Flood – Hazard Profile

Description

Floods are naturally occurring hazards that happen frequently throughout the world. The National Flood Insurance Program (NFIP), which is administered by the Federal Emergency Management Agency (FEMA), defines floods in the following way:

- A general and temporary condition of partial or complete inundation of two or more acres of normally dry land area or of two or more properties from:
    - Overflow of inland or tidal waters; or
    - Unusual and rapid accumulation or runoff of surface waters from any source; or
    - Mudflow; or
- Collapse or subsidence of land along the shore of a lake or similar body of water as a result of erosion or undermining, caused by waves or currents of water exceeding anticipated cyclical levels that result in a flood as defined above.

Floods are a natural phenomenon; however, human activities often intensify flood hazards because of the alteration of natural conditions. Floods often occur along rivers and streams, in poor drainage areas, or in oversaturated soils.

Flooding is North Dakota's most costly and repetitive natural hazard. All 53 counties have experienced severe damages and losses to public and private properties due to floods. The floodplain in Bismarck is developed with housing, streets, railroads, businesses, and recreational facilities. Hazardous materials (fixed facilities) in the floodplain leads to the potential for contamination and complicates and increases the extent of damage caused by flooding.

Surface water is that water found on the land surface, and includes overland flow and flow in distinct channels. The three major sources of surface water include streams and rivers flowing into the state, precipitation, and groundwater discharge along streambeds. Surface water leaves the state in out-flowing streams and rivers, by evaporation, and by percolating downward into the subsurface into the groundwater flow system.

Many floods in North Dakota occur because the ground is frozen and/or saturated with moisture and cannot absorb any further moisture. This moisture can come from several different sources and circumstances. One source is a heavy snowpack, which is affected by a rapid warming trend as well as spring rain falling directly on the snow pack.

The spring flood danger period generally occurs during March and April. The magnitude of the flooding varies from year to year depending on such factors as characteristics of the snow cover, soil moisture conditions, frost depth, winter temperatures, temperatures during spring melting, spring precipitation, and the extent of ice jams. A wet fall, early freeze up with saturated ground at the time of freezing, heavy winter precipitation, and warm rains during and after spring thaw add to the seriousness of the spring flooding situation. Smaller streams are more susceptible to flooding in the summer with peak flows resulting from thunderstorms.

Riverine Flooding
Riverine flooding originates from a body of water, typically a river, creek, or stream, as water levels rise onto normally dry land. The riverine hazard areas in Bismarck are mapped as part of the National Flood Insurance Program (NFIP). Under this program, an area is broken into zones to depict the level of flood hazard.

Most commonly, the areas within the 100-year floodplain are considered the greatest risk. The 100-year floodplain has a 1% chance of exceedance in any given year. Locations outside the 100-year floodplain may also experience flood conditions during greater magnitude floods, localized events, or along unmapped creeks, streams, and ditches.

Most riverine floods are slow developing events with a natural, predictable source of water or moisture, such as snowmelt, slow rain, or a controlled dam release. This type of flood can often be forecast based on the amount of moisture or water available. The timing and location of flood conditions can often be calculated to a reasonable degree. If implemented in a timely manner, protective measures can sometimes mitigate the potential damage and loss. Because river levels of the Missouri River at Bismarck are controlled to a large extent by the COE via the Garrison Dam, flood forecast products (NWS) do not exist for the Missouri River near Bismarck.

Ice Jams
Flooding can also result from ice jamming or blockage along streams and rivers. Ice breaking up into pieces, called floes, moves along with the flowing rivers or streams. The ice floes can jam at curves, narrow places in the channel, structures, river/stream confluences, or where there is a sharp decrease in river bed gradient, creating an effective dam that produces water backup and overflow. Ice jams can cause considerable increases in upstream water levels, while at the same time downstream water levels may drop. According to the US Army Corp of Engineers, the types of ice jams include freeze up jams, breakup jams, or combinations of both. When an ice jam releases, the effects downstream can be similar to that of a flash flood or dam failure.

Flash Flood
Another source of flooding, called flash flooding, occurs when heavy rain falls in such a short time that the soil cannot absorb it and/or drainage systems (natural or man-made) cannot carry the volume of water away as quickly as it accumulates. Flash flooding also occurs when heavy rain falls over a prolonged period of time and the ground becomes saturated and cannot absorb the additional moisture fast enough.

A flash flood is usually caused by severe thunderstorms, heavy rains on snowpack, slow moving storms, dam, dike, or levee failures, or ice jam releases. Flash floods can occur anywhere when a large volume of water inundates an area over a short time period. Because of the localized nature of flash floods, clear definitions of hazard areas do not exist. These types of floods often occur rapidly with significant impacts. Rapidly moving water, only a few inches deep, can lift people off their feet, and only a depth of a foot or two, is needed to sweep cars away. Most flood deaths result from flash floods.

Urban flooding is the result of development and the ground's decreased ability to absorb excess water without adequate drainage systems in place. Typically, this type of flooding occurs when land uses change from fields or woodlands to roads and parking lots. According to the National Oceanic and Atmospheric Administration, urbanization increases runoff two to six times more than natural terrain.
The flooding of developed areas may occur when the amount of water generated from rainfall and runoff exceeds a storm water system's capability to remove it. *Note: When property damage does not occur, these events are technically referred to as "urban ponding."*

Groundwater levels fluctuate from season to season and from year to year. Excessive groundwater may flood basements and crawlspaces but never reach the Earth's surface. Often this type of flooding occurs during or following periods of heavy rainfall or snowmelt.

Flooding is one of the most deadly hazards nationwide and in North Dakota. Most injuries and deaths occur when people are swept away by flood currents, and most property damage results from inundation by sediment-laden water. Fast-moving water can wash buildings off their foundations and sweep vehicles downstream. Pipelines, bridges, and other infrastructure can be damaged when high water combines with flood debris. Basement flooding can cause extensive damage.

A tremendous amount of soil erosion takes place by water movement and its pressures on land surfaces. Runoff from the eroded areas is swift, thus contributing to flood magnitude. Additionally, when the floodflow slackens, the suspended materials will settle to the bottom of the channel, reducing the space that was previously available to keep the river within its banks. This sedimentation increases flood potential.

Probable Maximum Precipitation (PMP) is defined by the Federal Emergency Management Agency as theoretically, *"the greatest depth of precipitation for a given duration that is physically possible over a given size storm area at a particular geographical location during a certain time of year."*

In June 2021, the ND Department of Water Resources completed an update of the statewide Probable Maximum Precipitation (PMP) data through a two-year PMP study. The PMP depths are used in the computation of the Probable Maximum Flood (PMF), generally for the design of high-hazard structures (ie: dams). See the Dam Failure Hazard Profile within section 10 of this plan for more information regarding Probable Maximum Precipitation.

Missouri River Basin

Comprised of seven major sub-basins, the Missouri River Basin, the state‘s largest, drains nearly 48 percent of the state‘s total area. The seven subdivisions included in the Missouri River Basin are the Grand, the Cannonball, the Heart, the Knife, the Little Missouri, the Missouri, and the Yellowstone rivers and direct, minor tributaries. The climate is mostly semiarid. Buttes, hills, and smaller valleys characterize the topography and are most prominent in the Badlands along the Little Missouri River. The area east of the Missouri River is marked with numerous small lakes and wetlands. Annual mean precipitation ranges from 13 inches in the northwest to 17 inches in the east.

Flood control measures in the basin include Fort Peck Dam located in northeast Montana, the Garrison Dam which forms Lake Sakakawea, Oahe Dam in South Dakota which forms Lake Oahe, and the Heart Butte and Dickinson Dams on the Heart River.

Lake Sakakawea was formed by the construction of the Garrison Dam in 1953. Lake Sakakawea covers 368,000 surface acres, can store a maximum of 24.5 million acre-feet, and has 1,600 miles of shoreline in six counties. Lake Oahe Dam in South Dakota covers 40,000 to 80,000 surface acres in North Dakota, with an average storage of 989,605 acre-feet and a maximum storage of 1,626,588 acre-feet, depending upon the management elevation of the lake. The two projects required a total of 550,000 acres of land in North Dakota, including shoreline acres needed for flood conditions.

Flood Insurance Study (FIS)

The revised Flood Insurance Study (FIS), effective June 6, 2024, covers the entire geographic area of Burleigh County, North Dakota. The FIS is available as a FEMA document. The Flood Insurance Study Number is 38015CV000C, Version Number 2.6.3.2.

Purpose of this Flood Insurance Study Report: The Flood Insurance Study (FIS) Report revises and updates information on the existence and severity of flood hazards for the study area. The studies described in the report developed flood hazard data that will be used to establish actuarial flood insurance rates and to assist communities in efforts to implement sound floodplain management.

The Basin Characteristics, Principal Flood Problems, and Historic Flooding Elevation Summaries below are copied from the current Flood Insurance Study.

Basin Characteristics

HUC-8 Sub-Basin Name	HUC-8 Sub-Basin Number	Primary Flooding Source	Description of Affected Area	Drainage Area (square miles)
Apple Creek	10130103	Apple Creek	Encompasses the majority, including the eastern portion of Burleigh Co. and water flows west	3,633
Painted Woods-Square Butte	10130101	Missouri River	Encompasses the northwestern portion of Burleigh Co. and water flows west and south	2,527
Upper Lake Oahe	10130102	Missouri River	Encompasses the southwest portion of Burleigh Co. and water flows south	3,630

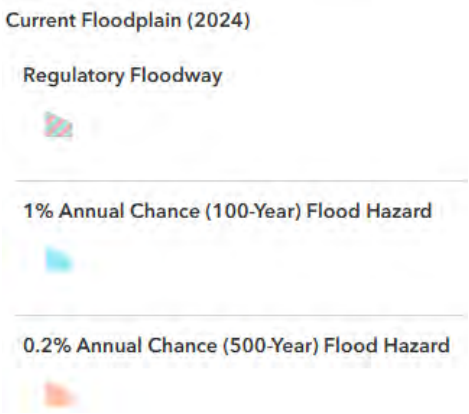
Principal Flood Problems

Flooding Source	Description of Flood Problems
Apple Creek	Short duration, high-intensity spring rainstorms, in combination with snowmelt are the principal cause of flooding. High intensity rainstorms also cause minor flooding.
Burnt Creek	Short duration, high-intensity spring rainstorms, in combination with snowmelt are the principal cause of flooding. High intensity rainstorms also cause minor flooding.
Hay Creek	Short duration, high-intensity spring rainstorms, in combination with snowmelt are the principal cause of flooding. High intensity rainstorms also cause minor flooding. Hay Creek is located in both rural and urban parts of the county. Flooding within the urban communities is particularly impactful because it affects structures.
Missouri River	Significant inflows from the Upper Missorui and Yellowstone Basins into Lake Sakakawea create long duration flood risks. Freeze-up and break-up ice jams have significantly contributed to flooding in the area. While the severity of ice jams has decreased since the construction of Garrison Dam, the potential for severe river blockage still exists.
Random Creek	Random Creek is located in a low-elevation marshy area.

Historic Flooding Elevations

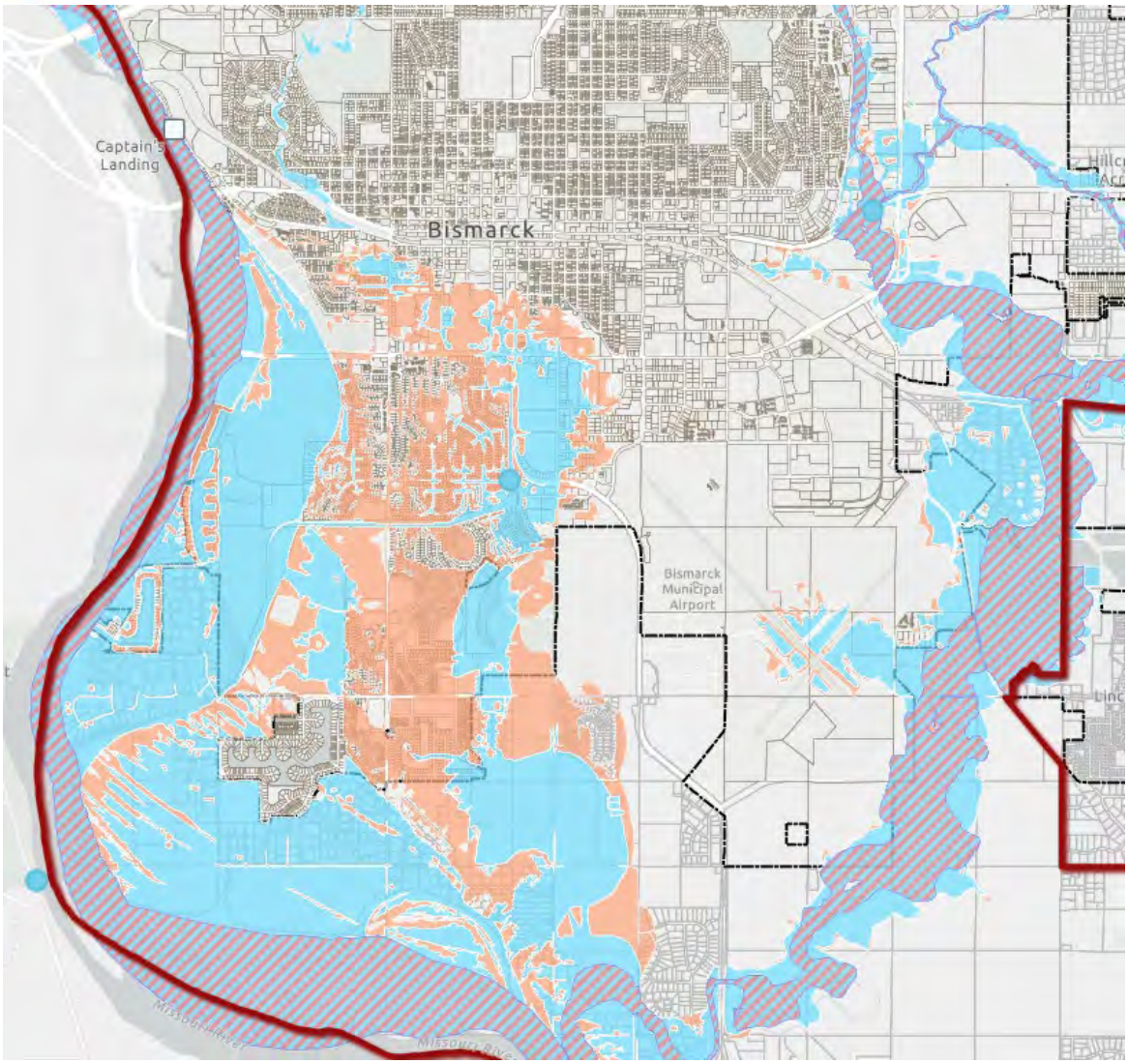
Flooding Source	Location	Historic Peak (Feet NAVD88)	Event Date	Approximate Recurrence Interval (years)	Source of Data
Apple Creek	Apple Creek Road – USGS Gage 06349500	1657.46	1979	50	USGS Gage
Burnt Creek	15th Street NW – USGS Gage 06342450	1706.34	1979	150	USGS Gage
Missouri River	Bismarck Water Treatment Plant – USGS Gage 06342500	1638.87	2011	400	USGS Gage

100-Year and 500-Year Floodplain Map – City of Bismarck



The FEMA Flood Map Service Center is the official online location to find all flood hazard mapping products created under the National Flood Insurance Program, including our community's flood map.

https://www.fema.gov/flood-maps



https://www.arcgis.com/apps/mapviewer/index.html?webmap=b6ba0e85b8b84ef48db3b24fb2d2de78

The “Floodplain Changes” map on the following page illustrates the location of structures added and removed from the 100-year floodplain as a result of the updated FIRM.

Structures within the 100-Year floodplain including Bismarck and the 4-mile ETA.

Year End	Total buildings within the SHFA. Includes Bismarck and the 4-mile ETA.
2020	2420
2021	2520
2022	2550
2023	2563
***2024**	**3,876**

***As a result of the FIRM update effective June 6, 2024, there were 1,742 buildings added to the floodplain and 413 were removed.** Additional structures were built within the floodplain (61) as well as 18 affected by map revisions in the year 2024. The current total buildings within the SFHA as of January 9, 2025 is 3,876.

Acronyms Used above:

SFHA: Special Flood Hazard Area (100-year floodplain)
FIRM: Flood Insurance Rate Map
ETA: Extraterrestrial Area (4 mile zone outside Bismarck city limits)

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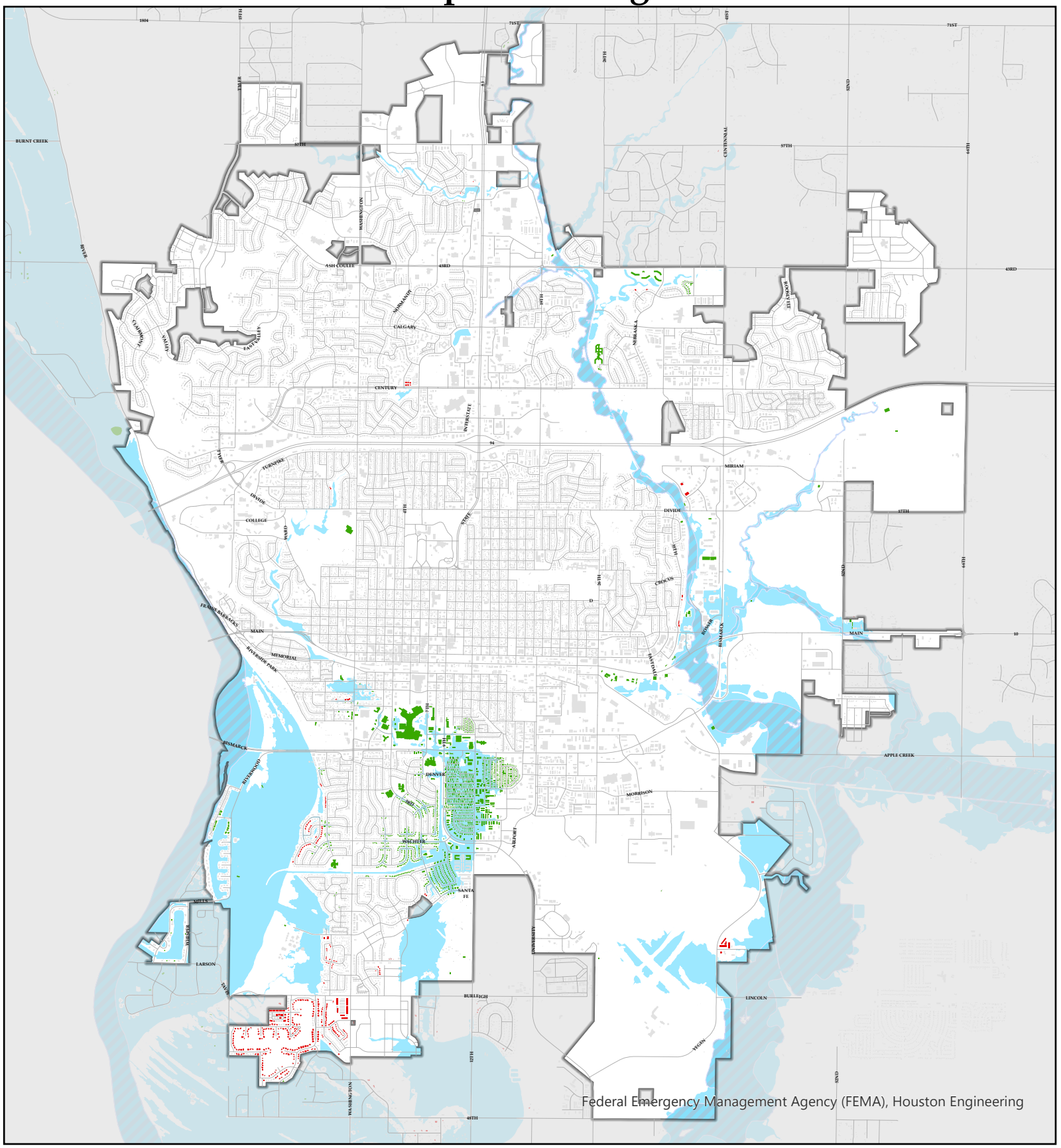
Floodplain Changes



Bismarck

- City Limits
- Buildings Added to Floodplain
- Buildings Removed from Floodplain
- 1% Annual Chance (100-Year) Flood Hazard

N

Date: 5/20/2025

This data is for representation only and does not represent a survey. No liability is assumed as to the accuracy of the data delineated herein.

0 ½ 1 2 Miles

National Flood Insurance Program – Community Statistics as of April 2025

Policy and Claims Data as of 4/24/2025:

State	County Name (Number)	Community Name (Number)	Number of Losses	Total Net Payment	Avg. Net Payment	Active Contracts	Active Policies	Total Premium + Policy Fee (Active Contracts)	Average Premium + Policy Fee (Active Contracts)	Cancelled Contracts	Expired Contracts
Grand Total			435	$7,472,139.66	$17,177.33	503	503	$600,963	$1,195	1,038	2,592
NORTH DAKOTA	BURLEIGH COUNTY (38015)	BISMARCK, CITY OF (380149)	435	$7,472,139.66	$17,177.33	503	503	$600,963	$1,195	1,038	2,592

Policies in Force & Payments as of 4/24/2025:

Community	Policies in Force (PIF)	Contracts in Force (CIF)	Total Coverage	Median Discounted Premium	Median Total Annual Payment	Total Discounted Premium	Total Annual Payment
	503	503	$146,987,000	$831	$1,063	$577,322	$732,979
BISMARCK, CITY OF	503	503	$146,987,000	$831	$1,063	$577,322	$732,979

Company Name (Number)	State	Claim Status	Number of Losses	Net Building Payments	Net Contents Payments	Net ICC Payments	Total Net Payments	LAE Fee	Special Expense Amount
Grand Total			435	$7,128,388	$313,752	$30,000	$7,472,140	$381,369	$62,362

Repetitive Loss Summary:

State/County/Community	State	Repetitive Loss Properties	Total Losses	Total Building Payments	Total Contents Payments
	Grand Total	26	53	$2,189,274.19	$159,322.51
BISMARCK, CITY OF (380149)	NORTH DAKOTA	26	53	$2,189,274.19	$159,322.51

Repetitive Loss Property (defined):
A repetitive loss property is any insurable building for which two or more claims of more than $1,000 were paid by the National Flood Insurance Program (NFIP) within any rolling ten-year period since 1978. The losses must be within 10 years of each other and be at least 10 days apart.

A severe repetitive loss (SRL) property is a residential property that has had at least four NFIP claim payments over $5,000 each with two such claims occurring within any ten-year period or a residential property that has had at least two separate claim payments within any ten-year period that have cumulatively exceeded the value of the property. Bismarck does not have any SRL properties.

Total Number of Closed ICC (Increased Cost of Compliance) Polices Data:

Date of Loss	Claim Close Date	Address	ICC Opened Date	ICC Closed Date	ICC Claim Indicator	ICC Mitigation Indicator	Occupancy Type	Flood Zone	Net ICC Payment
									$30,000
06/03/2011	8/17/2012				S	E	Single-Family (1)	AE	$30,000

NFIP policyholders may receive up to $30,000 under this coverage to comply with state or local floodplain management laws or ordinances. This insurance facilitates an insurance alternative to disaster assistance to reduce the escalating costs of repairing damage to buildings and their contents caused by floods.

Number of Policies by Month – March 2024 through March 2025:

Community	Mar-24	Apr-24	May-24	Jun-24	Jul-24	Aug-24	Sep-24	Oct-24	Nov-24	Dec-24	Jan-25	Feb-25	Mar-25	Growth
NFIP Filtered Total	487	474	471	463	471	497	513	515	519	516	512	510	506	19
BISMARCK, CITY OF	487	474	471	463	471	497	513	515	519	516	512	510	506	19

Note: The updated FIRM (Flood Insurance Rate Map) went into effect on June 6, 2024.

See pages 9-10 to review change in number of structures within the 100-year floodplain as a result of the FIRM update.

Groundwater issues, especially in south Bismarck, may arise when higher river levels are maintained for a long period of time during flooding events or simply during higher releases from the Garrison Dam. Extensive and recurring heavy rainfalls would contribute to higher water tables.

The map on the following page illustrates an example of groundwater conditions that promote the use of sump pumps in south Bismarck. The river stage at that time was 13.25 feet. At that point, the flows through Bismarck/Mandan had been about 60,000 cfs for almost a month; and therefore, had the longest amount of time to affect the surrounding groundwater levels. At the end of July that year, the USACE started decreasing flows. It is not fully understood how long it generally takes for the groundwater levels to respond to changes in river flow.

See **Depth to Water Table map** on the following page. The map serves as an example of the impact that higher river levels (for an extended period of time) have on the groundwater levels in south Bismarck.

The **Storm Watersheds** map on page 15 illustrates the movement of stormwater through the various watersheds that would occur during significant rain events.

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Depth to Water Table (feet)
River Stage at 13.25 feet

- *SWC Well Location/July 19-20, 2018 Elevation (ft NAVD88)*

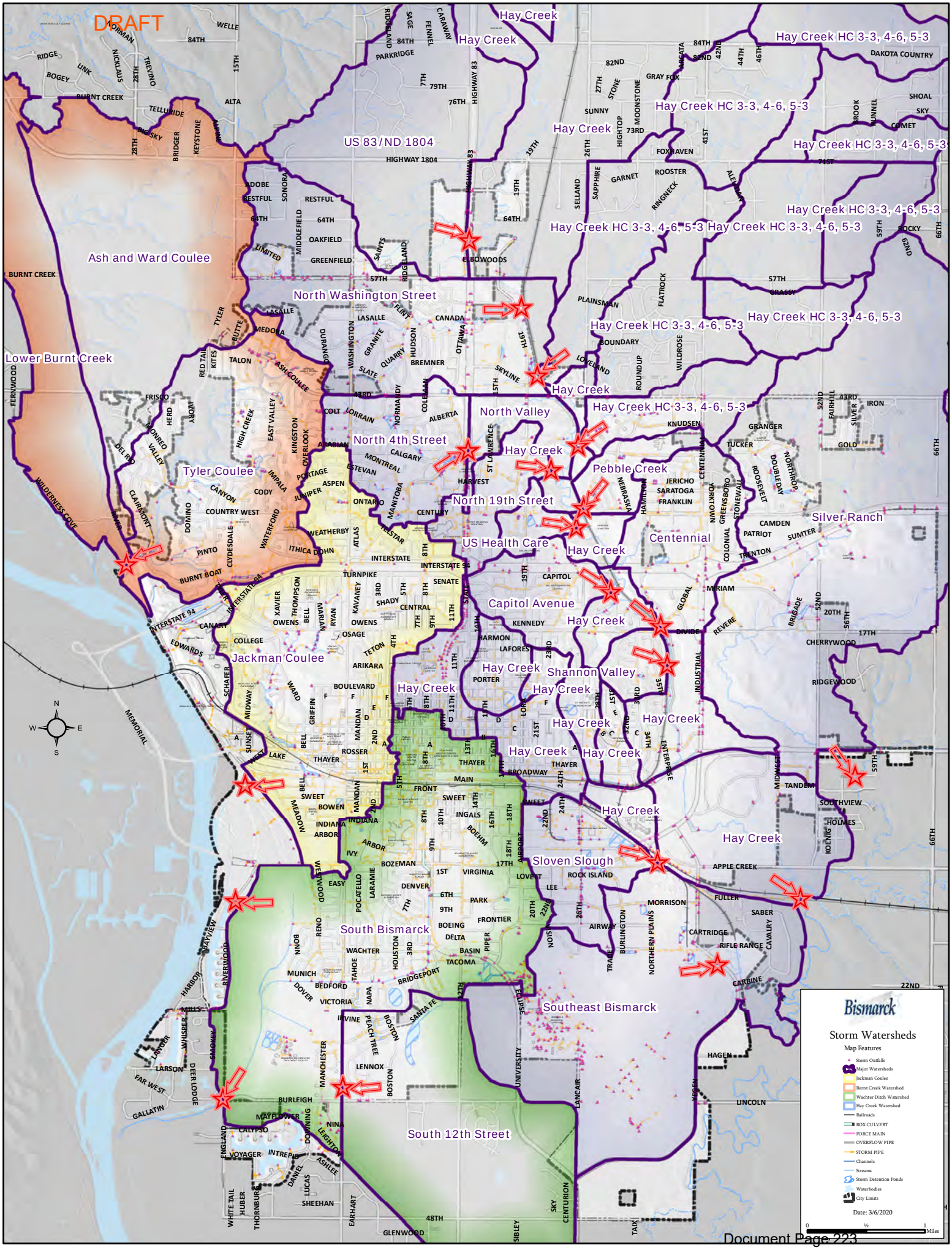
Depth to Water - 7/19/2018 and 7/20/2018

- *0*
- *0.1*
- *0.5*
- *1*
- *2*
- *3*
- *4*
- *5*
- *6*
- *7*
- *8*
- *9*
- *10*

*Legend color scheme revised 7/5/2018

North Dakota
State Water Commission

0.5 0 0.5 1 mile


DRAFT
Hay Creek
Hay Creek HC 3-3, 4-6, 5-3
US 83/ND 1804
Ash and Ward Coulee
North Washington Street
Lower Burnt Creek
Tyler Coulee
North 4th Street
North Valley
Pebble Creek
North 19th Street
Silver Ranch
Centennial
US Health Care
Capitol Avenue
Shannon Valley
Jackman Coulee
Sloven Slough
South Bismarck
Southeast Bismarck
South 12th Street
Bismarck
Storm Watersheds
Map Features
Storm Outfalls
Major Watersheds
Jackman Coulee
Burnt Creek Watershed
Wachter Ditch Watershed
Hay Creek Watershed
Railroads
BOX CULVERT
FORCE MAIN
OVERFLOW PIPE
STORM PIPE
Channels
Streams
Storm Detention Ponds
Waterbodies
City Limits
Date: 3/6/2020
Miles

Vulnerability Assessment

Vulnerability: Characteristics of community assets that make them susceptible to damage from a given hazard.

*Items in last column specific to 500 year flood are noted with an asterisk. 100 Year flood impacts are included in 500 year flood.

Flooding type	**Flash Flooding Urban Flooding**	**Ice Jam Debris / Blockage**	**Riverine 100 & *500 Year Flood**
Probability	Very Likely	Possible	Possible (100 Year) Unlikely (500 Year)
Speed of Onset	Limited warning Minutes to Hours	Some warning, Generally at least 24 hours	Controlled River (Garrison Dam / COE)
Duration	Hours	Days	Weeks/Months (2011 flood was over 3 months above flood stage)
Geographic Area	All areas of Bismarck subject to urban flooding	Generally low lying areas along river and in South Bismarck. See 100 Year Flood map.	See 100 Year and 500 Year Flood mapping
Death / Injury 1. Primary Causes A. Highest vulnerability	1. Driving through flood waters A. Driving through water – assuming roadbed is intact and vehicle will remain on street Most flood deaths result from flash flooding. Source: ND DES Mitigation Plan	1. Driving through flood waters A. Driving through water – assuming roadbed is intact and vehicle will remain on street	1. Driving through flood waters A. Driving through water – assuming roadbed is intact and vehicle will remain on street
Mass Casualty Incident	Limited probability	Limited probability	Limited probability

Flooding type	**Flash Flooding Urban Flooding**	**Ice Jam Debris / Blockage**	**Riverine 100 & *500 Year Flood**
Property Losses	1. Basement flooding – basement contents 2. Airport and Skyway Park Village 3. Basin Avenue Area	1. Basement Flooding – basement contents & utilities 2. Fox Island 3. Washington Street Bridge (concrete damages) 4. Riverwood Golf Course	1. Structures within 100 Year or 500 Year Flood Plain. 2. Main floor and contents (below base flood elevation)
Environmental	1. Basement flooding – basement contents	1. Debris / hazardous materials contaminating flood water 2. Septic systems *Flood waters are typically contaminated*	1. Structures in low lying areas (ie: 100 Year Flood plain) 2. Debris / hazardous materials contaminating water 3. Septic systems *Flood waters are typically contaminated*
COG/COOP	1. Employee/ Family Impact – availability of personnel 2. Bismarck PD	1. Employee/ Family Impact – availability of personnel	1. *Bismarck PD 2. Employee / Family impact – availability of personnel
Critical Facilities	1. South Fire Station	1. Wastewater Treatment Plant 2. South Fire Station access	1. Bismarck Airport 2. *Wastewater Treatment Plan
Critical Infrastructure	*Street Access:* 1. 12th Street – from University to Bismarck Expressway 2. Bismarck Expressway from 7th to 12th Street 3. 7th and 9th Street underpasses 4. S 3rd Street – Arbor Avenue to Bismarck Expressway 5. Broadway – 12th to 14th Street		*Railroad Access:* 1. *DMVW North/South Railroad
Schools		1. Prairie Rose Elementary	

Flooding type	**Flash Flooding** **Urban Flooding**	**Ice Jam** **Debris / Blockage**	**Riverine** **100 & *500 Year Flood**
High Risk Facilities (chemical)		1. Southport Marina (2009 ice jam) (The “Pier”)	1. Southport Marina 2. *Wastewater Treatment Plant 3. Little Dukes 4. Pony Express 5. Holiday Gas 6. Exxon Station (Red Carpet)
Specific Populations: Public Assembly, Vulnerable / Special Populations			1. Dakota Zoo 2. *Crescent Manor
Economy (community wide)	Minor (THIRA rating)	Minor (THIRA rating)	Moderate (THIRA rating)
OTHER:	Mobile HazMat (transportation)	Mobile Hazmat (transportation)	Mobile Hazmat (transportation)

Bismarck Facilities and Infrastructure within 100-Year Floodplain	
Critical Infrastructure	
Bridge: Railroad over Hay Creek	East of 3727 Pebbleview Lp
Bridge: Railroad over Main Av	South of 906 Missouri Av
Bridge: Riverwood Dr	2300 Riverwood Dr
Bridge: Rosser Av Over Hay Creek	North of 3605 E Rosser Av
Bridge: Tavis Rd	3300 Tavis Rd
Clear Channel Radio - KFYR/Y93	3500 E Rosser Av
Fox Island Boat Ramp	North of 2650 Mills Av
Grant Marsh Bridge Boat Ramp	North of 1103 River Rd
Pipeline at Missouri River	West of 4051 Sandy River Rd
Power Line at Missouri River	West of 6948 Burnt Creek Lp
Power Line at Missouri River	West of 5716 Misty Waters Dr
Railroad Crossing at Rosser Av	East of 3422 E Rosser Av
Railroad Over Hay Creek	East of 3120 E Capitol Av
Railroad Over Hay Creek	SE of 2920 E Capitol Av
Sanitary Sewer Pump Station	2516 River Rd
Sanitary Sewer Pump Station	3701 E Bismarck Ex
Hazmat Sites (ie: Tier II sites)	
South Port Marina	1120 Riverwood Dr
Western Area Power Administration	719 N Bismarck
Schools	
Prairie Rose Elementary (Bismarck Public Schools)	2200 Oahe Bend
Vulnerable/Special Populations	
Dakota Zoo	600 Riverside Park Rd

See 100-Year Flooplain map on page 7.

Bismarck Facilities and Infrastructure within 500-Year Floodplain	
Critical Facilities	
Bismarck Police Department	700 S 9th St
Bismarck Public School Facilities & Transportation	705 S 9th St
Cash Wise Foods	1144 E Bismarck
Family Fare - South	835 S Washington St
Fire Station 2 - South	835 E Bismarck
Salvation Army	601 S Washington St
Sanford Clinic - South	1040 Tacoma Av
Sanford Health Warehouse	1112 S 12th St
Vitalent (Blood Services)	517 S 7th St
Critical Infrastructure	
Bridge: 3rd St over drainage ditch	Southeast Of 1922 S 3rd St
Bridge: Railroad over Hay Creek	East of 3727 Pebbleview Lp
Bridge: Railroad over Main Av	South of 906 Missouri Av
Bridge: Railroad over River Rd and Missouri River	North of 1103 River Rd
Bridge: Riverwood Dr	2300 Riverwood Dr
Bridge: Rosser Av Over Hay Creek	North of 3605 E Rosser Av
Bridge: Southport Lp	1500 Southport Lp
Bridge: Tavis Rd	3300 Tavis Rd
Bridge: Wachter over Drainage Ditch	800 Wachter Av E
Bridge: Washington over Drainage Ditch	2201 Washington St
Clear Channel Radio - KFYR/Y93	3500 E Rosser Av
Fox Island Boat Ramp	North of 2650 Mills Av
Grant Marsh Bridge Boat Ramp	North of 1103 River Rd
Railroad Crossing at Divide Av	SE of 3500 Divide Av E
Railroad Crossing at Rosser Av	East of 3422 E Rosser Av
Railroad Over Hay Creek	East of 3120 E Capitol Av
Railroad Over Hay Creek	SE of 2920 E Capitol Av
Sanitary Sewer Pump Station	100 E Indiana Av
Sanitary Sewer Pump Station	2516 River Rd
Sanitary Sewer Pump Station	850 E Wachter Av
Sanitary Sewer Pump Station	3701 E Bismarck Ex
Wastewater Treatment Plant	601 W London Av

Bismarck Facilities and Infrastructure within 500 Year Floodplain cont'd	
HazMat Sites (Ie: Tier II Sites)	
Alltel	541 S 7th St
AmeriPride Linen & Apparel	1238 Frontier Dr
Bismarck Public School Facilities & Transportation	705 S 9th St
Exxon Station (aka Red Carpet)	919 S Washington St
Holiday Gas	905 E Bismarck
Little Dukes	1140 E Bismarck
Pony Express	1020 S Washington St
South Port Marina	1120 Riverwood Dr
Wastewater Treatment Plant	601 W London Av
Western Area Power Administration	719 N Bismarck
Schools	
Ascension Church School	1911 S 3rd St
Dorothy Moses Elementary	1312 Columbia Dr
ECLC	1901 Oakland Dr
Jeanette Myhre Elementary	919 S 12th St
Noah's Ark Daycare	1550 Wichita Dr
Open Door Community Center	1140 S 12th St
Perfect Start	1001 Basin Ave
Prairie Rose Elementary	2200 Oahe Bend
Preschool Program - House of Prayer	1470 S Washington St
South Central High School	406 S Anderson St
Shepherd of the Valley Preschool	801 E Denver Av
Super Kids Jr. Academy	1227 Park Av
Victor Solheim Elementary	325 Munich Dr
Wachter Middle School	1107 S 7th St
Vulnerable/Special Populations	
Crescent Manor	107 E Bowen Av
Dakota Zoo	600 Riverside Park Rd
Diane's Hope House	315 W Indiana Av

See 500-Year Floodplain map on page 7.

Changes in Vulnerability

Since the previous plan update in 2020.

Increase in Vulnerability	Decrease in Vulnerability
As a result of the FIRM update effective June 6, 2024, there were 1,742 buildings added to the floodplain and 413 were removed. Additional structures were built within the floodplain (61) as well as 18 affected by map revisions in the year 2024. The current total buildings within the SFHA as of January 9, 2025 is 3,876. Of the new commercial permits issued, there is a limited number of structures located within the 100-year floodplain: • Bismarck Riverfront Festival Grounds Building • Burleigh County Housing (South Washington Street) – 3 structures • 3 Restaurants located at Kirkwood Mall (South 3rd Street) • 1 shop condo – Hagen Drive • Cell Tower (South 12th Street) • Lift Station (Boston Drive)	Bismarck improved it's Community Rating System rating from a class 8 to a class 7. Also, See Flood Hazard Mitigation Capabilities listed in Section 3. *Future Conditions to re-allocate risk and vulnerability:* The regulatory authority for much of the existing ETA (approximately 95%) will be transferred to Burleigh County. As part of this process, the 26 repetitive loss properties will be removed from Bismarck, and added to Burleigh County. These properties will not be included within the Bismarck CRS program in the future.
See "Floodplain Changes" map on page 9 illustrating properties added and removed from the 100-Year floodplain as a result of the 2024 FIRM update.	

Risk

See Section 10 of this plan document for risk assessment and hazard ranking of all hazards addressed in this plan.

Relationship to other Hazards: Heavy precipitation (flash floods), snowmelt, and flood events can trigger geologic hazards. Floods and droughts can induce geologic hazards through the expansion and/or shrinkage of clay soils. Flood events may contribute to the potential for dam failures.

Future Conditions

- **Location**: The location of flood hazards per FIRM map is expected to change after a successful completion of a planned South Bismarck Flood Mitigation Project. Approximately 900 properties may be removed from the 100-year floodplain. *These same properties were added to the 100-year floodplain based on the FIRM update completed in 2024.*
- **Extent/Intensity:** See "Anticipated Future Climate Impact" on next page.
- **Frequency:** See "Anticipated Future Climate Impact" on next page.
- **Duration:** The duration of flood hazards is not projected to change.

Anticipated Future Climate Impact – Flood
Future climate conditions are expected to produce increased precipitation across North Dakota, with winter and early spring precipitation expected to see the greatest increase, along with an increased risk of rainfall occurring during the traditional spring snowmelt period. In addition to increased precipitation during the cool/cold season, the number of days with strong thunderstorms and heavy rainfall is expected to increase by mid-century, especially in the eastern half of the state. Increased rainfall rates typically result in increased runoff rates and an increase in flash flooding, overland flooding, and/or riverine flooding in any season. However, rain occurring when the ground is frozen produces even more and faster runoff and is most likely to exacerbate the flood threat.

Previous Occurrences

Flood Related Declarations for Burleigh County Since 1989		
Flood Declaration	**Declaration Date**	**Incident Period**
North Dakota Flooding (DR-1981)	Major Disaster Declaration declared on May 10, 2011	Incident period: February 14, 2011 to July 20, 2011 Burleigh County was added Thursday, June 2, to the federal disaster declaration issued by President Obama on May 10 in response to North Dakota flooding beginning Feb. 14 and continuing.
North Dakota Flooding (EM-3318)	Emergency Declaration declared on April 7, 2011	April 5, 2011 to July 1, 2011
North Dakota Flooding (EM-3309)	Emergency Declaration declared on March 14, 2010	Incident period: February 26, 2010 to April 30, 2010
North Dakota Severe Storms and Flooding (DR-1829)	Major Disaster Declaration declared on March 24, 2009	Incident period: March 13, 2009 to August 10, 2009
North Dakota Severe Storms, Flooding, and Ground Saturation (DR-1597)	Major Disaster Declaration declared on July 22, 2005	Incident period: June 1, 2005 to July 7, 2005
North Dakota Floods (DR-1376)	Major Disaster Declaration declared on May 28, 2001	Incident period: March 1, 2001 to August 9, 2001
North Dakota Severe Storms And Flooding (DR-1334)	Major Disaster Declaration declared on June 27, 2000	April 5, 2000 to August 12, 2000
North Dakota Severe Storms, Tornadoes, Snow and Ice, Flooding, Ground Saturation, Landslides and Mudslides (DR-1279)	Major Disaster Declaration declared on June 8, 1999	March 1, 1999 to July 19, 1999
North Dakota Severe Storms/Flooding (DR-1174)	Major Disaster Declaration declared on April 7, 1997	Incident period: February 28, 1997 to May 24, 1997
North Dakota Flooding (DR-1118)	Major Disaster Declaration declared on June 5, 1996	Incident period: March 12, 1996 to June 21, 1996
North Dakota Severe Storms, Flooding, Ground Saturation (DR-1050)	Major Disaster Declaration declared on May 16, 1995	Incident period: March 1, 1995 to July 5, 1995
North Dakota Flooding, Severe Storms (DR-1001)	Major Disaster Declaration declared on July 26, 1993	Incident period: June 22, 1993 to September 24, 1993

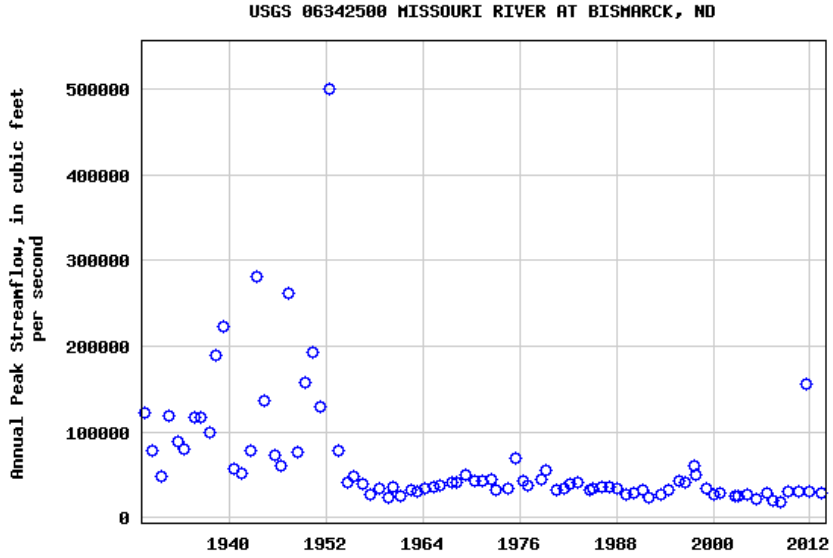
http://www.fema.gov/disasters?field_state_tid=11&field_disaster_type_term_tid=All&field_disaster_declaration_type_value=All&items_per_page=10&page=3

Riverine Flooding

Missouri River at Bismarck - Flood stages and Historical Crests (via Bismarck NWS website)		
Flood Stages		**Historical Crests**
Major Flood Stage	**18**	(1) 31.60 ft on 03/31/1883
Moderate Flood Stage	**16**	(2) 31.10 ft on 01/01/1887
Flood Stage	**14.5**	(3) 30.40 ft on 03/14/1910
Action Stage	**12.5**	(4) 27.90 ft on 04/06/1952
		(5) 27.70 ft on 04/08/1897
Note: As of 2012, "flood stage" is changed to 14.5 feet. Prior to 2012, 16 feet was defined as flood stage.		
In 1939, the Flood Stage was 19 Feet.		

Annual Peak Streamflow – Missouri River at Bismarck

Riverine Flooding (Missouri River at Bismarck) was a common occurrence prior to the construction of the Garrison Dam in 1953 as shown in the graph below.



Source: http://nwis.waterdata.usgs.gov/nd/nwis/peak/?site_no=06342500&agency_cd=USGS

2011 Flood: The 2011 Flood is the most significant Missouri River riverine flooding event impacting Bismarck since the construction of the Garrison Dam. The peak river elevation reached 19.24 feet on July 1, 2011. The peak releases from the Garrison Dam were 151,000 CFS on June 25, 2011. The river exceeded "action stage" (14 feet) from May 23 through August 31, 2011. Temporary protective measures (levee systems) were put in place to protect critical infrastructure (wastewater treatment plant) and south Bismarck in general (homes, streets, access, etc.). The maximum inflow during this period, according to the USACE was 190,000 CFS.

The largest peak discharge recorded at Bismarck following the closure of Garrison Dam in 1953 was 155,000 cfs on June 25, 2011. Source: http://www.swc.nd.gov/pdfs/south_bismarck_sediment_study_2014.pdf

Impact to homes within Bismarck city limits was limited to damage associated with basement seepage as a result of high groundwater due to the higher river levels for an extended period of time and heavy rains throughout the summer. The Missouri River did not overtop or breech the temporary levee systems. Overland river flooding impact was limited to the Meriwether's facility, Meriwether's parking lot, and Pioneer Park in Bismarck. Extensive heavy rains throughout the summer along with the need to close the gate (flood control structure) on South Washington did exacerbate flash flooding impacts (urban street flooding) on a few occasions. However, the pumping operations were successful and worked as planned. The costs of fighting the flood were extensive, but public infrastructure including the wastewater treatment plant and south Bismarck were protected as a result of combined flood fight efforts in Bismarck.

2011 Flood Event – Bismarck Flood Fight Cost *Total Cost: $17,700,838.73 90% Federal Share: $15,930,473.59 *(based on submitted Project Worksheets via the FEMA Public Assistance Program)*	Category A – Emergency Work Debris Removal: $5,941,821.36 Category B – Emergency Protective Measures: $11,323,273.13 Category C – Road and Bridges: $633,709.26 Category D – Water Control Facilities: $0.00 Category E – Buildings and Equipment: $8,273.01 Category F – Utilities: $95,440.35 Category G – Parks, Recreational Facilities, Other: $148,321.62

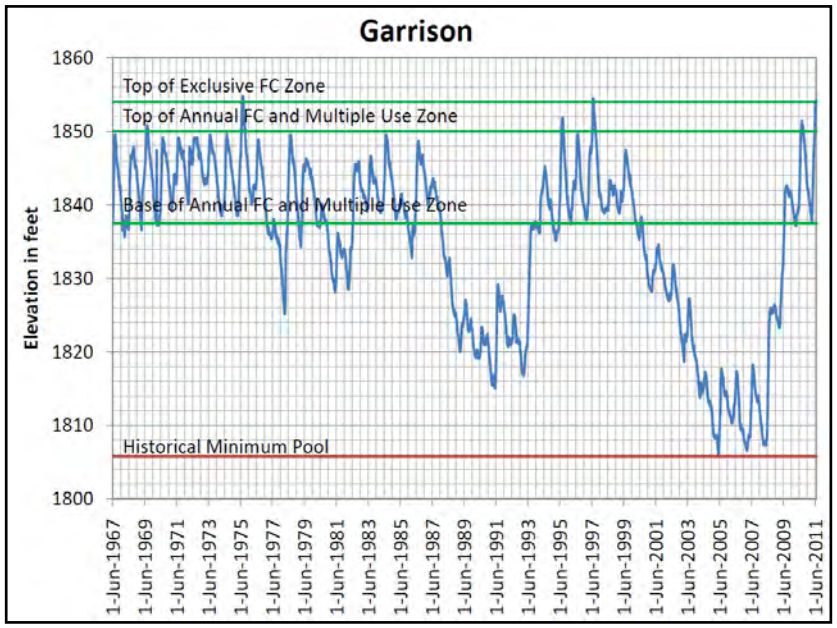
The following description came from the USACE website regarding the 2011 Flood:

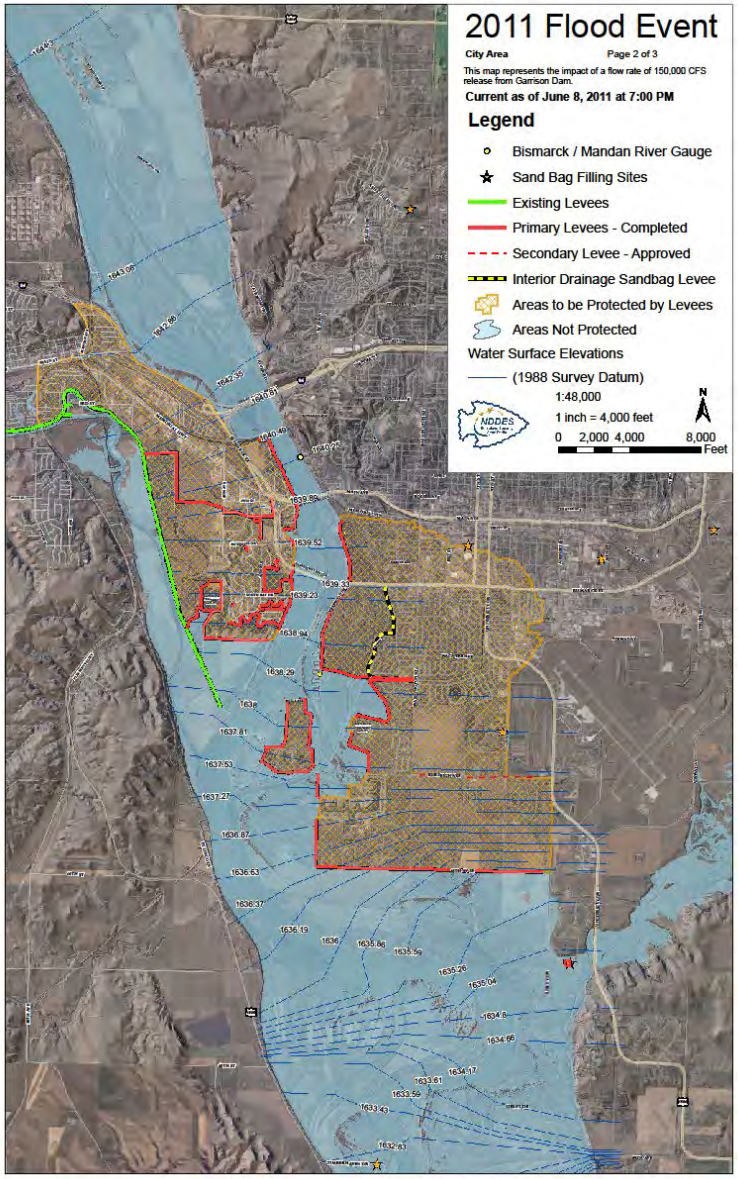
"Where is this flooding occurring?" Flooding is along the entire length of the longest river in the United States: the Missouri River- and many of its tributaries throughout Montana, North and South Dakota, Nebraska, Iowa, Kansas and Missouri. At 2,321 miles, the Missouri River's headwaters begin at Three Forks, MT and join the Mississippi River in St. Louis, MO.

"When did this inundation begin?" May 23, 2011 is recognized as the day that unparalleled flooding would soon commence.

"Why did this come about?" Flooding commenced with unseasonably heavy snows across the Great Plains. This was followed by three to six times the normal rainfall in May in eastern Montana, northern Wyoming and the western Dakotas. Then the snowpack melt came perhaps two weeks later than usual with an accumulation that was around 23 to 40 percent greater than normal. The June 2011 runoff in the Missouri River Basin above Sioux City was 13.8 million acre feet (MAF), the single highest monthly runoff amount since 1898. May 2011 runoff was 10.5 MAF, the third single highest monthly runoff amount since 1898 and more than one and a half times the previous record May inflow of 7.2 MAF in 1995. Combined runoff in May and June, at 24.3 MAF was short of the normal annual runoff of 24.8 MAF. The forecast for total annual runoff into the Missouri River basin during 2011 is 57.7 MAF, more than double the normal.

Garrison Dam levels from 1967 to 2011





1997 Flood Five years of high precipitation coupled with record and late season snowfall led to the extreme flood event of 1997. As the record snows began melting and an April blizzard compounded the problem, water levels all across the state began rising to unprecedented levels.

1993 Flood Statewide, excessive rains during the spring destroyed crops and heavy thunderstorms on July 15-16 (4-7 inches of rain), July 22-27 (6-10 inches of rain), and August 21-22 (up to 7 inches of rain) caused flash flooding and damage to public and private property. Minor to moderate flooding occurred in the Missouri, James, Souris, and Devils Lake basins.

1952 Flood Event Article:
http://www.bismarckcafe.com/blogs/252/remembering-the-flood-of-april-1952

Remembering The Flood of April 1952
Source: Bismarck Tribune. May 1, 2009 **Posted in:** 2011 Flood

Recent flooding has caused devastation across the state, and within Bismarck itself. It has left many in southern Bismarck worrying about flood potential of the Missouri River. 2009 marked the first major flooding of the Missouri River in 57 years.

Flooding was a common occurrence in Bismarck prior to the closure of Garrison Dam, which occurred in April 1953. It was not uncommon for springtime floods to cover much of the land south of present-day Main Avenue.

Missouri River Flooding in April 1952 - Liberty Memorial Bridge in background.

One of the worst of such floods occurred in April 1952, when the Missouri River crested at 27.9 feet. On April 6, the river rose 5 feet in just 2 hours, increasing from 20.2 feet at 11:30am to 25 feet at 1:30pm. Nearly everything south of U.S. Hwy 10 (Memorial Hwy/Main Ave) was under water. 200 houses were destroyed and the Wachter Family reported the loss of 300 cattle.

The completion of Garrison Dam allowed, for the first time, major development south of Main Avenue. Prior to this, the Wachter Family and Yegen Family owned most of the land.

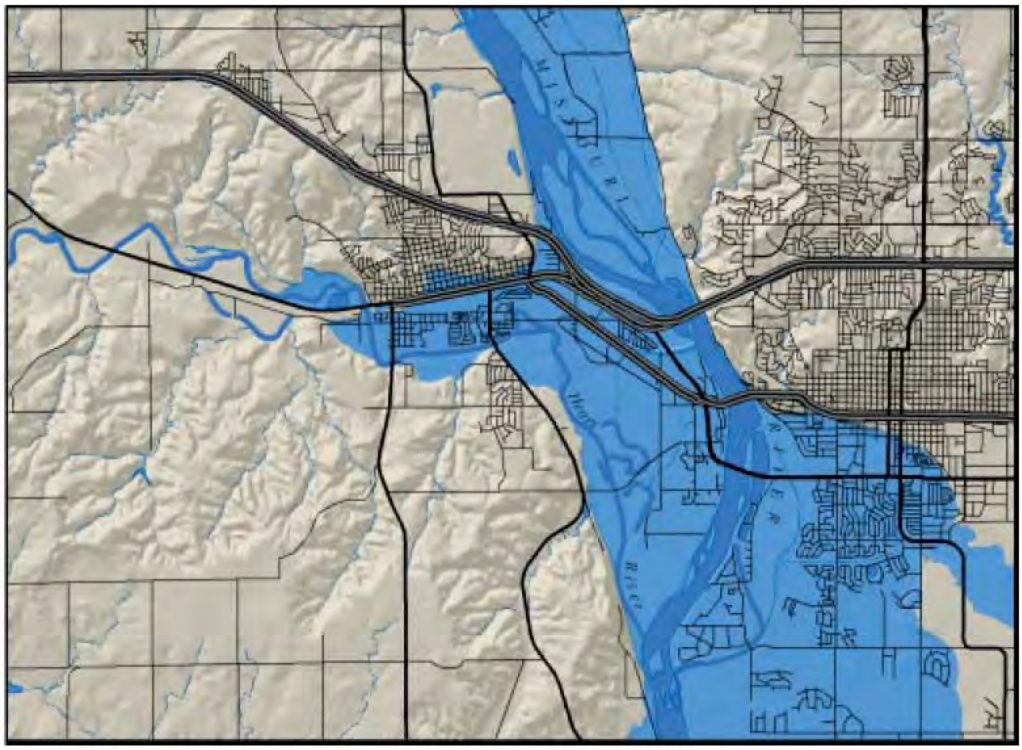
Like the flooding seen in 2009, the 1952 Flood was also primarily caused by ice jams. According to the National Weather Service, the April 1952 river level was the 4th highest recorded. The highest was 31.6 feet on March 31, 1881 *(year corrected).* Flood stage is 16 feet. **Date: 3/26/1939 -** Gage Number: 6342500 -Bismarck, ND Missouri River

The gage at Bismarck, North Dakota on the Missouri River recorded water levels of 19.1 feet on March 26, 1939 due to an ice gorge below the gage. Flood stage is 19 feet. The gorge was recorded through 30 March. -- Keywords: Missouri River at Bismarck, ND on Mar 26, 1939 [20020103133602]

Date: 03/31/1881 - Gage Number: 6342500 - Bismarck, ND Missouri River

Maximum annual gage height of 31.6 feet, affected by backwater from ice, reported at USGS gage Missouri River at Bismarck on March 31, 1881. This is the maximum stage for the period 1881, 1929-1963; maximum open-water stage for the same period was 27.9 feet on April 6, 1952 (500,000 cfs). -- Keywords: Missouri River at Bismarck, ND on Mar 31, 1881 [9352]

FLOODING AND SEEPAGE



Area inundated (in blue) by the historic flood of March 31, 1881.

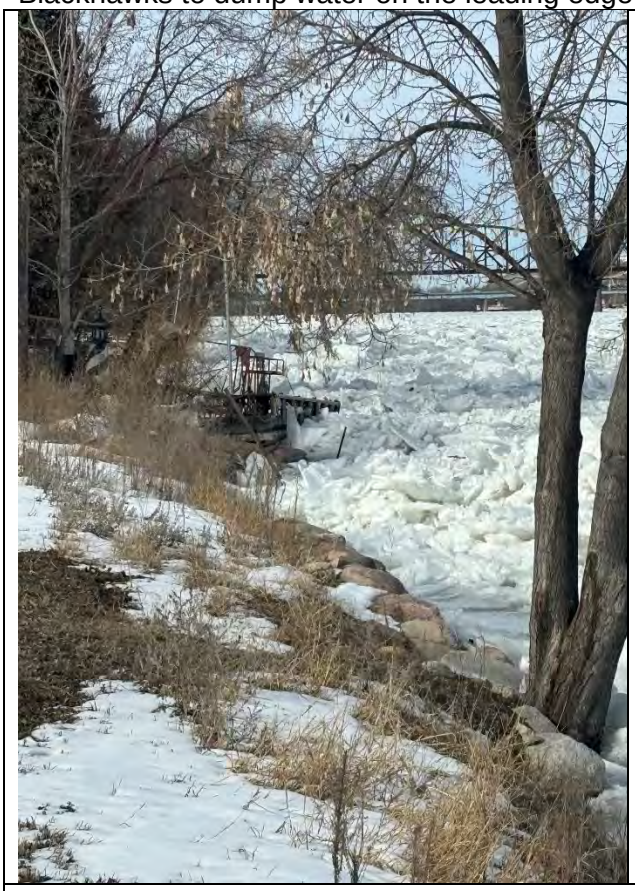
The highest recorded level of the Missouri River (1,649.88 feet) occurred on March 31, 1881. At this elevation, most of the area now occupied by the southern portions of Bismarck and Mandan would have been under 10 feet of water (see adjacent map.)

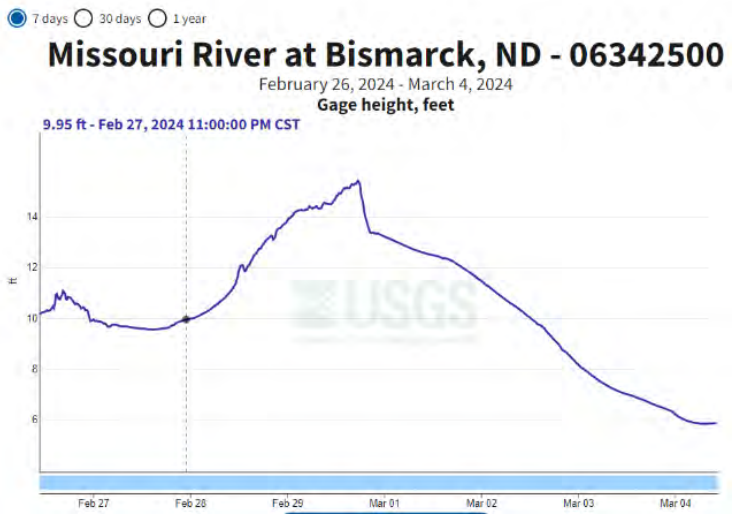
Overland flooding from unusually large rainfall events is a potential problem for homeowners in the area. Overland flow is focused into ravines and coulees that lead into the Heart and Missouri rivers. These ravines formed over the last 10,000 years, since the last glacier receded from this area. Development, particularly in north Bismarck, has partially or completely filled portions of these drainages with construction fill. Surface water and shallow groundwater still tend to concentrate along these courses. One of these, a four-mile long ravine, runs from Hay Creek to Zonta Park via the Tom O'Leary golf course. Perched groundwater can be concentrated at a number of stratigraphic horizons including: the base of construction fill, the contact between Cannonball sandstone and underling mudstone, as well as the upper surface of thin, well cemented sandstone layers in the Cannonball Formation. Seepage is a potential problem for basement slabs that are in close proximity to any of these settings.

Source: ND Geological Survey, Department of Mineral Resources
https://www.dmr.nd.gov/ndgs/documents/Publication_List/pdf/geoinv/GI_3.pdf

Ice Jams

February 28-29, 2024: On the evening of February 28, 2024, an ice jam began forming at the confluence of the Heart and Missouri Rivers, between Bismarck and Mandan, ND. Rapid rises in the level of the Missouri River threatened homes in the Fox Island neighborhood, requiring a whole of government response. State of ND used Bambi Buckets slung under UH-60 Blackhawks to dump water on the leading edge of the ice jam to break it up.

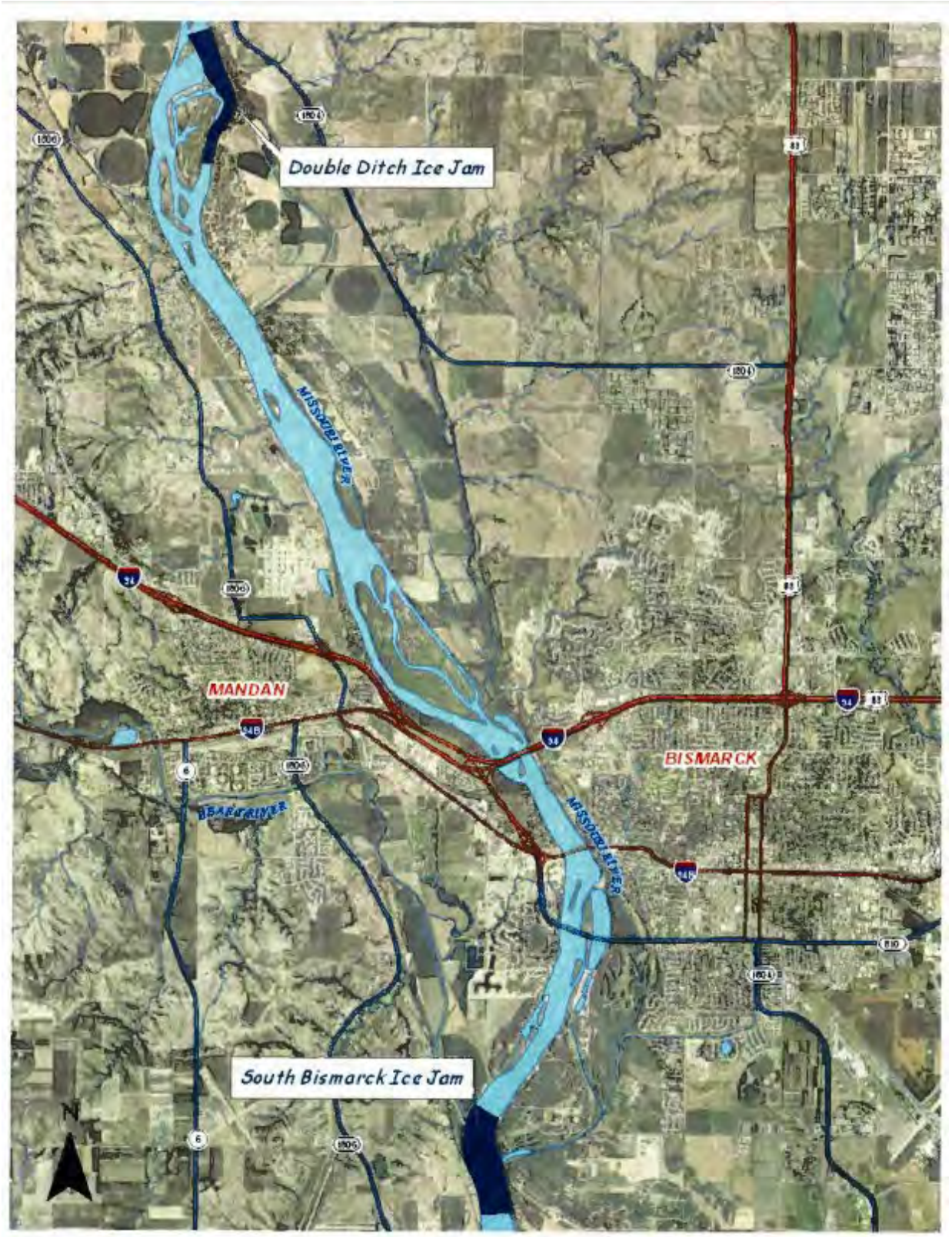




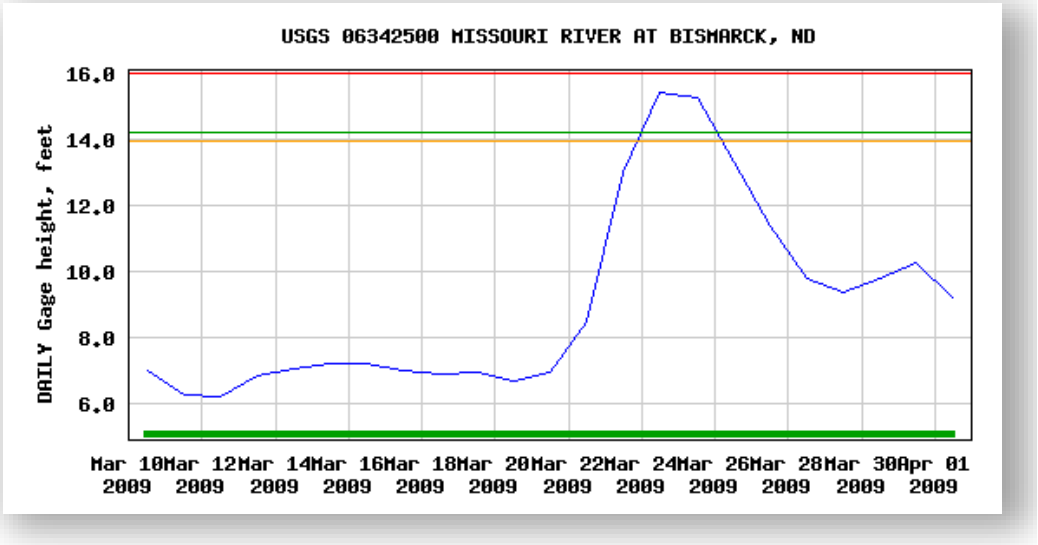
Additional ice jamming occurred one month later, in early March, 2024:

March 23-27, 2009: See ice jam location map, next page.

Spring Flood event was caused primarily by ice jams. Extensive amounts of ice floes from the Heart River were discharged into the Missouri and created an ice jam south of Bismarck. An ice jam also formed north of Bismarck near the Double Ditch area. (see ice jam location map) The ice jam (or ice dam) was created by ice and debris. The bends in the river, sediment, sandbars, and potentially the long cold winter of 2008 and 2009 contributed to the formation of the ice jam. Also, an extensive amount of snowfall from the winter season (73.9 inches through March 22), significant snow melt with 54 degrees as the high on March 20th, **a** thunderstorm on March 23rd adding 0.75 inches of rain on frozen ground, and a blizzard over March 23 and 24th dumped an additional 8.1 inches of snow. These events cumulatively exacerbated the flooding situation. High winds and blizzard conditions delayed evaluation (aerial view) of the ice jam by the COE ice jam expert. Prior to the flood event, snowmelt was causing isolated problems throughout the community – primarily relating to landscape and runoff issues. Throughout the flooding event, snow melt, additional moisture, and the ice jam contributed to backing up the storm drain system affecting the Airport Village / Skyway Park Village mobile home park residents and closing 12th Street and a section of Expressway from 9th Street to 12th Street. Bismarck Property impacted by the flooding was primarily in the areas of Fox Island (county), Southport, Munich Drive area, Santa Fe area, and the mobile home parks of Skyway Park Village and Airport Village. Solheim School relocated its students and staff to other area schools. Ultimately, the school was not impacted. Prairie Rose Elementary (just south of Bismarck) was threatened, but not impacted by the flood event.


Double Ditch Ice Jam
MISSOURI RIVER
MANDAN
BISMARCK
HEART RIVER
MISSOURI RIVER
South Bismarck Ice Jam
N

The graph below (2009 Ice Jam) illustrates limited time to react to an Ice Jam.



ICE Jam Flood Characteristics:

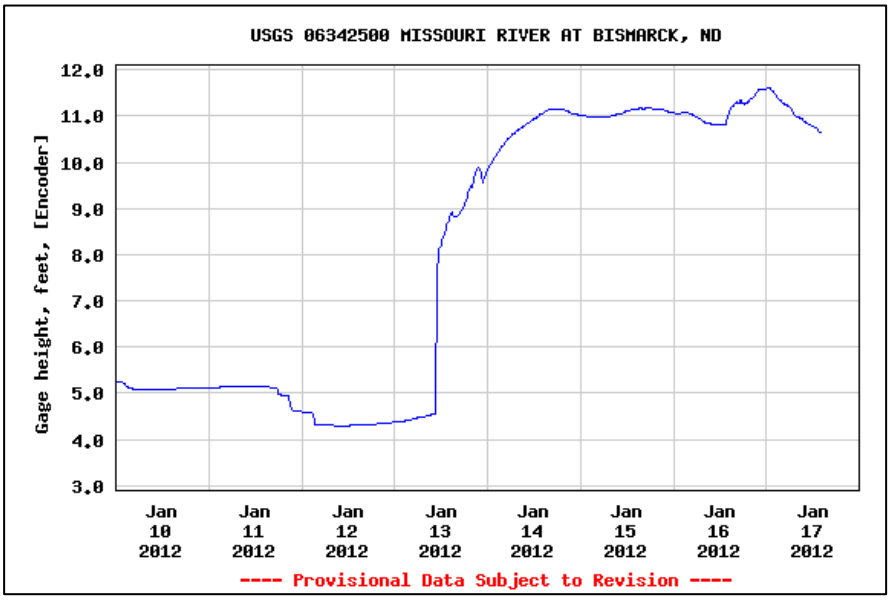
- **River Pool Effect**
- **Unpredictable (Timing and Location)**
- **Very Little Warning**
- **Require Closure of Key Internal Drainage Sys**
- **Protection Must be In Place Before the Event**

Freeze In 10-Year Average Rise at Bismarck

6.09-feet (2010-2019)

Freeze In 10-Year Average Stage at Bismarck

10.86-feet (2010-2019)



2012 Freeze-In

Missouri River – Ice Jam Date: March 23, 2009. Jam Type: Break-Up

Rapid warmup over heavy snowpack led to large increases in discharge on Missouri River tributaries throughout North Dakota, leading to breakup of ice in the headwaters region of Lake Oahe. USACE-Northwest Division Missouri River Region Water Management Office released news release 23 Mar 2009 that Garrison Dam releases were being reduced to near record low levels due to influx of tributary water and ice into Missouri River in Bismarck region. Burleigh County EM issued a Civil Emergency message shortly after noon (CDT) on 23 Mar 2009 asking residents of Fox Island to voluntarily evacuate as the river continues to rise and the unpredictability of stages due to a probable ice jam. Morton County EM issued a Civil Emergency Message at 534 pm Monday 23 March. Residents in the Jetty Beach and Tokach Bottoms area were also asked to voluntarily evacuate the area due to the rising river levels and unpredictable nature of the ice affected river. At 815 am Tuesday 24 March, the stage was 15.04 feet, Flood Stage is 16.0 feet. Burleigh County EM reported the Missouri River continuing to rise due to an ice jam, and advising any area south of Bismarck Expressway, west of South Washington Street, or south of Burleigh Ave, from the Missouri River to Apple Creek, to prepare for potential flooding. Lake Oahe is ice covered and river water will flow north. Monday, 0.75 inches of rain fell in Bismarck, with an additional 0.32 inches by 730 am Tuesday, as well as 3.0 inches of snow. The forecast for Bismarck at 1152 am Tuesday, was for heavy snow, freezing fog and wind, with a temperature of 28 F. At 220 pm Tuesday, NWS reported flooding or the potential for flooding across all of central and most of western ND. The stage was within 0.5 feet of Flood Stage, and rising, as a result of a jam just south of Fox Island. An additional jam was being reported north of Bismarck, near Double Ditch, with the effect uncertain, should the upstream jam release first. NWS reported the stage to be at 16.00 feet at 653 pm CDT Tuesday. By 615 am Wednesday, the stage had receded slightly to 15.77 feet. On Wednesday morning, 903 AM CDT, the ice jam north of Bismarck released and the ice was moving downstream. Officials were concerned about the potential for this ice to cause further increases in water level if it re-jammed at the ice jam at Fox island, south of Bismarck. Roger Kay of the USACE Omaha District was providing ice jam mitigation expertise at the scene. He relayed an update to Steve Daly of CRREL Wednesday morning, 25 March. The jam was reported to be 3 feet thick, having formed by ice released from the Heart River. Permits were in place to use rock salt on the sheet ice, located just downstream of the jam. Upstream of the jam, a 7-8 foot backwater rise was measured by USGS on Tuesday. Cooler temperatures and the river's response to Garrison Dam's water cutback on Monday, are likely causes for the drop in stages today, however, Roger Kay reported interior drainage to be a problem, with flooding ongoing. At 1030 am CDT NWS employees visually confirmed that the jam north of Bismarck, which was reported to have released, still remained in place. This jam is located from the Indian village of Double Ditch to Hogue Island. At 102 pm Weds NWS released a Public Information Statement reporting that the Morton County EM Office and the City of Mandan were downgrading the Mandatory Evacuation of residential areas along the west side of the Missouri River to a Voluntary Evacuation, in response to the fact that the jam north of Bismarck was still in place, but urged residents to be prepared, as a new Mandatory Evacuation Notice would be issued immediately should that jam release. Another Public Information Statement was issued at 127 pm Weds, reporting that the ND Department of Emergency Services needed the Morton County Sheriff's Department and Mandan Police Department to close Highway 1806 from Nineteenth St south to County Road 138 immediately so that experts can blast the ice jam, which was expected to occur between 1pm and 2pm. Water was reported to be flowing around the Double Ditch jam at 5 pm Wednesday. Overloaded storm drains have resulted in localized flooding in south Bismarck. By 915 am CDT Thursday 26 March, the stage at Bismarck had fallen to 13.52 feet, however, the ice jams still remained. Ongoing efforts continue Thursday to weaken the jam to the south of Bismarck. At 115 pm Saturday 28 March, the stage had dropped to 9.66 feet, below Flood Stage of 16.0 feet. In a 2010 review of the jam, it was noted that Gov. John Hoeven has said the cost of temporary levees, cleanup and repairs from last spring's flooding exceeded $78 million

Ice Jams in North Dakota 1881-May 2020

The US Army Corps of Engineers, Cold Regions Research and Engineering Laboratory (CRREL) maintains a database of historic ice jams.

Jam date	Jam type	Damages
1/1/2020	Break-up: no flooding	-
2/15/2016	Break-up	-
1/23/2012	-	-
3/23/2009	Break-up	exceeded $78 million
12/1/2006	Unknown	-
12/10/2005	Unknown	-
12/26/2004	Unknown	-
1/2/2004	Unknown	-
12/9/2002	Freeze-up	-
2/14/2003	Unknown	-
12/27/2001	Unknown	-
12/20/2000	Unknown	-
1/15/2000	Unknown	-
1/16/1999	Unknown	-
1/1/1998	Unknown	-
11/28/1993	Unknown	-
1/1/1989	Unknown	-
2/5/1989	Unknown	-
2/25/1987	Unknown	-
1/13/1983	Unknown	-
12/18/1979	Unknown	-
12/23/1972	Unknown	-
1/29/1971	Unknown	-
1/25/1963	-	?
1/26/1962	-	?
3/27/1960	-	?
12/3/1958	-	?
3/30/1958	-	?
12/10/1956	-	?
4/2/1956	-	?
4/4/1951	-	?
4/3/1949	-	?
4/1/1948	-	?
3/27/1946	-	?
3/18/1945	-	?
4/7/1944	-	?
3/26/1939	-	Unknown
3/20/1936	-	?
3/6/1930	-	?
3/17/1929	-	?
03/31/1881	-	?

Ice Jam/Ice Damming Summary: 1980 – 2020

The table below identifies maximum gage heights due to backwater from ice at the Missouri River USGS gaging station 644250 at Bismarck.

Jam Date	Maxium Gage Height	Estimated Daily Avg Discharge
January 1, 2020	11.13	24,000 CFS
1/23/2012	12.08	22,000 cfs
3/23/2009	16.00	
USACE reduced Garrison Dame release to Zero CFS, first time in history of the dam as a result of the March 2009 ice jam.		
12/1/2006	11.10	14,800 cfs
12/10/2005	11.34	15,200 cfs
12/26/2004	10.63	NA
1/2/2004	12.08	NA
2/14/2003	10.91	NA
12/27/2001	10.25	13,300 cfs
12/20/2000	13.01	18,800 cfs
1/15/2000	13.01	NA
1/16/1999	12.22	25,000 cfs
11/28/1993	13.55	13,800 cfs
2/5/1989	13.12	26,200 cfs
1/1/1989	14.44	19,500 cfs
2/25/1987	13.92	30,400 cfs
1/13/1983	14.8	Not reported

The peak discharge recorded at Bismarck was 500,000 cfs on April 6, 1952; this peak discharge was the result of a combination of rapid snowmelt and the release of an upstream ice jam. Source: South Bismarck Sediment Management Study (USACE) - http://www.swc.nd.gov/pdfs/south_bismarck_sediment_study_2014.pdf

The table below illustrates a 10-year average and median the increase in the Missouri River level following the initial freeze-in.

	Ice form date	Pre-ice stage	Max Stage	Increase
2010	12/3/2010	6.5	11.9	5.4
2011	1/13/2012	5.1	12	6.9
2012	12/24/2012	3.7	10.1	6.4
2013	12/5/2013	3	8.9	5.9
2014	12/1/2014	5	11.1	6.1
2015	12/29/2015	3.8	10.2	6.4
2016	12/8/2016	3.8	10	6.2
2017	12/24/2017	4.5	10.95	6.45
2018	12/28/2018	5.8	12	6.2
2019	12/12/2019	6.5	11.4	4.9
Average:		4.77	10.86	6.09
Median		4.75	11.025	6.2

The following are considered reasonable interpretations of information contained within the table above, based on communications with the local NWS hydrologist: The “pre-ice stage” is the initial date of really noticeable start in rise due to ice, and approximate max stage during the initial rise due to ice. *There is no consensus or accepted criteria for selecting the dates or maximum stage.* It is important to remember that the USACE has been lowering the river intentionally to allow the freezing in of the river, so the pre-ice stage is somewhat due to that as it may have been a foot or more higher as little as a week ahead of the pre-ice stage listed. The table above includes only the first freezing over of that winter. Some winters have had multiple events. Typically, the first freeze in has been the most dramatic in terms of increase in river level.

Flash Flooding (Urban Flooding). *Note: When property damage does not occur, these events are technically referred to as "urban ponding."*

August 13, 2024: Although the official rainfall measured at the airport location (National Weather Service) was only 0.77 inches, in north Bismarck there were reports of as much as 3 to 5 inches which fell in a short amount of time. Sanford Health experienced significant flooding causing damage in the millions of dollars. Bismarck (City Govt) total damages estimated at **$**217,620 including property damage, infrastructure damage, equipment usage, and labor costs for clean-up, debris removal, and street closures during response. Local area businesses reported a total damage of $225,082 as well as business losses of $16,575.00. This estimate is limited to the downtown area. Several home owners in central Bismarck (south of Divide Ave along Merdith) had 3" to 8" of water in the basement. One apartment building in central Bismarck had 3 feet of water in the basement – occupants had to evacuate for a few days. Another homeowner near the Elks Swimming location reported 5 feet of water in his basement. Sanford Hospital had about 1 to 2 inches of water on the main floor – with water coming in from both the 7th Street side and from Rosser. The lower level was also impacted as water came "raining down" within an MRI room. In conjunction with the rain event, street construction/maintenance along Rosser Avenue and 7th Street near Sanford restricted normal drainage (bags and/or filters at inlets), and an interior roof drain failed, contributing to the damage of the medical facility and equipment.

July 3, 2018: 1.92 inches of rain fell in a very short time causing street flooding and pooling of water in Bismarck. Due to the higher river levels, the Tavis control gate structure had to be closed, requiring pumping to lower the level of the drainage channel, which requires more time for drainage to occur from streets in lower lying areas (ex: 12th Street, Basin Avenue). The underpasses took more than 8 hours to drain. Left photo below is the drainage channel near the Ascension Church on 3rd Street. Right photo is Basin Avenue.

July 14, 2016: 1.69 inches of rain fell within one hour. Total rainfall for the day was 2.62 inches. The heavy rainfall caused a railroad gate malfunction at 5th street as the ponding water created a connection between the two rails. Bismarck Tribune: *"A 46-year-old daily rainfall record has fallen in Bismarck. The old record of 1.94 inches, set in 1970, was broken by 11 a.m., according to the National Weather Service. The weather service says*

1.69 inches fell in just one hour in Bismarck Tuesday morning, and by 2:30 p.m., 2.62 inches had fallen."

July 10, 2016: 1.42 inches of rain fell within 50 minutes. The underpasses on 7th and 9th streets were filled with water and closed to traffic. One vehicle was stranded in the water after entering the underpass on 7th Street.

July 30, 2011: Multiple reports were received from across Bismarck of water up to 18 inches deep flowing over roads. Mainly the flash flooding was in low lying and poor drainage areas of the city. In some cases water washed up to the foundation of homes and into window wells. Rain amounts were around two inches.

June 15/16, 2009: Rain amounts varied within the Bismarck and surrounding areas - from just over 3 inches to over 7 inches of rain. Bismarck/Burleigh Experienced flash flooding the evening of June 15 into the early am hours of June 16th. Within Bismarck, flash flooding lifted/removed manhole covers and caused street flooding. Dispatch was inundated with calls. Four road closures occurred within Bismarck - Divide Avenue (35th street area impacted by Hay Creek), 12th Street between Expressway and University; Main Ave from 19th to 26th, and 3rd Street from Expressway to Front.

August 23, 2004: Streets and underpasses flooded causing several major arteries to be closed. Water flowed across yards and into several basements of homes.

August 31, 2002: Streets and underpasses filled with water in Bismarck.

July 27, 2001: Rainfall of 3 to 4 inches over Bismarck caused flooding of streets and underpasses. Two mudslides on River Road covered northbound lanes.

July 26, 2001: Around 2 inches of rain fell in a very short time causing street flooding and pooling of water in Bismarck.

June 9, 2001: Widespread street flooding throughout the city of Bismarck where a foot or more covered the roads. Travel not advised. Up to 12 feet of water accumulated in the railroad underpasses.

The June 9 storm also produced significant hail (also noted in the "Thunderstorm" section of the mitigation plan:
In June 2001, a hailstorm caused an estimated $230 million in property damage in Burleigh and Morton Counties; an estimated 57,000 insurance claims were filed. (North Dakota Insurance Department, 2007) This hailstorm affected the urban Bismarck and Mandan areas. As the most damaging hailstorm in the state's history, the insurance industry was severely impacted, and insurance availability and premiums were affected statewide; many insurance companies pulled out of the state after the storm. (North Dakota State Water Commission, 2007c) According to the state situation report, officials estimated the North Dakota State Capitol Complex received approximately $100,000 worth of damage. Thirteen windows in the tower were broken; shingles on the State Library were damaged as well as the skylight in the atrium of the Judicial Wing. The exteriors of the State Office Building and the Grounds Maintenance Building were also damaged. Officials estimated that 400 North

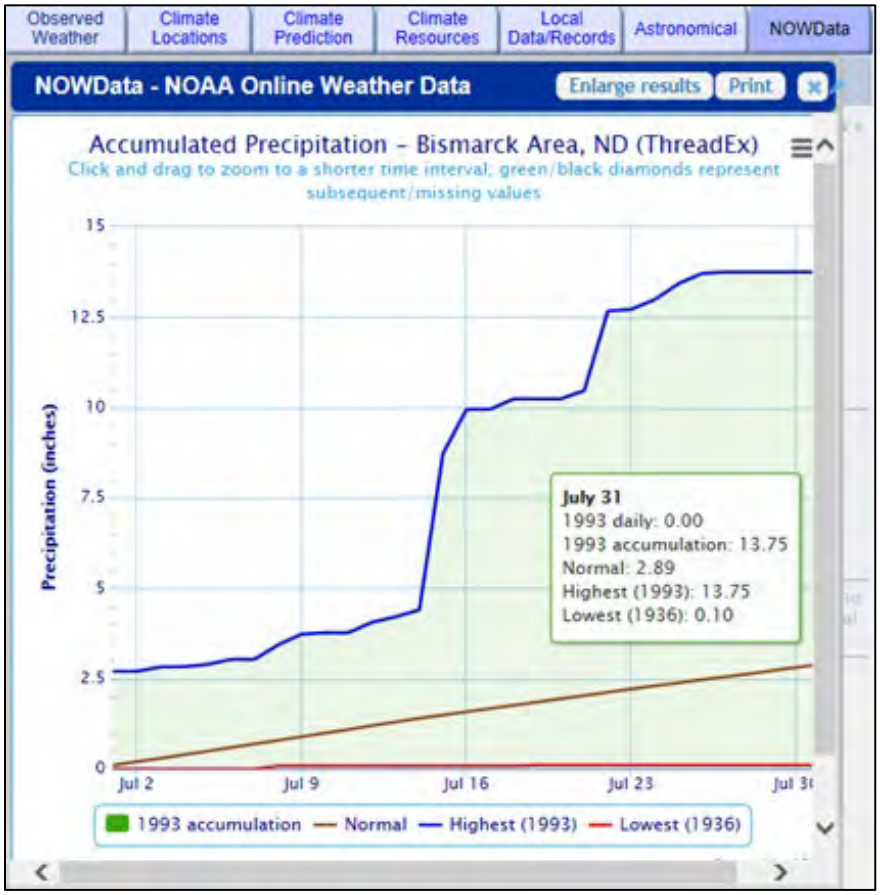
Dakota State Fleet vehicles suffered hail damage. Approximately 50 required glass replacement (North Dakota Department of Emergency Services, 2007).

August 12, 1999: Heavy rainfall from 4 to 7 inches. Hardest impact in the cities of Bismarck and Mandan. Two hundred twenty-one (221) homes and businesses received water damage. Twelve (12) road sites were damaged and a significant mudslide closed portions of Highway 1804 in north Bismarck.

August 21, 1998: 4.48 inches of rain in two hours

March 21, 1997: Minor overland flooding – wet basements.

July 15, 1993: National Weather Service reported 4.32 inches of rainfall. Cumulative rain for the month of July was 13.75, the record high for the month of July. Normal is 2.89 for the month.



Per Bismarck Tribune archived articles: 7 inches of rain in the Bismarck area causing damages of over $2 million in private property damages. Mayor Sorenson estimated that two-thirds of the flooded basements were on the north side, out of the flood plain, but that the most serious cases of individual damage were on the south side. The

American Red Cross provided services (clothes, housing and feeding) to 50 victims in Bismarck-Mandan, many of whom had been displaced from their homes. Norwest Bank set up unsecured low interest loans to help cover uninsured or underinsured flood related costs. Source: archived Bismarck Tribune articles

1993 Flood Statewide, excessive rains during the spring destroyed crops and heavy thunderstorms on July 15-16 (4-7 inches of rain), July 22-27 (6-10 inches of rain), and August 21-22 (up to 7 inches of rain) caused flash flooding and damage to public and private property. Minor to moderate flooding occurred in the Missouri, James, Souris, and Devils Lake basins.

Geologic Hazard – Hazard Profile

Description

A **landslide** is the movement of rock, soil, artificial fill, or a combination thereof on a slope in a downward or outward direction. The primary causes of landslides are slope saturation by water from intense rainfall, snowmelt, or changes in ground-water levels on primarily steep slopes, earthen dams, and the banks of lakes, reservoirs, canals, and rivers (US Geological Survey). Other causative factors include steepening of slopes by erosion or construction, alternate freezing or thawing, earthquake shaking, volcanic eruptions, and the loss of vegetation from construction or wildfires. The saturation or destabilization of a slope allows the material to succumb to the forces of gravity or ground movement.

Many different types of landslides exist: slides, falls, topples, flows, and lateral spreads. Slides involve the mass movement of material from a distinct zone of weakness separating the slide material from the more stable underlying material. The primary types of slides are rotational slides and translational slides. Falls occur when materials, mostly rocks and boulders, fall abruptly from a steep slope or cliff. Falls are strongly influenced by gravity, mechanical weathering, and the presence of interstitial water. Topples are similar to falls, yet they pivot around a connection point at the base of the material and are most often caused by gravity or fluids in the cracks of the rocks. Flows typically have a higher percentage of water material embedded in them and behave more like a liquid than other types of landslides. The five primary categories of flows are: debris flows, debris avalanches, earthflows, mudflows, and creeps. Lateral spreads usually occur on gentle slope or flat surfaces when liquefaction occurs and leads to fractures on the surface. Complex landslides involve any combination of these types (US Geological Survey).

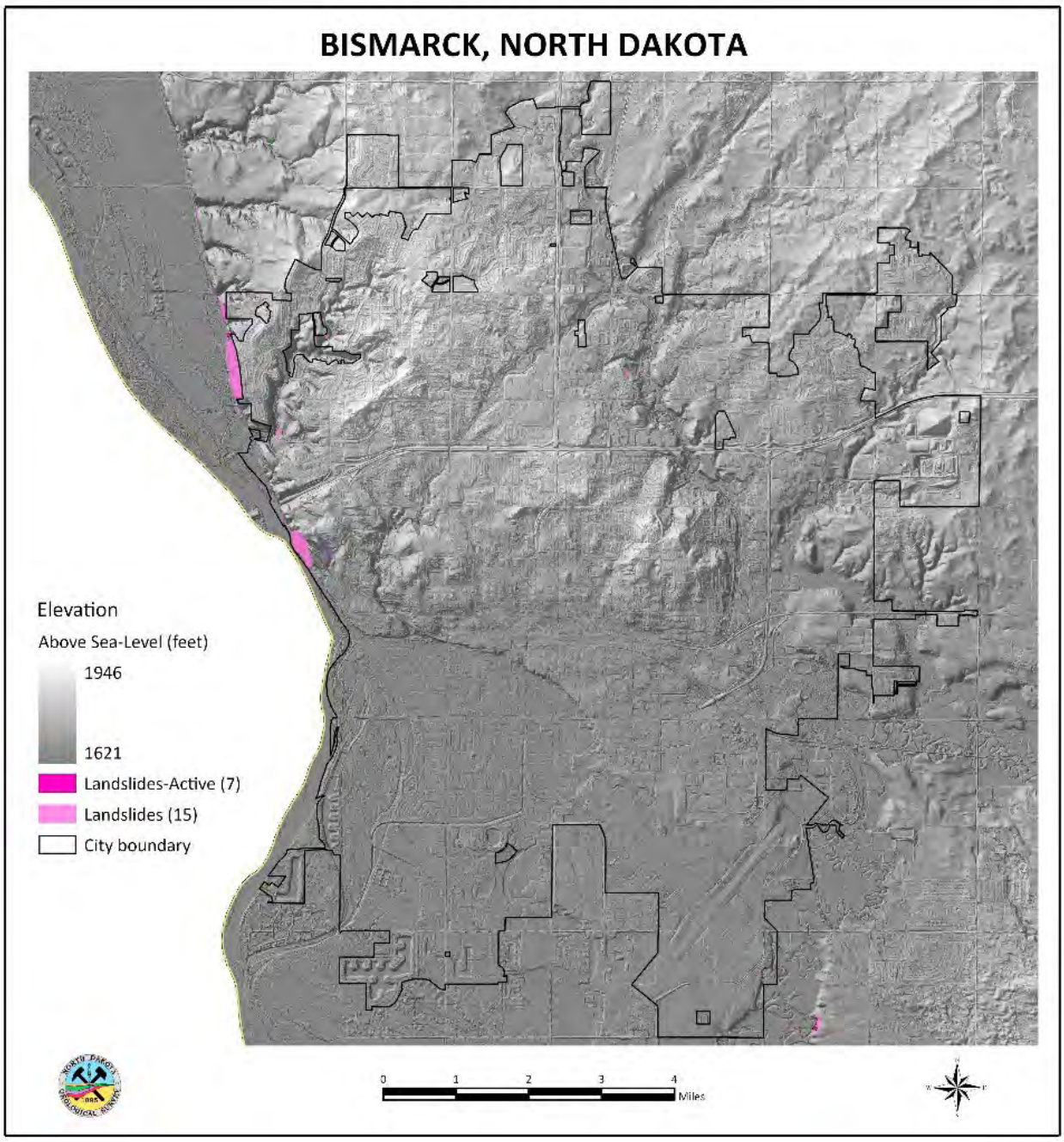
Landslides are typically associated with mountainous regions, but they can also occur in areas of low relief. In these areas, the landslides are often the result of cut-and-fill failures (from roadway and building excavations), river bluff failures, lateral spreading, or mine collapse (US Geological Survey).

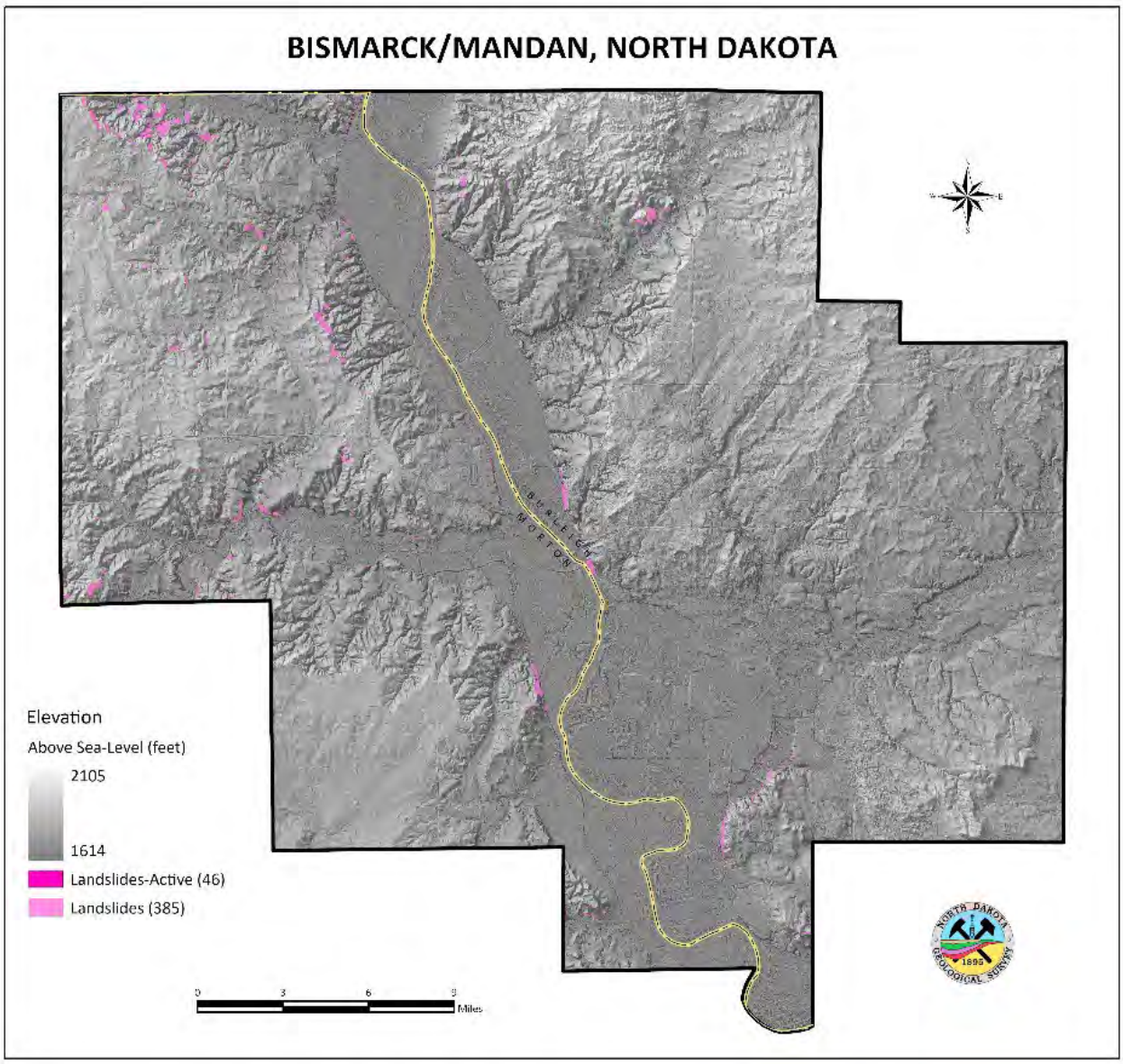
Landslides occur in natural and anthropogenic settings in North Dakota and are most commonly found within major river valleys and on engineered slopes along major transportation corridors. Landslides are dominantly found in two settings, controlled by the surface geology of the Great Plains in western and southwestern North Dakota and along major river valleys of the Missouri, Sheyenne, James, Souris, and Red Rivers (North Dakota Geological Survey).

Riverbank slumping can be considered a form of landslide and is often found along the rivers in North Dakota. The riverbank soils are inherently weak, and natural forces are always moving river channels.

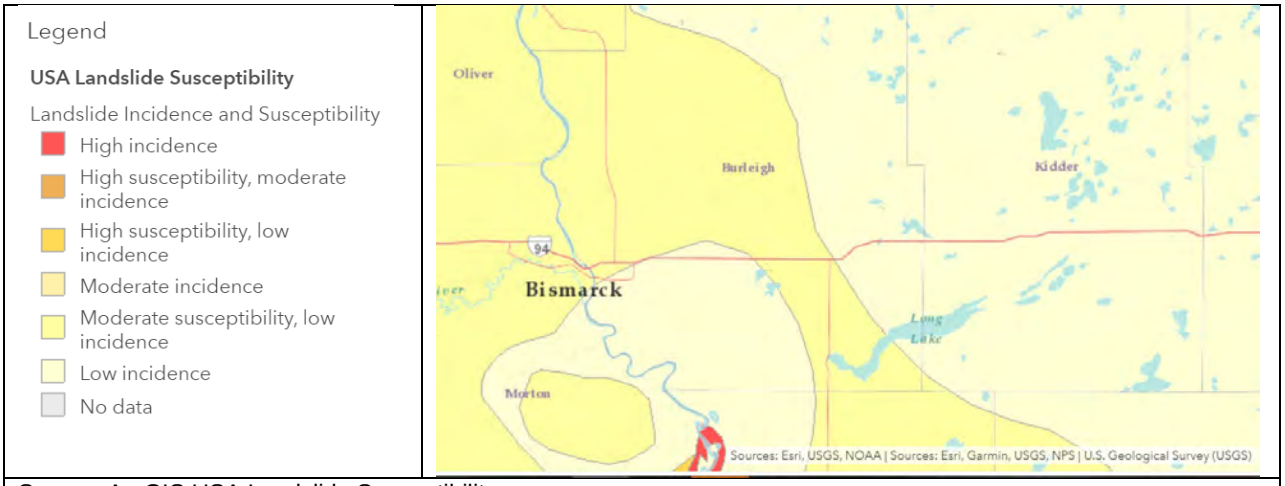
Landslides occur at an unobservable speed with regularity in North Dakota, and recent data upgrades make it possible to identify those small movements that will better enable forecasting the location of bigger movements with the capability to cause consequences. This new data improves warning time and helps to identify areas that may need intervention or warning signs ahead of an impactful landslide.

Fifteen landslides areas are identified to have occurred in the Bismarck area, with seven being considered “active.” Per ND Geological Survey, “active” landslides in the Bismarck area defined as "landslide areas showing movement between 2015 and 2024.

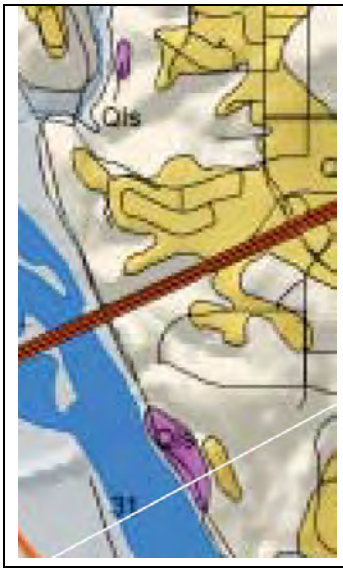




Some of these slides likely predate settlement of the area and are hundreds, if not thousands, of years old. Typically, more recent landslides are reactivations of these older, much larger landslide complexes. Landslides may occur throughout the year but are most prevalent in the spring and early summer due to the availability of moisture from snowmelt and rainfall events. In addition, studies have shown that landslides are most active during a wet period that follows an extended dry period. For these reasons, water is often said to “lubricate a slide.” Although this is an oversimplification of the mechanisms and rock properties, such as differential pore pressures, involved in slope failure, it is correct in its emphasis of the importance of water to slope movement. To a degree, landslides are self-perpetuating because more water seeps into the subsurface after a slide occurs due to the ponding of water in the newly formed surface depressions and infiltration of this water through numerous tension cracks.



Source: ArcGIS USA Landslide Susceptibility
https://www.arcgis.com/home/webmap/viewer.html?webmap=cc5e9da58860460188705c545e86c871

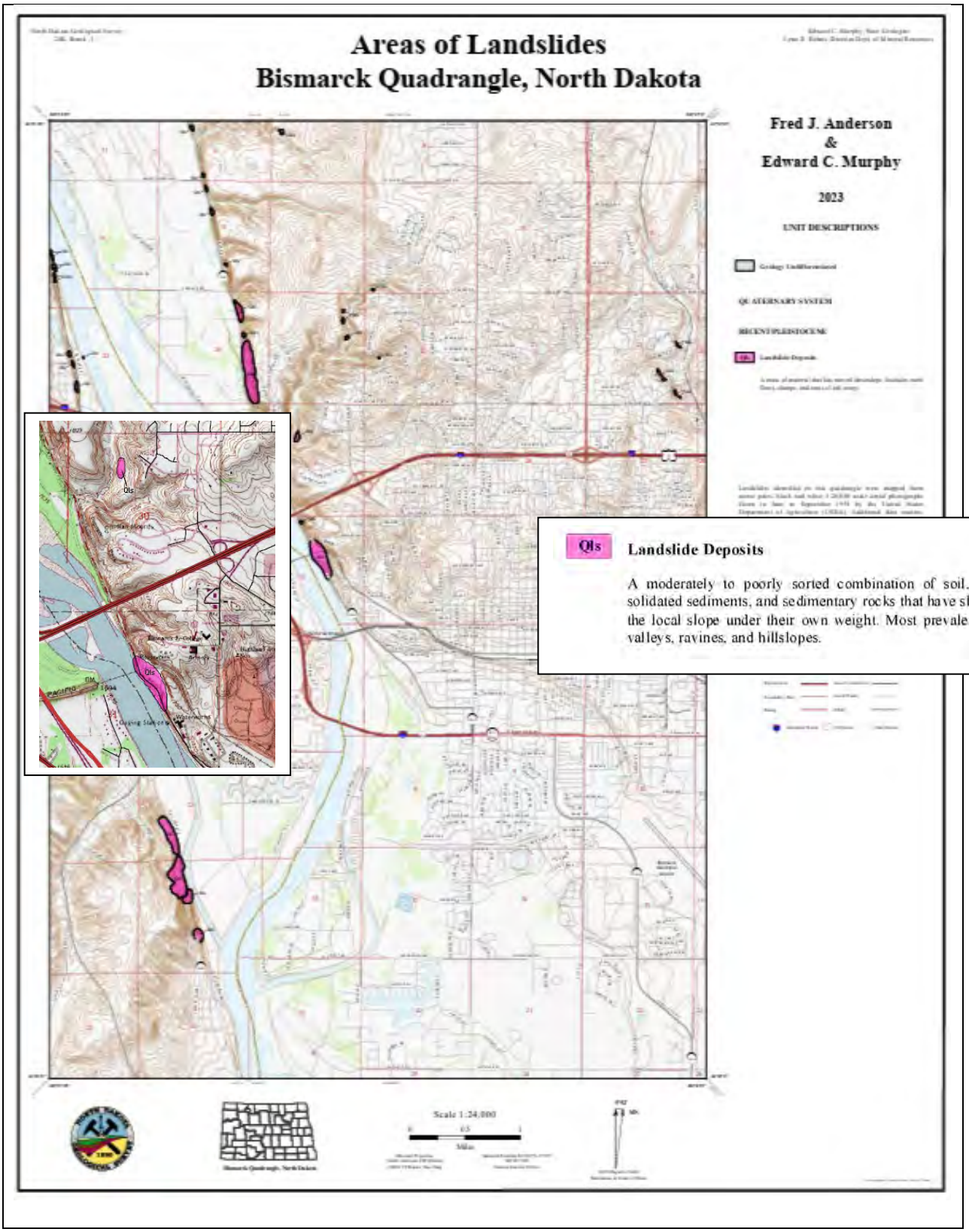


The areas in pink shading show previous areas of slope failure in Bismarck. The top location is north of Burnt Boat Drive. The bottom location is along River Road just south of the Interstate 94.
https://www.dmr.nd.gov/ndgs/documents/Publication_List/pdf/geoinv/GI_3.pdf

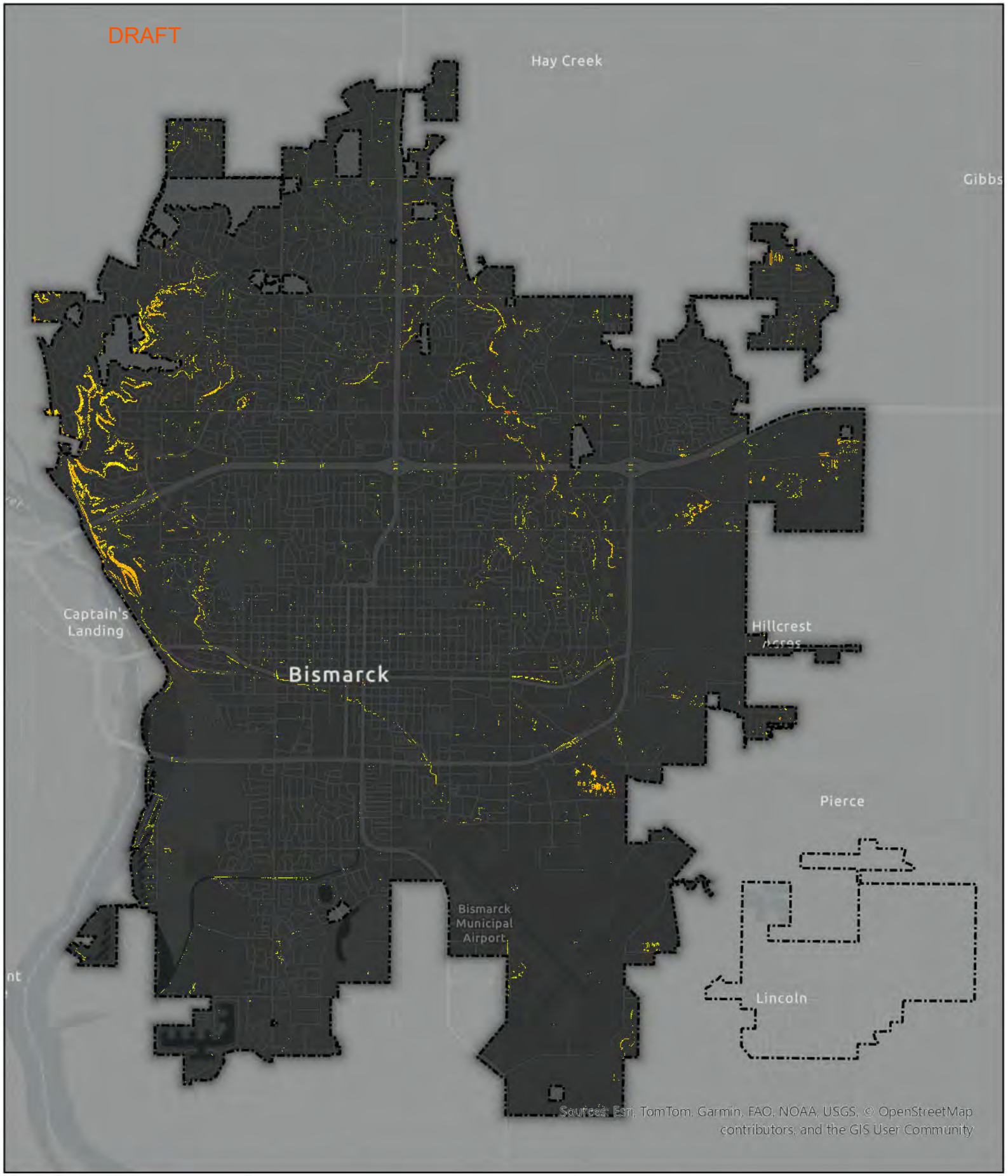
The ND Geological Survey (within ND Department of Mineral Resources) has Bismarck area Landslide maps available:
https://www.dmr.nd.gov/ndgs/landslides/Bismarck/Bismarck_24K_l.pdf

as well as a surface geology map:
https://www.dmr.nd.gov/ndgs/surfacegeo/BISMARCK_100K/WebSurfaceGeology/24k/bsmk_sg.pdf

Slope failure, also referred to as mass wasting, is the downslope movement of rock debris and soil in response to gravitational stresses. Three major types of mass wasting are classified by the type of downslope movement: falls, slides, and flows. Land subsidence is another type of ground failure covered.



https://www.dmr.nd.gov/ndgs/landslides/Bismarck/Bismarck_24K_l.pdf
https://www.dmr.nd.gov/ndgs/landslides/



Bismarck

Percent Slope

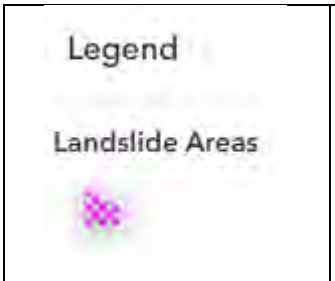
Map Created: June 2025
by GIS Division

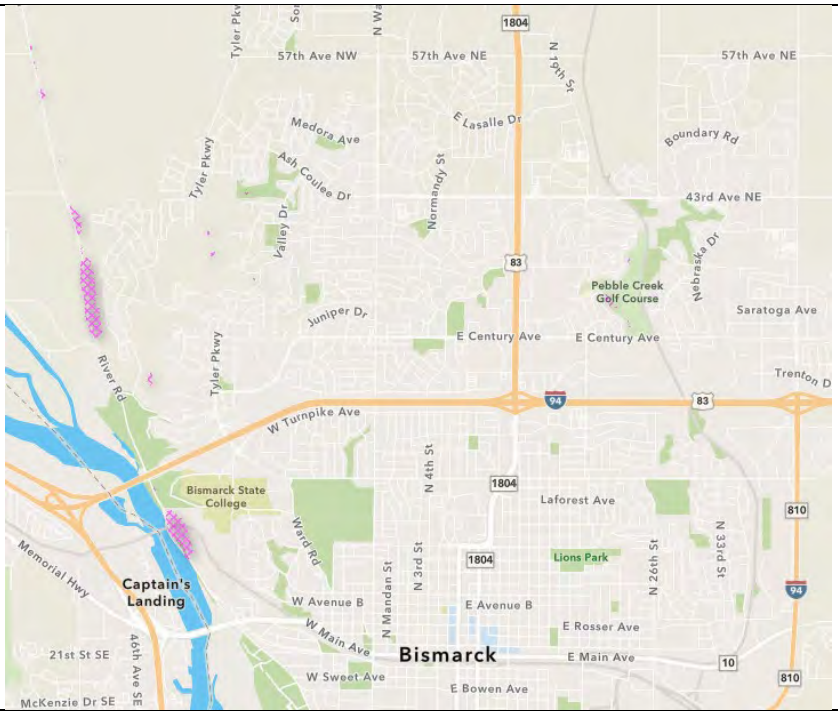
<40%
40% - 50%
50% - 120%
120%<

N

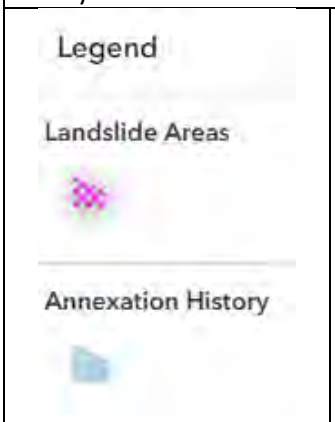
0 ½ 1 Mile

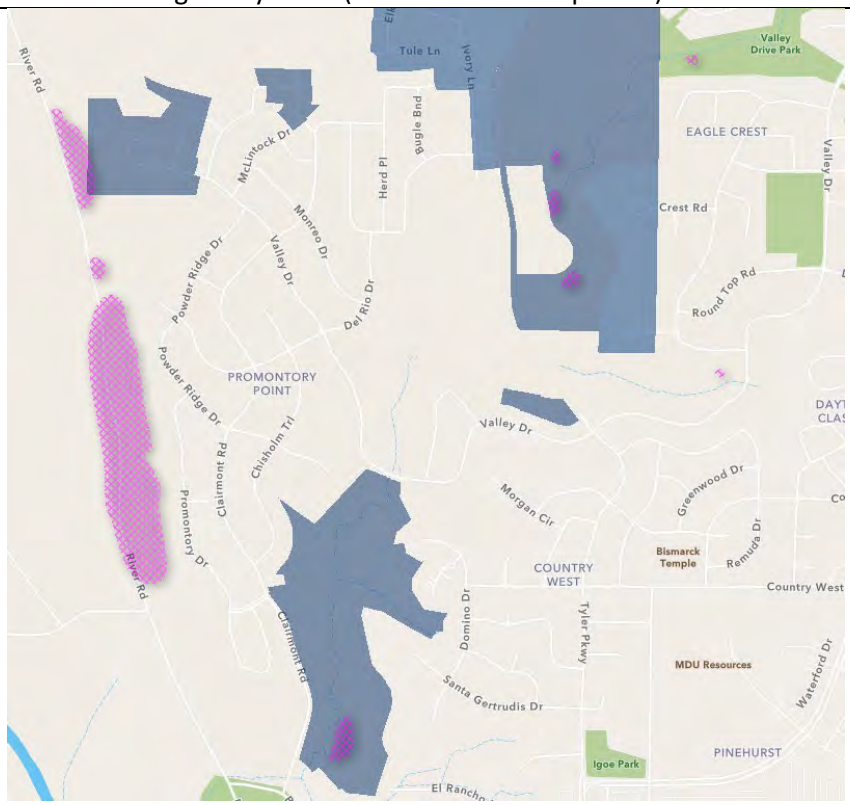
Locations of Landslide Occurrences



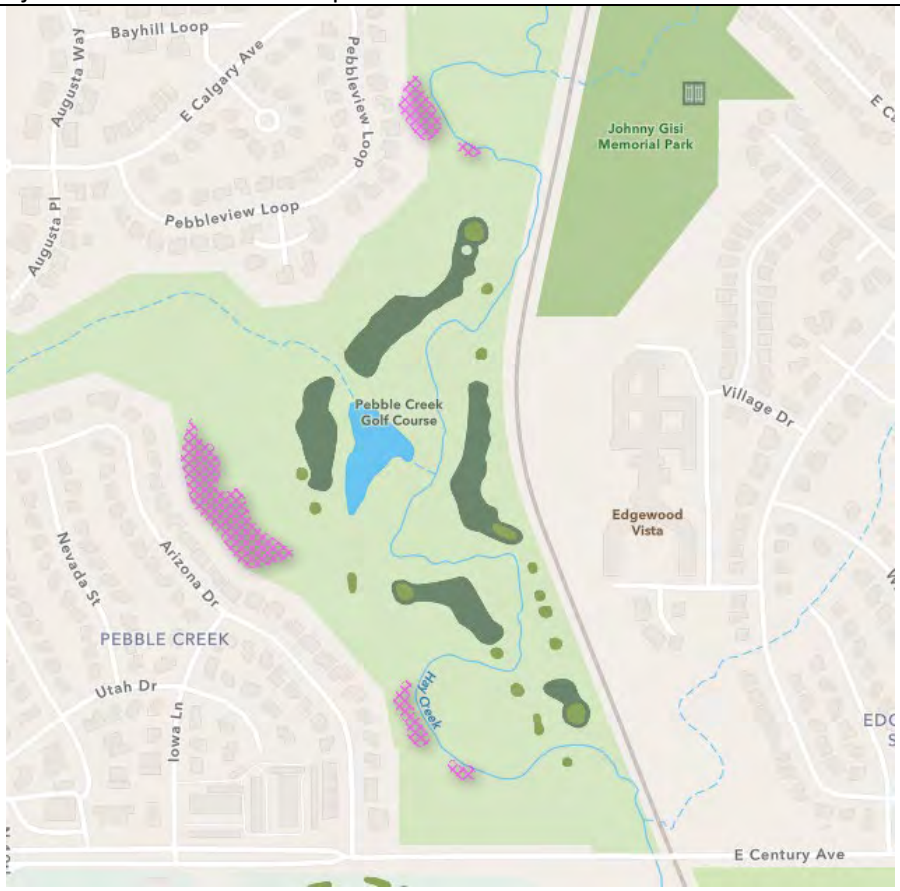


The following illustrates locations of landslide occurrences along River Road, as well as landslide areas that have been annexed since January 2020. Additional locations shown include landslide activity at Valley Drive Park and the single location along Valley Drive (south of Round Top Road)





The following illustrates locations of landslide occurrences within the Pebble Creek Golf course area and properties along Hay Creek adjacent to Pebble View Loop and Arizona Drive.

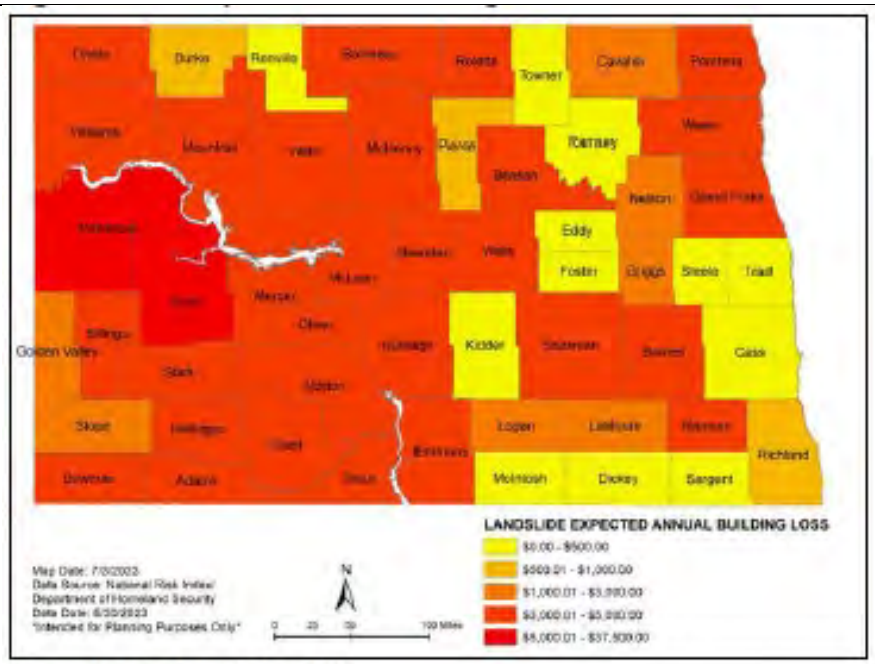


Landslide areas along River Road southwest of BSC and west of Gateway to Science.

Rivers and streams erode by undercutting the river banks on the outside of a meander or curve. This erosion creates over-steepened cliff faces that are highly susceptible to slope failure. Such is the case in west Mandan where landslides have occurred in the steep, tall cliffs overlooking the Heart River. A series of landslides in this area has displaced trees, a rock wall, and resulted in the abandonment of at least two lots due to safety concerns.

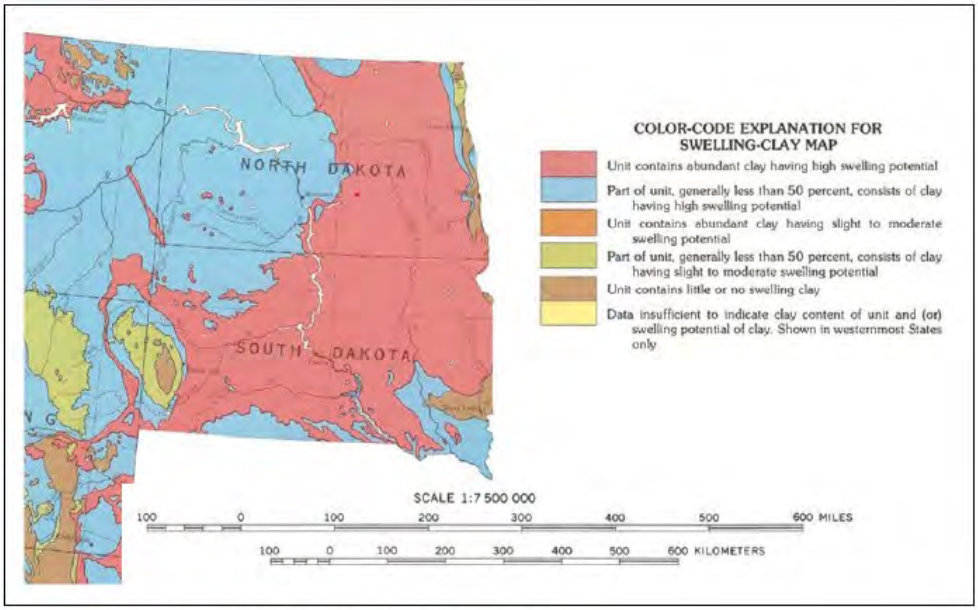
The mudstone of the Cannonball Formation contains interbedded lenses of sandstone and siltstone (grayish brown) and claystone (dark gray). The sand and clay content of the Cannonball mudstones is also variable, some mudstones are dominated by clay and others by sand and silt. Most of the mudstones in the Bismarck-Mandan area are dominated by claystone. The clays in the mudstone are mixed and contain varying percentages of swelling clays. Differential pore pressures within lenses in the mudstone and the presence of swelling clays may potentially damage building foundations.

All of the landslides identified in the Bismarck-Mandan area involve mudstones in the Cannonball Formation. Not only are these mudstones involved, but most of the slope failures appear to have originated within these rocks.
https://www.dmr.nd.gov/ndgs/documents/Publication_List/pdf/geoinv/GI_3.pdf

Expected Annual Building Loss from Landslides	 *Source: National Risk Index, 2023*

Land subsidence is a gradual settling or sudden sinking of the Earth's surface owing to subsurface movement of earth materials. The principal causes are aquifer-system compaction, drainage of organic soils, underground mining, hydrocompaction, natural compaction, sinkholes, and thawing permafrost.

Expansive Soils. The Drift Prairie region of the state includes soil with substantial clay content that is prone to expansion and shrinkage based on moisture content (Anderson, 2004; NDPSC, 2023), as shown in the following map (swelling clay) included in the state's mitigation plan. The map illustrates that clay soils having high swelling potential are common in our area.



Source: Adapted from USGS IMAP 1940, Olive et al., 1989,

Excessively dry or wet conditions will cause the physical space that the soil takes up to expand and contract. This can cause buckling and cracks in cement foundations, roadways, and sidewalks.

The primary risk from landslides and expansive soil is to property, facilities and infrastructure that can be damaged due to ground movement. Underground infrastructure, including sewer and water lines and mains are perhaps at greatest risk. Even small movements of the soil or land can cause leaks or breaks. These can introduce bacteria or other undesired elements to the water system. Similarly, wastewater leaks or pipeline spills can create environmental damage, in addition to disruptions in service. Both hazards threaten transportation infrastructure beyond roads. Airport runways, sidewalks, bridges, and dams can all be damaged by landslides or expansive soil.

The damage done by expansive soils tends to be a sudden consequence from heavy precipitation, snowmelt, or drought event.

As the community grows, new areas of development run the risk of increased property vulnerability to the geologic hazards of expansive soils.

Radon is prevalent across the state, with the entire state falling into the EPA Zone 1, where testing is recommended for all homes, as shown in Figure 4.12-16. According to the EPA (2023), radon cannot be seen or smelled, but is a radioactive carcinogen known to cause lung cancer. Radon continues to be a persistent threat to North Dakotans, and as housing ages, the cracks and deterioration that allows radon to enter the home will increase. Therefore, in areas

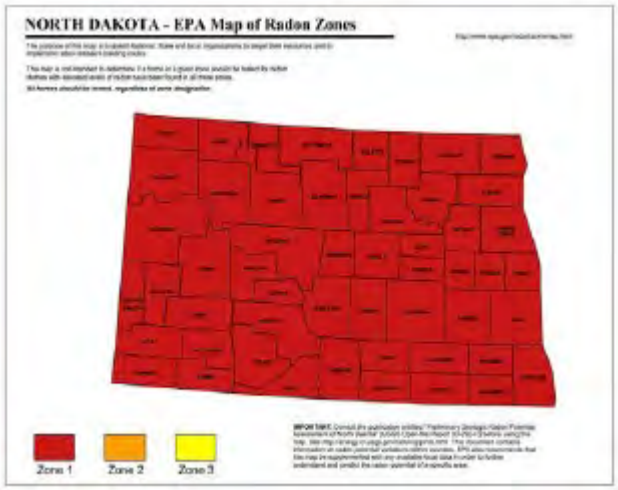
with aging housing stock, radon consequences are likely more probable than they were five years ago. New construction is less likely to expose individuals to radon.

North Dakota Radon Zones:

Radon is measured in picocuries per liter, though there is no known safe level.

Resources:
https://www.epa.gov/radon/what-epas-action-level-radon-and-what-does-it-mean

https://www.epa.gov/sites/default/files/2014-08/documents/north_dakota.pdf



Source: EPA, 2023

Earthquake is any sudden shaking of the ground caused by the passage of seismic waves through Earth's rocks. Seismic waves are produced when some form of energy stored in Earth's crust is suddenly released, usually when masses of rock straining against one another suddenly fracture and "slip." Earthquakes occur most often along geologic faults, narrow zones where rock masses move in relation to one another. The major fault lines of the world are located at the fringes of the huge tectonic plates that make up Earth's crust.

The Modified Mercalli Scale is used to describe the magnitude of an earthquake:

Intensity	Shaking	Description/Damage
I	Not felt	Not felt except by a very few under especially favorable conditions.
II	Weak	Felt only by a few persons at rest,especially on upper floors of buildings.
III	Weak	Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibrations similar to the passing of a truck. Duration estimated.
IV	Light	Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like heavy truck striking building. Standing motor cars rocked noticeably.
V	Moderate	Felt by nearly everyone; many awakened. Some dishes, windows broken. Unstable objects overturned. Pendulum clocks may stop.
VI	Strong	Felt by all, many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight.
VII	Very strong	Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken.
VIII	Severe	Damage slight in specially designed structures; considerable damage in ordinary substantial buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned.
IX	Violent	Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations.
X	Extreme	Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent.

https://www.usgs.gov/programs/earthquake-hazards/modified-mercalli-intensity-scale?qt-science_center_objects=0&qt-science_center_objects

Vulnerability Assessment

Vulnerability: Characteristics of community assets that make them susceptible to damage from a given hazard.

	Landslide (Slope Failure)
Probability	Possible
Warning Time	No Notice event in many cases.
Duration	Less than 6 hours, but days/weeks to remove material
Geographic Area	See applicable maps.
Death / Injury 1. Primary Causes A. Highest vulnerability	 1. Falling Rock, road washouts. A. Those living or traveling near areas of potential land subsidence.
Mass Casualty Incident	Unlikely
Property Losses (points of vulnerability – high priority)	1. Properties built, potentially on backfill or without adequate setback (prior to current master planning methods). - Tyler Coulee area - Promontory Point – West of Clairmount Road
Environmental (points of vulnerability – high priority)	1. Hay Creek (waterway impacted). 2. Impact to the Missouri River would be minimal.
COG/COOP (points of vulnerability – high priority)	1. No impacts
Critical Facilities (points of vulnerability – high priority)	1. Water Treatment Plant, located off River Road
Critical Infrastructure (points of vulnerability – high priority)	1. River Road – potential loss of access similar to June 2009: closed for 5 months to make repairs. Necessary detour can potentially cause delays in emergency response. 2. DMVW tracks run adjacent to Hay Creek through much of Bismarck. 3. BNSF Railroad Bridge Piers. 4. Private Utility Infrastructure in NW Bismarck – both overhead and underground utilities (ie: near River Road) - gas main near water treatment plant - gas force main – below the Missouri River
Schools (points of vulnerability – high priority)	1. Burnt Boat Drive – bus route.
High Risk Facilities (chemical) (points of vulnerability – high priority)	1. No impacts
Specific Populations: Public Assembly, Vulnerable / Special Populations (points of vulnerability – high priority)	1. Limited to populations affected to by road closure (ie: River Road) or site specific property impacts (ie: slope failure).
Economy (community wide)	1. Road Closures – delays in productivity
OTHER: (points of vulnerability – high priority)	The failure zone in both the Mary College *(University of Mary*) and the NP Railroad Bridge slides appeared to occur in the Hell Creek – a unit that contains more swelling clays. *E-mail comment: Edward C. Murphy, State Geologist North Dakota Geological Survey, ND Department of Mineral Resources, ND Industrial Commission*

Note: Vulnerability within the previous table focuses on the landslide hazard because of the higher likelihood of occurrence and more signficant impact. Vulnerability of the other geologic hazards is discussed, where applicable, within the narrative throughout this hazard profile. Also, see Section 3 for hazard vulnerability highlights.

Changes in Vulnerability

Since the previous plan update in 2020.

Increase in Vulnerability	Decrease in Vulnerability
As the community grows, new areas of development run the risk of increased property vulnerability to the geologic hazards of slope failure or expansive soils. See map on page 7	See Geologic Hazard Mitigation Capabilities listed in Section 3.

Risk

See Section 10 of this plan document for risk assessment and hazard ranking of all hazards addressed in this plan.

Relationship to other Hazards: Severe Summer Weather and Flood. Heavy precipitation, snowmelt, and flood events can trigger geologic hazards. Floods and droughts can induce geologic hazards through the expansion and/or shrinkage of clay soils.

Future Conditions

- **Location**: The locations of geologic hazards will remain the same, with the exception of additional areas as annexed into the city.
- **Extent/Intensity:** The extent and intensity of geologic hazards may change due to climate change, as impacts from projected future climate temperatures and/or precipitation increase.
- **Frequency:** Both drought and heavy precipitation events are projected to occur more frequently, which may contribute to an increased frequency of landslides where steep slopes are present or to riverbank collapse where undercutting due to subsoil flow and/or antecedent flooding is possible. There is also a potential for increased wind and water erosion.
- **Duration:** The duration of geologic hazards is not projected to change.

Anticipated Future Climate Impact – Geologic Hazard

Through the end of this century in North Dakota, expect more frequent, larger, and more intense geologic hazards, such as landslides, riverbank collapse, sink holes, and expansive (clay) soils. Both Drought and Heavy Precipitation events are projected to occur more frequently, which is expected to contribute to an increased frequency of expansive soils alternately cracking and swelling, landslides where steep slopes are present, or to riverbank collapse where undercutting due to subsoil flow and/or antecedent flooding is possible. Both extremes also increase the potential for wind and water erosion. Increased development pressure and the impacts of future climate conditions may increase the risk to a variety of state infrastructure and assets if constructed or situated in areas prone to geologic hazards.

Previous Occurrences - Landslides

December 9, 2025: A landslide just NW of Bismarck along River Road closed the two-lane road from Sandy River Drive to Wilderness Cove Road. The road was re-opened on December 16. This was the fourth landslide since 2019.

June 17, 2022: A landslide just NW of Bismarck along River Road closed the two-lane road from Sandy River Drive to Wilderness Cove Road. The road was re-opened on June 20. This was the third landslide since 2019.

March 3, 2020: A landslide just NW of Bismarck along River Road closed the two-lane road from Sandy River Drive to Wilderness Cove Road.

December 22, 2019: A large portion of the existing roadway back slope on the east side of River Road (around the 3900 block) let loose and blocked River Road. The material ranged from 10 to 15 feet deep on the east side of the roadway to around 2 to 5 feet deep on the west side. It extended along 200 feet of River Road. Clean-up activities were conducted on December 26. Stabilizing projects were initiated in July 2021. Construction included pavement rehabilitation and slope stability improvements north of the Grant Marsh Bridge at a cost of about 1.1 million.	

June 2016: Two properties along Arizona Drive in Bismarck backyards dropped as much as 7 feet in June, with continued dropping with every rainfall according to resident. Photo Credit: Bismarck Tribune	

June 2009 thru December 2009: River Road between the Memorial Bridge and the Railroad Bridge was closed as a result of slope failure (land subsidence). Sloping of the half-mile stretch between north of Bismarck's water plant and Keel Boat Park forced the city to close the road in June. Pavement had to be removed and pilings put in place. Permanent surfacing had to be applied in 2010.

Figure 6. Several landslide scarps are visible along the east slopes of the Missouri River Valley above the Bismarck Railroad Bridge. The top of a City of Bismarck water reservoir is visible just below the largest tree at the top of the east slope. Photograph taken by Ralph Peck in 1951.

The ND Department of Mineral Resources (DMR) July 2009 newsletter cites slope instability issue affecting the Northern Pacific Railway Bridge for several decades after it was completed in 1882: "…. Shortly after the railroad bridge was completed, the east pier began sliding towards the river. For the next 68 years, Northern Pacific engineers applied a variety of slope stabilization techniques in an attempt to stop the pier from moving. …. Peck seized the opportunity that was afforded during the straightening of the railroad track to remove a considerable amount of the hillside above the east pier and reduce the remaining slope to within his desired factor of safety. Finally, after all of those years, his efforts resulted in relative stability of the slope above the east bridge pier…"
https://www.dmr.nd.gov/ndgs/documents/newsletter/2009Summer/pdf/IceJamsLandslides.pdf

Photos below show slumping north of Burnt Boat Drive
Photo Date: October 9, 2009

NDSU has documented (photos) of slumping in the Double Ditch Area
http://www.ndsu.edu/nd_geology/nd_mass_wasting/index_mass_wasting.htm

This large slump is located north of Bismarck, at the site of the Double Ditch Indian Village. It was initiated by erosion against this slope by the Missouri River (just out of view to the right on this photo).

In the next photo, we see the progress of this slump over just nine months. (Use the telephone pole and highway as reference points between the two photos).
(Photo by J. Kostelecky, 1987).

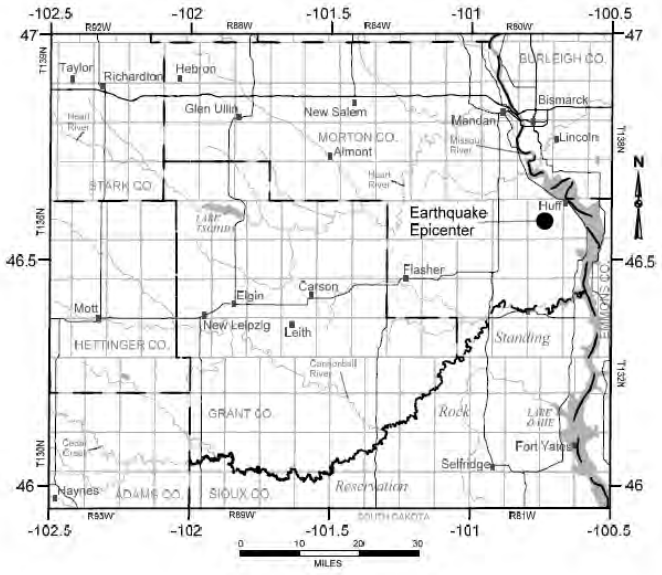
This is the same slump as in the previous photo, but nine months later. (Use the telephone pole and highway as reference points between the two photos).
(Photo by D.P. Schwert, North Dakota State University, 1988).

Previous Occurrences - Earthquake

Source: North Dakota Geological Survey, North Dakota Earthquake Catalog (1870-2015) by Fred J. Anderson.

July 8, 1968 M 4.4 Earthquake near Huff, North Dakota.
A magnitude M 4.4 earthquake was recorded five miles southwest of Huff in eastern Morton County in south-central North Dakota during the morning of Monday, July 8, 1968 at an estimated depth of 20.5 miles. This earthquake was the first instrumentally verified earthquake recorded in North Dakota and was reported to have been felt over approximately 3,000 square miles of south-central North Dakota. It was reported that “a television set shifted and sounds like thunder were heard.” Additionally, Mercalli earthquake Intensity IV effects were noted at Bismarck, Fort Rice, Huff, Linton, Mandan, Menoken, and Moffit; and Mercalli intensity I-III effects at Almont, Flasher, Halliday, and St. Anthondy (Coffman and Cloud, 1970).

Day	Date	Time (local)	Time (UTC)	Magnitude	Depth (miles)	MMI	T & R	Longitude	Latitude
Monday	07/08/1968	10:50:12	16:50:12	4.4	20.5	IV	136-80	-100.74	46.59



Applicable Mercalli Intensity Level Descriptions

III Felt indoors by several, motion usually rapid vibration. Sometimes not recognized to be an earthquake at first. Duration estimated in some cases. Vibration like that due to passing of light, or lightly loaded trucks, or heavy trucks some distance away. Hanging objects may swing slightly. Movements may be appreciable on upper levels of tall structures. Rocked standing motor cars slightly.

IV Felt indoors by many, outdoors by few. Awakened few, especially light sleepers. Frightened no one, unless apprehensive from previous experience. Vibration like that due to a passing of heavy or heavily loaded trucks. Sensation like heavy body striking building or falling of heavy objects inside. Rattling of dishes, windows, doors; glassware and crockery clink and clash. Creaking of walls, frame, especially in the upper range of this grade. Hanging objects swung, in numerous instances. Disturbed liquids in open vessels slightly. Rocked standing motor cars noticeably.

V Felt indoors by practically all, outdoors by many or most: outdoors direction estimated. Awakened many, or most. Frightened few –slight excitement, a few ran out doors. Buildings trembled throughout. Broke dishes, glassware, to some extent. Cracked windows – in some cases, but not generally. Overturn vases, small or unstable objects, in many instances, with occasional fall. Hanging objects, doors, swing generally or considerably. Knocked pictures against walls, or swung them out of place. Opened, or closed, doors, shutters, abruptly. Pendulum clocks stopped, started or ran fast, or slow. Moved small objects, furnishings, the latter to slight extent. Spilled liquids in small amounts from well-filled open containers. Trees, bushes, shaken slightly.

The North Dakota Earthquake Catalog (1870-2015) provides seismological information on thirteen earthquakes that have been reported to have occurred in the state. Today and historically, the state continues to be in one of the most geologically stable areas of the North American Continent. Earthquakes that have occurred in the state are generally of magnitude (M) 3.0 or less and may occur about once per decade. The largest earthquake to have occurred in the state remains to be the July 8, 1968 M4.4 Huff earthquake which is also the first earthquake in the state to have had an instrumentally located epicenter. There are currently three seismic monitoring stations in operation in North Dakota with the capabilities to detect earthquakes that originate at local, regional, and global distances: one location south of Bismarck near Huff, one in the Red River Valley just northwest of Fargo, and one southeast of Devils Lake near Maddock.

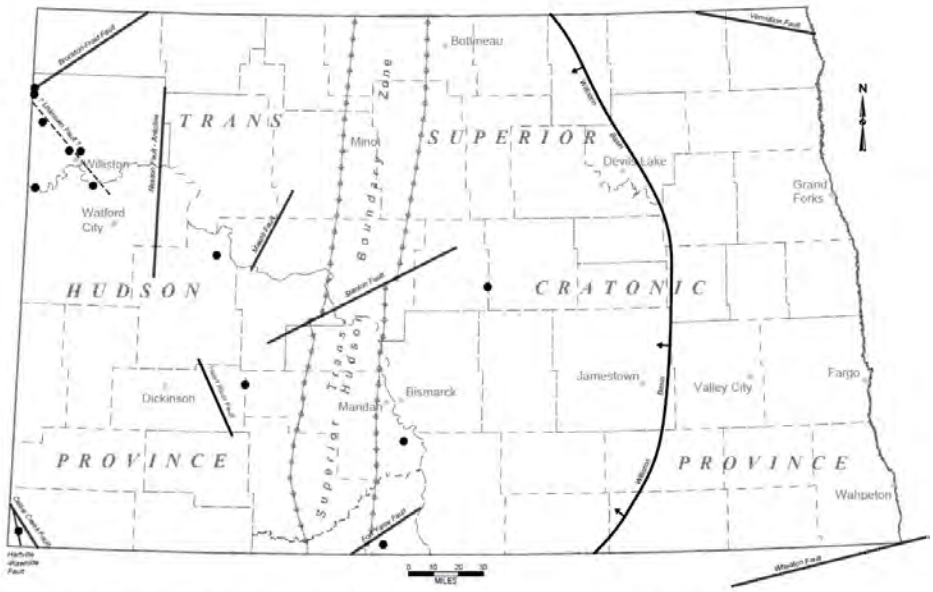


Figure 1. Locations of major faults and tectonic boundaries along with earthquakes that have occurred in North Dakota (as modified from Sims, et.al., 1991, and Nesheim, 2012).

Table 1. Summary of earthquakes that have been reported to have occurred in North Dakota.

Day	Date	Time (local)	Magnitude	Depth (mi.)	Modified Mercalli Intensity	Longitude	Latitude	City or Vicinity of Earthquake
Friday	September 28, 2012	05:53:43	3.3	0.4*	III	-103.48	48.01	SE of Williston
Monday	June 14, 2010	02:58:03	1.4	3.1	I	-103.96	46.03	Boxelder Creek
Sunday	March 21, 2010	11:56:40	2.5	3.1	II	-103.98	47.98	Buford
Sunday	August 30, 2009	20:24:23	1.9	3.1	I	-102.38	47.63	Ft. Berthold SW
Saturday	January 3, 2009	07:53:48	1.5	8.3	I	-103.95	48.36	Grenora
Saturday	November 15, 2008	10:21:27	2.6	11.2	II	-100.04	47.46	Goodrich
Wednesday	November 11, 1998	06:59:37	3.5	3.1	IV	-104.03	48.55	Grenora
Tuesday	March 9, 1982	07:10:50	3.3	11.2	III	-104.03	48.51	Grenora
Monday	July 8, 1968	10:50:12	4.4	20.5	IV	-100.74	46.59	Huff
Tuesday	May 13, 1947	00:02:--	3.7e	U	IV	-100.90	46.00	Selfridge
Sunday	October 26, 1946	15:37:--	3.7e	U	IV	-103.70	48.20	Williston
Friday	April 29, 1927	20:15:--	3.2e	U	III	-102.10	46.90	Hebron
Sunday	August 8, 1915	09:15:--	3.7e	U	IV	-103.60	48.20	Williston

e = magnitude estimated from reported Modified Mercalli Intensity value.

*estimated depth.

Source: North Dakota Geological Survey, North Dakota Earthquake Catalog (1870-2015) by Fred J. Anderson.

Hazardous Materials Release – Hazard Profile

Description

Hazardous materials are materials that if released, can pose a threat to human health or the environment. Hazardous material releases can cause long/short term health effects, damage to property, expensive cleanup/contractor costs, serious injury, and even death.

A Hazardous material release in Bismarck could result in either evacuation or “shelter-in-place” situations. A hazardous material release may be a rare occurrence, but one major release could have a significant impact.

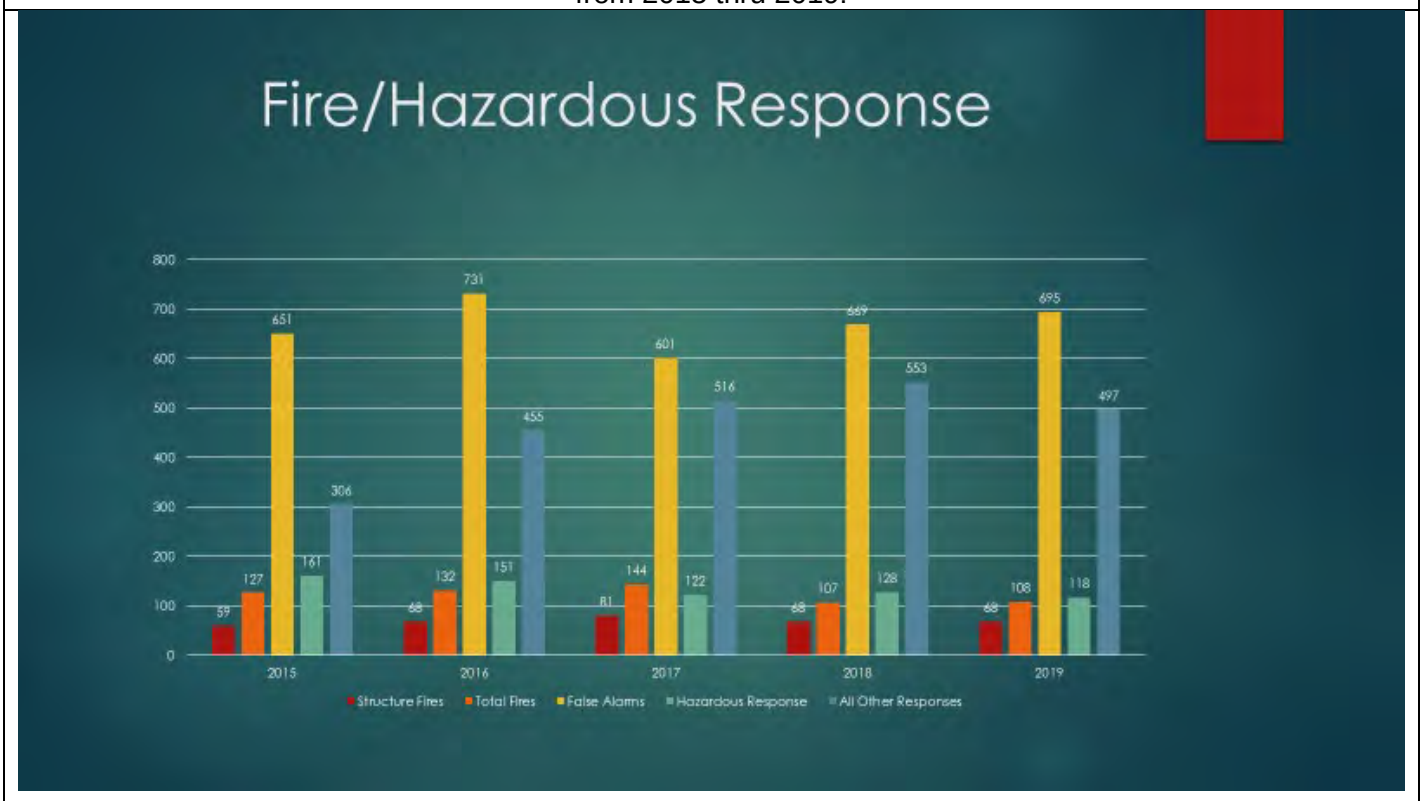
The hazard profile addresses three primary origins of potential hazmat incidents: Fixed Facilities, Transportation, and Pipeline. Train Derailment (including hazmat) is addressed as its own hazard with a separate hazard profile.

History

Within the last 20 years, Bismarck has not experienced many significant hazardous materials incidents. Actual Hazmat incidents of potential significant impact within the last 20 years include:

1. A Gasoline Tanker Leak: An MC 306 tank trailer, containing gasoline was unhooked from the semi-tractor, which was in the shop for engine repairs. It was parked on the street and set on the trailer's landing gear, which are not designed to support the trailer loaded. The excessive weight coupled with the slope of the street caused the landing gear to collapse and puncture the tank, releasing gasoline. The gasoline was running down the gutter towards a storm sewer that drained into the Hay Creek Watershed. The spill was confined and the trailer contents were offloaded successfully.
2. SuperValue Warehouse Ammonia piping system. All personnel evacuated safely and there was not impact outside the facility.

The following graph illustrates the Fire and Hazmat Responses conducted by the Bismarck Fire Department
from 2015 thru 2019:



This section of the hazard profile will address three primary origins of potential hazmat incidents: Fixed Facilities, Transportation, and Pipeline. Train Derailment (including hazmat) is addressed in its own hazard profile section. The hazard profile concludes with the vulnerability assessment.

Fixed Facilities

Hazardous materials being used or stored at industrial facilities and in buildings is defined as a *fixed facility* hazardous material release hazard. The Emergency Planning and Community Right-to-Know Act (EPCRA), also known as SARA Title III, was enacted in November 1986 to enable state and local governments to adequately prepare and plan for chemical emergencies. Facilities covered by EPCRA must submit an emergency and hazardous chemical inventory form to the Local Emergency Planning Committee (LEPC), the State Emergency Response Commission (SERC) and the local fire department annually.

Bismarck has 69 facilities that are reported as “Tier II” facilities for year 2024 (down from 81 in year 20120). Tier II facilities are determined based on the quantity and/or type of material stored or used on site. Many facilities (ie: gas stations) are not considered “Tier II” facilities and are not required to report. However, the Bismarck Fire Department inspects all commercial and industrial businesses annually and is aware of those additional fixed facilities and materials on site.

The total number of facilities using, storing, or selling hazardous materials, including non-Tier II facilities, will fluctuate on a regular basis. The approximate number of facilities in Bismarck is 242 sites using, storing, or selling materials that are classified as hazardous (including common household products). The vast majority are NOT “Tier II” facilities, and are not required to report per EPCRA.

The Tier II sites (facilities) may be viewed online at https://arcg.is/04KXXn.

Tier II Facilities in Bismarck - 2024		
Name	**Address**	**Chemical (BOLD = EHS)**
AT&T - ND0410	1823 N 16th St	Lead, Diesel Fuel, **Sulfuric Acid**
Bismarck Public Schools Facilities and Transportation	705 S 9th St	Gasoline, Diesel Fuel
Bismarck Public Schools Legacy High School	3400 E Calgary Av	Propane
Bismarck Tribune, The	707 E Front Ave	CentraNews Vintage O/S Ink
Bobcat Doosan – Acceleration Center	3901 Morrison Ave.	Diesel, Lithium ion batteries
Burleigh County Highway Dept Shop	8100 43rd Av NE	Gasoline, Diesel Fuel, Asphalt Cement
Burleigh County Sheriff's Dept - East	514 E Thayer Ave	Gasoline
Central Power Electric Cooperative- Bismarck North Substation	2105 E Century Ave	**Sulfuric Acid**, Transformer Oil
Central Power, Hay Creek Substation	629 N Bismarck Expressway	**Sulfuric Acid**, Transformer Oil
Central Power, South Washington Substation	4100 South Washington St	Transformer Oil
Central Power Electric Cooperative	701 N Bismarck Expressway	**Sulfuric Acid**, Transformer Oil
CenturyLink (Qwest Corporation)	220 N 5th St	**Sulfuric Acid**, Lead Acid Batteries, Diesel Fuel
CHI St Alexius Health	900 E Broadway Av	Oxygen, Diesel Fuel
CHI St Alexius Health Technology & Education Building	1310 E Main	Diesel Fuel
City of Bismarck Public Works Department	601 S 26th St	Beet Brine Mix, BEET HEET, CRS-2 Dura Patch Oil, Diesel Fuel, Gasoline, Propane, Salt Wter Brine, Tac Oil
City of Bismarck Public Works Department-Haycreek Lift Station	3701 E Bismarck Expwy	Aqua Hawk HSX
City of Bismarck Public Works- Municipal Landfill	2111 N 52nd St	Chip Seal Oil CRS-2P, Crack Seal Oil, Diesel Fuel
City of Bismarck Public Works- Old Airport Lift Station	2301 University Dr #19	Azone
City of Bismarck Public Works- Pioneer Park Lift Station	2516 River Rd	Aqua Hawk HSX
City of Bismarck Public Works- Wastewater Treatment Plant	601 London Ave	Azone 15, Ferric Chloride, Sodium Bisulfite, Sodium hydroxide
City of Bismarck Public Works- Water Treatment Plant	615 River Rd	**Chlorine**, Carbon Dioxide, Diesel Fuel
City of Bismarck Public Works- West End Pump Station	1701 Edwards Av	Ammonium Sulfate
Coca-Cola Bottling Company High Country	3225 E Thayer Av	**Anhydrous Ammonia,** Carbon Dioxide, **Lead Acid Batteries,** Sodium hydroxide, **Sulfuric Acid**
Cofells Plumbing & Heating Inc	1000 Industrial Dr	Gasoline, Diesel Fuel
Dakota Carrier Network LLC (DCN)	4202 Coleman St	**Sulfuric Acid**
Dakota Supply Group	901 S 26th St	**Lead Acid Battery**
Dakota Supply Group	3021 E. Broadway	**Lead Acid Battery**
Dean Foods North Central (Land O'Lakes)	1207 E Main Ave	**AC-55-5 RED,** Diesel Fuel, **Lead**

Tier II Facilities in Bismarck - 2024		
Name	**Address**	**Chemical (BOLD = EHS)**
		Acid Battery, Mandate Plus, Sulfuric Acid, Vortexx
Doosan/Bobcat	521 S 22nd St	Argon, Carbon Dioxide, Powercron Charcoal Paste, Diesel Fuel, **Gardobond Additive**, **GF Adjust 105,** GF Adjust 213, **Lead Acid Batteries**, Meyer, Mitfloc
Duram School Services	3750 E Rosser Ave	Motor oil, used oil
Executive Air Taxi Corp Fuel Farm	2301 University Dr	100LL Aviation Gasoline, Type A Jet Fuel
Ferguson Waterworks	2005 Channel Drive	**Sulfuric Acid – contained in Lead Acid Batteries**
Ferrellgas Bismarck	2300 E Main Ave	Propane
GCCD Bismarck Terminal	1316 E Front Ave	Cement
General Services Administration Bismarck FB/CH/PO	220 East Rosser Ave.	Fuel Oil
Gerdau-Bismarck	1320 Airport Rd	Diesel Fuel, **Lead/Acid Batteries**
HERC Rentals Bismarck 9452	3101 Morrison Ave	Diesel Fuel, Hydraulic Fluid, Motor Oil, Propane
Holcim (US) Inc-NPCC Terminal	2103 Trade St	Cement
Jiffy Lube #519	1017 S Washington St	Methanol, Motor Oil
Knife River ND - Bismarck Rock Island Pl	3305 Rock Island Place	Fly Ash, Cement, Diesel Fuel
Linde Gas & Equipment	2730 Vermont Ave.	Argon Cryogenic Liquid, carbon dioxide, Nitrogen cryogenic Liquid, Oxygen Cryogenic Liquid
Lowe's of Bismarck, ND Store #2533	1402 Century Ave W	Diesel Fuel, **Lead Acid Batteries**
Montana-Dakota Utilities Bismarck Service Center	909 Airport Rd	Mineral Oil
Montana-Dakota Utilities General Office Generator	400 N 4th St	Diesel Fuel
National Weather Service	2301 University Dr. Blng 27	Diesel Fuel
ND Health & Human Services HHS Warehouse	1509 Gruman Lane	Carbon Dioxide
ND Department of Transportation Bismarck HQ	218 Airport Rd	Tar Oil, Diesel Fuel, Gasoline
ND Department of Transportation-Capitol Ground	600 E Boulevard Av	Gasoline
ND National Guard - Army Aviation Support Facility	3410 Airway Av	Gasoline, Diesel Fuel, Aviation Fuel, Used Oil
ND National Guard - Fraine Barracks	432 Fraine Barracks Rd	**Lead Acid Batteries**, Gasoline, Diesel Fuel, Used Oil
ND National Guard - Raymond J Bohn Armory	4200 E Divide Ave	Diesel Fuel, Gasoline, Used Oil
New Cingular Wireless PCS, LLC (Bismarck - ZX2GBF)	1925 N 11th St	**Sulfuric Acid**
Palmer Mfg & Tank	700 S 26th St	100 Clean Up Solvent
TSafety-Kleen Systems Inc	3704 Saratoga Ave	Petroleum Naphtha, Motor Oil

Tier II Facilities in Bismarck - 2024		
Name	**Address**	**Chemical (BOLD = EHS)**
Sam's Club #4933	2821 Rock Island Pl	**Lead Acid Batteries**
Sprint United Management Company	215 S 15th St	Fuel Oil, **Sulfuric Acid**
Stamart Travel Center #1224	3936 Miriam Ave	Diesel Fuel
Target T2194-Burleigh	600 Kirkwood Mall	Sulfuric Acid
UNFI Distribution (Food)	707 Airport Rd	**Anhydrous Ammonia**, Diesel Fuel, Lead, **Sulfuric Acid**
United Rentals	3925 Miriam Ave	Lead Acid Batteries
US Foods	3500 Saratoga Ave	**Sulfuric Acid,** Lead
Verizon Wireless-Country West 698998	1160 W Divide Ave	**Lead Acid Batteries**
Verizon Wireless-Expressway 4932311	911 S 9th St	**Lead Acid Batteries**
Vestis Uniforms	1238 Frontier Drive	Performance XXL Alkali, Performance Laundry Detergent, Pro Plus Alkali, Pro Plu Industrial Detergent
Western Area Power – Bismarck Warehouse	700 N Bismarck Expressway	**Sulfuric Acid,** Mineral Oil
Western Area Power Administration – Bismarck Administration Building	707 N Bismarck Expressway	**Sulfuric Acid**
Western Area Power – Bismarck Substation	719 N Bismarck Expressway	**Sulfuric Acid,** Mineral Oil
Williston Basin Interstate - Bismarck Station	850 57th Ave NW	New/Used Oil, Slop Oil with Natural Gas Condensate
Zayo Group	1520 E Sweet Av	**Sulfuric Acid**

The following table lists chemicals that are used at various facilities in Bismarck and are identified as EHS, and/or pose an inhalation hazard, and/or have a relatively low IDLH. This list is not all inclusive of chemicals used or stored in Bismarck.

Chemical Name	EHS	Inhalation Hazard	IDLH
Chlorine		x	10 ppm
Anhydrous Ammonia	x	x	300 ppm
Ammonia	x	x	300 ppm
Sulfuric Acid	x	x	15 mg/m
Nitric Acid	x	x	25 ppm
Sulfur Dioxide		x	
Sodium Hydroxide			10mg/m
Oxygen			0.5 ppm
Liquid Nitrogen			20 ppm
Benzene (gasoline)	x		500 ppm
Benzene (diesel fuel)	x		500 ppm
Lead (lead acid batteries)	x		100 mg/m
Paraquat Dichloride	x		1 mg/m
Petroleum Naphtha			1100 ppm
Propane	x		2100 ppm
Actamaster (ammonium sulfate)			1500 mg/m
Carbon Dioxide			40,000 ppm
Petroleum Distillate (liquid asphalt)			1100 ppm
Heptane			750 ppm
Mercury			10mg/m
Toluene			500 ppm
Trichloroethylene			1000 ppm

EHS= Extremely Hazardous Substance (per EPA List of Lists)
Inhalation Hazard – per NIOSH Guide
IDLH: Immediately Danger to Life or Health (parts per million)

The most common hazardous materials within Bismarck at fixed facilities are gasoline and diesel fuel in the sense that they are used, stored, and/or sold at the most locations throughout Bismarck. The number of locations is approximate since they can change frequently. The purpose of the table is to illustrate the common hazardous materials at many of the fixed facilities.

Product	**Number of Locations**
Gasoline	32
Diesel Fuel	28
Propane	16
Sulfuric Acid	12
Oxygen	10
Motor Oil	8
Acetylene	7
Fuel Oil #1	6
Sodium Hydroxide	6
Chlorine	4
Argon	4

Transport (ie: Truck)

Note: Hazardous Materials Release is also addressed in the “Train Derailment” Hazard Profile. Hazmat incidents as a result of train derailment will not be duplicated in this section.

Bismarck has designated truck routes which serve as hazmat routes. However, there are no hazmat routes specifically designated at this time.

Although a Hazmat Flow Study was conducted in 2012 for all of Burleigh County, it’s assumed that all materials stored or used at fixed facility locations in Bismarck or anywhere in North Dakota are transported through Bismarck via I-94 and US83 primarily, and also throughout the city (ie: truck routes) if used or stored at a local fixed facility.

The US Department of Transportation (DOT) defines hazardous material as items which pose a risk to health, safety, and property during commerce related transportation. Vehicles transporting hazardous materials are common. These materials could pose a risk should a spill or other release occur. The DOT divided these materials into nine hazard classes, each exhibiting a common threat to health and/or property. These classes offer the general nature of the material being transported when exact identification is not possible. US DOT class identifications are listed below:

- Class 1: Explosives
- Class 2: Gases
- Class 3: Flammable Liquids
- Class 4: Flammable Solids/Spontaneously Combustible/Water Reactive
- Class 5: Oxidizers/Organic Peroxides
- Class 6: Toxic/Infectious
- Class 7: Radioactive
- Class 8: Corrosive
- Class 9: Miscellaneous

https://www.phmsa.dot.gov/about-phmsa/offices/office-hazardous-materials-safety

The harm posed to humans can be characterized by one or more characteristics:

- *Ignitability:* Sustains fire which may cause physical harm.
- *Corrosivity:* May corroding metal or other material, poses a chemical hazard.
- *Reactivity:* Can create explosions or toxic releases, posing a physical harm.
- *Toxicity:* Harmful ingested, breathed, or absorbed, posing a chemical harm.
  Definitions from USEPA at www.epa.gov

The US DOT in the Code of Federal Regulations has standards for marking, labeling, placarding, shipping papers, emergency response information, packaging, handling, and transporting of hazardous materials, but there are no reporting requirements for hazardous material transportation. (49 CFD 100-185)

Northern Plains Commerce Centre – Bismarck

The Northern Plains Commerce Centre (NPCC) is a premier industrial park with immediate access to road and rail transport located in Bismarck, North Dakota. The NPCC allows companies to improve their ability to efficiently distribute products within the Northern Plains region and globally. The facility offers both rail and non-rail served sites.

Located adjacent to the Bismarck Airport, the NPCC is home to a 100,000 square foot Bobcat Company Manufacturing Sequencing Center (MSC) and Tubular Transport and Logistics (TTL). Tubular Transport and Logistics offers rail to truck reloading, trucking and storage services allowing non-rail served businesses to take advantage of long haul cost savings by using rail.

The NPCC has access to both Canadian Pacific and the BNSF via the DMVW Railroad. The truck route between US I-94 and the Northern Plains Commerce Centre is considered a heavy haul corridor.
More information: https://www.bismarckmandanedc.com/site-selection/northern-plains-commerce-centre/

Hazmat Traffic Flow Overview

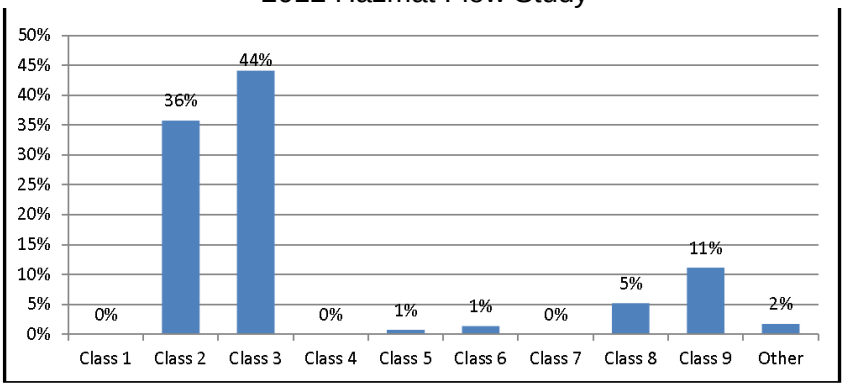
(The following overview is based on the 2012 Hazmat Flow Study for Burleigh County funded by the Local Emergency Planning Committee)

Surface Transportation by Highway: Within Burleigh County, the majority of hazardous materials transported by highway are transported via I-94 (approx. 71%) and US 83 (approx. 26%). Both I-94 and US83 intersect Bismarck. The remaining highways (ND1804, ND14, ND36, and ND41) account for the remaining 3%. The sample included 247 vehicles observed during the 2012 hazmat flow study.

The most common commodities transported by highway were identified as Anhydrous Ammonia, Gasoline, Diesel, Asphalt, and Propane. These top five commodities accounted for 78% of the hazardous materials during the traffic flow study in 2012.

The following graph, from the 2012 Hazmat Flow Study illustrates the hazard classification of the materials transported by highway noted during the study.

DOT Hazard Classification of Materials Transported by Highway
2012 Hazmat Flow Study



Schools and other locations of higher vulnerability based on proximity to I-94 are noted in the table below. Potential icy road conditions along with the higher traffic speed of I-94 enhances the risk of a more significant traffic accident which may involve hazardous materials. Certainly, additional locations are vulnerable, and those listed here would not necessarily be impacted depending on incident location, wind conditions, etc.

Schools and Other Populations in close proximity to I-94 (hazmat traffic)	
Schools	**Other**
Bismarck State College	Family Fare Supermarket (near I-94 clover leaf – west Bismarck)
Theo Art School	Hampton Inn (near I-94 clover leaf – west Bismarck)
Montessori Daycare (adjacent to I-94, significant slope)	Residential community Adjacent to 1-94 (properties are approximately 200 feet from I-94)
Grimsrud Elementary (> ¼ mile)	
Centennial Elementary (1/3 mile)	

Air Transportation: The 2012 hazmat flow study included hazardous materials transported in and out of the Bismarck Airport. Air transportation of hazardous materials has the smallest presence by mode as expected due probably to its relative high cost. Hazardous material shipments by air are handled by UPS and FedEx.

In the sample data period of June 1, 2011 through May 31, 2012 there were 960 inbound shipments of hazardous materials at the Bismarck Airport by FedEx (UPS declined to participate in the study citing homeland security concerns). These shipments are significantly smaller than the shipments that are transported by truck or by railway. When inbound hazardous shipments are categorized according to general DOT hazard classifications, hazards falling into class seven are the most reported. Hazard class seven is radioactive material. The majority of these shipments are shipped in Type A Packaging. Material typically shipped in Type A Packages include nuclear medicines (radiopharmaceuticals). Type A packaging are only used to transport non-life-endangering amounts of radioactive material. Type B(U) packaging is also used for shipments into Burleigh County. This packaging includes shipments in 55-gallon drums. Material typically shipped in Type B(U) packaging includes spent nuclear fuel, high-level radioactive waste, and high concentrations of other radioactive material such as cesium and cobalt.

The sample data period of June 1, 2011 through May 31, 2012 there were 192 outbound shipments of hazardous materials at the Bismarck Airport by FedEx. Hazards falling into class three are the most reported outbound shipments by air.

Top Commodities by Count
Radioactive Material: Type A
Compressed Gas, n.o.s.
Radioactive Material: expected
Sulphuric Acid
Radioactive Material: Type B(U)

Top Commodities by Count
Diesel Fuel
Gasoline
Radioactive Material: Type B(U)
Infectious Substance: Affecting Humans
Petroleum Crude Oil

Rail

The most common commodities transported by rail during the 2012 flow study are Petroleum Crude Oil, Liquefied Petroleum Gas, Alcohols, Anhydrous Ammonia, and Fak-Hazardous Materials with the vast majority being Petroleum Crude (72% in 2012). Since 2012, the percentage of crude oil shipments has increased dramatically. See Train Derailment Hazard Profile for more information.

Pipeline

Bismarck has a petroleum pipeline running east/west along north Bismarck which also runs under the Missouri River to Marathon Petroleum Corporation in Mandan. There is a natural gas pipeline (WBI) in northwest Bismarck running north/south.

NuStar

- Product names: Gasoline, Diesel, Jet Fuel
- Quantities: @1800 bbls per hour
- Pressure: 500 PSI

WBI

- Product names Compressed Methane / Natural Gas
- Quantities 12" Diameter Pipeline
- Pressure 204 PSI MAOP (maximum allowable operating pressure)
- Most common Methane / Natural Gas only
- Highest level of concern:

  Per the 2008 Emergency Response Guide Book :

  - Extremely Flammable
  - Easily ignited by heat, sparks or flames
  - Forms explosive mixtures with air
  - Displaces air and can cause asphyxiation without warning
  - High pressure compressed gas

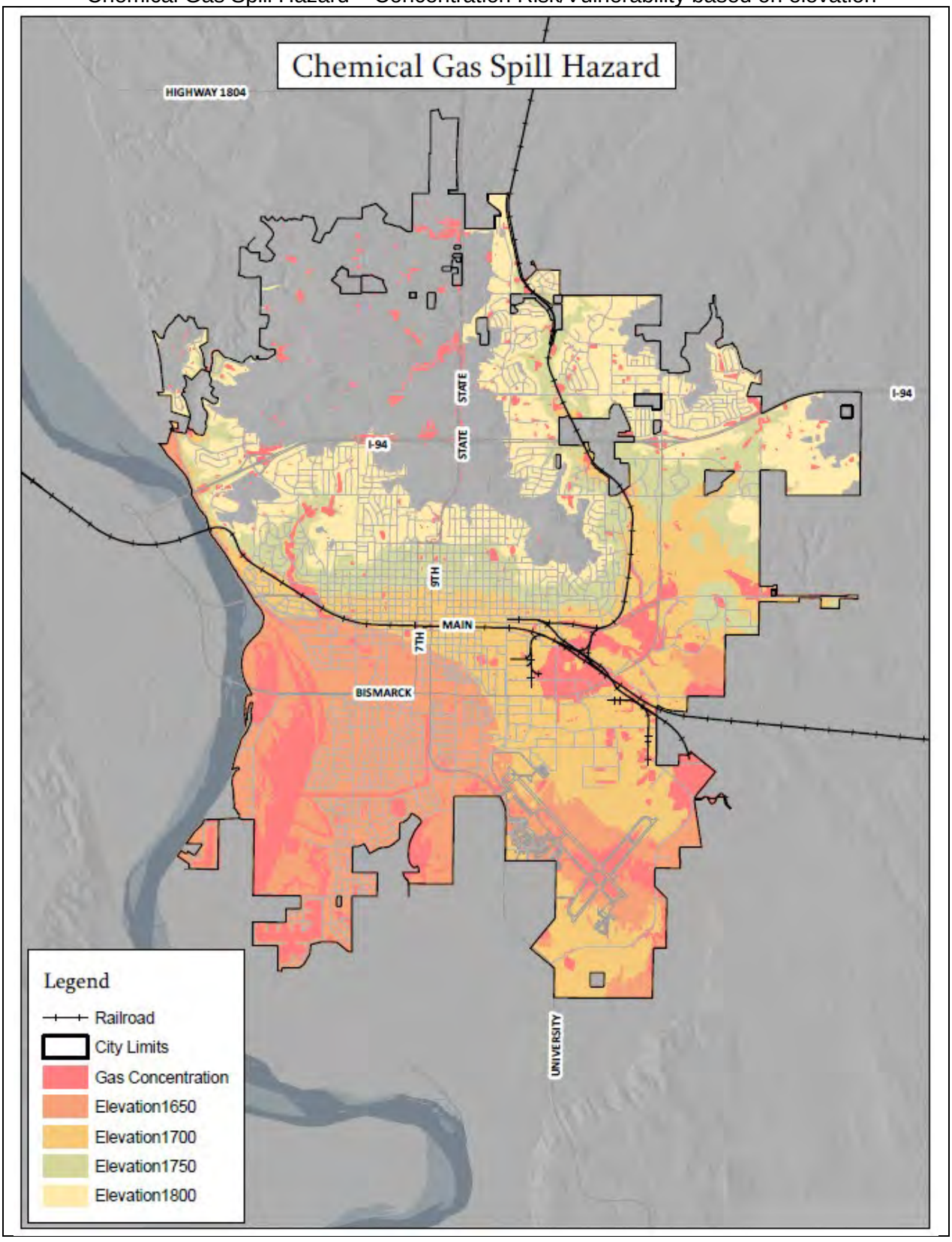
MDU

- Product names: Natural Gas
- Quantities : ~200,000 dkt/yr (dekatherms – heating measure)
- Pressure pressures range from 90 psi to .5 psi.
- Most common: 35 psi
- Highest level of concern: explosive.

Utility Map showing Natural Gas and Petroleum Pipelines

WBI Pipeline – High Consequence Area

Chemical Gas Spill Hazard – Concentration Risk/Vulnerability based on elevation



Vulnerability Assessment

Vulnerability: Characteristics of community assets that make them susceptible to damage from a given hazard.

*Note: Train Derailment is addressed separately within the mitigation plan.

Incident Type	**Fixed Facility Incident**	***Transportation (ie: Truck)**	**Pipeline**
Probability	Possible	Likely	Possible
Speed of Onset	No notice event	No notice event	No notice event
Geographic Area	Localized	Localized	Localized
Death / Injury 1. Primary Causes A. Highest vulnerability	1. Fire, explosion, inhalation hazards A. Employees of hazmat facilities	1. Fire, explosion, inhalation hazards A. Involved parties in closer proximity	1. Fire, explosion A. WBI pipeline High Consequence Area as mapped
Mass Casualty Incident	Possible	Possible	Possible
Property Losses (points of vulnerability – high priority)	1. Involved property and properties in close proximity to incident	1. Property in close proximity 2. Properties along Interstate 94	1. Property in close proximity 2. WBI HCA as mapped
Environmental	1. Stormwater drainage system 2. Sanitary Sewer System	1. Stormwater drainage system 2. Sanitary Sewer System	1. Oil Pipeline – east/west pipeline 2. Hay Creek 3. Missouri River
COG/COOP	1. Public Works – proximity to Praxair 2. Water Treatment Plant 3. Wastewater Treatment Plant		

Incident Type	**Fixed Facility Incident**	***Transportation (ie: Truck)**	**Pipeline**
Critical Facilities	1. Public Works – proximity to Praxair Public Works 2. Fraine Barracks (proximity to Water Treatment Plant)	1. Sanford Health 2. CHI St. Alexius Health 3. Fire Station 2 4. Police Department 5. Water Treatment Plant - organic material overwhelming the sewage treatment process (ex: milk truck) 6. Metro Area Ambulance South 7. Public Health 8. Public Works	1. Water Treatment Plant (near WBI pipeline) 2. Fraine Barracks (WBI pipeline)
Critical Infrastructure	1. Potential impact to water or wastewater treatment plant	1. Temporary blocked streets / Interstate	1. Temporary disruption of petroleum or natural gas distribution.
Schools	1. Ehrmantraut Academy (proximity to Ferrelgas)	1. Jeanette Myhre Elementary 2. Bismarck High School 3. Century High School 4. Solheim Elementary 5. Wachter Middle School 6. Centennial Elementary 7. Emmanuel Christian School 8. St. Mary's Elementary 9. ECLC 10. Rasmussen College 11. Exploring Minds 12. Montessori Daycare 13. YMCA Daycare 14. Northridge Elementary 15. Open Door Community Center	1. Bismarck State College (WBI) 2. Horizon Middle School 3. Grimsrud Elementary School 4. Centennial Elementary School

Incident Type	**Fixed Facility Incident**	***Transportation (ie: Truck)**	**Pipeline**
		16. Super Kids Jr. Academy 17. Bismarck State College 18. Theo Art School	
High Risk Facilities (chemical)	1. Praxair (near Public Works) 2. Ferrell Gas (ie: propane bulk tanks) 3. Waste Water Treatment Plant (ie: chlorine) 4. Water Treatment Plant (ie: chlorine)		
Specific Populations: Public Assembly, Vulnerable / Special Populations	1. Individuals, including the homeless population, without immediate access to transportation resources (inability to evacuate). 2. Homeless population with limited or no building access to shelter in place.	1. Kirkwood Mall 2. Maple View (north) 3. Numerous Churches along truck (hazmat) routes 4. Primrose Assisted Living 5. Individuals, including the homeless population, without immediate access to transportation resources (inability to evacuate). 6. Homeless population with limited or no building access to shelter in place.	1. Waterford Apartment (HCA) 2. Touchmark Nursing Home 3. Horizon Care Home 4. Primrose Assisted Living 5. Women's Health Center (HCA) 6. Individuals, including the homeless population, without immediate access to transportation resources (inability to evacuate). 7. Homeless population with limited or no building access to shelter in place.
Economy (community wide)	Moderate (THIRA rating)	Moderate (THIRA rating)	Significant (THIRA rating)
OTHER:			

Changes in Vulnerability Since the previous plan update in 2020.	
Increase in Vulnerability	Decrease in Vulnerability
No changes.	No changes. See hazard mitigation capabilities specific to Hazardous Materials in Section 3.

Risk
See Section 10 of this plan document for risk assessment and hazard ranking of all hazards addressed in this plan.

Relationship to other Hazards: Hazardous Materials events or releases may be initiated by other hazards including Fire (urban fire), as well as severe weather events including Tornado or lightning (to initiate fire and a hazmat release as a cascading event). Flood events can also interact with hazmat storage sites and initiate hazmat releases. Flood waters always need to be considered contaminated. A hazmat release can be intentional via Cyberattack or other intentional acts.

Future Conditions

- **Location**: No change, with the exception of additional areas as annexed into the city.
- **Extent/Intensity:** See "Anticipated Future Climate Impact" below.
- **Frequency:** See "Anticipated Future Climate Impact" below.
- **Duration:** No change.

Future vulnerabilities to monitor: Nuclear Power Plants (if established in ND) and AI data centers. As of 2025, these do not apply.

Anticipated Future Climate Impact – Hazardous Materials Release Hazard

Although this hazard is largely human-caused, future climate conditions may cause both direct and indirect impacts. Warmer temperatures may directly result in the expansion of gases, increases in biologic agents, or other such actions that could put hazardous material storage containers, transporters, applicators (i.e., anhydrous), or facilities at an increased risk. Increased summer and winter storms, wildfires, floods, transportation incidents, etc. could indirectly put hazardous material containers, transports, applicators (i.e., anhydrous), or facilities at an increased risk.

Previous Occurrences

See page 2 of this section.

Infectious Disease - Hazard Profile

Description

Infectious diseases are naturally occurring biological diseases in humans as well as those biological agents found in the environment, or diagnosed in animals, that have the potential for transmission to humans. An infectious disease is a clinically evident illness resulting from the presence of pathogenic biological agents, including pathogenic viruses, pathogenic bacteria, fungi, protozoa, multicellular parasites, and aberrant proteins known as prions. These pathogens are able to cause disease in animals and/or plants. Infectious pathologies are also called Infectious diseases or transmissible diseases due to their potential of transmission from one person or species to another by a replicating agent (as opposed to a toxin).

Transmission of an infectious disease may occur through one or more of diverse pathways including physical contact with infected individuals. These infecting agents may also be transmitted through liquids, food, body fluids, contaminated objects, airborne inhalation, or through vector-borne spread. Transmissible diseases which occur through contact with an ill person or their secretions, or objects touched by them, are especially infective, and are sometimes referred to as contagious diseases. Infectious (Infectious) diseases which usually require a more specialized route of infection, such as vector transmission, blood or needle transmission, or sexual transmission, are usually not regarded as contagious, and thus are not as amenable to medical quarantine of victims.

Human epidemics may lead to quarantines, large-scale use of the medical care system, and mass fatalities. Typically, the elderly, young children, and those with suppressed immune systems at greatest risk from Infectious diseases. The following biologic agents are considered the highest bioterrorism threats (Category A) due to their ease of dissemination or person-to-person transmission, high mortality rate with potential for major public health impacts, and potential for public panic and social disruption: Anthrax, Botulism, Plague, Smallpox, Tularemia, and Viral Hemorrhagic Fevers. (Centers for Disease Control and Prevention, 2010)

In addition to global disease and bioterrorism concerns, naturally occurring diseases can threaten communities. Natural illnesses of particular concern include Influenza, Meningitis, Pertussis (Whooping Cough), Measles, Norwalk Virus, Severe Acute Respiratory Syndrome (SARS), and food-borne illnesses such as E. coli and Salmonella outbreaks, among others. These diseases can infect populations rapidly, particularly through groups of people in close proximity such as schools, assisted living facilities, and workplaces.

An **influenza pandemic** is a global outbreak of a new influenza A virus. Pandemics happen when new (novel) influenza A viruses emerge which are able to infect people easily and spread from person to person in an efficient and sustained way. https://www.cdc.gov/flu/pandemic-resources/index.htm

The COVID-19 pandemic has illustrated that incidents considered less likely to happen can and do occur, and that pandemics may impact areas that are considered less vulnerable due to the more rural nature and less densely populated areas such as here in North Dakota. The COVID-19 pandemic also demonstrated in 2019 through 2023 that the largest threat to human health may be from a disease currently unknown to the world.

Measles and mumps are less common since the emergence of vaccinations in the last century, but are becoming more common as vaccination rates decline. On May 2nd, the first case of Measles was reported in North Dakota (Williams County). Since then, 36 cases were reported in 4 counties through August 1, 2025.

A previous outbreak of Measles in the state occurred in 1986, when 25 people in nine counties tested positive for the disease. Local health officials encouraged parents to keep children from crowded areas, including churches and movie theaters. Unvaccinated children were encouraged not to attend school or daycare. A prom was canceled near Grand Forks, and the state track meet was in peril until the week of the event, the Grand Forks public health officials determined that after-school activity bans had reduced the spread of the disease. The differing guidance from one county to the next was seen as a contributor to the outbreak (Prairie Public, 2021). In response, the North Dakota Legislature passed a law that allowed state health officials to determine the control measures for outbreaks, which was next used for the COVID-19 pandemic.

According to the CDC, measles had been officially eliminated from the United States in 2000. https://www.cdc.gov/measles/data-research/index.html#cdc_data_surveillance_section_6-history-of-measles-cases

Measles can be prevented with immunizations but the percentage of kindergarten exemptions from vaccination for moral or philosophical reasons is increasing in North Dakota. (2.4% in 2014 to 6.72% in 2024). *August 1, 2025 ND Daily Intelligence Report (NDDES / NDHHS).*

There are 75 individual reportable infectious diseases among humans that can lead to death or serious illness. Roughly 20 of these have an individual vaccine that can reduce symptoms and/or increase resistance to contracting the disease. 2024-2029 ND Enhanced Mitigation Plan.

Foodborne Illness

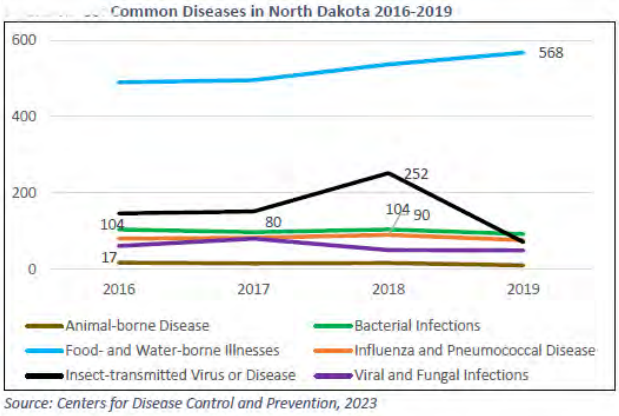
Foodborne illness (sometimes called "foodborne disease," "foodborne infection," or "food poisoning) is a common, costly—yet preventable—public health problem. The Centers for Disease Control and Prevention (CDC) define a foodborne illness outbreak when two or more people get the same illness from the same contaminated food or drink. Many different disease-causing microbes, or pathogens, can contaminate foods, so there are many different foodborne infections. In addition, poisonous chemicals, or other harmful substances can cause foodborne diseases if they are present in food. Foodborne illnesses are a major public health problem. The CDC estimate that each year one in six Americans get sick by consuming contaminated foods or beverages; 128,000 are hospitalized; and 3,000 die of foodborne diseases.

Recreational Water Illness

Recreational water illnesses (RWIs) are caused by germs spread by swallowing, breathing in mists or aerosols of, or having contact with contaminated water in swimming pools, hot tubs, water parks, water play areas, interactive fountains, lakes, rivers, or oceans. RWIs can also be caused by chemicals in the water or chemicals that evaporate from the water and cause indoor air quality problems. RWIs include a wide variety of infections, such as gastrointestinal, skin, ear, respiratory, eye, neurologic, and wound infections. The most commonly reported RWI is diarrhea. In the past two decades, there has been a substantial increase in the number of RWI

outbreaks associated with swimming. Crypto (short for Cryptosporidium) which can stay alive for days even in well-maintained pools, has become the leading cause of swimming pool-related outbreaks of diarrheal illness.

The figure at the right, derived from the 2024-2029 ND Enhanced Mitigation Plan illustrates that Food and Water-borne illnesses were the more common diseases experienced by North Dakotans (absent a pandemic) in the years of 2016-2019.



Source: Centers for Disease Control and Prevention, 2023

West Nile

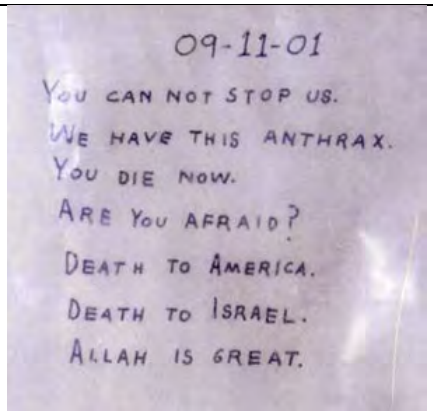
West Nile virus (WNV) is most commonly transmitted to humans by mosquitoes. There are no medications to treat or vaccines to prevent WNV infection. Most people infected with WNV will have no symptoms. About 1 in 5 people who are infected will develop a fever with other symptoms. Less than 1% of infected people develop a serious, sometimes fatal, neurologic illness.

In 2012, an unprecedented outbreak of WNV occurred in Texas; 1,868 cases were reported, including 844 (45%) cases of (WNV neuroinvasive disease [WNND], which included encephalitis, meningoencephalitis, and meningitis) and 89 deaths (case-fatality rate 5%). Male patients, persons >65 years of age, and minorities were at highest risk for neuroinvasive disease. Fifty-three percent of counties reported a case; 48% of case-patients resided in 4 counties around Dallas/Fort Worth. The economic cost was >$47.6 million.

Infectious diseases, whether human, animal, or plant are not governed by geographic boundaries. However, those jurisdictions with the highest human and livestock populations and crop exposure are at greatest risk from Infectious diseases.

Bio-Terrorism

The following biologic agents are considered the highest bioterrorism threats (Category A) due to their ease of dissemination or person-to-person transmission, high mortality rate with potential for major public health impacts, and potential for public panic and social disruption: Anthrax, Botulism, Plague, Smallpox, Tularemia, and Ebola Hemorrhagic Fever.
Centers for Disease Control and Prevention: https://www.cdc.gov/infection-control/hcp/isolation-precautions/appendix-a-table-3.html

Bioterrorism: A Brief History CDC and USDA: https://www.selectagents.gov/overview/history.htm	October 2001 U.S. Anthrax letter
A bioterrorism attack is the deliberate release of viruses, bacteria, or other biological agents used to cause illness or death in people, animals, or plants. In the hands of the wrong people, materials intended for legitimate scientific, medical, or commercial use have the potential to harm large numbers of people. Although the anthrax attacks in the weeks following the 9/11 terrorist attacks focused national attention more acutely on our potential vulnerability; bioterrorism is not a new phenomenon. Throughout history, individuals and groups have used it as a weapon against both military and civilian populations. • In one of the earliest recorded instances of bioterrorism, Persian armies in the 6th century BC poisoned wells with a fungus that affects rye plants (*rye ergot*). • During the American Civil War, it was reported that a Kentucky physician provided clothing exposed to smallpox and yellow fever to Union troops.	
In October 2001, bioterrorism in the U.S. became a reality again when four letters laced with anthrax were sent through the U.S. Postal Service. The attacks resulted in the illness in 22 people, the death of 5, and fear and anxiety in millions of others. The cost of decontaminating offices that were exposed totaled over $23 million.	
Evolution of the Federal Select Agent Program	
1995-1996 A former Aryan Nations member illegally obtained a bacterium that causes plague (*Yersinia pestis*) by mail order. As a result, Congress passed Section 511 of the *Antiterrorism and Effective Death Penalty Act of 1996* requiring HHS to publish regulations for the transfers of select agents that have the potential to pose a severe threat to public health and safety (Additional Requirements for *Facilities Transferring or Receiving Select Agents*, 42 CFR Part 72.6; effective April 15, 1997). **2001-2002** Following the anthrax attacks of 2001 that resulted in five deaths, Congress significantly strengthened oversight of select agents by passing the *USA PATRIOT Act* in 2001 and the *Public Health Security and Bioterrorism Preparedness and Response Act* of 2002 requiring HHS & USDA to publish regulations for possession, use, and transfer of select agents (Select Agent Regulations, 7 CFR Part 331, 9 CFR Part 121, and 42 CFR Part 73; effective February 7, 2003). **2009** On January 9, 2009, President Bush signed Executive Order 13486, "Strengthening Laboratory Biosecurity in the United States," to review the effectiveness of biosecurity policies regarding select agents. **2010** On July 2, 2010, President Obama signed Executive Order 13546 entitled "Optimizing the Security of Biological Select Agents and Toxins in the United States" that directed the Department of Health and Human Services (HHS) and the Department of Agriculture (Agriculture) as a part of their ongoing review, to tier, and consider the reduction of the select agent list; and establish physical security standards for select agents with the highest risk of misuse. A final rule published on October 5, 2012 designated Tier 1 select agents, reduced the number of agents on the select agent list, and established physical security and information security standards for Tier 1 select agents. The subset of select agents designated as Tier 1 present the greatest risk of deliberate misuse with significant potential for mass casualties or devastating effect to the economy, critical infrastructure, or public confidence. Select Agents and Toxins list: https://www.selectagents.gov/sat/list.htm	

Infectious Disease Information Resources

- The ND Department of Health identifies mandatory reportable diseases and conditions: https://www.hhs.nd.gov/health/diseases-conditions-and-immunization/STI/report
- Community Health reports for Bismarck/Burleigh area are available at: https://ruralhealth.und.edu/projects/community-health-needs-assessment/reports#burleigh
- Seasonal Flu Monitoring Website: https://www.health.nd.gov/flu http://www.ndflu.com/DataArchive/

Vulnerability Assessment (1 of 2)

Vulnerability: Characteristics of community assets that make them susceptible to damage from a given hazard.

Scenario:	**Infectious Disease**	**Pandemic Influenza**	**Bio-Terrorism**
Probability	Likely	Possible	Possible
Speed of Onset	May be a “no-notice” event or slow onset depending on location of origin	May be a “no-notice” event or slow onset depending on location of origin	May be a “no-notice” event or slow onset depending on location of origin
Duration	Varies	Months/Years	Weeks
Geographic Area	Local, regional…. worldwide	Local, regional…. Worldwide	Local, regional…. worldwide
Death / Injury 1. Primary Causes A. Highest vulnerability	1. Reportable Infectious Diseases. A. Those with underlying medical conditions or suppressed immune systems. B. Elderly and young C. Those living or working in close proximity. • Schools, universities, assisted living, nursing homes D. Those unvaccinated E.	1. Reportable Infectious Diseases. 2. Supply chain issues, including no vaccine immediately available for new (novel) diseases. 3. Domestic abuse 4. Child abuse and neglect A. Those with underlying medical conditions or suppressed immune systems. B. Elderly and young C. Those living or working in close proximity. D. Schools, universities, assisted living, nursing homes E. Those unvaccinated	1. Anthrax, Botulism, Plague, Smallpox, Tularemia, and Ebola Hemorrhagic Fever. Also, see CDC / USDA select agent list: https://www.selectagents.gov/sat/list.htm A. Those who come in direct contact with the bio-agent (i.e.: targeted victims, first responder community and hospital staff). B. Those in close proximity to location of dispersal C. As bio-agent dissipates, risk and vulnerability are reduced.

Scenario:	**Infectious Disease**	**Pandemic Influenza**	**Bio-Terrorism**
Mass Casualty Incident	Yes Possible	Yes Probable	Yes Likely
Property Losses (points of vulnerability – high priority)	1. Decontamination of a facility may be required before reuse. 2. Use may be discontinued until threat has passed.	1. Decontamination of a facility may be required before reuse. 2. Use may be discontinued until threat has passed.	1. Decontamination of a facility may be required before reuse. 2. Use may be discontinued until threat has passed.
Environmental (points of vulnerability – high priority)	1. Incident Specific • Water, Soil, Air, Food	1. Incident Specific • Water, Soil, Air, Food	2. 1. Incident Specific • Water, Soil, Air, Food
COG/COOP (points of vulnerability – high priority)	1. Employee/Family Illness 2. Orders of Succession all departments. 3. Public Health Department, response capability compromised 4. Emergency Services staffing, services, and capabilities compromised.	1. Employee/Family Illness 2. Order of Succession all departments 3. Public Health Department, response capability compromised 4. Emergency Services staffing, services, and capabilities compromised. 5. Supply Chain issues.	1. First Response Emergency Services • Fire • EMS • Police 2. Public Health
Critical Facilities (points of vulnerability – high priority)	1. Hospitals 2. Clinics 3. Other Emergency Service Providers 4. Airport 5. Civic Center 6. Prison, jail and other institutional facilities	1. Hospitals - Including issues with capacity / available bed space - Workforce shortages 2. Clinics 3. Other Emergency Service Providers 4. Airport 5. Civic Center 6. Prison, jail and other institutional	1. Federal/State Agencies 2. Hospitals - may be treating victims with unknown bioterrorism agent 3. HVAC systems of Critical Facilities 4. Emergency Services 5. USPS Warehouse sorting facility

Scenario:	Infectious Disease	Pandemic Influenza	Bio-Terrorism
		facilities	
Critical Infrastructure (points of vulnerability – high priority)	1. Availability and capability to restore services may be impacted: such as Water, Food, Medication, Sanitation, Communications. 2. Transportation – Airport	1. Availability and capability to restore services may be impacted: such as Water, Food, Medication, Sanitation, Communications. 2. Transportation - Airport	1. Transportation - Airport
Schools (points of vulnerability – high priority)	1. Entire school population is of high vulnerability. 2. School facilities may require decontamination, delayed use, or may be needed for alternative purposes.	1. Entire school population is of high vulnerability. 2. School facilities may require decontamination, delayed use, or may be needed for alternative purposes.	
High Risk Facilities (chemical) (points of vulnerability – high priority)	1. Facilities containing hazardous materials may pose a greater risk depending on impact to staffing and on-site safety and security personnel.	1. Facilities containing hazardous materials may pose a greater risk depending on impact to staffing and on-site safety and security personnel.	
Specific Populations: Public Assembly, Vulnerable / Special Populations (points of vulnerability – high priority)	1. Elderly 2. Young 3. School population 4. Universities 5. Day Cares 6. Those living or working in close proximity 7. Senior Citizen Facilities 8. Nursing Home 9. Assisted Living 10. Incarcerated, institutional settings 11. Indoor/Outdoor Events 12. Malls/Stores 13. Churches 14. Social Gathering	1. Elderly 2. Young 3. School population 4. Universities 5. Day Cares 6. Those living or working in close proximity 7. Senior Citizen Facilities 8. Nursing Home 9. Assisted Living 10. Incarcerated, institutional settings 11. Indoor/Outdoor Events 12. Malls/Stores 13. Churches 14. Social Gathering 15. Vulnerable Populations	1. Non-specific, depends on terrorism group and motives. May involve special populations and motives relating to government or religion for example.

Scenario:	Infectious Disease	Pandemic Influenza	Bio-Terrorism
		including: • Economically disadvantaged • Uninsured (health insurance) • English as a 2nd language • Those without internet services (limited access to information and services)	
Economy (community wide)		1. Supply Chain issues 2. Significant impact to local, regional, national, and global economies. See additional impact and vulnerability statements following this table.	
OTHER: (points of vulnerability – high priority)	1. Those NOT vaccinated for vaccine preventable diseases. 2. Vaccines exist for many, but not all diseases. 3. Multi-Drug Resistant Organisms: fungi and bacteria resistant to antibiotics 4. ND allows for opting out of vaccines for religious, moral, or philosophical reasons.	1. Those NOT vaccinated for vaccine preventable diseases. 2. The unavailability of vaccines at the start of new (novel) disease. 3. ND allows for opting out of vaccines for religious, moral, or philosophical reasons.	

The following impact and vulnerability descriptions based on the COVID-19 event are derived from the 2024-2029 ND Enhanced Mitigation Plan:

- *The COVID-19 global pandemic demonstrated that the indirect consequences of a widespread infectious disease can be as difficult as the disease itself. Workplace shutdowns and restrictions initiated to stop the spread of the disease led to skyrocketing unemployment and economic impact. Supply-chain issues created shortages of essential goods such as infant formula. The need for medical care demonstrated the limits of health care systems and impacts of stress in healthcare professionals.*
- *COVID-19 demonstrated the vulnerability in supply chains and the criticality of low-skilled labor in the economy. Shutdowns from outbreaks in the food processing industry early in the pandemic impacted food supplies and prices. Outbreaks in the food processing industry were among some of the earliest in the United States, and most of the infected were poor, uninsured, and spoke English as a second language.*
- *Shortages exposed the vulnerability of the global supply chain. Among some of the more impactful shortages were the shortage of computer chips, lumber, baby formula, and tampons.*
- *Minorities and immigrants are in positions more likely to be deemed essential work, more likely to have essential workplaces that expose them to others, and less likely to have sick-pay benefits, creating a higher probability of infection in communities more likely to experience co-morbidities, health inequities, and less likely to have equal access to healthcare.*
- *As operations became more virtual in nature, households that did not have access to quality internet service would face additional challenges in receiving information and services.*
- *Domestic violence, child abuse and neglect, and divorce all increased during COVID-19. Stress, the disruption of protective and supportive social networks, decreased access to services, and fewer interactions with the public were contributors to the escalation of domestic abuse. Suicides and mental health crises increased during and after the public health emergency, sometimes in response to increased stress due to changing household economics, stressful essential work, resentment over the lack of employment options, or from regressive social behavior exhibited by adults (Turcotte-Tremblay, et al., 2021).*
- *Facilities that were designed for public gatherings often struggled financially during COVID-19 as these activities were delayed, canceled, or moved to a virtual space (Turcotte-Tremblay, et al., 2021). This led to an increase in bankruptcies and the need for financial assistance.*
- *Mandatory closures for in-person businesses in March and April 2020 economically impacted small business and municipal and state revenues. The implementation of the ND Smart Restart plan created additional costs for conducting in-person business, including decreasing the number of customers that could be served, masking and testing requirements, and social distancing (Turcotte-Tremblay, 2021).*
- *In government, losses in income at the household level result in lower tax revenues to provide government services.*

Vulnerability Assessment (2 of 2)

Scenario:	**Foodborne Illness**	**Rec Water Illness**	**West Nile Outbreak**
Probability	Likely	Likely	Likely
Speed of Onset	No notice	No notice	No notice
Duration			
Geographic Area	Statewide/nationwide	Statewide/nationwide	Statewide/nationwide
Death / Injury 1. Primary Causes A. Highest Vulnerability	1. Consuming food or drink that contains a pathogen (i.e.: bacteria, virus or parasite) or harmful chemical or substances A. Young, elderly and Immuno-compromised	1. Swallowing, breathing in mists or aerosols of, or having contact with contaminated water A. Young, elderly and Immuno-compromised	1. Getting bit by an infected mosquito A. People with certain medical conditions such as cancer, diabetes, hypertension and kidney disease are also at greater risk for serious illness.
Mass Casualty Incident	Yes, potentially	Most likely not	Yes, potentially
Property Losses	NA	NA	NA
Environmental	NA	NA	NA
COG/COOP	NA	NA	NA
Critical Facilities	NA	NA	NA
Critical Infrastructure	NA	NA	NA
Schools	NA	NA	NA
High Risk Facilities (chemical)	NA	NA	NA
Specific Populations: Public Assembly, Vulnerable / Special Populations	Those affected are likely to have consumed a common meal from a common source (ie: donated or intentional act)	Those recreating in untreated water – lakes, rivers, reservoirs.	Those who work outside or participate in outdoor activities
Economy (community wide)	Medical costs Lost productivity	Medical costs Lost productivity	Medical costs Lost productivity
OTHER:			

Changes in Vulnerability

Since the previous plan update in 2020.

Increase in Vulnerability	Decrease in Vulnerability
There is an increase in vulnerability since the previous plan update due to lower rates of vaccination among North Dakotans for various diseases as discussed in this plan. Not all parents choose to vaccinate their children. Consequently, parents who don't vaccinate their children are in essence depending on the vaccination of other children to protect their child from getting vaccine preventable diseases. *Lower-than-national-average, and generally decreasing rates of vaccination makes negative public health outcomes, illness, and death from communicable diseases more probable in the state. Source: 2024-29 ND Enhanced Mitigation Plan.*	Drive-thru vaccination and/or dispensing capability is established at the new Public Health facility (heated area). See additional Infections Disease Hazard Mitigation Capabilities listed in Section 3.

Risk

See Section 10 of this plan document for risk assessment and hazard ranking of all hazards addressed in this plan.

Relationship to other Hazards: Our winter weather season has an impact on infectious diseases as a result of changing behaviors (congregating and staying indoors more frequently). Infectious diseases may be caused intentionally as a Terrorist or Nation State Attack. Bioterrorism is discussed within this Infectious Disease Hazard profile.

Future Conditions

- **Location**: No change.
- **Extent/Intensity:** See “Anticipated Future Climate Impact” below.
- **Frequency:** See “Anticipated Future Climate Impact” below.
- **Duration:** No change.

Anticipated Future Climate Impact – Infectious Disease Hazard
North Dakota should expect larger, more frequent, and more intense outbreaks of certain infectious diseases and pests, though some human and animal diseases may also decrease in occurrence. Somewhat shorter and less cold winter seasons could lead to decreased incidents of certain infectious diseases among both human and animal populations during this period, depending on how and where population growth (or withdrawal) and development occur.

Previous Occurrences

COVID-19 Pandemic
Presidential Disaster Declaration issued in 2020 **DR-4509**
Incident Period: January 20, 2020 - May 11, 2023
Declaration declared on: April 1, 2020
Entire State Declared

Summary derived from the 2024-2029 ND Enhanced Mitigation Plan.

On March 11, 2020, the World Health Organization declared COVID-19 to be a global pandemic, and the nation followed on March 13, 2020. The emergency officially ended in the United States on April 10, 2023, and worldwide on May 5, 2023. The incident period for EM-3477-ND, issued for the entire state at the onset of COVID-19, spanned nearly four years, ending on May 11, 2023. As conditions deteriorated, North Dakota received a federal declaration on April 1, 2020, which also ended May 11, 2023.

North Dakota identified its first COVID-19 case and recorded its first death in March 2020, leading to the closure of schools and limiting of public gatherings to stop the spread. Businesses began re-opening in late spring 2020, although schools continued to operate through distance learning.

Vaccines were not available in North Dakota until December 14, 2020, about the time when hospitalizations and deaths peaked in North Dakota.

Although North Dakota COVID-19 cases peaked in January 2022, the state was in a better position to deal with the situation because vaccines and treatments were more readily available leaving North Dakota positioned to respond when the peak hit (UND School of Medicine and Health Sciences, 2023). Deaths reported to the North Dakota Department of Health and Human Services showed a pattern similar to that of hospitalizations, with an early virus peak during the Fall 2020 season, and a smaller peak as the Delta and Omnicron variants emerged, October 2021 through January 2022 (NDHHS, 2023). Indoor activities were likely a factor in these peaks as people congregate in indoor areas, increasing transmission. Mutations of the virus occurred during the global pandemic, and variations of the virus were dominant at different periods of the pandemic.

Burleigh County cumulative COVID-19 cases reported through April 2023: 41,598. Only Cass County had more cases. Burleigh County had a 0.42 infection rate per capita (3rd highest rate in the state behind Rolette and Sioux Counties). About one in three North Dakotans contracted COVID-19 during the emergency period (NDHHS, 2023).

Vaccines are reported to have reduced the rate of infection by 50 percent and reduced the rate of hospitalizations by 50 to 66 percent when compared to unvaccinated cohorts (NDHHS, 2023).

For those unvaccinated, immune-compromised or having other co-morbidities or health inequities, serious illness and death continue to be consequences of the disease.

Not all impacts were negative, such as opportunities created via remote work: Remote work increases opportunities for those who are homebound or struggle with mobility issues, increases the pool of workers beyond the local area, and allows people who also have caretaker duties in the home more opportunity to participate in the workforce.

2017 Influenza Season

Summary

The North Dakota Department of Health (NDDoH) received reports of 8,530 cases of laboratory-identified influenza, the largest seasonal case count on record. This statistic captures cases that are identified with a laboratory test. Cases diagnosed based on symptomology or contact with another known case are not reported. Additionally, not all people with influenza will seek the care of a medical professional. Therefore, the true seasonal burden of influenza is higher than presented in this report.

The predominant strain this season was the influenza A H3N2. This strain also predominated last season. According to the Centers for Disease Control and Prevention, the 2017-18 season was one of the most severe seasons on records, and the most severe since the 2009 pandemic.

As usual, the influenza A 2009 H1N1 pandemic strain circulated as well, in much lower numbers. As did both influenza B lineages, with B Yamagata making up a large majority of the influenza B cases.

County	Case Count
Adams	37
Barnes	111
Benson	169
Billings	0
Bottineau	51
Bowman	47
Burke	36
Burleigh	955
Cass	1983

Source: **https://www.hhs.nd.gov/sites/www/files/documents/Files/MSS/Flu/Weekly_Reports/2017-18/2017-18%20Influenza%20Seasonal%20Summary.pdf**

2009 H1N1

In the spring of 2009, a novel influenza A (H1N1) virus emerged. It was detected first in the United States and spread quickly across the United States and the world. This new H1N1 virus contained a unique combination of influenza genes not previously identified in animals or people. This virus was designated as influenza A (H1N1)pdm09 virus.

The (H1N1)pdm09 virus was very different from H1N1 viruses that were circulating at the time of the pandemic. Few young people had any existing immunity (as detected by antibody response) to the (H1N1)pdm09 virus, but nearly one-third of people over 60 years old had antibodies against this virus, likely from exposure to an older H1N1 virus earlier in their lives. Since the (H1N1)pdm09 virus was very different from circulating H1N1 viruses, vaccination with seasonal flu vaccines offered little cross-protection against (H1N1)pdm09 virus infection. While a monovalent (H1N1)pdm09 vaccine was produced, it was not available in large quantities until late November—after the peak of illness during the second wave had come and gone in the United States. From April 12, 2009 to April 10, 2010, CDC estimated there were 60.8 million cases (range: 43.3-89.3 million), 274,304 hospitalizations (range: 195,086-402,719), and 12,469 deaths (range: 8868-18,306) in the United States due to the (H1N1)pdm09 virus.
Source: https://archive.cdc.gov/www_cdc_gov/flu/pandemic-resources/2009-h1n1-pandemic.html

The following summary information is carried over from the previous mitigation plan due to the 2009-2010 H1N1 Pandemic Report no longer being available via ND HHS website.
The first case of novel H1N1 in a North Dakota resident was confirmed May 8, 2009. This marked the beginning of the first wave of 2009 H1N1 influenza illness in North Dakota. Seasonal influenza strains continued to co-circulate through the month of May but soon transitioned to only 2009 H1N1 influenza being detected by PCR testing methodologies. Children and teens were the age groups more affected by 2009 H1N1 influenza compared to all other age groups. The largest number of positive influenza cases was reported in the 11- to 19-year-old age range (877 in ND). Those ages 19 and younger comprised 69 percent of the total cases reported during the 2009- 2010 influenza season. The median age of reported cases was 12.96 years and ranged from 0.01 to 87.76 years. 618 influenza cases were from Burleigh County for the 2009-10 season which was the highest count in ND. Cass had the 2nd highest reported with 305. The report did not identify the number of deaths specific to ND other than the statement “no influenza associated deaths among children were identified in North Dakota.” The emergence of this virus caused the first influenza pandemic in more than 40 years.

1918 and 1920 Spanish Influenza epidemic
Source: 2024-2029 ND Enhanced Mitigation Plan.

North Dakota experienced two waves of the Spanish Influenza epidemic in 1918 and 1920. The 1918 outbreak in North Dakota began in Fargo in late September 1918, with unexpected lethality for people between 20 and 35 years old. Much as in modern day, schools and gathering places, including churches, shuttered to stem the spread of the disease that took more than 500,000 American lives and sickened 20 million (The Forum, 2005). According to the Report of (ND) State Board of Health, a total of 1,378 North Dakotans died of influenza between 1 July 1918 and 30 June 1919, versus 9 persons in the previous 12-month period (State Historical Society of North Dakota, 2023). The second wave came in early 1920, prompting a return to limiting social gatherings after an outbreak began at the North Dakota Agricultural College (now NDSU). Emergency field hospitals were opened in Grand Forks and Stark County and businesses were forced to limit patrons (Prairie Public, 2021). Dances and after-school activities were canceled. Some areas with especially prolific outbreaks went into complete shutdown, including Stark and Stutsman Counties.

Pest Infestation – Hazard Profile

Urban Forest Damaging Pests

Description

There are several pests and diseases, some more harmful than others, that are prevalent in Bismarck.

Dutch Elm Disease (DED): The most common disease in Bismarck every year is Dutch Elm Disease (DED). Approximately fifty Elm trees are removed in Bismarck each year due to DED. Click here to view the map showing the history of DED.

Dutch elm disease (DED) was first detected in Mandan, North Dakota in 1969 and has since been recorded in all North Dakota counties. Dutch elm disease is a wilt disease caused by the fungus *Ophiostoma novo-ulmi* and only affects trees in the elm family (*Ulmaceae*). Dutch elm disease (DED) is spread (vectored) by native elm bark beetles, European elm bark beetles and the banded elm bark beetle in North Dakota. DED is also spread by moving elm firewood from infected trees into new areas.

Dutch Elm Disease (DED) is a fungus that is spread by elm bark beetles. When an elm tree is infected with DED, branches in the upper crown will yellow, curl and wilt, commonly referred to as *flagging*. If a healthy elm tree is next to a tree infected with DED it is possible for the fungus to spread through the root systems. This happens when trees are planted close together and as they mature their roots fuse together, also known as root grafting.

Tree mortality can occur within one year of infection, though DED generally takes three years or more to kill a tree.

Why is Dutch elm disease a problem?

- Dutch elm disease kills trees rapidly and spreads readily if not properly managed.
- There is no 'cure' for DED and the disease is widespread in urban and rural areas throughout North Dakota.
- Dutch elm disease kills American elm trees, the North Dakota State Tree, which is well-adapted to environmental conditions in our state.
- Management of Dutch elm disease in North Dakota communities is costly.

What are the current impacts of Dutch elm disease in North Dakota?

- Continual need to spend considerable amounts of money to manage Dutch elm disease in North Dakota communities.
- Continual loss of a prominent, well-adapted tree species in natural settings.
- Continual incremental loss of a prominent and excellent tree for urban settings.

The Forestry Division is also on watch for **Emerald Ash Borer (EAB).** EAB attacks Ash (*Fraxinus*) trees. EAB has been found in LaMoure County in the State of North Dakota. It has also been found in Moorhead, MN and Winnipeg, Canada along with other Midwest States.

Emerald Ash Borer (EAB), Agrilus planipennis Fairmaire, is an exotic beetle that was discovered in southeastern Michigan near Detroit in the summer of 2002. The adult beetles nibble on ash foliage but cause little damage. The larvae (the immature stage) feed on the inner bark of ash trees, disrupting the tree's ability to transport water and nutrients. Emerald ash borer probably arrived in the United States on solid wood packing material carried in cargo ships or airplanes originating in its native Asia. As of February 2025, it is now found in 37 states, and 6 Canadian provinces.

The world has become a Global Market, meaning North America and other countries are receiving material from other parts of the world. Along with these products invasive pests are also being shipped. Looking back at the major pest problems all are an invasive pest or disease; Gypsy Moth, Dutch Elm Disease (DED), Chestnut Blight, and now EAB. It is difficult to tell what future pest will be introduced to the North America and North Dakota. In the case of EAB, around 22% of Bismarck's boulevard trees are composed of an ash species. Bismarck has been successful in its efforts with DED. As the City report states when City staff has to address EAB this will detract from our DED program. This will then put the 14% elm street tree population at risk of finally succumbing to DED. With those two efforts the City of Bismarck has the potential of losing 36% of its street population. This does not account for the Bismarck Park District and private trees.

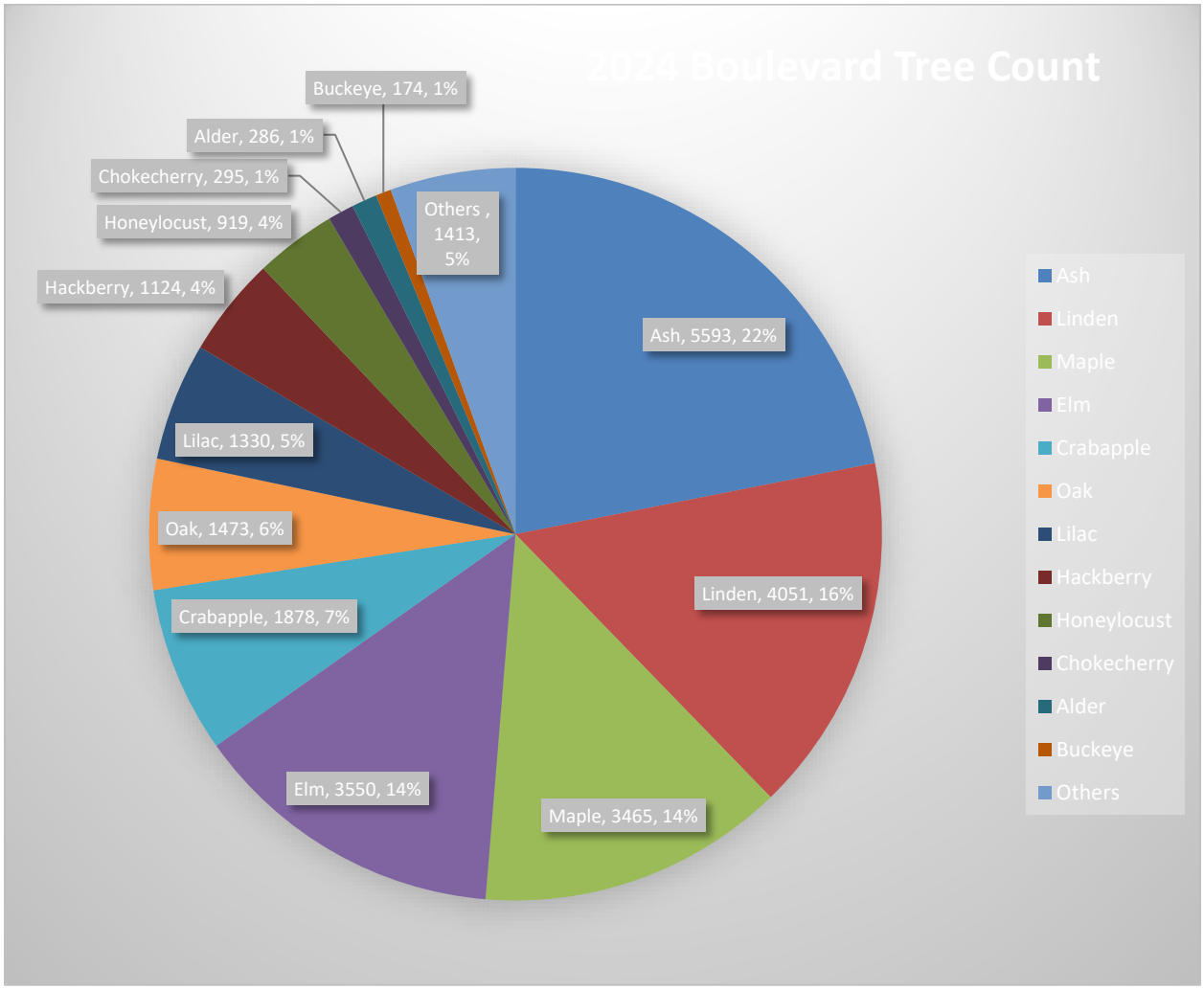
Scope of Emerald Ash Borer Impact on Bismarck:

Ash is one of the most important and abundant species in the City of Bismarck and the surrounding area. Ash composes nearly 22% of all street trees (5,593 street trees, all of these ash trees will be impacted by EAB) in Bismarck. This does not take into account park property and private trees in Bismarck. Once introduced to Bismarck and the surrounding area, it is likely that every ash tree will be impacted by EAB.

In 2020, the Forestry Division surveyed a few local tree services and nurseries to develop cost estimates. The estimates presented here represent 2020 dollars:

Removal and stump grinding of a medium sized tree could cost $1000 per tree. Replanting a 2" caliper tree would cost anywhere from $500-550 per tree. Taking a conservative approach, the City would be spending 5.5 million dollars for removals and citizens could spend 3 million dollars replanting lost ash trees. This does not account for the lost economic benefits that these trees provide to the City and the residents such as; more rainwater would work its way into the storm water systems without the trees to intercept the rainwater, household cooling cost would increase due to the lost shade provided by the trees, winter heating cost would increase without these trees blocking the harsh winter winds.

History: EAB is an exotic beetle that was discovered in southeastern Michigan near Detroit in the summer of 2002. The adult beetles nibble on ash foliage but cause little damage. The larvae (the immature stage) feed on the inner bark of ash trees, disrupting the tree's ability to transport water and nutrients. Emerald ash borer probably arrived in the United States on solid wood packing material carried in cargo ships or airplanes originating in its native Asia. As of February 2025, it is now found in 37 states, and 6 Canadian provinces. This pest has killed millions of ash trees along the way.



Vulnerability Assessment

Vulnerability: Characteristics of community assets that make them susceptible to damage from a given hazard.

	Pest Infestation – Emerald Ash Borer and Dutch Elm Disease
Probability	Likely
Speed of Onset	Slow
Duration	Years
Geographic Area	City, County, Statewide, Regional
Death / Injury 1. Primary Causes A. Highest vulnerability	1. Trimming or removing trees. A. Those without adequate training or experience in tree removal, if attempting to trim or remove their own trees. B. City Forestry staff due to a potentially high number of impacted trees should EAB impact Bismarck.
Mass Casualty Incident	No.
Property Losses	1. Potentially ALL Ash Trees (Emerald Ash Borer) 2. Elm Trees (Dutch Elm Disease)
Environmental	1. Loss of shading and protection increases heating and cooling requirements (and costs) of surrounding facilities. 2. Aesthetics. 3. Storm water system impacted due to rainwater not being intercepted by mature trees.
COG/COOP	1. No impact on continuity of government or continuity of operations.
Critical Facilities	1. None.
Critical Infrastructure	1. None.
Schools	1. None.
High Risk Facilities (chemical)	1. None.
Specific Populations: Public Assembly, Vulnerable / Special Populations	1. None.
Economy (community wide)	Moderate impact. See “Scope of Emerald Ash Borer Impact on Bismarck” on page 2.
OTHER:	Transporting of infested firewood.

Changes in Vulnerability Since the previous plan update in 2020.	
Increase in Vulnerability	Decrease in Vulnerability
No changes aside from additional property as annexed into the city. See Community Profile Section 7.	See Pest Infestation Hazard Mitigation Capabilities listed in Section 3.

Risk
See Section 10 of this plan document for risk assessment and hazard ranking of all hazards addressed in this plan.

Relationship to other Hazards: See "Anticipated Future Climate Impact" below.

Future Conditions

- **Location**: The locations of pest infestation hazard will remain the same, with the exception of additional areas as annexed into the city.
- **Extent/Intensity:** See "Anticipated Future Climate Impact" below.
- **Frequency:** See "Anticipated Future Climate Impact" below.
- **Duration:** The duration of pest infestation hazards is not projected to change.

Anticipated Future Climate Impact – Pest Infestation Hazard
As a result of slightly warmer and longer summers, more pests and invasive weeds will be able to thrive and spread, contributing to increases in insect populations such as *Emerald Ash Borers* and *Elm Bark Beetles*, or certain vector-borne diseases such as *Dutch Elm Disease Spores* or *West Nile Disease*.

Previous Occurrences

Dutch Elm Disease (DED): The most common disease in Bismarck every year is Dutch Elm Disease (DED). Approximately fifty Elm trees are removed in Bismarck each year due to DED. Click here to view the map showing the history of DED.

Severe Summer Weather Hazard Profile

Including Lightning, Wind (Downburst and Straight-Line), Hail, and Extreme Heat.
Note: Tornado is addressed as a separate hazard.

Description

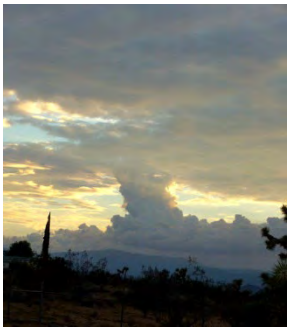
Thunderstorm
Severe summer storms can result in loss of life, injuries, and damage to property and crops. Although thunderstorms affect relatively small areas when compared to other hazards such as winter storms. All thunderstorms are dangerous. Every thunderstorm produces lightning, which kills more people each year than tornadoes. Heavy rain from thunderstorms can lead to flash flooding. Strong winds, hail, and tornadoes are also dangers associated with some thunderstorms.

Of the estimated 100,000 thunderstorms that occur each year in the United States, only about 10 percent are classified as severe. The typical thunderstorm is 15 miles in diameter and lasts an average of 30 minutes. The National Weather Service considers a thunderstorm severe if it produces hail at least 1” in diameter, winds of 58 mph or stronger, or a tornado.

Thunderstorms are most likely to happen in the spring and summer months during the afternoon and evening hours, but they can occur year-round and at all hours. Annually, the central and northern parts of North Dakota may have an average of 10 to 30 days with thunderstorm activity, while the southern part of the state averages between 30 to 50 days.

Thunderstorms form when moisture, unstable air, and lift are present in the atmosphere. Thermal instability, fronts, and the sun’s heat are capable of lifting the air to help form thunderstorms. All thunderstorms proceed through a three-stage life cycle.

The Cumulus Stage



The cumulus stage occurs when thunderstorm development begins. At this stage, the storm consists only of upward-moving air currents called updrafts. These updrafts reach heights of around 20,000 feet above the ground, but the base of the storm may lower, as moisture becomes more plentiful. As a thunderstorm develops, towering cumulus clouds indicate rising air. There is usually little rain during this stage and only occasional lightning.
Source: photo http://en.wikipedia.org/wiki/File:Towering_Vertical_Cloud_1.jpg

The Mature Stage

The mature stage is the strongest and most dangerous stage of a storm's life cycle. As the storm matures, the clouds have a black or dark green appearance. Hail, heavy rain, frequent lightning, strong winds, and tornadoes are most likely to occur during this phase, lasting an average of 10 to 20 minutes. At this stage, the storm contains both upward and downward moving air currents (updrafts and downdrafts) with precipitation in the downdraft area. These updrafts and downdrafts can reach velocities of 170 mph.

When the cool downdraft hits the ground, it spreads out and forms a gust front, which may include damaging wind called a downburst. The updraft also causes the top of the storm to spread out.

Source: Photo http://upload.wikimedia.org/wikipedia/commons/0/0c/FoggDam-NT.jpg

The Dissipating Stage

In the dissipating stage, the precipitation and downdraft dominate the storm and weaken the updraft. As the gust front moves away from the storm, the inflow of energy into the storm is cut off. As the thunderstorm dissipates, rainfall may decrease in intensity, but lightning and strong winds remain a danger.

Severe Summer Weather Data Resources:

- US Climate Extremes Data may be found at https://www.ncdc.noaa.gov/extremes/cei/graph/wn/06-08/1
- NOAA Storm Events Database: http://www.ncdc.noaa.gov/stormevents/

Lightning

Lightning Season Start/End Dates 1995-2019	
March 8, 2000	Earliest seasonal lightning strike
October 19, 2004	Latest seasonal lightning strike

Lightning develops when ice particles in a cloud move around, colliding with other particles. These collisions cause a separation of electrical charges. Positively charged ice particles rise to the top of the cloud and negatively charged ones fall to the middle and lower sections of the cloud. The negative charges at the base of the cloud attract positive charges at the surface of the Earth. Invisible to the human eye, the negatively charged area of the cloud sends a charge called a stepped leader toward the ground. Once it gets close enough, a channel develops between the cloud and the ground. Lightning is the electrical transfer through this channel. The channel rapidly heats to 50,000 degrees Fahrenheit and contains approximately 100 million electrical volts. The rapid expansion of the heated air causes thunder. (National Weather Service, 2007c)

Lightning occurs with all thunderstorms, and averages 80 to 93 deaths and 300 injuries in the United States each year. Lightning also causes several hundred million dollars in damage to property and forests annually. Most lightning deaths and injuries occur when people are caught outdoors, especially under or near tall trees, in or on water, or on or near hilltops. Between 1984 and 1994, over 15,000 lightning induced fires nationwide resulted in several hundred million dollars in damages and the loss of two million acres of forest.

Lightning can cause fatalities, injuries, and property damage directly and indirectly. Lightning can strike humans, animals, aircraft, buildings, equipment, and the surface of the earth causing death and destruction. Lightning can trigger other hazards including fires, power surges, interruption of communications, downed power lines, and exposure to noxious gas due to vaporization of materials. Computer equipment is especially vulnerable to damage from power surges.

A CG (cloud-to-ground) lightning forecast predicts the likelihood of cloud-to-ground lightning strikes from thunderstorms, often combined with the expected flash rate.

Lightning Threat Levels (National Weather Service)
Source: https://www.weather.gov/mlb/lightning_threat

Lightning Threat Level	Threat Level Descriptions
Extreme	**"An Extreme Threat to Life and Property from Lightning."** Within 12 miles of a location, a moderate likelihood of CG lightning (or 50% thunderstorm probability), with storms capable of excessive CG lightning. AND/OR...a high likelihood of CG lightning (or 60% to 70% thunderstorm probability), with storms capable of frequent CG lightning. AND/OR...a very high likelihood of CG lightning (or 80% to 90% thunderstorm probability), with storms capable of occasional CG lightning.
High	**"A High Threat to Life and Property from Lightning."** Within 12 miles of a location, a low likelihood of CG lightning (or 30% to 40% thunderstorm probability), with storms capable of excessive CG lightning. AND/OR...a moderate likelihood of CG lightning (or 50% thunderstorm probability), with storms capable of frequent CG lightning. AND/OR...a high likelihood of CG lightning (or 60% to 70% thunderstorm probability), with storms capable of occasional CG lightning.
Moderate	**"A Moderate Threat to Life and Property from Lightning."** Within 12 miles of a location, a very low likelihood of CG lightning (or 10% to 20% thunderstorm probability), with storms capable of excessive CG lightning. AND/OR...a low likelihood of CG lightning (or 30% to 40% thunderstorm probability), with storms capable of frequent CG lightning. AND/OR...a moderate likelihood of CG lightning (or 50% thunderstorm probability), with storms capable of occasional CG lightning.
Low	**"A Low Threat to Life and Property from Lightning."** Within 12 miles of a location, a very low likelihood of CG lightning (or 10% to 20% thunderstorm probability), with storms capable of frequent CG lightning. AND/OR...a low likelihood of CG lightning (or 30% to 40% thunderstorm probability), with storms capable of occasional CG lightning.
Very Low	**"A Very Low Threat to Life and Property from Lightning."** Within 12 miles of a location, a very low likelihood of CG lightning (or 10% to 20% thunderstorm probability), with storms capable of occasional CG lightning.
Non-Threatening	**"No Discernable Threat to Life and Property from Lightning."** Within 12 miles of a location, environmental conditions do not support CG lightning.

Note: With cloud-to-ground (CG) lightning, every strike is potentially lethal.
Occasional - CG lightning at the rate of 1 to 3 flashes per minute (about 5 to 15 flashes per 5 minutes) associated with a given lightning storm.

Frequent - CG lightning at the rate of 4 to 11 flashes per minute (about 20 to 55 flashes per 5 minutes) associated with a given lightning storm.

Excessive - CG lightning rate of 12 flashes or more per minute (about 60 flashes or more per 5 minutes) and is nearly continuous associated with a given lightning storm.

Wind

Strong winds can form along the leading edge of a thunderstorm. **Downburst winds** occur when air is carried into a storm's updraft, cools rapidly, and comes rushing to the ground. Cold air is denser than warm air, and therefore, wants to fall to the surface. On warm summer days, when the cold air can no longer be supported up by the storm's updraft, or an exceptional downdraft develops, the air crashes to the ground in the form of strong winds. These winds are forced horizontally when they reach the ground and can cause significant damage. These types of strong winds can also be referred to as straight-line winds. Downbursts with a diameter of less than 2.5 miles are called microbursts and those with a diameter of 2.5 miles or greater are called macrobursts. A derecho, or bow echo, is a series of downbursts associated with a line of thunderstorms. This type of phenomenon can extend for hundreds of miles and contain wind speeds in excess of 100 mph.

Straight-line winds are responsible for most thunderstorm wind damage. During the summer in the western states, thunderstorms often produce little rain but very strong wind gusts and dust storms. Downbursts can be extremely dangerous to aviation. Damage attributed to tornadoes is frequently caused by straight-line winds from a downburst. Downbursts can produce a "roaring" sound and damage similar to a tornado. These strong winds can damage trees, blow vehicles off the road, break windows, down power lines, damage roofs and fences, and cause other structural damages. Individuals caught outside are also at risk of injury from blowing dust and debris.

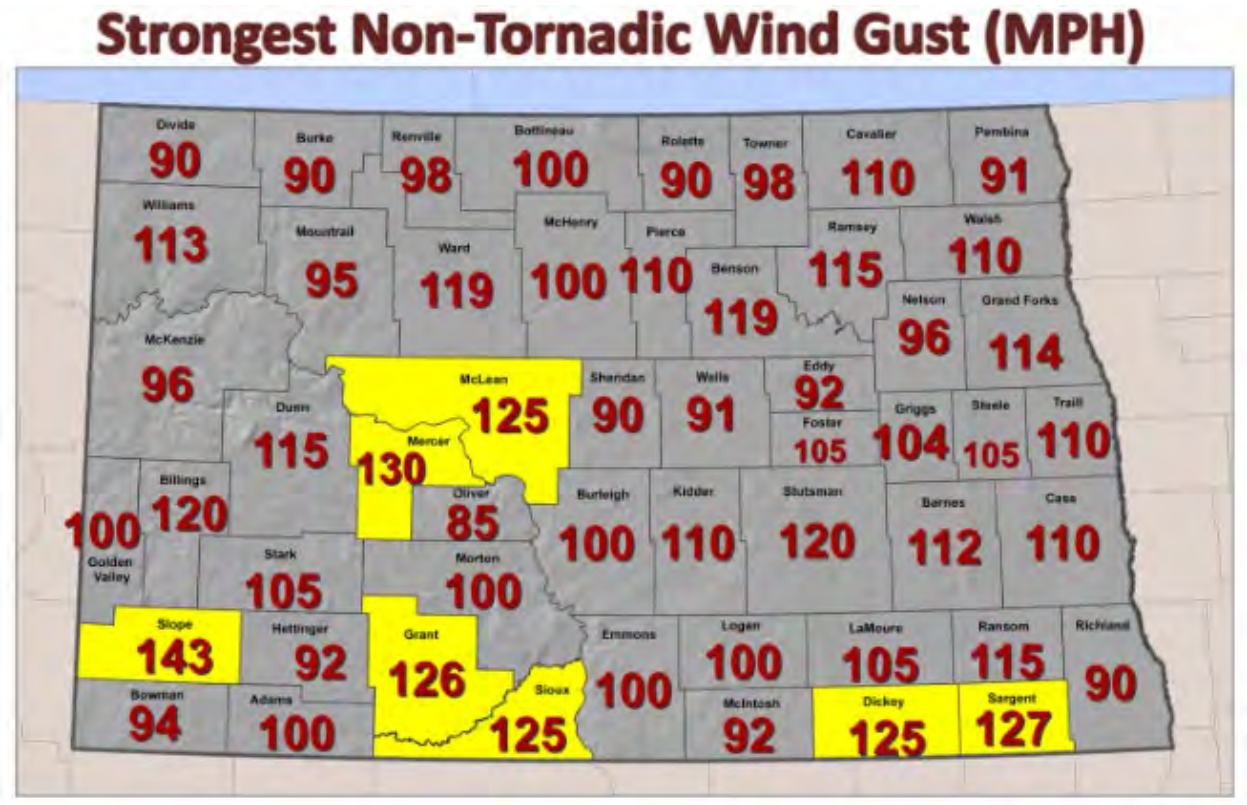
Severe winds associated with thunderstorms are not uncommon during the summer months in North Dakota. Wind events can cause death injury due to flying debris, collapsed structures, and to those in tractor trailers, vehicles, mobile homes, campers, tents or aircraft.

Strong winds can also occur outside of tornadoes and severe thunderstorms. These winds typically develop with strong pressure gradients and gusty frontal passages. The closer and stronger two systems (one high pressure, one low pressure) are, the stronger the pressure gradient, and therefore, the stronger the winds are. Strong winds can occur at any time of year.

Based on the historical record, North Dakota can expect over 76 high wind events, not related to tornadoes or thunderstorm winds, in any given year. This makes a high wind event highly likely (greater than 90% chance of probability) in a given year. The Federal Emergency Management Agency places the majority of North Dakota, including Bismarck, in Zone II (160mph) for structural wind design. As history demonstrates, these types of winds can remove roofs, move mobile homes, topple trees, take down utility lines, and destroy poorly-built or weak structures.

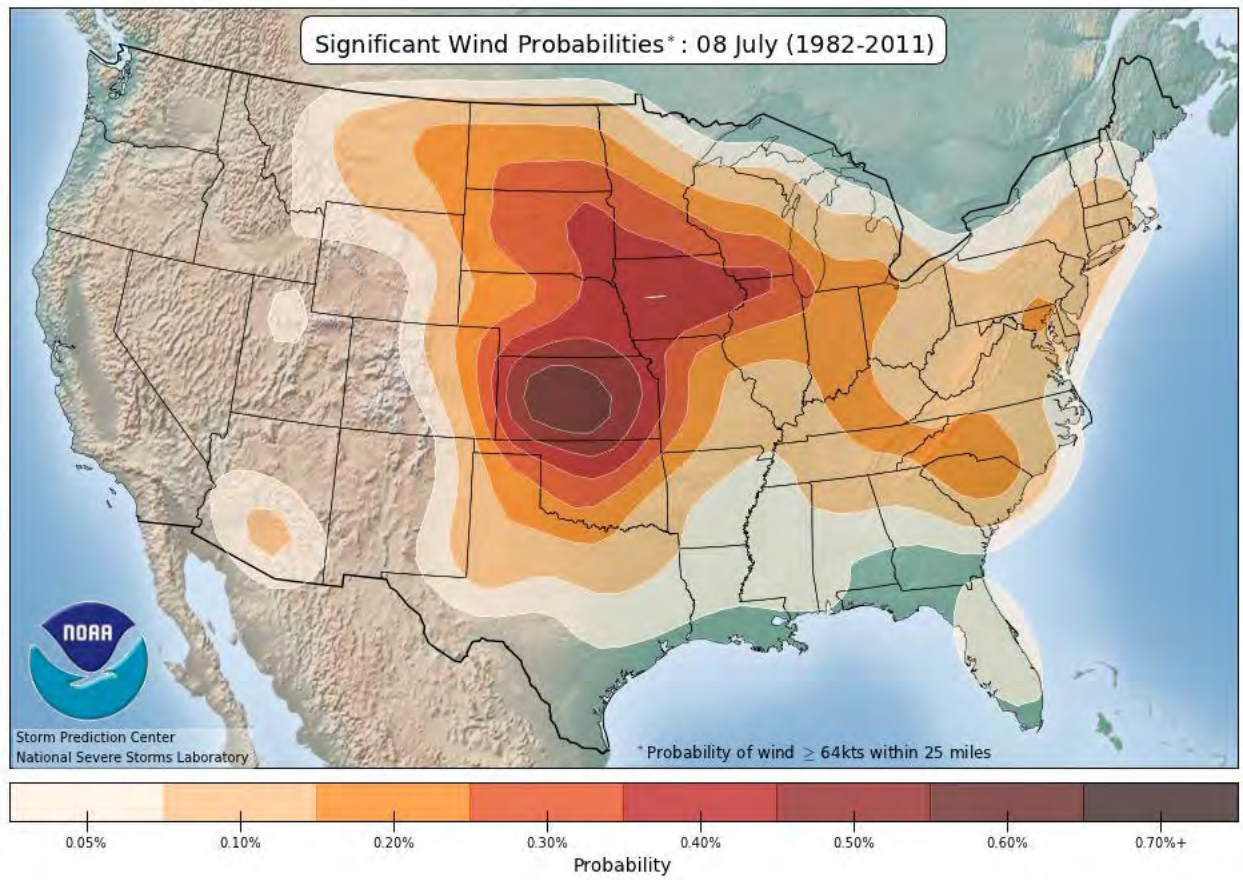
Criteria for high wind includes **sustained winds equal to or greater than 40 mph or gusts greater than or equal to 58 mph.** Sustained wind speeds can be estimated using the Beaufort Wind Scale. https://www.weather.gov/mfl/beaufort

Maximum wind speed reported 1950-2024



Burleigh County High Wind Speed Records Source: NWS Bismarck			
Speed	Date	Location	Damage Estimate
110	June 20, 2025	Near Lincoln	
Damage includes several homes with roof damage, siding, and deck damage, as well as damage to garages, including one with a side of a wall blown out.			
100	August 28, 2024	Just south of Sterling	$800,000
Significant damage in and to the south of Sterling. A large grain bin was dislodged. Power poles were broken on both sides of US Highway 83. Sunflower fields flattened. Damage estimated at $800,000.			
90	June 25, 1999	Bismarck	$2 Million
78 knots. Widespread damage to building, downed power lines, uprooted trees, street flooding and water damage to homes. Property damage from this storm is estimated at $2 million.			
96	July 10, 2011	3.5 miles southwest of Moffit	$250,000
Double poled wood transmission lines were snapped. A ranch sign with three foot long concrete anchors was torn from the ground. A camper was flipped off the highway and tossed over a tree row 25 yards away.			

Significant Wind Probability



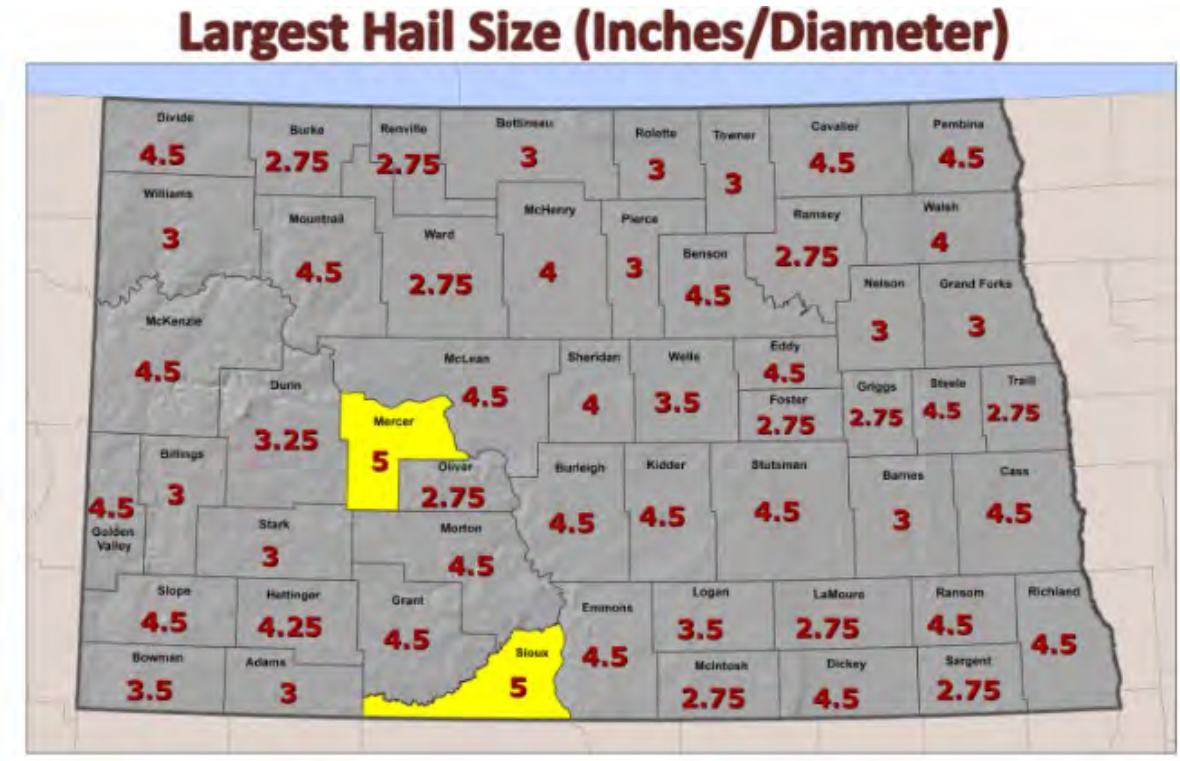
*These probability values were estimated from a 30-year period of severe weather reports from 1982-2011. http://www.spc.noaa.gov/new/SVRclimo/climo.php?parm=sigWind

Hail

Hail is precipitation in the form of a lump of ice. Hail occurs when strong rising currents of air within a storm, called updrafts, carry water droplets to a height where freezing occurs. The ice particles grow in size, finally becoming too heavy to be supported by the updraft and fall to the ground. Hailstones are usually round but can be conical or irregular in shape. They can range from pea size to the size of grapefruit, and large hailstones can fall at speeds faster than 100 mph. Hail tends to fall in swaths that range from a few acres to an area ten miles wide and one hundred miles long.

Most hail events affect only relatively small areas. Hail causes considerable damage to crops and property in the United States, occasionally causing death to farm animals, but seldom causing loss of human life. The damaging aspects of hail falls include the **hailstone sizes (average and maximum), number of hailstones per unit area, and associated winds**; hail risk is a combination of these factors plus the frequency of hail at a point or over an area. Crop hail losses in recent years nationally are estimated at $1.3 billion annually, representing between 1 and 2 percent of the annual crop value. Hail losses vary considerably regionally, representing, for example, 1 to 2 percent of the crop value in the Midwest, 5 to 6 percent of the crops produced in the High Plains, and much less elsewhere in the nation. Property hail losses have been increasing with time, now appearing to approximate crop-hail losses recently with crudely estimated annual losses of $1 billion. (Changnon, 1997)

Maximum **hail size** reported 1950-2024



Extreme Heat

According to information provided by FEMA, extreme heat is defined as temperatures that hover 10 degrees or more above the average high temperature for the region and last for several weeks. Heat kills by taxing the human body beyond its abilities. In a normal year, about 175 Americans succumb to the demands of summer heat. In the 40-year period from 1936 through 1975, nearly 20,000 people were killed in the United States by the effects of heat and solar radiation. In the heat wave of 1980, more than 1,250 people died.

Heat disorders generally have to do with a reduction or collapse of the body‘s ability to shed heat by circulatory changes and sweating or a chemical (salt) imbalance caused by too much sweating. When heat gain exceeds the level the body can remove, or when the body cannot compensate for fluids and salt lost through perspiration, the temperature of the body‘s inner core begins to rise and heat-related illness may develop. Elderly persons, small children, chronic invalids, those on certain medications or drugs, and persons with weight and alcohol problems are particularly susceptible to heat reactions, especially during heat waves in areas where moderate climate usually prevails.

The following two charts show the Heat Index (HI) as a function of heat and relative humidity. The Heat Index describes how hot the heat-humidity combination makes it feel. As relative humidity increases, the air seems warmer than it actually is because the body is less able to cool itself via evaporation of perspiration. As the HI rises, so do health risks.

- When the HI is 90°F, heat exhaustion is possible with prolonged exposure and/or physical activity.
- When it is 90°-105°F, heat exhaustion is probable with the possibility of sunstroke or heat cramps with prolonged exposure and/or physical activity.
- When it is 105°-129°F, sunstroke, heat cramps or heat exhaustion is likely, and heatstroke is possible with prolonged exposure and/or physical activity.
- When it is 130°F and higher, heatstroke and sunstroke are extremely likely with continued exposure. Physical activity and prolonged exposure to the heat increase the risks.

Temperature (°F)

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

Likelihood of Heat Disorders with Prolonged Exposure or Streuous Activity

Caution | Extreme Caution | Danger | Extreme Danger

Possible Heat Disorders by Heat Index Level

Heat Index	Category	Possible heat disorders for people in high risk groups
130°F or higher	Extreme Danger	Heatstroke risk extremely high with continued exposure.
105° - 129°F	Danger	Sunstroke, Heat Cramps and Heat Exhaustion likely. Heatstroke possible with prolonged exposure and/or physical activity.
90° - 105°F	*Extreme Caution*	*Sunstroke, Heat Cramps and Heat Exhaustion possible with prolonged exposure and or physical activity.*
80° - 90 °F	Caution	Fatigue possible with prolonged exposure and/or physical activity.

Source: National Weather Service

The NWS has in place a system to initiate alert procedures (advisories or warnings) when the Heat Index is expected to have a significant impact on public safety. The expected severity of the heat determines whether advisories or warnings are issued. A common guideline for the issuance of excessive heat alerts is when the maximum daytime high is expected to equal or exceed 105°F and a nighttime minimum high of 80°F or above is expected for two or more consecutive days. The NWS offices in Bismarck and Grand Forks can issue the following heat-related advisory as conditions warrant.

- **Excessive Heat Outlook**: are issued when the potential exists for an excessive heat event in the next 3-7 days. An Outlook provides information to Heat Index forecast map for the contiguous United States those who need considerable lead time to prepare for the event, such as public utilities, emergency management and public health officials.
- **Excessive Heat Watch**: is issued when conditions are favorable for an excessive heat event in the next 12 to 48 hours. A Watch is used when the risk of a heat wave has increased, but its occurrence and timing is still uncertain. A Watch provides enough lead time so those who need to prepare can do so, such as cities that have excessive heat event mitigation plans.
- **Excessive Heat Warning/Advisory:** are issued when an excessive heat event is expected in the next 36 hours. These products are issued when an excessive heat event is occurring, is imminent, or has a very high probability of occurring. The warning is used for conditions posing a threat to life or property. An advisory is for less serious conditions that cause significant discomfort or inconvenience and, if caution is not taken, could lead to a threat to life and/or property.

Vulnerability Assessment

Vulnerability: Characteristics of community assets that make them susceptible to damage from a given hazard.

	Lightning	Hail	High Winds or Downbursts
Probability	Very Likely	Very Likely	Very Likely
Speed of Onset	Warning lead time: 30 minutes to several hours	Warning lead time: 30 minutes to several hours	Warning lead time: 30 minutes to several hours
Geographic Area	All of Bismarck Typically 15 miles in diameter	All of Bismarck	All of Bismarck
Duration	Average of 30 minutes Can last much longer	Usually 30 minutes or less.	Minutes to Hours (high wind)
Death / Injury 1. Primary Causes A. Highest vulnerability	1. Direct or indirect lightning strike. A. Those outdoors, especially under or near tall trees, or B. On Water, or C. On Hilltops	1. Impact by large hail stones. Hail seldom causes loss of life. A. Those outdoors with no access to shelter.	1. Flying Debris *Non-secure outdoor items* A. Aviation B. Mobile home C. Motor Home D. Camp sites E. Being Caught Outdoors F. In a vehicle G. Insufficient shelter H. Windows
Mass Casualty Incident	No mass casualty incidents reported in ND. Lightning kills – averaging 80 to 93 deaths and 300 injuries in the US each year.	No mass casualty incidents reported in ND.	No mass casualty incidents reported in ND.

	Lightning	Hail	High Winds or Downbursts
Property Losses (points of vulnerability – high priority)	1. Property losses due to Fire (lightning as cause) 2. Computer equipment due to power surges 3. Downed power lines and trees	1. Shingles 2. Windows 3. Siding 4. Auto body damages 5. Trees/plants/crops	1. Mobile home 2. Motor Home 3. Windows/doors 4. Trees 5. Fences 6. Power lines 7. Roofs
Environmental			1. Debris 2. Hazardous Waste debris
COG/COOP	1. Computers and other electronic equipment 2. Loss of power	1. Could delay emergency response time.	1. Employee / family casualties 2. Key personnel – Orders of Succession
Critical Facilities	1. Computers and other electronic equipment 2. Loss of power	1. Windows	1. Windows 2. Garages 3. Doors 4. Large Span Roofs Structure – depending on design / materials
Critical Infrastructure	1. Loss of Power	1. Similar to snow event – blocked streets	2. Electricity: Substations & Overhead Power Lines 3. Streets Blocked 4. Communications
Schools	1. Computers and other electronic equipment	1. Windows	1. Portable Classrooms 2. Windows

	Lightning	Hail	High Winds or Downbursts
	2. Loss of power		3. Doors 4. Loss of roofing materials
High Risk Facilities (chemical)	1. Computers and other electronic equipment 2. Loss of power		1. Windows 2. Garages/doors 3. Doors 4. Large Span Roofs
Specific Populations: PublicAssembly,Vulnerable or Special Populations	1. Outdoor Activities – sporting events, water sports, etc.	1. Outdoor Activities – sporting events, water sports, etc.	1. Outdoor Recreation Areas 2. Public Assembly (high population densities) 3. Special Outdoor events
Economy (community wide)	Localized properties impacted	Significant impact to Insurance Industry and to property owners	Impact to insurance industry and property owners
OTHER:			

Changes in Vulnerability Since the previous plan update in 2020.	
Increase in Vulnerability	Decrease in Vulnerability
New properties and population within newly annexed areas. See Community Profile Section 7.	See Severe Summer Weather Mitigation Capabilities listed in Section 3.

Risk

See Section 10 of this plan document for risk assessment and hazard ranking of all hazards addressed in this plan.

Relationship to other Hazards: Also see tornado hazard profile (separate hazard profile). Flooding events as a result of heavy rain may occur simultaneously. Heat and extreme heat for an extended period contributes to the potential for drought and fire.

Future Conditions

- **Location**: The location of the severe summer weather hazard will remain the same, with the exception of additional areas as annexed into the city.
- **Extent/Intensity:** See “Anticipated Future Climate Impact” below.
- **Frequency:** See “Anticipated Future Climate Impact” below.
- **Duration:** See “Anticipated Future Climate Impact” below.

Anticipated Future Climate Impact – Severe Summer Weather Hazard

Through the end of this century in North Dakota, expect more frequent, larger, and longer duration storms with an increase in intense rain and flooding, and an increase in large hail. Potential Impacts include an expected increase (high confidence) in heavy precipitation events overall, higher in NC and NE ND and somewhat lesser in SW ND, with a likely increase in areal and/or flash flooding but less certain impacts on summertime riverine flooding. Hail size, frequency of large hail, and length of the hail season should increase (medium confidence) with a commensurate increase in the frequency and intensity of lightning and damaging downburst winds which are tied to hail production. Expected increases in temperature are likely to lead to an increase in days with a high Heat Index and the potential for lost workhours during such periods.

Previous Occurrences

Also see the separate"Tornado Hazard Profile."

Lightning Events

The following storm events are identified for Bismarck (1995 to 2025):
http://www.ncdc.noaa.gov/stormevents/

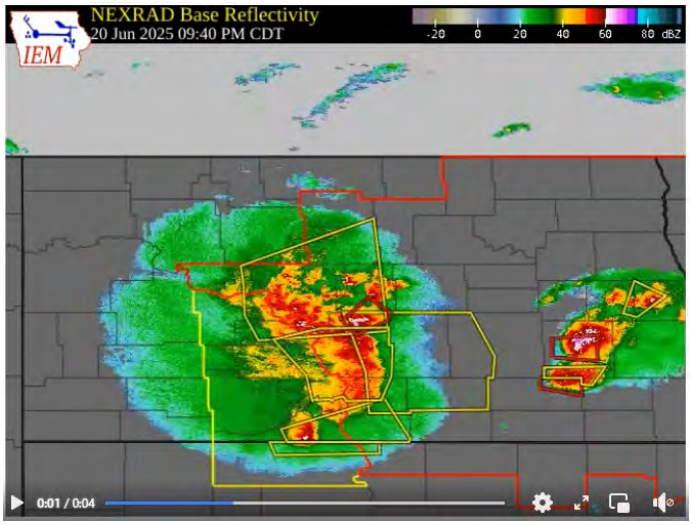
July 30, 2011: A lightning strike to a rural north Bismarck home caused a fire that destroyed the home several hours later.

August 2, 1996: Lightning struck the roof of a garage in Bismarck. Property damage as a result of this storm is estimated at $2,000.

Wind Events

Notable high wind events within Bismarck are noted below. Additional high wind events may be reviewed via the NOAA storm events database: http://www.ncdc.noaa.gov/stormevents/

June 20, 2025: The state of ND issued a statewide Disaster Declaration and received a Presidential Disaster Declaration **DR-4888** as a result of high winds and tornadic activity throughout much of the state. Bismarck wind speeds were reported at 66 mph (Bismarck Airport) to 82 mph (2 WNW Bismarck). Damages include extensive tree damage and damage to homes and property (sporadic). There were 14 transformer/power line fires reported. At one point, MDU power outage map showed 5,539 customers without power in the Bismarck/Mandan area. Within Bismarck, power loss occurred primarily between Divide Avenue and Main Avenue. This storm also produced thirteen (13) tornadoes throughout the state. None occurred in Burleigh County.
https://www.weather.gov/bis/SevereWx06202025



The June 20, 2025 wind event was classified as a Derecho by the Storm Predication Center. To learn more about what a derecho is and how it is classified, visit **https://www.spc.noaa.gov/misc/AbtDerechos/derechofaq.htm**

June 29, 2018: 65 knots. The Broadcast Media estimated thunderstorm wind gusts of 75 mph. (NWS database)

70 mph gusts reported (Bismarck Tribune).

Bismarck Tribune Photo.

June 17, 2016: Hail/Wind Event:
A severe thunderstorm struck northern portions of the city of Bismarck around 4:30 AM. Large hail combined with strong wind gusts to cause substantial damage. The largest hail with a diameter of 3.25 inches fell near Legacy High School. Winds of 75 mph combined with large hail to cause a swath of substantial damage from along Divide Avenue in north Bismarck to approximately 5 miles north of the city of Bismarck. Siding, roofs, and windows were damaged on homes. Multiple car dealerships sustained hail damage, which included the largest dealership in the city. Source: NWS

June 19, 2015: The strongest winds were reported in Burleigh County, where winds blew up to 90 mph. Extensive tree damage and power line damage with some structural damage was reported in the city of Bismarck and surrounding rural areas. Power outages lasted up to 72 hours. Source: NWS

- 82 mph wind gusts from the N-NW. Sustained wind of 60 mph.
  - Event Time (approx): 9 PM to 9:30 PM (higher winds).
- 0.87" rainfall (heavy rain) – short amount of time (approximately 1 hour).
- Two cars submerged in flooded underpass– 7th Street Underpass.
- 11,000 customers impacted by power outages in Bismarck/Mandan area. Many without power overnight.
- Spaedy Office complex on 25th and
- Broadway had roof torn off by the wind.
- New siren installation ended up with a 20 degree tilt or angle.
- City Forestry: The heaviest hit section of town is between Divide Ave and Main Ave from the river east to 26th St. A lot of trees uprooted or completely failed trees in this section of town. The south and north parts of town experienced limb breakage and hangers. Some smaller trees uprooted.

June 22, 2013
Tree debris primarily located from Divide Avenue south to Denver Avenue and from Washington Street to 3rd Street Area. Extensive tree damages in Sertoma Park area as well.

Bismarck – June 22, 2013 Tree debris primarily located from Divide Avenue south to Denver Avenue and from Washington Street to 3rd Street area. Extensive tree damages in Sertoma Park area as well. Photos: Gary Stockert, Bismarck Emergency Manager

July 31, 2011: High winds peaking at 68 mph were measured at the National Weather Service ASOS at the Bismarck Airport during this severe thunderstorm. The wind gusted at or above 60 mph for 20 minutes. This storm also impacted many trees in flood impacted areas including Fox Island and Sibley Park areas. Due to saturated soils as a result of the 2011 flood, many trees were tipped or leaning because the soils could not hold the root systems in place. This caused additional damages to homes already impacted by the Missouri River Flood of 2011.

October 26, 2008: A 59 mph wind gust was reported three miles east of Moffit. High winds were also blamed for a house fire in Bismarck. Local authorities reported the high winds tore down a tree onto power lines, which then started a house basement on fire. No injuries or fatalities were reported.

July 21, 2005: Thunderstorm, High Winds & Hail – Winds estimated between 60 and 70 mph – golf ball-size hail. The storm occurred on July 21 around 8:00 pm. Damage includes destroyed trees, tree damage, broken windows, damaged shingles, and damage to cars. It had been reported by citizens that a few man-hole covers had been displaced. Downed trees reported were primarily in the areas of River Road north of the interstate, North Grandview, Juniper, Ave B near the Cathedral Church, 12th Street, and Pioneer Park.

August 23, 2004: The severe thunderstorm brought strong winds, very heavy rainfall and hail across the Bismarck area. Numerous tree damage was reported. Power lines were downed by the winds causing citywide power outages. Hail sizes up to 2.00 inches were reported in the city. Streets and underpasses flooded causing several roads to become impassible. Water flowed across yards and into several basements of homes.

March 13, 2004: An Alberta Clipper brought very strong winds, sustained at 50 mph and gusting to around 60 mph at times, to western and central North Dakota during the afternoon

and early evening hours on March 13, 2004. The winds subsided during the late evening hours on the 13th.

November 29, 2002: After record high temperatures on Thanksgiving Day a strong Canadian cold front moved rapidly south through the state producing strong northwest winds of 40 to 70 mph over western and central North Dakota. The winds diminished during the evening hours. The cold front brought much colder air and a few snow showers to the region Friday night and Saturday.

February 11, 2002: Strong low pressure system moving across southern Canada produced a tight surface pressure gradient over North Dakota. Wind speeds averaged 50 to 70 miles an hour beginning early in the day and ending late in the evening. Overall, wind damage was minimal, however one semi-truck, which was empty, was blown over on its side along Interstate 94 in Bismarck. In Jamestown, a power outage occurred, but just for a short time period. Other locations reported loose objects were tossed around in the wind. (69 knots)

July 19, 2001: Thunderstorm winds (66 knots) were reported at the Bismarck Airport. Widespread tree damage across the southern half of the city of Bismarck. The property damage figure ($50,000) was for cleanup only. Power outage across much of the city. Several homes and business, including the Bismarck airport terminal building sustained damage.

April 5, 2000: A low-pressure system over Alberta, Canada moved southeast and intensified along the Canadian/North Dakota border. A very tight pressure gradient resulted in very high winds causing injuries and property damages throughout western and central North Dakota. Wind gusts of 55 to 70 mph were common. The injuries were mainly in Burleigh County in the city of Bismarck where 9 people were taken to area hospitals injured from flying debris. One person suffered a broken wrist from falling. Damage was widespread. Widespread power outages occurred. Homes, automobiles, trees, power lines, and businesses were damaged. Several grass fires erupted across the region.

June 25, 1999: Thunderstorm winds (78 knots) were reported in Bismarck. Widespread damage to buildings, downed power lines, uprooted trees, street flooding and water damage to homes. Property damage from this storm is estimated at $2 million.

July 17, 1996: The Bismarck area received anywhere from 1 to 2 inches of rain in an hour. There were reports of manhole covers being blown out. An 80 yr. old man suffered a heart attack while shoveling water away from his apartment complex.

May 16, 1996: As the storm moved into the Bismarck area, the National Weather Service at the airport received a gust to 79 mph. A small plane was tipped over at the airport, with part of the airport terminal roof blown off. There was at least 1 mobile home that was destroyed. Significant damage was done to trees, buildings and road signs. An estimated 3,000 people in Bismarck lost power. The Melroe
Company had its roof lifted off. Property damage from this storm is estimated at $3.2 million.

May 21, 1995: Thunderstorm winds (55 knots) were reported in Bismarck. Two thunderstorms merged north of Mandan causing torrential rain, hail up to golf ball-size for over 20 minutes, and winds to 65 mph, in Bismarck and Mandan. Piles of pea to golf ball-size hail covered the ground. Homes in Mandan had windows broken due to the hail.

Hail Events

Notable hail events within Bismarck are noted below. Additional events may be reviewed via the NOAA storm events database: http://www.ncdc.noaa.gov/stormevents/

In June 2001, a hailstorm caused an estimated $230 million in property damage in Burleigh and Morton Counties; an estimated 57,000 insurance claims were filed. (North Dakota Insurance Department, 2007)

This hailstorm affected the urban Bismarck and Mandan area. As the most damaging hailstorm in the state's history, the insurance industry was severely impacted and insurance availability and premiums were affected statewide; many insurance companies pulled out of the state after the storm. (North Dakota State Water Commission, 2007c)

In July 2005, nickel size to tennis ball size hail combined with 70 mph winds and caused extensive and widespread damage in Bismarck. The larger hail fell on the north side of the city where most of the damage occurred. Numerous homes and vehicles were damaged. There was damage to siding and roofs, and windows were broken. (National Climatic Data Center, 2007)

Burleigh County: Largest hailstone... 4.5 inch diameter – July 29, 2024
5:55 PM CDT to 6:40 PM CDT -2.5 miles west-southwest of Bismarck to 5.7 miles south of Lincoln - Extensive damage to housing developments south of Bismarck, and through the city of Lincoln. Slow moving thunderstorms with an extended period of large hail. The largest stone fell one mile south of the city of Lincoln. Damage estimated at $10.25 million.

Hail – 2 inches and larger January 1, 2000 thru June 24, 2025 See property damage (PrD) below.	23 events within Burleigh County. 10 events within Bismarck. Source: NWS https://www.ncdc.noaa.gov/stormevents

Location	County/Zone	St.	Date	Time	T.Z.	Type	Mag	Dth	Inj	PrD
Totals:								0	0	157.485M
BISMARCK	BURLEIGH CO.	ND	07/21/2005	18:25	CST	Hail	2.50 in.	0	0	93.000M
BISMARCK	BURLEIGH CO.	ND	06/17/2016	03:30	CST-6	Hail	3.25 in.	0	0	50.000M
BISMARCK	BURLEIGH CO.	ND	07/29/2024	16:55	CST-6	Hail	4.50 in.	0	0	10.000M
BALDWIN	BURLEIGH CO.	ND	07/29/2024	16:35	CST-6	Hail	2.50 in.	0	0	2.000M

August 25, 2019: A thunderstorm moved through Bismarck producing hail up to two inches in diameter, damaging many roofs and gutters.

June 17, 2016:
A severe thunderstorm struck northern portions of the city of Bismarck around 4:30 AM. Large hail combined with strong wind gusts to cause substantial damage. The largest hail with a diameter of 3.25 inches fell near Legacy High School. Winds of 75 mph combined with large hail to cause a swath of substantial damage from along Divide Avenue in north Bismarck to approximately 5 miles north of the city of Bismarck. Siding, roofs, and windows were damaged on homes. Multiple car dealerships sustained hail damage, which included the largest dealership in the city. Source: NWS

July 21, 2005: 2.50 inches of hail was reported in Bismarck. Nickel size to tennis ball size hail combined with 70 mph winds caused extensive and widespread damage in Bismarck. The larger hail fell on the north side of the city where most of the damage occurred. Numerous homes and vehicles damaged.
There was damage to siding and roofs, and windows were broken. Property damage estimates were provided by the North Dakota Insurance Commissioner.

June 9, 2001: 1.00 inch hail reported at the Bismarck Airport. An approaching upper level system provided lift to produce severe thunderstorms over central North Dakota Saturday afternoon and evening. Abundant low-level moisture combined with relatively cool air aloft lead to the formation of an incredible amount of hail with many of these storms. The hail caused a tremendous amount of damage to homes and vehicles in the Bismarck and Mandan areas. An estimated damage from the hail in the two cities amounted around $260 million. The wind speed associated with the storm ranged between 50 to 60 mph.

June 9, 2001: 1.75 inch hail reported 3 miles north of Bismarck Airport causing an estimated $113,000,000 in property damages.

June 9, 2001
Severe Storms Pummel Southern North Dakota

An approaching upper level system provided lift to produce thunderstorms across western North Dakota Saturday afternoon. The storms intensified as they traveled east southeast along an instability axis extending into South Dakota. Abundant low level moisture combined with relatively cool air aloft lead to the formation of an incredible amount of hail with many of these storms. The hail caused a tremendous amount of damage to homes and vehicles in Bismarck and Mandan. One tornado was reported just north of Hazelton, which is about 30 miles southeast of Bismarck. No known deaths occurred with these storms but numerous injuries were reported. The pictures below will help put the damage into perspective.

The day after: clearing hail from the railroad underpass on 7th street in Bismarck. Photo taken by NWS employee.

June 20, 1995: 0.75 inch hail and 60 to 80 mph winds were reported. Extensive damage done to the city of Bismarck. Extensive tree damage. A mobile home northeast of Bismarck had its roof blown off. Reports of a few vehicles totaled due to large trees or tree branches falling on them. Extensive house damage due to falling trees or tree branches.

May 21, 1995: Two thunderstorms merged north of Mandan causing torrential rain, hail up to golf ball size for over 25 minutes, and winds to 65 mph, in Bismarck and Mandan. Piles of pea to golf ball-size hail covered the ground. Homes in Mandan had windows broke due to the hail.

State Historical Society of North Dakota

Extreme Heat Events

Excessive Heat **January 1, 2001 through June 24, 2025** Source: NWS https://www.ncdc.noaa.gov/stormevents	**Storm Events Database** **Search Results for Burleigh County, North Dakota** **Event Types:** Excessive Heat **Burleigh county contains the following zones:** Burleigh 1 events were reported between 01/01/2000 and 06/24/2025 (9307 days) **Summary Info:** Number of County/Zone areas affected: 1 Number of Days with Event: 1 Number of Days with Event and Death: 0 Number of Days with Event and Death or Injury: 0 Number of Days with Event and Property Damage: 0 Number of Days with Event and Crop Damage: 0 Number of Event Types reported: 1
July 19, 2011	Heat index values topped out between 110 and 120 degrees, not a common thing in North Dakota. Although no human life was lost and no injuries were reported, there were livestock losses associated with the heat. It is estimated that up to 700 head of cattle died from the heat wave.

Space Weather – Hazard Profile

Description

According to the NOAA Space Weather Prediction Center, Space Weather is the condition in space that affects Earth and its technological systems. Space Weather is a consequence of the behavior of the Sun, the nature of Earth‘s magnetic field and atmosphere, and our location in the solar system. The active elements of space weather are particles, electromagnetic energy, and magnetic field, rather than the weather contributors on earth of water, temperature, and air.

The Space Weather Prediction Center forecasts space weather to assist users in avoiding or mitigating severe space weather. These are storms that originate from the sun and occur in space near Earth or in the Earth‘s atmosphere. Most of the disruptions can be categorized into three types of events that can have environmental effects on Earth. They are: geomagnetic storms, solar radiation storms, and radio blackouts.

Solar flares, coronal mass ejections, solar particle events, and the solar wind form the recipe for space weather that affects life on Earth and astronauts in space. (NASA)
https://science.nasa.gov/heliophysics/focus-areas/space-weather/#:~:text=This%20is%20what%20we%20define,objects%20in%20the%20solar%20system

Space Weather describes the variations in the space environment between the sun and Earth. In particular Space Weather describes the phenomena that impact systems and technologies in orbit and on Earth. Space weather can occur anywhere from the surface of the sun to the surface of Earth. As a space weather storm leaves the sun, it passes through the corona and into the solar wind. When it reaches Earth, it energizes Earth’s magnetosphere and accelerates electrons and protons down to Earth’s magnetic field lines where they collide with the atmosphere and ionosphere, particularly at high latitudes. Each component of space weather impacts a different technology. (NOAA SWPC)
https://www.swpc.noaa.gov/phenomena#:~:text=Space%20Weather%20describes%20the%20variations,to%20the%20surface%20of%20Earth

Space Weather Impacts
Different types of space weather can affect different technologies at Earth. Solar flares can produce strong x-rays that degrade or block high-frequency radio waves used for radio communication during events known as Radio Blackout Storms. Solar Energetic Particles (energetic protons) can penetrate satellite electronics and cause electrical failure. These energetic particles also block radio communications at high latitudes during Solar Radiation Storms. (NOAA SWPC)

Coronal Mass Ejections (CMEs) can cause Geomagnetic Storms at Earth and induce extra currents in the ground that can degrade power grid operations.

Geomagnetic storms can also modify the signal from radio navigation systems (Global Positioning System (GPS) and Global Navigation Satellite System (GNSS)), causing degraded accuracy. Space weather will impact people who depend on these technologies.
The electrical transmission grid within North Dakota is at risk from potential geomagnetic storms, particularly in eastern North Dakota, and less so in the west and central.

Geophysical investigation and moedling by the USGS and NOAA's Space Weather space Weather Prediction Center show that eastern North Dakota has a higher susceptibility to geomagnetically induced currents. This is due to the shallower depth of more electrically resistant rocks in the eastern part of the state as opposed to the west.

Geomagnetically induced currents can travel along power lines and pipelines, creating overloads in the power grid and causing damages to transformers, resulting in large scale power blackouts. one of the more famous historical space weather events was the Carrington event (named after richard Carrington, an amateur sky observer in redhill, england) which occurred in september of 1859 and set telegraph lines afire and resulted in an aurora seen around the world (Dobrijeciv and may, 2022). the Carrington solar storm is considered the largest on record. it is estimated that a Carrington-scale event occurring in today's electrified world would result in damages in the trillions of dollars.
https://www.dmr.nd.gov/ndgs/documents/newsletter/2023Summer/Recent_Geophysical_Research_Identifies_North_Dakota_Electrical_Transmission_Grid_At_Risk_From_Potential_Geomagnetic_Storms_-_July_2023.pdf

Geomagnetic storms also produce the aurora.

Electric Power Transmission
The electric power grid, and consequently the power to homes and businesses, can be disrupted by space weather.

HF Radio Communications
Space weather impacts radio communication in a number of ways. At frequencies in the 1 to 30 mega Hertz range (known as "High Frequency" or HF radio), the changes in ionospheric density and structure modify the transmission path and even block transmission of HF radio signals completely. These frequencies are used by amateur (ham) radio operators and many industries such as commercial airlines. They are also used by a number of government agencies such as the Federal Emergency Management Agency and the Department of Defense.

Satellite Communications
Satellite communication refers to any communication link that involves the use of an artificial satellite in its propagation path. Satellite communications play a vital role in modern life. There are over 2000 artificial satellites in use. Space weather can lead to a total loss of communication due to attenuation and/or severe scintillation when the broadcast signals cross the ionosphere.

GPS System
The use of single and dual frequency satellite radio navigation systems, like the Global Positioning System (GPS), has grown dramatically. GPS receivers are now in nearly every cell phone and in many automobiles, trucks, and any equipment that moves and needs precision location measurements. High precision dual frequency GPS systems are used for farming, construction, exploration, surveying, snow removal and many other applications critical to a functional society.

There are several ways in which space weather impacts GPS function. GPS radio signals travel from the satellite to the receiver on the ground, passing through the Earth's ionosphere. When the ionosphere is disturbed by a space weather event, receivers are unable to calculate an accurate position based on the satellites overhead (due to inaccurate modeling).

The Sun goes through approximately 11-year periods of minimum activity and maximum activity called solar cycles. It's currently in Solar Cycle 25, which began at the end of 2019 and is expected to peak in late 2024 or early 2025.

Every sunspot creates an impactful geomagnetic event potentially aimed at Earth. However, not every geomagnetic event impacts the Earth, as its magnetic field repels portions of what is thrown at it. In every 11-year solar cycle, there has been an average of 360 days of G2 events, 130 days of G3 events, 60 days of G4 events, and 4 days of G5 events. **If G4 and G5 are the only events that are likely to do harm to people on the planet, this represents 64 days over 4,019 days, or a 5.8 percent chance annually, of experiencing an event that has the possibility of causing impacts (Gannon et al., 2017).** According to Maffei (2023), these severe G4 and extreme G5 events create an expanded terrestrial impact or danger zone (areas with highest geomagnetically induced currents) in the geomagnetic latitudinal band between 50 and 60 degrees. Their modeling studies show that North Dakota lay within that geomagnetic danger zone during the 1859 Carrington Event, is in that zone now, and will likely remain in the danger zone through 2070, if not beyond.

Where the Earth is in relation to its orbit around, and angle relative to, the Sun may also help give some direction as to when impacts are more likely to occur. Looking at previous longitudinal data divided by month, September and March were the most active months from 1932 to 2007.

NOAA Space Weather Scales

The NOAA Space Weather Scales were introduced as a way to communicate to the general public the current and future space weather conditions and their possible effects on people and systems.

The scales describe the environmental disturbances for three event types: **geomagnetic storms, solar radiation storms, and radio blackouts**. The scales have numbered levels, analogous to hurricanes, tornadoes, and earthquakes that convey severity. They list possible effects at each level. They also show how often such events happen, and give a measure of the intensity of the physical causes. https://www.swpc.noaa.gov/noaa-scales-explanation

DRAFT

NOAA Space Weather Scales

Category		Effect	Physical measure	Average Frequency (1 cycle = 11 years)
Scale	Descriptor	Duration of event will influence severity of effects		
Geomagnetic Storms			Kp values* determined every 3 hours	Number of storm events when Kp level was met; (number of storm days)
G 5	Extreme	Power systems: widespread voltage control problems and protective system problems can occur, some grid systems may experience complete collapse or blackouts. Transformers may experience damage. Spacecraft operations: may experience extensive surface charging, problems with orientation, uplink/downlink and tracking satellites. Other systems: pipeline currents can reach hundreds of amps, HF (high frequency) radio propagation may be impossible in many areas for one to two days, satellite navigation may be degraded for days, low-frequency radio navigation can be out for hours, and aurora has been seen as low as Florida and southern Texas (typically 40° geomagnetic lat.).**	Kp=9	4 per cycle (4 days per cycle)
G 4	Severe	Power systems: possible widespread voltage control problems and some protective systems will mistakenly trip out key assets from the grid. Spacecraft operations: may experience surface charging and tracking problems, corrections may be needed for orientation problems. Other systems: induced pipeline currents affect preventive measures, HF radio propagation sporadic, satellite navigation degraded for hours, low-frequency radio navigation disrupted, and aurora has been seen as low as Alabama and northern California (typically 45° geomagnetic lat.).**	Kp=8, including a 9-	100 per cycle (60 days per cycle)
G 3	Strong	Power systems: voltage corrections may be required, false alarms triggered on some protection devices. Spacecraft operations: surface charging may occur on satellite components, drag may increase on low-Earth-orbit satellites, and corrections may be needed for orientation problems. Other systems: intermittent satellite navigation and low-frequency radio navigation problems may occur, HF radio may be intermittent, and aurora has been seen as low as Illinois and Oregon (typically 50° geomagnetic lat.).**	Kp=7	200 per cycle (130 days per cycle)
G 2	Moderate	Power systems: high-latitude power systems may experience voltage alarms, long-duration storms may cause transformer damage. Spacecraft operations: corrective actions to orientation may be required by ground control; possible changes in drag affect orbit predictions. Other systems: HF radio propagation can fade at higher latitudes, and aurora has been seen as low as New York and Idaho (typically 55° geomagnetic lat.).**	Kp=6	600 per cycle (360 days per cycle)
G 1	Minor	Power systems: weak power grid fluctuations can occur. Spacecraft operations: minor impact on satellite operations possible. Other systems: migratory animals are affected at this and higher levels; aurora is commonly visible at high latitudes (northern Michigan and Maine).**	Kp=5	1700 per cycle (900 days per cycle)

* Based on this measure, but other physical measures are also considered.
** For specific locations around the globe, use geomagnetic latitude to determine likely sightings (see www.swpc.noaa.gov/Aurora)

Solar Radiation Storms			Flux level of ≥ 10 MeV particles (ions)*	Number of events when flux level was met**
S 5	Extreme	Biological: unavoidable high radiation hazard to astronauts on EVA (extra-vehicular activity); passengers and crew in high-flying aircraft at high latitudes may be exposed to radiation risk. *** Satellite operations: satellites may be rendered useless, memory impacts can cause loss of control, may cause serious noise in image data, star-trackers may be unable to locate sources; permanent damage to solar panels possible. Other systems: complete blackout of HF (high frequency) communications possible through the polar regions, and position errors make navigation operations extremely difficult.	10^5	Fewer than 1 per cycle
S 4	Severe	Biological: unavoidable radiation hazard to astronauts on EVA; passengers and crew in high-flying aircraft at high latitudes may be exposed to radiation risk.*** Satellite operations: may experience memory device problems and noise on imaging systems; star-tracker problems may cause orientation problems, and solar panel efficiency can be degraded. Other systems: blackout of HF radio communications through the polar regions and increased navigation errors over several days are likely.	10^4	3 per cycle
S 3	Strong	Biological: radiation hazard avoidance recommended for astronauts on EVA; passengers and crew in high-flying aircraft at high latitudes may be exposed to radiation risk.*** Satellite operations: single-event upsets, noise in imaging systems, and slight reduction of efficiency in solar panel are likely. Other systems: degraded HF radio propagation through the polar regions and navigation position errors likely.	10^3	10 per cycle
S 2	Moderate	Biological: passengers and crew in high-flying aircraft at high latitudes may be exposed to elevated radiation risk.*** Satellite operations: infrequent single-event upsets possible. Other systems: effects on HF propagation through the polar regions, and navigation at polar cap locations possibly affected.	10^2	25 per cycle
S1	Minor	Biological: none. Satellite operations: none. Other systems: minor impacts on HF radio in the polar regions.	10	50 per cycle

* Flux levels are 5 minute averages. Flux in particles·s^{-1}·$ster^{-1}$·cm^{-2} Based on this measure, but other physical measures are also considered.
** These events can last more than one day.
*** High energy particle (>100 MeV) are a better indicator of radiation risk to passenger and crews. Pregnant women are particularly susceptible.

Radio Blackouts			GOES X-ray peak brightness by class and by flux*	Number of events when flux level was met; (number of storm days)
R 5	Extreme	HF Radio: Complete HF (high frequency**) radio blackout on the entire sunlit side of the Earth lasting for a number of hours. This results in no HF radio contact with mariners and en route aviators in this sector. Navigation: Low-frequency navigation signals used by maritime and general aviation systems experience outages on the sunlit side of the Earth for many hours, causing loss in positioning. Increased satellite navigation errors in positioning for several hours on the sunlit side of Earth, which may spread into the night side.	X20 ($2x10^{-3}$)	Fewer than 1 per cycle
R 4	Severe	HF Radio: HF radio communication blackout on most of the sunlit side of Earth for one to two hours. HF radio contact lost during this time. Navigation: Outages of low-frequency navigation signals cause increased error in positioning for one to two hours. Minor disruptions of satellite navigation possible on the sunlit side of Earth.	X10 (10^{-3})	8 per cycle (8 days per cycle)
R 3	Strong	HF Radio: Wide area blackout of HF radio communication, loss of radio contact for about an hour on sunlit side of Earth. Navigation: Low-frequency navigation signals degraded for about an hour.	X1 (10^{-4})	175 per cycle (140 days per cycle)
R 2	Moderate	HF Radio: Limited blackout of HF radio communication on sunlit side of the Earth, loss of radio contact for tens of minutes. Navigation: Degradation of low-frequency navigation signals for tens of minutes.	M5 ($5x10^{-5}$)	350 per cycle (300 days per cycle)
R 1	Minor	HF Radio: Weak or minor degradation of HF radio communication on sunlit side of the Earth, occasional loss of radio contact. Navigation: Low-frequency navigation signals degraded for brief intervals.	M1 (10^{-5})	2000 per cycle (950 days per cycle)

* Flux, measured in the 0.1-0.8 nm range, in W·m^{-2}. Based on this measure, but other physical measures are also considered.
** Other frequencies may also be affected by these conditions.

URL: *https://www.spaceweather.gov/noaa-scales-explanation* December 11, 2023

Highlights, conclusions, and data limitations noted below are identified in the 2024-2029 North Dakota Enhanced Mitigation Plan, and are relevant at the local level.

Highlights and conclusions regarding Space Weather:

- Most space weather poses a threat primarily to users of specialized GPS technology, HF radio communications, or upper-latitude avionics over a brief period and limited geography, though stronger events generally produce impacts over expanded areas.
- North Dakota is far enough north that it is more at risk for impacts from stronger space weather events than most states, and in the danger zone for severe G4 and G5 geomagnetic events.
- A severe G4 or G5 geomagnetic event could do significant damage to the electrical infrastructure, hinder communications, and cause massive blackouts across the state.
- The SWPC works with regional council coordinators when geomagnetic levels reach G4 levels to assure that levels are being monitored to avoid overloading and serious damage and outages.
    - *The North American Electric Reliability Corporation (NERC) is the organization of grid operators who work together to assure reliable and secure bulk electric production and distribution throughout Canada and the United States.*
- There is limited certainty and limited time available for warning about upcoming large events. Significant space weather eruptions from the Sun can be observed from one to three days in advance, but the severity and timing of what will impact Earth can be estimated less than a day before those consequences are felt.
- In the event of a severe space weather event, the loss of normal communications and electrical power will complicate communications with the public and other emergency agencies.
- Power outages from transformer damage may be long-lasting, and if occurring in connection with extreme heat or cold, may lead to increased human suffering and possible loss of life.
- In the event of a severe G4 or G5 storm, loss of precision GPS applications and eventual pipeline corrosion are two areas of industrial impacts that will hit North Dakota hard.
- Opportunities exist to work with pipeline operators to assure they are aware of events that may impact the durability of their systems.
- North Dakota’s annualized loss from severe space weather events is estimated at around $238,865.00.
- Newer industrial technology for grid infrastructure is costly, and sometimes bulky, but can increase grid resilience.

Data Limitations:
There is a great deal of unknown science involved in the prediction of space events. There are just two spacecraft that are focused on relaying information to scientists about solar flares and geomagnetic storms and they are very near Earth. The orbit of the Earth is such that both spacecraft are not always able to simultaneously monitor the sun, thus compromising the ability of space weather forecasters to make accurate and timely forecasts. Even with clear data and forecast tools operating at their best, forecasting is just a few days out at best, which gives local and state agencies limited time to plan or mobilize for potential space weather impacts in their respective areas.

Vulnerability Assessment

Vulnerability: Characteristics of community assets that make them susceptible to damage from a given hazard.

Scenario	**Radio Blackout Activity R-ratings Extreme – R5**	**Solar Radiation Activity S-ratings Extreme – S5**	**Geomagnetic Activity G-ratings Extreme – G5**
Probability	1 in 4,000 chance (annually)	1 in 4,000 chance (annually)	1 in 1,000 for a G5 event (annually) *5.8% chance for a G4 or G5*
Note: Probabilities for minor events are MUCH higher. See NOAA Space Weather Scales Chart on page 3.			
Speed of Onset	Less than 24 hours for estimated impact – 1 to 3 days for advance warning to monitor. There is limited certainty and limited time available for warning about upcoming large events. Significant space weather eruptions from the Sun can be observed from one to three days in advance, but the severity and timing of what will impact Earth can be estimated less than a day before those consequences are felt.		
Duration	Several hours	More than one day	Hours to days. However, impacts may require months to years for full recovery. Power outages from transformer damage may be long-lasting.
Geographic Area	Regional +	Regional +	Regional +
Death / Injury 1. Primary Causes A. Highest vulnerability	Not expected.	Radiation hazard impacting high-flying aircraft Pregnant women at higher risk.	The loss of power, especially if prolonged due to transformer damage, could lead to indirect deaths from heat or cold if a space weather event caused infrastructure damage that took significant time to repair (NERC, 2008). Wait times for these massive systems may exceed 12 months, meaning that an affected area would be without power until workarounds could be implemented.

Scenario	Radio Blackout Activity R-ratings **Extreme – R5**	Solar Radiation Activity S-ratings **Extreme – S5**	Geomagnetic Activity G-ratings **Extreme – G5**
			Elderly, patients, infants, and those impacted by loss of heat, cooling, and loss of electronic medical devices.
Mass Casualty Incident	Unlikely	Unlikely	Some possibility – indirect due to power outages – potentially concurrent with winter storms
Property Losses (points of vulnerability – high priority)	NA	NA	Sensitive Electronics impacted. Secondary effect may be loss of security at facilities (theft, etc)
Environmental	NA	NA	Impacts to pipelines can cause leaks, impacting the environment (land and waterways)
COG/COOP	Impact to HF Radio – Ham Radio and Satellite Communications. Ham Radio is a back-up communications system. Bismarck City Government does not use Satellite Communications.	Anything that relies on satellite communications will be impacted. GPS may not be functional or accurate.	Severe loss of city government functionality due to power loss for duration of event. Could be hours or days. Communicating with the public prior to the event will be critical – but time is very limited. Communicating with the public during the event will be extremely difficult to nearly impossible due to loss of electricity and impact to sensitive electronics. *Normal means of communicating via broadcast, the Emergency Alert System, and the internet may be unavailable to the public when power is lost, and public reaction to the loss and lack of information about the return of electricity would be difficult to predict.*

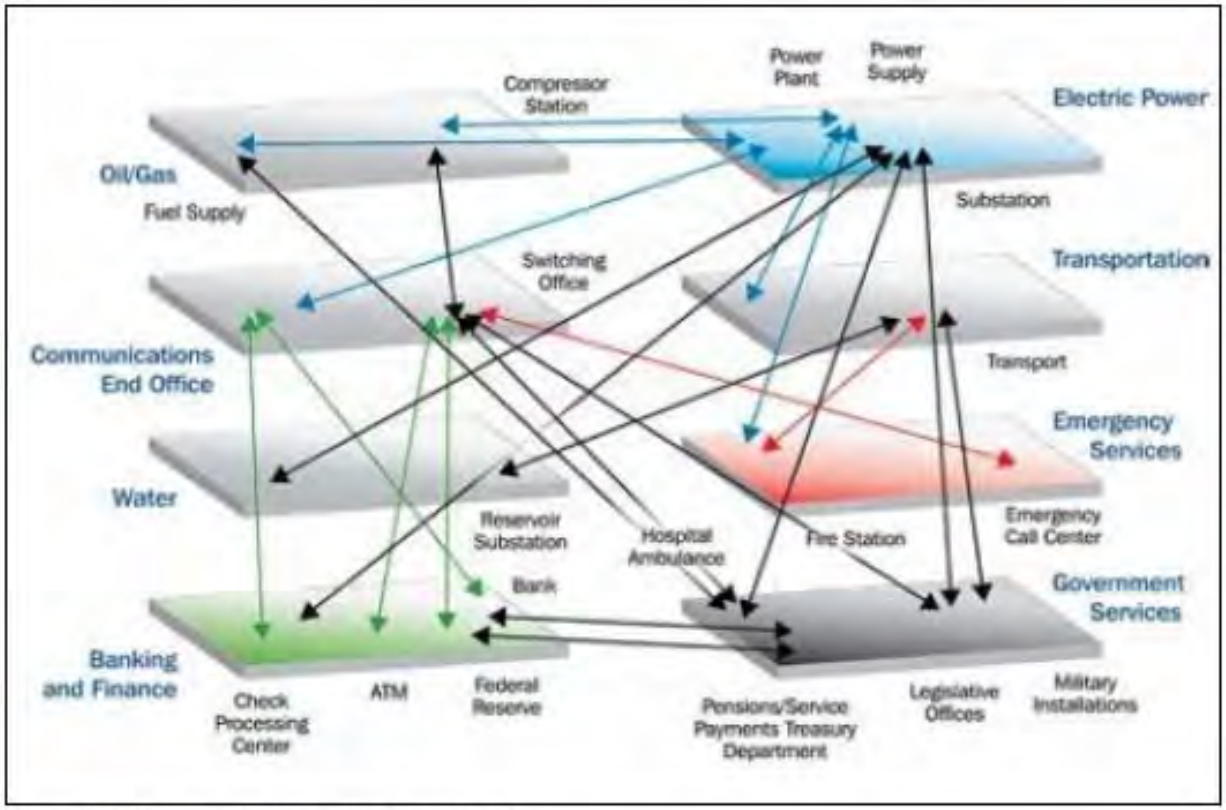
Scenario	Radio Blackout Activity R-ratings **Extreme – R5**	Solar Radiation Activity S-ratings **Extreme – S5**	Geomagnetic Activity G-ratings **Extreme – G5**
			Even with clear data and forecast tools operating at their best, forecasting is just a few days out at best, which gives local and state agencies limited time to plan or mobilize for potential space weather impacts in their respective areas.
Critical Facilities	NA	NA	Same as above (COG/COOP) Also, loss of Airport operations.
Critical Infrastructure	HF Radio impacted.	NA	Significant impact to electric grid. *Transformers can be 200-ton machines that are built in place and have a backlog of years to replace.* Also, Space weather has been linked to pipeline corrosion. Pipelines are natural conduits of currents generated in geomagnetic storms. Pipeline corrosion can cause a hazardous materials incident by weakening the pipe and leading to leaks or catastrophic failure. This can release hazardous substances, which can result in fires, explosions, and severe environmental damage. Corrosion is a significant cause of pipeline incidents, especially for hazardous liquid and gas transmission pipelines.

Scenario	Radio Blackout Activity R-ratings **Extreme – R5**	Solar Radiation Activity S-ratings **Extreme – S5**	Geomagnetic Activity G-ratings **Extreme – G5**
			Water and Wastewater systems impacted *(pipelines and loss of electricity)* *Water may need to be boiled for consumption. Lack of electricity limits the ability to boil water.*
Schools	NA	NA	Limited impact. May need to close for the duration of the event due to lack of electricity (lights, refrigeration, etc)
High Risk Facilities (chemical)	NA	NA	Same impact as schools, as well as additional potential impact if any necessary back-up generators are impacted.
Specific Populations: Public Assembly, Vulnerable / Special Populations	NA	NA	In a combined severe weather/space weather event, the vulnerability presented with the elderly, children, and sick would apply, and hospitalized individuals would be at an increased risk. According to the National Research Council (2008), if an outage or internet loss impacts medical care, or generators during hot or cold events, more human suffering and indirect death could occur. *Hospitals working without power or on generators, will be working at a reduced capacity. Simultaneously, there are likely to be spikes in the need for medical care due to the lack of electricity for home medical aid devices,*

Scenario	Radio Blackout Activity R-ratings **Extreme – R5**	Solar Radiation Activity S-ratings **Extreme – S5**	Geomagnetic Activity G-ratings **Extreme – G5**
			increased panic, and the lack of modern conveniences and sanitation facilities, all of which may overwhelm healthcare facilities.
Economy (community wide)	None to Limited	None to Limited	Significant to Catastrophic Impact Financial Systems Impacted (banking, use credit cards, etc) Railways and pipelines affected impact the economy.
OTHER:			Interpersonal communications capabilities, business and home operations, online banking and other money transfer technologies, energy production and transmission, and even the operation of gas pumps are increasingly reliant on technologies that are most at risk to space weather events (in the event of power loss). See graphic on next page, illustrating interconnectedness of critical infrastructure impacted by power loss.

The following graphic produced by the US Department of Homeland Security examines the interconnectedness of sectors from the National Infrastructure Protection Plan (2012). It shows the cascading effects that can be felt from the loss of power in the upper right extending into all sectors of the economy and government.

Interconnectedness of Public and Economic Sectors



Source: U.S. Department of Homeland Security, 2012

Changes in Vulnerability Since the previous plan update in 2020.	
Increase in Vulnerability	Decrease in Vulnerability
No change.	No change.

Risk
See Section 10 of this plan document for risk assessment and hazard ranking of all hazards addressed in this plan.

Relationship to other Hazards: Although Space Weather would not be impacted by other hazards, and other hazards would not cause a Space Weather event, a space weather event could potentially occur at the same time as other hazards, making the event more challenging to manage, adding Space Weather impacts and vulnerabilities to those of the other hazard occurrence.

Future Conditions

- **Location**: No change.
- **Extent/Intensity:** See "Anticipated Future Climate Impact" below.
- **Frequency:** No change.
- **Duration:** No change.

Anticipated Future Climate Impact – Space Weather Hazard
Through the end of this century in North Dakota, future climate conditions are not expected to directly impact the occurrence of space weather events, though indirectly the Extent, Intensity, and Frequency of hazard related impacts could potentially be increased. Indirectly, if extreme climate variability and/or climate change begin to stress area power grids, satellite and terrestrial communications infrastructure, and other critical facilities, then there is a potential for increased (compounding) impacts from any concurrent Space Weather Hazard phenomena in these and related areas.

Previous Occurrences

There are no recorded catastrophic space weather events within North Dakota. There are several relevant historical occurrences noted in the 2024 ND Enhanced Mitigation plan. Some of those are noted here to illustrate likelihood and potential impacts.

- The Carrington Event in September 1859 disrupted communications, caused sparks, and ignited fires in telegraph offices in a largely pre-electric world. Vivid auroras were seen across the globe, in both northern and southern hemispheres.

- An event in 1921 known as the New York Railroad Storm is considered the biggest in the 20th century and may have rivaled the Carrington Event. Its name comes from the disruption to trains caused by a fire in the railroad control tower in Brewster due to build up on the third rail from the geomagnetic storm. That control tower burned to the ground and telegraph services across the U.S., including ND, were delayed due to blown fuses and damaged equipment (O'Callaghan, 2019). Ontario and Sweden also experienced similar impacts.

- The Great Quebec Blackout of 1989 was the result of a solar storm/space weather event that brought significant power fluctuations and outages to the bulk power distribution systems in North America, including areas like North Dakota which are served by the Western Area Power Administration along with portions of Northern Europe and Scandinavia (NERC, 1990; OECD, 2011). Damages were most extreme across Quebec and portions of New England, with Hydro-Quebec experiencing outages lasting nine hours or longer, leaving an estimated 6 million people without electricity, with cascading impacts across the United States/Canada shared electrical grid. New York Power and New England Power had a significant loss of power with service disrupted to 96 utilities in New England before backup power sources came online. Satellites tumbled in space and the space shuttle Discovery had unusual error messages (Odenwald, 2009). That CME, 36 times the size of Earth, produced power surges that destroyed a transformer at a nuclear reactor in New Jersey.

- In July 2012, a potentially Carrington-scale event was a near-miss to Earth. It tore through Earth's orbital route on July 23, but Earth was one-week further down its path.

- SpaceX owner Elon Musk sent 49 satellites into space on February 3, 2022, only to have them encounter space weather the next day, losing up to 40 of the 49 satellites that were sent to join his Starlink satellite internet network (BBC News, 2022). The satellites fell from orbit and were burned up in the Earth's atmosphere. According to Patel (2022), the Starlink satellites are smaller than most satellites and orbit at a lower altitude, making them more vulnerable to even mild events like this 2022 event.

What if this 1859 solar storm happened today?

Back then, the telegraph was just about the only communication technology they had. Today, such a storm could severely damage satellites, disable communications by telephone, radio, and TV, and cause electrical blackouts over whole continents. It could takes weeks or longer to fix the damage.
Solar storms like the one in 1859 happen only about every 500 years—thankfully. But smaller storms happen frequently, and storms half as intense as the 1859 storm happen about every 50 years.

https://scijinks.gov/what-was-the-carrington-event/

- Recent research has uncovered an extreme type of solar event that may occur in an approximate 1,000-year interval. These events, known as “Miyake Events”, named from the Japanese scientist who discovered them in 2012, have the potential to be severely destructive to global infrastructure and communications. Although these types of events are currently not well understood or predicted, their possibility of occurrence should continue to be evaluated and considered as an extreme end case in space weather and long-term mitigation planning.

Terrorist, or Nation-State Attack

Description

This section examines the risks posed by an attack from a terrorist group or a nation-state as it would impact the state of North Dakota and/or Bismarck specifically. These would include any chemical, biological, radiological, nuclear, explosive, industrial, food/food production, or armed assault intended to force political action or to single out a group of people for harm. This section also includes a description and outlines the potential impact of an intentional electromagnetic pulse event.

ND follows the FBI's categories of terrorism:

- **International terrorism** -- Violent, criminal acts committed by individuals and/or groups who are inspired by, or associated with, designated foreign terrorist organizations or nations (state-sponsored) (FBI, 2023).
- **Domestic terrorism** -- Violent, criminal acts committed by individuals and/or groups to further ideological goals stemming from domestic influences, such as those of a political, religious, social, racial, or environmental nature (FBI, 2023).
- **Lone offenders** – (FBI, 2023). Terrorist threats evolved from large-group conspiracies toward lone-offender attacks can be domestic or international terrorism. These individuals often radicalize online and mobilize to violence quickly. Without a clear group affiliation or guidance, lone offenders are challenging to identify, investigate, and disrupt.
- **Foreign Terrorist Organizations (FTOs)** -- Foreign organizations that are designated by the Secretary of State in accordance with section 219 of the Immigration and Nationality Act (INA), as amended (U.S. Department of State, 2023). FTO designations play a critical role in our fight against terrorism and are an effective means of curtailing support for terrorist activities and pressuring groups to get out of the terrorism business. Attacks under this categorization can be international or domestic.

In its 2023 Strategic Intelligence Assessment submitted to Congress, the FBI designates five threat categories of domestic terrorism, which are defined as follows:

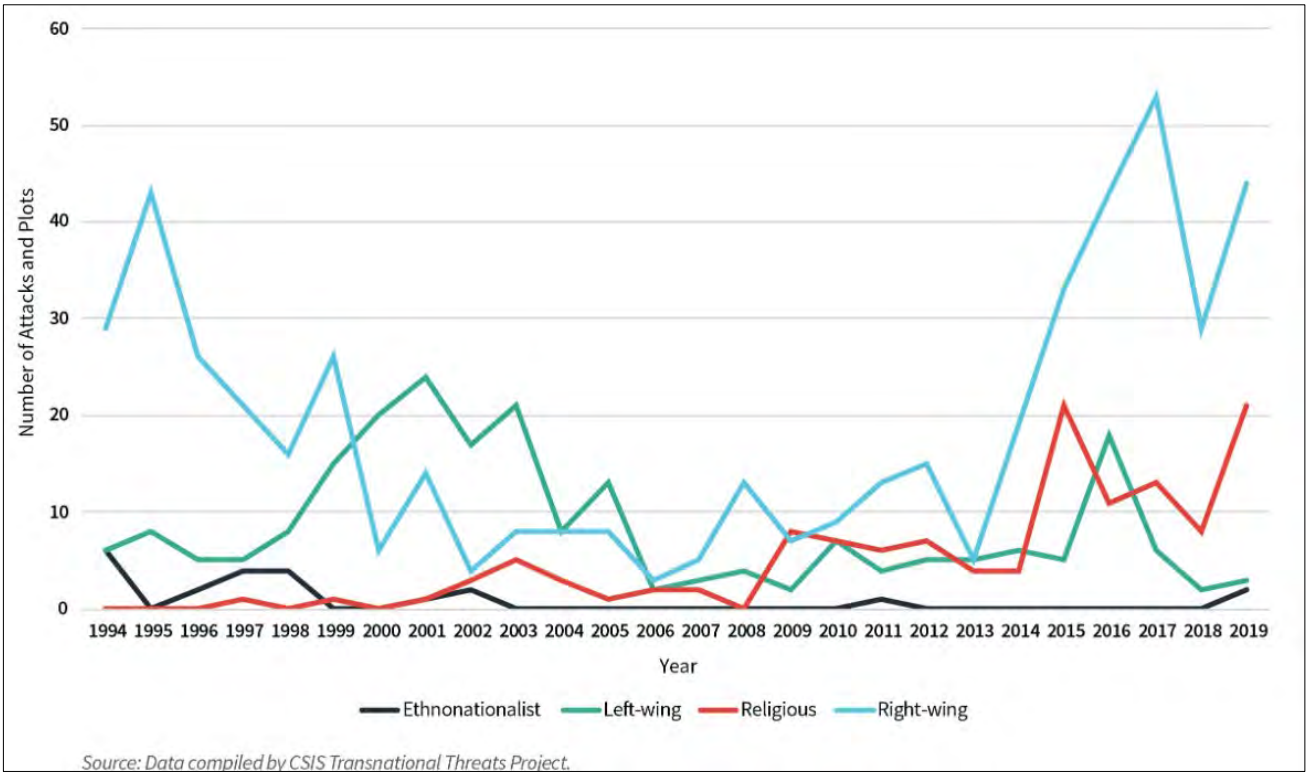
1) **Racially or Ethnically Motivated Violent Extremism** – violent acts or threats that are derived from bias of the actor against a given population group, often a racial group.
2) **Anti-Government or Anti-Authority Violent Extremism** – violent acts or threats derived from an anti-government or anti-authority sentiment, which includes actions from anarchists, militia, or sovereign citizen extremists.
3) **Animal Rights/Environmental Extremism** – violent acts or threats derived to further a political or social agenda related to animal cruelty, harm, or exploitation of animals and/or destruction of natural resources or the environment.

4) **Abortion-Related Violent Extremism** – violent acts or threats related to political or social agendas relating to abortion, whether that position be one of support or opposition to the practice.

5) **Other Domestic Terrorism Threats** – violent acts or threats derived from other agendas that may include personal grievances, political concerns, conspiracy theories or sexual orientation (DHS and FBI, 2022).

The Center for Strategic & International Studies (CSIS) examined the risk of terrorism in the United States and noted that there are shifting origins and targets. There are an increasing number of right-wing attacks in the nation, while attacks on religious groups are also increasing (Jones, Doxsee, & Harrington, 2020), as shown below.
Source: https://www.csis.org/analysis/escalating-terrorism-problem-united-states

Terrorist Attacks and Plots by Perpetrator Orientation, 1994-2019
Source: Jones et al, 2020



The NDSLIC (ND State and Local Intelligence Center) mission is “to gather, store, analyze and disseminate information on crimes, both real and suspected, to the law enforcement community, government officials and private industry concerning dangerous drugs, fraud, organized crime, terrorism and other criminal activity for the purposes of decision making, public safety and proactive law enforcement while ensuring the rights and privacy of citizens” (NDSLIC, 2023). Serving as a knowledge and communications agent for the public and government agencies around terrorism incidents is part of its responsibility (DHS, 2023). As part of that role, it

disseminates bulletins from the National Terrorism Advisory System, which is used by the Department of Homeland Security to make the public aware of the risk for terrorism.

Identifying and Reporting Suspicious Activity

The North Dakota State Local and Intelligence Center (NDSLIC) is the primary state agency for terrorism and has a system to report suspicious activities to the state for further investigation (NDSLIC, 2023). Online reports are made at https://apps.attorneygeneral.nd.gov/tip

But how is suspicious defined? The NDSLIC follows the Nationwide Suspicious Activity Reporting (SAR) Initiative (NSI) regarding the following indicators of terrorism or criminal behavior:

- Breach/attempted intrusion of a nonpublic area
- Misrepresentation to hide illegal activity
- Theft/loss/diversion of articles associated with a building or infrastructure, such as a uniform or security badge
- Sabotage/tampering/vandalism of a building or infrastructure
- Cyberattacks
- Expressed or implied threats
- Suspicious aviation activity
- Eliciting information about a building
- Recruiting/financing the gathering of information about a building, its staff, or financials
- Testing or probing of security
- Suspicious photography of buildings or security features
- Suspicious observation/surveillance of structures or infrastructure beyond professional or touristic curiosity
- Materials acquisition or storage of unusual materials that could be used in an attack
- Acquisition of security, weapons, or tactical skills
- Collecting weapons
- Suspicious sector-specific incidents, i.e., public health sector

Nation-State Attack

A nation-state attack is an attack that originates from a foreign government. These may be cyber in nature. Similar to terrorism attacks, the goal of a nation-state attack is politically coercive in nature in that such an attack would be to force action or inaction by the federal government through an act of violence or targeted attack. In the event of a nation-state attack impacting the state of North Dakota, the United States military would be the lead agency in the event of an armed incursion. If the attack comes in the form of cyber, espionage, assassination, etc., the FBI will be the lead agency.

For a nation-state attack, American military targets, federal buildings, and targets that could impact the national economy would be the likely targets of any nation-state attack in the state. In North Dakota, these would likely be high-value oil or agricultural targets.

Both terrorist and nation-state attackers are unlikely to give warning for law enforcement to act in a manner to thwart the attack. However, law enforcement activities and reporting of suspicious activity by the public can identify indicators of terrorist plans allowing intervention that stops violence. The duration of most attacks is brief, as the goal is typically to enact the most violence before law enforcement can respond.

In many terror or nation-state attacks, the public has been the main target with the goal to enact enough violence to influence social or political behavior. Many terror attacks are violent criminal attacks on other people, either for the point of doing the most harm or targeting a particular group of people that the actor wants to change or cause to leave.

Attacks can have impacts on members of the public who were not directly impacted. Fear and trauma can impact the lives, mental, and physical health of members of the public not involved in the attack due to stress and fear of a repeat or similar attack.

Propaganda and vandalism can also create trauma and fear, and breed hostility within communities where it is occurring. Often, that is the goal of the actions.

The list of organizations that the FBI, ADL (Anti-Defamation League), or SPLC (Southern Poverty Law Center) identify as extremist changes regularly, as do the threats posed to the public. Cultural, political, and demographic shifts can newly disgruntle a person who might enact violence on their beliefs. Access to information and like-minded people through the internet, and the proliferation of propaganda, conspiracy theories, and provocations through the internet can help generate local violence before law enforcement understands the threat. Technology, demographic change, and national politics are not something that state and local responders can control but will likely shape the nature and motivation of future activities and attacks. Given growing international geopolitical hostilities, the presence of military bases in Minot, ND and Grand Forks, ND and presence of missiles or the perceived presence of such may make North Dakota a target.

Areas with large numbers of people provide more targets and damage for terrorist and nation-state attacks. The urban areas of the state are anticipated to have a 24.6 percent growth rate between 2020 and 2040 (U.S. Census Bureau, 2020). Areas in and near Fargo, ND, Grand

Forks, ND, Bismarck, ND, and Williston, ND will see more people and events, making these areas more appealing targets.

Various media and social media platforms make the distribution of misinformation, disinformation, or mal-information potentially more effective in promoting lack of trust in government and officials who are traditionally considered subject matter experts, and civil disturbance incidents may occur, partially as a result of inaccurate information or propaganda.

Definitions from the Princeton Library https://princetonlibrary.org/guides/misinformation-disinformation-malinformation-a-guide/

- **Misinformation** is defined as false, incomplete, inaccurate/misleading information or content which is generally shared by people who do not realize that it is false or misleading. This term is often used as a catch-all for all types of false or inaccurate information, regardless of whether referring to or sharing it was intentionally misleading.
- **Disinformation** is false or inaccurate information that is intentionally spread to mislead and manipulate people, often to make money, cause trouble or gain influence.
- **Malinformation** refers to information that is based on truth (though it may be exaggerated or presented out of context) but is shared with the intent to attack an idea, individual, organization, group, country or other entity.Mediadefence.org

Data Limitations:

Much of the data that can give the clearest picture of probable risk and consequences or that could identify targets is appropriately unavailable for analysis. The exact likelihood of North Dakota falling victim to a nation-state attack, and the actions taken by law enforcement to infiltrate or thwart terror attacks is privately held so as not to interfere with ongoing law enforcement activities or to disclose methods and leads.

Electromagnetic Pulse (EMP)
A worst-case scenario

Most of the drivers of terrorist and nation-state activity are out of state and local control, such as an Electromagnet Pulse, caused intentionally by a high-altitude nuclear explosive.

The use of a high-altitude nuclear detonation with the intention of causing an Electromagnetic Pulse to shut down critical infrastructure (electric utility) over a wide geographic area is potentially the worst-case scenario in creating a shortage of critical materials. A highly effective EMP event could potentially cause a shortage of all critical materials and services.

Below are excerpts from the May 8, 2014 Opening Statement remarks prepared for the Subcommittee on Cybersecurity, Infrastructure Protection, and Security Technologies Committee on Homeland Security.

"… EMP is simply a burst of electromagnetic radiation that results from certain types of high energy explosions or from a suddenly fluctuating magnetic field. A frightening point is that EMP can be generated by nuclear weapons, from naturally-occurring sources such as solar storms, or specialized non-nuclear EMP weapons. Nuclear weapon EMPs are most catastrophic when a nuclear weapon is detonated at high altitude, at approximately 30 kilometers (20 miles), above the intended target. The consequences of such an attack could be catastrophic; all electronics, power systems, and information systems could be shut down. This could then cascade into interdependent infrastructures such as water, gas, and telecommunications. While we understand this is an extreme case, we must always be prepared in case a rouge state decides to utilize this technology…"
Source: https://www.govinfo.gov/content/pkg/CHRG-113hhrg89763/pdf/CHRG-113hhrg89763.pdf

EMP Commission and Commission and Commission Report:
http://www.empcommission.org/
http://www.empcommission.org/docs/A2473-EMP_Commission-7MB.pdf

Vulnerability Assessment (1 of 2)

Vulnerability: Characteristics of community assets that make them susceptible to damage from a given hazard.	**Terrorist, or Nation State Attack**
Probability	Low
Speed of Onset	No Notice
Duration	Months/Years
Geographic Area	City-Wide, Statewide, Regional, or Nationwide
Death / Injury 1. Primary Causes A. Highest vulnerability	1. Direct or indirect impact by explosives or chemical, biological, radiological, or nuclear attack. 2. Loss of essential services and/or supplies (ex: power, water) 3. Lack of evacuation capability (transportation) for relocation to a safer location A. Targeted groups such as government entities/employees and first responders. B. Critical Infrastructure and Critical Facilities C. Vulnerable Populations including Elderly, Young, Hospital Patients, and the Disabled. All populations are the primary target of terrorism.
Mass Casualty Incident	Yes, Likely
Property Losses (points of vulnerability – high priority)	Government Buildings (ie: Federal, State) Property owned by or catering to groups targeted for hate crimes.
Environmental (points of vulnerability – high priority)	Intentional Contamination of Water and/or Air. Missouri River (intentional destruction of the Garrison Dam)
COG/COOP (points of vulnerability – high priority)	State Government (ie: State Capitol) Law Enforcement All City Departments
Critical Facilities (points of vulnerability – high priority)	Airport Federal Buildings Hospitals Water Treatment Plant
Critical Infrastructure (points of vulnerability – high priority)	Electric Substations Pipelines Water Treatment Plant Communications Internet
Schools (points of vulnerability – high priority)	Equally vulnerable as the general population
High Risk Facilities (chemical) (points of vulnerability – high priority)	Potential Theft of Hazardous Materials (Domestic Terrorism) Water Treatment Plant
Specific Populations: Public Assembly, Vulnerable / Special Populations (points of vulnerability – high priority)	Dense Populations (ex: Event Center) Places of Worship Government Buildings & Staff
Economy (community-wide)	Supply Chain Disruption (ex: Railway disruption)
OTHER: (points of vulnerability – high priority)	Oil Industry Energy Industry

Electromagnetic Pulse (EMP) Event, Intentional Event

EMP Vulnerabilities

"….Today's microelectronics are the foundation of our modern civilization, but are over one million times more vulnerable to EMP than the far more primitive and robust electronics of the 1960s, that proved vulnerable during nuclear EMP tests of that era. Tests conducted by the EMP Commission confirmed empirically the theory that, as modern microelectronics become ever smaller and more efficient, and operate ever faster on lower voltages, they also become ever more vulnerable, and can be destroyed or disrupted by much lower EMP field strengths.

Microelectronics and electronic systems are everywhere, and run virtually everything in the modern world. All of the civilian critical infrastructures that sustain the economy of the United States, and the lives of 310 million Americans, depend, directly or indirectly, upon electricity and electronic systems.

Of special concern is the vulnerability to EMP of the Extra High-Voltage (EHV) transformers, that are indispensable to the operation of the electric grid. EHV transformers drive electric current over long distances, from the point of generation to consumers (from the Niagara Falls hydroelectric facility to New York City, for example). The electric grid cannot operate without EHV transformers--which could be destroyed by an EMP event. The United States no longer manufactures EHV transformers. They must be manufactured and imported from overseas, from Germany or South Korea, the only two nations in the world that manufacture such transformers for export. Each EHV transformer must be custom made for its unique role in the grid. A single EHV transformer typically requires 18 months to manufacture. The loss of large numbers of EHV transformers to an EMP event would plunge the United States into a protracted blackout lasting years, with perhaps no hope of eventual recovery, as the society and population probably could not survive for even one year without electricity.

Another key vulnerability to EMP are Supervisory Control And Data Acquisition systems (SCADAs). SCADAs essentially are small computers, numbering in the millions and ubiquitous everywhere in the critical infrastructures, that perform jobs previously performed by hundreds of thousands of human technicians during the 1960s and before, in the era prior to the microelectronics revolution. SCADAs do things like regulating the flow of electricity into a transformer, controlling the flow of gas through a pipeline, or running traffic control lights. SCADAs enable a few dozen people to run the critical infrastructures for an entire city, whereas previously hundreds or even thousands of technicians were necessary. Unfortunately, SCADAs are especially vulnerable to EMP.

EHV transformers and SCADAs are the most important vulnerabilities to EMP, but are by no means the only vulnerabilities. Each of the critical infrastructures has their own unique vulnerabilities to EMP…"

Source: Dr. Peter Vincent Pry, Congressional EMP Commission, Congressional Strategic Posture Commission, Executive Director of the Task Force on National and Homeland Security, Witness Statement [PDF]

Additional statements regarding the EMP Threat:

- Hon. Trent Franks, A Representative in Congress from the State of Arizona, Witness Statement [PDF]
  https://docs.house.gov/meetings/HM/HM08/20140508/102200/HHRG-113-HM08-Wstate-F000448-20140508.pdf
- Dr. Peter Vincent Pry, Congressional EMP Commission, Congressional Strategic Posture Commission, Executive Director of the Task Force on National and Homeland Security, Witness Statement [PDF]
  https://docs.house.gov/meetings/HM/HM08/20140508/102200/HHRG-113-HM08-Wstate-PryP-20140508.pdf
- Dr. Michael J. Frankel, Senior Scientist, Penn State University, Applied Research Laboratory,
  Witness Statement [PDF]
  https://docs.house.gov/meetings/HM/HM08/20140508/102200/HHRG-113-HM08-Wstate-FrankelM-20140508.pdf
- Dr. Chris Beck, Vice President, Policy and Strategic Initiatives, The Electric Infrastructure Security Council, Witness Statement [PDF]
  https://docs.house.gov/meetings/HM/HM08/20140508/102200/HHRG-113-HM08-Wstate-BeckC-20140508.pdf

Vulnerability Assessment (2 of 2)

Vulnerability: Characteristics of community assets that make them susceptible to damage from a given hazard.	**ElectroMagnetic Pulse, Intentional High Altitude Nuclear Detonation** (a worst case scenario)
Probability	Unlikely, yet "unknown"
Speed of Onset	Warning time would depend on detection or recognition of event. A "no notice" event is possible.
Geographic Area	Statewide, Regional, National
Duration	Months to Years
Death / Injury 1. Primary Causes A. Highest vulnerability	1. Starvation, disease, societal collapse A. Those who are not self-reliant for all necessities (food, water, heat, etc.) and those who require medicines or medical attention.
	Some residents will have stand-by generators but the majority of residents do not.
Mass Casualty Incident	Yes, potentially a majority of the population directly impacted. Food, potable water, and medical supplies likely to be depleted.
Property Losses (points of vulnerability – high priority)	1. Power Grid and other Electric Utility property and equipment losses. 2. Equipment having electronic components being disabled or destroyed.
	Structures may be affected by sewer back-up if back-up generators would fail (lift stations)
Environmental (points of vulnerability – high priority)	1. Loss of Power would impact water and sewer services. 2. Waste management. 3. Availability of potable water for drinking, food processing, etc.
COG/COOP (points of vulnerability – high priority)	1. Community Safety and Security. 2. Limited or no communications with the public. 3. Most, if not all government services would be very difficult to sustain. 4. Emergency Services impacted by loss of utility and loss of phone and radio communications 5. Lack of fuel *(depleted based on impact to transportation and utilities)*

Vulnerability: Characteristics of community assets that make them susceptible to damage from a given hazard.	**ElectroMagnetic Pulse, Intentional High Altitude Nuclear Detonation** (a worst case scenario)
Critical Facilities (points of vulnerability – high priority)	1. Water and Wastewater. 2. All critical facilities due to lack of electricity, water, as well as impacts to communications and transportation infrastructure. 3. Grocery Stores – food supplies depleted. 4. Hospitals, Nursing Homes, Assisted Living Centers 5. Prisons, Jails
Critical Infrastructure (points of vulnerability – high priority)	1. Power Grids may take months to years to repair. 2. All critical infrastructure requiring electricity would be impacted including transportation, communications, water, wastewater, heating/cooling).
Schools (points of vulnerability – high priority)	1. Schools closed, potentially used for alternative emergency response purposes.
High Risk Facilities (chemical) (points of vulnerability – high priority)	1. All businesses would be closed or severely impacted. High risk facilities may pose additional risk due to limited (if any) emergency services. 2. Safety/Security may be compromised at high risk facilities when fuel for back-up power is depleted.
Specific Populations: Public Assembly, Vulnerable / Special Populations (points of vulnerability – high priority)	1. Life threatening risk in the very short term for those requiring medical attention, medicines, or use of electricity for life support. 2. Evacuation and relocation capabilities seriously compromised.
Economy (community-wide)	1. Catastrophic 2. Potential for societal collapse.
OTHER: (points of vulnerability – high priority)	It may take hours or days to confirm and then communicate the cause of the power outage to the public.

The Bismarck Community is reliant on mitigation stakeholders to deter, prevent, and mitigate the impacts of an electro-magnetic pulse (EMP) attack or other intentional attacks on utility infrastructure. Stakeholders include state and federal government as well as the utility industry and scientific community.

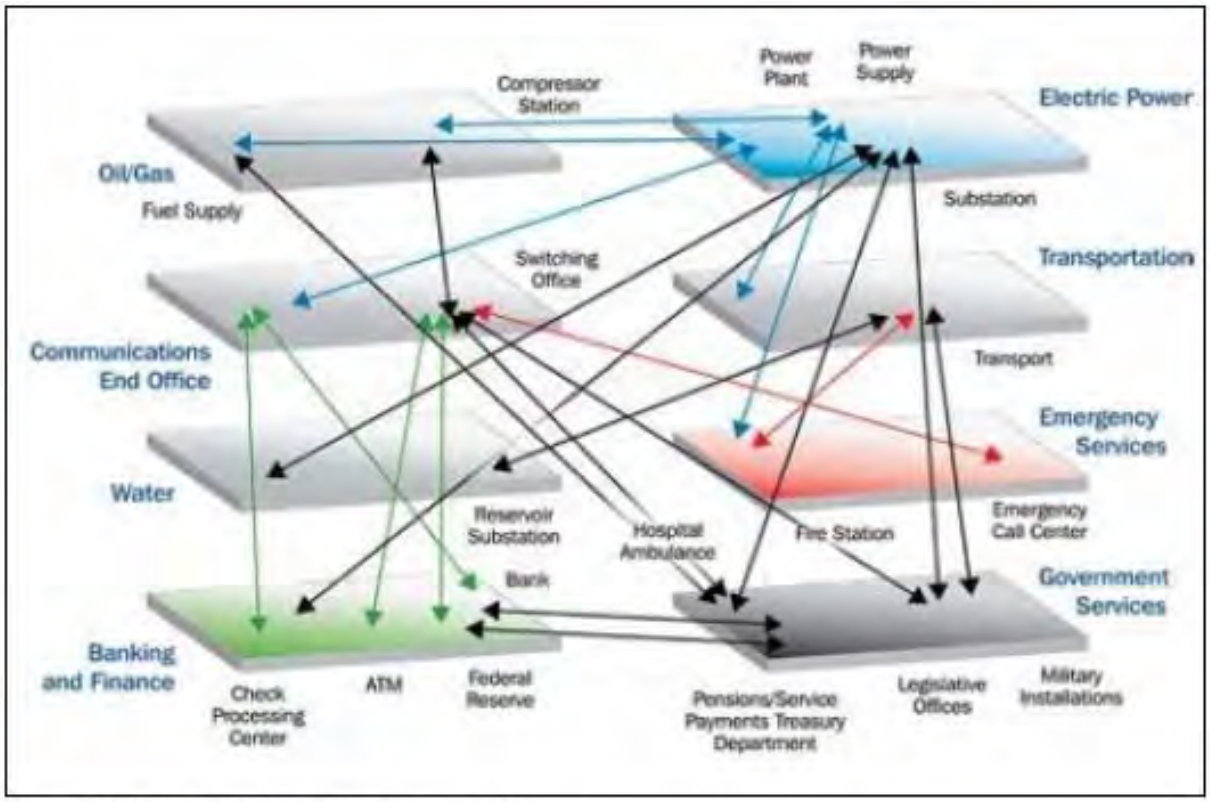
The electric utility industry on a nationwide basis is not hardened against the electro-magnetic pulse threat. In turn, communities nationwide including Bismarck are vulnerable. Assuming a significant EMP event would impact the transportation infrastructure, our population would be vulnerable due to lack of deliveries: food, medicines, fuel, etc.

In general, our society has become reliant on the electric utility industry to maintain operations for other critical infrastructure, and to sustain life and quality of life. Additionally, other critical infrastructures are reliant on computer and other sophisticated electronics which are very susceptible to the effects of an EMP attack.

Loss of Power

The following graphic produced by the US Department of Homeland Security examines the interconnectedness of sectors from the National Infrastructure Protection Plan (2012). It shows the cascading effects that can be felt from the loss of power in the upper right extending into all sectors of the economy and government.

Interconnectedness of Public and Economic Sectors



Source: U.S. Department of Homeland Security, 2012

Changes in Vulnerability Since the previous plan update in 2020.	
Increase in Vulnerability	Decrease in Vulnerability
No change.	No changes. See Hazard-Specific Mitigation Capabilities listed in Section 3.

Risk
See Section 10 of this plan document for risk assessment and hazard ranking of all hazards addressed in this plan.

Relationship to other Hazards: Cyberattack, as a hazard, may be the approach to a Terrorist-Nation State Attack.

Future Conditions

- **Location**: No change.
- **Extent/Intensity:** No change.
- **Frequency:** No expected change.
- **Duration:** No change.

Anticipated Future Climate Impact – Terrorist or Nation-State Attack Hazard
Similar to Civil Disturbance, most Terrorism results from societal reasons such as economic hardship, social injustices, ethnic differences with long-standing oppression by a group of people towards another, objections to world organizations or certain governments, political grievances, and terrorist acts (USAR_2005). Future climate projections through the end of the century do indicate the potential for increased societal insecurities and instabilities (Hoegh-Guldberg, 2018), including places like the Northern Great Plains (NGP) region. *Source: 2024-29 ND Enhanced Mitigation Plan.*

Previous Occurrences

Bismarck has not had previous occurrences of Terrorism or Nation-State Attack incidents. Previous occurrences have occurred relating to Civil Disturbance and Active Threat (separate hazard profiles).With North Dakota being centrally located in the continent and its rural nature.