less than 4 occurrences
3-5	4 to 7 occurrences
5-7	8 to 12 occurrences
7-9	More than 12 occurrences

Probability – Likelihood of the hazard occurrence, sometimes without regard to hazard history

Rating	Likelihood	Frequency of occurrence
1-3	Unlikely	Less than 1% probability in the next 100 years
3-5	Possible	Between 1 and 10% probability in the next year, or at least one chance in the next 100 years
5-7	Likely	Between 10 and 100% probability in next year, or at least one chance in the next 10 years
7-9	Highly Likely	Near 100% chance in the next year

Vulnerability – Measure of the percentage of people and property that would be affected by the hazard event

Rating	Magnitude	Percentage of people and property affected
1-3	Negligible	Less than 10%
3-5	Limited	10 to 25%
5-7	Critical	25 to 50%
7-9	Catastrophic	More than 50%

Maximum Threat – Spatial extent of the community that might be impacted

Rating	Magnitude	Percentage of jurisdiction that can be affected
1-3	Negligible	Less than 10%
3-5	Limited	10 to 25%
5-7	Critical	25 to 50%
7-9	Catastrophic	More than 50%

Severity of Impact – Assessment of the severity in terms of fatalities, injuries, property losses, and economic losses

Rating	Likelihood	Characteristics
1-3	Negligible	Few if any injuries or illness. Minor quality of life lost with little or no property damage. Brief interruption of essential facilities and services for less than four hours.
3-5	Limited	Minor injuries and illness. Minor or short tern property damage which does not threaten structural stability. Shutdown of essential facilities and services for 4 to 24 hours.
5-7	Critical	Serious injury and illness. Major or long term property damage, which threatens structural stability. Shutdown of essential facilities and services for 24 to 72 hours.
7-9	Catastrophic	Multiple deaths. Property destroyed or damaged beyond repair. Complete shutdown of essential facilities and services for 3 days or more.

Speed of Onset – Potential amount of warning time available before the hazard occurs.

Rating	Probable amount of warning time
1-3	More than 24 hours warning time.
3-5	12 to 24 hours warning time.
5-7	5 to 12 hours warning time.
7-9	Minimal or no warning time.

<table>
<tr><th colspan="2">Natural Hazard: Flood</th></tr>
<tr><td>Definition</td><td>Riverine Flood: A rising and overflowing of rivers and streams onto normally dry land. The most common type of flood event. The primary causes of Riverine flooding are rainfall, melting snow, or a combination of rainfall and melting snow.

Flash Flood: A flood that rises and falls very quickly and is usually characterized by high flow velocities. Flash floods often result from intense rainfall over a small area.</td></tr>
<tr><td>Description</td><td>The extent of flood damage is influenced by six characteristics: depth or elevation of flooding, flow velocity, flood frequency, rate of rise and fall, duration, and debris impact. (See Appendix for a discussion of these characteristics.)

Riverine Flooding. The volume of water in the floodplain is a function of the size of the contributing watershed and topographic characteristics such as watershed shape and slope, and climatic and land-use characteristics. (See Community Profile).

Flash Flooding. In urban areas, flash flooding is an increasingly serious problem due to the removal of vegetation, paving and replacement of ground cover by impermeable surfaces that increase runoff, and construction of drainage systems that increase the speed of runoff.

Of all the natural hazards occurring in the U.S., flooding occurs most often; at least 90% of disasters in the U.S. are floods. In Iowa, it is estimated that flooding causes annual damages exceeding $543 million.

FEMA has not identified a special flood hazard area in the City.</td></tr>
<tr><td>Historical Occurrence</td><td>Historically, Darwin has not experienced riverine flooding within the corporate limits.

During the 1960s, there was frequent flash flooding, Darwin experienced flash flooding in low-lying areas and infiltration into the sanitary sewer system. However, in 1996 the City did a storm sewer project to mitigate the flooding problems.

During periods of heavy rains ponding occurs at a few intersections if storm water intakes have become blocked by debris (sticks, leaves, etc.) washed down with the rain. There have been no damages or traffic interruptions.

The Committee estimates that flash flooding currently occurs every 4 to 6 years.</td></tr>
<tr><td>Probability</td><td>No special flood hazard areas have been identified in Darwin. Historically, moderate flash flooding occurs approximately every four to six years.</td></tr>
<tr><td>Vulnerability</td><td>The Committee estimates that riverine flooding would not impact the community. The City is aware that if annexation occurs into areas identified as part of the County floodplain or areas that are regulated under State Law, this situation could change. FEMA has not identified any Special Flood Hazard Areas in unincorporated areas adjacent to Darwin.</td></tr>
</table>

	The City monitors annexation and new developments and construction within the new developments. Any annexed areas would be incorporated into the City's zoning ordinances. Flash flooding impacts less than 5% of the people and property in the community.
Maximum Threat	None of the area within the current City limits is threatened by riverine flooding. The Committee estimates that flash flooding impacts less than 5% of the jurisdiction.
Severity of Impact	There are no interruptions of essential services due to the flash flooding. Property damage is limited to minor basement and landscaping damage. Estimated cost of basement damage from flooding and sewer back-up ranges from $500 to $1200. Street flooding may occur for short periods of time. The City has taken steps to lessen the impact of flash flooding by enforcing ordinances to prevent home owners from tying gutter-drain spouts and sump pumps into the storm water system, upgrading the City's stormwater drainage system, and conducting testing (smoke tests and camera) of the sewer system to identify vulnerable areas that may need repair. In addition, the City has implemented a maintenance program to clean and inspect vulnerable portions of the sanitary sewer main line each year.
Speed of Onset	The Committee estimates that they have more than 24 hours of warning time of conditions that could result in flash flooding.

Natural Hazard: Tornado/Extreme Wind	
Definition	Tornado: A violently rotating column of air extending from a thunderstorm to the ground. Extreme Wind: High straight line winds (58 miles per hour or greater) and microbursts (powerful downdrafts).
Description	Each year approximately 1,000 tornadoes are spawned by severe thunderstorms. Although most tornadoes remain aloft, in an average year, 800 tornadoes are reported nationwide, resulting in 80 deaths and over 1,500 injuries. Over the past 20 years, 106 Federal disaster declarations included damage associated with tornadoes. Tornadoes follow the path of least resistance. People living in valleys, which normally are the most highly developed areas, have the greatest exposure. The most violent tornadoes are capable of tremendous destruction and wind speeds can approach 300 miles per hour. Tornadoes have been known to lift and move huge objects, destroy or move whole buildings long distances and siphon large volumes from bodies of water. Damage paths can be in excess of one mile wide and 50 miles long. The Fujita Tornado Scale measures tornado damage severity. The scale assigns numerical values based on wind speeds and categorizes tornadoes from 0 to 5. The original Fujita wind damage scale had two sections added to further categorize tornadoes by the lengths and widths of their damage paths. (Fujita-Pearson Scale). Considering path length and width as welt as wind speeds provides a more comprehensive estimation of damages. (See Fujita-Pearson Scale below) Extreme winds other than tornadoes are experienced in all regions of the U.S. It is difficult to separate the various wind components that cause damage from other wind-related natural events that often occur with or generate windstorms. The three primary sources of extreme winds are: hurricanes and tropical storms, severe thunderstorms, and winter storms. Windstorms and wind-related events caused 63 fatalities in 1993. Over the past 20 years, 193 Federal disaster declarations involved wind-induced damage.
Historical Occurrence	In Iowa, most tornadoesoccur in thespring and summer months in the late afternoon to evening hours, but they can occur in every month of the year and at any time of the day. Between 1950 and 1995, Iowa averaged 31 tornadoes per year. Of these approximately 11 were rated as "strong-violent" (F2 or higher). Between January 1950 and April 30, 2002, 17 tornadoes were reported in Beagle County, none of the reported tornadoes occurred prior to August of 1965. During the same time period, 85 high wind events were reported. (See Appendix for historical data.) No tornadoes have been reported in Darwin. Two extreme wind events have been reported, both in June 1998. Winds speeds of 65 and 70 knots per hour were reported. Total reported property damages were $195,000. Typical damages included roof damage, broken windows, and damages to trees.

Probability	According to FEMA, Iowa is within the "moderate risk" area for tornadoes and "high risk" area for winds. The Uniform Building Code wind risk map shows 80 miles per hour as Darwin/jasper County's 50-year return period fastest mile speed. According to NOAA records, Darwin is in an area experiencing 25-30 significant (F-2 or greater) tornadoes in a 100-year period (4 year frequency) and 1.5-1.75 high wind days (75 miles per hour or greater) per year.
Vulnerability	Following the 1999 tornadoes in Oklahoma and Kansas, FEMA assessed the performance of buildings during the tornadoes. They found that manufactured homes and those that did not meet established building codes sustain the greatest damages. Other vulnerable segments of the population include: • People in automobiles • People in camp grounds • People who do not understand the meaning of warnings, particularly if there are language barriers • People who do not hear the warning sirens (outside the coverage area). • People who are unable to reach shelter areas due to distance of shelter or physical limitations • The elderly and the very young. People living in manufactured homes (mobile homes) are particularly vulnerable to extreme winds, particularly if building codes do not cover manufactured homes. There are no mobile homes in Darwin. Older homes in deteriorating condition are also vulnerable. The Committee noted that homes in Darwin are well maintained and, thus, less susceptible to damage. The Planning Committee felt that homes built between 1940 and 1959 were more vulnerable to those constructed prior to 1939 due to building practices and material availability during this period of time. 67 (18.5%) of the housing units in Darwin were built between 1940 and 1959 and 87 (24%) were built prior to 1939. The majority of these homes are multi-level, with basements and well maintained. However, the Committee agreed these homes would probably be the most vulnerable to damage. The value of 60.4% of the owner-occupied units is between $50,000 and $99,000. 26.5% of the owner-occupied homes are valued between $100,000 and $149,000. The median value of owner-occupied units is $81,000. The Community Center houses City Hall and serves as the Emergency Operations Center. All fire-emergency response equipment is housed in one location. Therefore, a direct "hit" on the Community Center and/or fire station could result in a loss of essential services. Neighboring communities could provide emergency services through existing agreements; however, the financial loss would be catastrophic for the community.
Maximum Threat	The path width of a tornado is usually less than .6 of a mile. The path length can range from a few hundred feet to over a mile. A tornado typically moves at speeds between 40 and 125 miles per hour. The lifespan of a tornado is seldom longer than 30 minutes. The threat can be substantially increased by accompanying thunderstorms, lightning and hail. In some cases, a thunderstorm may generate multiple tornadoes. Because a tornado or high winds can strike anywhere, the entire community is at risk.

Severity of Impact	A tornado typically moves at speeds between 40 and 125 miles per hour and can generate internal winds exceeding 300 miles per hour. In Beagle County, one of the reported tornadoes was an F4, two were F3's, four were F2's and the remainder were FO's. Potential impact/damages range from roof damage and minor property damage resulting from flying debris to total destruction and loss of life. Although residents could find shelter in basements, if the basements are exposed due to upper level damage, residents would be in danger from flying debris and projectiles. Flying debris could result in injuries. Structures could also sustain damage from trees falling on the structure. The Planning Committee reviewed the potential impact/damage table below and agreed the most likely impact would be moderate damage to residential and commercial properties; and brief interruptions in essential services. They agreed severe high-wind and tornado events could result in deaths and property damaged beyond repair and interruption or delay of essential services for 2 to 3 days.
Speed of Onset	Tornado and severe weather watches provide warning that conditions are favorable for the development of a tornado. Recent advances tracking storms and disseminating storm information have improved warning times. However, tornadoes can develop rapidly and often are characterized by rapid changes in direction. Citizens in Darwin, receive warning via sirens and NOAA weather radio. County and City officials closely monitor severe weather and have identified vulnerable segments of the population that may need assistance. The fire department delivers warning directly to vulnerable areas of the population. The NWS reported the citizens had 25 minutes warning (time between the first severe weather warning and the event) for a recent (March 2002) Beagle County event.

Fujita-Pearson Scale

Scale	Fujita Wind Speed	Pearson Path Length	Pearson Path Width
---	0 – 40 mph	Less than 0.3 miles	Less than 6 yards
0	40 – 72 mph	0.3 – 0.9 miles	6 – 17 yards
1	73 – 112 mph	1.0 – 3.1 miles	18 – 55 yards
2	113 – 157 mph	3.2 – 9.9 miles	56 – 175 yards
3	158 – 206 mph	10 – 31 miles	176 – 566 yards
4	207 – 260 mph	32 – 99 miles	0.3 – 0.9 miles
5	261 – 318 mph	100 – 315 miles	1.0 – 3.1 miles

TORNADO- POTENTIAL IMPACT AND DAMAGE

Managing Risk	Fujita Scale	Description of Damage
The threat to property and personal safety can be minimized through compliance with up-to-date model building codes and engineering standards.	F0	Some damage can be seen to poorly maintained roofs. Unsecured lightweight objects, such as trashcans, are displaced.
	F1	Minor damage to roofs and broken windows occur. Larger and heavier objects become displaced. Minor damage to trees and landscaping can be observed.
Property and personal protection can be improved through wind hazard mitigation techniques not normally required by current building codes.	F2	Roofs are damaged, including the loss of shingles and some sheathing. Manufactured homes on nonpermanent foundations can be shifted off their foundations. Trees and landscaping either snap or are blown over. Medium-sized debris becomes airborne, damaging other structures.
	F3	Roofs and some walls, especially unreinforced masonry, are torn form structures. Small ancillary buildings are often destroyed. Manufactured homes on nonpermanent foundations can be overturned. Some trees are uprooted.
Personal protection can only be achieved through use of a specially designed extreme wind refuge area, shelter, or safe room.	F4	Well-constructed homes, as well as manufactured homes, are destroyed, and some structures are lifted off their foundations. Automobile-sized debris is displaced and often tumbles. Trees are often uprooted and blown over.
	F5	Strong frame houses and engineered buildings are lifted from their foundations or are significantly damaged or destroyed. Automobile-sized debris is moved significant distances. Trees are uprooted and splintered.

Source: FEMA Publication 320

Natural Hazard: Severe Thunderstorm (Lightning and Hail)	
Definition	Thunderstorm: Weather systems accompanied by strong winds, lightning, heavy rain or hail, and possible tornadoes. The National Weather Service classifies a thunderstorm as severe if its winds reach or exceed 53 mph, it produces a tornado, or it drops surface hail of at least 0.75 inches in diameter.
Description	Thunderstorms affect relatively small areas compared to other atmospheric hazards such as hurricanes and winter storms. The typical thunderstorm is 15 miles in diameter and lasts an average of 30 minutes. However, weather-monitoring reports indicate thunderstorm systems can travel intact for distances in excess of 600 miles. About 10 percent of the 100,000 thunderstorms that occur each year are classified as severe. Lightning occurs with all thunderstorms and can strike anywhere. Lightning is generated by the buildup of charged ions in a thundercloud. The discharge of a lightning bolt interacts with the best conducting object or surface on the ground. The air in the channel of a lightning strike reaches temperatures of over 50,000 degrees Fahrenheit. The rapid heating and cooling of the air near the channel causes a shock wave that produces thunder. In the U.S., an average of 93 people are killed and 300 injured each year by lightning. Most lightning casualties occur in the summer months during the afternoon and early evening. Hailstorms occur when updrafts (strong rising currents of air within a storm) carry water droplets to a height where freezing occurs. When the ice particles become too heavy to be supported by the updraft, they fall to the ground. The size of the hailstone depends on the severity and size of the storm. Hailstones may be as small as ¼ Inches in diameter and as large as golf balls. The larger the hailstone, the faster they fall to the earth. Large hailstones can fall at speeds over 100 mph. Hailstorms cause nearly $1 billion in property and crop damage annually. Long stemmed vegetation is particularly vulnerable to hail damage. Hailstorms can also cause considerable damage to buildings and automobiles, but rarely result in loss of life.
Historical Occurrence	4 Lightning events were reported in Beagle County between January 1950 and May 2002. One lightning event, with $1,000 in property damage was reported in Darwin. Lightning struck a tree near a house in Darwin. The lightning traveled through one of the roots of the tree and blew a whole in the driveway and curled up the metal trim on the garage. All of the brooms and tools within the garage were knocked onto the floor. In another event, reported by the Committee (but NOT reported in the NWS data) a Darwin woman was struck by lightning. The woman survived but suffered severe burns. 55 hail events were reported between January 1950 and May 2002. Four events were reported in Darwin. All reported events occurred in 2001. Reported damages ranged from $0 (0.75 inch diameter) to $25,000 (1.75 inch diameter).

Probability	On average, Beagle County experiences between 40 and 50 thunder events per year. A thunder event is composed of lightning and rainfall and can intensify into a severe thunderstorm with damaging hail, high winds, tornadoes, and flash flooding. The average number of hailstorm days per year 4-5. According to NOAA, an individual's chance of being struck by lightning are estimated to be in 600,000.
Vulnerability	Lightning presents the greatest immediate threat during a thunderstorm. People who are outdoors, especially under or near tall trees, in or on water, or on or near hilltops are most vulnerable. While lightning could occur anywhere within the community, the impact, damage would be confined to property that was struck and its occupants. The greatest damage from hail occurs to property, especially automobiles and mobile homes. People or animals unable to reach shelter may also be at risk. Hail events have the potential of impacting the entire community.
Maximum Threat	In Iowa, the average length of thunderstorms is between 60 and 70 minutes; however, severe thunderstorms are often faster moving and shorter in duration. The area impacted is usually between 5 and 15 minutes. The entire community is at risk. One cannot predict where lightning may strike and hailstorms move through the community.
Severity of Impact	In an average year, lightning kills more people in the U.S. than the number of persons killed from tornadoes, floods, and hurricanes combined. Lightning can also result in property damage and fires. The greatest threat from hail is property damage, particularly to cars and homes. Broken windows and roof damage are common during hailstorms. Typical hail damage does not threaten the structural integrity of buildings.
Speed of Onset	Advances in weather prediction and surveillance have increased warning times. The National Weather Service watches and warnings are broadcast over NOAA Weather Alert radios and local television and radio stations. Darwin has NOAA Weather Alert system coverage as well as warning sirens that cover the entire City. If residents understand and heed the National Weather Service warnings they usually have time to seek shelter and take appropriate action.

Natural Hazard: Winter Storm (Snow and Ice)	
Definition	Winter storms consist of extreme cold weather and heavy concentrations of snowfall or ice. There are three categories of winter storm: blizzard, heavy snowfall, and ice storms.
Description	Winter storms are most likely to occur between late October and late March. In the Midwestern and Great Plains states winter storms usually begin as mid-latitude depression weather systems originating in Canada and the Arctic. Blizzards, the most dangerous of winter storms, combine low temperatures, heavy snowfall, and high winds that blow the snow into drifts and reduce visibility. The National Weather Service describes a blizzard as large amounts of falling or blowing snow and winds of at least 35 miles per hour that are expected to last for several hours. A severe blizzard is characterized by considerable falling or blowing snow, winds of at least 45 miles per hour, and temperatures of 10 degrees Fahrenheit or lower lasting for several hours. A heavy snowstorm is one that drops four or more inches of snow in a 12-hour period or six or more inches in a 24-hour period. Often high winds accompany the storm, blowing the snow into drifts and causing poor visibility. Ice storms occur when a significant amount of moisture falls from clouds and freezes immediately upon impact. Ice storms make driving and even walking extremely hazardous.
Historical Occurrence	According to NOAA, Beagle County experienced 32 reported snow and ice events between January 1993 and April 30, 2002. These storms resulted in 6 deaths, total property damage of $58,856 million and total crop damage of $65 million.
Probability	Snow level measurements provide the probability and frequency of occurrence associated with severe winter storms. In Beagle County, snow depths with a 5% chance of being equaled or exceeded in any given year are between 50 and 75 cm (19.5- 29.25 inches).
Vulnerability	Large snowstorms, ice storms, and severe blizzards have a substantial impact on utilities and transportation systems and can result in loss of life due to accidents or hypothermia. People can become stranded at home, often without utilities or other services. The most vulnerable segments of the population are people in automobiles, people who work outdoors or whose work require them to travel, and people who are most susceptible to the dangers of extreme cold weather – the very young, the elderly, and those with health conditions such as heart and respiratory diseases. People living in poorly insulated homes are more susceptible. This includes homes built prior to 1970 that have not been retrofitted/weatherized.

	Heavy snowfall and blizzards can trap motorists in their cars. Ice storms result in particularly hazardous driving conditions. The leading cause of death is automobile accidents. Ice storms can also break power lines. Extreme cold weather may cause water mains to freeze. If the storm lasts more than one or two days, the possibility of utility failures and interruption of services increases greatly. Emergency services ability to respond quickly may also be impacted. Fire presents a great danger because water supplies may freeze and firefighting equipment may not be able to get to the fire.
Maximum Threat	Since winter storms are generally large, due to the compact size of Darwin, the entire community could be impacted.
Severity of Impact	The severity of the impact depends on the type of storm, the intensity of the storm, the duration of the storm, the community's ability to respond, and the degree the public understands and responds to weather advisories. Heavy ice and snow may disrupt power distribution. A very intense storms and/or storms lasting for more than one or two days may impact the utility company's ability to restore power and the City's ability to remove ice and/or snow from roads and highways. Power and transportation disruption could impact emergency services. In Darwin, the impact of winter storms has been limited to transportation problems or power failures. The impacts from major storms usually diminish within 2 to 3 days.
Speed of Onset	National Weather Service weather advisories (winter storm watch, winter storm warning, ice storm warning, heavy snow warning, blizzard warning, and travelers advisories) are widely distributed via the NOAA weather alert system and local radio and television. Winter storms are tracked several days in advance. As a result City and County emergency services staff and the general public are kept well informed and prepared for the event.

Natural Hazard: Drought	
Definition	Drought: A water shortage caused by a deficiency of rainfall.
Description	A drought occurs when there is a natural reduction in the amount of precipitation expected over an extended period of time, usually a season or more in length. High temperatures, prolonged high winds, and low relative humidity can intensify the severity of a drought. Drought differs from other natural hazards in three ways: • A droughts onset and end are difficult to determine because the effects accumulate slowly and may linger after the apparent end of the event. • There is no precise and universally accepted definition. This causes confusion about whether a drought exists and, if it does, its severity. • The impacts of drought are less obvious and are spread over larger geographic area. These differences have hindered the development of accurate, reliable, and timely estimates of drought severity and effects. Thus making hazard analysis and risk assessment more difficult. Three types of drought relevant to Iowa are: • Meterologic drought, which is defined solely on the degree actual precipitation, differs from tile expected average or normal amount. • Hydrologic drought which is related to the effects of precipitation shortfalls on streamflows and reservoir, lake, and ground water levels. • Agricultural drought which is defined principally in terms of soil moisture deficiencies relative to water demands of crops.
Historical Occurrence	During the 20th Century two severe droughts impacted the Midwest (the 1930's Dust Bowl drought and the 1976-77 drought). Between January 1950 and August 2001, 4 drought events were reported for Beagle County. All events were reported after 1995. The August 1995 event resulted in reported crop damages of $109.9 million. The July 1999 event resulted in reported crop damages of $150.1 million. The August and September 2000 events resulted in a reported $161.0 million in crop damages.
Probability	The most reliable information available was historical. Historical occurrence indicates that the probability of a severe drought in as least one chance in 100 years. The likelihood of a less severe drought is much higher with four short-term events occurring in a 6-year period.
Vulnerability	A severe drought would impact the entire community. The agricultural sector would be most severely impacted. Agricultural production could be damaged by loss of crops or livestock. Increased demand for water and electricity could result in shortages and rationing. The number and severity of wild fires may also increase. A short-term drought could result in limiting water usage such as watering lawns. The community may also be exposed to greater risk from fire resulting in burning restrictions.

Maximum Threat	Severe droughts generally impact large geographical areas. Thus, a drought impacting Darwin would most likely impact much of Iowa.
Severity of Impact	Severe drought would have the greatest impact on agricultural crops, livestock, wildlife and streamflows. Although drought seldom results in the loss of life, a severe drought would have substantial economic impacts. In the mid-1970's drought, 40 separate drought relief programs administered by 16 Federal agencies provided nearly $8 billion in relief.
Speed of Onset	Droughts develop over wide geographical areas over extended period of time. During the past decade, research efforts, such as those at the University of Nebraska Drought Center, attempts to predict droughts and develop policy on preparedness, mitigation, and warnings have increased. However, this research is in its early stages and accurate, consistent drought warning/prediction methodology is not readily available.

Natural Hazard: Earthquake	
Definition	Earthquake: A wave like movement of the earth's surface that results from the sudden shifting of rock beneath the earth's crust.
Description	The earth's crust and upper part of the mantle are constantly pushing and moving against one another along what are known as fault lines. When rock masses slip along a fault, the energy of an earthquake is released in seismic waves. Earthquakes can also be produced by volcanic eruptions. The damage caused by an earthquake depends on its intensity. Today geologists use the Modified Mercalli (MM) intensity scale to measure the intensity of ground shaking at a particular site. The MM scale has 12 graduations. Quakes of intensity I-IV are minor and often not even noticed. By intensity V nearly everyone senses the movement, and earthquakes of intensities greater than VII are considered major.
Historical Occurrence	Iowa has experienced only minor earthquake activity since 1803. The New Madrid earthquakes of 1811-1812 were the first reported felt in Iowa. Since 1867, 12 earthquakes with epicenters in Iowa have occurred. None have been located in Beagle County. The last reported earthquake in Iowa occurred in Oxford on April 20, 1948.
Probability	Darwin is located in Seismic Zone 0, the lowest risk zone in the United States. It is unlikely an earthquake event would occur in Darwin.
Vulnerability	Although Darwin is in the lowest risk zone, this does not guarantee an earthquake would never impact the area. Current earthquake research indicates that if a significant earthquake occurred along the New Madrid fault, the impact on Beagle County would be less than a MMV.
Maximum Threat	Darwin would experience minor damage, if any. At MMV most people would feel the earthquake. Many would be awakened. Some dishes and windows may be broken and unstable objects could be overturned
Severity of Impact	There would be few, if any injuries and little or no property damage. Essential services would not experience interruption.
Speed of Onset	Currently there are no reliable warning systems.

Technological Hazard: Hazardous Materials	
Definition	Hazardous materials are substances or materials that, because of their chemical, physical, or biological nature, pose a potential risk to life, health, or property if they are released.
Description	Cities, counties, and towns where hazardous materials fabrication, processing, and storage sites are located and those where hazardous waste treatment storage or disposal facilities operate are at risk for HAZMAT incidents. The storage and use of hazardous materials does not occur only in and around chemical manufacturing plants. In addition, facilities such as service stations and hospitals store and use hazardous materials and many hazardous materials are located in homes In addition to large quantities of hazardous materials maintained in communities, hazardous materials are transported daily by air, water, road, rail, and pipeline. Of the 1.5 billion tons of materials transported each year, more than half move by trucks along the nation's highways. Of the 6,774 HAZMAT events that occur on average each year, 5,517 are highway events, 991 are railroad events, and 266 are due to other causes. Rains, high winds, and fires can worsen conditions surrounding HAZMAT events making it even more difficult to contain releases and deter the short and long term effects. Burning fuels or chemicals entering sewers or drains that are not completely filled with stormwater runoff have caused underground fires. Fires involving certain types of HAZMAT may generate more toxic gas or smoke than would otherwise normally evolve. The City is located 10 miles south of Interstate 80. State Highway 225 forms the northern boundary of the City.
Historical Occurrence	The Beagle County Emergency Management Risk Assessment dated December 2000, reported 12 major hazardous materials events and 3 injuries between 1985 and December 2000. The analysis estimated an average of 75-80 annual incidents. A tractor-trailer owned by Darwin Transport parked at the Darwin Coop Exchange anhydrous plan storage facility was damaged (split tank). Anhydrous ammonia was released and the downtown area evacuated.
Probability	The Planning Committee felt that based on past history, it is highly likely (nearly 100%) that a hazardous materials incident may occur in any given year.
Vulnerability	People living in close proximity to transportation routes or fixed facilities classified as 302 facilities would be most vulnerable to injury from a HAZMAT event. There are 12 EPA reporting facilities in Darwin. In addition, several trucking firms are located near the community. The Committee felt the greatest threat is from an

	anhydrous plant storage facility located in the center of town. Trailers are loaded at this area and frequently are parked in the area over night. The Committee estimates that up to 50% of the population could be impacted by an event. (See Appendix H for location map)
Maximum Threat	The Beagle County Local Emergency Planning Committee (LEPC) has an in-depth hazard analysis identifying HAZMAT facilities, their locations, and the stored chemicals. The analysis indicates there is a moderate risk of release of hazardous materials that would not impact more than a ¼ mile radius. The Committee estimated that 30% of the Community is within ¼ mille of HAZMAT facilities. The number of people impacted would be greater during the day when businesses are open.
Severity of Impact	A well-trained, well-equipped response team in close proximity to the location of an incident substantially reduces the severity of the impact. The Fire Department employees are trained in HAZMAT response. City trained response personnel are on-call 7 days a week, 24 hours a day. In addition, The Beagle County Hazardous Materials Response Team is located in Newton, Iowa. The team provides 7 day a week, 24 hour a day response capabilities. The estimated response time is .5 to 1 hour. Immediate dangers from HAZMAT include fires, explosion, and the possible contamination of the community's air, land, and water. Direct contact with skin may cause painful and damaging burns. Contamination of air, ground, or water may harm fish, wildlife, livestock, and crops.
Speed of Onset	It is impossible to predict when a HAZMAT incident may occur.

Hazard Analysis and Risk Assessment Summary

Hazard Ranking

After completing the hazard analysis, the Planning Committee assigned ratings to each hazard. Following is a list of the hazards, their ratings, and the Committee's ranking.

1. Snow and Ice 38
2. Extreme Wind 37
3. Tornado 36
4. Hazardous Materials 33
5. Thunderstorm-Hail 32
6. Thunderstorm-Lightning 24
7. Drought 22
8. Flood 11
9. Earthquake 14

After discussing the criteria and the threat to the City, the Committee ranked flood higher than earthquake. The Committee noted the earthquake rating of 14 was a result of the speed of onset and that the community was more vulnerable to the impacts of occasional flash flooding.

Ratings by Criteria

	Snow-Ice	Tornado	Wind	HAZMAT	Tstorm Hail	Tstorm Lightning	Drought	Earth-Quake	Flood
Historical	8	1	2	3	3	1	1	1	3
Probability	8	6	7	7	7	6	5	1	3
Vulnerability	7	7	8	7	6	3	6	1	1
Max Threat	7	6	8	5	7	4	6	1	1
Severity	3	8	5	3	4	5	3	1	1
Onset	5	8	7	8	5	5	1	9	2
TOTAL	38	36	37	33	32	24	22	14	11

Asset Inventory

The City is currently in the process of conducting an inventory of community assets. Following is a summary of the City's preliminary inventory.

Hazards: Snow/Ice, Tornado, Wind, Thunderstorm (Hail, Lightning). Entire Community is “Hazard Area”

Type of Structure	Number of Structures			Value of Structures			Number of People		
	# in City	# in Hazard Area	% in Hazard Area	$ in City	$ in Hazard Area	% in Hazard Area	# in City	# in Hazard Area	% in Hazard Area
Residential	362	362	100	34,956,475	34,956,465	100	904	904	100
Commercial	60	60	100%						
Industrial	0	0	0	0	0	0	0	0	0
Agriculture	0	0	0	0	0	0	0	0	0
Religious/ Non-Profit	3	3	100						
Government	3	3	100	1,000,000	1,000,000	1,000,000			
Education	2	2	100				764	764	764
Utilities	3	3	3						

Residential/Commercial Value = Assessed value
Government = Community Center (7,200 sq ft), fire station, maintenance building
Education = Staff and students at public school grades kindergarten – 12 and private school grades 1-8
Utilities = Wastewater treatment plant, water plant and city wells

Other hazards:

- HAZMAT: Risk area = structures and people within ¼ mile (3-4 blocks) of facilities. See Map in Appendix H.
- Riverine flooding: No flood hazard area
- Flash flooding: Low lying areas, scattered throughout community

See hazard tables for estimate of the % of People and Property and % (spatial area) of City at risk in an event. The Committee referred to the Fujita-Pearson Scale to estimate risk. For example, the entire community is a tornado risk area; however, a F-2 event has an estimated width of 56 -- 175 yards (1 mile = 1,760 years).

APPENDIX B

FLOOD OVERVIEW

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Beagle County Floodplain Map (Beagle County – USGS)	10

FLOODING

Of all the natural hazards that occur in the U.S., flooding occurs most often; at least 90% of disasters in the U.S. are floods. In Iowa, it is estimated that flooding causes annual damages exceeding $534 million. The National Flood Insurance Program (NFIP) defines flooding as:

A partial or complete inundation of normally dry land areas from:

1. The overland flood of a lake, river, stream, ditch, etc.
2. The unusual and rapid accumulation or runoff of stream waters.
3. Mudflows or the sudden collapse of shoreline land.

Riverine flooding is usually the result of heavy or prolonged rainfall or snowmelt occurring in upstream inland watersheds. Melting snow can combine with rain in the winter and early spring; severe thunderstorms can bring heavy rain in the spring or summer. Intense rainfall over a short period of time, or an ice or debris jam can also cause a river or stream to overflow. Riverine floodwaters can occur quickly and move rapidly, as in a flash flood, or waters can rise slowly over a period of hours or even a few days as they often do where the land is gently sloping or flat.

Flooding can also be caused by inadequate or improper drainage systems including storm sewers, culverts, and drainage ditches. These systems are usually designed to carry up to a specific amount of water (design capacity). When heavy rainfall causes the design capacity of the systems to be exceeded, water will begin to back up and fill low-lying areas near system inlets and along open ditches. This is most common in urban areas. As land is converted from fields or woodlands to roads and parking lots, it looses its ability to absorb rainfall. Urbanization increases runoff two to six times over what would occur on natural terrain.

The extent of damage caused by floods is determined by many factors including depth, frequency, velocity, rate of rise, duration and the potential presence of ice and debris. These factors also determine which mitigation methods will work best.

Depth is the primary factor in evaluating the potential for flood damage. Every floodplain is unique in terms of the different levels of flooding that can be expected.

- Very shallow flooding, usually defined as a depth of one foot or less, is not life threatening, but can still cause considerable amounts of damage to a building.
- Shallow flooding of one to three feet in depth can result in significant amounts of damage both to structures and their contents.
- Moderate flooding, depths of three to six feet, can destroy buildings and threaten lives because of the large flood forces involved.
- Deep flooding, depths exceeding six feet, are the most destructive and dangerous.

Frequency, or how often the flooding occurs, is usually the second factor considered. All floodplains are subject to floods of differing depths, with the lower depths occurring more often, or frequently, than higher levels. Although historical flood depths provide some indication of the level of risk, there is no certain method to predict future flood levels.

A method of estimating flood frequencies has been developed to determine the statistical probability of specific flood levels. For example, the flood that has a 1-percent (1 in 100) probability of being equaled or exceeded in any year is referred to as the 100-year flood event. However, this does not mean that a 100-year event is one that happens every 100 years or that once a 100-year event happens it will not occur again for another 100 years. This is only a statistical tool used to estimate the risk of certain flood levels.

The 100-year flood is known as the base flood elevation or BFE. Once a BFE has been established, it is published on a Flood Insurance Rate Map (FIRM). These maps delineate areas of a specific community that are subject to the base flood.

Velocity is the speed at which floodwaters move.

- Slow moving floodwaters are usually defined as those having a velocity of less than three feet per second and they usually do not present substantial problems.
- Faster moving floodwaters, those moving over five feet per second, can quickly erode or scour the soil leading to foundation failure or even moving the house off its foundation.

Historical information from past flood events is often the best source of determining potential flood velocities even though it is possible to hydraulically calculate theoretical velocities.

The speed floodwaters rise, or **Rate of Rise,** is the primary factor in determining the amount of warning time. In steep topography or when large amounts of rainfall occur within a short period of time, flash floods can occur. In low, flat areas the warning time can be several hours or even days.

The rate of rise is also important because of the effects of hydrostatic pressure. For example, if the water rises quickly, water may not be able to flow into the building fast enough for the pressure inside to rise as quickly as the level outside. When the internal and external pressures (pressure of the water inside the building and the water outside the building) are significantly different, it could cause serious structural damage and even collapse.

The **duration** of the flood is how long it lasts. Often duration is related to rate of rise and rate of fall. Usually water that rises and falls rapidly will recede more rapidly and water that rises and falls slowly will recede more slowly. How long the structural members, interior finishes, service equipment, and building contents are affected by floodwaters is related to how much damage will occur. Duration also determines how long buildings remain uninhabitable.

Ice and/or debris can often pose a greater danger than the floodwater itself. For example ice floes, caused by ice breakup, can often strike a building causing serious damage or the ice may form around a flooded building causing uplift and structural damage. Floodwaters can carry all types of debris, including trees, portions of flood damaged buildings, storage tanks, mobile homes, as well as dirt and other substances such as oil, gasoline, sewage and chemicals. At low velocities the debris can cause damage and pose a health and safety threat, at higher velocities it can destroy structures, including buildings and bridges.

47 FLOOD EVENT(S) WERE REPORTED IN **Beagle County, Iowa** between **01/01/1950** and **06/30/2002.**

Mag: Magnitude
Dth: Deaths
Inj: Injuries
PrD: Property Damage
CrD: Crop Damage

Location or County	Date	Time	Type	Mag	Dth	Inj	PrD	CrD
1 IAZ026>030 - 035>042 - 045>054 - 056>064 - 070>079 - 080>099 -	03/02/1993	1200	Flooding	N/A	0	0	50K	0
2 IAZ002>011 - 013>054 - 056>064 - 070>074 - 080>084 - 090>096	05/07/1993	1800	Flood	N/A	0	0	5.0M	5.0M
3 BEAGLE	08/11/1993	1900	Flash Flood	N/A	0	0	50K	50K
4 IAZ005>011 - 024>030 - 036>042 - 049>054 - 061>064 - 075>078 - 086>089 - 098 - 099 -	08/14/1993	2400	Flood	N/A	0	0	5.0M	5.0M
5 IAZ002>005 - 013>015 - 022>026 - 033>037 - 045>050 - 058>064 - 071>078 - 083 - 088 - 095>099	08/16/1993	0600	Flood	N/A	0	0	5.0M	5.0M
6 IAZ002>011 - 013>054 - 056>064 - 070>078 - 080>099	08/29/1993	0300	Flood	N/A	0	0	5.0M	5.0M
7 All Of Iowa	09/01/1993	0000	Flood	N/A	0	0	500K	500K
8 IAZ034>040 - 046>052 - 058>064 - 072>078 - 083>089 - 095>099	09/14/1993	0600	Flood	N/A	0	0	500K	500K
9 IAZ028>030 - 040>054 - 056>064 - 070>078 - 080>099	09/25/1993	1400	Flood	N/A	0	0	5.0M	5.0M
10 Central And	10/01/1993	0000	Flooding	N/A	0	0	50K	50K
11 Central Iowa	10/09/1993	0600	Flooding	N/A	0	0	5K	5K
12 Much Of Iowa	02/19/1994	0600	Flooding	N/A	0	0	500K	0
13 IAZ001>099	06/22/1994	2330	Flooding	N/A	0	0	500K	500K
14 IAZ004>006 - 015 - 048>050 - 061>064 - 074>078 - 082>089 - 094>099	04/10/1995	0900	Flooding	N/A	0	0	10K	0
15 IAZ004>006 - 015 - 035>037 - 048>052 - 061>064 - 074>078 - 085>089 - 097>099	04/26/1995	1500	Flooding	N/A	0	0	25K	0
16 IAZ033 - 006 - 045>052 - 057>068 - 070>078 - 081>089 - 092>099	05/07/1995	1200	Flooding	N/A	0	0	200K	10K
17 IAZ004>011 - 015>019 - 023>030 - 035>042 - 047>054 - 060>068 - 074>078 - 084>089 - 095>099	06/06/1995	2300	Flood	N/A	0	0	50K	100K

18 IAZ046>050 - 059>062 - 074>075	02/09/1996	06:00 AM	Flood	N/A	0	0	50K	0
19 IAZ060>062 - 072>075 - 081>086 - 092>097	05/19/1996	06:00 AM	Flood	N/A	0	0	100K	50K
20 Newton	05/09/1996	09:00 PM	Urban/sml Stream Fld	N/A	0	0	50K	0
21 IAZ057>062 - 070>075 - 081>086 - 092>097	05/23/1996	03:00 PM	Flood	N/A	0	0	250K	75K
22 IAZ057>062 - 070>075 - 081>086 - 092>097	05/26/1996	12:00 PM	Flood	N/A	0	0	400K	100K
23 IAZ029 - 033>039 - 045>050 - 058>062 - 074>075	06/17/1996	03:00 AM	Flood	N/A	0	0	500K	1.0M
24 IAZ036 - 047>048 - 061 - 075	06/17/1996	04:00 AM	Flood	N/A	0	0	1.0M	500K
25 IAZ034>039 - 044>050 - 057>062 - 070>075 - 081>086 - 092>097	02/18/1997	06:00 PM	Flood	N/A	0	0	750K	0
26 IAZ024>028 - 035>039 - 048>049 - 061 - 075	06/21/1997	03:00 PM	Flood	N/A	0	0	60K	100K
27 IAZ061 - 074>075 - 083>084 - 095>096	05/07/1998	01:00 AM	Flood	N/A	0	0	175K	70K
28 Colfax	05/19/1998	05:15 PM	Urban/sml Stream Fld	N/A	0	0	30K	2K
29 IAZ061 - 074>075 - 083>084	05/24/1998	06:00 AM	Flood	N/A	0	0	125K	50K
30 IAZ027 - 037 - 049>050 - 059>061 - 074>075	06/08/1998	06:00 PM	Flood	N/A	0	0	450K	90K
31 Newton	06/14/1998	04:00 PM	Urban/sml Stream Fld	N/A	0	0	50K	30K
32 IAZ034 - 037 - 045>046 - 048>050 - 057>061 - 070 - 074>075 - 083>084	06/14/1998	09:00 AM	Flood	N/A	0	0	5.4M	655K
33 IAZ023>024 - 027 - 035 - 037 - 047>050 - 059>061 - 072>075	06/18/1998	02:00 AM	Flood	N/A	0	0	8.7M	460K
34 IAZ016>017 - 027 - 037 - 049>050 - 061 - 074>075	06/21/1998	06:00 AM	Flood	N/A	0	0	900K	180K
35 Newton	06/29/1998	01:00 PM	Urban/sml Stream Fld	N/A	0	0	50K	10K
36 IAZ034 - 037>038 - 045>046 - 049 - 058>062 - 073>075 084>086 - 095	07/06/1998	03:00 AM	Flood	N/A	0	0	900K	1.8M
37 Galesburg	02/26/1999	10:45 PM	Urban/sml Stream Fld	N/A	0	0	1K	0
38 IAZ004>006 - 016 - 023 - 025>027 - 033>037 - 071>073 - 048>049 - 058>061 - 071>073 - 075 - 083>086 - 095	04/06/1999	06:00 PM	Flood	N/A	0	0	210K	0

39 IAZ004>007 - 015>017 - 023>027 - 033>037 - 045>046 - 048>049 - 058>061 - 071>072 - 075 - 083>086 - 095	04/22/1999	06:00 AM	Flood	N/A	0	0	370K	0
40 IAZ004>006 - 016>017 - 023>028 - 035>039 - 045>046 - 048>049 - 058>061 - 072>075 - 083>085 - 095	05/16/1999	09:00 PM	Flood	N/A	0	0	7.6M	875K
41 IAZ004>006 - 016>017 - 023>028 - 035 - 037>039 - 045>046 - 048>049 - 058>061 - 071>075	05/21/1999	03:00 PM	Flood	N/A	0	0	1.4M	280K
42 IAZ004>007 - 016>017 - 023>028 - 033>039 - 045>049 - 057>062 - 074>075 - 083>084 - 094>095	06/09/1999	06:00 AM	Flood	N/A	0	0	1.8M	2.7M
43 IAZ026>027 - 038 - 061 - 074>075 - 083>086 - 094>095 - 097	06/24/2000	03:00 AM	Flood	N/A	0	0	650K	975K
44 IAZ046>050 - 057>062 - 023>028 - 033>039 - 044>050 - 057>062 - 070>075 - 081>086 - 092>097	03/15/2001	03:00 PM	Flood	N/A	0	0	260K	0
45 IAZ004>007 - 015>017 - 023>028 - 033>039 - 044>050 - 057>062 - 070>075 - 081>086 - 092>097	03/23/2001	06:00 PM	Flood	N/A	0	0	383K	0
46 IAZ004>007 - 015>017 - 023>026 - 033>038 - 045>046 - 048>049 - 059>061 - 073>075 - 083>086 - 094>095	06/12/2001	03:00 PM	Flood	N/A	0	0	825K	1.7M
47 IAZ061>062 - 074>075	06/13/2002	04:00 PM	Flood	N/A	0	0	40K	80K
				TOTALS:	0	0	60.819M	33.947M

Floodplain Management in Iowa

As part of an effort to stem the increase in flood damages sustained after a number of devastating flood events in the 1940's, the Iowa General Assembly created the Iowa Natural Resources Council in 1949. Originally, the Council's power over floodplain activities was advisory in nature. Its regulatory functions were established by 1957 and 1965 amendments. After a number of state reorganizations, Iowa's floodplain regulatory authority now resides with the Water Resource Section of the Iowa Department of Natural Resources (IDNR).

Iowa's floodplain program is different from most states in that its authority extends to virtually all floodplain construction within the state and is not limited to FEMA regulatory floodplains. Regulatory thresholds of rural development in watersheds draining ten square miles or more, and urban developments in watersheds draining two square miles or more require a permit from the IDNR. Other developments below these thresholds have relatively minor impacts and are not considered.

Iowa law allows IDNR to delegate State's floodplain regulatory functions to a local government that has a flood study identifying the regulatory floodway and floodway fringe along the 100-year flood profile and a floodplain management ordinance meeting certain minimum requirements. The State allows communities with delegated floodplain management authority to issue floodplain development permits in lieu of the IDNR. The State has delegated floodplain authority to approximately 135 NFIP participating communities. As part of the delegation process, the State retains the right to concur or deny with the granting of any variance from the community's floodplain management regulations.

Although the State of Iowa's criteria for new floodplain development is similar to the minimum NFIP criteria in most respects, there are some important differences, for example:

- The lowest floor of new structures must be elevated an additional 1.0 foot above the 100-year (base) flood.
- Iowa does not allow new residential structures in the floodway.
- Residential structures must have wheeled vehicular access during the 100-year flood.
- The substantial improvement threshold is reached with an additional 25% or more of flood area.
- All post-Firm (Flood Insurance Rage Map) additions are considered cumulative improvements in the determination of increase in flood area.

(Source: FEMA Region VII and IDNR)

Beagle County Floodplains

The Beagle County Flood Insurance Rate Maps (FIRM) contains four panels (see following page). FEMA has not identified Special Flood Hazard Areas (SFHA) in the portion of the County NOT included within these four panels. Thus, substantial portions of Beagle County, including unincorporated areas along the North Skunk River, are classified as No Special Flood Hazard Areas (NSFHA). Floods of greater than the 100-year flood, flooding caused by local drainage problems, and flash flooding may damage structures in these areas.

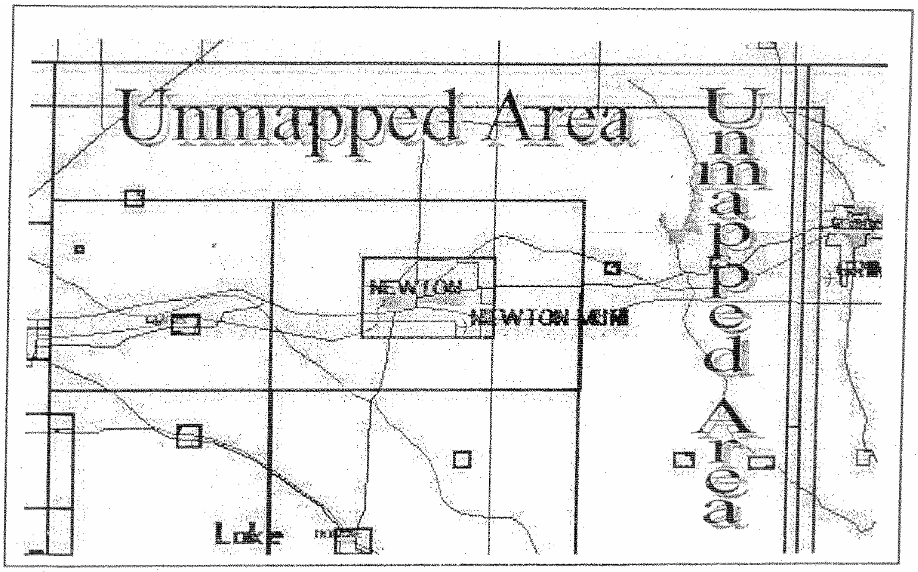
There are five mapped communities in Beagle County: Colfax, Kellogg, Newton, Reasnor, and Mingo. Colfax, Kellogg, Newton, and Reasnor participate in the National Flood Insurance Program. Mingo does not participate. Flood insurance is not available and no direct Federal assistance can be legally provided for the acquisition or construction of buildings in non-participating communities.

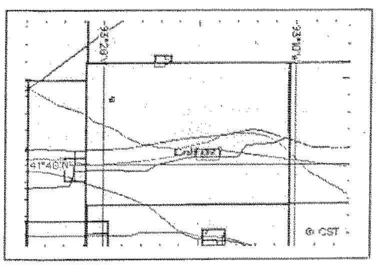
The National Flood Insurance Program (NFIP) classifies Beagle County and all mapped communities within the County as "minimally flood-prone" areas. In these areas, the Flood Hazard Boundary Map was converted to Flood Insurance Rate Map by letter, no change in flooding is shown on the map, and no elevations are shown on the map.

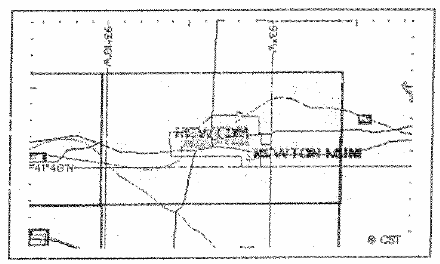
Construction within the state and is not limited to FEMA regulatory floodplains. Regulatory thresholds of rural development in watersheds draining ten square miles or more, and urban developments in watersheds draining two square miles or more require a permit from the Iowa Department of Natural Resources (IDNR). (Refer to "Floodplain Management in Iowa" for more information.)

(Source: National Flood Insurance program Community Status Booklet, State of Iowa)

BEAGLE COUNTY FLOODPLAIN MAP PANELS

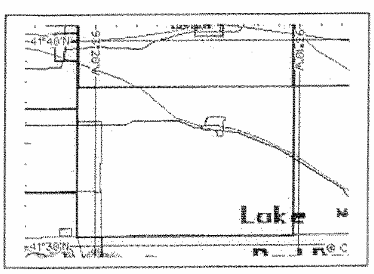


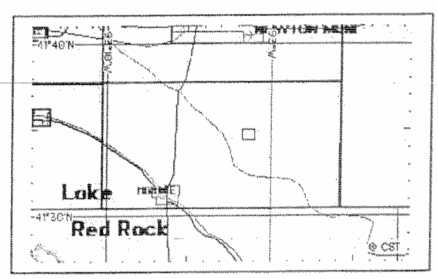




Community: 190880
Panel: 0001 Surrounding Colfax
Date: 01/01/1987

Community: 190880
Panel: 0002 Surrounding Newton
Date: 01/01/1987





Community: 190880
Panel: 0003 Surrounding Prairie City
Date: 01/01/1987

Community: 190880
Panel: 0004 Surrounding Monroe and Reasnor
Date: 01/01/1987

APPENDIX C

TORNADO-EXTREME WINDS

TABLE OF CONTENTS

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Tornadoes in Iowa	3
Tornado Risk – Wind Risk	6
Tornado Activity – Wind Zones – Risk Table	7
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Thunderstorms and High Wind in Beagle County	11

Tornadoes- Extreme Winds

Tornadoes

Each year approximately 1,000 tornadoes are spawned by severe thunderstorms. Although most tornadoes remain aloft, those that touch ground are forces of destruction. Tornadoes have been known to lift and move huge objects, destroy or move whole buildings long distances, and siphon large volumes from bodies of water. Tornadoes generate a tremendous amount of debris, which often becomes airborne shrapnel that causes additional damage. Tornadoes are almost always accompanied by heavy precipitation. Over the past 20 years, 106 Federal disaster declarations included damage associated with tornadoes.

Tornadoes follow the path of least resistance. People living in valleys have the greatest exposure. People living in manufactured or mobile homes are most exposed to damage from tornadoes. Even if anchored, mobile homes do not withstand high wind speeds as well as some permanent, site-built structures.

Mitigation Measures

- Attention to the type of structure used in tornado-prone areas, particularly avoiding highly susceptible manufactured or mobile homes.
- Quality construction and reinforcement of walls, floors, and ceilings provides, the greatest protection.
  - Proper anchoring of walls to foundations and roofs to walls
  - Code adoption, compliance, and inspection of new homes
- Seeking shelter in basements, small interior rooms, or hallways and avoiding rooms with large roof spans.
- Constructing reinforced, in-residence tornado shelter.
- Constructing community shelters; mobile home part shelters.
- Equipping gathering places with weather radios with an audible alert.
- Testing response and preparedness plans.
- Making special efforts to inform mobile home residents about the impacts of tornadoes and locations of safe shelters.

Extreme Winds

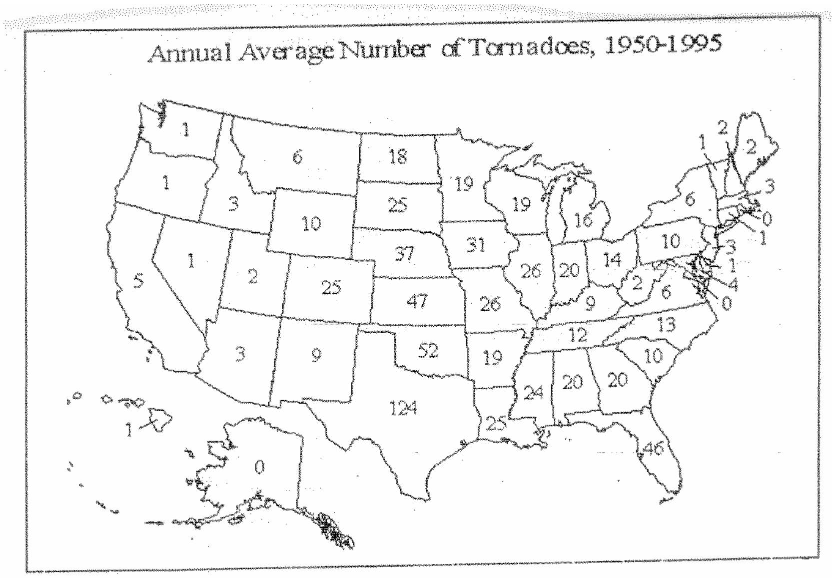
Extreme winds other than tornados are experienced in all regions of the United States. It is difficult to separate the various wind components that cause damage from other wind-related natural events that often occur with or generate windstorms. The three primary sources of extreme winds are hurricanes and tropical storms, severe thunderstorms, and winter storms. Windstorms and wind-related events caused 63 fatalities in 1993. Over the past 20 years, 193 Federal disaster declarations involved wind-induced damage.

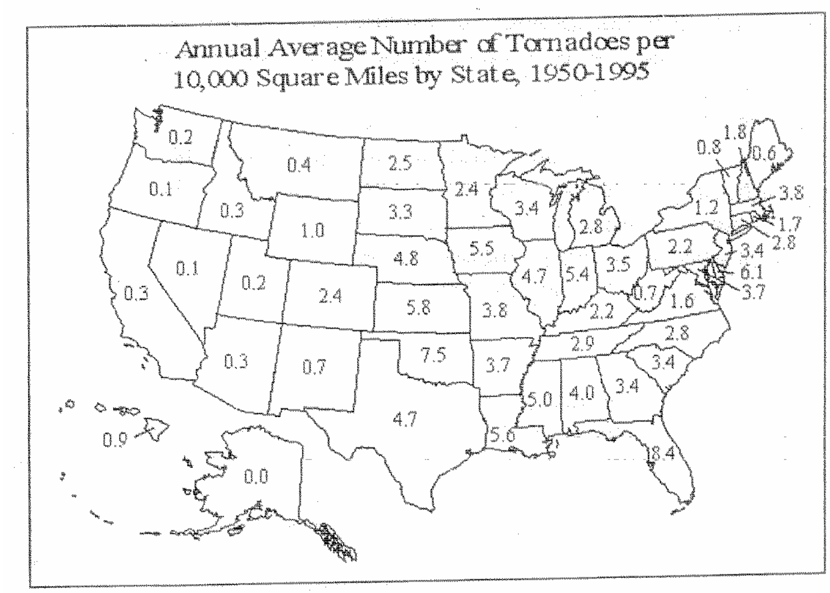
Mitigation Measures

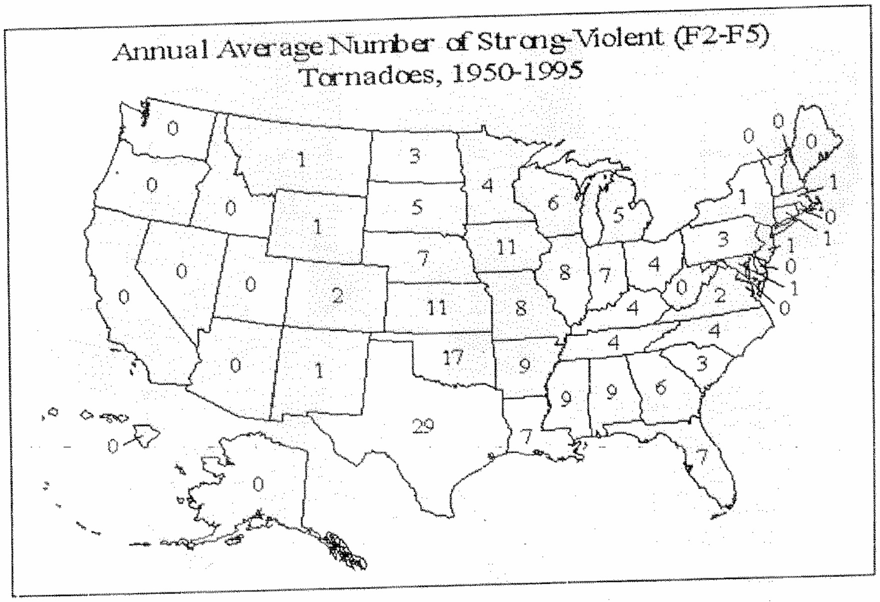
- Similar to tornado mitigation. Quality construction and reinforcement of walls, floors, and ceilings provide the greatest protection (See above).
- See wind mitigation checklist.

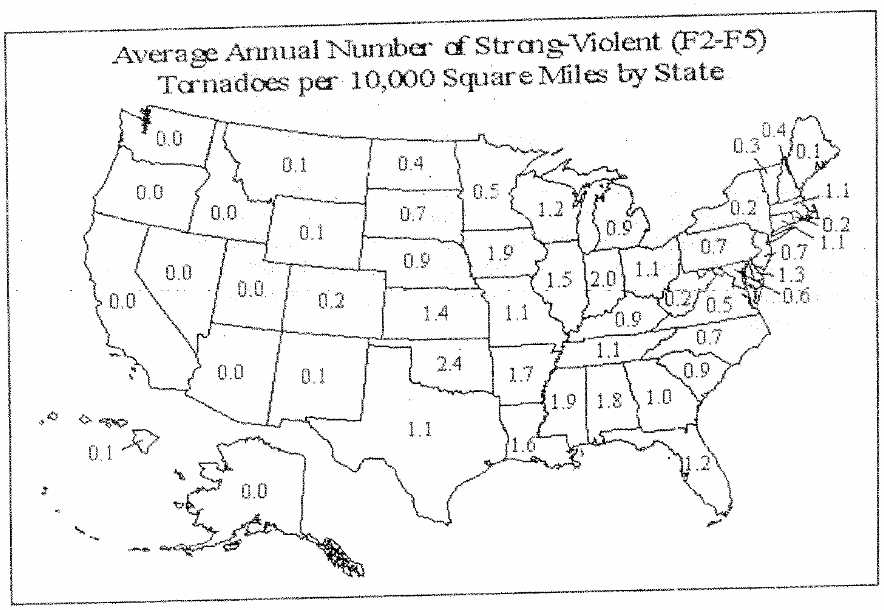
Iowa Tornadoes

In Iowa, most tornadoes occur in the spring and summer months in the late afternoon to evening hours, but they can occur in every month of the year and at any time of the day. Between 1950 and 1995, Iowa average 31 tornadoes per year. Of these approximately 11 are rated as "strong-violent" (F2 or higher on the Fujita Scale). The following maps summarize tornado activity in Iowa between 1950 and 1995.

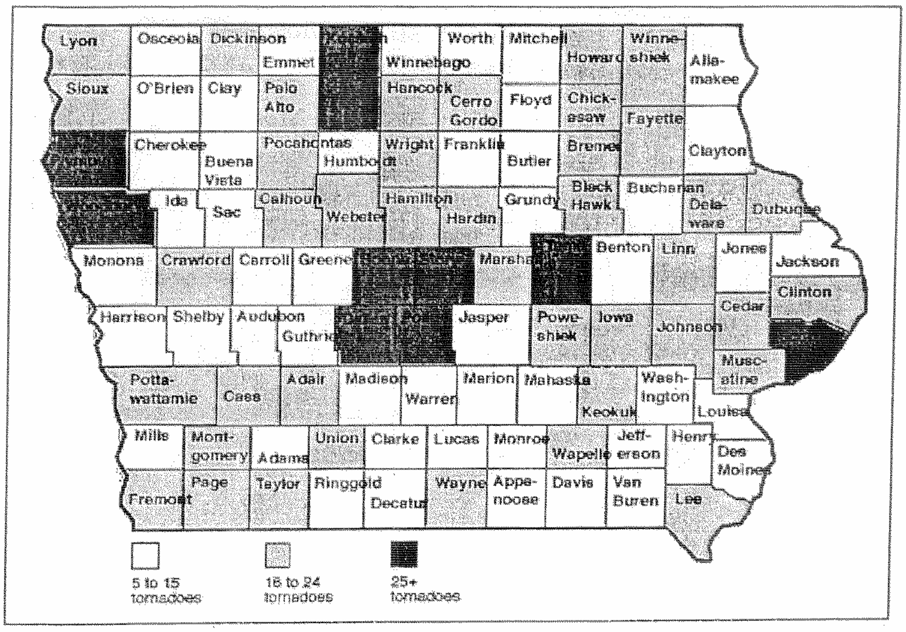





Annual Average Number of Strong-Violent (F2-F5)
Tornadoes, 1950-1995


Average Annual Number of Strong-Violent (F2-F5)
Tornadoes per 10,000 Square Miles by State

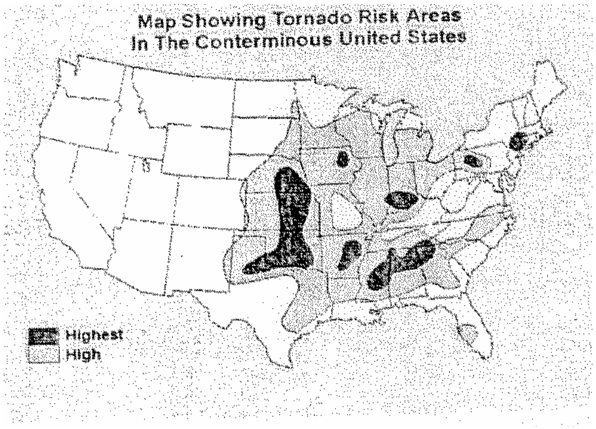
Number of tornadoes reported in Iowa's 99 counties from 1950 through 1995.



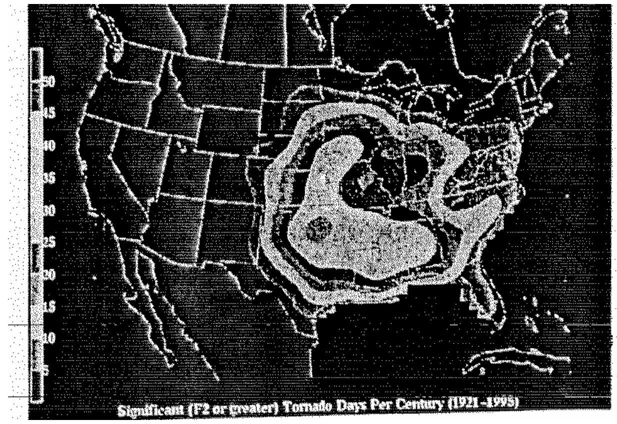
Highest counties: Story and Scott (35 tornadoes)
Lowest county: Allamakee (6 tornadoes)
Statewide average: 16.2 tornadoes

NOTE: Harry Hillaker, the state's climatologist, said the counties that are more populated are more likely to spot tornadoes and have tornado damage. Hillaker said there were fewer tornadoes reported in the 1950s and 1960s because multiple tornadoes in different parts of the state were often counted as one storm. Theoretically, Hillaker said, southwest Iowa should be the most prone to tornadoes because it's closest to Oklahoma and Kansas, states that are in "Tornado Alley," where heat and humidity generate the nation's highest number of tornadoes.

TORNADO RISK MAPS

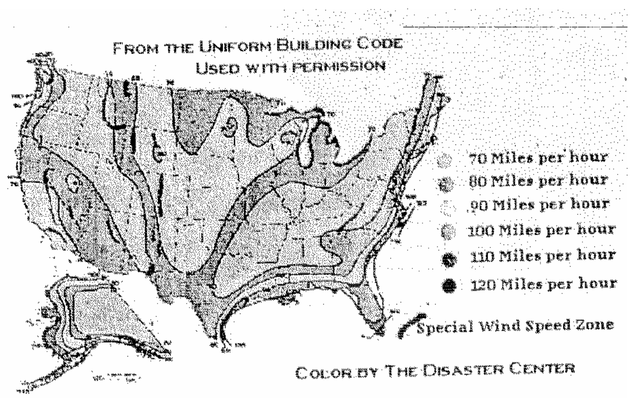


Source: fema.gov



Source: NOAA

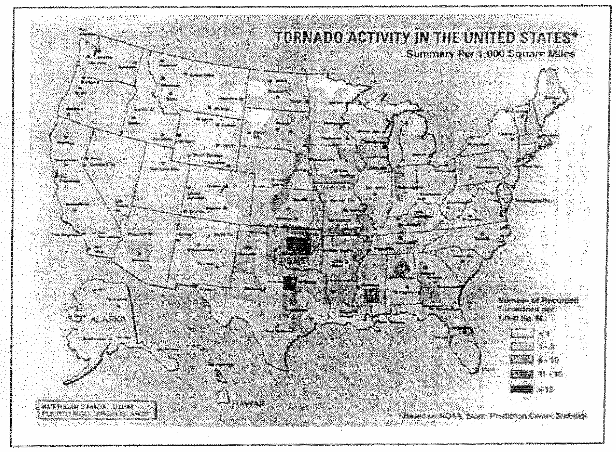
EXTREME WIND RISK MAPS



Source: fema.gov

Source: NOAA

Tornado Activity



Wind Zones

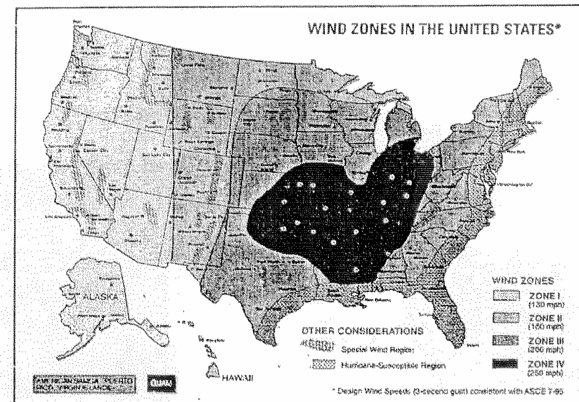


Figure I.2 Wind zones in the United States

Risk Table

NUMBER OF TORNADOES PER 1,000 SQUARE MILES (See Figure I.1)	WIND ZONE (See Figure I.2)			
	I	II	III	IV
<1	LOW RISK	LOW RISK ★	LOW RISK ★	MODERATE RISK
1 - 5	LOW RISK	MODERATE RISK ★	HIGH RISK	HIGH RISK
6 - 10	LOW RISK	MODERATE RISK ★	HIGH RISK	HIGH RISK
11 - 15	HIGH RISK	HIGH RISK	HIGH RISK	HIGH RISK
>15	HIGH RISK	HIGH RISK	HIGH RISK	HIGH RISK

LOW RISK: Need for high-wind shelter is a matter of homeowner preference

MODERATE RISK: Shelter should be considered for protection from high winds

HIGH RISK: Shelter is preferred method of protection from high winds

★ Shelter is preferred method of protection from high winds if house is in hurricane-susceptible region

FUJITA-PEARSON SCALE

The original wind damage scale developed by T. Theodore Fujita, which bares his name, had two additional sections added to further categorize tornadoes by the lengths and widths of their damage paths. Both ratings were the products of researcher Allen Pearson, director of the National Weather Service's National Severe Storms Forecast Center, in 1971. The P - for Pearson - scale was accepted for use by NSSFC in 1973, creating the Fujita-Pearson Scale, or "FPP" Scale, which is still mentioned in some literature. In practice, the Pearson Scales are not as widely used today.

For an example of the Fujita-Pearson scale, Tom Grazulis writes in his book *Significant Tornadoes:* 1680-1991 that "the Sardorus, Ill;, tornado of March 20, 1976 leveled homes, had a path length or 63 miles, and had a path width of 800 yards (2,400 feet, or just under a half mile)." Using the Table below, the tornado's rating was F ,P ,P 4,4,4: a Fujita Intensity Scale rating of F-4, a Pearson Path Length Scale rating of P-4, and a Pearson Path Width Scale rating of P-4.

Scale	Fujita Wind Speed	Pearson Path Length	Pearson Path Width
---	0 – 40 mph	Less than 0.3 miles	Less than 6 yards
0	40 – 72 mph	0.3 – 0.9 miles	6 – 17 yards
1	73 – 112 mph	1.0 – 3.1 miles	18 – 55 yards
2	113 – 157 mph	3.2 – 9.9 miles	56 – 175 yards
3	158 – 206 mph	10 – 31 miles	176 – 566 yards
4	207 – 260 mph	32 – 99 miles	0.3 – 0.9 miles
5	261 – 318 mph	100 – 315 miles	1.0 – 3.1 miles

Source: Significant Tornadoes: 1680

17 TORNADO(s) were reported in **Beagle County, Iowa** between **01/01/1950** and **10/31/2002.**

Mag: Magnitude
Dth: Deaths
Inj: Injuries
PrD: Property Damage
CrD: Crop Damage

Iowa

Location or County	Date	Time	Type	Mag	Dth	Inj	PrD	CrD
1 BEAGLE	08/26/1965	1858	Tornado	F2	0	0	25K	0
2 BEAGLE	10/14/1966	1432	Tornado	F3	0	0	25K	0
3 BEAGLE	03/30/1968	1900	Tornado	F0	0	0	3K	0
4 BEAGLE	04/03/1968	1600	Tornado	F2	0	0	25K	0
5 BEAGLE	06/04/1973	1435	Tornado	F2	0	0	250K	0
6 BEAGLE	09/16/1978	1935	Tornado	F3	2	2	250K	0
7 BEAGLE	08/19/1979	2032	Tornado	F0	0	0	0K	0
8 BEAGLE	08/26/1979	1730	Tornado	F1	0	0	25K	0
9 BEAGLE	05/08/1986	1600	Tornado	F1	0	0	25K	0
10 BEAGLE	09/28/1986	1648	Tornado	F4	0	0	2.5M	0
11 BEAGLE	05/08/1988	1104	Tornado	F1	0	0	250K	0
12 BEAGLE	06/13/1990	2333	Tornado	F0	0	0	3K	0
13 BEAGLE	06/16/1990	0607	Tornado	F0	0	0	3K	0
14 Baxter	05/12/1997	04:48 PM	Tornado	F0	0	0	0	0
15 Kellogg	07/09/1998	05:05 PM	Tornado	F0	0	0	0	1K
16 Prairie City	04/08/1999	04:46 PM	Tornado	F2	0	1	1.0M	0
17 Colfax	04/11/2001	02:40 PM	Tornado	F1	0	0	10K	0
				TOTALS:	2	3	4.393M	500

Knots to Miles Per Hour Conversion Chart

Surface Weather Observations – METAR always have wind speeds recorded in knots. The conversion below will provide a quick conversion for winds from calm to 99 knots. The converted values are all rounded to the nearest integer. For a more accurate conversion use the following formula:

1 KNOT = 1.5155 MILES PER HOUR

KTS	0	1	2	3	4	5	6	7	8	9
	MPH	MPH	MPH	MPH	MPH	MPH	MPH	MPH	MPH	MPH
0	0	1	2	3	5	6	7	8	9	10
10	12	13	14	15	16	17	18	20	21	22
20	23	24	25	26	28	29	30	31	32	33
30	35	36	37	38	39	40	41	42	44	45
40	46	47	48	49	51	52	53	54	55	56
50	58	59	60	61	62	63	64	66	67	68
60	69	70	71	72	74	75	76	77	78	79
70	81	82	83	84	85	86	87	89	90	91
80	92	93	94	96	97	98	99	100	101	102
90	104	105	106	107	108	109	110	112	113	114

Land Beaufort Scale

The Beaufort Scale was originally developed in 1805 by Sir Francis Beaufort as a system for estimating wind strength without the use of instruments. It is currently stilli n use for this same purpose as well as to tie together various components of weather (wind strength, sea-state, observable effects) into a unified picture.

Force	**Speed**		Land Conditions
	knots	**mph**	
0	<1	<1	Calm, smoke rises vertically
1	1-3	1-3	Light air, direction of wind shown by smoke drift only
2	4-6	4-7	Light breeze, wind felt on face, leaves rustle, vanes moved by wind
3	7-10	8-12	Gentle breeze, leaves and small twigs in constant motion, wind extends light flag
4	11-16	13-18	Moderate breeze, raises dust, loose paper, small branches move
5	17-21	19-24	Fresh breeze, small trees in leaf begin to sway
6	22-27	25-31	Strong breeze, large branches in motion, umbrellas used with difficulty
7	28-33	32-38	Near gale, whole trees in motion, inconvenience felt walking against the wind
8	34-40	39-46	Gale, breaks twings off trees, impedes progress
9	41-47	47-54	Strong gale, slight structural damage occurs
10	48-55	55-63	Storm, trees uprooted, considerable damage occurs
11	56-63	64-73	Violent storm, widespread damage
12	64+	74+	Hurricane, extreme destruction

86 THUNDERSTORM & HIGH WIND event(s) were reported in **Beagle County, Iowa** between **01/01/1950** and **06/30/2002.**

*Click on **Location or County** to display Details.*

Mag: Magnitude
Dth: Deaths
Inj: Injuries
PrD: Property Damage
CrD: Crop Damage

Iowa								
Location or County	**Date**	**Time**	**Type**	**Mag**	**Dth**	**Inj**	**PrD**	**CrD**
1 BEAGLE	07/08/1955	1100	Tstm Wind	0 kts.	0	0	0	0
2 BEAGLE	05/31/1958	1345	Tstm Wind	0 kts.	0	0	0	0
3 BEAGLE	09/26/1959	1000	Tstm Wind	0 kts.	0	0	0	0
4 BEAGLE	05/07/1962	1730	Tstm Wind	0 kts.	0	0	0	0
5 BEAGLE	07/05/1966	1710	Tstm Wind	0 kts.	0	0	0	0
6 BEAGLE	04/12/1970	1730	Tstm Wind	0 kts.	0	0	0	0
7 BEAGLE	05/13/1974	0630	Tstm Wind	0 kts.	0	0	0	0
8 BEAGLE	06/14/1974	1635	Tstm Wind	0 kts.	0	0	0	0
9 BEAGLE	06/22/1974	0300	Tstm Wind	0 kts.	0	0	0	0
10 BEAGLE	05/10/1979	1415	Tstm Wind	61 kts.	0	0	0	0
11 BEAGLE	04/03/1981	1940	Tstm Wind	0 kts.	0	0	0	0
12 BEAGLE	04/03/1981	1940	Tstm Wind	0 kts.	0	0	0	0
13 BEAGLE	04/03/1981	2010	Tstm Wind	0 kts.	0	0	0	0
14 BEAGLE	07/02/1983	0220	Tstm Wind	0 kts.	0	0	0	0
15 BEAGLE	09/09/1984	1725	Tstm Wind	0 kts.	0	0	0	0
16 BEAGLE	10/16/1984	1604	Tstm Wind	0 kts.	0	0	0	0
17 BEAGLE	09/22/1985	2015	Tstm Wind	52 kts.	0	0	0	0
18 BEAGLE	07/28/1986	2140	Tstm Wind	52 kts.	0	0	0	0
19 BEAGLE	07/28/1986	2150	Tstm Wind	52 kts.	0	0	0	0
20 BEAGLE	08/14/1986	1715	Tstm Wind	50 kts.	0	0	0	0
21 BEAGLE	08/14/1986	1732	Tstm Wind	50 kts.	0	0	0	0
22 BEAGLE	05/24/1989	0030	Tstm Wind	50 kts.	0	0	0	0
23 BEAGLE	07/10/1989	1955	Tstm Wind	50 kts.	0	0	0	0
24 BEAGLE	08/05/1989	0845	Tstm Wind	52 kts.	0	0	0	0
25 BEAGLE	08/05/1989	0852	Tstm Wind	50 kts.	0	0	0	0
26 BEAGLE	06/02/1990	1030	Tstm Wind	0 kts.	0	0	0	0
27 BEAGLE	06/02/1990	1041	Tstm Wind	56 kts.	0	0	0	0
28 BEAGLE	03/22/1991	1730	Tstm Wind	50 kts.	0	0	0	0
29 BEAGLE	09/12/1991	1450	Tstm Wind	50 kts.	0	0	0	0

30 IAZ002>009 - 013>019 - 022>028 - 031>039 - 043>051 - 056>063 - 070>076 - 081>087 - 093>099 -	03/09/1993	2230	High Winds	0 kts.	0	0	500K	0
31 All of Iowa	04/14/1994	2200	High Winds	0 kts.	0	0	500K	0
32 Most of Iowa	04/26/1994	0900	High Winds	0 kts.	0	3	5.0M	0
33 Newton	07/01/1994	0200	Tstm Winds	N/A	0	0	5K	1K
34 BEAGLE	08/03/1994	1300	Tstm Winds	N/A	0	0	5K	50K
35 IAZ001>068 - 070>078 - 083>089	11/18/1994	0230	High Winds	0 kts.	0	0	200K	0
36 All Of Iowa	02/10/1995	0000	High Winds	0 kts.	0	0	100K	0
37 IAZ004>011 - 015>019 - 023>030 - 033>042 - 044>054 - 057>068 - 070>078 - 081>089 - 092>099	04/03/1995	1300	High Winds	0 kts.	0	0	125K	0
38 IAZ004>011 - 015>019 - 023>030 - 033>042 - 044>054 - 057>068 - 070>078 - 081>089 - 092>099	04/18/1995	0700	High Winds	0 kts.	0	0	500K	0
39 Prairie City	07/04/1995	1714	Tstm Winds	N/A	0	0	10K	2K
40 Newton	07/04/1995	1730	Tstm Winds	N/A	0	0	20K	1K
41 Much Of Iowa	10/23/1995	1300	High Winds	0 kts.	0	0	100K	0
42 IAZ004>011 - 015>019 - 023>029 - 033>039 - 044>050 - 057>062 - 070>075 - 081>086 - 092>097	01/17/1996	09:00 PM	High Wind	55 kts.	0	0	250K	0
43 IAZ004>011 - 015>019 - 023>029 - 033>039 - 044>050 - 057>062 - 070>075 - 081>086 - 092>097	02/10/1996	12:00 PM	High Wind	56 kts.	0	0	350K	0
44 IAZ004>011 - 015>019 - 023>029 - 033>039 - 044>050 - 057>062 - 070>075 - 081>086 - 092>097	03/24/1996	05:00 PM	High Wind	54 kts.	0	0	300K	0
45 IAZ004>011 - 015>019 - 023>029 - 033>039 - 044>050 - 057>062 - 070>075 - 081>086 - 092>097	04/25/1996	09:30 AM	High Wind	59 kts.	0	0	750K	0
46 IAZ004>007 - 015>017 - 023>028 - 033>039 - 044>050 - 057>062 - 070>075 - 081>086 - 092>097	10/29/1994	11:00 AM	High Wind	57 kts.	0	0	500K	100K

47 IAZ004>007 - 015>017 - 023>028 - 033>039 - 044>050 - 057>062 - 070>075 - 081>086 - 092>097	04/06/1997	09:00 AM	High Wind	55 kts.	0	0	1.8M	0
48 IAZ049>050 - 061>062 - 074>075 - 084>086 - 095>097	04/30/1997	12:00 PM	High Wind	52 kts.	0	0	100K	0
49 IAZ004>007 - 015>017 - 023>028 - 033>039 - 044>050 - 057>062	05/05/1997	12:30 PM	High Wind	52 kts.	0	1	75K	0
50 Newton	08/14/1997	11:36 PM	Tstm Wind	52 kts.	0	0	10K	0
51 Colfax	08/15/1997	12:45 AM	Tstm Wind	65 kts.	0	0	40K	10K
52 Lynnville	08/16/1997	08:44 PM	Tstm Wind	65 kts.	0	0	15K	3K
53 IAZ004>007 - 015>017 - 023>028 - 033>039 - 044>050 - 057>062 - 070>075 - 081>086 - 092>097	04/12/1998	08:00 AM	High Wind	54 kts.	0	0	2.6M	0
54 Newburg	06/11/1998	01:00 PM	Tstm Wind	56 kts.	0	0	35K	2K
55 Colfax	06/11/1998	12:38 PM	Tstm Wind	65 kts.	0	0	15K	0
56 Colfax	06/11/1998	12:45 PM	Tstm Wind	52 kts.	0	0	5K	0
57 Baxter	06/11/1998	12:50 PM	Tstm Wind	50 kts.	0	0	3K	0
58 Colfax	06/18/1998	01:10 PM	Tstm Wind	61 kts.	0	0	40K	5K
59 Newton	06/18/1998	01:39 PM	Tstm Wind	52 kts.	0	0	5K	0
60 Monroe	06/18/1998	01:47 PM	Tstm Wind	50 kts.	0	0	3K	0
61 Darwin	06/18/1998	02:00 PM	Tstm Wind	65 kts.	0	0	75K	10K
62 Newton	06/18/1998	11:00 AM	Tstm Wind	50 kts.	0	0	3K	0
63 Monroe	06/27/1998	11:15 PM	Tstm Wind	52 kts.	0	0	10K	0
64 Colfax	06/29/1998	01:15 PM	Tstm Wind	52 kts.	0	0	3K	0
65 Prairie City	06/29/1998	01:16 PM	Tstm Wind	56 kts.	0	0	30K	2K
66 Newton	06/29/1998	01:22 PM	Tstm Wind	65 kts.	0	0	60K	5K
67 Monroe	06/29/1998	01:30 PM	Tstm Wind	52 kts.	0	0	15K	0
68 Lynnville	06/29/1998	12:42 PM	Tstm Wind	56 kts.	0	0	40K	0
69 Darwin	06/29/1998	12:46 PM	Tstm Wind	70 kts.	0	0	120K	25K
70 Colfax	07/06/1989	09:18 PM	Tstm Wind	52 kts.	0	0	3K	0
71 IAZ004>007 - 015>017 - 023>028 - 033>039 - 044>050 - 057>062 - 070>075 - 081>086 - 092>097	11/10/1998	02:00 AM	High Wind	61 kts.	1	0	17.3M	260K
72 IAZ028 - 038>039 - 049>050 - 061>062 - 072>075 - 081>086 - 092>097	03/08/2000	11:00 AM	High Wind	52 kts.	0	0	230K	0

73 Colfax	05/08/2000	04:00 AM	Tstm Wind	52 kts.	0	0	7K	0
74 Kellogg	05/08/2000	04:20 AM	Tstm Wind	56 kts.	0	0	5K	0
75 Kellogg	11/01/2000	01:25 PM	Tstm Wind	52 kts.	0	0	15K	0
76 IAZ004>007 - 015>017 - 023>028 - 033>039 - 044>050 - 057>062 - 070>075 - 081>086 - 092>097	04/07/2001	04:00 AM	High Wind	72 kts.	0	4	3.2M	0
77 Prairie City	06/12/2001	07:47 AM	Tstm Wind	52 kts.	0	0	2K	0
78 Colfax	07/22/2001	03:30 PM	Tstm Wind	57 kts.	0	0	25K	50K
79 Prairie City	09/07/2001	08:28 PM	Tstm Wind	52 kts.	0	0	5K	0
80 Prairie City	09/07/2001	08:40 PM	Tstm Wind	52 kts.	0	0	3K	0
81 Newton	09/07/2001	08:46 PM	Tstm Wind	61 kts.	0	0	15K	4K
82 IAZ004>007 - 015>017 - 023>028 - 033>039 - 044>050 - 057>062 - 070>075 - 081>086 - 092>097	03/09/2002	06:00AM	High Wind	54 kts.	0	0	2.6M	0
83 Newton Muni Arpt	03/09/2002	12:09 AM	Tstm Wind	87 kts.	0	0	1.5M	0
84 Colfax	03/09/2002	12:10 AM	Tstm Wind	52 kts.	0	0	5K	0
85 Newton Muni Arpt	03/09/2002	12:12 AM	Tstm Wind	55 kts.	0	0	5K	0
86 Monroe	06/02/2002	03:15 AM	Tstm Wind	52 kts.	0	0	10K	0
				TOTALS:	1	8	38.847M	530K