

#### 4.4.10 Urban Fire or Structure Collapse

##### 4.4.10.1 Characteristics

Fire is the result of three components: a heat source, a fuel source, and an oxygen source. When combined, these three sustaining factors will allow a fire to ignite and spread. Within a structure, a small flame can get completely out of control and turn into a major fire within seconds. Thick black smoke can fill a structure within minutes. The heat from a fire can be 100 degrees Fahrenheit at floor level and rise to 600 degrees at eye level. In five minutes, a room can get so hot that everything in it ignites at once; this is called flashover. (US Fire Administration, 2006)

The urban fire department is one of the oldest continuing institutions in the United States. Professional firefighters are well trained in the latest skills for preserving life and applying their abilities to limit property damages. They attempt to arrive at the fire as soon as possible, get all human life to safety, and suppress the fire as quickly as possible. The amount of lives and property saved from fire by fire departments tremendously exceeds losses which are reported in statistics.

North Dakota has approximately 400 fire departments. There are only four fully funded departments. These include Bismarck, Fargo, Grand Forks and Minot. There are seven partially funded departments, which include Devils Lake, Dickinson, Jamestown, Mandan, Valley City, West Fargo, and Williston. The remaining fire departments are volunteer departments. These firefighters are sometimes only paid for a response call or not at all.

The overall picture of fire safety information reveals that, per capita, the United States has one of the highest fire death rates in the industrialized world. Approximately 3,760 people die in fires in this country annually, and about 20,000 are injured. Children under the age of 5 and the population over the age of 54 are at the highest risk of death in fires. Men are 1.6 times more likely to die in a fire than women. On average, fire kills more Americans annually than all natural disasters combined. Approximately 100 firefighters die each year in duty-related incidents. Statistics show approximately 1.6 million fires are reported annually; many others go unreported, causing additional injuries and property loss. About \$10 billion in direct property losses occur annually. (US Fire Administration, 2007)

In 2004, North Dakota had a fire death rate of 12.6 people per million, just above the national death rate of 12.4. (US Fire Administration, 2007) North Dakota averages nearly 2,200 fire incidents per year. Records show that from 1998-2006 the average annual reported loss was \$14.7 million. Careless smoking is the leading cause of residential fire deaths. In non-residential/commercial properties, arson is the major cause of deaths and property loss. Cooking equipment fires cause approximately 25% of all structure fires. (National Fire Protection Association, 2007)

Winter weather can have a major effect on the number of fires that occur. Increasing costs of electricity, natural gas, propane, and fuel oil has led many people to look for alternative heating methods for their homes. Consequently, the use of space heaters, fireplaces, wood-burning stoves, and even continued use of coal stoves has created an increased fire hazard. Most people have limited experience with wood burners. Wood burning for heating has a poor safety record. Codes for the installation of stoves and

chimneys may not be followed strictly, leading to an increased fire risk. Other energy sources include portable LP (propane) gas or kerosene heaters with self contained fuel supplies; these are hazardous appliances, even when used according to manufacturer's instructions. Open flames and the leakage of fuel from containers are fire hazards and could cause explosions.

Although structure fires are usually individual disasters and not community-wide ones, the potential exists for widespread urban fires that displace several businesses or families and exceed local and even state resources. Urban blocks, commercial structures, and apartment buildings are especially vulnerable. The "downtown" urban areas of North Dakota are particularly vulnerable to this hazard. An urban fire that rages uncontrollably despite firefighting efforts and burns a large portion of a downtown area or an important structure could have significant economic impacts. Large fires of this nature have also been known to require significant community resources if lives are lost. North Dakota has the potential for large scale residential fires, commercial fires, and fires in public venues. In industrial areas, there is the potential of chemical plant fires producing hazardous smoke and fumes.

Smoke detectors, automatic fire alarm systems, automatic sprinkler systems, fire doors, and fire extinguishers can all prevent deaths, injuries, and damages from fire. Automatic sprinkler systems are especially important in preventing a small fire from becoming a conflagration.

Structure collapse occurs when the forces of gravity or other external forces overcome the structural integrity of a building. The reasons for structure collapse can vary from poor construction to extreme winds to heavy snow loads. Structure collapse can trap occupants and damage valuable property. Urban fires and structure collapse can happen independently from other types of incidents.

Alone a fire or collapse can have devastating effects, but they can also be secondary to another hazard. For example, a heavy snow event could lead to structure failure due to overwhelming snow loads. Strong winds and tornadoes can also lift roofs and render structures uninhabitable. Urban fires can be caused by hazardous material releases, lightning, and wildfires. Acts of terrorism and civil unrest may also lead to structure fires or structure collapse. Despite the cause, urban fires and structure collapse can lead to complete building losses in addition to other losses from the causative hazard.

#### **4.4.10.2 History**

Urban fires occur regularly in North Dakota, but some of the more significant events are listed below. Structure collapse occurs with much less frequency.

1882 – Fire destroyed a large portion of Grand Forks.

1884 – Half of the City of Devils Lake was destroyed by fire.

1893 – Fire destroyed almost the entire business section of Fargo, including City Hall and many of the City’s residences, covering 160 acres.

1894 – Fire destroyed four city blocks, including City Hall, in LaMoure.

1898 – Fire almost destroyed the entire Bismarck business section.

1930 – The North Dakota Capitol was destroyed by fire on December 28. The original state constitution was saved by the Secretary of State. Many state records were completely lost. A new Capitol building was constructed by 1934.



**Figure 4.4.10.2A** Aftermath of the Great Fargo Fire of 1893.  
Source: City of Fargo Fire Department, 2007.

1947 – An explosion and fire killed three people and destroyed four city blocks, including nine businesses in Minot on July 21.

1966 – Fire destroyed Fargo Central High School on April 19. Losses were estimated at \$1 million.

1968 – On March 27, seven Jamestown businesses, including the historic Gladstone Hotel were lost to fire.

October 1994 – The highest fatality fire in North Dakota occurred in Devils Lake when nine people died in a house fire.

January 1997 – A portion of the roof of the Winter Show Building in Valley City collapsed postponing events there.

April 1997 – During the 1997 extreme flood event in Grand Forks, a downtown fire, surrounded by floodwaters, burned eleven businesses covering three blocks, including the Grand Forks Herald building and its 120 years of archives.

(State Historical Society of North Dakota, 2007; City of Fargo Fire Department, 2007; The Forum, 1999)

Table 4.4.10.2B shows North Dakota fire statistics since 1987. Note the state fire marshal indicates that only about 80-85% of cases were reported.

**Table 4.4.10.2B North Dakota Fire Statistics from 1987-2006**

Year	Total Number of Fire Incidents	Estimated Losses	Structure Fires	Vehicle Fires	Wildland Fires	Intentional Fires	Fatalities
1987	1,882 fires	\$16,800,000	703	422	472	100	12
1988	2,363 fires	\$13,000,000	764	421	1,003	33	12
1989	1,889 fires	\$12,800,000	719	427	652	44	10
1990	1,697 fires	\$11,300,000	614	385	563	44	4
1991	1,654 fires	\$12,500,000	534	410	479	31	14
1992	1,674 fires	\$9,900,000	531	391	447	33	11
1993	2,240 fires	\$8,000,000	567	355	424	67	12
1994	1,754 fires	\$12,800,000	688	428	518	52	11
1995	1,367 fires	\$15,500,000	610	383	359	50	16
1996	1,637 fires	\$20,000,000	660	441	518	52	10
1997	1,654 fires	\$68,900,000*	693	489	472	69	5
1998	2,116 fires	\$22,000,000	886	585	541	52	7
1999	2,016 fires	\$22,496,819	645	537	508	50	8
2000	1,754 fires	\$17,448,004	572	433	492	46	9
2001	1,636 fires	\$7,935,149	674	448	674	111	10
2002	2,513 fires	\$8,417,885	647	448	1,017	73	11
2003	2,689 fires	\$8,756,663	675	480	1,009	102	4
2004	2,336 fires	\$11,772,206	648	477	706	118	7
2005	2,310 fires	\$22,265,117	643	445	717	149	11
2006	2,794 fires	\$11,533,834	592	429	1,216	145	8

\* includes the devastating flood/fire in Grand Forks

Source: North Dakota Fire Marshal, 2007.

**Table 4.4.10.2C North Dakota Urban Fire or Structure Collapse Declared Disasters and Emergencies**

Declaration	Location	Date	Magnitude	Casualties	Damages
None					

#### 4.4.10.3 Probability and Magnitude

On average, North Dakota experiences 2,182 fire incidents annually, 668 of which are in structures. Losses typically total \$14,736,186 and 8 deaths in an average year. These statistics generally encompass smaller incidents and fires. The probability of a major urban fire is much more difficult to define. With the exception of the major fire during the Grand Forks flood, a significant urban fire has not affected North Dakota communities since the 1960's. Similarly, only minor structure collapse incidents have been recorded. Those structures lacking automatic sprinkler systems are more likely to experience a major urban fire, and those structures with large span roofs or not up to building code standards are more likely to collapse.

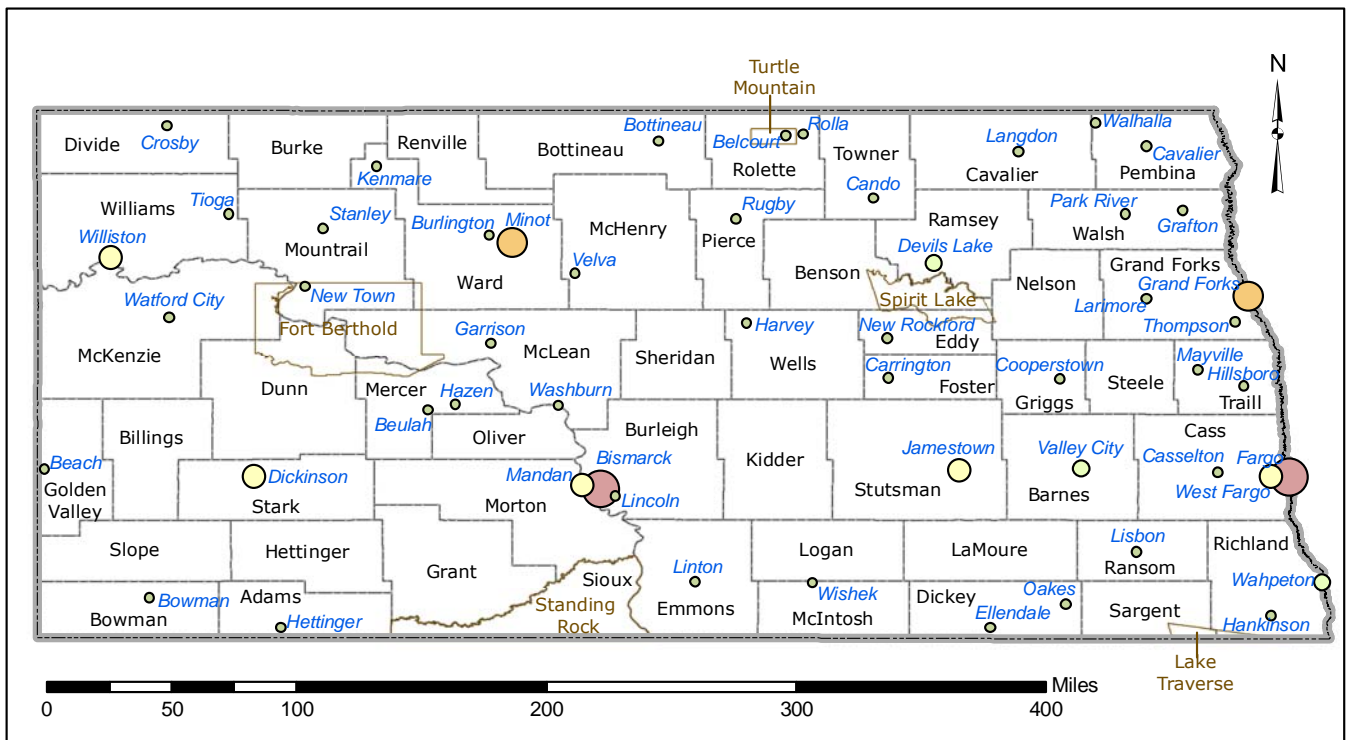
A realistic yet devastating urban fire or structure collapse scenario for North Dakota is the complete and rapid destruction of an occupied building. In this scenario, little warning might exist for occupants and many could become trapped.

**4.4.10.4 Mapping**

Urban fires can occur anywhere, but are generally most significant in downtown areas. Map 4.4.10.4A shows the communities with 1,000 or more people based on 2000 census data that presumably have a vulnerable downtown area and public venues.

**Map 4.4.10.4A**

**Cities of 1,000 or Greater Population  
State of North Dakota**



Data Source: North Dakota Department of Transportation  
Data Date: January 2006  
Map Coordinates: NAD 1983

**2000 City Population**

- 1,000-4,999 people
- 5,000 - 9,999 people
- 10,000 - 24,999 people
- 25,000 - 49,999 people
- 50,000 or more people

Map Created By:  
Pam Shrauger, October 2007



**4.4.10.5 Vulnerabilities of State-Owned Buildings and Property**

Any building is vulnerable to structure fire and collapse, however, sprinkler systems can minimize fire losses. Those state-owned buildings that do not have a sprinkler system are at greater risk for fire losses. Like structure fire, structure collapses will likely result in total or nearly total structural losses. Using a general assumption, given improvements on construction methodologies over the years, the older the building or property, the more likely it is to succumb to a structural collapse. Flat roofs are also more susceptible to heavy snow loading and collapse. Table 4.4.10.5A shows the claims paid by the North Dakota State Fire and Tornado Fund to state-owned buildings and property for fire, smoke, and collapse since 1989.

**Table 4.4.10.5A Structure Fire and Collapse Claims Paid on State-Owned Buildings and Property since 1989**

County	Amount Paid for Fire	Amount Paid for Smoke	Amount Paid for Collapse	Total Amount Paid
<i>North Dakota</i>	\$214,221	\$36,709	\$2,702,008	\$2,952,938
Barnes	\$0	\$0	\$2,685,272	\$2,685,272
Bottineau	\$0	\$0	\$3,909	\$3,909
Burleigh	\$198,624	\$36,453	\$12,827	\$247,904
Stutsman	\$15,597	\$256	\$0	\$15,853

Source: North Dakota State Fire and Tornado Fund, 2007.

**4.4.10.6 Vulnerabilities of Critical Facilities and Infrastructure**

Urban fires or structure collapse in a critical facility could result in temporary delays in emergency and critical services. Depending on the type of infrastructure, a fire or structure failure could result in short-term disruptions while services are rerouted. In the case of a supporting facility, such as the water treatment plant or a lift station, long-term disruptions could be seen. For example, a fire at an electric substation may leave residents without power for several hours or days or a fire at or collapse of a water treatment plant may leave communities without water for days or weeks. Tables 4.4.10.6A and 4.4.10.6B shows the claims paid to local governments and other critical agencies for fire, smoke, and collapse by the North Dakota State Fire and Tornado Fund.

**Table 4.4.10.6A Fire and Smoke Claims Paid on Critical Facilities Insured by the State since 1989**

County	Local Government	Adjutant General	Airports	University System	School Districts	Total
<i>North Dakota</i>	\$2,644,444	\$29,079	\$20,810	\$2,790,747	\$4,423,656	\$9,908,736
Adams				\$3,432		\$3,432
Barnes	\$554,121			\$6,345	\$462	\$560,928
Benson	\$16,430				\$10,266	\$26,696
Billings						\$0
Bottineau	\$5,600				\$210	\$5,810
Bowman	\$607					\$607
Burke	\$59,846				\$5,352	\$65,197
Burleigh	\$153,774	\$14,666		\$176,616	\$1,243,636	\$1,588,691
Cass	\$53,765			\$921,004	\$18,667	\$993,436
Cavalier	\$825				\$37,902	\$38,727
Dickey	\$66,362				\$4,747	\$71,108
Divide						\$0
Dunn	\$73					\$73
Eddy						\$0
Emmons	\$28,171					\$28,171
Foster	\$97,476				\$1,676	\$99,152
Golden Valley						\$0
Grand Forks	\$3,432			\$200,665	\$3,471	\$207,568
Grant	\$5,948				\$37,140	\$43,088
Griggs						\$0
Hettinger						\$0
Kidder					\$4,106	\$4,106
LaMoure	\$1,034				\$10,629	\$11,663
Logan						\$0
McHenry	\$830				\$17,970	\$18,799
McIntosh	\$11,157				\$35,685	\$46,842
McKenzie	\$1,054				\$2,375	\$3,429
McLean						\$0
Mercer						\$0
Morton	\$290				\$7,442	\$7,732
Mountrail					\$9,166	\$9,166
Nelson	\$13,416					\$13,416
Oliver					\$2,753,809	\$2,753,809
Pembina	\$1,018,635				\$1,552	\$1,020,187
Pierce						\$0
Ramsey		\$14,413		\$10,011	\$2,145	\$26,568
Ransom	\$275				\$4,269	\$4,544

**Table 4.4.10.6A Fire and Smoke Claims Paid on Critical Facilities Insured by the State since 1989  
(continued)**

County	Local Government	Adjutant General	Airports	University System	School Districts	Total
Renville					\$5,089	\$5,089
Richland	\$30,000			\$127,407	\$35,230	\$192,637
Rolette	\$15,944				\$1,500	\$17,444
Sargent	\$17,199					\$17,199
Sheridan						\$0
Sioux					\$24	\$24
Slope						\$0
Stark	\$20,858			\$268,531	\$11,078	\$300,467
Steele						\$0
Stutsman	\$197,806		\$20,810		\$2,124	\$220,741
Towner	\$21,751				\$6,089	\$27,840
Traill	\$1,827			\$3,725	\$13,438	\$18,990
Walsh	\$76,581				\$29,203	\$105,784
Ward	\$37,586			\$1,073,012	\$16,993	\$1,127,591
Wells	\$127,166				\$12,818	\$139,984
Williams	\$4,604				\$77,394	\$81,999

Source: North Dakota State Fire and Tornado Fund, 2007.

**Table 4.4.10.6B Collapse Claims Paid on Critical Facilities Insured by the State since 1989**

County	Local Government	University System	School Districts	Total
<i>North Dakota</i>	\$509,798	\$1,752	\$104,540	\$616,090
Barnes	\$1,150		\$50,805	\$51,955
Benson			\$5,000	\$5,000
Bowman			\$1,154	\$1,154
Burke	\$1,670			\$1,670
Burleigh	\$21,577			\$21,577
Cass	\$303,891	\$1,752	\$201	\$305,844
Dickey	\$1,002			\$1,002
Divide	\$5,764			\$5,764
Eddy	\$3,236			\$3,236
Foster	\$1,625			\$1,625
Grand Forks	\$62,143		\$1,758	\$63,901
Grant	\$3,601			\$3,601
Griggs			\$5,770	\$5,770
LaMoure	\$3,142			\$3,142
McIntosh	\$1,174			\$1,174
McKenzie	\$3,771			\$3,771
Morton	\$3,292		\$3,481	\$6,773
Nelson	\$71,743			\$71,743
Oliver			\$825	\$825
Ramsey			\$8,748	\$8,748
Ransom	\$1,059			\$1,059
Sioux			\$10,498	\$10,498
Stutsman	\$2,188		\$1,833	\$4,021
Towner	\$1,000			\$1,000
Traill			\$6,533	\$6,533
Walsh	\$9,200		\$3,925	\$13,124
Wells	\$7,571		\$4,010	\$11,581

Source: North Dakota State Fire and Tornado Fund, 2007.

Table 4.4.10.6C shows the critical facilities and infrastructure summary for the counties with a high or very high urban fire or structure collapse rating. See Section 4.3.2 for more details.

**Table 4.4.10.6C Critical Facilities and Infrastructure in High and Very High Urban Fire or Structure Collapse Hazard Counties**

County	Local	State	Hospitals	National Guard	Comms	Energy	Trans.	Univ.	Schools	Special Needs
Barnes	M	L	L	M	VH	M	H	H	M	L
Burke	L	L	L	L	M	L	M	L	L	L
Burleigh	VH	H	H	VH	VH	M	VH	H	VH	H
Cass	VH	L	H	H	VH	L	VH	VH	VH	L
Divide	M	L	L	L	M	M	M	L	L	L
Eddy*	L	L	L	L	L	L	M	L	L	L
Emmons	M	L	L	L	M	L	M	L	L	L
Golden Valley	L	L	L	L	M	M	H	L	L	L
Grand Forks	VH	L	H	H	VH	L	VH	VH	H	L
Griggs	L	L	L	L	L	L	M	L	L	L
McHenry	M	L	L	L	M	M	M	L	L	L
McIntosh	M	L	L	L	M	M	M	L	L	L
Nelson*	M	L	L	L	M	L	M	L	L	L
Ramsey*	M	L	L	VH	M	L	H	H	M	L
Ransom	M	L	L	L	M	L	M	L	L	H
Richland*	M	L	L	M	VH	M	H	H	M	L
Sheridan	L	L	L	L	M	L	L	L	L	L
Slope	L	L	L	L	L	M	L	L	L	L
Stutsman	H	L	L	M	VH	M	VH	M	M	H
Towner	M	L	L	L	L	L	M	L	L	L
Traill	M	L	L	L	M	L	H	H	M	L
Ward*	H	L	H	H	VH	L	H	H	H	L
Wells	M	L	L	L	L	L	M	L	L	L
Williams	H	L	L	L	VH	H	H	H	M	L

VH=Very High; H=High; M=Moderate; L=Low

\* includes at least part of the reservation

#### 4.4.10.7 Vulnerabilities to Jurisdictions

Property and the population are at risk from urban fires and structure collapses. Property losses are usually covered by insurance, but can be devastating to the building occupants, particularly for primary residences. The American Red Cross also provides emergency assistance to families in these types of situations. These types of event often do not result in community-wide disasters, unless the structure is critically important to the economy. Fires and collapses that result in a significant loss of life or encompass the large part of a downtown or urban area would present the most significant challenges to local, tribal, and state government.

Depending on the time and location, a major structure fire could result in the loss of life either to firefighters or building occupants. The potential for this type of loss is difficult to determine due to advances in firefighter safety and the installation of sprinkler and alarm systems in many commercial and apartment structures. Those structures lacking smoke detectors are especially dangerous to the population. Should lives be lost, significant resources could be needed to manage the recovery.

Economic values could be lost if a business district were destroyed in an urban fire or structure collapse. For example, facilities of large employers or central community structures such as grain elevators could lead to significant community losses. Most historic buildings lack sprinkler systems and would lose much of their historical value in a fire or collapse. Ecological and social values would likely remain unchanged.

Table 4.4.10.7A shows the urban fire or structure collapse hazard. The county ratings were determined based on the number and size of urban areas within the county. The age of structures in the county can also be an important factor with respect to fire and collapse vulnerability. Map 4.3.4C shows the median year built for housing units by county.

**Table 4.4.10.7A Urban Fire or Structure Collapse Risk to Jurisdictions**

County	Urban Fire or Structure Collapse Hazard	Hazard Rating in Local/Tribal Plan	Additional Information from Local/Tribal Plan
Adams	Moderate	C	
Barnes	High	C	\$5M in potential urban fire losses
Benson	Low	NP	
Billings	Low	C	
Bottineau	Moderate	C	
Bowman	Moderate	D	
Burke	High	C	
Burleigh	High	D	
Cass	Very High	C/D	
Cavalier	Moderate	C	
Dickey	Moderate	C	
Divide	High	NP	
Dunn	Low	C	
Eddy	High	C	
Emmons	High	C	
<i>Fort Berthold<sup>^</sup></i>	<i>Moderate</i>	<i>NP</i>	
Foster	Moderate	C	
Golden Valley	High	C	
Grand Forks	High	D	
Grant	Moderate	C	
Griggs	High	C	
Hettinger	Moderate	D	
Kidder	Low	C	
<i>Lake Traverse<sup>^</sup></i>	<i>Low</i>	<i>NP</i>	
LaMoure	Moderate	C	
Logan	Low	B	
McHenry	High	D	
McIntosh	High	C	

**Table 4.4.10.7A Urban Fire or Structure Collapse Risk to Jurisdictions (continued)**

County	Urban Fire or Structure Collapse Hazard	Hazard Rating in Local/Tribal Plan	Additional Information from Local/Tribal Plan
McKenzie	Low	NP	
McLean	Moderate	B	
Mercer	Moderate	C	
Morton	Moderate	D	
Mountrail	Moderate	C	
Nelson	High	C	
Oliver	Low	C	
Pembina	Moderate	D	
Pierce	Moderate	C	
Ramsey	High	D	
Ransom	High	A	
Renville	Moderate	C	
Richland	High	C	
Rolette	Moderate	NP	
Sargent	Low	NP	
Sheridan	High	NP	
Sioux	Low	NP	
Slope	High	NP	
<i>Spirit Lake</i>	<i>Low</i>	<i>NP</i>	
<i>Standing Rock</i> <sup>^</sup>	<i>Low</i>	<i>NP</i>	
Stark	Moderate	NP	
Steele	Moderate	NP	
Stutsman	High	B	
Towner	High	C	
Traill	High	D	
<i>Turtle Mountain</i> <sup>^</sup>	<i>Moderate</i>	<i>NP</i>	
Walsh	Moderate	B	
Ward	High	NP	
Wells	High	D	
Williams	High	B	

NP = no local plan

<sup>^</sup> includes only North Dakota parts of the reservation

#### **4.4.10.8 Vulnerabilities to Future Development**

Nationally, fire officials are working toward improved and stricter fire codes in all buildings. Fire codes usually cover the bare minimum of protection when buildings are constructed or remodeled. Future development in communities lacking fire and building codes will be more vulnerable than development that has the appropriate fire suppression systems and building codes for snow loads and structural stability

in place. The development of industrial facilities housing hazardous materials could enhance the fire hazard. Population increases are being seen or are expected in Barnes, Benson, Burleigh, Cass, Grand Forks, Morton, Mountrail, Ransom, Rolette, Sargent, Sioux, and Stark Counties. Rolette and Sioux Counties do not have any jurisdictions that have adopted the state building code. Only small percentages of the populations in Barnes, Benson, Mountrail, and Ransom Counties have adopted the building codes.

#### **4.4.10.9 Data Limitations and Other Key Documents**

Fire data provides an estimation of future problems, but does not specifically address the potential for a large urban fire or structure collapse. Further evaluation of downtown areas and local building code enforcement would provide further information in assessing the risk to the communities.

Other key documents related to the Urban Fire or Structure Collapse hazard include:

- North Dakota Emergency Operations Plan, Fire Annex