SE Minnesota
Disaster Health Coalition
Enhancing Regional Preparedness, Response and Recovery

Regional Risk Profile

2019

TABLE OF CONTENTS

Regional Profile 3
Southeast Minnesota Demographics 3
Population 3
Rural Urban Commuting Areas (RUCA) 3
Southeast Minnesota Climate 6
Regional Hazard & Threat Environment 7
Atmospheric Hazards 7
Hydrologic Hazards 17
Geologic Hazards 22
Seismic Hazards 24
Technological Hazards 26
Infectious Disease Hazards 39
Sociological (Human-Induced) Threats 49
Social Vulnerability 62
Overall 63
Socioeconomic 64
Minority Status/Language 64
Housing/Transportation 65
Household Composition/Disability 65
emPOWER 66
Health Ranking 73
Regional Risk 75
Impact Assessment 79
Supporting References 81
County Health Rankings 81
Community Health Needs Assessment (CHNA)/Health Improvement Plan 81
Threat & Hazard Identification & Risk Assessment (THIRA) 81
Mitigation Plan 81
Flood Insurance Studies 81
Miscellaneous 81

Regional Profile

Southeast Minnesota Demographics

Population

Southeastern MN Counties	US Census 1980	1990	2000	2010	Population Change 1980-90	%	1990-00	%	2000-10	%
Dodge	14,773	15,731	17,731	20,087	958	6.5%	2,000	12.7%	2,356	13.3%
Fillmore	21,930	20,777	21,122	20,866	(1,153)	-5.3%	345	1.7%	-256	-1.2%
Freeborn	36,329	33,060	32,584	31,255	(3,269)	-9.0%	-476	-1.4%	-1,329	-4.1%
Goodhue	38,749	40,690	44,127	46,183	1,941	5.0%	3,437	8.4%	2,056	4.7%
Houston	18,382	18,497	19,718	19,027	115	0.6%	1,221	6.6%	-691	-3.5%
Mower	40,390	37,385	38,603	39,163	(3,005)	-7.4%	1,218	3.3%	560	1.5%
Olmsted	**92,006**	**106,470**	**124,277**	**144,248**	**14,464**	**15.7%**	**17,807**	**16.7%**	**19,971**	**16.1%**
Rice	46,087	49,183	56,665	64,142	3,096	6.7%	7,482	15.2%	7,477	13.2%
Steele	30,328	30,729	33,680	36,576	401	1.3%	2,951	9.6%	2,896	8.6%
Wabasha	19,335	19,744	21,610	21,676	409	2.1%	1,866	9.5%	66	0.3%
Winona	46,256	47,828	49,985	51,461	1,572	3.4%	2,157	4.5%	1,476	3.0%
Total	**404,565**	**420,094**	**460,102**	**494,684**	**15,529**	**3.8%**	**40,008**	**9.5%**	**34,582**	**7.5%**

Table 1. Southeast Minnesota County Population and Change from 1980-2010

Rural Urban Commuting Areas (RUCA) [1]

RUCAs are conceptually similar to metropolitan and micropolitan statistical areas, but employ the smaller geography of census tracts, rather than counties. RUCAs are also related to urbanized areas and urban clusters (population hubs of various sizes), but more precisely describe the degree of the primary, or most common, commuting flows within and between them, if any. Finally, RUCA codes also divide urban clusters into larger and smaller towns. The RUCA scheme allows the ability to see the economic and social interdependence of communities that are geographic neighbors, as well as the opposite—small communities that are remote from any sizeable population centers. RUCAs are based on 2010 census data.

Figure 1. Rural Urban Community Areas by Type

[1] https://www.ers.usda.gov/data-products/rural-urban-commuting-area-codes/

Race/Ethnicity	Rural		Small town		Large town		Urban	
White (non-Hispanic)	397,100	91%	358,000	92%	534,400	88%	3,132,300	79%
Black	4,300	1%	5,000	1%	13,800	2%	328,200	8%
American Indian	17,400	4%	8,500	2%	19,800	3%	56,400	1%
Asian/Pacific Islander	4,800	1%	3,500	1%	10,600	2%	257,500	7%
Hispanic	12,500	3%	16,000	4%	32,500	5%	203,300	5%

Table 2. Southeast Minnesota RUCA by Race/Ethnicity

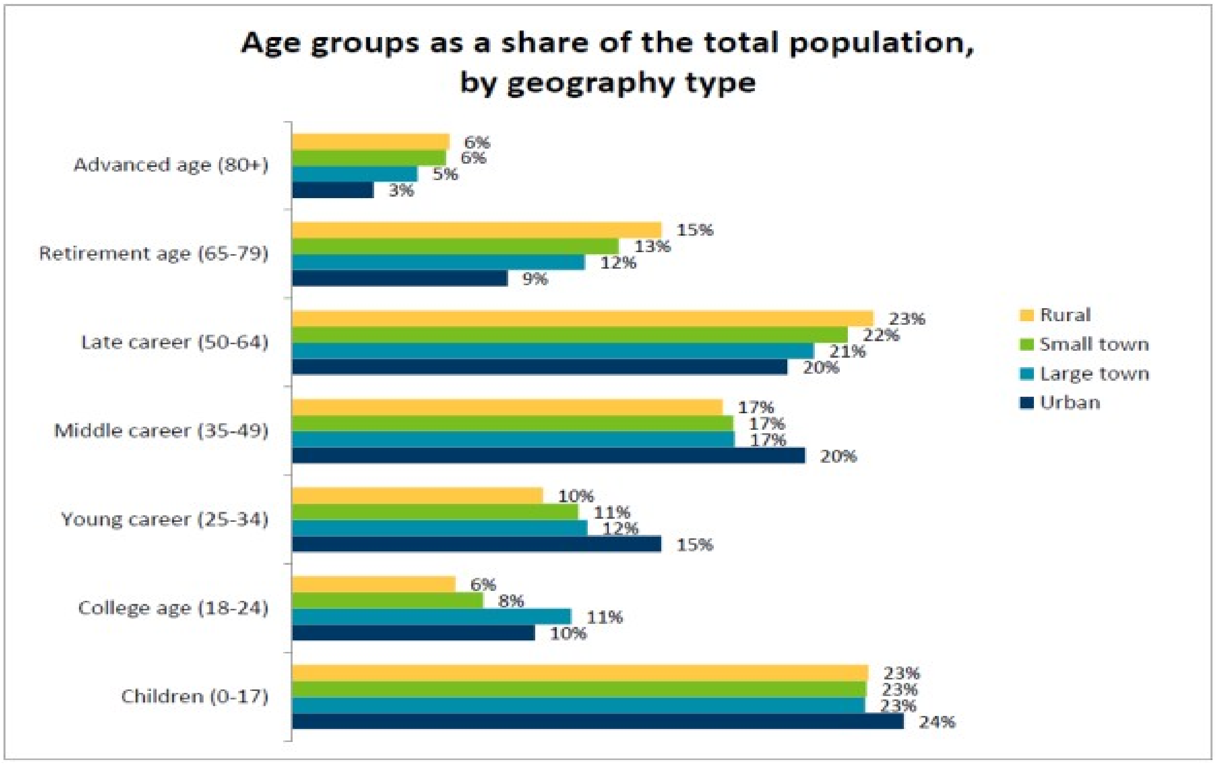


Figure 2. Southeast Minnesota RUCA by Age Group

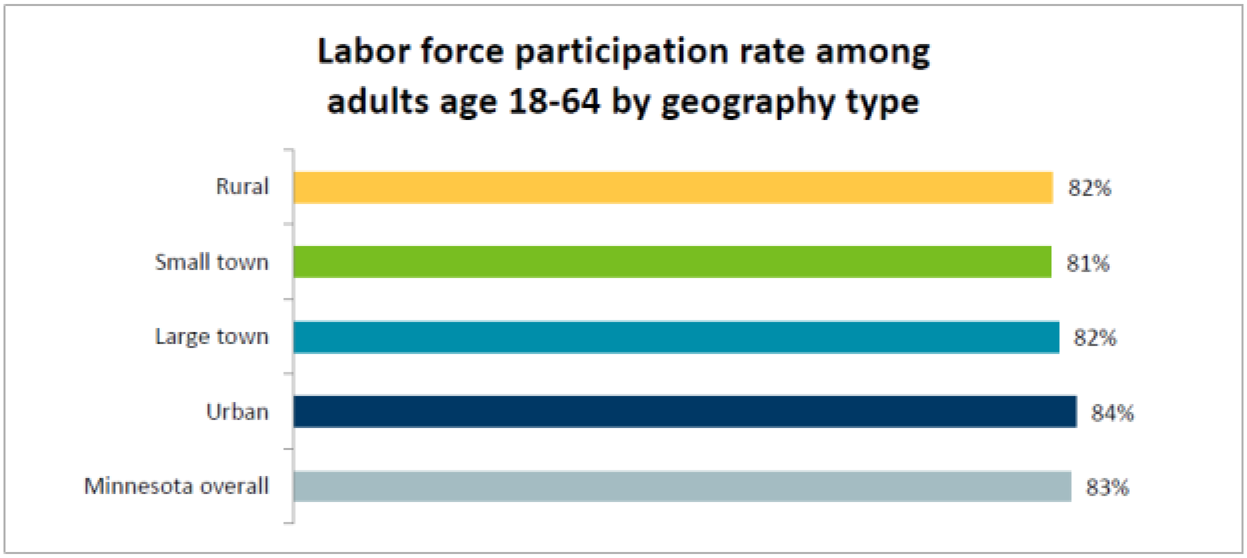


Figure 3. Southeast Minnesota RUCA by Labor Force Participation

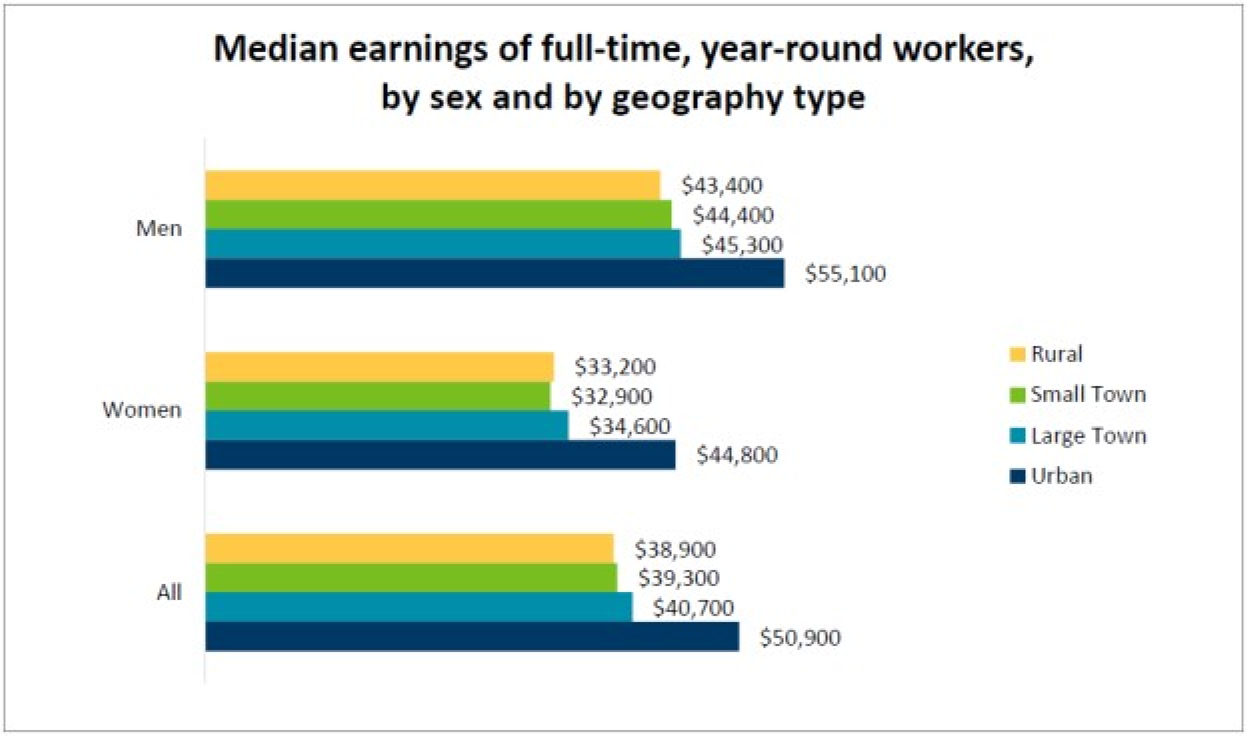


Figure 4. Southeast Minnesota RUCA by Median Earnings

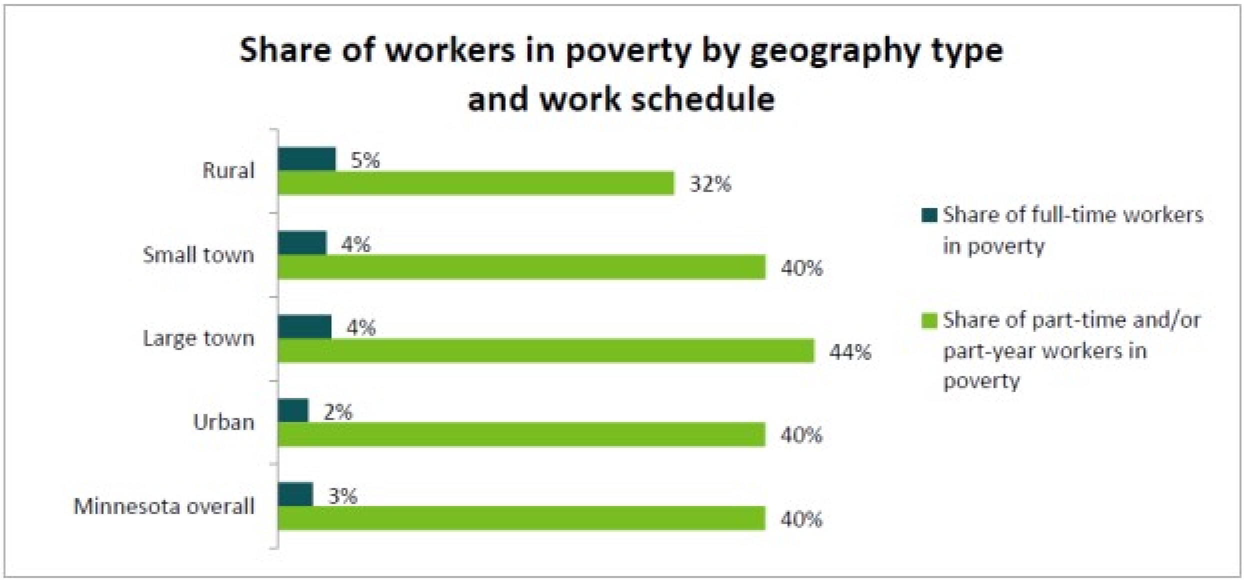


Figure 5. Southeast Minnesota RUCA Poverty

Southeast Minnesota Climate

The Southeast Minnesota area has a “continental” climate; that is, due to its distance from the oceans’ climate moderating effects, the area’s seasonal temperature variation is quite large. Winters are long and cold, summers are warm and humid. Normal 30-year (1981-2010) average temperatures range from 14.8 degrees in January to 70.5 degrees in July. Weatherpages.com ranked areas within the region as the third highest in weather variability. Severe thunderstorms, potential tornadoes, damaging hail, winter storms, and extreme cold and heat are routine in this part of the country.

In 2015, the Minnesota Department of Health published *Minnesota Climate and Health Profile Report 2015: An Assessment of Climate Change Impacts on the Health & Well-Being of Minnesotans*. This report notes changes are happening in Minnesota’s climate that are resulting in serious health and wellbeing consequences. Air pollution, extreme heat, flooding, drought, and ecosystem threats were considered to be the most relevant hazards to Minnesotans, resulting in such direct health impacts as cardiovascular and pulmonary disease, asthma, allergies, waterborne disease, and vector-borne disease. Infrastructure failures, strain on essential services, and fiscal strains were also identified as likely results.

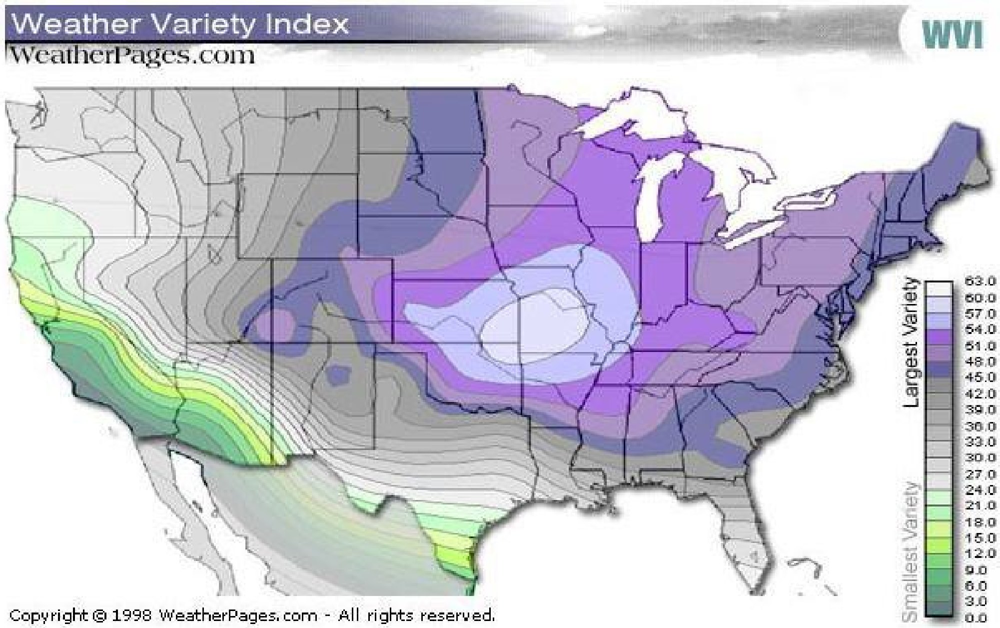


Figure 6. Weather Variability Index

Regional Hazard & Threat Environment

Atmospheric Hazards

Thunderstorms & Lightning

The likelihood of a severe thunderstorm occurring depends upon certain atmospheric and climatic conditions. Duration and frequency can be used as indicators of potential severity. The figures below depict the duration and frequency of thunderstorms for the United States. Thunderstorm duration is similar to other areas of Minnesota and towards the middle of duration for thunderstorms across the U.S. Southeast Minnesota thunderstorm frequency is relatively higher than most other areas of Minnesota, but lower than most areas of Southeastern United States.

The period of thunderstorm activity is not well-defined in the Midwest. Significant activity occurs during different months, but mostly from spring until early winter. People and property across Southeastern Minnesota are at risk to damage, injury, and loss of life from thunderstorms. Cascading hazards could include: infrastructure/wildfires, power outages, road access blockage, flooding.

Lightning is the most dangerous and frequently encountered weather hazard that most people in the United States experience annually. Lightning is the second most frequent weather-related killer in the U.S., behind floods and flash floods, with nearly 100 deaths and 500 injuries annually.

From 1/1/1990 to 9/30/2010, there were 183 lightning strikes in Minnesota with 10 fatalities and 70 injuries due to lightning strikes, according to NOAA. Lightning caused over $12.87 million in property damages and $65,000 in crop damages.

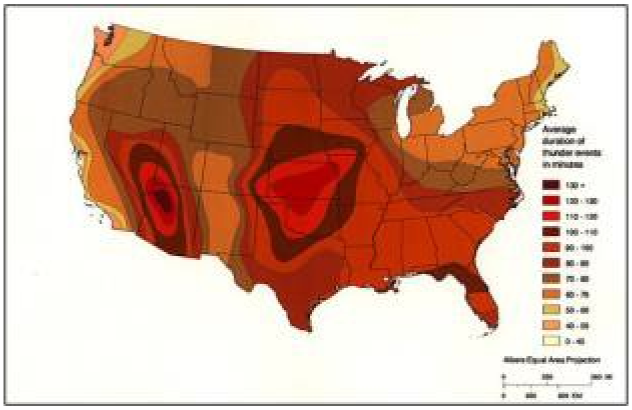


Figure 7. Thunderstorm Duration

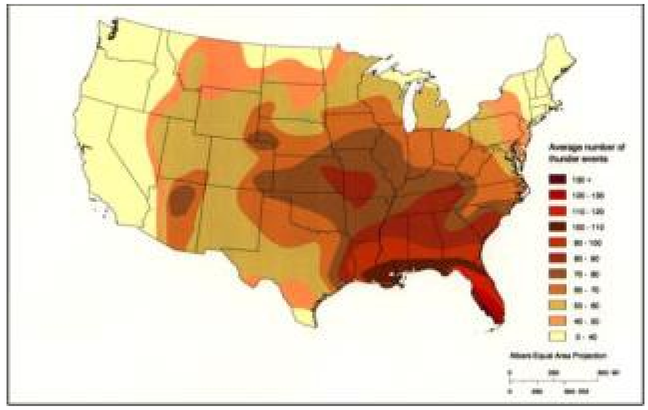


Figure 8. Thunderstorm Frequency

During a measured period of years in Minnesota (1959-1992), 31% of lightning deaths occurred in open fields, baseball parks and open spaces; 25% occurred under trees; 10% occurred during boating, fishing or other water related activities; 12% occurred near tractors and heavy road equipment; and 2% occurred on golf courses (4% occurred at telephones; and 17% occurred at various other and unknown locations). No deaths occurred in Southeast Minnesota.

During that same time period, 13% of lightning injuries occurred in open fields, baseball parks and open spaces; 18% occurred under trees; 6% occurred during boating, fishing or other water related activities; 5% occurred near tractors and heavy road equipment; and 11% occurred on golf courses (10% occurred at telephones; and 36% occurred at various other and unknown locations).

Lightning injuries in Minnesota have occurred during the same months, with the most injuries recorded May through August. Since the 2008 Plan, six additional persons were injured by lightning.

Damage from lighting strikes will likely increase with longer duration and more frequent thunderstorm occurrence. Therefore, the geographic areas with a high density of lightning strikes, measured in units of flashes per square kilometer, are at a higher risk for damage or potential loss of life during a thunderstorm.

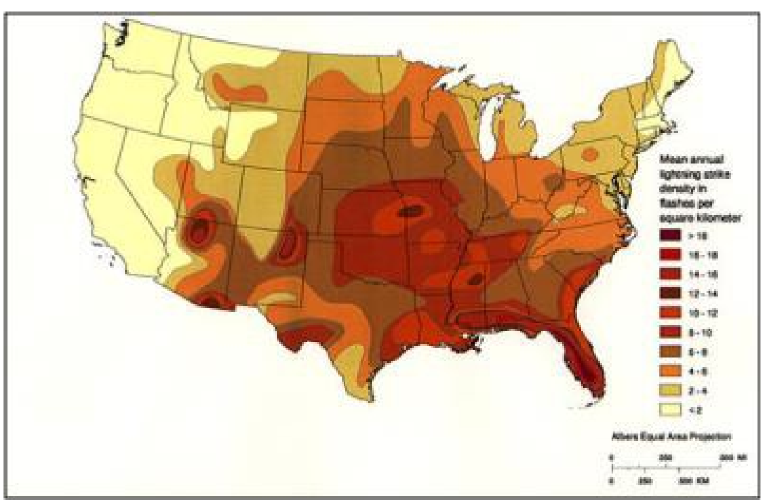


Figure 9. Mean annual density of lightning strikes

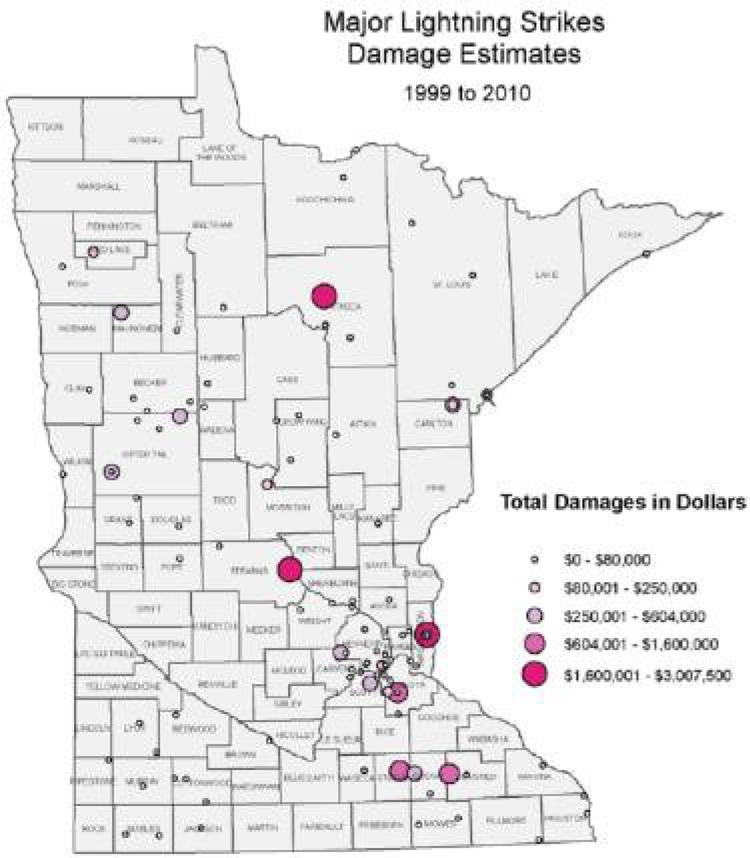


Figure 10. Major Lightning Strikes Damage Estimates[2]

The probability of lightning occurring is high in the region. However, the site-specific incidence of lightning is considered low because of the localized nature of the hazard. The annual incidence of lightning across the region is presumed to remain stable, although year-to-year fluctuations are expected.

Tornadoes

Similar to thunderstorms, the likelihood of a tornadic activity depends upon certain atmospheric and climatic conditions. Tornado intensity is rated by damage indicators, expressed in the Enhanced Fujita (EF) Scale.

[2] Source: MN All-Hazards Mitigation Plan

OPERATIONAL EF SCALE	
EF Number	3 Second Gust (mph)
0	65-85
1	86-110
2	111-135
3	136-165
4	166-200
5	Over 200

Table 3. Enhanced F Scale for Tornado Damage[3]

Figure x shows the historical occurrences of tornadoes across the U.S. for EF-3 and above. EF-3 (136-165 mph) is the level where typical damage is severe, which can result in Entire stories of well-constructed houses destroyed; severe damage to large buildings such as shopping malls; trains overturned; trees debarked; heavy cars lifted off the ground and thrown; structures with weak foundations blown away some distance.[4] The "tornado month" in the State is June, with July next, and then May. During these three months, over 75 percent of all tornadoes occur. While tornadoes occur periodically in Southeastern Minnesota, the number of deaths that result has historically been minimal.

According to The Disaster Center (data period 1950-1995), compared with other States, Minnesota ranks 17th for frequency of Tornadoes, 18th for number of deaths, 19th for injuries and 6th for cost of damages. When compared to other States by the frequency per square mile, Minnesota ranks 29th for the frequency of tornadoes, 22nd for fatalities, 26th for injuries per area and 11th for costs per area. *Note: The Center calculates risk by dividing the square mileage of each state against the frequency of death, injury, number of tornadoes, and cost of damages for each state. The Center then ranks each State by these individual categories and then adds the total of each State's individual rankings and divided by the number of factors (four).*[5]

Figure 11. Tornado Activity in the U.S. (1950-1998)

Figure 12. Average # Deaths from Tornadoes (1953-1993)

---

[3] http://www.spc.noaa.gov/efscale/ef-scale.html
[4] Wunderground
[5] http://www.disastercenter.com/minn/tornado.html

Figure 13. Southeast Minnesota Tornadoes (EF3+), 1950-2015

Major Tornado Incidents

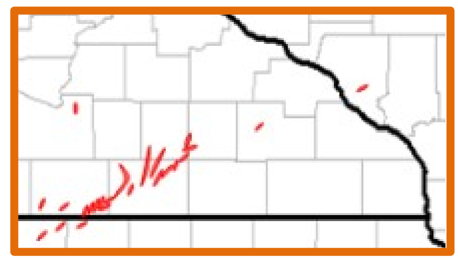


Figure 14. June 17, 2010 Tornado Touchdowns Southern Minnesota

- June 17, 2010
  - Near Albert Lea in Freeborn County, EF-4
    - Three fatalities
  - Rochester, EF-1
  - [June 17-June 26 (Houston County)]
- April 30, 1967 (Black Sunday)
  - 6:05 PM - Freeborn, F3; Steele County, F1
  - 6:15 PM – Freeborn, F4
  - 6:20 PM – Freeborn, F2 (SE of Manly)
  - 6:23 PM – Freeborn/Steele, F4 (Albert Lea, Near Owatonna)
  - 6:28 PM – Freeborn, F3 (Near London)
  - 7:15 PM – Mower, F2 (SE of Austin)
  - 8:10 PM – Olmsted, F2 (NE of Eyota)
  - 13 Fatalities; Freeborn County suffered the most damage.

Windstorms

Winds in excess of 58 miles per hour, excluding tornadoes, are windstorms. Windstorms are among the nation's most severe natural hazards in terms of both lives lost and property damaged. The National Weather Service notes the following effects of various wind speeds.

Note: Straight Line Winds and Windstorms are used interchangeably in the Plan. This hazard is treated as a different category than Tornadoes (may also include high winds).

Figure 15. Wind Zones in the United States

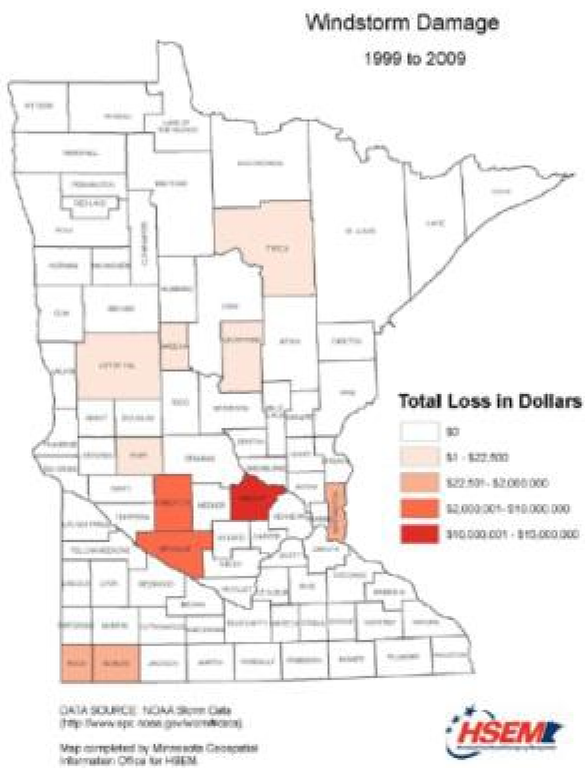


Figure 16. Windstorm Damage Costs, 1999-2009 (Source: MN All-Hazards Mitigation Plan)

Windstorms can occur throughout the State of Minnesota, at any time of year. Most occur during the months of April through September. This recurrence is expected to remain relatively stable, although there will be year-to-year fluctuations. Long-term changes in weather patterns may also influence the number of windstorms that occur. The qualitative rating for windstorms is High.

Major Windstorm Incidents

- April 2001, 50-75 mph winds
  - Freeborn, Goodhue, Rice, Steele
  - $8 million property damage
- April 1991, Freeborn County
  - One fatality
- April 1984, Southern MN
  - Extensive power outages, especially rural areas
- March-April 1982
  - Houston, Freeborn
  - Two deaths, several injuries, some property damage
- June 1980
  - SE Minnesota
  - $1.4 million power damage
  - Power interruption

Hail

Severe hailstorms cause considerable damage to buildings, automobiles, and airplanes. Significant property damage does not occur until hailstone size reaches about 1.5 inches in diameter. This size will cause damage to cars, windows, and siding. When hailstones get larger and approach three inches in diameter, roofs start to experience major damage. Damage depends not only on the size of the hail but upon depends on the hardness of the stones, the angle of the impact and wind speed while the hail is in progress.

The annual probability of severe hail occurring somewhere in the state is quite high. However, the site-specific incidence of hail is considered low because of the localized nature of the hazard.

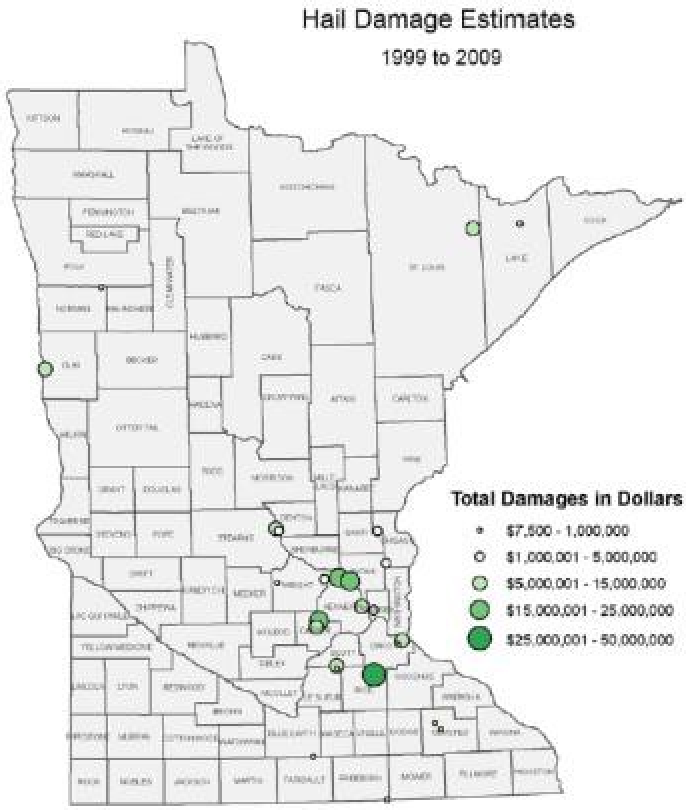


Figure 17. Minnesota Hail Damage Estimates, 1999-2009 (Source: MN All-Hazards Mitigation Plan)

Extreme Winter Weather

Winter Storms

Southeastern Minnesota is at risk for severe winter storms. The occurrence of larger snow storms, ice storms, and severe blizzards has a substantial impact on communities, utilities, transportation systems, agriculture, communications, and often results in loss of lifer due to accidents or hypothermia. Snow depth, depicted in Figure x, provides an indication of the likelihood of severe winter storms.

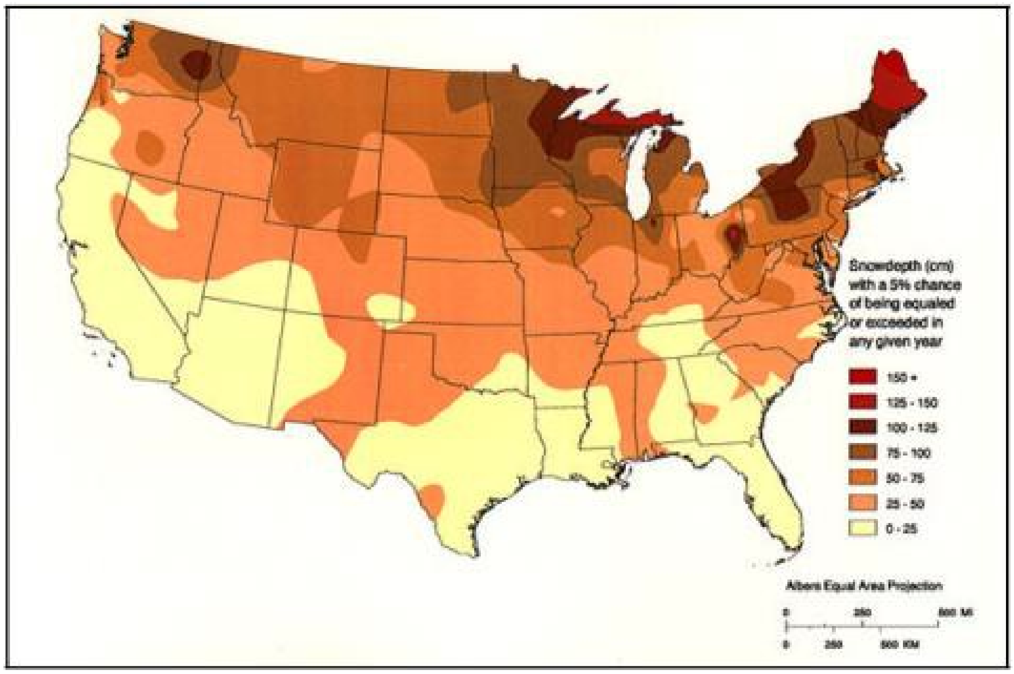


Figure 18. Snow Depth with 5% Chance of Being Equaled/Exceeded in any Given Year

One type of winter storm that can be particularly damaging is the ice storm - a storm in which freezing rain glazes roads and other exposed outdoor surfaces. Urban areas tend to suffer more economic and physical damage than rural areas because of the concentration of utilities and transportation systems (aircraft, trains, vehicles) — all of which may be affected to a great degree by the ice storm. Trees and power lines, in particular, can be heavily damaged. A half inch of ice on a tree branch or on power lines can add hundreds of pounds of weight. In the more severe ice storms, broadcast towers and similar structures hundreds of feet high can be crumpled by the weight of ice.[6]

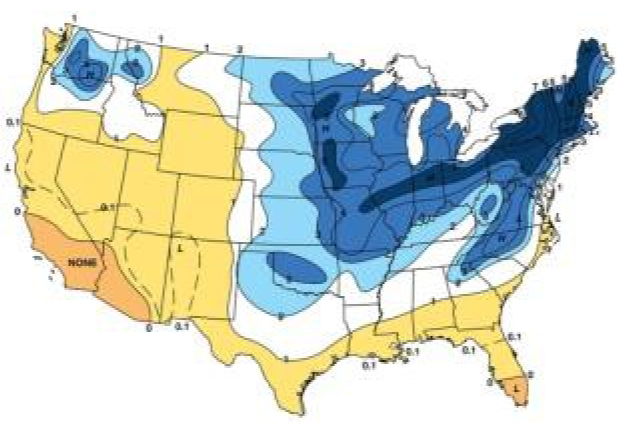


Figure 19. Average number of days with freezing rain

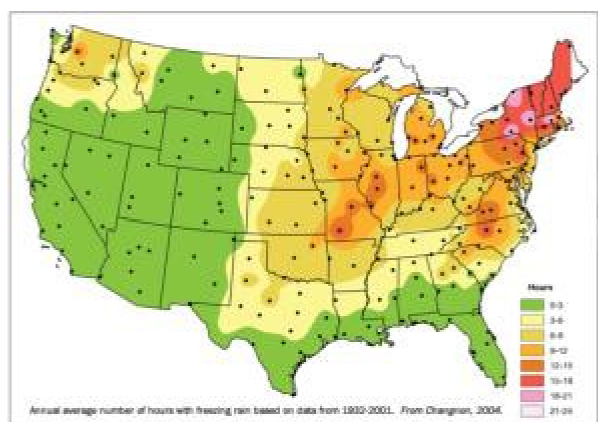


Figure 20. Average Number of Hours with Freezing Rain (1958-2000)

[6] Midwestern Regional Climate Center

Winter Storm Disaster Declarations

- April 9-11, 2003, Southwest Minnesota (Ice Storm)
- November 27-29, 2005
- March 1-May 30, 1999, Northwester Minnesota (Ice Storm)
- January 3-February 3, 1997
- November 14-30, 1996
- October 31-November 29, 1991

Extreme Cold

Arctic cold outbreaks impact Southeast Minnesota when a persistent period of low winter temperatures combines with moderate to strong northwest winds to produce dangerous wind chills. Snow depth can modify these cold temperatures, leading to sub-zero readings. The coldest temperatures usually occur in January and February, with average lows in the single digits and record lows colder than -30°F most days. Sub-zero temperatures and wind chills routinely occur each winter in Southeast Minnesota. Low temperatures, when combined with strong winds, create wind chills that put people and animals at risk. Frostbite can strike in a matter of minutes and death can occur with prolonged exposure to the elements. Property damage due to cold does not happen often, but periods of extreme cold can result in burst water pipes and septic system failures.

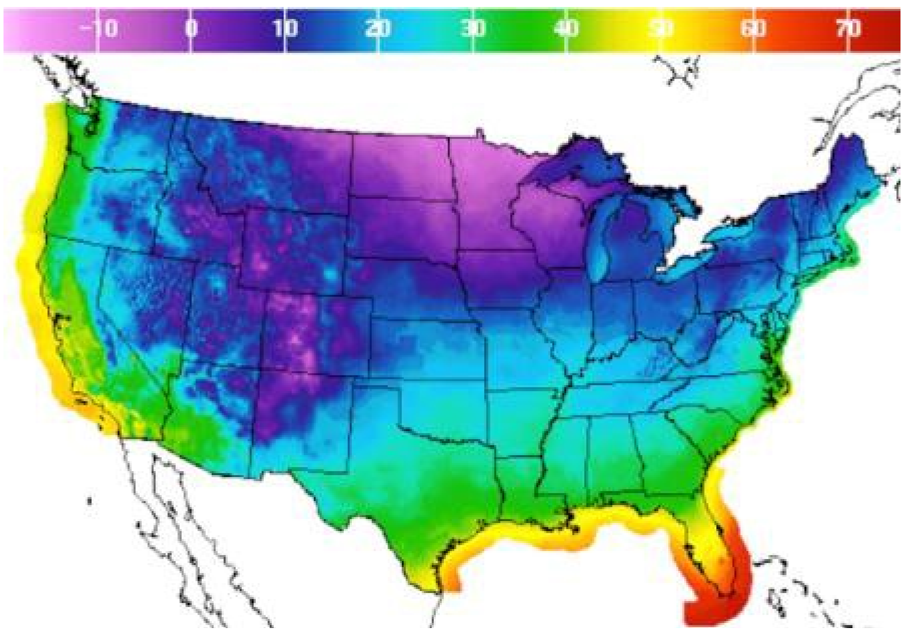


Figure 21. Typical Winter Temperatures, United States (Source: NOAA)

Extreme Summer Weather

Southeast Minnesota's continental climate makes summer conditions ripe for hot, humid weather. All communities in Southeast Minnesota are susceptible to this hazardous weather. July and August tend to be the hottest months. Nationwide, heat events — prolonged periods of hot weather — cause more deaths than any other natural disaster. Extreme heat events are likely to continue on a regular basis in the future, particularly as climate change leads to more extreme weather events.

Dehydration, heat exhaustion, and heat stroke can occur when the body becomes too hot and can't cool down. Heat can also exacerbate chronic conditions such as asthma, heart disease, and diabetes. The Minnesota Department of Health (MDH) notes that some of these vulnerable populations are based on the amount of time spent in the heat, while others are affected by the ability of people to regulate their body temperature.

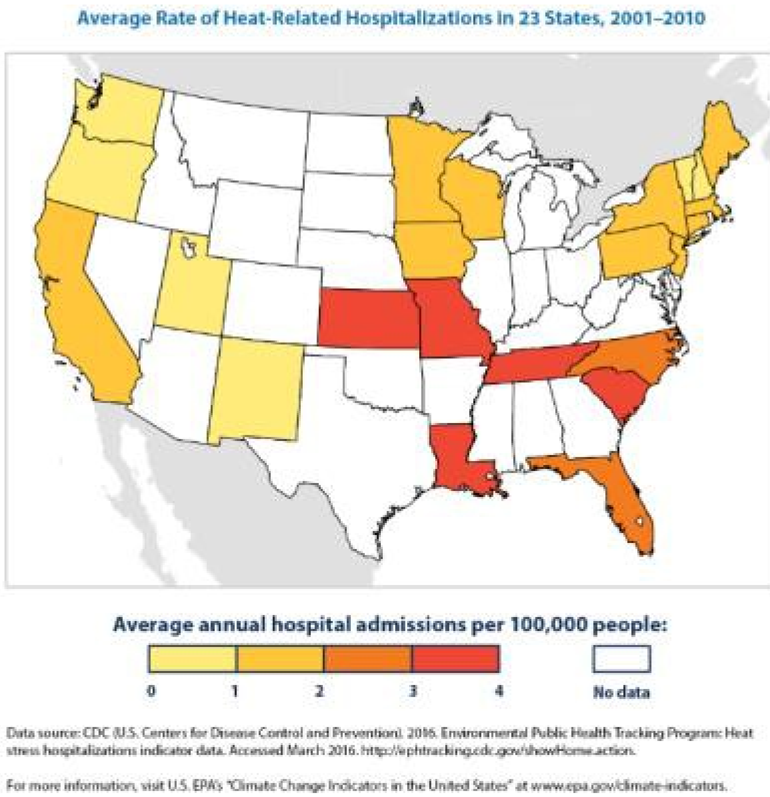


Figure 22. Annual Hospital Admissions per 100,000 People

While heat does not tend to impact property, widespread power outages can result from an increase in demand for electricity to power air conditioning. Water usage may also increase as people search for ways to cool off.

The apparent temperature, or heat index, is a quantitative measure of extreme summer weather that can be used to characterize the probability of heat hazards.

Hydrologic Hazards

Flood

Flooding is a widespread management challenge in the United States and accounts for three fourths of Presidential Disaster Declarations. Historical floods for Southeast Minnesota are available through the National Weather Service at: https://www.weather.gov/arx/historicalfloods.

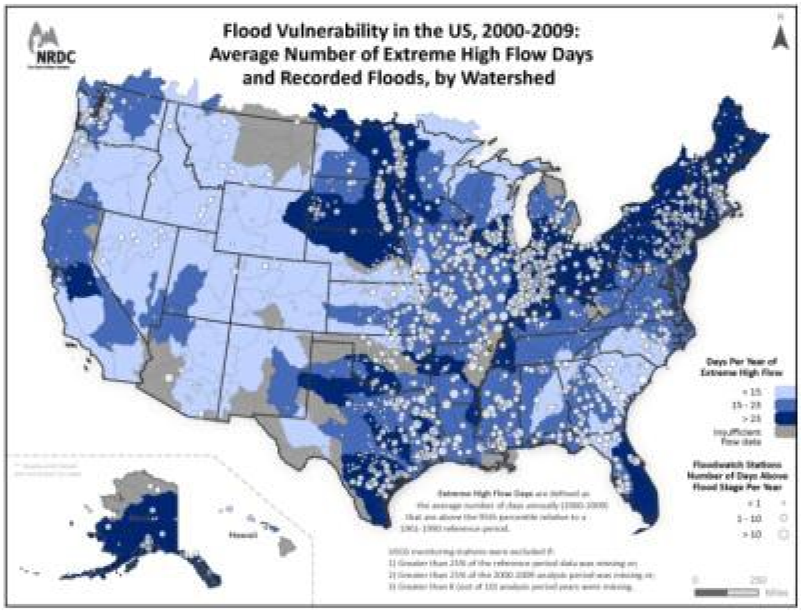


Figure 23. Flood Vulnerability in the US, 2000-2009

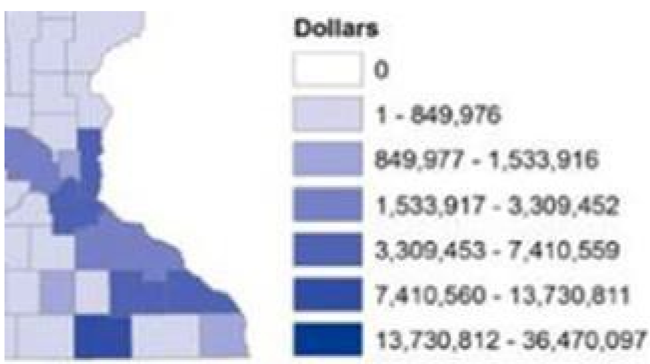


Figure 24. National Flood Insurance Program Loss Payments Southeast Minnesota 1973-20013 (Source: FEMA/NFIP, 2014)

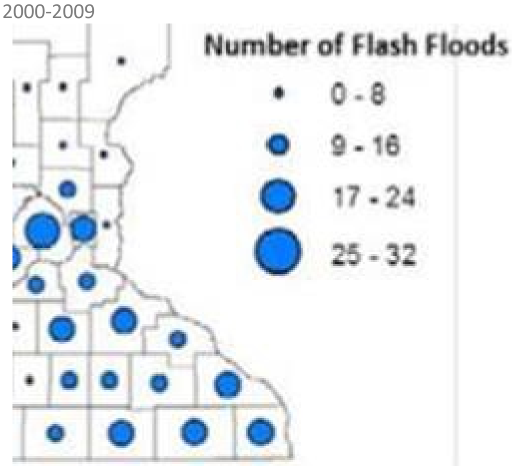


Figure 25. Number of Flash Floods in Southeast Minnesota 1996-2013. (Source: NOAA/NCDC)

Spring flooding is often the result of late summer and fall precipitation, soil saturation levels, stream flow levels, temperatures, frost depth, snowpack, and rate of snowmelt. NOAA provides flood prediction analysis. Many Coalition partners work directly with the National Weather Service, La Crosse Station, for specific flood risk outlooks.

Flood probability and magnitude are highly location-specific, so it is not possible to characterize these generally across the region in a meaningful way. Across the region, floods are rated "High" for probability in the qualitative ranking.

Major Flood Incidents

- September 22-October 14, 2010 (SEMN)
    - Presidential Declaration, DR-1941-MN
    - Flooding forced evacuations in communities including New Richland, Owatonna, Pine Island, Zumbro Falls, Hammond, and Waseca
    - Extensive damage occurred in the Zumbro Falls and Hammond areas of Wabasha County.
- June 17-26, 2010
    - Presidential Declaration, DR-1921-MN
        - Freeborn, Houston, Olmsted, and Steele Counties
    - Tornadoes and Flooding
- July 16-17, 2008
    - Winona and Houston County, many streets were flooded in La Crescent and the intersection of Main and Elm Street was under two feet of water. Mudslides were reported along I-94 near Dresbach in far southeastern Winona County.
- June 7-12, 2008
    - Presidential Disaster Declaration, DR-1772-MN
        - Winona, Fillmore, Houston, Olmsted, Dodge, Steele and Wabasha
    - June 7-9, Hardest hit areas in Minnesota were Fillmore and Houston Counties.
    - June 11-12, rains were the heaviest over south eastern Minnesota in the Austin area

- September 20-21, 2007
    - 7 counties impacted; 7 fatalities; $179 million estimated damages
    - The towns of Stockton, Houston, Elba, Minnesota City, and portions of Winona, on the Mississippi River, were evacuated.
- October 7, 2004
    - Presidential Disaster Declaration, DR-1569-MN
    - Dodge, Freeborn, Mower, and Steele Counties
- May-July 2000
    - Presidential Disaster Declaration, DR-1333-MN
    - Dodge, Freeborn, Fillmore, Houston, Mower, Winona
- March 21-24, 1997 (Fillmore County)
- June 30 – September 12, 1978
    - 13 deaths
    - Widespread over east central and southeast Minnesota. Several roads were blocked or washed out; numerous bridges were impassable. Widespread damage to crops, gardens, and homes. The citizens of Elba and 600 campers were forced to evacuate. Heavy property damage with many stalled and stranded cars. There were many power outages and heavy tree damage.

Drought

Drought is an extended period of deficient precipitation, usually lasting a season or more, resulting in a water shortage. It is a normal feature of all climate zones and happens cumulatively rather than abruptly. Since it is a temporary variance from normal precipitation levels, what constitutes a drought varies from location to location.

Drought can occur throughout the area and is a normal part of all climatic regions. The United States [Drought Monitor] has established a drought severity classification system and regularly posts maps on their website showing areas of concern. Conditions of severe drought with an annual Palmer Drought Index of -3 or lower are expected on the average about once in 25 years over eastern Minnesota.

When rainfall is below normal for a significant period of time, stream and river flow declines, water levels in lakes and reservoirs fall, and water tables drop. Area crops may fail, impacting the price and availability of fresh food. The groundwater system is less likely to be affected by short term droughts unlike surface water systems. Droughts can cause a shortage of water for human and industrial consumption, hydroelectric power, recreation and navigation, an increase in unemployment and decrease in land values. Water quality may decline and the number and severity of wildfires may increase.

Drought differs from other national hazards in three significant ways.

1. Onset and end are difficult to determine since the effects accumulate slowly and may linger
2. Absence of a precise and universally accepted definition
3. Impacts are less obvious and are spread over a larger geographic area

These characteristics have hindered the development of accurate, reliable, and timely estimates of drought severity and effects. There is no commonly accepted approach for assessing risks associated with droughts. There is no commonly accepted non-exceedance probability for defining the risk from hydrologic droughts that is analogous to the 100-year or 1-percent-annual-chance flood. Figure x shows July to January mean monthly flow with non-exceedance probability of 0.05, which means mean monthly streamflow will be less than this value once in 20 years on average. Besides streamflow variation, the map also illustrates the influence of factors such as precipitation, elevation and evapotranspiration.

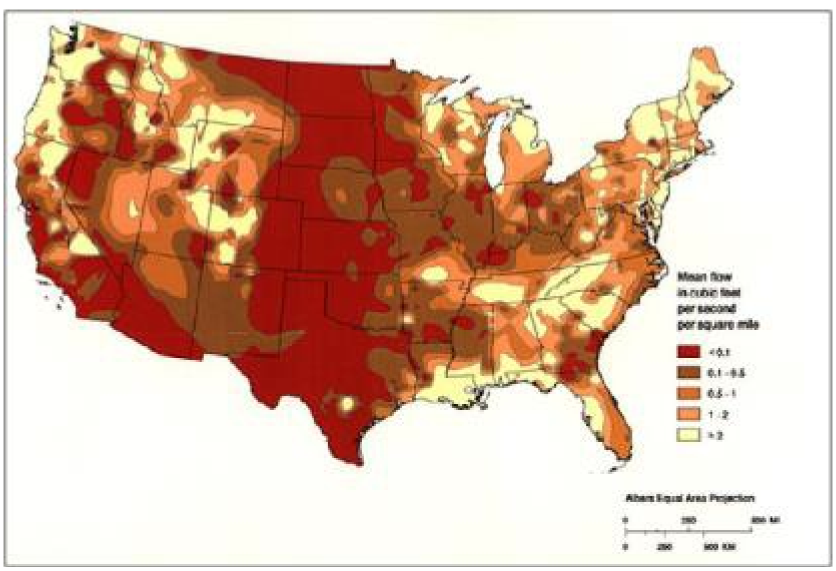


Figure 26. Spatial Variation in the July-to-January Mean Flow with a 5% chance of not being exceeded in any given year

Significant Droughts

- June 17, 1976 (Emergency Declaration)
- September 26, 2012 (USDA Disaster Declaration; No SEMN Counties)

Wildfires

If not promptly controlled, wildfires may grow into an emergency or disaster. Even small fires can threaten lives, resources, and destroy improved properties. It is also important to note that in addition to affecting people, wildfires may severely affect livestock and pets. Such events may require the emergency watering/feeding, shelter, evacuation, and even burying of animals.

Wildfires can occur at any time of day and during any month of the year, however, the greatest wildland fire activity usually occurs from snow melt in March or April, through green up in late May or early June. Careless fire use, arson, equipment use and weather conditions such as wind, low humidity, and lack of precipitation are the chief factors determining the number of fires and acreage burned. Generally, fires are more likely when vegetation is dormant or after extended drought periods. Wildland fires are capable of causing significant injury, death, and damage to property.

It must be noted that in the residential setting the leading causes of wildland fires are debris burning, arson, and equipment use. However, as the urban-rural interface in Minnesota increases, the fire ignition sources become less clear. Urban fires can result from wildland fires in the wildland urban interface where wildland fires usually result from human rather than natural causes. Only two percent of the Minnesota wildfires are a result of lightning compared to 85 percent that result from human causes. Nationally, lightning causes 16% of the wildland fires.

County	Avg # Fire/ Year	Avg Acres/ Fire	Avg Acres/ Year	Avg Cost/ Fire	Total Cost
Dodge	0	0	0	0	0
Fillmore	5	5	21	$1,429	$64,287
Freeborn	0	1	0	$500	$500
Goodhue	1	8	7	$372	$3,350
Houston	10	4	41	$1,346	$129,257
Mower	0	9	4	$1,283	$5,130
Olmsted	0	3	1	$343	$1,370
Rice	1	50	25	$100	$500
Steele	0	0	0	0	0
Wabasha	3	6	16	$667	$16685
Winona	11	3	29	$657	$68,943

Table 4. Southeast Minnesota Wildfire Statistics 2000-2010 (Source: MN All Hazard Mitigation Plan)

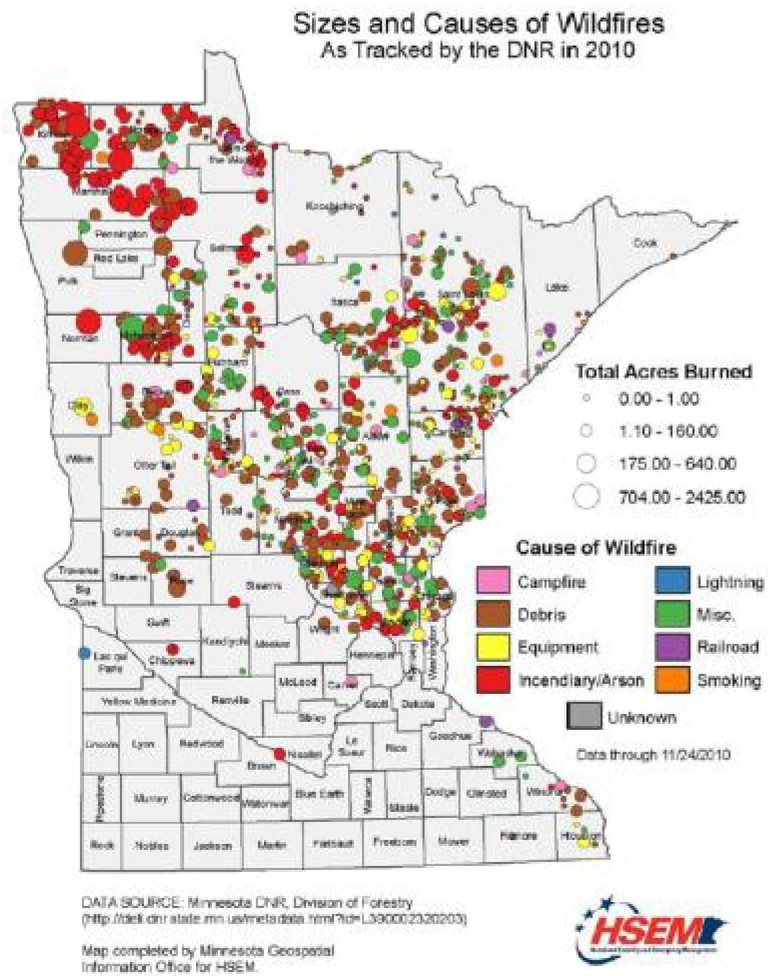


Figure 27. Sizes and Causes of Wildfires in 2010, Minnesota (Source: MN All-Hazards Mitigation Plan)

Like most weather-related phenomena, wildfire probability cannot be accurately predicted in the short-term. It is reasonable to assume that wildfire incidence will remain stable over the long-term, bearing in mind that weather patterns (in particular periods of drought and very low humidity); fuel load, insect infestations and human behavior can all greatly influence near-term probabilities. The qualitative probability is rated Medium for the region compared with other areas of the state.

Geologic Hazards[7]

Current risk assessment methodologies for geologic hazards do not quantify or qualify the frequency of occurrence.

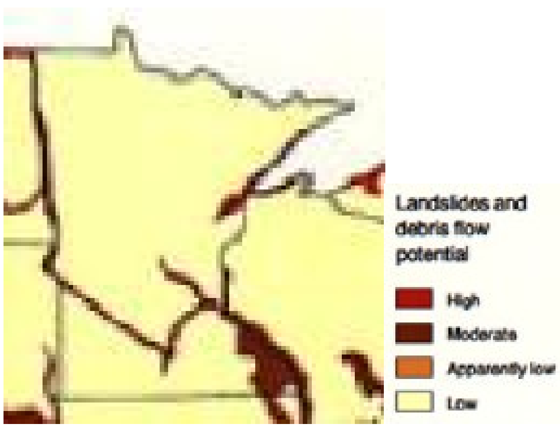
[7] FEMA MHIRA

Landslides

Landslides are the movement of rock, dirt, and debris down a slope. Major natural hazards such as extreme storm events, flooding, seismic events, and wildfire may trigger landslides; debris flows resulting from these events may also causes them. Landslides and mudslides are capable of wiping out buildings, infrastructure, and life.

Landslides occurred throughout Southeast Minnesota during the record breaking storm in August, 2007. These landslides occurred along waterways, roads, and in developed areas. The blockage of stream flow could have significant impact on flood potential in topographic settings that constrict the flow of floodwaters during high flow events. Landslides also can affect access and traffic safety during these same storm events in addition to costs of repair of infrastructure. Landslides in developed areas can cause significant damage to buildings and property.

Steep slopes are the most important factor that makes a landscape susceptible to landslides; slopes greater than 18% are considered to be "steep". Other key factors include deforestation, the presence of roads, the strength of bedrock and soils, and the location of [faults](). Figure x shows areas in Minnesota which are susceptible to landslides.



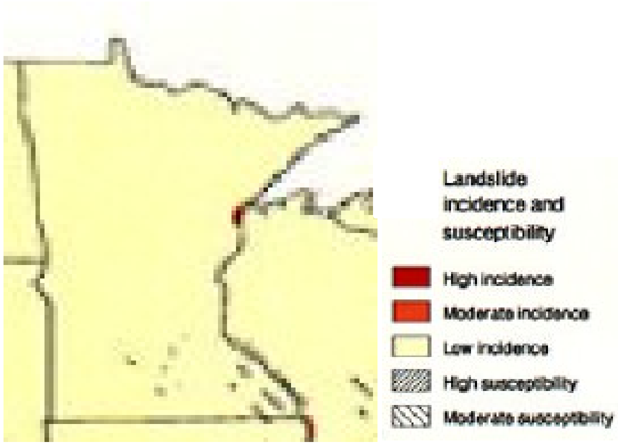


Figure 28. Landslide Potential in Minnesota

Figure 29. Landslide Incidence and Susceptibility in Minnesota

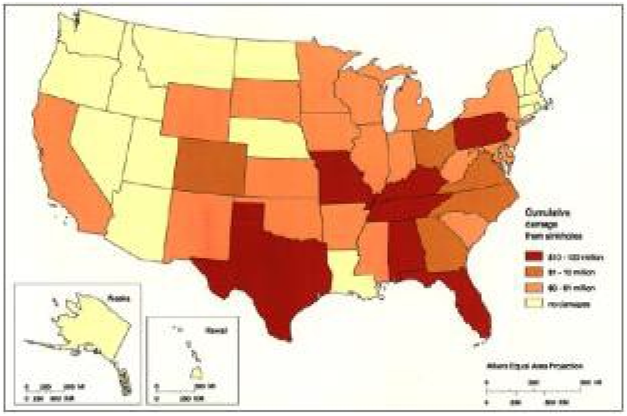
Note: Ratings are assigned on the basis of the number of known landslides and the potential for future landslides. Frequency of occurrence is not associated with the rating given Figures (above).

Land Subsidence

Land subsidence occurs slowly and continuously over time or on abrupt occasions as in the case of sudden formation of sinkholes. In general, land subsidence in a karst setting is an ongoing, naturally occurring process. Human activities resulting in the collapse of materials into sinkholes, however, may accelerate this process.

According to the Minnesota Geological Survey's ***Geologic Atlas – Olmsted County, Minnesota***, southeast Minnesota's mildly acid groundwater is slowly dissolving the carbonate bedrock that underlies areas throughout Southeast Minnesota, producing distinctive groundwater conditions and landforms called "karst". Common features of karst geology include cracks, crevices, caves, sinkholes, and springs that serve as direct conduits for surface pollutants to the groundwater below. These geologically sensitive areas are oftentimes overlain by only thin layers of soil.

At the surface, the collapse of unconsolidated rock material into sinkholes can cause damage to buildings, roads, sewer lines, wells, and other structures including water retention facilities. Such facilities may hold contaminants that if released through a chronic or catastrophic failure would cause pollution of the groundwater system. The Geologic Atlas reported that the rate of sinkhole formation appeared to have increased in the last few decades.



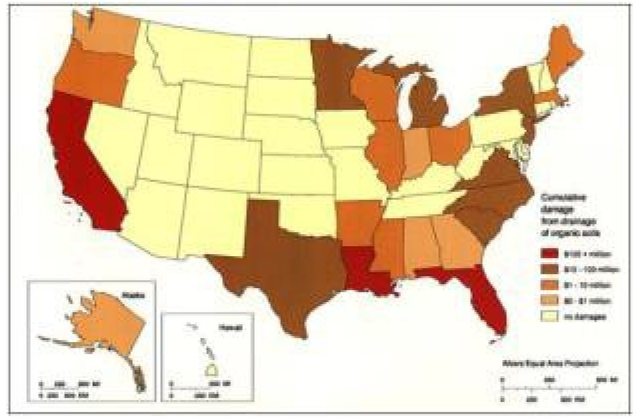


Figure 30. Cumulative Damage Caused by Sinkholes .....

Figure 31. Cumulative Subsidence Damage from Drainage of Organic Soils

Note: The maps in Figures (above) do not imply probability or frequency of occurrence.

Seismic Hazards

In Minnesota, the only relevant seismic hazards are earthquakes. Seismic hazards often trigger other devastating events: landslides, fires, damaged dams and levees leading to flood, and damaged infrastructure leading to building collapse, power failure, etc

The zone of greatest seismic activity is along the Pacific Coast in Alaska and California. However, intermountain west, central and eastern regions have experienced significant earthquakes. Social, physical and economic impacts may be very long term.

The effect of an earthquake on the Earth’s surface is called the intensity, most commonly indicated by the Modified Mercalli Intensity Scale (MMI). The scale is composed of 12 increasing levels of intensity ranging from imperceptible to catastrophic.

Figure x shows a U.S. Geological Survey National Hazard Map indicating distribution of earthquake shaking levels that have a certain probability of occurring in the United States. The likelihood of earthquakes having a significant negative impact for Southeast Minnesota communities is low.

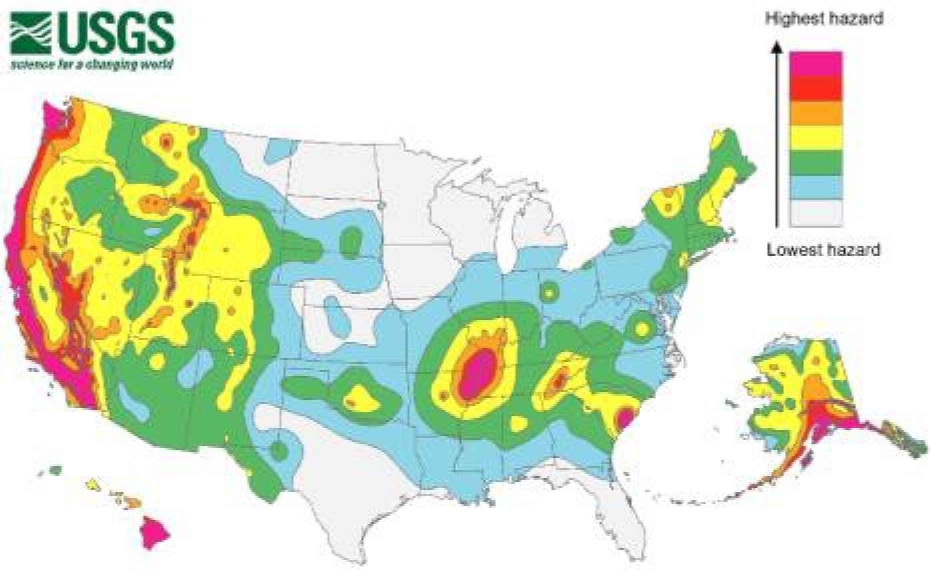


Figure 32. USGS National Hazard Map – Distribution of Earthquake Shaking Levels

The USGS also provide a map showing the chance of damage from an earthquake in the Central and Eastern United States during 2017. Percent chances are represented as follows: pale yellow, less than 1 percent; dark yellow, 1 to 2 percent; orange, 2 to 5 percent; red, 5 to 10 percent; dark red, 10 to 12 percent.

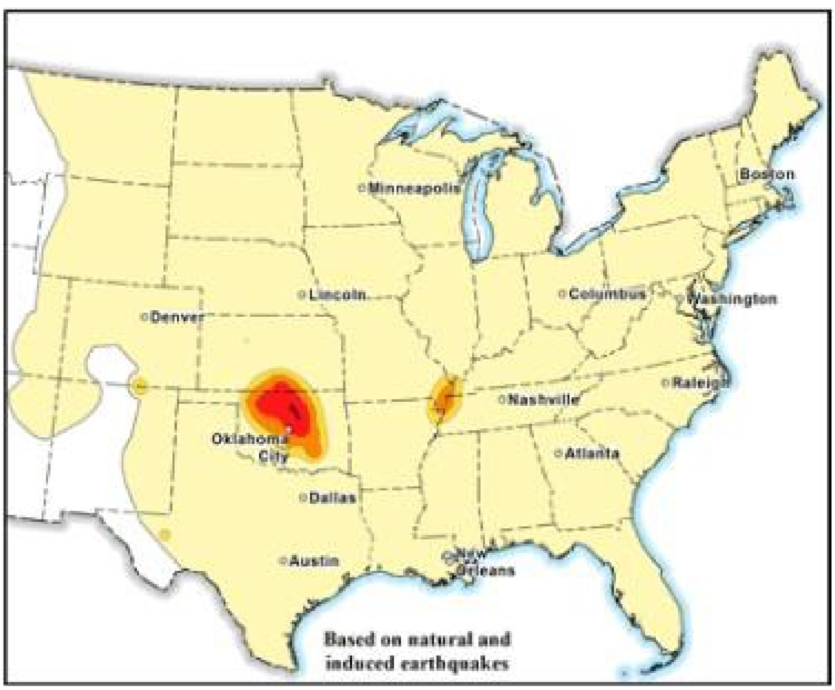


Figure 33. USGS 2017 One-Year Induced Seismicity Models

Figure 34. Recent Minnesota Earthquakes. (Source: http://earthquaketrack.com/p/united-states/minnesota/recent)

Risk assessment relies largely on earthquake history. The absence of major earthquakes, together with the infrequency of earthquakes in general, implies a low risk level for Minnesota overall and even less for Southeast Minnesota.

Technological Hazards

Power Failure

Southeast Minnesota shares the same risks to the economy, national security, and the health and safety of citizens due to loss of power. The electrical grid is one of the nation's most critical infrastructures; by its design, the grid is resilient with built-in redundancies that can adapt to rapidly changing demand, load, climate, and a host of other factors. The bulk power system is large, complex and robust system of networked generation facilities, transmission and distribution lines, transformer and substations, and control and communications technologies which together bring power to homes and businesses. The loss of large transformers is a particular concern; they are essentially custom orders taking six to 18 months to manufacture, costing between $5-10 million.[8]

While the majority of power failures from national grids last only a few hours, some blackouts can last days or even weeks, completely shutting down production at companies and critical infrastructures such as telecommunication networks, financial services, water supplies and hospitals. Power cuts are becoming more and more frequent. Large-scale, supra-regional blackouts are increasingly a realistic scenario. Even small outages can have disastrous effects on unprepared businesses.

[8] US Government Publishing Office. Blackout! Are we prepared to manage the aftermath of a cyberattack or other failure of the electrical grid? Available at: http://www.gpo.gov/fdsys/browse/committee.action?chamber=house&committee=transportation

A hazard that could impact the electrical infrastructure is a geomagnetic storm, which is a major disturbance of Earth's magnetosphere that occurs when there is a very efficient exchange of energy from the solar wind into the space environment surrounding Earth; these storms create harmful geomagnetic induced currents (GICs) in the power grid and pipelines.[9] An electrical system that is near peak level of demand prior to the geomagnetic storm event may not be able to meet the total power demand when the geomagnetic storm occurs, leading to partial or system wide blackouts.[10] The sun goes through cycles of high and low activity that repeats approximately every 11 years. Solar minimum refers to the several Earth years when the number of sunspots is lowest; solar maximum occurs in the years when sunspots are most numerous. During solar maximum, activity on the sun and the possibility of space weather effects on our terrestrial environment is higher.[11] The next solar maximum is expected in the 2020-2021 timeframe. Current conditions and forecasting are available from the Space Weather Prediction Center.

Furthermore, it is likely that power blackouts will become more frequent owing to the lack of incentives to invest in aged national grid infrastructures in Europe and the US, as well as the fact that energy from decentralized, "volatile" renewable sources is not well aligned to work on electricity grids that were designed 50 or 60 years ago. Also, as more and more grids are interconnected, a blackout in one region can trigger a domino effect that could result in supra-regional blackouts. Heightened risk from terrorism, cyberattacks and solar flares also highlights how vulnerable the world's energy grids are to systemic failure. Research shows that the financial impacts of even a small power cut can be catastrophic. Analyses from blackout events in the US show that a 30-minute power cut results in an average loss of US$15,709 for medium and large industrial clients, and nearly US$94,000 for an eight-hour interruption.[12]

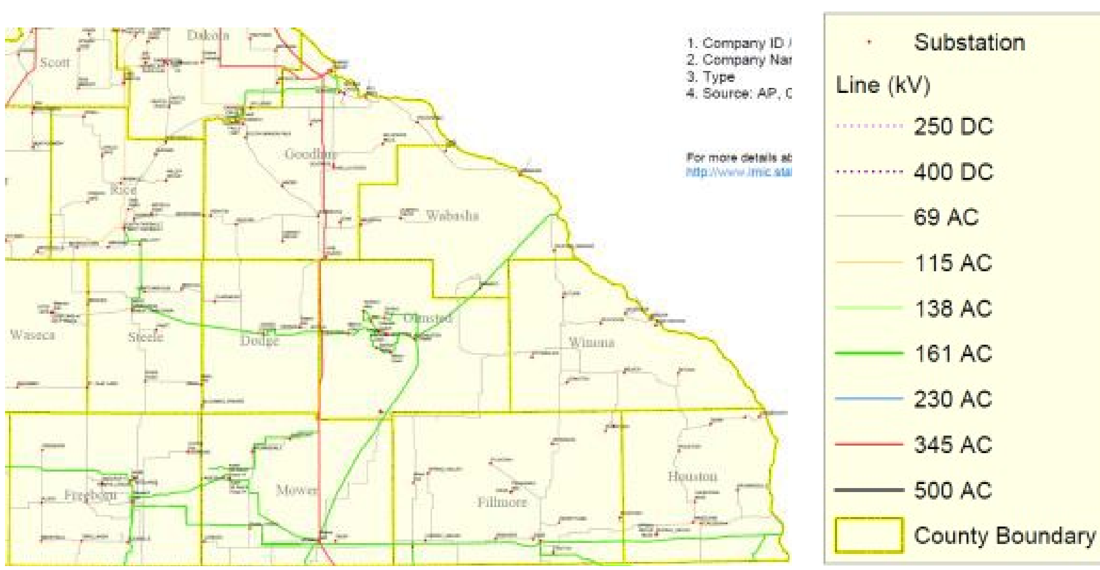


Figure 35. Southeast Minnesota Electrical Distribution Routes

[9] http://www.swpc.noaa.gov/phenomena/geomagnetic-storms
[10] http://www.swpc.noaa.gov/impacts/electric-power-transmission
[11] https://www.nasa.gov/mission_pages/sunearth/spaceweather/index.html
[12] Allianz. Power Trip, http://www.agcs.allianz.com/insights/expert-risk-articles/energy-risks/

The Energy Information Administration tracks and reports on selected significant storms that impact or could potentially impact energy infrastructure.[13]

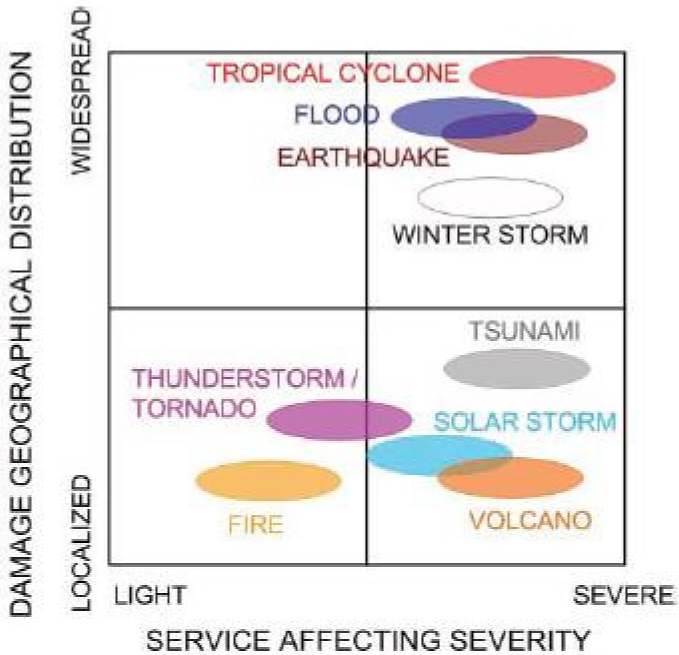


Figure 36. Natural Disaster Impact on the Electric Grid[14]

Natural Gas Failure

The U.S. natural gas pipeline network is a highly integrated transmission and distribution grid that can transport natural gas to and from nearly any location in the lower 48 States. Twenty-six interstate and at least eight intrastate natural gas pipeline companies operate within the Midwest Region (Illinois, Indiana, Michigan, Minnesota, Ohio, and Wisconsin). The principal sources of natural gas supply for the region are production areas in the Southwest, although Canadian natural gas pipelines now account for about one-fourth of natural gas pipeline capacity entering the region. Regional natural gas production, principally from Ohio and Michigan, accounts for little more than 8 percent of the gas consumed in the region.[15]

The main causes of natural gas pipeline leakage occurrence are design defect of auxiliaries and interference for the third party, especially the parties ignore signage. Once the leakage occurs, it is most likely to result in fire and explosion. Leakage of natural gas pipeline may result in serious accidents such as fire, exposition, and combustion with heavy casualties and huge economic losses.[16]

---

[13] U.S. Energy Information Administration, https://www.eia.gov/special/disruptions/
[14] A. Kwasinski. Analysis of Vulnerabilities of Telecommunication Systems to Natural Disasters, http://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=5482356
[15] U.S. Energy Information Administration, https://www.eia.gov/naturalgas/
[16] X. Shan, K. Liu, P. Sun. Risk Analysis on Leakage Failure of Natural Gas Pipelines by Fuzzy Bayesian Network with a Bow-Tie Model, https://www.hindawi.com/journals/sp/2017/3639524/

With respect to infrastructure resilience, aging infrastructure represents an ongoing challenge in the United States.[17] The ability to predict pipeline failures is not possible except in extreme measures.[18]

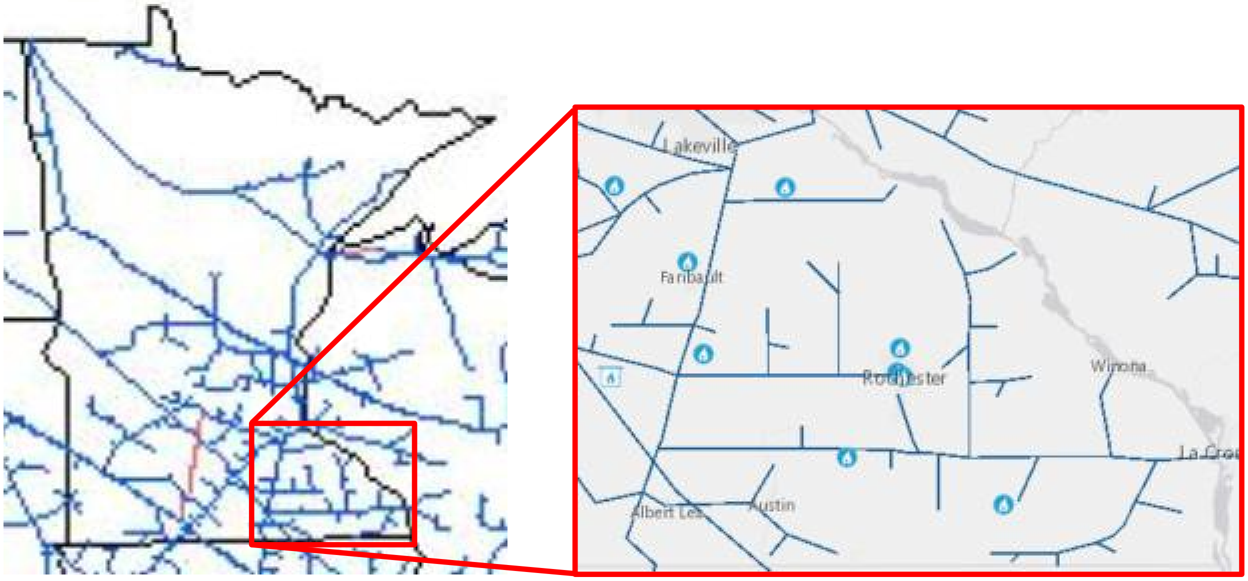


Figure 37. Natural Gas Distribution Pipelines and Plants in Southeast Minnesota

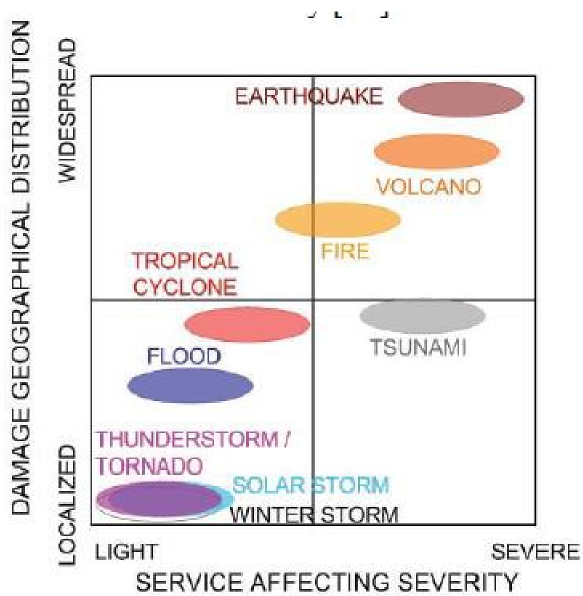


Figure 38. Natural Disasters Effect on Natural Gas Distribution[19]

[17] U.S. Department of Energy. Valuation of Energy Security for the United States, https://energy.gov/sites/prod/files/2017/01/f34/Valuation%20of%20Energy%20Security%20for%20the%20United%20States%20%28Full%20Report%29_1.pdf

[18] A. Hashem. Oil and Gas Pipeline Design, Maintenance and Repair, Part 13: Pipeline Risk Assessment, http://www.eng.cu.edu.eg/users/aelsayed/Part%2013%20%20Pipeline%20Risk%20Assessement.pdf

July 25, 2014: A TransCanada Corporation gas transmission pipeline exploded and burned, causing a natural gas shortage in Manitoba and parts of the United States, including Southeast Minnesota.

Telecommunications Failures[20]

Telecommunications infrastructure failures occur through a variety of mechanisms. Investigation of communications failures during large urban disasters in the past fifteen years reveals three primary categories of causes:

1. Physical destruction of network components
2. Disruption in supporting network infrastructure
3. Network congestion

Physical Destruction of Network Components

The most common and well-documented cause of telecommunications failures in recent disasters has been the physical destruction of network infrastructure. Because of the time and funding needed to repair or replace systems, service disruptions caused by physical destruction also tend to be more severe and last longer than those caused by disconnection or congestion.

The fragility of telecommunications networks is due to the fact that historically, these systems have not had a high degree of redundancy. The telephone network, for example, utilizes a branching structure in which destruction of a single network segment can disconnect entire neighborhoods instantaneously. Cities rarely escape even highly localized disasters without at least some physical damage to the telephone network.

Newer telecommunications networks are designed to be more resilient to physical destruction. Through both increased redundancy in network connections (Internet), and advanced routing techniques to circumvent damaged portions, so called “packet switched” networks can suffer severe damage before portions of the network become disconnected.

Yet despite its potential for resiliency, the Internet is not invulnerable. In fact, as ongoing research has shown, a handful of key interconnection facilities (“telco hotels”) located in major cities present major points of vulnerability for Internet communications. At the local level, Internet service for small businesses and homes is still largely delivered over the old, non-redundant copper wire of the telephone and cable television networks.

Disruption in supporting network infrastructure

While less common than outages caused by physical damage, outages caused by disruption in supporting infrastructure tend to be far more widespread and damaging to response and recovery efforts. Telecommunications networks rely upon many other local and regional technical systems to

---

[19] A. Kwasinski. Analysis of Vulnerabilities of Telecommunication Systems to Natural Disasters, http://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=5482356

[20] Townsend AM, Moss, ML. Telecommunications Infrastructure in Disasters: Preparing Cities for Crisis Communications. Center for Catastrophe Preparedness and Response & Robert F. Wagner Graduate School of Public Service, New York University. April 2005. Accessed May 30, 2017 at: https://www.nyu.edu/ccpr/pubs/NYU-DisasterCommunications1-Final.pdf

ensure their proper operation. These supporting infrastructures often date from an earlier era and lack resiliency to physical damage.

Electrical distribution systems are by far the most important supporting infrastructure for telecommunications networks. Electrical power is required to operate all modern telecommunications equipment, often in large amounts. Yet electric power distribution systems lack the “self-healing” capabilities of telecommunications networks.

While electrical power systems remain the most important supporting infrastructure for telecommunications facilities, cooling systems are critical and can fail independently of power supply. Additionally, transportation disruptions can also impact the supply of fuel for electric power generation.

<u>Network Congestion</u>
Crises generate intense human need for communication – to coordinate response activities, to convey news and information about affected groups and individuals, and as a panic reaction to crisis. Historically, major disasters are the most intense generators of telecommunications traffic, and the resulting surge of demand can clog even the most well-managed networks. Under this strain, calls are blocked and messages are lost.

In addition to the widespread use of untested technologies, congestion failures will remain a common occurrence because of the diversity of inter-linked causes. For example, increasingly complex networks like the Internet often have undiscovered bottlenecks that only become apparent under crisis conditions. In addition, for economic reasons, most communications networks are engineered for peak load at levels well beneath the demands placed on them during disasters. Finally, networks are increasingly subject to attacks based on creating congestion. Such “denial of service” attacks, combined with a physical strike, are widely suspected to be a future tactic of terrorist organizations.

Nuclear Plant Accident

The Prairie Island Nuclear Power Plant is located in Red Wing, Minnesota, and has two pressurized water nuclear reactors. The plant generates a total of 1,076 megawatts of power, enough to provide electricity for approximately a million homes.

Although the term "nuclear accident" has no strict technical definition, it generally refers to events involving the release of significant levels of radioactivity or exposure of workers or the general public to radiation. Although the possibility of a nuclear accident caused by a natural hazard is remote, the Prairie Island Nuclear Facility located in Goodhue County could be affected. The probability of release would be related to the probability of occurrence of the triggering natural hazard. To date, no major nuclear accident has occurred as a result of natural hazards, either in the United States or abroad.

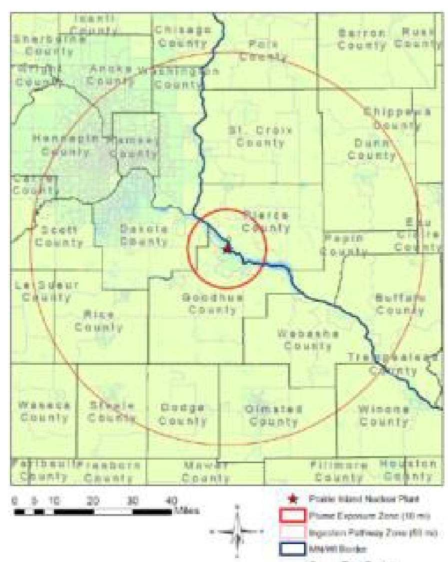


Figure 39. 10-Mile & 50-Mile Exposure Zones[21]

[21] J. Pankratz, Emergency Preparedness Analysis for Prairie Island Power Plant

Consequences associated with a nuclear accident triggered by a natural hazard would be a function of the nature of the hazard, the nature of the accident, and the population characteristics within the Emergency Planning Zone (EPZ) around the impacted facility. EPZs typically include a 10-mile Critical Risk Zone and a 50-mile Ingestion Pathway Zone.

There have been three major reactor accidents in the history of civil nuclear power – Three Mile Island, Chernobyl and Fukushima. One was contained without harm to anyone, the next involved an intense fire without provision for containment, and the third severely tested the containment, allowing some release of radioactivity. The evidence over six decades shows that nuclear power is a safe means of generating electricity. The risk of accidents in nuclear power plants is low and declining. The consequences of an accident are minimal compared with other commonly accepted risks. Radiological effects on people of any radioactive releases can be avoided.[22]

Dam Failure

“Dam" means any artificial barrier, together with appurtenant works, which does or may impound water and/or waste materials containing water. Hazard classification of dams is based on potential consequences, not the condition of the dam or likelihood of failure. There are three dam hazard classes:

- Class I –High: probable loss of life, main highways or major property losses
- Class II –Significant or Medium: high value property, secondary highways, economic loss
- Class III –Low: limited property loss, local county and township roads

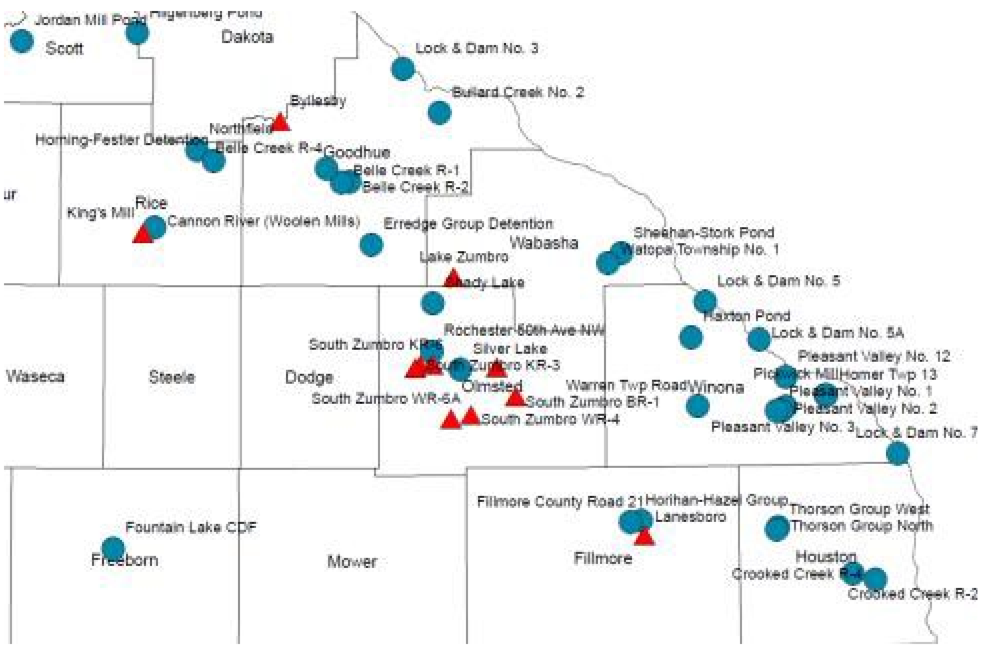


Figure 40. Southeast Minnesota Dams by Classification

[22] World Nuclear Association, http://www.world-nuclear.org/information-library/safety-and-security/safety-of-plants/safety-of-nuclear-power-reactors.aspx

Hazardous Materials Incidents

Hazardous materials (HAZMAT) fabrication, processing, and storage sites and hazardous waste treatment, storage, or disposal facilities exist in communities throughout Southeast Minnesota. HAZMAT releases pose short and long-term toxicological threats to people and to terrestrial and aquatic plants and wildlife. Toxic materials affect people through inhalation, ingestion, or direct contact with skin.

Railway Related Hazardous Materials Releases

Railway accidents can be a source of hazardous materials incidents. Such incidents can result in community evacuation, injuries, death and environmental damage. Department of Transportation provides information about recent rail accidents, which can occur without warning along any area of a rail track.

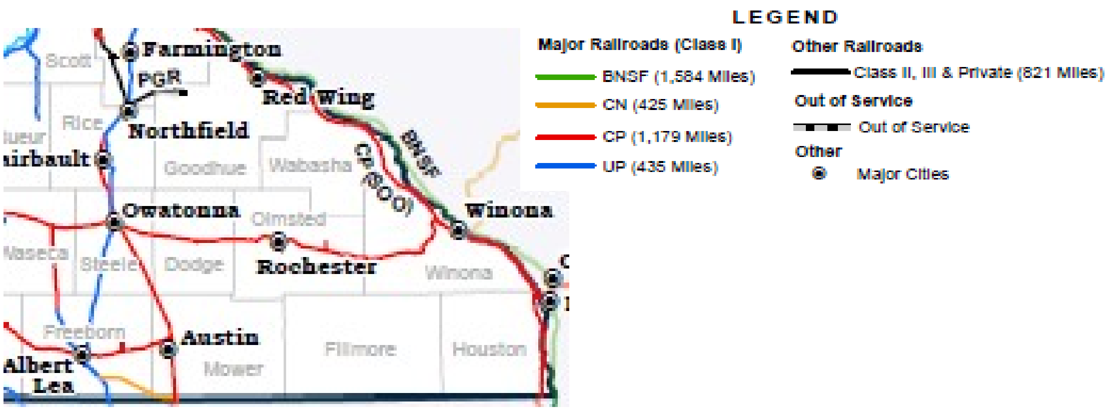


Figure 41. Minnesota Freight Rail Map (Source: http://www.dot.state.mn.us/ofrw/maps/MNRailMap.pdf)

A number of factors can impact the likelihood a rail accident will result in a hazardous materials release incident.

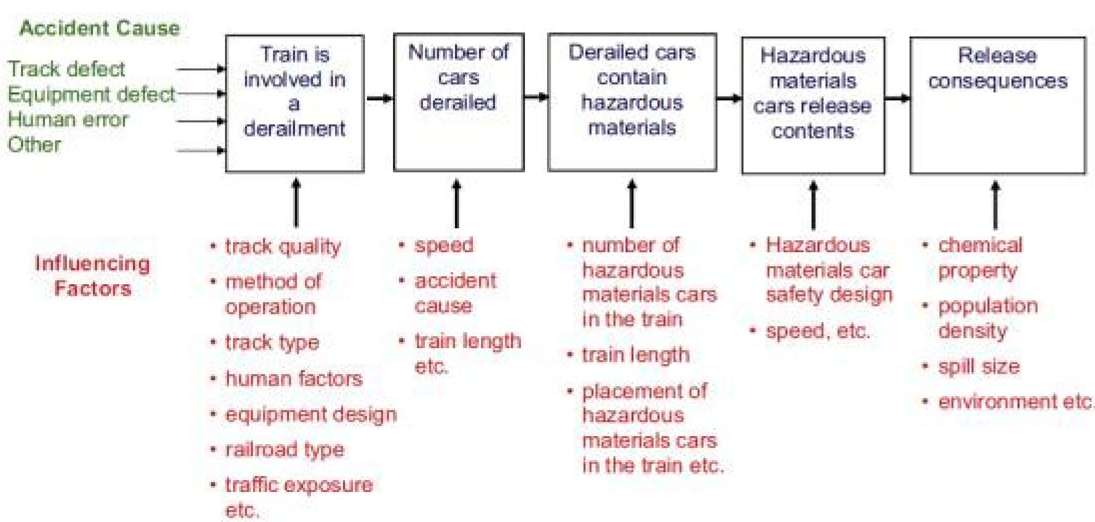


Figure 42. Sequence of Events Leading to a Hazardous Materials Release Incident[23]

[23] http://railtec.illinois.edu/articles/Files/Journal%20Articles/2014/Liu%20et%20al%202014%20JHM%20Multiple%20Car%20Release.pdf

Extremely Hazardous Substances Sites

Facilities storing any of 355 Extremely Hazardous Substances (EHS) above Threshold Planning Quantities (TPQ) at any one time are subject to preparedness and reporting rules. Facilities include manufacturers, retailers, wholesalers, agriculture, state and local governments. County/city site inventories are available from jurisdictional emergency management agencies.

Industrial Facilities Hazardous Materials Releases[24]

Facility accidents can be a source of hazardous materials incidents. Minnesota ranks 37 out of 56 states/territories nationwide based on total releases per square mile (Rank 1 = highest releases). The Environmental Protection Agency's Toxics Release Inventory (TRI) tracks the management of certain toxic chemicals that may pose a threat to human health and the environment. Certain industrial facilities in the U.S. must report annually how much of each chemical is recycled, combusted for energy recovery, treated for destruction, and disposed of or otherwise released on- and off-site. Figure x shows a map of TRI facilities in Southeast Minnesota.

Figure 43. 2015 TRI Facilities, Southeast Minnesota

Hazardous Materials Incident Risk Environment

While natural hazards pose the greatest risk to communities, historically, hazardous chemical spills continue to be a threat in the United States. From 2004-2009, nearly 15,000 hazardous materials incident occurred nationwide.[25] For example, the top hazardous substance released in Olmsted County and bordering counties from 2000-2009 was anhydrous ammonia, except for Fillmore County where the

[24] U.S. Environmental Protection Agency, https://iaspub.epa.gov/triexplorer/tri_factsheet.factsheet_forstate?&pstate=MN&pyear=2015&pParent=TRI&pDataSet=TRIQ1, Accessed May 30, 2017

[25] U.S. Department of Transportation, http://www.phmsa.dot.gov/hazmat/library/data-stats/incidents Accessed November 13, 2011

top substance was ethanol. (personal communication, Nancy Rice, Minnesota Department of Health, October 2010) Top hazards for the remaining SEMN counties include:

- Goodhue – anhydrous ammonia
- Houston – no reportable releases
- Freeborn – anhydrous ammonia
- Steele – Paints and Coatings
- Rice – Volatile Organic Chemicals

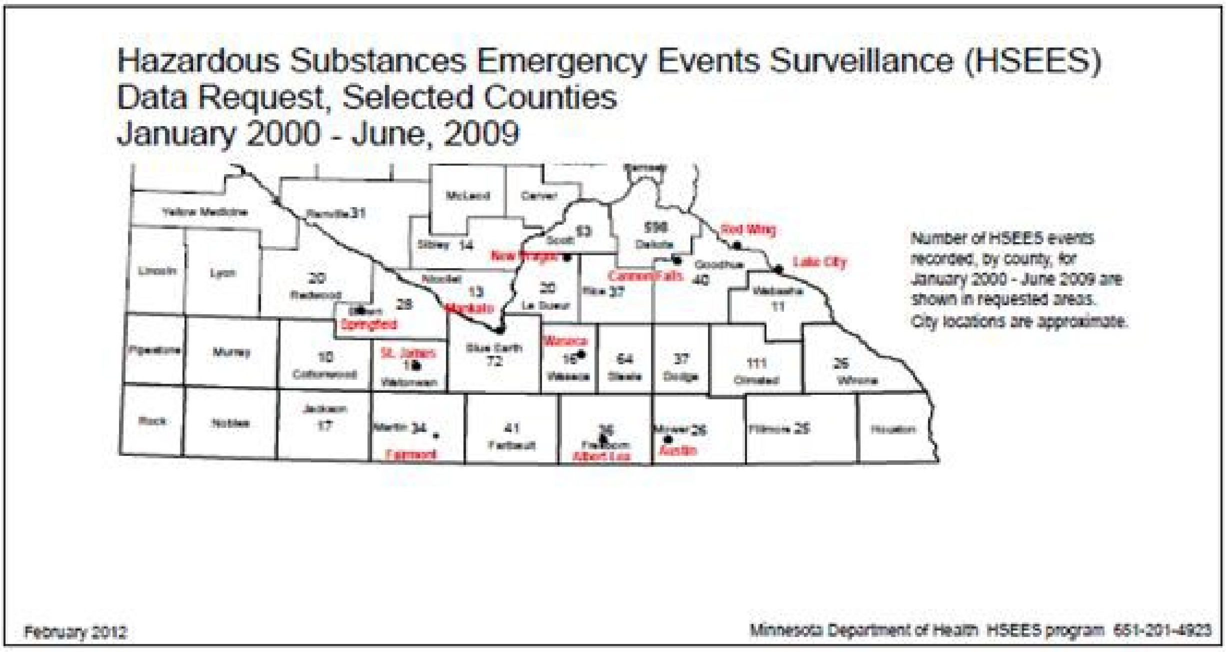


Figure 44. HSEES Data for 25 Southern Minnesota Counties, 2000-2009

Area incidents demonstrate that hazardous chemical spills are a hazard that should be considered by the community and hospitals for emergency planning, training and exercise activities. Recent events include:

- 8/6/10 – Alleged Chlorine (Valley Fair); 26 to Hospitals
- 10/5/10 – Sodium Bisulfate (St. Paul); 3 to Hospitals
- 10/26/10 – Sulfuric Acid (Owatonna); 3 to Hospitals
- 12/10/10 – Anhydrous Ammonia (Randolph); 55 to Hospitals

While chemical release incidents are not uncommon, incidents that result in contaminated patients presenting to the hospital Emergency Department are a small fraction of reported events[26] and cause few serious toxic exposures per event.[27] Yet, data indicates that hospitals cannot rely on public safety

---

[26] Minnesota Hazardous Substances Emergency Events Surveillance Report for 2008. Available at: http://www.health.state.mn.us/divs/eh/hazardous/surv/hseesrpt08.pdf Accessed November 12, 2011

[27] Koenig, K. Strip and Shower: The Duck and Cover for the 21st Century. *Ann Emerg Med*. 2033;42:391-394

agencies to control and decontaminate victims on scene; over 80% of victims from the chemical release site self-refer to the hospital outside of the pre-hospital system.[28]

Chemical incidents that occur outside of the hospital tend to be limited in size with very few casualties, often only one.vi[29] (personal communication, Nancy Rice, Minnesota Department of Health, October 2010) Chemical incidents that involve large numbers of exposed/contaminated victims are rare; between 1975 and 1999, worldwide there were only 25 incidents that resulted in over 25 deaths and 100 injuries.[30] Events that cause such large-scale casualties result from gas/vapor exposure to chemicals.

Local information, according to the Minnesota Department of Health, for hazmat incidents between 2002-2009 in Olmsted County and bordering counties, three victims received decontamination on scene and zero received decontamination at a medical facility (and nine not reported/unknown). The agents involved in the incidents that required victim decontamination were ethanol, nitrogen fertilizer and sulfuric acid. (personal communication, Nancy Rice, Minnesota Department of Health, October 2010) Table X indicates the location and number of victims decontaminated for incidents across 25 southern Minnesota counties from 2002 to 2009. This local data further supports other HSEES data that incidents involving decontamination at hospitals for higher risk hazardous substances are minimal.

Decontamination Location	# Victims Decontaminated
None	179
On Scene	16
Medical Facility	20
On Scene & Medical Facility	4
Not Reported/Unknown	6

Table 5. Victim Decontamination for 25 Southern MN Counties, 2002-2009

Considerations for chemicals of primary concern (Priority 1) on the Terrorism Listing of the Centers for Disease Control and Prevention include:

- Although **Priority 1 chemicals represent only 2.0% of reported chemicals**, events involving Priority 1 chemicals, especially ammonia, acids, and volatile organic compounds, **accounted for 20% of the releases**.
- Although Priority 1 chemicals represent only 2.0% of reported chemicals, events involving Priority 1 chemicals **resulted in twice as many incidents involving victims**, primarily from acids, ammonia, and chlorine.
- **Decontamination was performed at medical facilities during 1% of Priority 1 events** for:
    - 711 employees (of chemical sites)
    - 622 responders

[28] Macintyre, A, Christopher, G., Eitzen, J., et. al. Weapons of Mass Destruction Events with Contaminated Casualties. Effective Planning for Health Care Facilities. *JAMA* 2000;283(2):242-249
[29] Ruckart, P., Fay, M. Analyzing Acute-Chemical-Release Data to Describe Chemicals That May Be Used as Weapons of Terrorism. *J of Env Hlth.* 2006;69(1):9-14
[30] Murray V. Mass casualty incidents. Chemical Incident Report. 2001;22:2-13. Available at www.hpa.org.uk/webc/HPAwebFile/HPAweb_C/1194947315398, *Accessed November 12, 2011*

- 674 members of the general public[31]

Minnesota 2008 HSEES data provides additional information about the timing for higher risk of incidents occurring and therefore when patients could present to an Emergency Department.

- The highest number of incidents occurred in July (12.5%).
- **Nearly 85% of incidents occurred during the weekday**.
- **Over 70% of events occurred between 6:00 AM and 5:59 PM**; 16.2% occurred from 6:00 PM to 11:59 PM and 12.2% occurred from 12:00 AM to 5:59 AM.
- 58.2% incidents involved one victim; 16.4% involved two victims; 25.5% involved three or more victims – of the 14 incidents, five events involved more than ten victims.
  - Of the five events, three involved anhydrous ammonia releases, one involved a release of potassium hydroxide and ammonia, and one involved a release of carbon monoxide.
- 80% of victims were not decontaminated; 6.7% were decontaminated on scene; **10% (18) were decontaminated at a medical facility, 3.3% (6) were decontaminated both on scene and at a medical facility.**
- **The median number of uninjured decontaminated individuals was two persons per event (range: 1-6).**[32]

Data from the Hazardous Substances Emergency Event Surveillance (HSEES) system does not indicate secondary contamination of hospital Emergency Departments or personnel is a common occurrence; [33]however, limitations to the data include lack of awareness of the HSEES system by hospital staff, and limited participation of states in the HSEES program.

Although not common, Clarke et al. (2008) cited a number of articles that indicated secondary contamination of healthcare facilities and personnel had occurred, even with just a single contaminated patient.[34] While patients exposed to gas or vapor that have undergone pre-hospital decontamination at/near the incident scene were not likely to pose a secondary contamination risk to Emergency Department personnel, Burgess (1999) also recognized that patients grossly contaminated with liquid vapor or solid hazardous substances posed a risk to Emergency Department personnel.[35] Between 1995 and 2001, **0.4% of industrial chemical incidents resulted in secondary contamination of healthcare personnel**.[36] The health outcomes related to contamination is unknown.

As a result of the 1995 Sarin attack in Tokyo, 5,510 patients presented to area hospitals. The vast majority of patients posed no secondary contamination threat to hospital staff. Out of the total number

---

[31] Ruckart, P., Fay, M. Analyzing Acute-Chemical-Release Data to Describe Chemicals That May Be Used as Weapons of Terrorism. *J of Env Hlth.* 2006;69(1):9-14

[32] Minnesota Hazardous Substances Emergency Events Surveillance Report for 2008. Available at: http://www.health.state.mn.us/divs/eh/hazardous/surv/hseesrpt08.pdf Accessed November 12, 2011

[33] Horton, K. Secondary Contamination of Emergency Department Personnel from o-Chlorobenzylidene Malononitrile Exposure, 2002.

[34] Clark, S., Chilcott, R., Wilson, J., Kamanyire, R., Baker, D., Hallett, A. Decontamination of Multiple Casualties Who Are Chemically Contaminated: A Challenge for Acute Hospitals. *Prehospital and Disaster Medicine.* 2008;23(2):175-181.

[35] Burgess JL. Hospital Evacuations due to hazardous materials incidents. *Am J Emerg Med* 1999;17:50-52

[36] Horton DK, Berkowitz Z, Kay W. Secondary contamination of ED personnel from hazardous materials events, 1995-2001. *Am J Emerg Med* 2003;21:199-204.

of patients that arrived at hospitals, 17 were critically ill, 37 were severely ill, 984 were moderately ill; 54 required mechanical ventilation.[37] **For ambulatory patients that arrived on their own, especially those exposed to gas or vapor substances or those that had been decontaminated at/near the incident scene, the risk of secondary exposure to staff was relatively low**.[38] While the tremendous number of victims overwhelmed the primary hospital's Emergency Department, the low incidence rate of secondary exposure supports the conclusion that low acuity patients from a chemical exposure pose low risk to Emergency Department personnel.[39]

As hospitals surrounded by a large rural/agriculture region, differences of hazardous substance releases causing fatalities and/or people transported to hospitals in rural/agricultural areas versus other areas are considerations, including:

- The most frequently released chemicals in rural/agricultural areas were ammonia, chlorine, and pesticides.
- Decontamination was administered in 48% of the events.
- Most decontamination occurred at the scene.
- Most victims were attributed to ammonia releases.
- Zero hospital employees were injured as a result of secondary exposure to chemicals in the "rural/agriculture" category.
- Seven hospital employees were injured as a result of secondary exposure to chemicals in the "all other areas" category.
- Of admissions to hospitals, the majority sustained respiratory tract symptoms that were often accompanied by gastrointestinal symptoms, eye irritation, headache, shortness of breath or other symptoms.[40]

According to Hick, "there is no question that the nerve and **organophosphates** are the key agents that pose a significant contact and off-gassing **risk to providers**. Historically, these agents **have caused the most significant injuries**."[41]

Consideration of what have been the worst reported emergency department personnel injuries related to secondary contamination supports Hick's statement. In one case, one nurse required intubation and required antidote therapy after contact and vapor exposure to a patient that ingested organophosphate (OPP) pesticide; the patient had ingested organophosphates in a suicide attempt. The nurse was exposed to chemical in secretions and from off gassing.[42]

---

[37] Halpern, P., Mass Chemical Incidents: Principles of Hospital Management. Available at: www.ceep.ca/education/HAZMAT-CBRN.ppt, Accessed November 12, 2011

[38] Hick J., Penn P., Hanfling D., Lappe M., O Laughlin D., Burstein, J., Establishing and Training Healthcare Facility Decontamination Teams

[39] Okumura T, Suzuki K, Atsuhiro F, et al. The Tokyo Subway Sarin Attack: Disaster Management, Part 2: Hospital Response. *Academic Emergency Medicine*. 1998; 5:618-624.

[40] Berkowitz, Z., Horton, K., Kaye, W. Hazardous Substances Releases Causing Fatalities and/or People Transported to Hospitals: Rural/Agricultural vs. Other Areas. Prehospital Disaster Medicine. July-Sept 2004;19(3):213-220.

[41] HAZMAT Curriculum for Hospital Providers, Minneapolis/St. Paul Metropolitan Medical Response System, Compact Disc

[42] Centers for Disease Control and Prevention. Nosocomial poisoning associated with emergency department treatment of organophosphate toxicity – Georgia, 2000. *MMWR* 2001;49(51):1156-1158

In another case, two physicians required antidotes after exposed to Sarin severely poisoned patients in Tokyo; they did not have to stop providing patient care.[43] Staff that exhibited symptoms related to secondary exposure was providing cares in areas with poor ventilation – the ICU and a makeshift care area in the chapel. The incidence of secondary exposure in the Emergency Department was relatively low.[44]

Local HSEES data (Table X) indicates no hospital employees were injured as a result of chemical releases that occurred in 25 southern Minnesota counties from 2002 to 2009.

Category	# of Victims
Employee	104
General Public	53
Student	51
Firefighter	14
Responder (Not Specified)	6
Emergency Medical Technician	3
Police Officer	2
Category Not Available	1

Table 6. Victim Categories and Quantity from Incidents Occurring across 25 southern Minnesota counties, 2002-2009

Infectious Disease Hazards

Endemic Diseases, Epidemic Diseases, and High Consequence Infectious Disease (HCID) have different influences upon the risk environment. The SEMN region shares a similar risk profile with most of the upper Midwest; however the large number of international travelers who visit Rochester does present an expanded risk due to patients and visitors whose travels originate from or include countries with emerging diseases/outbreaks involving locally uncommon diseases including potential HCID.

Epidemic Diseases

Influenza[45]

Influenza A virus is spread via droplet, airborne and contact transmission, with droplet transmission probably serving as the most important during seasonal transmission. The overall attack rate in large populations is typically between 10% to 20% during the annual epidemics (seasonal flu), however some subpopulations or local outbreaks can have attack rates approaching 40%. These higher attack rates usually occur in children and, as such, they play a critical role in the spread of influenza in communities during the annual epidemics. Indeed, schools and/or daycare centers will often serve as the primary loci of infection transmission during these epidemics.

---

[43] Nozaki H, Hori S, Shinozama Y, et al. Secondary exposure of medical staff to sarin vapor in the emergency room. *Intensive Care Medicine* 1995;21:1032-1035

[44] Okumura T, Suzuki K, Atsuhiro F, et al. The Tokyo Subway Sarin Attack: Disaster Management, Part 2: Hospital Response. *Academic Emergency Medicine*. 1998; 5:618-624.

[45] Infection Landscapes, http://www.infectionlandscapes.org/2013/03/influenza.html

Seasonal, or epidemic, influenza follows an annual, roughly predictable, pattern each year in the temperate regions of the northern hemisphere; epidemics usually occur from October to May. The epidemic peak(s) usually occurs between November and March: manifested first by high rates of school and industrial absenteeism, followed by an increase in visits to health care facilities, an increase in pneumonia and influenza hospital admissions, and finally an increase in deaths from pneumonia or influenza. In any specific locality, epidemic influenza often begins abruptly, reaches a peak within three weeks, and usually ends by 8 weeks.

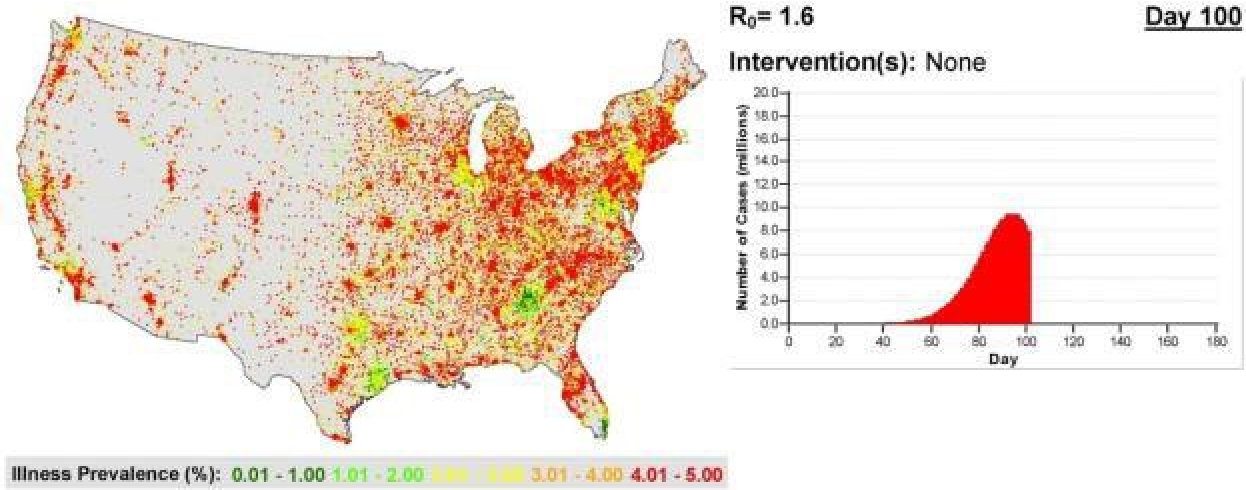


Figure 45. The prevalence of influenza in a single simulation of the United States 100 days after the start of an influenza epidemic with R0=1.6. The color of each dot corresponds to the illness prevalence in a census tract.

The above map (published in *PLoS Comput Biol 6(1): e1000656. doi:10.1371/journal.pcbi.1000656*) simulates the typical distribution of prevalent influenza cases in the US once the seasonal epidemic has begun, given that each infectious case will, on average, lead to more than one new infectious case in a completely susceptible population (R_0=1.6). The map demonstrates the high level of transmission, as well as the potential need for the mobilization of resources.[46]

[46] Infection Landscapes, http://www.infectionlandscapes.org/2013/03/influenza.html *Accessed June 1, 2017*

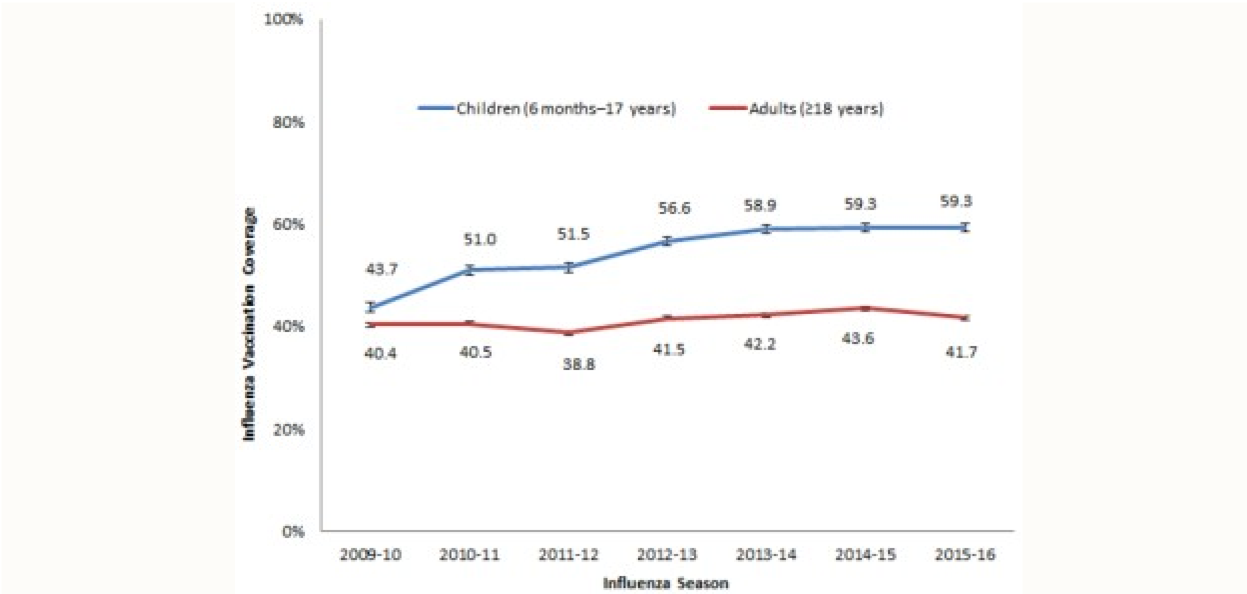


Figure 46. Seasonal Flue Vaccination Coverage, 2009-2016 (Source: CDC)

High Consequence Infectious Diseases

Category 1

This category of pathogens require CDC Bioterrorism Category A waste management for all medical waste. Examples include, but are not limited to: hemorrhagic fever diseases (e.g., Ebola, Marburg, Crimean-Congo, Guanarito, Machupo, Junin, Sabia, Lujo, Chapare, Kyasanur Forest Disease, Omsk Hemorragic Fever), poxvirus diseases (e.g., Variola/Smallpox, Monkeypox), febrile neurological/respiratory illnesses (e.g., Nipah, Hendra).

Hemorrhagic Fevers

These are typically viral infections that can frequently present with symptoms of bleeding and high fever. However, bleeding is not particularly sensitive or specific for many of the hemorrhagic fevers. Indeed, many of these infections initially present with much more generic, flu-like symptoms. Nevertheless, many of these infections do share two very important features. First, many (but, not all) of the viruses causing hemorrhagic fever are zoonotic in origin, which can create difficulty in identifying the sources of outbreaks, as well as implementing effective control measures. Second, many of these infections are highly virulent and potentially associated with high mortality in outbreak settings.[47]

Poxvirus Diseases

Smallpox

[47] Infection Landscapes, http://www.infectionlandscapes.org/2012/09/the-hemorrhagic-fevers.html *Accessed May 30, 2017*

The last natural outbreak of smallpox in the United States happened in 1949. The last naturally spread case in the entire world happened in 1977. The World Health Assembly declared smallpox eradicated in 1980.[48] Even a single confirmed case of smallpox today would be considered an emergency. There is no immediate, direct threat of a bioterrorist attack using smallpox. No bioterrorist attack using smallpox has happened in modern times. Throughout history, though, some people have used smallpox to their advantage by deliberately infecting their enemies with the disease. There is credible concern that in the past some countries made the virus into weapons, which may have fallen into the hands of terrorists or other people with criminal intentions.[49] A vaccine medical countermeasure is available to mitigate a smallpox outbreak; historically, the vaccine has been effective in preventing smallpox infection in 95% of those vaccinated. In addition, the vaccine was proven to prevent or substantially lessen infection when given within a few days after a person was exposed to the variola virus.[50]

Monkeypox

Monkeypox is a rare disease that is caused by infection with monkeypox virus. There are two distinct genetic groups (clades) of monkeypox virus—Central African and West African. West African monkeypox is associated with milder disease, fewer deaths, and limited human-to-human transmission. In 2003, the U.S. experienced an outbreak of monkeypox. This was the first time human monkeypox was reported outside of Africa. Forty-seven confirmed and probable cases of monkeypox were reported from six states—Illinois, Indiana, Kansas, Missouri, Ohio, and Wisconsin – during the 2003 U.S. outbreak.[51] Currently, there is no proven, safe treatment for monkeypox virus infection.[52]

Febrile Neurological/Respiratory Illnesses

Nipah Virus Infection (NiV) in humans has a range of clinical presentations, from asymptomatic infection to acute respiratory syndrome and fatal encephalitis. Hendra virus (HeV) infection is a rare emerging zoonosis that causes severe and often fatal disease in both infected horses and humans. [53] Transmission of NiV to humans may occur after direct contact with other NiV infected people.[54] To date, no human-

---

[48] The Centers for Disease Control and Prevention, https://www.cdc.gov/smallpox/history/history.html *Accessed May 30, 2017*

[49] The Centers for Disease Control and Prevention, https://www.cdc.gov/smallpox/bioterrorism/public/threat.html *Accessed May 30, 2017*

[50] The Centers for Disease Control and Prevention, https://www.cdc.gov/smallpox/vaccine-basics/index.html *Accessed May 30, 2017*

[51] The Centers for Disease Control and Prevention, https://www.cdc.gov/poxvirus/monkeypox/outbreak.html *Accessed May 30, 2017*

[52] The Centers for Disease Control and Prevention, https://www.cdc.gov/poxvirus/monkeypox/treatment.html *Accessed May 30, 2017*

[53] The Centers for Disease Control and Prevention, http://www.who.int/csr/disease/nipah/en/ *Accessed May 30, 2017*

[54] The Centers for Disease Control and Prevention, https://www.cdc.gov/vhf/nipah/transmission/index.html *Accessed May 30, 2017*

to-human transmission of HeV has been documented.[55] Treatment is limited to supportive care for both. However, the drug ribavirin has been shown to be effective against HeV in vitro, but the clinical usefulness of this drug is uncertain.[56]

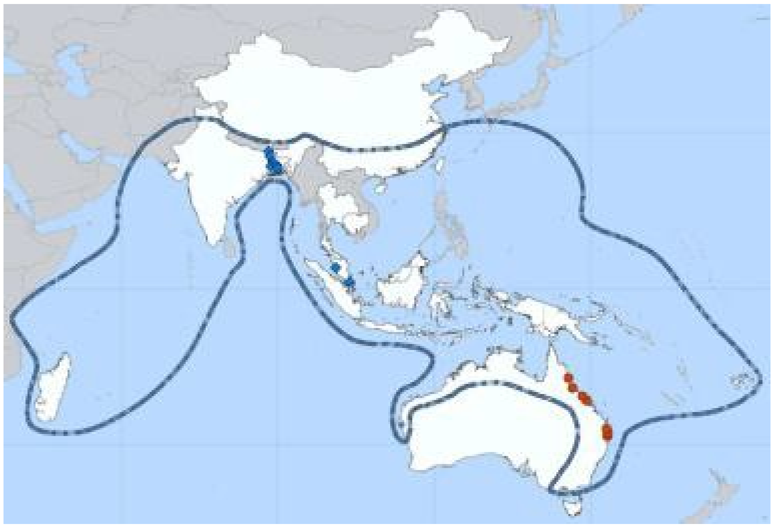


Figure 47. Nipah and Hendra Virus Outbreak Distribution Map[57]

Category 2

This category of pathogens do not require CDC Bioterrorism Category A waste management for all medical waste, but do pose potential risk to laboratory personnel from raw specimen and require special procedures for specimen collection, transportation, or testing. This includes febrile respiratory illness that can be transmissible between humans (e.g., MERS-CoV, SARS-CoV, measles)

Middle Eastern Respiratory Syndrome (MERS)[58]

MERS is an illness caused by a virus called Middle East Respiratory Syndrome Coronavirus (MERS-CoV). Most MERS patients developed severe acute respiratory illness with symptoms of fever, cough and shortness of breath. About 3 to 4 out of every 10 patients reported with MERS have died. The MERS situation in the U.S. represents a very low risk to the general public in this country. Only two patients in the U.S. have ever tested positive for MERS-CoV infection—both in May 2014.

[55] The Centers for Disease Control and Prevention, https://www.cdc.gov/vhf/hendra/transmission/index.html *Accessed May 30, 2017*

[56] The Centers for Disease Control and Prevention, https://www.cdc.gov/vhf/hendra/treatment/index.html *Accessed May 30, 2017*

[57] The Centers for Disease Control and Prevention, https://www.cdc.gov/vhf/nipah/outbreaks/distribution-map.html *Accessed May 30, 2017*

[58] The Centers for Disease Control and Prevention, https://www.cdc.gov/coronavirus/mers/us.html *Accessed May 30, 2017*

In May 2014, CDC confirmed two unlinked imported cases of MERS in the United States. Both cases were among healthcare providers who lived and worked in Saudi Arabia. Both traveled to the U.S. from Saudi Arabia, where they are believed to have been infected. Both were hospitalized in the U.S. and later discharged after fully recovering.

Health officials first reported the disease in Saudi Arabia in September 2012. Through retrospective investigations, health officials later identified that the first known cases of MERS occurred in Jordan in April 2012. So far, all cases of MERS have been linked through travel to, or residence in, countries in and near the Arabian Peninsula. The largest known outbreak of MERS outside the Arabian Peninsula occurred in the Republic of Korea in 2015. The outbreak was associated with a traveler returning from the Arabian Peninsula. As a result of the outbreak, Samsung Medical Center stopped receiving outpatients, suspended operations and restricted the visitors of hospitalized patients as part of its efforts to contain the virus.[59]

MERS-CoV has spread from ill people to others through close contact, such as caring for or living with an infected person. MERS can affect anyone. MERS patients have ranged in age from younger than 1 to 99 years old.[60] As of 2016 there is no specific vaccine or treatment for the disease.

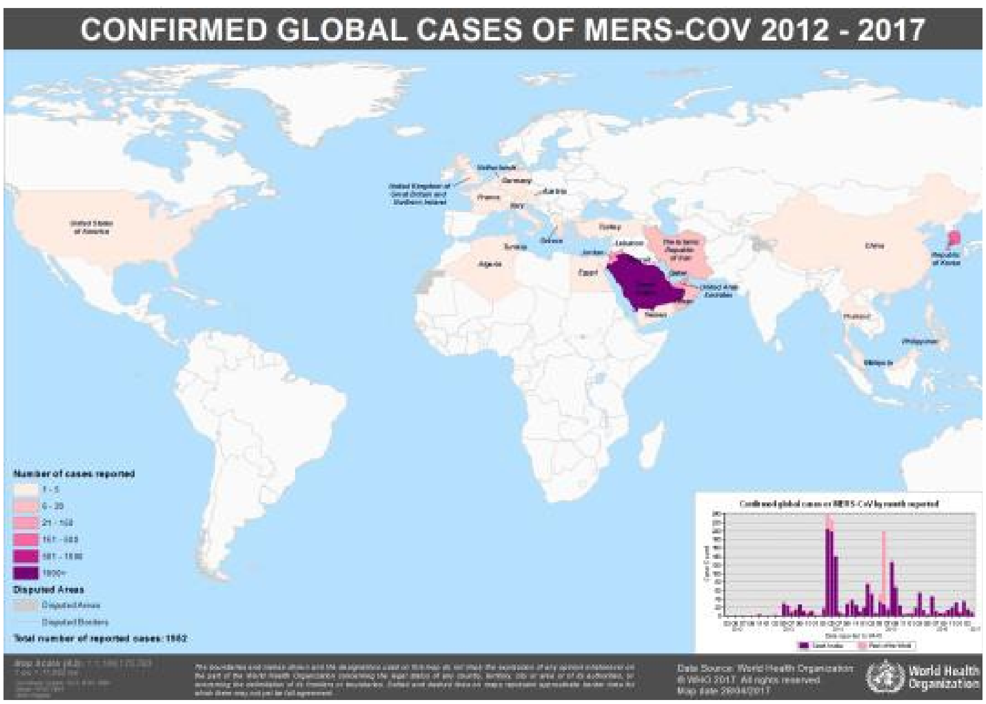


Figure 48. Confirmed Global Cases of MERS-CoV 2012-2017 (Source: World Health Organization)

---

[59] The Korea Herald, http://www.koreaherald.com/view.php?ud=20150614000362 *Accessed May 30, 2017*
[60] The Centers for Disease Control and Prevention, https://www.cdc.gov/coronavirus/mers/us.html, *Accessed May 30, 2017*

Measles

Caused by one of the most infectious human pathogens known, the World Health Organization (WHO) reported about a quarter of a million cases worldwide for 2009 based on passive surveillance, population-based survey estimates put the global incidence closer to 10 million cases each year. There are about 200,000 measles deaths per year. In the United States between 2000 and 2007 an average of 62 cases per year were reported, most of which were imported, and a case-fatality between 1 and 3 per 1000 cases.

Measles is a rare disease in Minnesota and in the U.S.; most measles cases occurring in Minnesota result from someone traveling to or from countries where measles is common, and who are infectious with measles after arriving in Minnesota. Measles can spread easily to unvaccinated persons.

Reported Cases of Measles, Minnesota, 1997-2016						
	Exposure outside U.S. (imported case)	Exposure to imported case	Linked to imported case	Total import-related cases	Other	Total measles cases
1997	3	4	0	7	1	8
1998	0	0	0	0	0	0
1999	1	0	0	1	0	1
2000	1	0	0	1	0	1
2001	2	0	0	2	2	4
2002	2	0	0	2	0	2
2003	0	0	0	0	0	0
2004	0	0	0	0	0	0
2005	0	0	0	0	0	0
2006	1	0	0	1	0	1
2007	1	0	0	1	0	1
2008	0	0	0	0	0	0
2009	0	0	0	0	1	1
2010	2	0	0	2	1	3
2011	3	6	16	25	1	26
2012	0	0	0	0	0	0
2013	2	0	0	2	0	2
2014	1	0	1	2	0	2
2015	2	0	0	2	0	2
2016	2	0	0	2	0	2
Total	**23**	**10**	**17**	**50**	**6**	**56**

Table 7. Reported Cases of Measles in Minnesota, 1997-2016 (Source: Minnesota Department of Health)

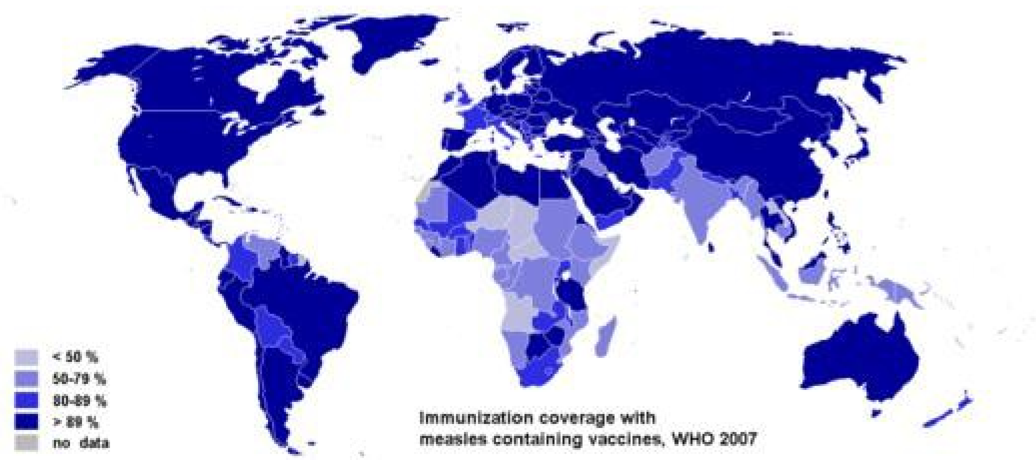


Figure 49. Immunization Coverage with Measles Containing Vaccine (Source: Infection Landscapes)

Minnesota Measles Outbreaks

- 2011 Outbreak[61]
  - 19 Children; Two Adults
  - Began when an unvaccinated 2-year-old was taken to Kenya, where he contracted the measles virus. After returning to the United States, the child developed a fever, cough and vomiting. However, before measles was diagnosed, he passed the virus on to three children in a drop-in child care center and another household member. Contacts then multiplied, with more than 3,000 people eventually exposed. The child infected in Kenya was of Somali descent, as were most of the children whose parents had declined the MMR vaccine because of safety fears.
  - No impact to SEMN communities
- 2017 Outbreak[62]
  - 32 Confirmed Cases, < 6 Years Old (As of 4/27/17)
  - 28 victims Somali-American
    - fears of a link to autism contribute to low vaccination rates (42% compared to 89%)
  - No impact to SEMN communities

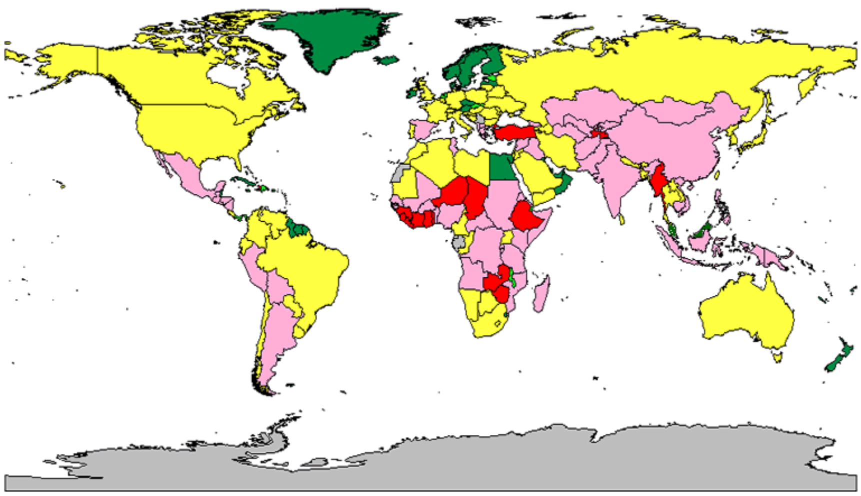
Category 3

This category of pathogens do not require CDC Bioterrorism Category A waste management for all medical waste, or pose potential risk to laboratory personnel from raw specimen but do pose risk of transmission to healthcare workers providing direct care and thus require the use of personal protective equipment (e.g., Avian Influenza, Pneumonic Plague, Anthrax)

61 http://www.cbsnews.com/news/how-one-unvaccinated-child-sparked-minnesota-measles-outbreak/
62 http://www.twincities.com/2017/04/27/minnesota-measles-outbreak-grows-to-29-cases-spreads-to-stearns-county/

Anthrax[63]

There are three primary modes of transmission for *B. anthracis* infection in humans. Direct contact between breaks or wounds in the skin and spores in the environment or via infected animals is probably the most common route for human infection. Infection via this route is associated with cutaneous anthrax. Airborne transmission is possible when the spores are inhaled and subsequently initiate infection in the lungs, which has been associated with processing in certain kinds of animal industry. Infection via this route leads to inhalational anthrax. Finally, food-borne transmission results from the consumption of contaminated meat. This mode of transmission is probably the least common in most endemic areas; however community outbreaks of gastrointestinal anthrax can be quite large particularly if infection is widespread among a herd of cattle slaughtered for food.



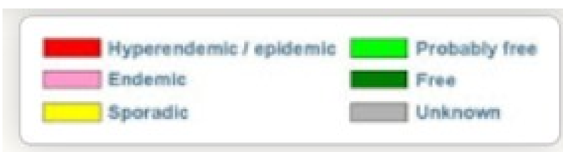


Figure 50. Anthrax Frequency, 1965-2009 (Source: The Research Foundation of State University of New York)

[63] Infection Landscapes, http://www.infectionlandscapes.org/2013/08/anthrax.html *Accessed May 30, 2017*

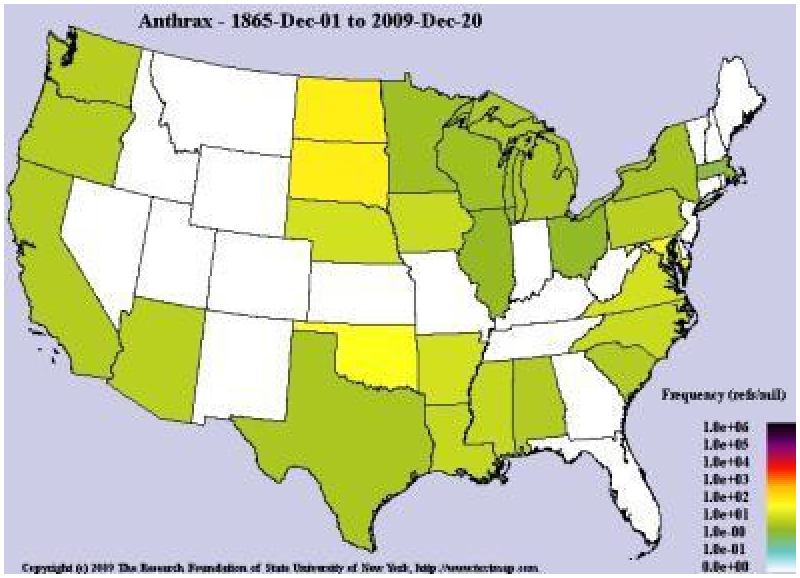


Figure 51. Anthrax Frequency, 1965-2009[64]

Pandemic Influenza

Throughout much of history, influenza pandemics "have posed the greatest threat of a worldwide calamity caused by infectious disease..."[65] As opposed to seasonal influenza outbreaks, which are annual events that can be predicted with some accuracy, pandemics occurs when a new strain of influenza virus emerges for which people have little or no immunity and for which there is no vaccine.[66]

Although the world experienced three influenza pandemics in the 20th century, (1918, 1957 and 1968)[67] and the first pandemic of the 21st century (H1N1 in 2009)[68], the 1918 pandemic remains the most severe in terms of morbidity and mortality. It was responsible for between 50 million and 100 million deaths worldwide[69] and, based on the U.S. mortality rate of 0.66%[70], can be extrapolated to have caused approximately 660,000 deaths in the United States alone, out of a population of 103 million, with approximately 30 percent of the American population infected.

Although most experts believe we will face another influenza pandemic, it is impossible to predict when it will appear, where it will originate, or how severe it will be. Nor is there agreement about the subtype

[64] The Research Foundation of State University of New York
[65] Michael T. Osterholm, "Preparing for the Next Pandemic", Foreign Affairs, July/August 2005
[66] World Health Organization
[67] ibid
[68] World Health Organization, http://www.who.int/csr/disease/swineflu/frequently_asked_questions/levels_pandemic_alert/en/index.html, *Accessed May 30, 2017*
[69] Jeffery K. Taubenberger and David M. Morens, "1918 Influenza: the Mother of All Pandemics, Emerging Infectious Diseases", www.cdc.gov/eid , Vol. 12, No. 1, January 2006

[70] ibid

of influenza virus most likely to cause the next pandemic. The threat posed by pandemics grows alongside increased globalization and technological innovation. Distant cultures can now be connected in a day's time, and international trade links global health and economic prosperity.[71]

Influenza pandemics are widely cited by experts and policy leaders as one of the greatest threats to public health and to national security.[72] A severe influenza pandemic like the one that occurred in 1918 is a rare event--it has only occurred once in the last hundred years--yet the impact on healthcare systems could be profound. A huge surge in patients would require much more than hospitals' normal stocks of supplies, pharmaceuticals and personal protective equipment (PPE).

While not predictive in nature, ongoing risk assessments from the CDC and WHO provide more dynamic risk information associated with pandemic influenza. The World Health Organization has processes to define the risk of emerging virus of concern, Tool for Influenza Pandemic Risk Assessment (TIPRA), adapted from the CDC's Influenza Risk Assessment Tool, and Rapid Risk Assessment of Acute Public Health Events.

High Consequence Infectious Disease Category 4

This category of pathogens do not require CDC Bioterrorism Category A waste management for all medical waste, or pose potential risk to laboratory personnel from raw specimen and do not pose risk of transmission to healthcare workers providing direct care, but could result in significant media attention and staff anxiety due to the relative novelty of the pathogen or the need to engage with Federal partners to rule-out acts of bioterrorism (e.g. Botulism, Tularemia, Glanders, Melioidosis).

Sociological (Human-Induced) Threats

Crime

Data from the Minnesota Bureau of Criminal Apprehension (BCA) provides a sense for sociological threats within Southeastern Minnesota. The BCA compiles a statistical report each year detailing the amount of criminal activity in the state. The data for this report is submitted by individual law enforcement agencies. The report includes offenses, clearances and arrests, as well as the number of law enforcement officers killed or assaulted, firearms discharges by law enforcement, missing children reports, police pursuits and bias offenses.[73]

---

[71] The Growing Thread of Pandemics: Enhancing Domestic and International Biosecurity. A Scowcroft Institute of International Affairs White Paper. March 2017. Available at http://bush.tamu.edu/scowcroft/white-papers/The-Growing-Threat-of-Pandemics.pdf *Accessed May 30, 2017*

[72] Cabinet Office of the UK, National Risk Registry, https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/211867/NationalRiskRegister2013_amended.pdf *Accessed May 30, 2017*

[73] State of Minnesota Bureau of Criminal Apprehension Uniform Crime Report 2015, https://dps.mn.gov/divisions/bca/bca-divisions/mnjis/Documents/2015-Minnesota-Uniform-Crime-Report.pdf *Accessed May 30, 2017*

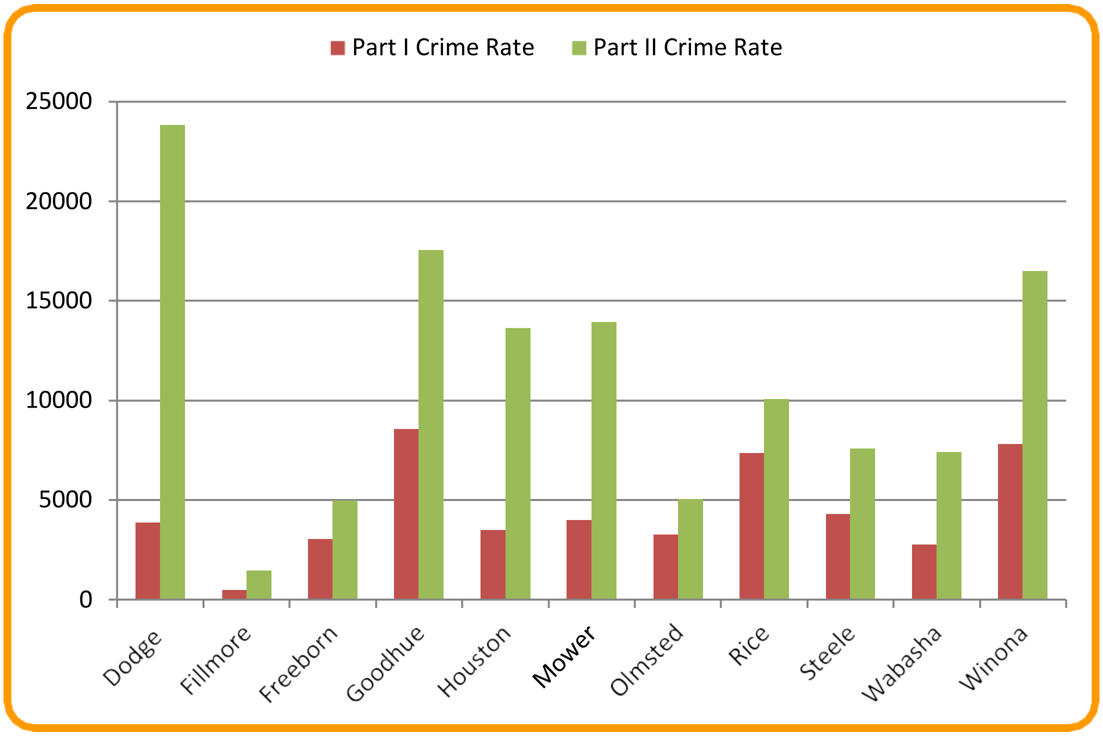


Figure 52. Crime Rates per 100,000 for Southeast Minnesota Counties

Part 1 crimes are collectively known as Index crimes, this name is used because the crimes are considered quite serious, tend to be reported more reliably than others, and are reported directly to the police and not to a separate agency (e.g., IRS).

Part II crimes include the following: simple assault, curfew offenses and loitering, embezzlement, forgery and counterfeiting, disorderly conduct, driving under the influence, drug offenses, fraud, gambling, liquor offenses, offenses against the family, prostitution, public drunkenness, runaways, sex offenses, stolen property, vandalism, vagrancy, and weapons offenses.

The major urban center in the region, Rochester crime statistics report an overall downward trend in crime based on data from 14 years with violent crime decreasing and property crime decreasing. Based on this trend, the crime rate in Rochester for 2017 is expected to be lower than in 2012. The city violent crime rate for Rochester in 2012 was lower than the national violent crime rate average by 61.67% and the city property crime rate in Rochester was lower than the national property crime rate average by 11.94%.

In 2012 the city violent crime rate in Rochester was lower than the violent crime rate in Minnesota by 35.78% and the city property crime rate in Rochester was lower than the property crime rate in Minnesota by 1.96%.

Figure x provides a sample of crime rates for communities located within Southeast Minnesota.[74] While some communities have property crime rates similar or higher to national average rates, most areas throughout Southeast Minnesota have lower property crime rates. All communities have lower than national average violent crime rates, most areas considerably lower.

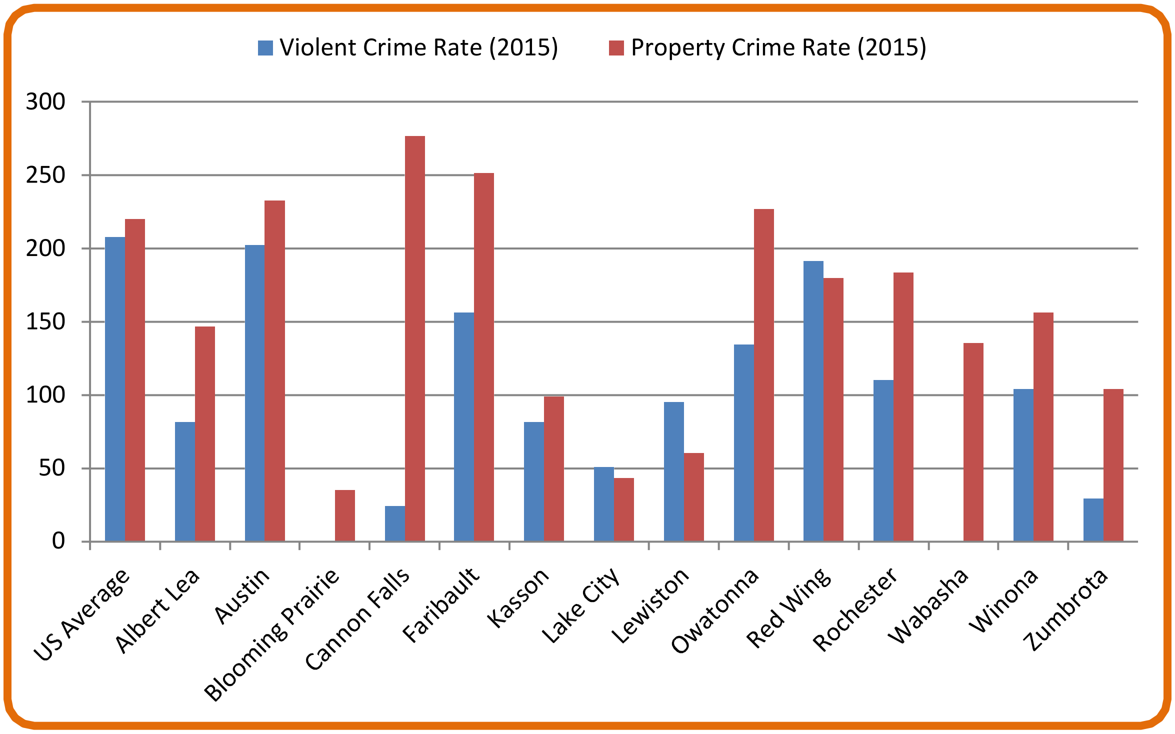


Figure 53. 2015 Crime Rates for Selected Communities in Southeast Minnesota

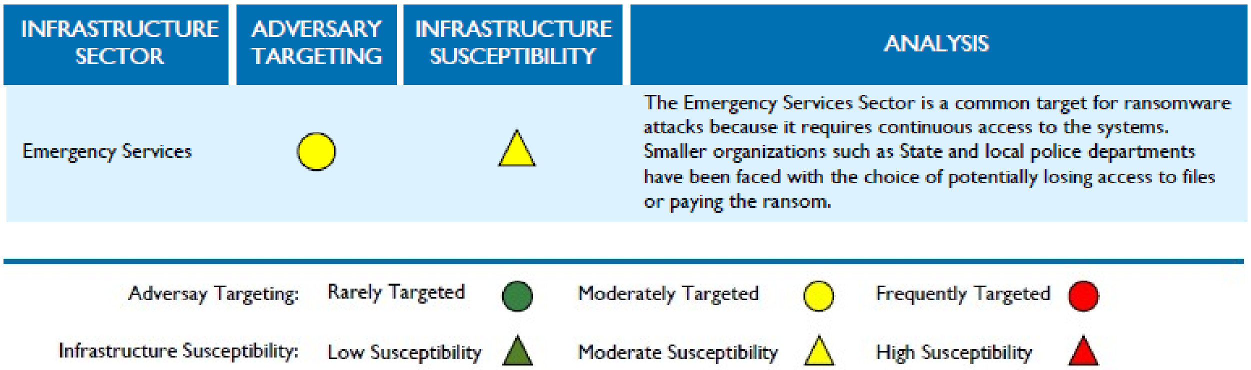
Targeted Against Healthcare

Cyber Attacks

Cyber threats have evolved from isolated incidents directed only at large financial institutions to something that has become an everyday occurrence for most organizations. The nature of healthcare system operations requires gathering, storing and transferring sensitive personal information including health and financial records for patients, staff and benefactors.

INFRASTRUCTURE SECTOR	ADVERSARY TARGETING	INFRASTRUCTURE SUSCEPTIBILITY	ANALYSIS
Healthcare and Public Health	●	▲	The need for the Healthcare and Public Health Sector to have immediate access to patient records will continue to make the sector a significant target for ransomware attacks. attacks.

[74] http://www.city-data.com/



INFRASTRUCTURE SECTOR	ADVERSARY TARGETING	INFRASTRUCTURE SUSCEPTIBILITY	ANALYSIS
Emergency Services			The Emergency Services Sector is a common target for ransomware attacks because it requires continuous access to the systems. Smaller organizations such as State and local police departments have been faced with the choice of potentially losing access to files or paying the ransom.

Figure 54. Ransomware Targeting and Susceptibility for Healthcare and Public Health and Emergency Services Sectors[75]

Global cybercrime statistics:

- $100 billion estimated annual cost
- 600% increase in malicious websites
- 556 million victims annually/1.5 million victims daily/18 victims every second

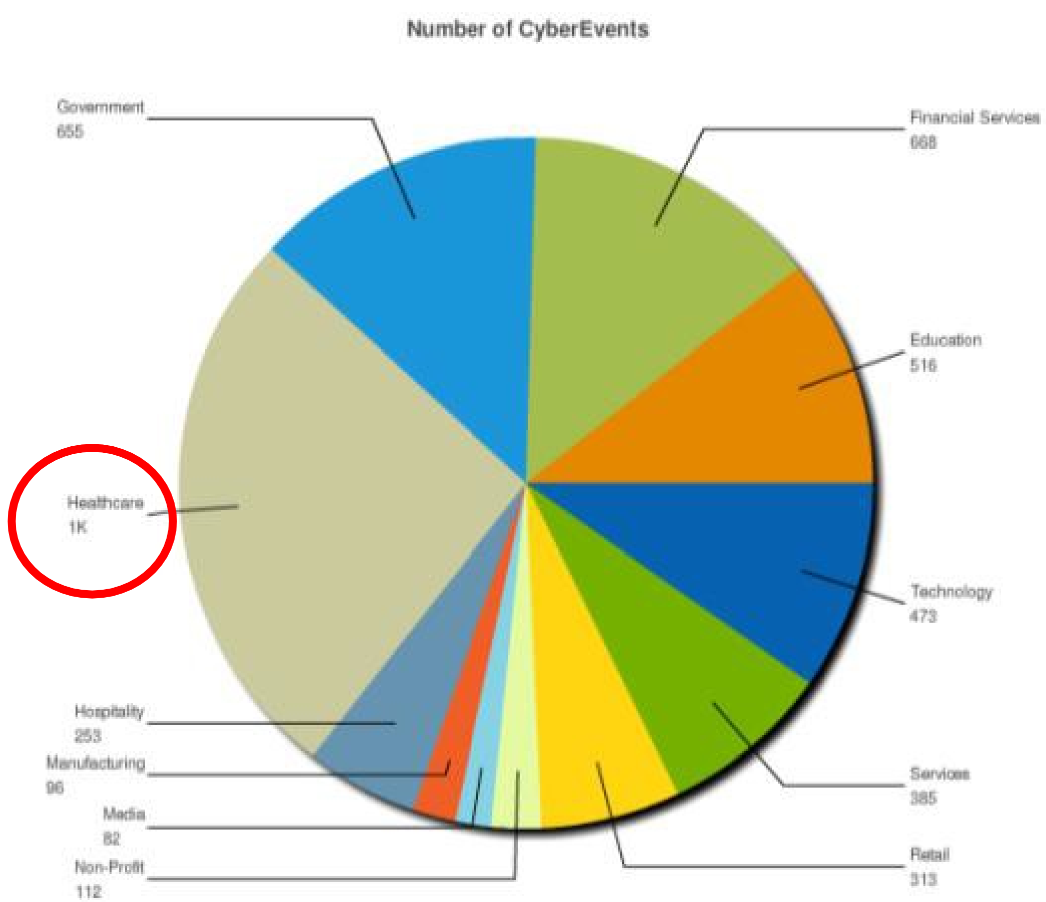


Figure 55. Cyber Events by Industry (2009 – 2014) *US Companies only Source: Liberty International Underwriters

[75] Critical Infrastructure Security and Resilience Note (U). Department of Homeland Security, National Protection and Programs Directorate, Office of Cber and Infrastructure Analysis (OCIA). June 2, 2017; 1200 EDT

Health organizations are a particularly attractive target for hackers due to the opportunity to sell information for both identity theft and insurance fraud. Criminal attacks are the leading cause of data breach in healthcare.[76] Healthcare and Public Health Sector is one of the most prevalent targets of ransomware because of its reliance on immediate access to patient records.[77] Sixty one percent of healthcare organizations have a security breach at least once a year. On average each hospital breach costs $398 per record in the US.[78]

The value of a person's medical record can be more valuable than any other form of information. A credit card number on the Black Market will net a cybercriminal $1. Compare that to a complete medical record that could be worth up to $1,000. Your health record is "an entire profile of who you are. It essentially allows someone to become you," Cynthia Larose, chair of the privacy and security practice at the law firm Mintz Levin in Boston, recently told the Associated Press.

Figure 56. Source: Mayo Clinic Officer of Information Security

[76] Ponemon Institute, http://www.ponemon.org/news-2/66
[77] Critical Infrastructure Security and Resilience Note (U). Department of Homeland Security, National Protection and Programs Directorate, Office of Cber and Infrastructure Analysis (OCIA). June 2, 2017; 1200 EDT
[78] Modern Healthcare, http://www.modernhealthcare.com/article/20150528/NEWS/150529899

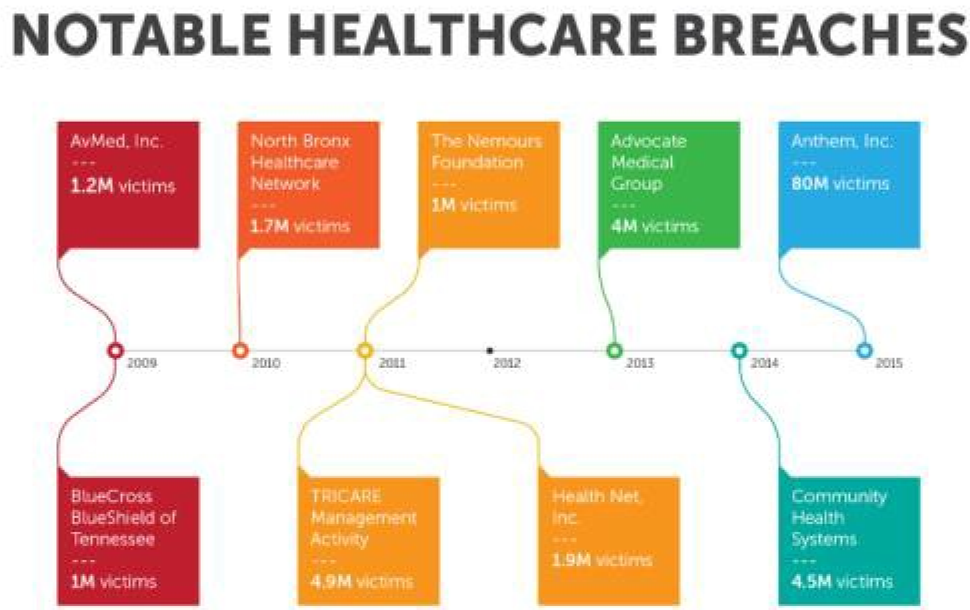


Figure 57. Source: http://trendmicro.com Accessed October 1, 2015

In 2014, the Federal Bureau of Investigation (FBI) issued a private industry notification (PIN) warning healthcare providers their cybersecurity systems are lax compared to other sectors, making them vulnerable to attacks by hackers searching for Americans' personal medical records and health insurance data. "The healthcare sector represents the highest breached industry with a persistent and cascading cyber attack security threat landscape." *– Press Release: National Health Information Sharing & Analysis Center (NH-ISAC), May 2012.*

Terrorism

The overall terrorism and political violence risk rating in the US has been raised in 2017 from low to medium. This is due to several areas of increasing risk related to Islamist and far-right terrorism, as well as civil unrest arising from political and racial tensions. There is a growing threat posed by lone-actors sympathetic to large global jihadist groups like Islamic State (IS) and Al-Qaeda. TerrorismTracker data shows that there have been at least eight terrorist attacks in the US in 2016, all of which appeared to have an Islamist motive. FBI Director James Comey said in December that roughly 80% of the agency's 1,000-plus active domestic terrorism investigations are linked to IS.[79]

[79] Aon Risk Solutions. 2017 Risk Maps. Available at: http://www.aon.com/2017-political-risk-terrorism-and-political-violence-maps/pdfs/2017-Aon-Risk-Maps-Report.pdf *Accessed May 30, 2017*

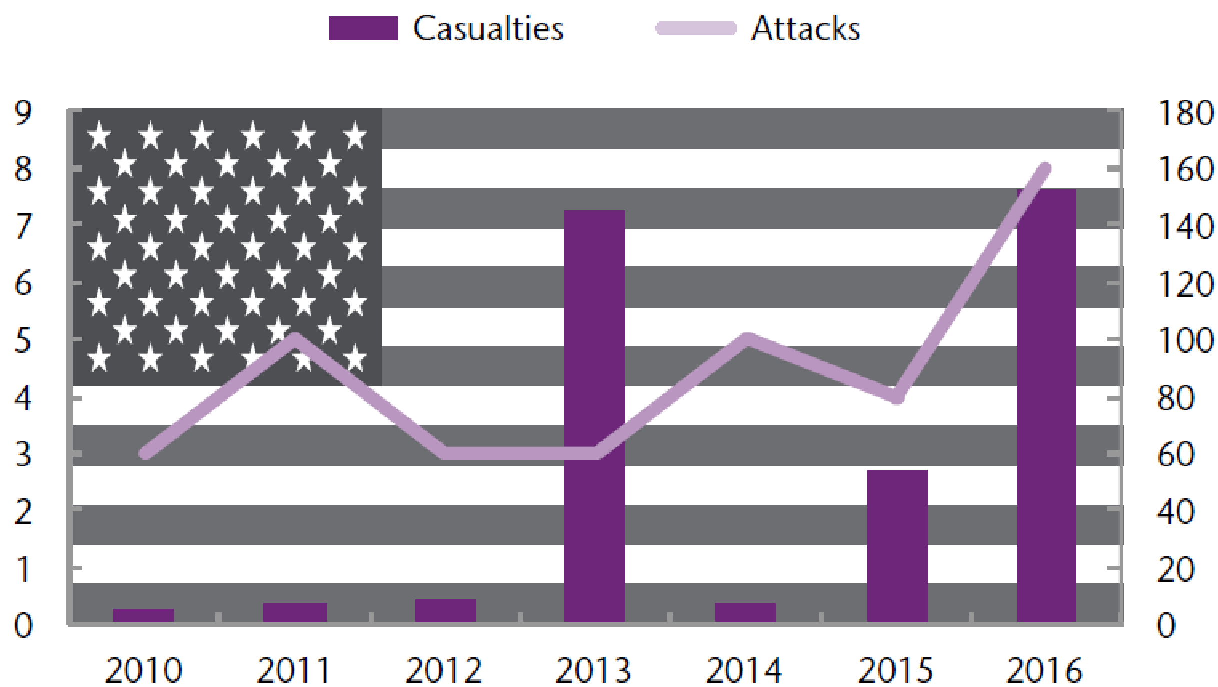


Figure 58. Terrorist Attacks in the US by Year[80]

Considering relative risks, data from the Global Terrorism Database and The National Counterterrorism Center suggests the chances of being killed in a terrorist attack are about 1 in 20 million. For comparison, a person is as likely to be killed by his or her own furniture, and more likely to die in a car accident, drown in a bathtub, or in a building fire than from a terrorist attack.[81]

Homegrown Threat

On May 16, 2017, Secretary of Homeland Security issued an updated National Terrorism Advisory System (NTAS) Bulletin pertaining to the homegrown terrorism threat due to the current threat environment of persistent threat from homegrown terrorists. This is the fourth iteration of the Bulletin on the homegrown threat since the initial Bulletin was issued in December 2015.[82] Minnesota leads the nation in would-be ISIL terrorists from U.S.[83,84]

---

[80] Aon Risk Solutions. 2017 Risk Maps. Available at: http://www.aon.com/2017-political-risk-terrorism-and-political-violence-maps/pdfs/2017-Aon-Risk-Maps-Report.pdf *Accessed May 30, 2017*

[81] Life Insurance Quotes, http://www.lifeinsurancequotes.org/additional-resources/deadly-statistics/ *Accessed May 30, 2017*

[82] U.S. Department of Homeland Security, https://www.dhs.gov/national-terrorism-advisory-system *Accessed May 30, 2017*

[83] http://www.startribune.com/minnesota-leads-the-nation-in-would-be-isil-terrorists-from-u-s-report-finds/329942131/ *Accessed May 1, 2017*

[84] CNN. Kenyan authrorities claim to have foiled potential bio-terror attack. http://www.cnn.com/2016/05/04/africa/kenya-foiled-terror-attack/ *Accessed June 2, 2017*

Southeastern Minnesota is home to numerous refugee groups. The chance of being murdered in a terrorist attack committed by an asylum-seeker was one in 2.73 *billion* a year. The chance of being murdered in a terrorist attack committed by a refugee is one in 3.64 *billion* a year.[85] Refugees have not been the primary perpetrators of any major terror attack that killed Americans in recent decades. Many of the major terror attacks that have killed Americans were carried out by U.S.-born citizens or permanent legal residents.[86]

Chemical Terrorism Threat[87]

Chemical attacks are mostly "limited" in scope, while biological attacks are mostly "unlimited" with a few exceptions such as Anthrax and other non-contagious agents. "limited" non-conventional terror attacks are within the range of many organizations, the use of "unlimited" non-conventional terrorism (e.g., biological, nuclear) is still a long way off; the perpetration of a limited non-conventional terror attack is much more likely than the perpetration of an unlimited non-conventional attack.

Since 2011, the number of chemical attacks has increased exponentially; these attacks were carried out by various organizations in approximately 30 countries throughout the world. There were forty-six confirmed chemical weapons attacks in 2013, sixty-five in 2014, and seventy-eight in 2015. It is possible that these numbers are lower than reality due to the fact that some chemical attacks may have gone unreported, or, more likely, been covered up by those who perpetrated them. In 2016, the number of chemical weapons attacks was lower than the previous three years. The largest number of incidents in which chemical weapons were used in the past 20 years (both by regime forces and rebel forces) took place in Syria, with Afghanistan in second place and Iraq in third place.

[85] A. Nowrasteh. Terrorism and Immigration: A Risk Analysis. Policy Analysis Cato Institute, September 13, 2016. Number 798. https://object.cato.org/sites/cato.org/files/pubs/pdf/pa798_1_1.pdf *Accessed May 1, 2017*

[86] PoliticFact California, http://www.politifact.com/california/statements/2017/feb/01/ted-lieu/odds-youll-be-killed-terror-attack-america-refugee/ *Accessed May 1, 2017*

[87] Halperin, M, Ganor, B. The Threat of Chemical Terrorism. International Institute for Counter-Terrorism. Summer 2016. https://www.ict.org.il/Article/1771/The-Threat-Of-Chemical-Terrorism Accessed September 19, 2017.

Figure 59. Location of Chemical Terrorism, 1995-2016

The most common agent used in the chemical weapons attacks of the last twenty-one years is chlorine gas. There have been one 133 chlorine gas attacks since 1995. Acid was used 12 times, sarin gas and diphenylaminechloroarsine, also known as adamsite, have been used 8 times, and cyanide and mustard gas have both been used 6 times in chemical weapons attacks since 1995. The chemical agents used in 69 chemical attacks involving poisonous gas since 1995 were not identified.

The targets of these attacks have overwhelmingly been civilian populations. Over seventy five percent of the chemical weapons attacks perpetrated since 1995 have targeted civilian populations. The remainder of the attacks have targeted either military, internal security, such as police, or government personnel and officials.

The risk of a chemical attack in western countries is becoming more concrete than ever before. The waves of migration to Europe and the military defeats suffered by the organization in Syria and Iraq increase the risk of such an attack taking place in a central European country. However, the direct threat to organizations and communities in SEMN is extremely low.

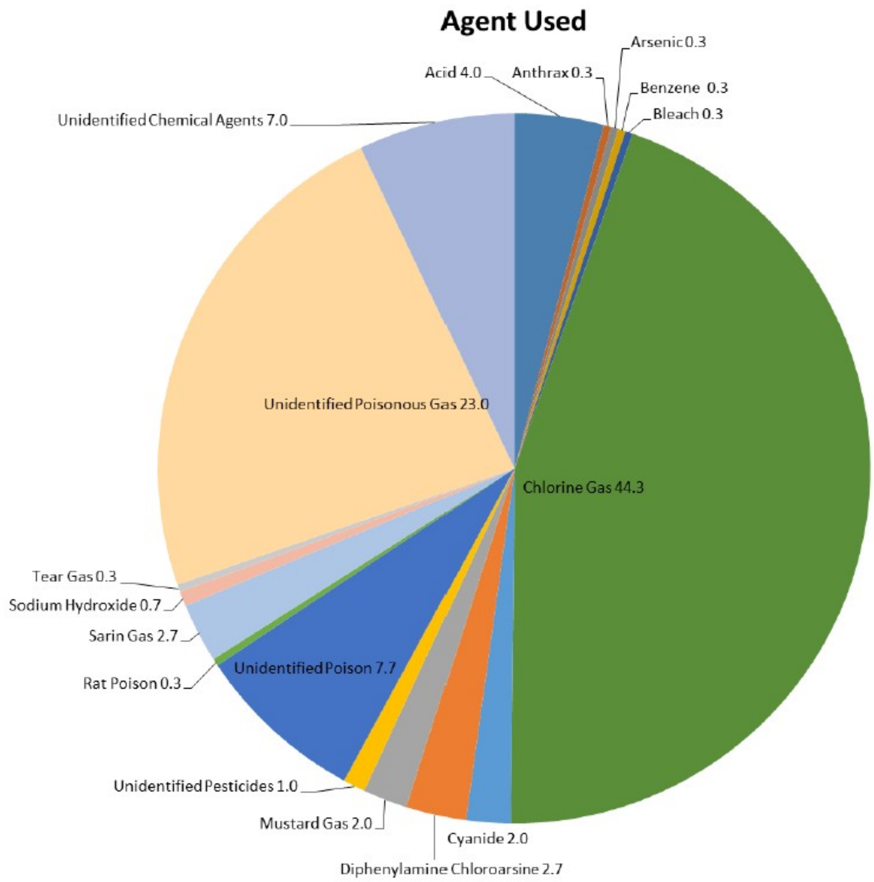


Figure 60. Type of Chemical Agent Used in Chemical Terrorism, 1995-2016

Bioterrorism Threat

Bioterrorism is not universally recognized as a true risk. Some indicate the threat of bioterrorism is increasing as a result of the rise of technical capabilities, the rapid expansion of the global biotechnology industry, and the growth of loosely sophisticated networks of transnational terrorist groups that have expressed interest in bioterrorism.[88] The overwhelming context in which the potential for bioterrorism is presented is that it will be carried out by terrorist groups with an international presence and international political objectives. These groups, however, have little or no scientific competence, little or no knowledge of microbiology, and no known access to pathogen strains or laboratory facilities. The most recent U.S. National Intelligence Council terrorist assessment makes no reference to any such capabilities.[89]

However, "There is no valid way to quantify actuarially the risk posed by biological terrorism."[i] Dr. Eric Toner, with the University of Pittsburgh Medical Center (UPMC) Center for BioSecurity, echoes this statement for the risk of an influenza pandemic. (personal communication, E. Toner November 2011). Banks offers an assessment of the current threat environment:

---

88 Madad, S. Bioterrorism: An Emerging Global Health Threat. Journal of Bioterrorism & Biodefence. https://www.omicsonline.org/open-access/bioterrorism-an-emerging-global-health-threat.php?aid=30147 *Accessed June 2, 2017*

89 Leitenberg, M. The Self-Fulling Prophecy of Bioterrorism. Nonproliferation Review, Vol. 16, No. 1, March 2009 https://www.nonproliferation.org/wp-content/uploads/npr/161_review_leitenberg.pdf *Accessed June 2, 2017*

> "Since 2001, there have been no known successful biological terrorist attacks, but the threat still exists and may be even stronger, primarily because the technological capability to produce bioweapons has become more mainstream and is more accessible. There have been some notable bioweapons attempts… Although there have been no successful biological terrorist attacks in the past decade, there have been two significant naturally occurring biological 'attacks.'"[ii]

Historically, terrorism incidents involving biological weapons have resulted in a small number of victims. (1984 Rajneeshee *S. typhimurium*; 1993 Aum Shinrikyo *B. anthracis*; 2001 *B. anthracis*)[iii] However, naturally-occurring epidemics and pandemics have been notable for decimating populations throughout history. "Three influenza pandemics occurred in the 20th century and killed tens of millions of people…"[iv]

While not a typical attack method for terrorist groups, *"bioterrorism"* remains a threat. In October 2001, anthrax spores were sent through the mail in an unprecedented act of bioterrorism against the U.S. This experience served as a wake-up call regarding our nation's vulnerability to biological threats. Today, ISIS and other terrorist organizations are showing continued interest in using biological weapons. In 2014 an ISIS laptop was recovered containing a 19-page document on how to develop biological weapons, and late last year Kenyan authorities disrupted an anthrax plot by a medical student and associates affiliated with ISIS.[90] In the event of bioterrorism, the people who would be on the front lines responding are largely comprised of public health, medical, and hospital professionals.

Nonetheless, most biological weapon agents are self-limiting because they are not communicable.[v] (The 2001 anthrax incident outcomes are consistent with this statement.) As such, there are few scenarios that could be imagined that would require provision of medical countermeasures to all citizens within a community or across SEMN. And, even if imagined, such a scenario in SEMN is considered unlikely.[vi]

Compared to other risks, various forms of cancer kill roughly 565,000 Americans per year; tobacco kills around 440,000, and obesity causes perhaps 400,000 or more deaths. Approximately 1.7 million patients develop infections annually while undergoing treatment in U.S. hospitals, resulting in an estimated 99,000 deaths.2 Together these four causes account for roughly 1.5 million U.S. deaths per year, every year. Bioterrorism killed zero U.S. citizens in the twentieth century and five to date in the twenty-first century.[91]

<u>Targeted Threat Against the Healthcare</u>

From 1981-2013, approximately 100 terrorist attacks have been perpetrated at hospitals worldwide (mostly outside of the U.S.), in 43 countries on every continent, killing 775 people and wounding 1,217 others. These attacks were perpetrated through bombings, suicide bombings, and car bombings.[92]

---

[90] Foreign Policy. Found: The Islamic State's Terror Laptop of Doom. http://foreignpolicy.com/2014/08/28/found-the-islamic-states-terror-laptop-of-doom/ *Accessed June 2, 2017*

[91] Leitenberg, M. The Self-Fulling Prophecy of Bioterrorism. Nonproliferation Review, Vol. 16, No. 1, March 2009 https://www.nonproliferation.org/wp-content/uploads/npr/161_review_leitenberg.pdf *Accessed June 2, 2017*

[92] Ganor B, Halperin Wernli M. Terroris Attacks against Hospitals Case Studies. International Institute for Counter-Terrorism. October 2013.

Figure 61. Locations of Hospital Terrorism 1981-2013[93]

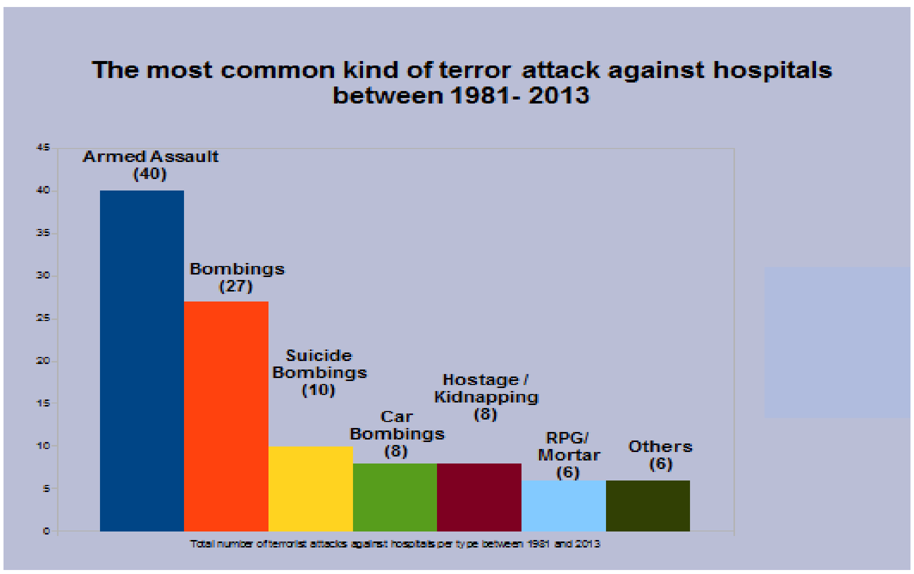


Figure 62. Most Common Kind of Terror Attack Against Hospitals, 1981-2013[94]

The large number of patients, visitors and medical staff on hand all but ensure that an attack on a hospital will produce multiple casualties. A primary attack on a hospital may be expected to receive extensive media coverage. Since hospitals serve entire populations, an attack on a hospital is more anxiety-provoking than an attack on almost any other site because of what is known as "personalization." Prior personal familiarity with a hospital would cause anyone to fear that such an attack could easily have involved him or those close to him. Hospitals are an attractive target for

[93] Ganor B, Halperin Wernli M. Terroris Attacks against Hospitals Case Studies. International Institute for Counter-Terrorism. October 2013.
[94] ibid

terrorist organizations for another reason as well; they house materials and knowledge that could be used by terrorists: medications, poisons, radioactive materials, biological cultures.[95]

Targeted Threat Against the Power Grid

Any of the grid elements can be damaged by intentional malicious events such as cyber and physical security attacks. Unlike cyber threats, which are constantly evolving, many threats to physical infrastructure have been known for years and are more readily understood. Electric utilities take these threats seriously and deploy measures to mitigate such threats.[96]

Electromagnetic Pulse (EMP)[97]

A nuclear EMP is a very real threat, given what we know about the Iranian and North Korean nuclear weapons and ballistic missile programs. Devices capable of subjecting transformers and other critical infrastructure to localized, but destructive, levels of EMP can be built from readily available equipment. While the damage would not be anywhere near as devastating or widespread as a nuclear EMP device might cause, the ease of acquiring and assembling parts obtainable from a local electronics shop means that terrorists have a relatively easy way to cause significant damage to local communities. The April 2013 attack on an electrical substation near San Jose, California demonstrates both the vulnerability of our physical grid infrastructure. Firing more than 100 shots altogether, they knocked out 17 transformers and, even though electric officials were able to avert a blackout, the damage took 27 days to repair.

Cyber Attacks

The U.S. Department of Homeland Security (DHS) reports that cyberattacks on the electric grid system are increasing in both frequency and sophistication. Such attacks come from a variety of different sources, including nation states and sub-national terrorist organizations. DHS reports that the energy sector is the target of more than 40 percent of all reported cyberattacks.[98]

Targeted Threat Against Nuclear Power Plants

Studies have looked at similar attacks on nuclear power plants. They show that nuclear reactors would be more resistant to such attacks than virtually any other civil installations. A thorough study was undertaken by the US Electric Power Research Institute (EPRI) using specialist consultants and paid for by the US Dept. of Energy. It concludes that US reactor structures "are robust and (would) protect the

---

[95] Ganor B, Halperin Wernli M. Terroris Attacks against Hospitals Case Studies. International Institute for Counter-Terrorism. October 2013.

[96] US Government Publishing Office. Blackout! Are we prepared to manage the aftermath of a cyberattack or other failure of the electrical grid? Available at: http://www.gpo.gov/fdsys/browse/committee.action?chamber=house&committee=transportation *Accessed May 1, 2017*

[97] Secure The Grid, http://securethegrid.com/the-basics-of-grid-security/ *Accessed May 1, 2017*

[98] Campbell, Richard J., Cybersecurity Issues for the Bulk Power System," Congressional Research Service, June 10, 2015, available at: http://www.crs.gov/pdfloader/R43989

fuel from impacts of large commercial aircraft." The consequences of an accident are minimal compared with other commonly accepted risks.[99]

Targeted Threat Against Telecommunication Systems

Telecommunications systems are vulnerable to various penetration techniques that may be used for gaining access to the system and intercepting and interpreting communications traffic carried over the system or inserting traffic into the system. The difficulty of penetration is dependent on such factors as the adequacy of administrative controls, the competence and integrity of telecommunications personnel, the physical security maintained over telecommunications facilities, the technical security resulting from telecommunications technology, and the penetrator's technical knowledge and financial resources. Investigation of abnormalities in telecommunications systems operations is the primary method used for detecting penetrations or attempted penetrations. However, a penetrator may not be identified due to the delays in identifying an abnormality and the investigation of its cause.[100]

Social Vulnerability

(Source: https://svi.cdc.gov/)

A number of factors, including poverty, lack of access to transportation, and crowded housing may weaken a community's ability to prevent human suffering and financial loss in the event of disaster. These factors are known as social vulnerability. The ***Social Vulnerability Index (SVI)*** uses U.S. Census data to determine the social vulnerability of every Census tract. The SVI ranks each tract on 14 social factors, including poverty, lack of vehicle access, and crowded housing, and groups them into four related themes.

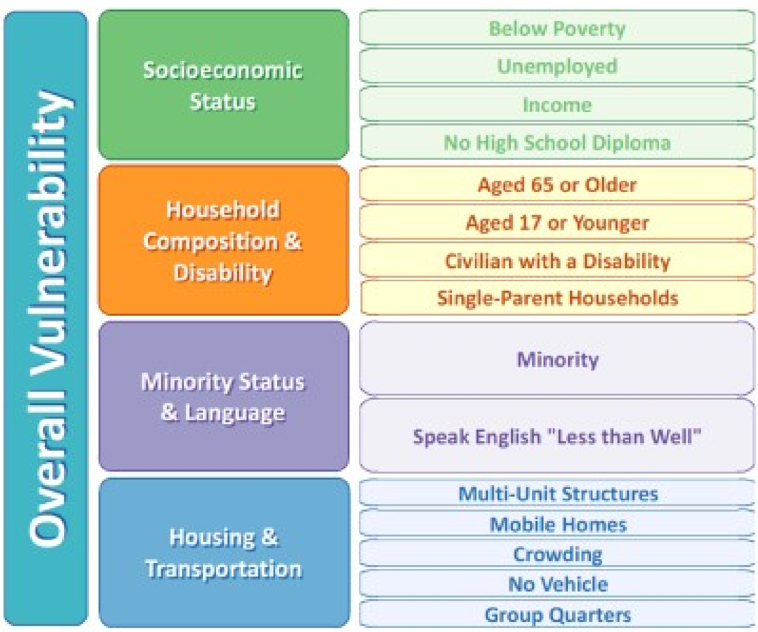


Figure 63. Social Vulnerability

The SVI can be used to:

- Estimate the amount of needed supplies like food, water, medicine, and bedding.
- Help decide how many emergency personnel are required to assist people.
- Identify areas in need of emergency shelters.

[99] World Nuclear Association

[100] U.S. Government Accounting Office. Vulnerabilities of Telecommunications Systems to Unauthorized Use, http://www.gao.gov/products/LCD-77-102

- Plan the best way to evacuate people, accounting for those who have special needs, such as people without vehicles, the elderly, or people who do not understand English well.
- Identify communities that will need continued support to recover following an emergency or natural disaster.

Maps of the four themes are shown in the figures below.

Overall

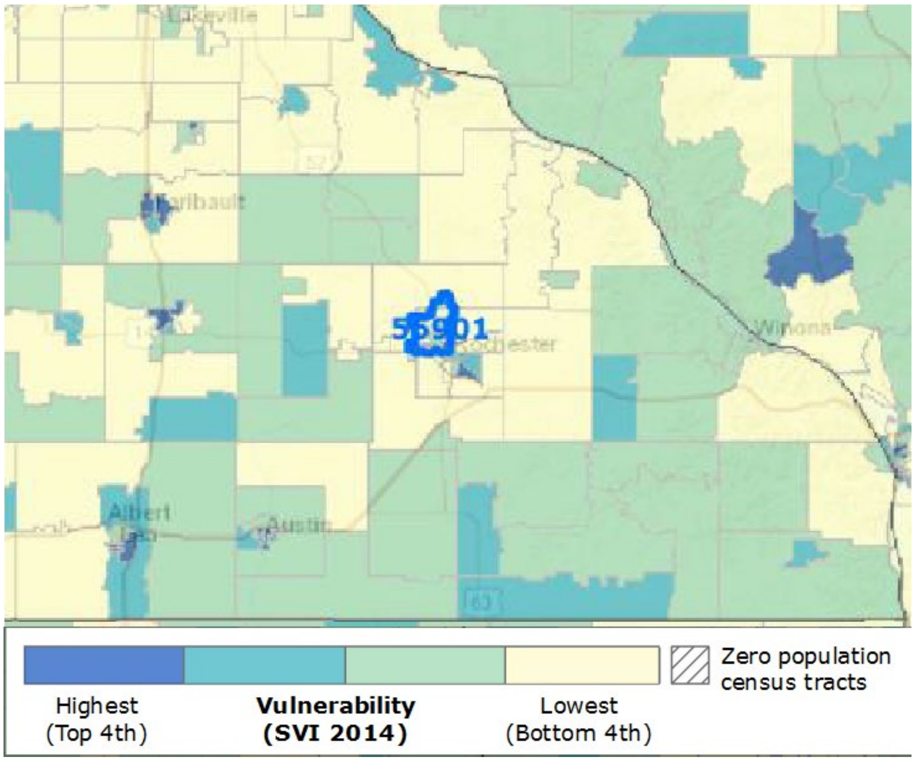


Figure 64. Overall Southeast Minnesota Social Vulnerability Index

Socioeconomic

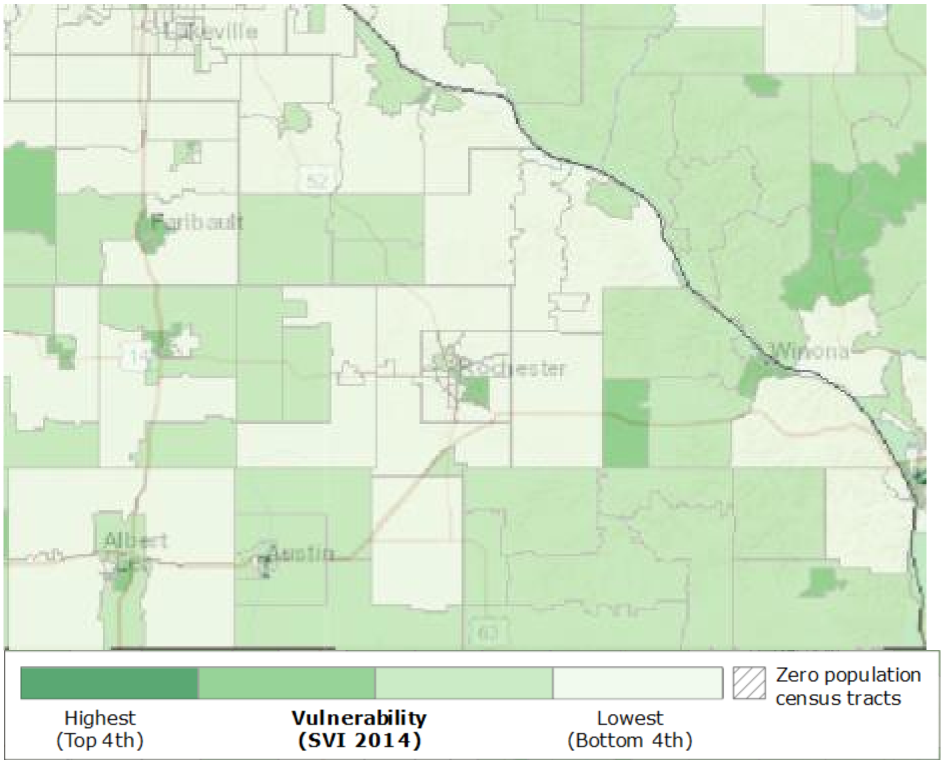


Figure 65. Southeast Minnesota Socioeconomic Social Vulnerability Index

Minority Status/Language

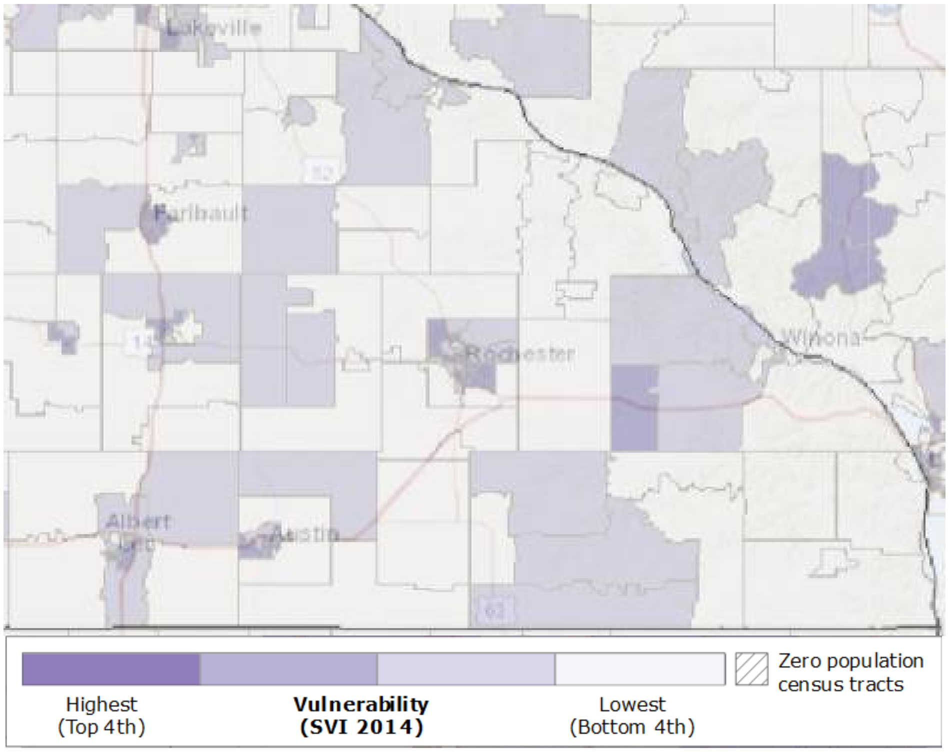


Figure 66 Southeast Minnesota Minority Status and Language Social Vulnerability Index

Housing/Transportation

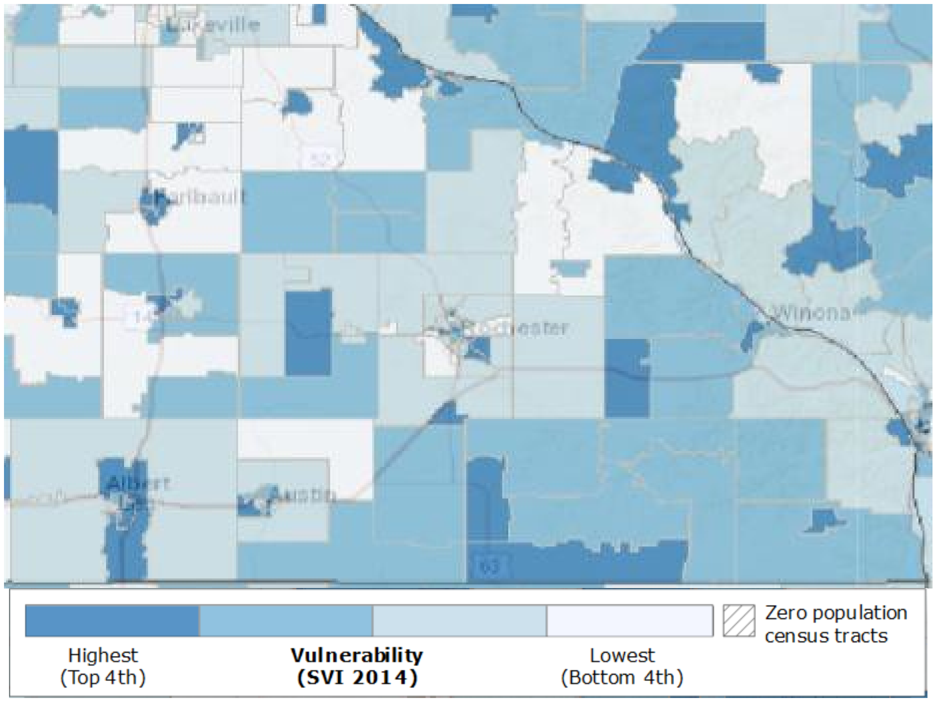


Figure 67. Southeast Minnesota Housing and Transportation Social Vulnerability Index

Household Composition/Disability

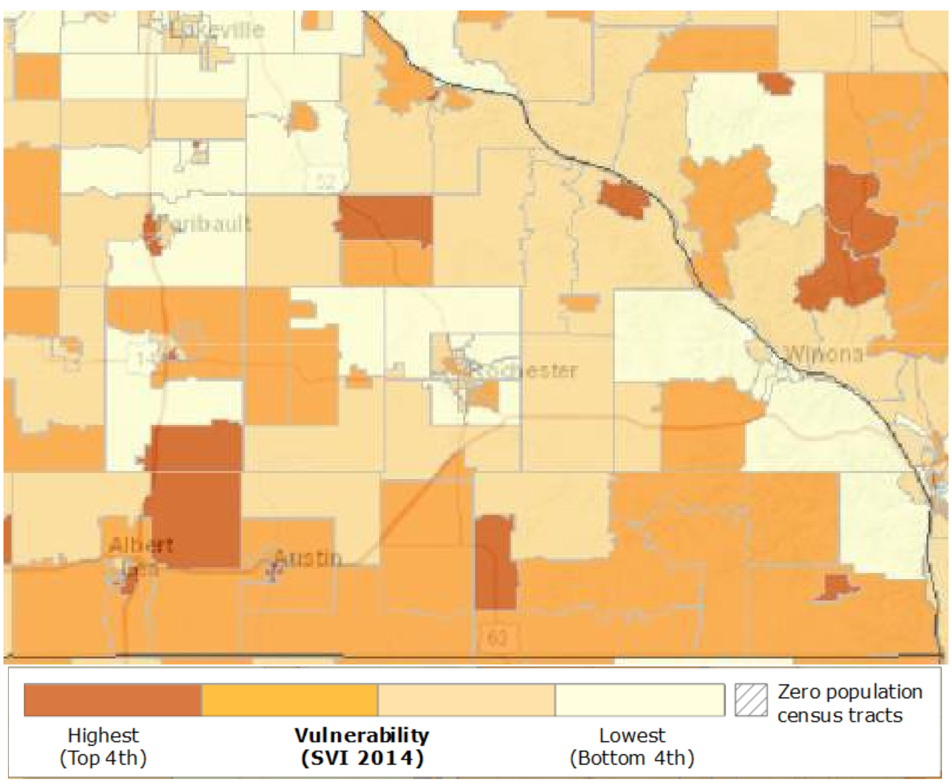


Figure 68. Southeast Minnesota Household Composition and Disability Social Vulnerability Index

emPOWER

A resource to help community partners better anticipate, plan for, and respond to the needs of electricity dependent populations in each community. Public health and emergency management officials, area aging agencies and community planners can use emPOWER to better understand the types of emergency resources that may be needed in an emergency. Hospitals, healthcare coalitions and first responders, including emergency medical services, can use emPOWER to anticipate and plan for a surge in assistance requests and demands for care during a prolonged power outage or other emergency.

Around 30,000 *Medicare beneficiaries* rely upon electricity-dependent medical and assistive equipment, such as ventilators and wheel chairs, and cardiac devices in Minnesota. The following figures provide a *indication of Medicare beneficiaries* (not all citizens) who are electricity-dependent, by county. **Note: The figures represent a snapshot in time; data changes regularly. Most current information, county and zip code level, is available on the interactive emPOWER map.**

Interactive Map: https://empowermap.hhs.gov/

Notes:

- The maps only show de-identified claims data for Medicare Fee-for-Service and Medicare Advantage (Parts A, B and C) beneficiaries that include Americans aged 65 and over and disabled Americans under age 65. This may be an under representation as some claims may not be recorded due to a submission lag or if the Medicare DME rental cap has been reached.
- The electricity-dependent number, by location, represents the total number of beneficiaries with claims from the prior month for: ventilator, BiPAP, internal feeding, IV infusion pump, suction pump, at-home dialysis, electric wheelchair, and electric bed equipment in the past13 months; oxygen concentrator equipment in the past 36 months; and an implanted cardiac device (i.e. LVAD, RVAD, BIVAD, TAH) in the past fiveyears.

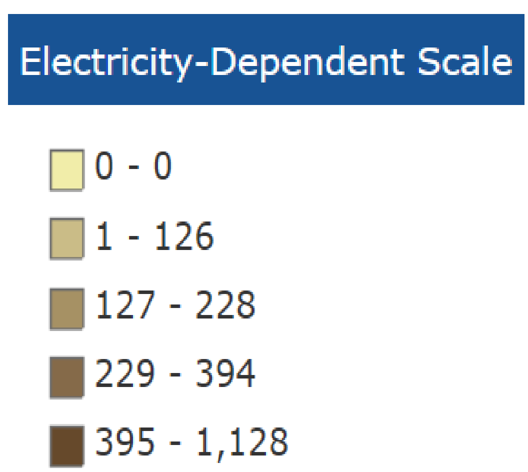


Figure 69. Electricity-Dependent Scale

Dodge County

Figure 70. Electricity-Dependent Population, Dodge County

Fillmore County

Figure 71. Electricity-Dependent Population, Fillmore County

Freeborn County

Figure 72. Electricity-Dependent Population, Freeborn County

Goodhue County

Figure 73. Electricity-Dependent Population, Goodhue County

Houston County

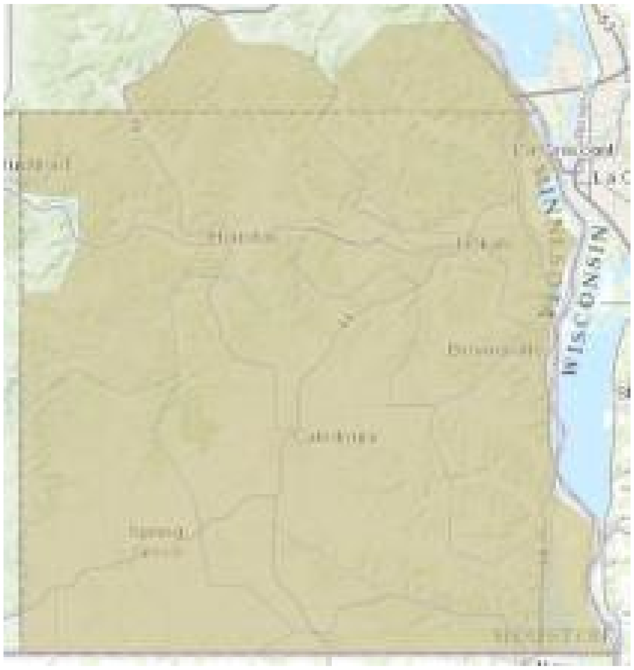


Figure 74. Electricity-Dependent Population, Houston County

Mower County

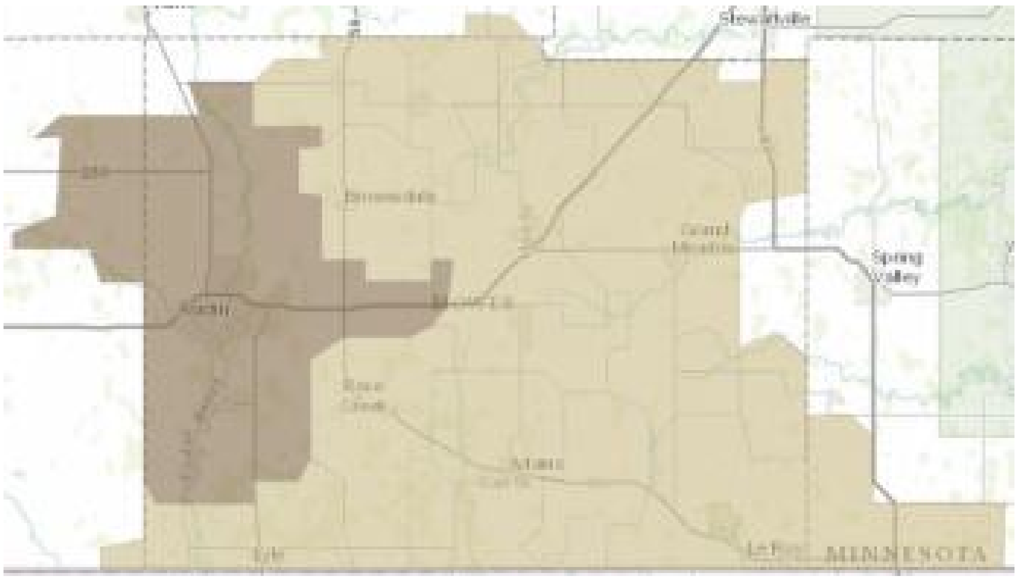


Figure 75. Electricity-Dependent Population, Mower County

Olmsted County

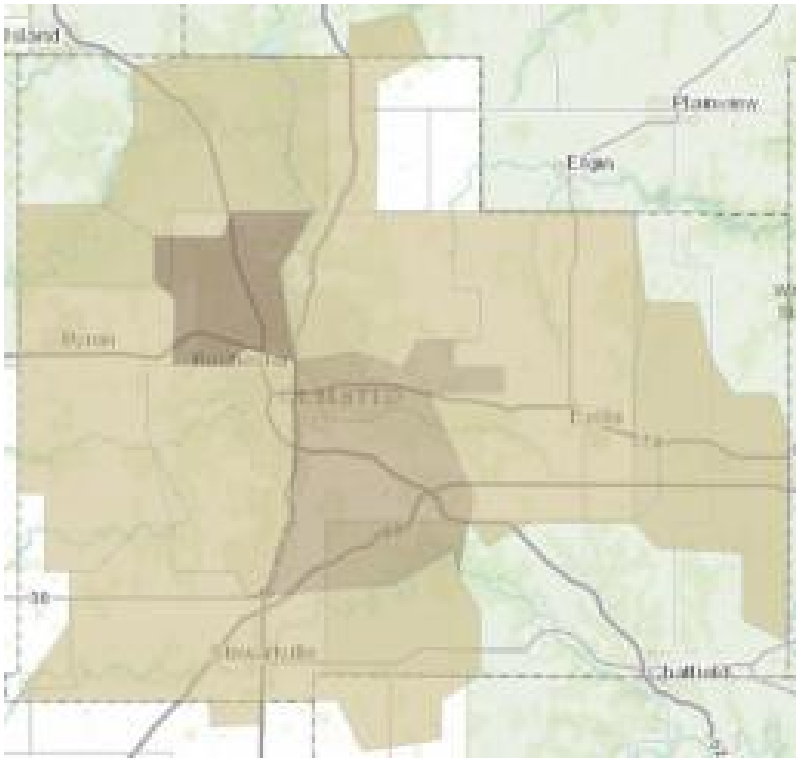


Figure 76. Electricity-Dependent Population, Olmsted County

Rice County

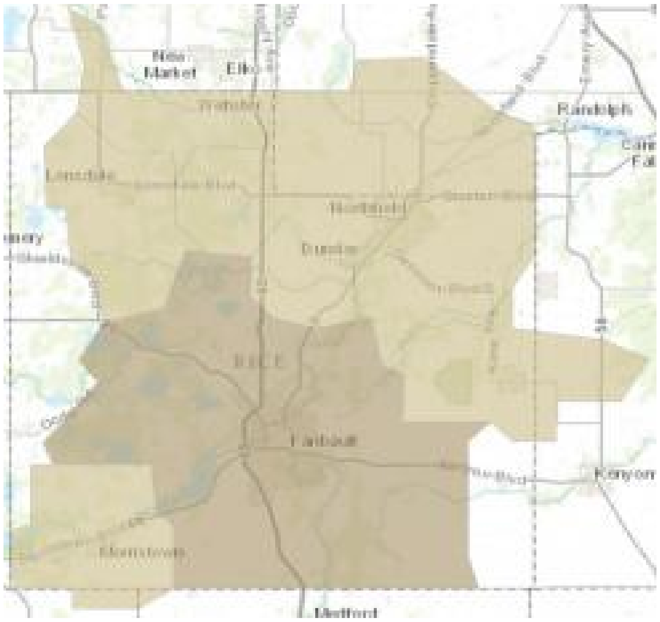


Figure 77. Electricity-Dependent Population, Rice County

Steele County

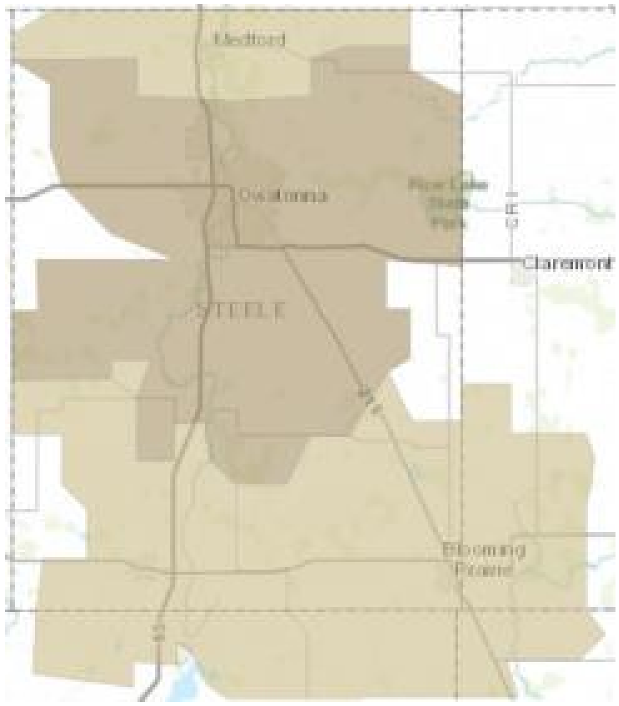


Figure 78.. Electricity-Dependent Population, Steele County

Wabasha County

Figure 79. Electricity-Dependent Population, Wabasha County

Winona County

Figure 80. Electricity-Dependent Population, Winona County

Elderly Living Alone

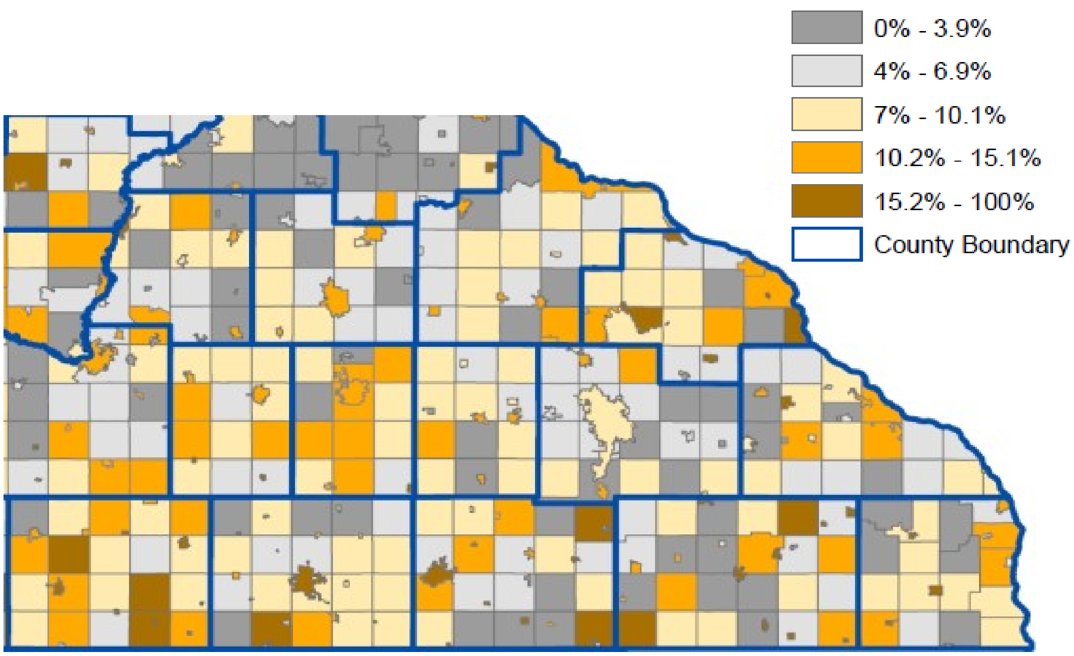


Figure 81. Percentage of Elderly Living Alone[101]

[101] Source: http://www.health.state.mn.us/divs/climatechange/docs/map_livealone.pdf

Health Ranking

County Health Rankings help illustrate what we know when it comes to what is making people sick or healthy. The Community Health Needs Assessment (CHNA) framework is based on the County Health Rankings model where health indicators are categorized into two broad sections - Health Outcomes and Health Factors. Together, the data helps to improve understanding of health in counties throughout the Southeast Minnesota. In turn, the data might suggest what existing health needs might be exacerbated during a disaster.

Southeast Minnesota 2017 county health rankings (out of 87 counties): Houston (#6), Wabasha (#9), Olmsted (#10), Dodge (#15), Fillmore (#17), Goodhue (#23), Rice (#32), Steele (#37), Freeborn (#44), Winona (#46), and Mower (#53).

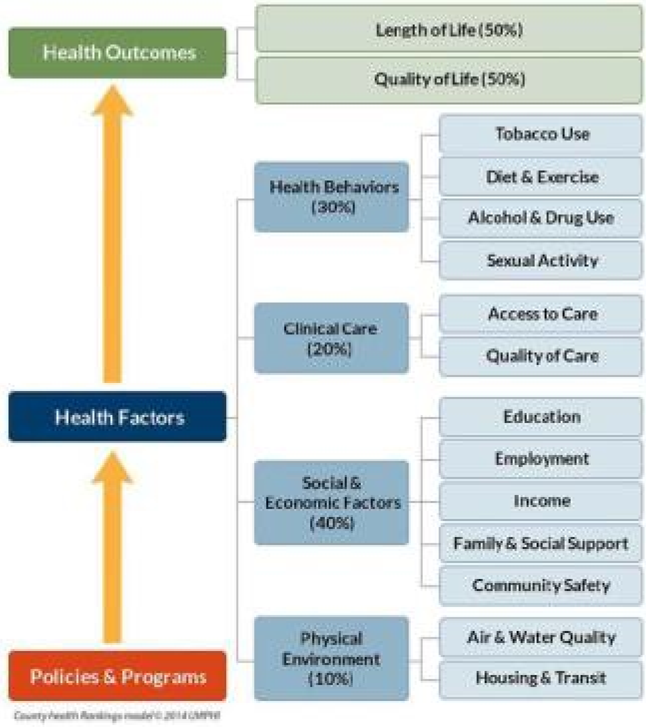


Figure 82. County Health Ranking Model

	Minnesota	Dodge (DD) , MN X	Fillmore (FI) , MN X	Freeborn (FR) , MN X	Goodhue (GO) , MN X	Houston (HU) , MN X	Mower (MW) , MN X	Olmsted (OL) , MN X	Rice (RI) , MN X	Steele (SE) , MN X	Wabasha (WB) , MN X	Winona (WI) , MN X
Health Outcomes		15	17	44	23	6	53	10	32	37	9	46
Length of Life		22	21	24	18	1	41	13	20	35	11	32
Quality of Life		16	24	69	43	30	65	12	54	42	11	62
Health Factors		6	21	70	35	15	76	1	30	28	13	42
Health Behaviors		9	8	52	37	5	76	6	34	42	25	60
Clinical Care		15	37	61	25	7	60	1	24	10	4	29
Uninsured	7%	5%	8%	8%	7%	6%	8%	6%	8%	5%	6%	7%
Primary care physicians	1,100:1	3,390:1	2,970:1	1,620:1	1,080:1	1,440:1	1,970:1	440:1	1,100:1	1,080:1	1,420:1	2,130:1
Dentists	1,480:1	5,090:1	1,890:1	2,550:1	2,210:1	2,090:1	2,170:1	1,080:1	1,720:1	1,190:1	1,420:1	1,960:1
Mental health providers	510:1	5,090:1	6,940:1	1,130:1	1,080:1	4,690:1	1,000:1	330:1	1,020:1	530:1	21,240:1	630:1
Social & Economic Factors		8	39	74	34	52	68	12	36	32	14	25
Physical Environment		44	54	70	62	67	78	22	43	65	64	75

Table 8. Health Outcomes & Factors Comparison for Southeast Minnesota Counties

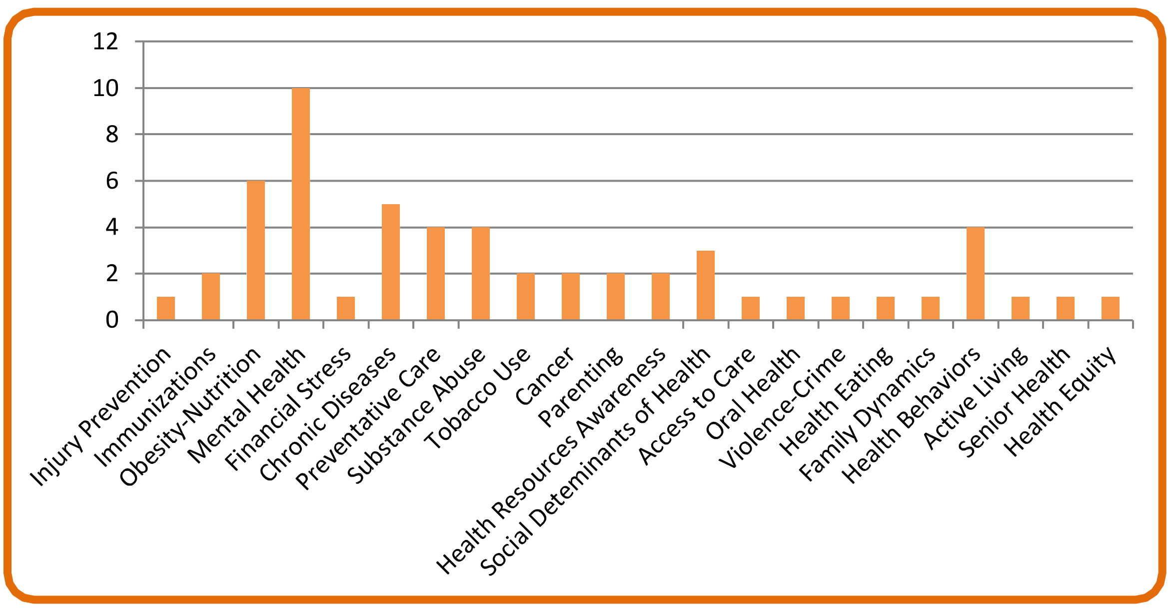


Figure 83. Southeast Minnesota CHNA Priorities Identified by Each County

Regional Risk

By aggregating the quantitative data that has been collected by the varied entities throughout the region and analyzing the qualitative assessments that have been conducted the Southeast Minnesota Disaster Health Coalition has been able to assemble as summary of the risk environment and synthesize a snapshot of the relative risk that exists at this moment in time. The SEMN DHC stakeholders represent an extremely broad cross section of partners who provide services where interaction is common yet the services provided have discreet components that present unique risks to the populations served and the service providers. In an effort to provide our members and partners with information that provides value we have chosen to separate the regional risks into categories that define stakeholder using the primary functions they provide.

Coalition Partner	Primary Service Provided	Primary Delivery Modality
Hospitals	Acute Inpatient Care	Fixed Facility
Long Term Care	Skilled Inpatient Type Residential Care	Fixed Facility
Public Health	Population Health	Outreach
Home Care	Skilled Inpatient and Outpatient Care and Services	Outreach
Jurisdictional EM	Public Safety	Outreach
Volunteer Organizations	Public Service	Outreach
Durable Medical Equipment Providers	Public Service	Outreach

Table 9. Partner Categorization Table

The hazards that exist across the southeast region are largely constant with data demonstrating the primary exacerbation of constant risks being related to highly specific geographic distinctions. A fixed facility or location where an individual receives services being located in a flood prone area being the most obvious. Geographically distinct locations throughout the region have unique characteristics that can create outlier risks; however to provide greatest possible value and make use of generalizable data this assessment will concentrate on broadly applicable risks and note outlier risks as a sub set.

A detailed review of individual facility and Hazard Vulnerability Assessments (HVA), Risk Assessments, and jurisdictional Threat and Hazard Identification and Assessments (THIRA) provided the information that has been included in a Regional HVA. The data produced has been validated by the members of the coalition as an accurate representation of the Hazards and Risks they have identified in their facility or service based assessments.

In the figure below a grid provides an illustration of the impact categorized threats/hazards listed on the vertical column found on the left have on the foundational dependencies listed in the horizontal row at the top. Participants chose the impact that an event meeting the description in the vertical column would have upon the dependency listed in the horizontal row at the top.

Threat/Hazard Category (Instructions below)	Structure	Power	Water	HVAC	Data	Capital Equipment	Supplies	Staffing
Hazardous Material Leak (external)	Negligible	Negligible	Critical	Critical	Negligible	Negligible	Negligible	Critical
Hazardous Material Leak (internal)	Negligible	Negligible	Marginal	Critical	Negligible	Negligible	Negligible	Negligible
Health Outbreak	None	None	Negligible	Negligible	None	None	Critical	Critical
>73 mph Wind	Marginal	Critical	Critical	Critical	Marginal	Marginal	Marginal	Critical
Information Technology Disruption	Negligible	Negligible	Negligible	Critical	Critical	Negligible	Marginal	Negligible
Land Movement	Critical	Critical	Critical	Critical	Critical	Marginal	Marginal	Marginal
Other Infrastructure Disruption	Marginal	Marginal	Marginal	Critical	Marginal	Marginal	Marginal	Critical
Power Disruption	Marginal	Critical	Marginal	Critical	Critical	Negligible	Negligible	Marginal
Radiological Incident (External)	Negligible	Negligible	Negligible	Marginal	Negligible	Negligible	Negligible	Negligible
Radiological Incident (Internal)	Marginal	Negligible	Negligible	Critical	Negligible	Marginal	Marginal	Marginal
Supply Disruption	None	None	None	None	Negligible	Negligible	Catastrophic	None
Transportation Accident	None	None	None	None	None	None	Marginal	Marginal
Transportation Disruption	None	Negligible	Negligible	Negligible	Negligible	None	Critical	Marginal
Water Intrusion (external)	Critical	Critical	Critical	Critical	Marginal	Marginal	Critical	Critical
Water Intrusion (internal)	Marginal	Marginal	Marginal	Negligible	Negligible	Marginal	Negligible	Negligible
Water Shortage	Negligible	Negligible	Critical	Marginal	None	Negligible	Marginal	Negligible

Table 10. Categorized Threat/hazard Impact

Among the complexities that challenge the analysis of data used to inform the risk assessment process for a multidisciplinary coalition are the exceptionally fluid interdependencies that exist among providers, patients, clients, the public, and the threats/hazards that may impact operations. In an effort to provide context for the interdependencies that dominate the activities of the coalition the members were asked to assess the cascading impacts that they would anticipate for each of the 22 threat/hazard categories.

Cascading Effect	Civil Disorder	Communication Disruption	Extreme Temperatures	Fire (External intruding)	Fire (Internal)	Hazardous Material Leak (external)	Hazardous Material Leak (internal)	Health Outbreak	High Wind (>73 mph)	Information Technology Disruption	Land Movement	Other Infrastructure Disruption	Power Disruption	Radiological Incident (External)	Radiological Incident (Internal)	Supply Disruption	Transportation Accident	Transportation Disruption	Water Intrusion (external)	Water Intrusion (internal)	Water Shortage
Civil Disorder		x		x	x			x		x		x	x	x	x	x	x	x		x	x
Communication Disruption				x	x	x	x	x	x	x	x	x				x	x	x			
Extreme Temperatures	x					x		x		x		x	x			x		x			x
Fire (External intruding)		x				x				x		x		x		x	x				x
Fire (Internal)		x		x			x			x	x					x				x	x
Hazardous Material Leak (external)		x			x						x	x	x			x	x				x
Hazardous Material Leak (internal)		x										x	x		x						
Health Outbreak											x					x					x
>73 mph Wind		x										x				x	x				
Information Technology Disruption		x			x	x			x		x		x	x	x	x					
Land Movement		x										x	x	x		x	x		x	x	x
Other Infrastructure Disruption		x			x	x	x	x	x		x		x			x					
Power Disruption		x			x	x	x		x	x	x			x	x	x	x				x
Radiological Incident (External)		x		x		x					x		x			x					x
Radiological Incident (Internal)											x										
Supply Disruption						x	x	x	x	x	x		x								
Transportation Accident				x		x					x		x			x					
Transportation Disruption						x	x	x	x	x	x		x			x					
Water Intrusion (external)		x									x					x	x				
Water Intrusion (internal)		x			x										x						
Water Shortage				x		x	x	x			x		x								

Figure 84. Categorized Threat/Hazard Cascade

Coalition members identified Workplace Violence as the most significant hazard to their missions and associated operations by a considerable margin. The ever present possibility of severe weather, specifically severe thunderstorms, was the second most noted hazard and a broad cross-section of disciplines identified failures of information systems as ranking third among the significant hazards to their missions and associated operations.

Comparative assessment of the relative risks when categorized indicates that human caused events are perceived as greater concern than are other risks. When evaluating the individual risks of workplace violence, severe thunderstorms, and information systems failures the data collected suggests that the perceptions have validity. The table below allows for comparison of the rankings assigned to the 22 Threat/Hazard categories, specifically calling out the top three concerns.

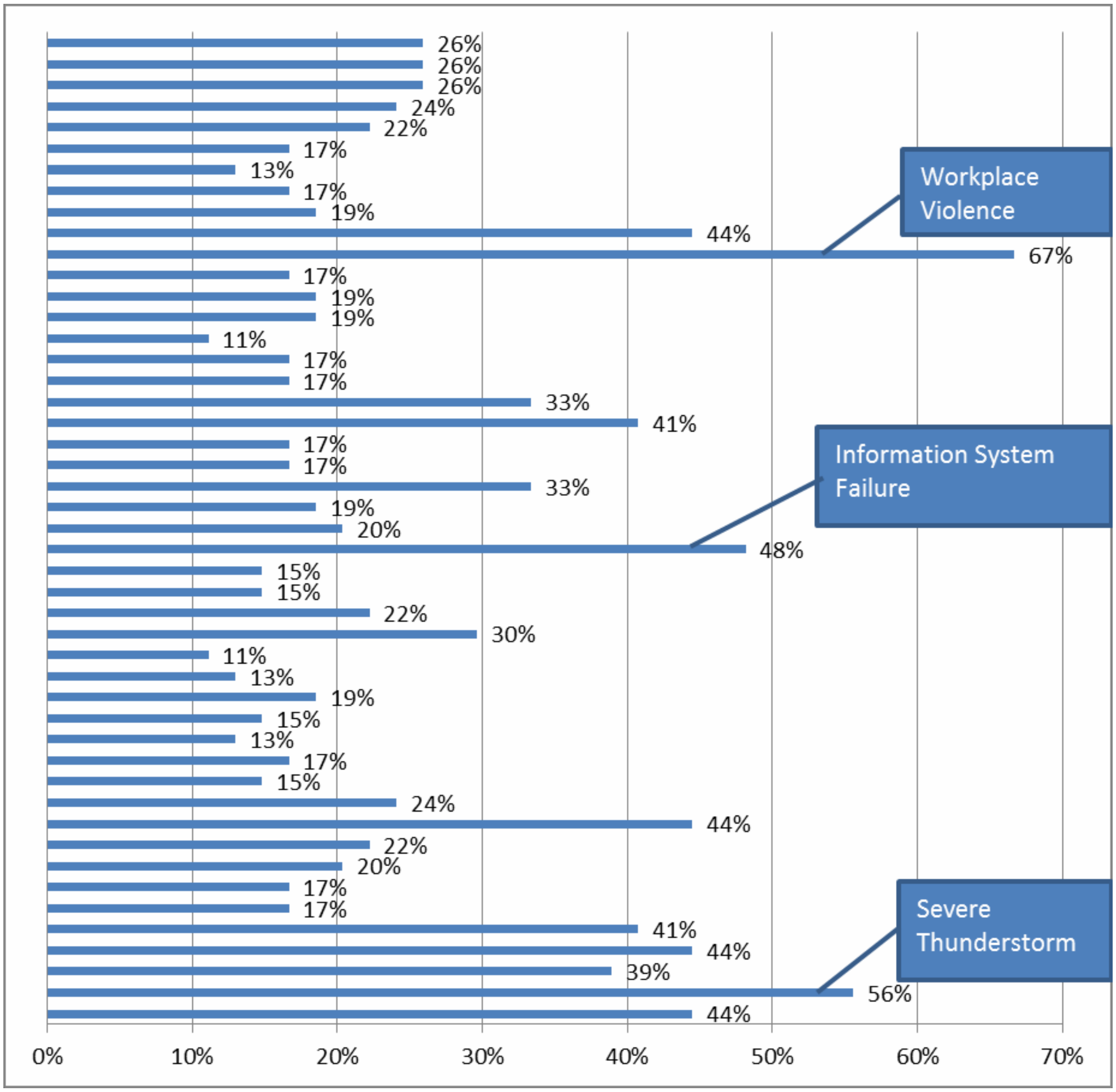


Figure 85. Categorical Ranking Comparative

Impact Assessment

Data concerning the impact of crisis events identified as the most significant concerns in regional hazard vulnerability assessments was gathered in a workshop session on risk at the June 2017 Southeast Minnesota Disaster Health Coalition Meeting.

A survey requesting information from the participants was conducted with all participants receiving the same instructions and information. Completion of the survey was facilitated and the participants were advises to list the discipline they represented on the survey. Information relating to the specific facility was optional and provided on less than half of the surveys completed.

Fifty-nine individuals representing forty-two entities from fourteen disciplines participated in the session. Thirty nine responses to the facilitated survey were provided. The summary that follows was created using the information provided.

Impact	Severe Weather			Workplace Violence			IT System Failure			Pandemic		
	Staff	Space	Stuff	Staff	Space	Stuff	Staff	Space	Stuff	Staff	Space	Stuff
None	0%	0%	0%	0	60%	80%	0%	20%	20%	0%	20%	20%
Negligible	0%	0%	0%	40%	20%	0%	0%	20%	0%	0%	20%	20%
Marginal	60%	40%	60%	20%	0%	0%	0%	20%	40%	40%	20%	0%
Critical	40%	60%	40%	40%	20%	20%	100%	40%	40%	60%	40%	60%
Catastrophic	0%	0%	0%	0%	0	0%	0%	0%	0%	0%	0%	0%

Table 11. Impact of Staff, Space and Stuff by Scenario

Impact Description	Impact Definition
None	No discernable impact— • No life safety impact • May not be noticed, has no impact on operations. • Information sharing is optional.
Negligible	Having insignificant or inconsequential impact – • Little or no life safety impact • Likely to be noticed but does not impact operations. • Efficiency is maintained and delays are possible • Information sharing is internal and relaxed.
Marginal	Having limited impact – • Potential for life safety impacts. • Creates inconvenience or requires changes to processes to maintain operations • Efficiency is reduced and delays are likely • Operational decisions include prioritization of non-emergent operational objectives. • Information sharing o Urgent/Emergent for Internal o Urgent/Emergent for External

Impact Description	Impact Definition
Critical	Has significant impact to operations – • Life safety impacts are likely • Changes in process must be made to fulfill mission critical operational demands. • Operational decisions include prioritization of non-emergent operational objectives. • Efficiency reduced, some operations may be discontinued and delays are unavoidable. • Information sharing is emergent and includes life and property preservation
Catastrophic	Has significant impact to operations – • Life safety impacts will occur • Changes in process must be made to fulfill mission critical operational demands. • Operational decisions include stopping all non-emergent operational activities. • Information sharing is emergent and dedicated to protecting life

Table 12. Impact Category and Definitions

Supporting References

County Health Rankings

- Minnesota 2017 County Health Rankings

Community Health Needs Assessment (CHNA)/Health Improvement Plan

- Dodge County
- Fillmore County
- Freeborn County
- Goodhue County
- Houston County
- Mower County
- Olmsted County
- Rice County
- Steele County
- Wabasha County
- Winona County

Threat & Hazard Identification & Risk Assessment (THIRA)

- City of Rochester THIRA
- Minnesota Region 1 THIRA

Mitigation Plan

- Minnesota All-Hazards Mitigation Plan
- City of Rochester
- Houston County
- Winona County

Flood Insurance Studies

- Olmsted County
- Rice County

Miscellaneous

- Earthquake History of Minnesota, Minnesota Geological Society
- Midwestern Regional Climate Center
- Minnesota Extreme Heat Toolkit
- Minnesota State Demographic Center
- MN Public Health Data Access Portal
- FEMA Multi-Hazard Identification and Risk Assessment (MHIRA)
- EPA Toxic Release Inventory
- Disasters in the New Millennium, A Historical Look at Minnesota Disasters, 2000-2010

- National Weather Service
    - Natural Hazard Statistics
    - Hazard Profiles
- Minnesota Statewide Drought Plan

---

[i] Cordesman, A. The Challenge of Biological Terrorisum. The CSIS Press. Washington, DC 2006

[ii] Banks, L., Biosurveillance: Detecting the Next "Silent" Attack. *DomPrep J*. 2011:7(12):14-15

[iii] http://en.wikipedia.org/wiki/Bioterrorism Accessed April 6, 2012

[iv] http://en.wikipedia.org/wiki/Influenza Accessed April 6, 2012

[v] http://www.bt.cdc.gov/agent/agentlist-category.asp Accessed April 6, 2012

[vi] Mayo Clinic Annual Hazard Vulnerability Assessment (HVA) 2011-2012: Annual HVA Task Force Report to Emergency Preparedness Subcommittee.

Change Management Documentation

Content and Update	Date
New Document	2017
Annual Review and approval by Advisory Committee	November 2018
Annual Review and approval by Advisory Committee	September 2019