5.4.2 SEVERE WINTER STORM / EXTREME COLD

This section provides a profile and vulnerability assessment for the severe winter storm and extreme cold hazards.

HAZARD PROFILE

This section provides profile information including description, extent, location, previous occurrences and losses and the probability of future occurrences.

Description

For the purpose of this HMP and as deemed appropriated by Fulton County, most severe winter storm hazards include heavy snow, blizzards, sleet, freezing rain, ice storms and can be accompanied by extreme cold. In addition, for the purpose of this plan and as consistent with the New York State HMP, extreme cold temperature events were grouped into this hazard profile. These types of winter events or conditions are further defined below.

Heavy Snow: According to the National Weather Service (NWS), heavy snow is generally snowfall accumulating to four inches or more in depth in 12 hours or less; or snowfall accumulating to six inches or more in depth in 24 hours or less. A snow squall is an intense, but short period of moderate to heavy snowfall, also known as a snowstorm, accompanied by strong, gusty surface winds and possibly lightning (generally moderate to heavy snow showers) (NWS, 2005). Snowstorms are complex phenomena involving heavy snow and winds, whose impact can be affected by a great many factors, including a region’s climatologically susceptibility to snowstorms, snowfall amounts, snowfall rates, wind speeds, temperatures, visibility, storm duration, topography, and occurrence during the course of the day, weekday versus weekend, and time of season (Kocin and Uccellini, 2004).

Blizzard: Blizzards are characterized by low temperatures, wind gusts of 35 miles per hour (mph) or more and falling and/or blowing snow that reduces visibility to 0.25 miles or less for an extended period of time (three or more hours) (NWS, 2005).

Sleet or Freezing Rain Storm: Sleet is defined as pellets of ice composed of frozen or mostly frozen raindrops or refrozen partially melted snowflakes. These pellets of ice usually bounce after hitting the ground or other hard surfaces. Freezing rain is rain that falls as a liquid but freezes into glaze upon contact with the ground. Both types of precipitation, even in small accumulations, can cause significant hazards to a community (NWS, 2005).

Ice storm: An ice storm is used to describe occasions when damaging accumulations of ice are expected during freezing rain situations. Significant accumulations of ice pull down trees and utility lines resulting in loss of power and communication. These accumulations of ice make walking and driving extremely dangerous, and can create extreme hazards to motorists and pedestrians (NWS, 2005).

Extra-Tropical Cyclone: Extra-tropical cyclone is a low-pressure storm system that primarily gets its energy from the horizontal temperature contrasts that exist in the atmosphere. They are also known as mid-latitude or baroclinic storms. These cyclones are associated with cold fronts, warm fronts and occluded fronts (when a cold front overtakes a warm front) (NOAA, 2004).

Nor'Easter (abbreviation for North Easter): Nor'Easters, named for the strong northeasterly winds blowing in ahead of the storm, are also referred to as a type of an extra-tropical cyclone (mid-latitude storms or Great Lake storms). It is a counterclockwise spinning storm that moves northeast near the eastern coast of the U.S. and Canada. Wind gusts associated with these storms can exceed hurricane-force intensities. Nor'Easters contain a cold core of low barometric pressure that forms that forms in the mid-latitudes, unlike tropical cyclones that have warm cores and form in the tropics. Nor'Easters can occur anytime of year, but are more common during the fall and winter months (New York State Emergency Management Office [NYSEMO], 2008).

Nor'Easters can cause heavy snow, rain, gale force winds, and oversized waves (storm surge) that can cause beach erosion, coastal flooding, structural damage, power outages and unsafe human conditions. Those that stay inland are generally weaker and only cause strong wind and rain. Nor'Easters that stay offshore can bring heavy snow, blizzards, ice, strong winds, high waves, and severe beach erosion.

Extreme Cold: Extreme cold events are when temperatures drop well below normal in an area. Extremely cold temperatures often accompany a winter storm, so individuals may have to cope with power failures and icy roads. Although staying indoors as much as possible can help reduce the risk of car crashes and falls on the ice, individuals may also face indoor hazards. Many homes will be too cold—either due to a power failure or because the heating system is not adequate for the weather.

What constitutes extreme cold and its effects can vary across different areas of the country. In regions relatively unaccustomed to winter weather, near freezing temperatures are considered "extreme cold". Exposure to cold temperatures, whether indoors or outside, can lead to serious or life-threatening health problems such as hypothermia, cold stress, frostbite or freezing of the exposed extremities such as fingers, toes, nose and ear lobes (Centers of Disease Control and Prevention [CDC], 2007).

Extent

The magnitude or severity of a severe winter storm depends on several factors including a region's climatological susceptibility to snowstorms, snowfall amounts, snowfall rates, wind speeds, temperatures, visibility, storm duration, topography, and time of occurrence during the day (e.g., weekday versus weekend), and time of season. The extent of a severe winter storm can be classified by meteorological measurements, such as those above, and by evaluating its societal impacts. The Northeast Snowfall Impact Scale (NESIS) categorizes snowstorms in this manner. Unlike the Fujita and Saffir-Simpson Scales that characterize tornados and hurricanes, respectively, there is no widely used scale to classify snowstorms. NESIS was developed by Paul Kocin of The Weather Channel and Louis Uccellini of the NWS to characterize and rank high-impact, northeast snowstorms. These storms have large areas of 10-inch snowfall accumulations and greater. NESIS has five ranking categories: Notable (1), Significant (2), Major (3), Crippling (4), and Extreme (5) (Table 5.4.2-1). The index differs from other meteorological indices in that it uses population information in addition to meteorological measurements. Thus, NESIS gives an indication of a storm's societal impacts. This scale was developed because of the impact northeast snowstorms can have on the rest of the country in terms of transportation and economic impact (Kocin and Uccellini, 2004).

Table 5.4.2-1. NESIS Ranking Categories 1 - 5

Category	Description	NESIS Range	Definition
1	Notable	1.0 – 2.49	These storms are notable for their large areas of 4-in. (10-cm) accumulations and small areas of 10-in. (25-cm) snowfall.

Category	Description	NESIS Range	Definition
2	Significant	2.5 – 3.99	Includes storms that produce significant areas of greater than 10-in. (25-cm) snows while some include small areas of 20-in. (50-cm) snowfalls. A few cases may even include relatively small areas of very heavy snowfall accumulations [greater than 30 in. (75 cm)].
3	Major	4.0 – 5.99	This category encompasses the typical major Northeast snowstorm, with large areas of 10-in. snows (generally between 50 and 150 × 103 mi^2—roughly 1–3 times the size of New York State with significant areas of 20-in. (50-cm) accumulations.
4	Crippling	6.0 – 9.99	These storms consist of some of the most widespread, heavy snows of the sample and can be best described as crippling to the northeast U.S, with the impact to transportation and the economy felt throughout the United States. These storms encompass huge areas of 10-in. (25-cm) snowfalls, and each case is marked by large areas of 20-in. (50-cm) and greater snowfall accumulations.
5	Extreme	10 +	The storms represent those with the most extreme snowfall distributions, blanketing large areas and populations with snowfalls greater than 10, 20, and 30 in. (25, 50, and 75 cm). These are the only storms in which the 10-in. (25-cm) accumulations exceed 200 × 103 mi^2 and affect more than 60 million people.

Source: Kocin and Uccellini, 2004
Notes: cm = centimeters. in = inches. mi^2 = square miles.

NESIS scores are a function of the area affected by the snowstorm, the amount of snow, and the number of people living in the path of the storm. These numbers are calculated into a raw data number ranking from "1" for an insignificant fall to over "10" for a massive snowstorm. Based on these raw numbers, the storm is placed into its decided category. The largest NESIS values result from storms producing heavy snowfall over large areas that include major metropolitan centers (Enloe, 2010). Storms that have occurred in the northeastern U.S. using this impact scale are listed in Table 5.4.2-4 in the "Previous Occurrences" section of this HMP.

Nor'Easters

Though the occurrence of a Nor'Easter can be forecasted with some accuracy, predicting the impact can be a little more complex. The extent of a Nor'Easter can be categorized by the Dolan-Davis Nor'Easter Intensity Scale. In 1993, researchers Robert Davis and Robert Dolan created this Nor'Easter intensity scale, but it deals primarily with beach and coastal deterioration. This scale, presented in Table 5.4.2-2, categorizes or rates the intensity of Nor'Easters from 1 (weak) to 5 (extreme) based on their storm class. This is used to give an estimate of the potential beach erosion, dune erosion, overwash and property damages expected from a Nor'Easter (Multi-County Environmental Storm Observatory [MESO], 2002).

Table 5.4.2-2. The Dolan-Davis Nor'Easter Intensity Scale

Storm Class	Beach Erosion	Dune Erosion	Overwash	Property Damage
1 (*Weak*)	Minor Changes	None	No	No
2 (*Moderate*)	Modest; mostly to lower beach	Minor	No	Modest
3 (*Significant*)	Erosion extends across the beach	Can be significant	No	Loss of many structures at local level
4 (*Severe*)	Severe beach erosion and recession	Severe dune erosion or destruction	On low beaches	Loss of structures at community level

Storm Class	Beach Erosion	Dune Erosion	Overwash	Property Damage
5 (*Extreme*)	Extreme beach erosion	Dunes destroyed over extensive areas	Massive in sheets and channels	Extensive at regional-scale; millions of dollars

Source: MESO, 2002

Dr. Gregory Ziellinski, Maine state climatologist and an associate research professor at the University of Maine Institute for Quaternary and Climate Studies, developed a way to help weather forecasters and the public understand the likely impacts of winter storms. Dr. Zielinski applies his analysis mainly to two types of storms: Nor'Easters that often intensity in the mid-Atlantic region and move up the coast into New England; and storms that originate east of the Rocky Mountains and that move through the Great Lakes region or up the Ohio River valley. These storms are often called the Witches of November and have been responsible for shipwrecks on the Great Lakes (sinking of the Edmund Fitzgerald) (MESO, 2002).

In an article posted in the January 2002 issue of the Bulletin of the American Meteorological Society (BAMS), Dr. Zielinski explains: "My classification scheme allows forecasters and meteorologists to easily summarize the intensity of a winter storm by giving it an intensity index and placing it into its appropriate category on a 1-5 scale. The potential impact of the storm can then be passed on to public service officials so they may make plans for precipitation amounts, particularly snow, snowfall rates, wind speeds, drifting potential and overall impact on schools, businesses, travelers, and coastal communities" (MESO, 2002).

His approach to storms uses two features of a storm: air pressure and forward speed. Based on the calculations to determine the different characteristics of the storms (Dolan-Davis Nor'Easter Intensity Scale), which reflects the storm's strength, Dr. Zielinski places the storm into a category between one and five. Forward speed is important because even moderately intense storms can have a large impact if they move slowly.

In Dr. Zielinski's classification system, a second number reflecting forward speed is used together with the first number from the Dolan-Davis Nor'Easter Intensity Scale. Like the Intensity Scale, the second number of his scale ranges between one and five. A five would be the slowest moving and thus longest duration storm. A storm's category might be 2.4 or 4.3, reflecting intensity with the first digit and duration with the second (MESO, 2002).

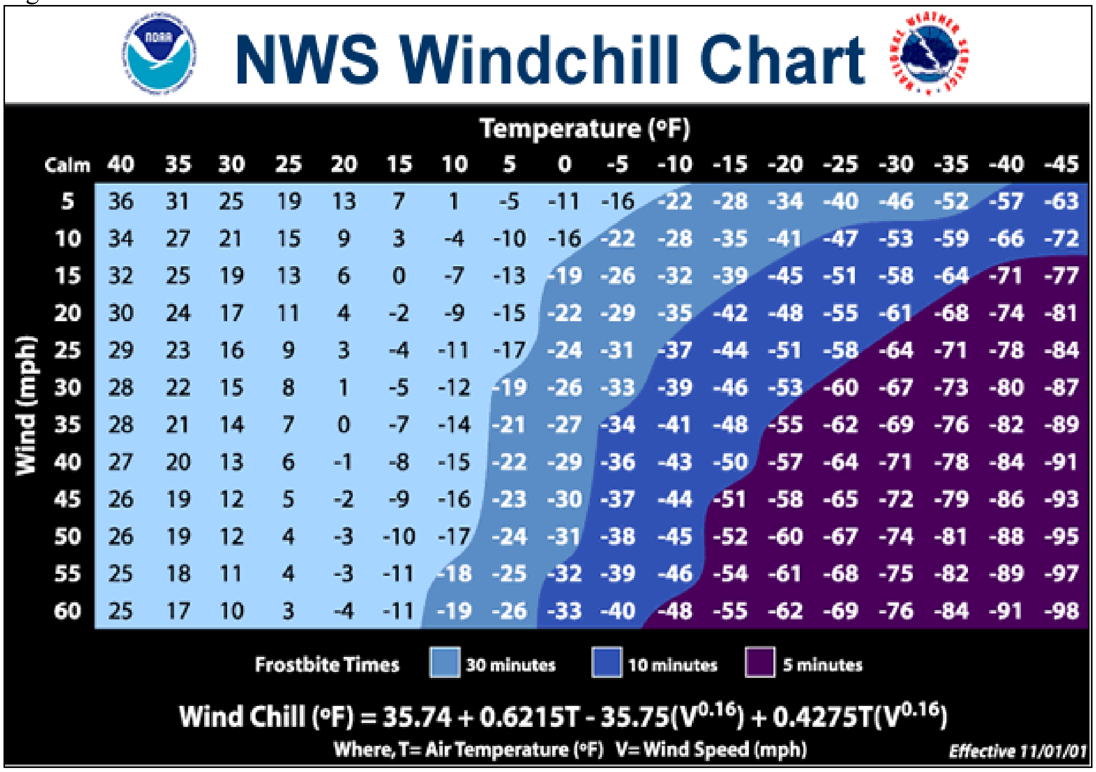
Dr. Zielinski has used his system to classify more than 70 past storms. He has made over 550 individual classifications, looking at the March 1993 "Storm of the Century", the Great Arctic Outbreak of 1899, and Blizzard of 1888 and other storms that are a part of legendary U.S. weather (Zielinski, 2003).

Extreme Cold Temperatures

The extent (severity or magnitude) of extreme cold temperatures are generally measured through the Wind Chill Temperature (WCT) Index. Whenever temperatures drop well below normal and wind speed increases, heat can leave your body more rapidly. The WCT Index is the temperature your body feels when the air temperature is combined with the wind speed. It is based on the rate of heat loss from exposed skin caused by the effects of wind and cold. As the speed of the wind increases, it can carry heat away from your body much more quickly, causing skin temperature to drop. When there are high winds, serious weather-related health problems are more likely, even when temperatures are only cool. The importance of the wind chill index is as an indicator of how to dress properly for winter weather to avoid extreme cold affects to human health. The Wind Chill Chart (Figure 5.4.2-1), which was improved in

November 2001 from its original 1945 version, shows the difference between actual air temperature and perceived temperature, and amount of time until frostbite occurs (NWS, 2008).

Figure 5.4.2-1 NWS Wind Chill Index



NWS Windchill Chart

Temperature (°F)

Wind (mph)	40	35	30	25	20	15	10	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45
Calm																		
5	36	31	25	19	13	7	1	-5	-11	-16	-22	-28	-34	-40	-46	-52	-57	-63
10	34	27	21	15	9	3	-4	-10	-16	-22	-28	-35	-41	-47	-53	-59	-66	-72
15	32	25	19	13	6	0	-7	-13	-19	-26	-32	-39	-45	-51	-58	-64	-71	-77
20	30	24	17	11	4	-2	-9	-15	-22	-29	-35	-42	-48	-55	-61	-68	-74	-81
25	29	23	16	9	3	-4	-11	-17	-24	-31	-37	-44	-51	-58	-64	-71	-78	-84
30	28	22	15	8	1	-5	-12	-19	-26	-33	-39	-46	-53	-60	-67	-73	-80	-87
35	28	21	14	7	0	-7	-14	-21	-27	-34	-41	-48	-55	-62	-69	-76	-82	-89
40	27	20	13	6	-1	-8	-15	-22	-29	-36	-43	-50	-57	-64	-71	-78	-84	-91
45	26	19	12	5	-2	-9	-16	-23	-30	-37	-44	-51	-58	-65	-72	-79	-86	-93
50	26	19	12	4	-3	-10	-17	-24	-31	-38	-45	-52	-60	-67	-74	-81	-88	-95
55	25	18	11	4	-3	-11	-18	-25	-32	-39	-46	-54	-61	-68	-75	-82	-89	-97
60	25	17	10	3	-4	-11	-19	-26	-33	-40	-48	-55	-62	-69	-76	-84	-91	-98

Frostbite Times: 30 minutes; 10 minutes; 5 minutes

$$\text{Wind Chill (°F)} = 35.74 + 0.6215T - 35.75(V^{0.16}) + 0.4275T(V^{0.16})$$

Where, T= Air Temperature (°F) V= Wind Speed (mph)

Effective 11/01/01

Source: NWS, 2008

Location

The location of winter weather and extreme cold temperatures throughout New York State and Fulton County are further identified below.

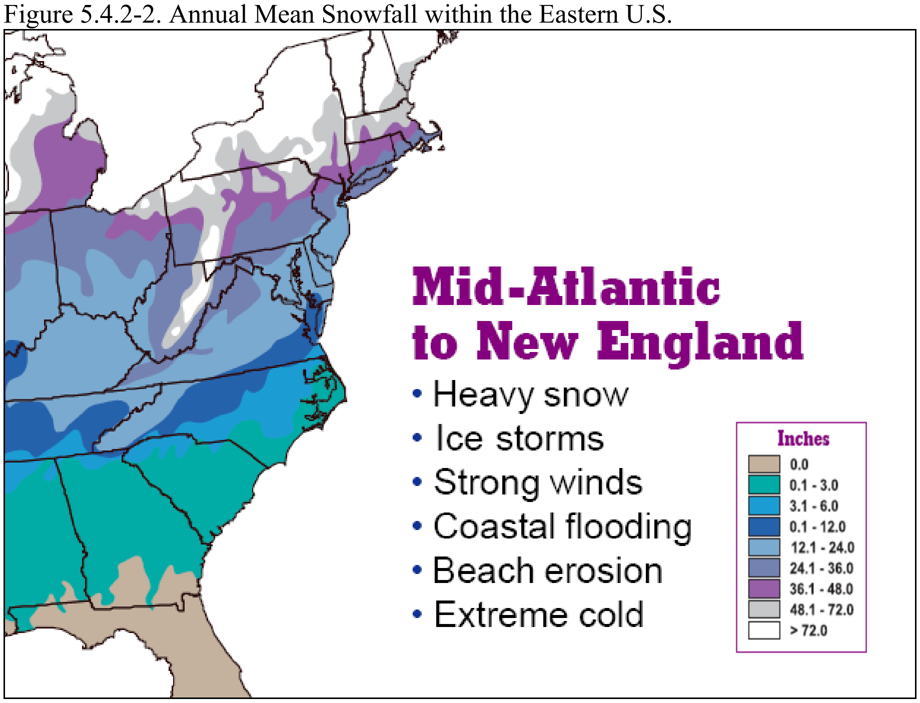
Winter Weather

Winter weather, particularly snowstorm events, has historically affected many U.S. states, mainly in the Northeast and Midwest. The climate of New York State is marked by abundant snowfall. With the exception of the coastal communities, the State receives an average seasonal amount of 40 inches or more of snow. The average snowfall is greater than 70 inches over approximately 60-percent of New York State's area. The influence of the Atlantic Ocean reduces snow accumulation to 25 to 35 inches in the New York City and Long Island area (New York State Climate Office [NYSC], Date Unknown).

Topography, elevation and location to large bodies of water result in a variation of snowfall in New York State. Maximum seasonal snowfall, averaging more than 175 inches, occurs on the western and southwestern slopes of the Adirondacks and Tug Hill. A maximum of 150 to 180 inches of snow occurs in the southwestern highlands, between 10 to 30 miles inland from Lake Erie. Three different areas of the Eastern Plateau record heavy snowfall accumulations, averaging 100 to 120 inches. These areas are: the uplands of southwestern Onondaga County and connecting counties; Cherry Valley section of northern Otsego and southern Herkimer Counties; and the Catskill highlands in Ulster, Delaware, and Sullivan Counties. Minimum seasonal snowfall of 40 to 50 inches occurs in Niagara County, near the south shore of Lake Ontario; the Chemung and mid-Genesee River Valleys of western New York State; and near the Hudson River in Orange, Rockland and Westchester Counties, upstream to the southern portion of Albany County (NYSC, Date Unknown).

Winter weather can reach New York State as early as October and is usually in full force by late November with average winter temperatures between 20° F and 40° F. As indicated in the New York State HMP, communities in New York State receive more snow than most other communities in the nation. The Cities of Syracuse, Buffalo, Rochester, and Albany are typically in the top 10 cities in the country in annual snowfall. These municipalities are located in Onondaga, Erie, Monroe, and Albany Counties (New York State Disaster Preparedness Commission [NYSDPC], 2008). With the exception of coastal New York State, in 2001, it was reported that the State receives an average seasonal amount of 40 inches of snow or more. The average annual snowfall is greater than 70 inches over 60-percent of New York State's area. Fulton County receives between 48 and 72 inches (Figure 5.4.2-2). According to the NYSC, between 1961 and 1990, the seasonal snowfall normals for the City of Gloversville in Fulton County was 78.7 inches (NYSC, Date Unknown).

Figure 5.4.2-2. Annual Mean Snowfall within the Eastern U.S.



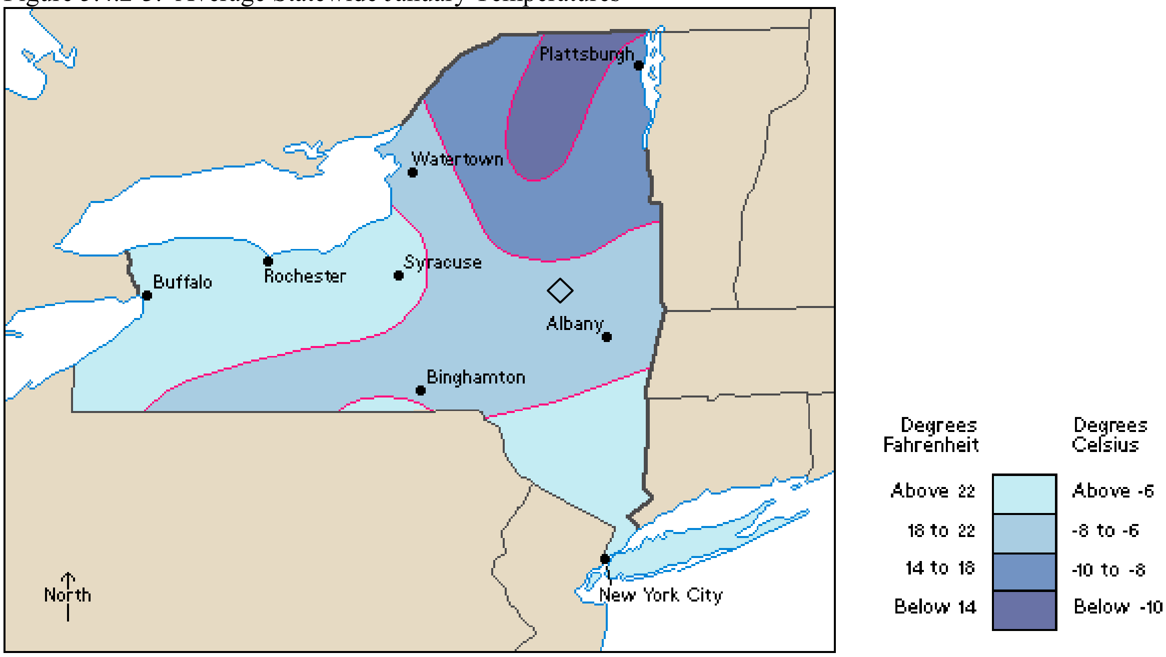
Source: NWS, 2001

The NYSDPC and NYSEMO listed Fulton County as the 40th County in the State most threatened by snow and vulnerable to snow loss, with an annual average snowfall of 84 inches. Fulton County is also listed as the 52nd County in New York State most threatened by ice storms and vulnerable to ice storm loss (NYSDPC, 2008). Although Fulton County is not ranked as a highly susceptible county to snow and ice hazards, they do constitute a hazard of local concern because of their frequency, drain on local resources and potential for economic hardships, property damage and transportation disruption.

Extreme Cold Temperatures

Extreme cold temperatures are existent throughout most of the winter season and generally accompany most winter storm events throughout the State. The NYSC Office of Cornell University indicates that cold temperatures prevail over the State whenever arctic air masses, under high barometric pressure, flow southward from central Canada or from Hudson Bay (NYSC, Date Unknown). Figure 5.4.2-3, identifies the average January temperatures of the State, with the northeast sections experiencing the coldest conditions and the west and southeast experiencing the mildest winters.

Figure 5.4.2-3. Average Statewide January Temperatures

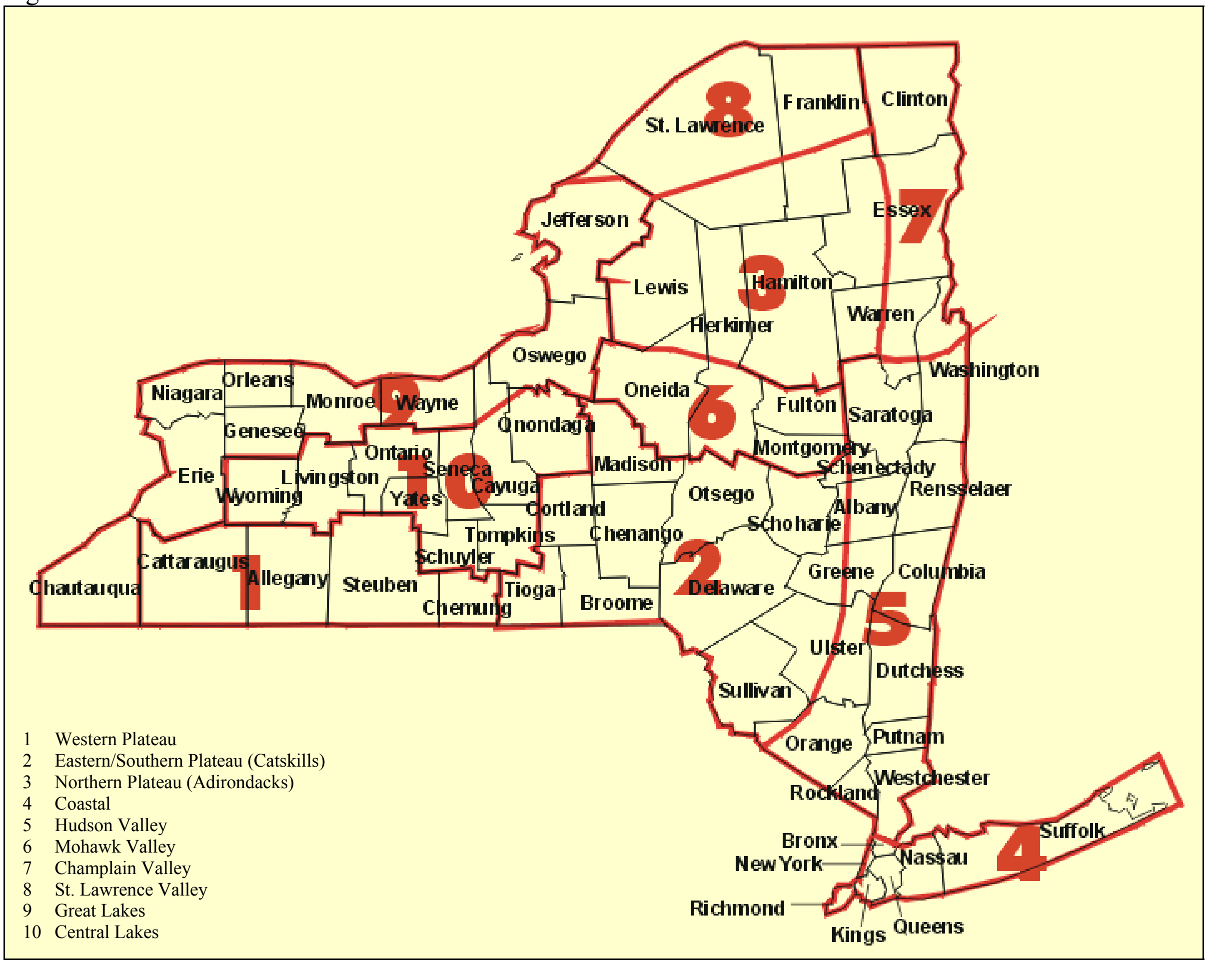


Source: World Book Inc., 2007

Note: ◊ indicates the approximate location of Fulton County.

Many atmospheric and physiographic controls on the climate result in a considerable variation of temperature conditions over New York State. The average annual mean temperature ranges from about 40°F in the Adirondacks to near 55°F in the New York City area. In January, the average mean temperature is approximately 16°F in the Adirondacks and St. Lawrence Valley, but increases to about 26°F along Lake Erie and in the lower Hudson Valley (Westchester County) and to 31°F on Long Island. The record coldest temperature in New York State is -52°F at Stillwater Reservoir (northern Herkimer County) on February 9, 1934 and also at Old Forge (also northern Herkimer County) on February 18, 1979. Some 30 communities have recorded temperatures of -40°F or colder, most of them occurring in the northern one-half of the State and the remainder in the Western Plateau Climate Division and in localities just south of the Mohawk Valley (Climate Division 6) (Earth System Research Laboratory [ESRL], Date Unknown; NYSC, Date Unknown). Figure 5.4.2-4 identifies the 10 climate divisions of the State: Western Plateau (1), Eastern Plateau (Catskill Mountains) (2), Northern Plateau (Adirondack Mountains) (3), Coastal (4), Hudson Valley (5), Mohawk Valley (6), Champlain Valley (7), St. Lawrence Valley (8), Great Lakes (9), and Central Lakes (10) (CPC, 2005). These regions have been divided because they are climatically homogenous or similar in comparison (Energy Information Administration, 2005).

Figure 5.4.2-4. Climate Divisions of New York State



Source: CPC, 2005; NYSC, Date Unknown

Fulton County falls within the Mohawk Valley (Division 6) (NCDC, Date Unknown; CPC, 2005; ERSL, Date Unknown). In 2008, the average winter temperature for the Mohawk Valley was 25°F (South Dakota University, Date Unknown).

As provided by The Weather Channel, a range of average high and low temperatures during the winter months in Fulton County are identified in Table 5.4.2-3.

Table 5.4.2-3. Average High and Low Temperature Range for Winter Months in Fulton County

Month	Average High (°F)	Average Low (°F)	Record Low Events
January	28	9	-29°F (1996)
February	31	11	-26°F (1979)
March	41	21	-14°F (1980)
November	42	28	0°F (1951)
December	33	17	-23°F (1980)

Source: The Weather Channel, 2010

Previous Occurrences and Losses

Many sources provided historical information regarding previous occurrences and losses associated with flooding throughout New York State and Fulton County. With so many sources reviewed for the purpose of this HMP, loss and impact information for many events could vary depending on the source. Therefore, the accuracy of monetary figures discussed is based only on the available information identified during research for this HMP.

According to Paul Kocin of The Weather Channel, Louis Uccellini of the NWS, and Jesse Enloe of NOAA, over 74 snowstorm incidences were identified and ranked that affected the northeastern U.S between 1956 and 2009 (Table 5.4.2-4) (Kocin and Uccellini, 2010). These storms have large areas of 10 inch snowfall accumulations and greater. Although the severity of these events may vary throughout the State, many of these listed storms impacted Fulton County. This list does not represent all storms that may have impacted the northeastern U.S.

Table 5.4.2-4. Snowstorm Cases That Affected the Northeastern U.S (1956 – 2009) (Arranged by Rank/Category)

Rank	Date	NESIS	Category	Description
1	Mar 12-14, 1993	13.2	5	Extreme
2	Jan 6-8, 1996	11.78	5	Extreme
3	Feb 15-18, 2003	8.91	4	Crippling
4	Mar 2-5, 1960	8.77	4	Crippling
5	Feb 2-5, 1961	7.06	4	Crippling
6	Jan 11-14, 1964	6.91	4	Crippling
7	Jan 21-24, 2005	6.8	4	Crippling
8	Jan 19-21, 1978	6.53	4	Crippling
9	Dec 25-28, 1969	6.29	4	Crippling
10	Feb 10-12, 1983	6.25	4	Crippling
11	Feb 14-17, 1958	6.25	4	Crippling
12	Jan 29-31, 1966	5.93	3	Major
13	Feb 5-7, 1978	5.78	3	Major
14	Feb 12-15, 2007	5.63	3	Major
15	Jan 21-23, 1987	5.4	3	Major

Rank	Date	NESIS	Category	Description
16	Feb 8-12, 1994	5.39	3	Major
17	Feb 17-19, 1979	4.77	3	Major
18	Feb 18-20, 1972	4.77	3	Major
19	Dec 11-13, 1960	4.53	3	Major
20	Feb 22-28, 1969	4.29	3	Major
21	Feb 12-13, 2006	4.1	3	Major
22	Jan 18-21, 1961	4.04	3	Major
23	Dec 18-21, 2009	4.03	3	Major
24	Dec 23-25, 1966	3.81	2	Significant
25	Feb 8-10, 1969	3.51	2	Significant
26	Mar 18-21, 1958	3.51	2	Significant
27	Feb 5-8, 1967	3.5	2	Significant
28	Apr 6-7, 1982	3.35	2	Significant
29	Mar 15-18, 2007	2.55	2	Significant
30	Jan 24-26, 2000	2.52	2	Significant
31	Dec 30-31, 2000	2.37	1	Notable
32	Mar 31 - Apr 1, 1997	2.29	1	Notable
33	Mar 18-19, 1956	1.87	1	Notable
34	Mar 1-3, 2009	1.65	1	Notable
35	Feb 22-23, 1987	1.46	1	Notable
36	Feb 2-4, 1995	1.43	1	Notable
37	Jan 25-26, 1987	1.19	1	Notable

Source: Kocin and Uccellini, 2010

Between 1954 and 2009, FEMA declared that New York State experienced 22 winter storm-related disasters (DR) or emergencies (EM) classified as one or a combination of the following disaster types: winter storms, severe storms, coastal storms, ice storm, blizzard, snowstorm, severe Nor'Easter, ice jam and flooding. Generally, these disasters covered a wide region of the State; therefore, they may have impacted many counties. However, not all counties were declared as disaster areas. Of those events, Fulton County was not included in any of the declared disasters or emergency declarations (FEMA, 2010; NYSDPC, 2008).

Based on all sources researched, winter storm and extreme cold events that have impacted Fulton County are identified in Table 5.4.2-5. With winter storm documentation for New York State being so extensive, not all sources may have been identified or researched. Hence, Table 5.4.2-5 may not include all events that have occurred throughout the region.

Table 5.4.2-5. Severe Winter Events between 1993 and 2010

Event Date / Name	Location	Losses / Impacts	Source(s)
Heavy Snow December 21-22, 1993	Multi-County	Across eastern New York State, snowfall totals ranged between five and 18 inches, with higher totals in some areas. The heavy snow with wind gusts downed trees and power lines. Damages overall were approximately $5 M. Fulton County experienced approximately $25 K in property damages.	NOAA-NCDC, SHELDUS
Heavy Snow March 2-4, 1994	Multi-County	This storm brought heavy snow to eastern New York State, with snowfall totals between six and 30 inches. Traffic accidents were reported across the area. Overall property damage for the entire area was $500 K. In Fulton County, the City of Gloversville had 21 inches of snow. Property damage in the County was approximately $1,800.	NOAA-NCDC, SHELDUS
Heavy Snow November 13-14, 1997	Multi-County	Heavy snow fell over eastern New York State, with the greatest accumulations in the Mohawk Valley, Capital District and southern Adirondacks. Snowfall totals ranged between eight inches and 14 inches. In Fulton County, 11 inches of snow fell at Caroga Lake. Overall damages to the state was approximately $44K. Damages in Fulton County were approximately $3,000.	NOAA-NCDC, SHELDUS
Heavy Snow December 29-30, 1997	Multi-County	A winter storm tracked from North Carolina to New England. In New York State, the storm produced heavy snow across the Catskills, eastern Mohawk Valley, southern Adirondacks, northern Saratoga County, and surrounding higher terrain north and west of the Capital District. The snow caused widespread power outages in southern Herkimer, Fulton, Montgomery and Schoharie Counties. Snowfall totals ranged between two inches and 18 inches. In Fulton County, Caroga Lake received 11 inches of snow. Overall, the storm caused $155 K to the areas affected. Fulton County had approximately $14 K in damages.	NOAA-NCDC, SHELDUS
Winter Storm January 14-15, 1999	Multi-County	This storm brought heavy snow, sleet and freezing rain. It also brought freezing temperatures, as low as -9°F. Snowfall totals for the State ranged between 11 inches and 15 inches. In Fulton County, the City of Gloversville had 15 inches of snow. In the Town of Mayfield, a roof of a barn collapsed, killing one cow and injuring others. Total storm damages for the affected area was approximately $174 K. Damages in Fulton County	NOAA-NCDC, SHELDUS

Event Date / Name	Location	Losses / Impacts	Source(s)
		were approximately $11 K.	
Winter Storm January 31, 2000	Multi-County	Snowfall totals for this storm ranged between four 21 inches. In Fulton County, Caroga Lake had 21 inches and the City of Gloversville had 18 inches. The storm closed schools and businesses. Overall damages were approximately $363 K. Fulton County had approximately $25 K in property damages.	NOAA-NCDC, SHELDUS
Winter Storm March 9-10, 2001	Multi-County	Snowfall amounts ranged between six and 12 inches fell across the Catskills, Mohawk Valley northward to Saratoga Springs and portions of the eastern Taconics. In Fulton County, in the City of Gloversville, the weight of the snow caused the roof of a cold-storage leather facility plant to collapse. An overall damage for the affected areas was approximately $50 K. Total property damage for Fulton County was approximately $5 K.	NOAA-NCDC, SHELDUS
Snowstorm February 17, 2003 "President's Day Snowstorm"	Multi-County	In the New York City and Boston areas, this storm was considered a blizzard, producing record breaking snowfall for the Washington, DC, Baltimore, MD and Philadelphia, PA areas. Up to one foot of snow fell in the immediate Capital Region and between 14 and 20 inches of snow fell in the eastern Catskills, mid-Hudson Valley and Berkshire and Litchfield Counties. Snowfall totals in Fulton County ranged between five and 15 inches.	CBS6Albany.com , NOAA-NCDC
Snowstorm December 31,2008 – January 1, 2009	Multi-County	As this storm moved east, heavy snow fell across the western and central Mohawk Valley and the immediate Capital District. Snowfall totals ranged between six and 11 inches in these areas. Further south and east, snowfall amounts totaled three to six inches. Snowfall totals for Fulton County ranged between 4.6 inches at Peck Lake to 8.5 inches in the Town of Broadalbin	NOAA-NCDC, NWS
Snowstorm / Nor'Easter February 23-24, 2010	Multi-County	Snowfall totals in Fulton County ranged between six inches in the City of Gloversville to 12.5 inches in the Town of Perth.	Anich, NWS

Note (1): This table does not represent all events that may have occurred throughout the County due to a lack of detail and/or their minor impact upon the County. The NOAA NCDC storm query indicated that Fulton County has experienced 130 snow and ice storm events and 14 extreme cold temperature/wind chill events between January 1, 1950 and December 31, 2009. However, most events are regional events not specific to Fulton County alone. Therefore, not all of these events were identified in this table due to minimal information made available or their minor impact on the County.

Note (2): Monetary figures within this table were U.S. Dollar (USD) figures calculated during or within the approximate time of the event. If such an event would occur in the present day, monetary losses would be considerably higher in USDs as a result of inflation.

K Thousand ($)
M Million ($)
NCDC National Climate Data Center
NOAA National Oceanic Atmospheric Administration
NWS National Weather Service
SHELDUS Spatial Hazard Events and Losses Database for the United States

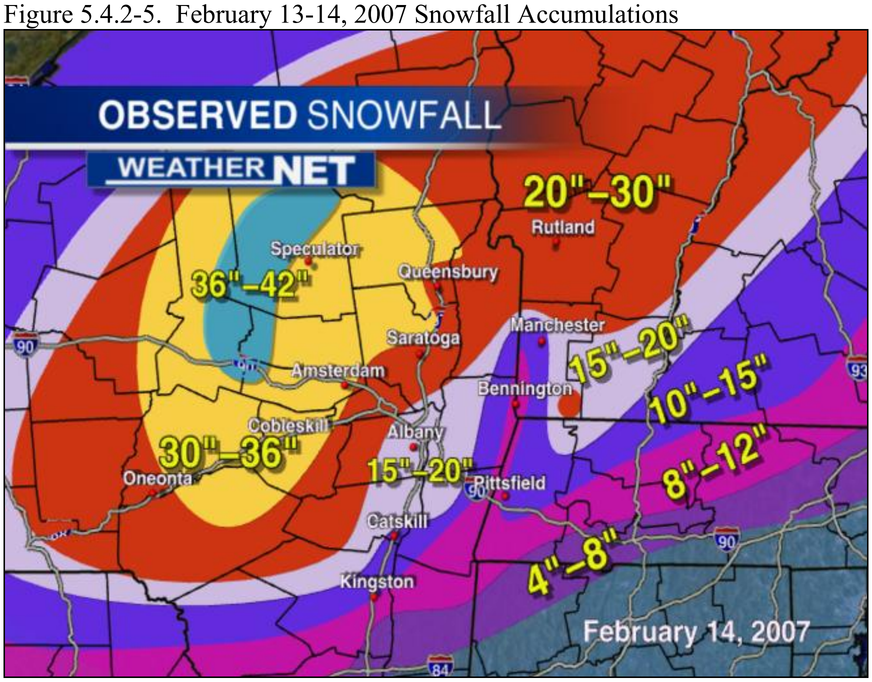
Further descriptions of particular severe winter storm/extreme cold events that have impacted Fulton County are provided below for selected events where details regarding their impact were available. These descriptions are provided to give the reader a context of the winter storm and extreme cold events that have affected the County and to assist local officials in locating event-specific data for their municipalities based on the time and proximity of these events.

Monetary figures within the event descriptions were U.S. Dollar (USD) figures calculated during or within the approximate time of the event (unless present day recalculations were made by the sources reviewed). If such an event would occur in the present day, monetary losses would be considerably higher in USDs as a result of inflation.

February 12-15, 2007 ("Valentine's Day Storm"): This storm was a complex and wide-reaching winter storm that moved from the mid-Mississippi Valley into the Tennessee Valley on February 13th and into the mid-Atlantic and New England on February 14th and 15th. The storm produced widespread snowfall across the Mid Atlantic and New England, with the heaviest hit areas being the Adirondack Mountains in New York State and Northern Vermont. Over two feet of snow fell in these parts. Across Pennsylvania, totals ranged from a few inches to almost 20 inches (NWS, 2007). The Valentine's Day Storm was the largest storm to affect central New York State and northeast Pennsylvania during the 2006-2007 winter season (Evans, 2007).

In the Albany, New York area, snowfall amounts totaled between one foot and over three feet. Snowfall totals in Fulton County ranged between 32 inches in the Village of Northville to 42 inches in the Town of Stratford. The City of Gloversville and the Town of Caroga had 33 inches of snow; and the Towns of Broadalbin and Mayfield had 34 inches (NWS, 2007). Cost estimates of property damage or losses in Fulton County were unavailable in the materials reviewed to develop this plan. Figure 5.4.2-5 shows the snowfall accumulations New York State and some New England states.

Figure 5.4.2-5. February 13-14, 2007 Snowfall Accumulations



Source: Freedom Communications, 2008

Probability of Future Events

Winter storm hazards in New York State are virtually guaranteed yearly since the State is located at relatively high latitudes resulting winter temperatures range between 0°F and 32 °F for a good deal of the fall through early spring season (late October until Mid-April). In addition, the State is exposed to large quantities of moisture from both the Great Lakes and the Atlantic Ocean. While it is almost certain that a number of significant winter storms will occur during the Winter and Fall season, what is not easily determined is how many such storms will occur during that time frame (NYSDPC, 2008). Similar to winter storms, the frequency of occurrence for ice storms cannot be predicted.

Earlier in this section, the identified hazards of concern for the County were ranked. The New York State HMP includes a similar ranking process for hazards that affect the State. The probability of occurrence, or likelihood of the event, is one parameter used in this ranking process. Based on historical records and input from the Planning Committee, the probability of at least one winter snow storm of emergency declaration proportions, occurring during any given calendar year is virtually certain in the State. Based on historical snow related disaster declaration occurrences, New York State can expect a snow storm of disaster declaration proportions, on average, once every 3-5 years. Similarly, for ice storms, based on historical disaster declarations, it is expected that on average, ice storms of disaster proportions will occur once every 7-10 years within the State (NYSDPC, 2008).

As indicated previously in this hazard profile, Fulton County is currently listed as the 40th County in the state most threatened by and vulnerable to snow and snow loss, with an annual average snowfalls of 84 inches. Fulton County is also listed as the 52nd County in New York State most threatened by and vulnerable to ice storms and ice storm loss (NYSDPC, 2008). The probability of future events in Fulton County is considered 'frequent' (hazard event is likely to occur within 25 years) (Section 5.3).

Extreme Cold Temperatures

Extreme cold temperatures are not separately discussed in detail in the NYS HMP; however, it is anticipated that the State will continue to experience cold temperature events during the winter weather months. The severity of extreme cold events is expected to vary from county to county within the State, due to topography, geographical conditions, the potential impact of future climate change and other factors.

Many sources indicate that future climate change could become a large factor in influencing the frequency of not only extreme cold temperatures but also the overall frequency and severity of winter storm events throughout the U.S. In the event of climate change, research has indicated that temperatures will become warmer, even during winter months, which could influence the quantity of winter storm events. According to the *Fourth Assessment Report of the Intergovernmental Panel of Climate Change (IPCC)*, all of North America is very likely to warm during this century, and the annual mean warming is likely to exceed the global mean warming in most areas.

In northern region of the U.S., which includes New York State, warming is likely to be largest in winter, and in the southwest U.S., largest in summer. The lowest winter temperatures are likely to increase more than the average winter temperature in the northern U.S., and the highest summer temperatures are likely to increase more than the average summer temperature in the southwest U.S (IPCC, 2007). If temperatures become warmer, as predicted, the occurrence of winter storms and extreme cold temperatures is anticipated to decrease or have less of an impact; therefore, making an overall prediction regarding future probability of winter-related events difficult to determine.

Although many uncertainties exist regarding magnitude, severity or impact of climate change, the U.S. Environmental Protection Agency (USEPA) indicated that future temperature changes, including a greater number of heat waves, are anticipated as a result, along with atmospheric, precipitation, storm and sea level changes (USEPA, 2007).

According to the 1997 USEPA publication *EPA 230-F-97-008ff: Climate Change and New York*, over the last century, temperatures in Albany, New York, have warmed by more than 1°F, and precipitation throughout the state has increased by up to 20-percent. Over the next century, New York State's climate may change even more. Based on projections given by the IPCC and results from the United Kingdom Hadley Centre's climate model (HadCM2), a model that has accounted for both greenhouse gases and aerosols, by 2100 temperatures in New York State could increase about 4°F in winter and spring, and slightly more in summer and fall (with a range of 2-8°F) (USEPA, 1997).

Local studies regarding climate change and its affects to Fulton County have not been found. However, if scientific predictions are accurate and based on the regional studies that have been done for New York State and its surrounding states, it is anticipated that Fulton County will be no exception and will also experience a change in temperatures in the future, which will determine the overall severity of winter conditions within the County.

VULNERABILITY ASSESSMENT

To understand risk, a community must evaluate what assets are exposed or vulnerable in the identified hazard area. For severe winter storms and extreme cold temperatures, the entire County has been identified as the hazard area. Therefore, all assets in Fulton County (population, structures, critical facilities and lifelines), as described in the County Profile (Section 4), are vulnerable. The following text evaluates and estimates the potential impact of severe winter storms and extreme cold temperatures on the County including:

- Overview of vulnerability
- Data and methodology used for the evaluation
- Impact, including: (1) impact on life, safety and health of County residents, (2) general building stock, (3) critical facilities, (4) economy and (5) future growth and development
- Further data collections that will assist understanding of this hazard over time
- Overall vulnerability conclusion

Overview of Vulnerability

Severe winter storms and extreme cold temperature events are of significant concern to Fulton County because of their frequency and magnitude in the region. Additionally, they are of significant concern due to the direct and indirect costs associated with these events; delays caused by the storms; and impacts on the people and facilities of the region related to snow and ice removal, health problems, cascade effects such as utility failure (power outages) and traffic accidents, and stress on community resources.

Data and Methodology

National weather databases and local resources were used to collect and analyze severe winter storm and extreme cold temperature impacts on the County. Default HAZUS-MH MR4 data was used to support an evaluation of assets exposed to this hazard and the potential impacts associated with this hazard.

Impact on Life, Health and Safety

According to the National Oceanic and Atmospheric Administration (NOAA) National Severe Storms Laboratory (NSSL); every year, winter weather indirectly and deceptively kills hundreds of people in the U.S., primarily from automobile accidents, overexertion and exposure. Winter storms are often accompanied by strong winds creating blizzard conditions with blinding wind-driven snow, drifting snow and extreme cold temperatures and dangerous wind chill. They are considered deceptive killers because most deaths and other impacts or losses are indirectly related to the storm. People can die in traffic accidents on icy roads, heart attacks while shoveling snow, or of hypothermia from prolonged exposure to cold. Heavy accumulations of ice can bring down trees and power lines, disabling electric power and communications for days or weeks. Heavy snow can immobilize a region and paralyze a city, shutting down all air and rail transportation and disrupting medical and emergency services. Storms near the coast can cause coastal flooding and beach erosion as well as sink ships at sea. The economic impact of winter weather each year is huge, with costs for snow removal, damage and loss of business in the millions (NSSL, 2006).

Heavy snow can immobilize a region and paralyze a city, stranding commuters, stopping the flow of supplies, and disrupting emergency and medical services. Accumulations of snow can collapse buildings and knock down trees and power lines. In rural areas, homes and farms may be isolated for days, and unprotected livestock may be lost. In the mountains, heavy snow can lead to avalanches. The cost of snow removal, repairing damages, and loss of business can have large economic impacts on cities and towns (NSSL, 2006).

Heavy accumulations of ice can bring down trees, electrical wires, telephone poles and lines, and communication towers. Communications and power can be disrupted for days while utility companies work to repair the extensive damage. Even small accumulations of ice may cause extreme hazards to motorists and pedestrians. Bridges and overpasses are particularly dangerous because they freeze before other surfaces (NSSL, 2006).

Extreme cold often accompanies a winter storm or is left in its wake. Prolonged exposure to the cold can cause frostbite or hypothermia and become life threatening. Infants and elderly people are most susceptible. What constitutes extreme cold and its effect varies across different areas of the U.S. In areas unaccustomed to winter weather, near freezing temperatures are also considered "extreme cold." Freezing temperatures can cause severe damage to citrus fruit crops and other vegetation. Pipes may freeze and burst in homes that are poorly insulated or without heat. In the north, below zero temperatures may be considered as extreme cold. Long cold spells can cause rivers to freeze, disrupting shipping. Ice dams may form and lead to flooding (NSSL, 2006).

For the purposes of this HMP, the entire population in Fulton County (55,073 people) is exposed to severe winter storm and extreme cold temperature events (U.S. Census, 2000). Snow accumulation and frozen/slippery road surfaces increase the frequency and impact of traffic accidents for the general population, resulting in personal injuries. Refer to Table 4-2 in the County Profile for population statistics for Fulton County. The elderly are considered most susceptible to this hazard due to their increased risk of injuries and death from falls and overexertion and/or hypothermia from attempts to clear snow and ice. In addition, severe winter storm events can reduce the ability of these populations to access emergency services.

Extreme cold temperatures are often associated with severe winter storms. The high cost of fuel to heat residential homes can create a financial strain on populations with low or fixed incomes (a portion of which includes the elderly population). Residents with low incomes may not have access to housing or their housing may be less able to withstand cold temperatures (e.g., homes with poor insulation and heating supply). Table 5.4.2-6 summarizes the population over the age of 65 and individuals living below the Census poverty threshold.

Table 5.4.2-6. Vulnerable Population Exposed to the Severe Winter Storm Hazard in Fulton County

Population Category	Number of Persons Exposed**	Percent of Total Population**
Elderly (Over 65 years of age) (1)	9,729	17.0
Persons living below Census poverty threshold* (2)	6,235	10.9
Elderly (Over 65 years of age) living below Census poverty threshold (2)***	638	1.2
Population Category	**Number of Persons Exposed**	**Percent of Total County Population**
Elderly (Over 65 years of age) (1)	8,900	16.2
Persons living below Census poverty threshold* (2)	6,686	12.1
Elderly (Over 65 years of age) living below Census poverty threshold (2)	638	1.2

Source(s): (1) HAZUS-MH MR4; U.S. Census 2000.
* The Census poverty threshold for a three person family unit is approximately $15,000.
** These values represent Fulton County and the entire Village of Dolgeville.
*** This value only represents the population within the Fulton County boundary and does not include the portion of the Village of Dolgeville located in Herkimer County.

Impact on General Building Stock

The entire general building stock inventory in Fulton County is exposed and vulnerable to the severe winter storm/extreme cold hazard. In general, structural impacts include damage to roofs and building frames, rather than building content. Table 5.4.2-8 (on the following page) presents the total exposure value for general building stock by occupancy class for the County and each municipality (structure only).

Current modeling tools are not available to estimate specific losses for this hazard. As an alternate approach, this plan considers percentage damages that could result from severe winter storm/extreme cold conditions. Table 5.4.2-7 below and Table 5.4.2-9 summarize percent damages that could result from severe winter storm/extreme cold conditions for the County as a whole and each municipality's total general building stock. Given professional knowledge and information available, the potential losses for this hazard are considered to be overestimated; hence, conservative estimates for losses associated with severe winter storms/extreme cold events.

Table 5.4.2-7 General Building Stock Exposure (Structure Only) and Estimated Losses from Severe Winter Storm/Extreme Cold Events in Fulton County

Building Occupancy Class	Total Value	1% Damage Loss Estimate	5% Damage Loss Estimate	10% Damage Loss Estimate
Residential	$3,239,979,000	$32,399,790	$161,998,950	$323,997,900
Commercial	$569,959,000	$5,699,590	$28,497,950	$56,995,900
Industrial	$240,661,000	$2,406,610	$12,033,050	$24,066,100
Agricultural	$10,979,000	$109,790	$548,950	$1,097,900
Religious	$68,539,000	$685,390	$3,426,950	$6,853,900
Government	$52,742,000	$527,420	$2,637,100	$5,274,200
Educational	$59,591,000	$595,910	$2,979,550	$5,959,100
Total	**$4,242,450,000**	**$42,424,500**	**$212,122,500**	**$424,245,000**

Source: HAZUS-MH MR4
Notes:

(1) The building values shown are building structure only because damage from the severe winter storm/extreme cold hazard generally impact structures such as the roof and building frame (rather than building content).
(2) The valuation of general building stock and the loss estimates determined in the study area (Fulton County and the entire Village of Dolgeville) were based on the default general building stock database provided in HAZUS-MH MR4. The general building stock valuations provided in HAZUS-MH MR4 are Replacement Cost Value from RSMeans as of 2006.

Table 5.4.2-8 Building Stock Replacement Value (Structure Only) by Occupancy Class

Municipality	Total Replacement Value	Residential Replacement Value	Commercial Replacement Value	Industrial Replacement Value
Bleecker (T)	$56,230,000	$53,315,000	$2,010,000	$508,000
Broadalbin (T)	$256,461,000	$226,108,000	$14,830,000	$3,500,000
Broadalbin (V)	$90,402,000	$58,644,000	$14,958,000	$5,649,000
Caroga (T)	$234,377,000	$219,551,000	$8,990,000	$1,273,000
Dolgeville (V)	$149,722,000	$108,123,000	$22,202,000	$10,818,000
Ephratah (T)	$78,484,000	$72,610,000	$3,946,000	$1,738,000
Gloversville (C)	$1,105,210,000	$807,907,000	$174,348,000	$81,231,000
Johnstown (C)	$776,521,000	$471,419,000	$174,731,000	$86,356,000
Johnstown (T)	$479,387,000	$361,025,000	$60,335,000	$19,783,000
Mayfield (T)	$353,165,000	$295,984,000	$40,031,000	$8,052,000
Mayfield (V)	$57,057,000	$43,949,000	$5,349,000	$1,163,000
Northampton (T)	$168,935,000	$157,963,000	$8,998,000	$1,053,000
Northville (V)	$92,066,000	$74,175,000	$11,183,000	$1,202,000
Oppenheim (T)	$87,130,000	$65,088,000	$7,338,000	$10,003,000
Perth (T)	$206,155,000	$176,770,000	$19,140,000	$8,210,000
Stratford (T)	$51,148,000	$47,348,000	$1,570,000	$122,000
Fulton County	**$4,242,450,000**	**$3,239,979,000**	**$569,959,000**	**$240,661,000**

Source: HAZUS-MH MR4

Notes:

(1) Replacement value reflects the building structure and does not include building contents. The valuation of general building stock and the loss estimates determined in Fulton County were based on the default general building stock database provided in HAZUS-MH MR4. The general building stock valuations provided in HAZUS-MH MR4 are Replacement Cost Value from RSMeans as of 2006.

(2) Total RV is the sum of all building classes (Residential, Commercial, Industrial, Agricultural, Religious, Government and Education).

(3) The total RV for the agricultural occupancy class is $10,979,000; the total RV for the religious occupancy class is $65,539,000; the total RV for the government occupancy class is $52,752,000; and the total RV for the education occupancy class is $59,591,000.

(4) The building stock replacement value represents the entire Village of Dolgeville (portions in both Fulton and Herkimer Counties).

Table 5.4.2-9 General Building Stock Estimated Losses from Severe Winter Storm/Extreme Cold Events in Fulton County

Municipality	Total (All Occupancy Classes)			Residential		
	1% Damage Loss Estimate	5% Damage Loss Estimate	10% Damage Loss Estimate	1% Damage Loss Estimate	5% Damage Loss Estimate	10% Damage Loss Estimate
Bleecker (T)	$562,300	$2,811,500	$5,623,000	$533,150	$2,665,750	$5,331,500
Broadalbin (T)	$2,564,610	$12,823,050	$25,646,100	$2,261,080	$11,305,400	$22,610,800
Broadalbin (V)	$904,020	$4,520,100	$9,040,200	$586,440	$2,932,200	$5,864,400
Caroga (T)	$2,343,770	$11,718,850	$23,437,700	$2,195,510	$10,977,550	$21,955,100
Dolgeville (V) (3)	$1,497,220	$7,486,100	$14,972,200	$1,081,230	$5,406,150	$10,812,300
Ephratah (T)	$784,840	$3,924,200	$7,848,400	$726,100	$3,630,500	$7,261,000
Gloversville (C)	$11,052,100	$55,260,500	$110,521,000	$8,079,070	$40,395,350	$80,790,700
Johnstown (C)	$7,765,210	$38,826,050	$77,652,100	$4,714,190	$23,570,950	$47,141,900
Johnstown (T)	$4,793,870	$23,969,350	$47,938,700	$3,610,250	$18,051,250	$36,102,500
Mayfield (T)	$3,531,650	$17,658,250	$35,316,500	$2,959,840	$14,799,200	$29,598,400
Mayfield (V)	$570,570	$2,852,850	$5,705,700	$439,490	$2,197,450	$4,394,900
Northampton (T)	$1,689,350	$8,446,750	$16,893,500	$1,579,630	$7,898,150	$15,796,300
Northville (V)	$920,660	$4,603,300	$9,206,600	$741,750	$3,708,750	$7,417,500
Oppenheim (T)	$871,300	$4,356,500	$8,713,000	$650,880	$3,254,400	$6,508,800
Perth (T)	$2,061,550	$10,307,750	$20,615,500	$1,767,700	$8,838,500	$17,677,000
Stratford (T)	$511,480	$2,557,400	$5,114,800	$473,480	$2,367,400	$4,734,800
Fulton County	**$42,424,500**	**$212,122,500**	**$424,245,000**	**$32,399,790**	**$161,998,950**	**$323,997,900**

Source: HAZUS-MH MR4

Notes:

(1) The building values shown are building structure only because damage from the severe winter storm/extreme cold hazard generally impact structures such as the roof and building frame (rather than building content).

(2) The valuation of general building stock and the loss estimates determined in the study area (Fulton County and the entire Village of Dolgeville) were based on the default general building stock database provided in HAZUS-MH MR4. The general building stock valuations provided in HAZUS-MH MR4 are Replacement Cost Value from RSMeans as of 2006.

(3) These values represent the entire Village of Dolgeville (portions both in Fulton and Herkimer Counties).

Historic information indicates Fulton County has experienced losses up to $25,000 in property damages due to a single severe winter storm event ($25,000 in property damage from heavy snow in 2003 and $25,000 in property damage from a winter storm in 2000). Specific losses to structures are unknown. These historic losses are less than the 1% damage loss estimates outlined above. Therefore, 1% damages to the general building stock structure may be over-estimating the estimated damages the County may incur as a result of a severe winter storm event.

A specific area that is vulnerable to the severe winter storm hazard is the floodplain. At risk general building stock and infrastructure in floodplains are presented in the flood hazard profile (Section 5.4.1). Generally, losses from flooding associated with severe winter storms should be less than that associated with a 100-year or 500-year flood. In summary, snow and ice melt can cause both riverine and urban flooding. Additionally, cold winter temperatures cause rivers to freeze. A rise in the water level due to snow/ice melt or a thaw breaking the river ice/compacted snow into large pieces can become jammed at man-made and natural obstructions (a.k.a., ice jams). Ice jams can act as a dam, resulting in severe flash riverine flooding. Estimated losses due to riverine flooding and ice jam events in Fulton County are discussed in Section 5.4.3.

Impact on Critical Facilities

Full functionality of critical facilities such as police, fire and medical facilities is essential for response during and after a severe winter storm/extreme cold event. HAZUS-MH MR4 estimates the replacement value for each police station is $1,652,000; and for each fire station is $708,000. These critical facility structures are largely constructed of concrete and masonry; therefore, they should only suffer minimal structural damage from severe winter storm events. Because power interruption can occur, backup power is recommended for critical facilities and infrastructure. Infrastructure at risk for this hazard includes roadways that could be damaged due to the application of salt and intermittent freezing and warming conditions that can damage roads over time. Severe snowfall requires infrastructure to clear roadways, alert citizens to dangerous conditions, and following the winter requires resources for road maintenance and repair. Additionally, freezing rain and ice storms impact utilities (i.e., power lines and overhead utility wires) causing power outages for hundreds to thousands of residents.

Impact on Economy

The cost of snow and ice removal and repair of roads from the freeze/thaw process can drain local financial resources. Another impact on the economy includes impacts on commuting into, or out of, the area for work or school. The loss of power and closure of roads prevents the commuter population traveling to work within and outside of the County.

Future Growth and Development

As discussed in Section 4, areas targeted for future growth and development have been identified across the County. Any areas of growth could be potentially impacted by the severe winter storm/extreme cold hazard because the entire planning area is exposed and vulnerable. For the severe winter storm hazard, the entire County has been identified as the hazard area. Please refer to Section 4 (County Profile) and each jurisdiction's annex (Section 9) for hazard maps that illustrate where potential new development is located in relation to Fulton County's hazard areas.

Additional Data and Next Steps

The assessment above identifies vulnerable populations and economic losses associated with this hazard of concern. Historic data on structural losses to general building stock are not adequate to predict specific losses to this inventory; therefore, the percent of damage assumption methodology was applied. This methodology is based on FEMA's How to Series (FEMA 386-2), Understanding Your Risks, Identifying and Estimating Losses (FEMA, 2001) and FEMA's Using HAZUS-MH for Risk Assessment (FEMA 433) (FEMA, 2004). The collection of additional/actual valuation data for general building stock and critical infrastructure losses would further support future estimates of potential exposure and damage for the general building stock inventory.

Overall Vulnerability Assessment

Severe winter storms and extreme cold temperatures are common in the study area, often causing impacts and losses to the County and local roads, structures, facilities, utilities, and population. The overall hazard ranking determined for this HMP for the severe winter storm/extreme cold hazard is 'high', with a 'frequent' probability of occurrence (hazard event is likely to occur within 25 years) (see Tables 5.3-3 through 5.3-6 in Section 5.3).

Existing and future mitigation efforts should continue to be developed and employed that will enable the study area to be prepared for these events when they occur. The cascade effects of severe winter storm/extreme cold temperature events include utility losses and transportation accidents and flooding. Losses associated with the flood hazard are discussed in Section 5.4.3. Particular areas of vulnerability include low-income and elderly populations, mobile homes, and infrastructure such as roadways and utilities that can be damaged by such storms and the low-lying areas that can be impacted by flooding related to rapid snow melt.