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 Saratoga County, most severe winter storm hazards include heavy snow, blizzards, sleet, freezing rain, ice storms and can be accompanied by extreme cold. Since most extra-tropical cyclones, particularly northeasters (or Nor'Easters), generally take place during the winter weather months (with some exceptions), Nor'Easters have also been grouped as a type of severe winter weather storm in this section. 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 cyclones, sometimes called mid-latitude cyclones, are a group of cyclones defined as synoptic scale, low pressure, weather systems that occur in the middle latitudes of the Earth. These storms have neither tropical nor polar characteristics and are connected with

fronts and horizontal gradients in temperature and dew point otherwise known as "baroclinic zones". Extra-tropical cyclones are everyday weather phenomena which, along with anticyclones, drive the weather over much of the Earth. These cyclones produce impacts ranging from cloudiness and mild showers to heavy gales and thunderstorms. Tropical cyclones often transform into extra-tropical cyclones at the end of their tropical existence, usually between 30° and 40° latitude, where there is sufficient force from upper-level shortwave troughs riding the westerlies (weather systems moving west to east) for the process of extra-tropical transition to begin. A shortwave trough is a disturbance in the mid or upper part of the atmosphere which induces upward motion ahead of it. During an extra-tropical transition, a cyclone begins to tilt back into the colder air mass with height, and the cyclone's primary energy source converts from the release of latent heat from condensation (from thunderstorms near the center) to baroclinic processes (Canadian Hurricane Centre [CHC], 2003).

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 extra-tropical cyclones (mid-latitude storms, or Great Lake storms). A Nor'Easter is a macro-scale extra-tropical storm whose winds come from the northeast, especially in the coastal areas of the Northeastern U.S. and Atlantic Canada. More specifically, it describes a low pressure area whose center of rotation is just off the coast and whose leading winds in the left forward quadrant rotate onto land from the northeast. Wind gusts associated with these storms can exceed hurricane forces in intensity. Unlike tropical cyclones that form in the tropics and have warm cores (including tropical depressions, tropical storms and hurricanes); Nor'Easters contain a cold core of low barometric pressure that forms in the mid-latitudes. Their strongest winds are close to the earth's surface and they often measure several hundred miles across. Nor'Easters may occur at any time of the year but are most common during the fall and winter months (September through April) (New York City Office of Emergency Management, 2008).

Nor'Easters can cause heavy snow, rain, gale force winds, and oversized waves (storm surge) potentially leading to beach erosion, coastal flooding, structural damage, power outages and unsafe human conditions. If a Nor'Easter cyclone stays just offshore, the results are much more devastating than if the cyclone meanders up the coast on an inland track. Nor'Easters that stay inland are generally weaker and only cause strong wind and rain. Those that stay offshore can bring heavy snow, blizzards, ice, strong winds, high waves, and severe beach erosion. In these storms, the warmer air is aloft. Precipitation falling from this warm air moves into the colder air at the surface, causing crippling sleet or freezing rain.

If a significant pressure drop occurs within a Nor'Easter, this change can turn a simple extra-tropical storm into what is known as a "bomb." "Bombs" are characterized by a pressure drop of at least 24 millibars within 24 hours (similar to a rapidly-intensifying hurricane). Even though "bombs" occasionally share some characteristics with hurricanes, the two storms have several differences. "Bombs" (being a type of Nor'Easter) are extra-tropical, and therefore, are associated with fronts, higher latitudes, and cold cores. They require strong upper-level winds, which would destroy a hurricane (McNoldy, Date Unknown).

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], 2005).

Also, winter storms can generate coastal flooding, ice jams and snow melt, resulting in significant damage and loss of life:

- Coastal Floods: Winds generated from intense winter storms can cause widespread tidal flooding and severe beach erosion along coastal areas.
- Ice Jams: Long cold spells can cause rivers and lakes to freeze. A rise in the water level or a thaw breaks the ice into large chunks that become jammed at man made and natural obstructions. Ice jams can act as a dam, resulting in severe flooding.
- Snowmelt: Sudden thaw of a heavy snow pack often leads to flooding (NSSL, 2006).

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, including Nor'Easter events, 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.
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,

Category	Description	NESIS Range	Definition
			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, 2007). 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 their 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 as 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
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

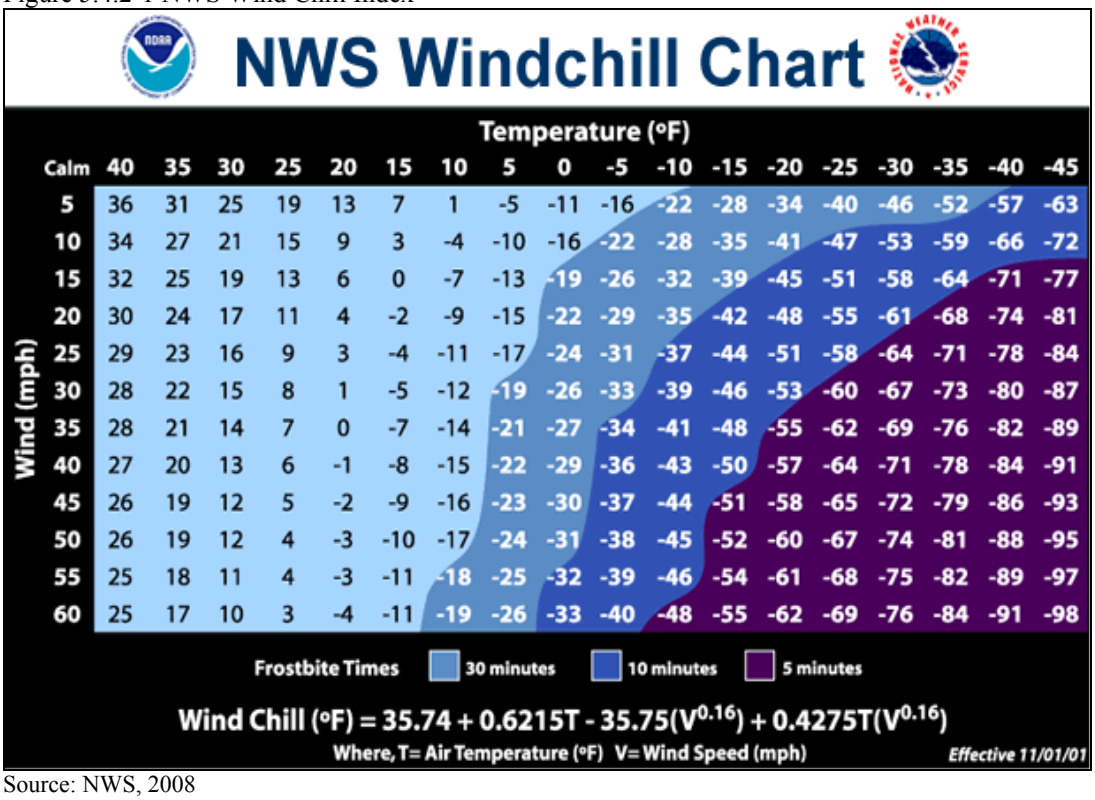
Dr. Gregory Zielinski, Maine's state climatologist and an associate research professor at the University of Maine Institute for Quaternary and Climate Studies, has developed a Nor'Easter intensity scale that deals more with the impact of the winter weather events associated with Nor'Easters. He uses this scale in application not only to Nor'Easters, but also for the Great Lakes Storms, like the one that sank the Edmund Fitzgerald. 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." In Zielinski's classification system, a second number reflecting forward speed is used together with the first number that is based on intensity. The second number also ranges between 1 and 5. A 5 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). Zielinski has used his scale in a historical investigation of New England's climate. He has classified more than 70 storms of the past, including the Great Arctic Outbreak of 1899, the Blizzard of 1888 and other storms that are part of U.S. weather lore. A December 2000 storm was the most intense event found in his study (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



Source: NWS, 2008

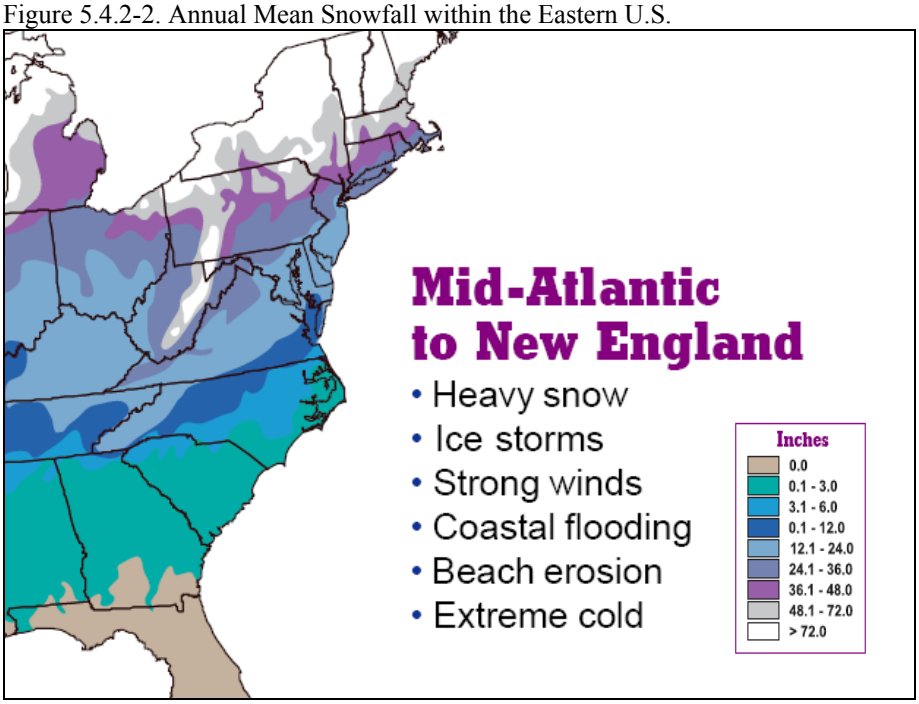
Location

The location of winter weather and extreme cold temperatures throughout New York State and Saratoga 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. 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 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. Although the entire State of New York is subject to winter storms, the eastern and west-Central portions of the State are more likely to suffer under winter storm occurrences than any other location (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. Saratoga County receives between 48 and 72 inches (Figure 5.4.2-2).

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



Source: NWS, 2001

Topography, elevation and proximity to large bodies of water result in a great variation of snowfall in the State's interior, even within relatively short distances. Maximum seasonal snowfall, averaging more than 175 inches, occurs on the western and southwestern slopes of the Adirondacks and Tug Hill. A secondary maximum of 150 to 180 inches prevails in the southwestern highlands, some 10 to 30-miles inland from Lake Erie. Record heavy snow accumulations, averaging from 100 to 120 inches, also occur within (1) the uplands of southwestern Onondaga County and adjoining counties; the Cherry Valley section of northern Otsego and southern Herkimer counties; and (3) the Catskill highlands in Ulster, Delaware and

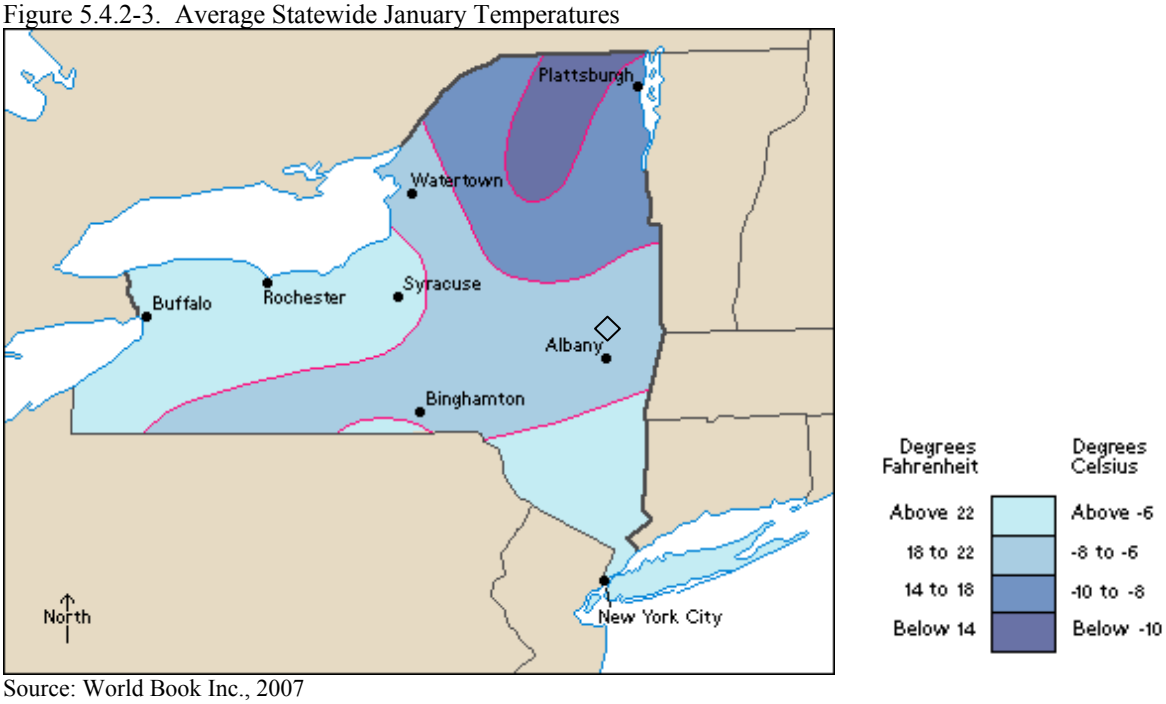
Sullivan counties. Minimum seasonal snowfall of 40 to 50 inches occur upstate in (1) Niagara County, near the south shore of Lake Ontario, (2) the Chemung and mid-Genesee River Valleys of western New York, and (3) near the Hudson River in Orange, Rockland, and Westchester Counties upstream to the southern portion of Albany County (New York State Climate [NYSC] Office, Date Unknown; NCDC, 2006).

The NYSDPC and NYSEMO listed Saratoga County as the 20th County in the State most threatened by and vulnerable to snow and snow loss, with an annual average snowfall of 68.7 inches. Saratoga County is also listed as the 40th County in New York State most threatened by and vulnerable to ice storms and ice storm loss (NYSDPC, 2008). Although Saratoga 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



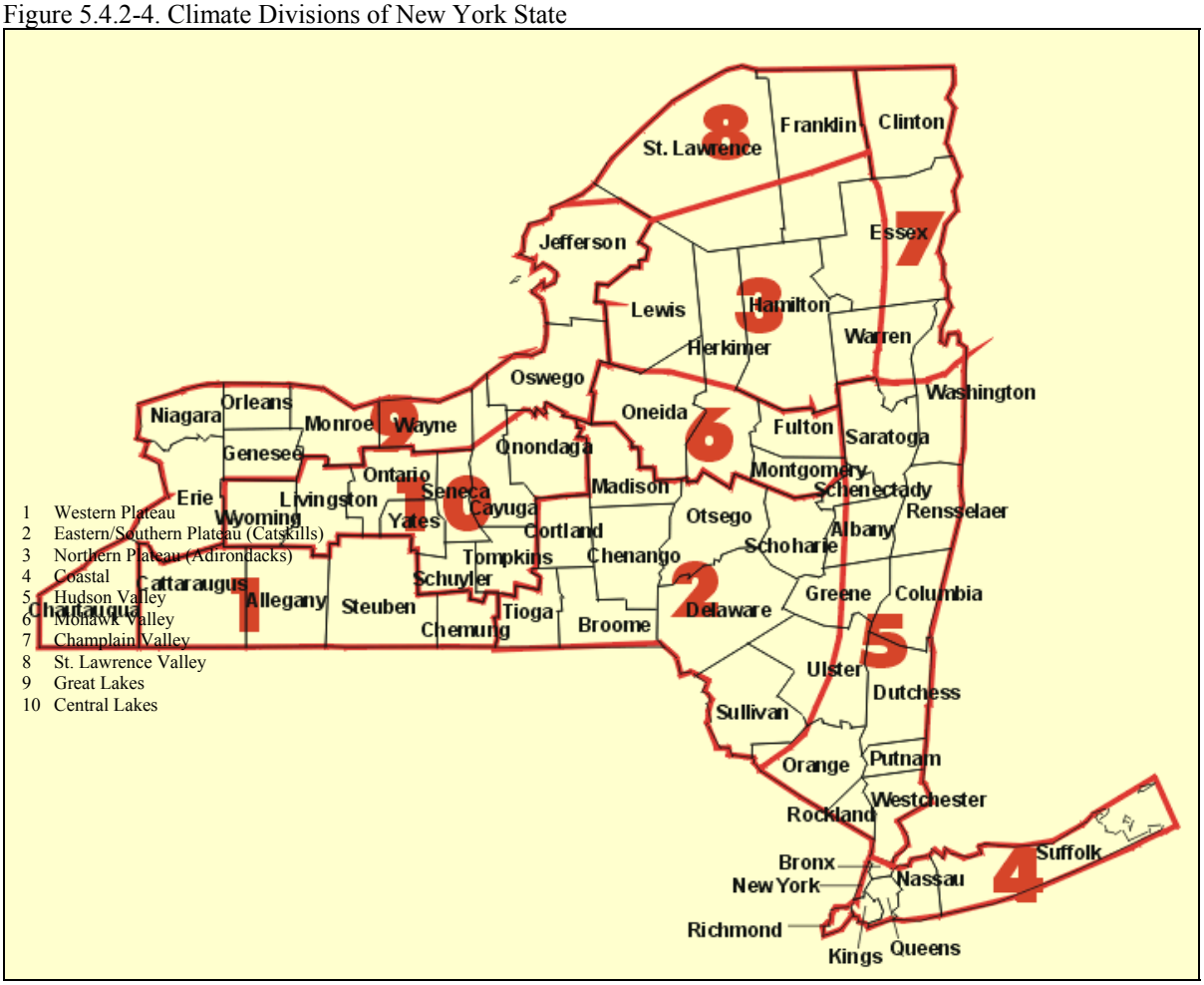
Source: World Book Inc., 2007

Note: ◊ indicates the approximate location of Saratoga 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

Saratoga County falls within the Hudson Valley (Division 5) (NCDC, Date Unknown; CPC, 2005; ERSL, Date Unknown). Winter temperatures in Division 5 are moderated by the Atlantic Ocean in the southern portion of the Hudson Valley Division. The coldest temperature in most winters will range between 0° and -10°F (NYSC, Date Unknown).

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

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

Month	Average High (°F)	Average Low (°F)	Record Low Events
January	28 - 34	8 - 15	-30 °F (1961) -26 °F (1968) -28 °F (1971) -23 to -35 °F (1994)
February	32 - 38	9 - 16	-22 °F (1943) -28 °F (1948) -23 °F (1967) -17 to -30 °F (1979) -30 °F (1994)
March	42 - 47	20 - 26	-16 to -21 °F (1948) -24 °F (1950) -13 °F (1967) -13 °F (1982) -13 °F (1984)
November	46 - 51	28 - 33	-11 °F (1938) -1 °F (1951) 2 °F (1962)
December	34 - 39	16 - 21	-23 °F (1950) -23 °F (1955) -22 °F (1969) -15 to -29 °F (1980)

Source: The Weather Channel, 1995-2007

Previous Occurrences and Losses

Many sources provided historical information regarding previous occurrences and losses associated with flooding throughout New York State and Saratoga 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 1888 and 2007 (Table 5.4.2-4) (Kocin and Uccellini, 2004; Enloe, 2007). 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 Saratoga 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 (1888 – 2007) (Arranged by Rank/Category)

Rank	Date	NESIS	Category	Description	Snowfall Range in Saratoga County (in inches)
1	March 12-14, 1993	12.52	5	Extreme	10-30
2	January 6-8, 1996	11.54	5	Extreme	0
3	February 15-18, 2003	8.91	4	Crippling	4-10
4	March 11-14, 1888	8.34	4	Crippling	30-50
5	February 11-14, 1899	8.11	4	Crippling	4-10
6	March 2-5, 1960	7.63	4	Crippling	4-20
7	January 21-24, 2005*	6.80	4	Crippling	NA

Rank	Date	NESIS	Category	Description	Snowfall Range in Saratoga County (in inches)
8	February 10-12, 1983	6.28	4	Crippling	0
9	February 5-7, 1978	6.25	4	Crippling	4-10
10	February 2-5, 1961	6.24	4	Crippling	10-30
11	February 14-17, 1958	5.98	3	Major	20-30
12	January 19-21, 1978	5.90	3	Major	4-20
13	January 11-14, 1964	5.74	3	Major	4-10
14	February 12-15, 2007*	5.63	3	Major	10-30
15	December 25-28, 1969	5.19	3	Major	20-40
16	January 29-31, 1966	5.05	3	Major	0
17	January 21-23, 1987	4.93	3	Major	10-20
18	January 7-8, 1988	4.85	3	Major	NA
19	February 8-12, 1994	4.81	3	Major	0-10
20	December 11-13, 1960	4.47	3	Major	4-10
21	January 22-23, 1966	4.45	3	Major	NA
22	February 17-19, 1979	4.42	3	Major	0
23	December 24-25, 2002	4.42	3	Major	10-30
24	February 18-20, 1972	4.19	3	Major	10-20
25	February 14-15, 1960	4.17	3	Major	NA
26	January 16-18, 1978	4.10	3	Major	NA
27	February 12-13, 2006*	4.10	3	Major	0-4
28	February 22-28, 1969	4.01	3	Major	1-10
29	March 18-21, 1958	3.92	2	Significant	1-4
30	February 5-7, 1967	3.82	2	Significant	0
31	December 23-25, 1966	3.79	2	Significant	10-30
32	April 6-7, 1982	3.75	2	Significant	4-10
33	March 3-5, 1971	3.73	2	Significant	NA
34	March 12-13, 1959	3.64	2	Significant	NA
35	January 27-29, 1922	3.63	2	Significant	0
36	March 3-5, 2001	3.53	2	Significant	20-30
37	February 2-4, 1995	3.51	2	Significant	10-20
38	December 26-27, 1947	3.50	2	Significant	4-10
39	January 18-21, 1961	3.47	2	Significant	0-4
40	March 2-4, 1994	3.46	2	Significant	NA
41	February 8-10, 1969	3.34	2	Significant	4-10
42	December 19-20, 1995	3.32	2	Significant	NA

Rank	Date	NESIS	Category	Description	Snowfall Range in Saratoga County (in inches)
43	December 22-23, 1963	3.17	2	Significant	NA
44	January 24-26, 2000	3.14	2	Significant	4-20
45	December 10-12, 1992	3.10	2	Significant	NA
46	January 13-15, 1982	3.08	2	Significant	NA
47	March 16-17, 1956	2.93	2	Significant	NA
48	January 3-5, 1994	2.87	2	Significant	NA
49	March 6-7, 1962	2.76	2	Significant	NA
50	January 3-4, 2003	2.65	2	Significant	10-30
51	March 15-18, 2007*	2.55	2	Significant	10-20
52	December 30-31, 2000	2.48	1	Notable	10-30
53	February 19-20, 1964	2.39	1	Notable	NA
54	March 31-April 1, 1997	2.37	1	Notable	4-10
55	November 25-27, 1971	2.33	1	Notable	NA
56	January 1-2, 1987	2.26	1	Notable	NA
57	March 18-19, 1956*	2.23	1	Notable	0
58	March 15-16, 1999	2.20	1	Notable	NA
59	February 16-17, 1952	2.17	1	Notable	NA
60	December 31 – January 1, 1971	2.10	1	Notable	NA
61	February 2-4, 1996	2.03	1	Notable	NA
62	December 4-5, 2002	1.99	1	Notable	0
63	January 16-17, 1965	1.95	1	Notable	NA
64	March 28-29, 1984	1.86	1	Notable	NA
65	January 25-26, 1987	1.70	1	Notable	0
66	February 16-17, 1996	1.65	1	Notable	NA
67	February 14-15, 1962	1.59	1	Notable	NA
68	December 26-27, 1990	1.56	1	Notable	1-4
69	February 22-23, 1987	1.46	1	Notable	0
70	December 23-25, 1961	1.37	1	Notable	NA
71	December 3-5, 1957	1.32	1	Notable	NA
72	March 8-9, 1984	1.29	1	Notable	NA
73	March 21-22, 1967	1.20	1	Notable	NA
74	February 6-7, 2003	1.18	1	Notable	0

Source: Kocin and Uccellini, 2004; Enloe, 2007
Note: The two sources used for this table identify different NESIS ratings for each event; therefore, the NESIS rating may vary upon reviewing the source.
* Additional events listed by Enloe (NOAA) between 2003 and 2007 that were not identified by Kocin and Uccellini.
NA Information regarding actual snowfall totals was not provided for these events.

Between 1953 and 2007, FEMA declared that New York State experienced over 18 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 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, Saratoga County has been declared as a disaster area as a result of four winter storm events (FEMA, 2008; NYSDPC, 2008). No extreme cold temperature events resulted in federal disaster declarations. Table 5.4.2-5 summarizes the FEMA Presidential Disaster (DR) or Emergency (EM) Declarations for winter storm events for the County.

Table 5.4.2-5. Presidential Disaster / Emergency Declarations for Severe Winter Storm Events in Saratoga County

Type of Event*	Date**	Declaration Number	Cost of Losses (approximate)***
Severe Winter Storm	October 1987	DR-801	New York State experienced approximately $13.5 M in eligible damages. Three inches up to about 2 feet of extremely wet snow fell across eastern New York and western New England resulting in many deaths and injuries and an enormous amount of property damage. The storm dumped over a foot of wet snow in Saratoga County, toppling trees and power lines and leaving some without power for over a week. Estimated losses in the County are unknown.
Severe Blizzard ("The Storm of the Century") (also identified as a Nor'Easter)	March 1993	EM-3107	Listed as a top billion dollar weather disaster storm, impacting 26 states and resulted in approximately $3 B in damages. FEMA declared an EM in 17 states, including New York State. New York State experienced approximately $8.4 M in eligible damages. Saratoga County received between 10 to 30 inches of snow from this event. Clifton Park received over 27 inches of snow. Estimated losses in the County are unknown.
Severe Winter Storm	January 1998	DR-1196	This event was identified as a winter storm event with major flooding. The heavy rain and snow melt during the event resulted in significant flooding throughout six counties of New York State, including Saratoga County. New York State experienced approximately $68.1 M in damages. NCDC and SHELDUS indicated that Saratoga County experienced between $125 and $745 K in property damages.
Snowstorm	December 2002 / January 2003	EM-3173	Multiple counties throughout New York State experienced an impact from this disaster. In December 2002, Saratoga County received between 10 to 30-inches of snow. NWS indicated that snow totals in Saratoga County ranged from 18.2 inches in the Town of Clifton Park to 22.0 inches in the Village of Ballston Spa. However, other sources indicated that the County received much more snow, including 26 inches in Saratoga Springs. A transformer malfunction left 2,600 customers in the dark in the Ballston Spa area with spotty power outages noted elsewhere. Snow totals during the January 2003 event in Saratoga County ranged from 14 inches in Corinth and Town of Edinburg to 22 inches in the Town of Malta. Saratoga County was only declared a disaster area for the December 2002 event; however, according to SHELDUS, the County suffered over $29 K in property losses during the January 2003 event. More than $11.3 M in disaster aid was approved for the State for both events. On April 29, 2003, FEMA indicated that Saratoga County received approximately $559 K in disaster aid.

Source: FEMA, 2008; NCDC, 2008; NYSEMO, 2006; Kocin and Uccellini, 2004
Note (1): Dollars rounded to nearest thousand. Recorded losses indicate the dollar value of covered losses paid, as available through the public records reviewed.
* The 'Type of Event' is the disaster classification that was assigned to the event by FEMA.
** Date of Incident
*** Flood impact or damage associated with any of these events are further discussed in Section 5.4.1

B	Billion ($)
cfs	Cubic Feet Per Second
FEMA	Federal Emergency Management Agency
K	Thousand ($)
M	Million ($)
EM	Emergency Declaration
DR	Presidential Disaster

Based on all sources researched, winter storm and extreme cold events that have impacted Saratoga County are identified in Table 5.4.2.6. With winter storm documentation for New York State being so extensive, not all sources may have been identified or researched. Hence, Table 5.4.2-6 may not include all events that have occurred throughout the region.

Table 5.4.2-6 Severe Winter Events between 1888 and 2008

Event Date / Name	Location	Losses / Impacts	Source(s)
Blizzard March 11-14, 1888 (Blizzard of '88 or "Great White Hurricane")	Multi-State	$25 M nationwide in fire losses, 30 to 50 inches of snow fell in Saratoga County. 58 inches of snow fell in Saratoga Springs.	Brunner, Kocin and Uccellini, Lott, Kocin
Blizzard February 1, 1898	Multi-County	The worst blizzard Saratoga and the Adirondacks have suffered since March 1888. Railroad traffic paralyzed.	New York Times
Snowstorm February 9, 1906	Multi-County	Spier Falls (Town of Moreau) received 24 inches.	NCDC Snow Climatology
Blizzard February 12, 1910	Multi-County	Snowdrifts were 20-feet deep in Saratoga County.	New York Times
Snowstorm December 14, 1917	Multi-County	Spier Falls (Town of Moreau) received 20 inches.	NCDC Snow Climatology
Snowstorm January 30, 1925	Multi-County	Spier Falls (Town of Moreau) received 18 inches.	NCDC Snow Climatology
Extreme Cold December 29-20, 1933	Countywide	Low temperatures in the Town of Clifton Park: -18 to -21^{O}F.	The Weather Channel
Extreme Cold February 9, 1934	Countywide	Low temperatures in the Town of Clifton Park: -20^{O}F.	The Weather Channel
Extreme Cold November 26, 1938	Countywide	Record low temperatures for the month of November in the Town of Clifton Park: -11^{O}F.	The Weather Channel
Snowstorm January 31, 1939	Multi-County	Spier Falls (Town of Moreau) received 21 inches in a 2 day period.	NCDC Snow Climatology
Extreme Cold February 15-16, 1943	Countywide	Record cold event for the City of Saratoga Springs and the Town of Clifton Park: -20 to -35^{O}F.	The Weather Channel, MRCC
Blizzard December 26-27, 1947	Multi-State	4 to 10 inches of snow fell in Saratoga County.	Kocin and Uccellini
Extreme Cold January 30-31, 1948	Countywide	Low temperatures in the hamlets of Ballston Lake and Rexford and Town of Clifton Park: -16 to -26^{O}F.	The Weather Channel
Extreme Cold February 1-11, 1948	Countywide	Record low temperatures for the month of February in the hamlets of Ballston Lake and Rexford: -5 to -28^{O}F.	The Weather Channel
Extreme Cold March 5-6, 1948	Countywide	Record low temperatures for the month of March in the hamlets of Ballston Lake and Rexford and Town of Clifton Park: -9 to -21^{O}F.	The Weather Channel
Extreme Cold March 3-4, 1950	Countywide	Record low temperatures for the month of March in the Village of South Glen Falls: -17 to -24^{O}F. Low temperatures in the hamlets of Ballston Lake and Rexford and Town of Clifton	The Weather Channel

Event Date / Name	Location	Losses / Impacts	Source(s)
		Park: -6 to -20^{O}F.	
Extreme Cold December 27-28, 1950	Countywide	Record low temperatures for the month of December in the Town of Milton: -13 to -23^{O}F.	The Weather Channel
Extreme Cold November 28, 1951	Countywide	Record low temperatures for the month of November in the Village of South Glen Falls: -1^{O}F.	The Weather Channel
Extreme Cold January 17-18, 1954	Countywide	Low temperatures in the Town of Milton: -16 to -22^{O}F.	The Weather Channel
Extreme Cold December 21-23, 1955	Countywide	Record low temperatures for the month of December in the Villages of Ballston Spa, Galway, Round Lake, Schuylerville City of Saratoga Springs, ,Greenfield Center, Victory Mills, Middle Grove and hamlet of Rock City Falls: -19 to -23^{O}F.	The Weather Channel
Extreme Cold January 14-19, 1957	Countywide	Low temperatures in Ballston Spa, Galway, Greenfield Center, Round Lake, City of Saratoga Springs, Schuylerville, Victory Mills, Middle Grove, Rock City Falls, Stillwater, City of Mechanicville, Waterford and Clifton Park: -19 to -32^{O}F.	The Weather Channel
Snowstorm February 14-19, 1958	Multi-State	20 to 30 inches of snow fell in Saratoga County. West Milton and Spier Falls (Town of Moreau) received between 23 and 25 inches over a 4 day period.	Kocin and Uccellini, NCDC Snow Climatology
Snowstorm March 2-5, 1960	Multi-County	Saratoga County experienced over $8 K in property damages. 4 to 20 inches of snow fell in Saratoga County.	Hazards and Vulnerability Research Institute (SHELDUS), Kocin and Uccellini
Extreme Cold December 28-29, 1960	Countywide	Low temperatures in Ballston Spa, Galway, Greenfield Center, Round Lake, Saratoga Springs, Schuylerville, Victory Mills, Middle Grove and Rock City Falls: -14 to -20^{O}F.	The Weather Channel
Extreme Cold January 21-23, 1961	Countywide	Record low temperatures for the month of January in the Town of Milton: -16 to -30^{O}F.	The Weather Channel
Snowstorm / Extreme Cold February 1-5, 1961	Statewide	Saratoga County experienced approximately $81 K in property damages. 10 to 30 inches of snow fell in Saratoga County. Conklingville Dam received over 22 inches in a 2 day period. Low temperatures in Ballston Spa, Galway, Greenfield Center, Round Lake, Saratoga Springs, Schuylerville, Victory Mills, Middle Grove, Rock City Falls, Milton, Ballston Lake, Rexford, Stillwater, Mechanicville, Waterford: -8 to -22^{O}F.	Hazards and Vulnerability Research Institute (SHELDUS), Kocin and Uccellini, Evans, The Weather Channel, NCDC Snow Climatology
Snowstorm February 15, 1962	Multi-County	Conklingville Dam received 15.8 inches.	NCDC Snow Climatology
Extreme Cold March 2-4, 1962	Countywide	Low temperatures in Ballston Spa, Galway, Greenfield Center, Round Lake, Saratoga Springs, Schuylerville, Victory Mills, Middle Grove and Rock City Falls: -12 to -13^{O}F.	The Weather Channel
Extreme Cold November 19, 1962	Countywide	Low temperatures in Ballston Spa, Galway, Greenfield Center, Round Lake, Saratoga Springs, Schuylerville, Victory Mills, Middle Grove and Rock City Falls: 2^{O}F.	The Weather Channel
Extreme Cold December 30-31, 1963	Countywide	Low temperatures in Ballston Spa, Galway, Greenfield Center, Round Lake, Saratoga Springs, Schuylerville, Victory Mills,	The Weather Channel

Event Date / Name	Location	Losses / Impacts	Source(s)
		Middle Grove, Rock City Falls, Stillwater, Mechanicville, Waterford and South Glen Falls: -1 to -22^{O}F.	
Snowstorm December 23-29, 1966	Multi-County	10 to 30 inches of snow fell in Saratoga County.	Kocin and Uccellini
Extreme Cold February 8, 1967	Countywide	Record low temperatures for the month of February in the Town of Milton and Village of South Glen Falls: -23 to -28^{O}F.	The Weather Channel
Extreme Cold February 13, 1967	Countywide	Low temperatures in Ballston Spa, Galway, Greenfield Center, Round Lake, Saratoga Springs, Schuylerville, Victory Mills, Middle Grove, Rock City Falls and South Glen Falls: -25^{O}F.	The Weather Channel
Extreme Cold March 17-19, 1967	Countywide	Record low temperatures for the month of March in Stillwater, City of Mechanicville, Waterford, Town of Milton and Village of South Glen Falls: 4 to -15^{O}F.	The Weather Channel
Extreme Cold January 8-13, 1968	Countywide	Record low temperatures for the month of January in Ballston Lake and Rexford: -15 to -26^{O}F. Low temperatures in Ballston Spa, Galway, Greenfield Center, Round Lake, Saratoga Springs, Schuylerville, Victory Mills, Middle Grove, Rock City Falls, Stillwater, Mechanicville, Waterford, Milton and Clifton Park: -6 to -31^{O}F.	The Weather Channel
Extreme Cold December 25, 1969	Countywide	Record low temperatures for the month of November in the Town of Clifton Park: -22^{O}F.	The Weather Channel
Snowstorm December 25-28, 1969	Multi-County	20 to 40 inches of snow fell in Saratoga County. Conklingville Dam received over 22 inches in a 3 day period.	Kocin and Uccellini, NWS, NCDC Snow Climatology
Extreme Cold January 1-3, 1970	Countywide	Low temperatures in Clifton Park: -14 to -20^{O}F.	The Weather Channel
Extreme Cold January 16-19, 1971	Countywide	Record low temperatures for the month of January in the Town of Clifton Park: -16 to -28^{O}F.	The Weather Channel
Snowstorm November 25-27, 1971	Multi-County	West Milton and Saratoga Springs received between 22 and 24 inches over a 2 day period.	NCDC Snow Climatology
Extreme Cold February 17-19, 1973	Countywide	Low temperatures in the Village of South Glen Falls and Town of Clifton Park: -4 to -29^{O}F.	The Weather Channel
Extreme Cold January 9-19, 1976	Countywide	Low temperatures in Towns of Hadley and Corinth and Village of South Glen Falls: -15 to -30^{O}F.	The Weather Channel
Extreme Cold January 23, 1976	Countywide	Low temperatures in the Village of South Glen Falls: -32^{O}F.	The Weather Channel
Extreme Cold December 3-4, 1976	Countywide	Low temperatures in Ballston Spa, Galway, Greenfield Center, Round Lake, Saratoga Springs, Schuylerville, Victory Mills, Middle Grove and Rock City Falls: -5 to -11^{O}F.	The Weather Channel
Extreme Cold December 11-12, 1977	Countywide	Low temperatures in Ballston Spa, Galway, Greenfield Center, Round Lake, Saratoga Springs, Schuylerville, Victory Mills, Middle Grove, Rock City Falls, Hadley and Corinth: -12 to -17^{O}F.	The Weather Channel

Event Date / Name	Location	Losses / Impacts	Source(s)
Blizzard January 19-22, 1978	Multi-County	10 to 20 inches of snow fell in Saratoga County. West Milton received 26 inches over a 4 day period.	Kocin and Uccellini, NCDC Snow Climatology
Blizzard / Extreme Cold February 4-8, 1978	Multi-County	4 to 10 inches of snow fell in Saratoga County. Low temperatures in Ballston Spa, Galway, Greenfield Center, Round Lake, Saratoga Springs, Schuylerville, Victory Mills, Middle Grove and Rock City Falls: -17 to -20^{O}F.	Kocin and Uccellini, The Weather Channel
Extreme Cold January 19, 1979	Countywide	Low temperatures in Hadley and Corinth: -26^{O}F.	The Weather Channel
Extreme Cold February 10-14, 1979	Countywide	Low temperatures in the Towns of Hadley, Corinth, Milton and Village of South Glen Falls: -12 to -25^{O}F.	The Weather Channel, MRCC
Extreme Cold February 17-19, 1979	Countywide	Record low temperatures for the month of February in Conklingville Dam, Ballston Spa, Galway, Greenfield Center, Round Lake, Saratoga Springs, Schuylerville, Victory Mills, Middle Grove, Rock City Falls, Hadley, Corinth, Stillwater, Mechanicville, Waterford: -11 to -30^{O}F.	The Weather Channel, MRCC
Extreme Cold December 20 -27, 1980	Countywide	Low temperatures in Ballston Spa, Galway, Greenfield Center, Round Lake, Saratoga Springs, Schuylerville, Victory Mills, Middle Grove, Rock City Falls, Milton, Hadley and Corinth: -11 to -22^{O}F. Record low temperatures for the month of December in Ballston Lake, Rexford, Stillwater, Mechanicville, Waterford and South Glen Falls: -10 to -29^{O}F.	The Weather Channel
Extreme Cold January 3-4, 1981	Countywide	Low temperatures in Ballston Spa, Galway, Greenfield Center, Round Lake, Saratoga Springs, Schuylerville, Victory Mills, Middle Grove and Rock City Falls: -16 to -31^{O}F.	The Weather Channel
Extreme Cold January 3-13, 1981	Countywide	Low temperatures in Hadley and Corinth: -12 to -24^{O}F.	The Weather Channel
Extreme Cold March 4, 1982	Countywide	Record low temperatures for the month of March in Ballston Spa, Galway, Greenfield Center, Round Lake, Saratoga Springs, Schuylerville, Victory Mills, Middle Grove, Rock City Falls, Hadley and Corinth: -12 to -13^{O}F.	The Weather Channel
Snowstorm April 6-7, 1982	Multi-County	4 to 10 inches of snow fell in Saratoga County.	Kocin and Uccellini
Snowstorm January 15-17, 1983	Multi-County	Snow falls in Saratoga County reached 30 inches. West Milton received 21 inches and Conklingville Dam received over 31.4 inches in a 3 day period. The heavy snow brought travel to a standstill across many locations, and may injuries were reported due to auto accidents. Saratoga County experienced approximately $238 K in property damages.	Hazards and Vulnerability Research Institute (SHELDUS), NWS, NCDC Snow Climatology
Snowstorm January 23, 1983	Countywide	Saratoga County experienced approximately $238 K in property damages.	Hazards and Vulnerability Research Institute (SHELDUS)
Snowstorm February 6, 1983	Countywide	Saratoga County experienced approximately $27 M in property damages (this appears inaccurate).	Hazards and Vulnerability Research Institute (SHELDUS)

Event Date / Name	Location	Losses / Impacts	Source(s)
Snowstorm April 19, 1983	Countywide	Saratoga County experienced approximately $238 K in property damages.	Hazards and Vulnerability Research Institute (SHELDUS)
Snowstorm December 6, 1983	Countywide	Saratoga County experienced approximately $179 K in property damages.	Hazards and Vulnerability Research Institute (SHELDUS)
Snowstorm December 29, 1983	Countywide	Saratoga County experienced approximately $179 K in property damages.	Hazards and Vulnerability Research Institute (SHELDUS)
Snowstorm February 28, 1984	Multi-County	Saratoga County experienced approximately $238 K in property damages.	Hazards and Vulnerability Research Institute (SHELDUS)
Extreme Cold March 10-12, 1984	Countywide	Record low temperatures for the month of March in the Towns of Hadley and Corinth: -11 to -13^{O}F	The Weather Channel
Snowstorm March 7, 1986	Multi-County	Saratoga County experienced approximately $24 K in property damages.	Hazards and Vulnerability Research Institute (SHELDUS)
Snowstorm January 21-24, 1987	Multi-County	10 to 20 inches of snow fell in Saratoga County.	Kocin and Uccellini
Extreme Cold February 15-16, 1987	Countywide	Low temperatures in Ballston Spa, Galway, Greenfield Center, Round Lake, Saratoga Springs, Schuylerville, Victory Mills, Middle Grove and Rock City Falls: -16 to -20^{O}F.	The Weather Channel
Extreme Cold December 22-24, 1989	Countywide	Low temperatures in Ballston Spa, Galway, Greenfield Center, Round Lake, Saratoga Springs, Schuylerville, Victory Mills, Middle Grove, Rock City Falls, Hadley, Corinth, Milton and South Glen Falls: -12 to -23^{O}F.	The Weather Channel
Snowstorm February 24-25, 1990	Countywide	Saratoga County experienced approximately $545 K in property damages.	Hazards and Vulnerability Research Institute (SHELDUS)
Snowstorm March 20, 1990	Countywide	Saratoga County experienced approximately $29 K in property damages.	Hazards and Vulnerability Research Institute (SHELDUS)
Freezing Rain January 16, 1991	Countywide	Saratoga County experienced approximately $36 K in property damages.	Hazards and Vulnerability Research Institute (SHELDUS)
Freezing Rain March 3, 1991	Countywide	Saratoga County experienced approximately $833 K in property damages.	Hazards and Vulnerability Research Institute (SHELDUS)
Snowstorm December 29, 1991	Countywide	Saratoga County experienced approximately $17 K in property damages.	Hazards and Vulnerability Research Institute (SHELDUS)
Snowstorm November 17, 1992	Countywide	Saratoga County experienced approximately $56 K in property damages.	Hazards and Vulnerability Research Institute (SHELDUS)
Nor'Easter December 11-12, 1992	Multi-State	Resulted in a Disaster Declaration for multiple New York State counties (DR-974), however, it did not include Saratoga County. Snow totals in Saratoga County ranged from 2.5 inches in Round lake to 6.2 in Clifton Park	CBS06, FEMA, NYSDPC, NYSEMO
Snowstorm January 3, 1993	Countywide	Saratoga County experienced approximately $31 K in property damages.	Hazards and Vulnerability Research Institute (SHELDUS)
Snowstorm / Extreme Cold February 6-7, 1993	Countywide	Saratoga County experienced approximately $31 K in property damages. Low temperatures in Ballston Spa, Galway, Greenfield Center, Round Lake, Saratoga Springs,	Hazards and Vulnerability Research Institute (SHELDUS), The Weather Channel

Event Date / Name	Location	Losses / Impacts	Source(s)
		Schuylerville, Victory Mills, Middle Grove, Rock City Falls, Hadley, Corinth and South Glen Falls: -21 to -26^{O}F.	
Blizzard "The Storm of the Century" March 12-15, 1993 (FEMA EM-3107)	Statewide	See FEMA Disaster Declarations (Table 5.4.2-5)	FEMA, Kocin and Uccelliini, NYSDPC, NWS, Steinberg (New York Times), Miller
Extreme Cold March 15-19, 1993	Countywide	Low temperatures in Ballston Spa, Galway, Greenfield Center, Round Lake, Saratoga Springs, Schuylerville, Victory Mills, Middle Grove, Rock City Falls, Hadley and Corinth: -4 to -12^{O}F.	The Weather Channel
Frost September 20, 1993	Countywide	Saratoga County experienced approximately $31 K in property damages.	Hazards and Vulnerability Research Institute (SHELDUS)
Extreme Cold January 16-21, 1994	Countywide	Record low temperatures for the month of January in Hadley, Corinth and South Glen Falls: -19 to -34^{O}F.	The Weather Channel
Winter Storm / Extreme Cold January 27-28, 1994	Countywide	Record low temperatures for the month of January in the Cities of Saratoga Springs and Mechanicville, Towns of Corinth, Galway, Hadley, Milton, Stillwater, Waterford, Villages of Ballston Spa, Schuylerville, South Glen Falls, Greenfield Center, Round Lake, Victory Mills, Middle Grove, Rock City Falls,: -18 to -35^{O}F. Saratoga County experienced approximately $27 K in property damages.	The Weather Channel, Hazards and Vulnerability Research Institute (SHELDUS)
Extreme Cold February 9-10, 1994	Countywide	Record low temperatures for the month of February in the Village of South Glen Falls:-16 to -30^{O}F.	The Weather Channel
Winter Storm March 1-31, 1994	Countywide	Saratoga County experienced approximately $31 K in property damages. Conklingville Dam received 28 inches of snow on March 4-5.	Hazards and Vulnerability Research Institute (SHELDUS), NCDC Snow Climatology
Winter Storm December 31, 1994	Countywide	Saratoga County experienced approximately $36 K in property damages.	Hazards and Vulnerability Research Institute (SHELDUS)
Snowstorm February 2-4, 1995	Multi-State	10 to 20 inches of snow fell in Saratoga County.	Kocin and Uccellini
Snowstorm February 15-16, 1995	Countywide	Saratoga County experienced approximately $500 K in property damages.	Hazards and Vulnerability Research Institute (SHELDUS)
Snowstorm March 8-9, 1995	Countywide	Saratoga County experienced approximately $100 K in property damages.	Hazards and Vulnerability Research Institute (SHELDUS)
Blizzard / Extreme Cold January 6-8, 1996	Multi-State	Resulted in a Disaster Declaration for multiple New York State counties (DR-1083), however, it did not include Saratoga County. Saratoga County received approximately 2 to 8 inches if snow. Low temperatures in the Towns of Hadley, Corinth, Stillwater and Waterford, and City of Mechanicville: -16 to -21^{O}F.	FEMA, NYSDPC, NYSEMO, Kocin and Uccellini, The Weather Channel, NSIDC
Snowstorm / Extreme Cold March 8-10, 1996	Multi-State	The region's heaviest snows were in upstate New York: 9.3 inches in Albany County and 14 inches in Saratoga County.	NOAA-NCDC, McFadden, The Weather Channel

Event Date / Name	Location	Losses / Impacts	Source(s)
		Low temperatures in the Village of South Glen Falls: -10 to -14°F.	
Winter Storm March 31- April 1, 1997	Multi-County	Snow accumulations in Saratoga County ranged from 7 inches in the Village of Ballston Spa to 15 inches in Clifton Park. Saratoga County experienced approximately $709 K in property damages.	NOAA-NCDC, Hazards and Vulnerability Research Institute (SHELDUS), Freedom Communications
Winter Storm April 1, 1997	Multi-County	10 inches of snow fell in Saratoga Springs.	NOAA-NCDC
Winter Storm November 14, 1997	Multi-County	11 inches of snow fell in Saratoga Springs.	NOAA-NCDC
Snow / Ice Storm January 5-17, 1998 (FEMA DR-1196)	Multi-State	See FEMA Disaster Declarations (Table 5.4.2-5)	FEMA, NYSDPC, NYSEMO
Freezing Rain December 8, 1998	Wilton	Freezing rain produced slick roads that lead to a five car collision in the town of Wilton in Saratoga County. The Town of Wilton experienced approximately $10 K in property damages.	NOAA-NCDC
Snowstorm December 22, 1998	Wilton	A band of lake effect snow off Lake Ontario moved across northern portions of the Mohawk Valley and the Lake George Saratoga Region. While accumulations from this lake effect snow were relatively light, the band produced locally poor visibilities and slick roads. As a result, there were dozens of accidents on the evening of December 22. The worst accident included a six car pile-up on Union Avenue in Saratoga Springs in Saratoga County. The accident forced twenty cars off the road.	NOAA-NCDC
Winter Storm January 2, 1999	Multi-County	Ice buildup downed power lines which caused 2,500 residents to be without power in the Mid Hudson Valley and an additional 1,200 customers without power in the Saratoga region.	NOAA-NCDC
Snowstorm January 14-15, 1999	Multi-County	Saratoga Springs received 9.5 inches of snow.	Freedom Communications
Snowstorm March 6-7, 1999	Multi-County	Snowfall totals In Saratoga County ranged from 9.7 inches in the Town of Clifton Park to 16.0 inches in the Town of Hadley.	Freedom Communications
Heavy Snow January 25-26, 2000	Multi-County	Snow totals in Saratoga County ranged from 7 inches in Greenfield Center to 13 inches in Porter Corners. Saratoga County experienced approximately $43 K in property damages.	Freedom Communications, Kocin and Uccellini, Hazards and Vulnerability Research Institute (SHELDUS)
Winter Storm February 14, 2000	Multi-County	Stillwater received 13 inches of snow; Round Lake received 11.2 inches of snow. Saratoga County experienced approximately $28 K in property damages.	NOAA-NCDC, Hazards and Vulnerability Research Institute (SHELDUS)
Snowstorm	Multi-County	Snow totals in Saratoga County ranged from 5.5 inches in	CBS06, NOAA-NCDC, Hazards and

Event Date / Name	Location	Losses / Impacts	Source(s)
April 9, 2000		Corinth to 15 inches in Clifton Park. Up to 35,000 customers in eastern New York were without power during the height of the storm. Counties affected experienced approximately $375 K in property damages. Saratoga County experienced approximately $25 K in property damages.	Vulnerability Research Institute (SHELDUS)
Snowstorm December 30-31, 2000	Multi-State	Snow totals in Saratoga County ranged from 6.5 inches in the Town of Northumberland to 12.5 inches in Porter Corners.	NOAA-NCDC, Kocin and Uccellini, McFadden, Freedom Communications
Snowstorm February 5, 2001	Multi-County	Snow totals in Saratoga County ranged from 5.25 inches in the Town of Corinth to 8.25 inches in the Town of Providence.	Freedom Communications
Nor'Easter March 4-7, 2001	Multi-County	Snow totals in Saratoga County ranged from 21 inches in Middle Grove and the Town of Edinburg to 31.5 inches in Saratoga Springs.	Freedom Communications, Kocin and Uccellini, NOAA-NCDC, NCDC Snow Climatology
Winter Storm March 9, 2001	Multi-County	This event resulted in twenty-five vehicles being stuck on Corinth Mountain Road, in Saratoga County, but with no injuries or damage to the vehicles. Counties affected experienced approximately $50 K in property damages.	NOAA-NCDC
Snowstorm January 6-7, 2002	Multi-County	Snow totals in Saratoga County ranged from 8.3 inches in Galway to 11.7 inches in Round Lake.	NWS
Winter Storm December 11-12, 2002	Multi-County	Snow totals in Saratoga County ranged from 4.6 inches in Clifton park to 10.0 inches in Conklingville.	NOAA-NCDC, NWS
Snowstorm December 24-25, 2002 and January 3-4, 2003	Multi-County	See FEMA Disaster Declarations (Table 5.4.2-5)	FEMA, Kocin and Uccellini, NOAA-NCDC, Hazards and Vulnerability Research Institute (SHELDUS), NWS
Extreme Cold January 28, 2003	Countywide	Low temperatures in the Village of South Glen Falls: -27^{O}F.	The Weather Channel
Extreme Cold February 14, 2003	Countywide	Low temperatures in the Village of South Glen Falls: -24^{O}F.	The Weather Channel
Snowstorm "President's Day Storm" February 17-18, 2003	Multi-State	Resulted in an Emergency Declaration for multiple New York State counties (EM-3184), however, it did not include Saratoga County. Snow totals in Saratoga County ranged from 10.3 inches in Harmony Corner to 12 and 14 inches in Jonesville, Malta and Round Lake.	FEMA, NWS, NOAA-NCDC, NYSDPC, Hazards and Vulnerability Research Institute (SHELDUS), Kocin and Uccellini, Freedom Communications, NWS
Snow / Ice Storm April 3-5, 2003	Multi-County	Across the north country counties of Hamilton, Warren, northern Saratoga, northern Washington in New York, and northern Bennington, and Rutland counties in Vermont it was a major snow storm that produced between 12 inches and 18 inches of snowfall over the three day period ranking the event as one of the heaviest snow makers of the entire 2002/03 season for those counties and among the largest April snowstorms on record. The Town of Hadley received 14 inches if snow.	CBS06, NOAA-NCDC, Freedom Communications
Winter Storm	Multi-County	Snow totals in Saratoga County ranged from 12.9 inches in	NWS, NOAA-NCDC, Freedom

Event Date / Name	Location	Losses / Impacts	Source(s)
December 6-7, 2003		Malta to 22 inches in Saratoga Springs.	Communications
Winter Storm December 11, 2003	Multi-County	This wintery mix of precipitation produced very slick road conditions. A four year old was injured in a crash near the Batchellerville Bridge in Edinburg, Saratoga County. Another person suffered minor injuries in the Town of Corinth when he lost control of his vehicle due to icy conditions.	NOAA-NCDC
Snowstorm / Nor'Easter December 14-15, 2003	Multi-County	Snow totals in Saratoga County ranged from 8 inches in the Town of Clifton Park to 13 and 14 inches in the Towns of Corinth and Hadley and City of Saratoga Springs.	Freedom Communications, NWS
Extreme Cold January 14-15, 2004	Countywide	Low temperatures in the Towns of Hadley and Corinth: -21^{O}F.	The Weather Channel
Snowstorm / Extreme Cold January 22-24, 2005	Multi-County	Snow totals in Saratoga County ranged from 9 inches in the Town of Malta to 14 inches in Gansevoort. Low temperatures in the Village of South Glen Falls: -25^{O}F.	NOAA-NCDC, NWS
Snowstorm February 28 - March 2, 2005	Multi-County	Snow totals in Saratoga County ranged from 8 inches in Town of Wilton to 15 inches in Middle Grove.	Freedom Communications, NWS
Snowstorm March 8-9, 2005	Multi-County	Snow totals in Saratoga County ranged from 2 inches in Charlton to 10 inches in Gansevoort.	NWS
Snowstorm March 23-24, 2005	Countywide	Northern Saratoga County received 10 inches of snow.	NOAA-NCDC, NWS
Snowstorm December 9, 2005	Multi-County	Snow totals in Saratoga County ranged from 4.4 inches in Round Lake to 8.8 inches in Gansevoort.	NWS
Snowstorm January 23, 2006	Multi-County	Snow totals in Saratoga County ranged from 2.5 inches in Greenfield Center to 7.3 inches in Waterford.	NWS
Snowstorm February 26, 2006	Multi-County	Snow totals in Saratoga County ranged from 2.7 inches in Clifton Park to 8.2 inches in the Town of Corinth.	NWS
Ice Storm January 14-15, 2007	Multi-County	This ice storm had a significant impact on travel and economy across the region, with areas immediately north of the Mohawk River, including the Saratoga Springs and Lake George regions, and the western Mohawk Valley being hardest hit. Estimates of 100,000 customers were affected by power outages at the height of the ice storm, with the majority of outages in Saratoga county (nearly half).	NOAA-NCDC, NWS
Valentine's Day Nor'Easter February 14-15, 2007	Multi-County	Snow totals in Saratoga County ranged from 18 inches in Mechanicsville to 30 inches in Greenfield Center and Porter Corners.	Freedom Communications, NWS
Snowstorm / Nor'Easter March 16-17, 2007	Countywide	Snow totals in Saratoga County ranged from 8 inches in Galway to 14 inches in Porter Corners and the Town of Clifton Park.	NWS, Freedom Communications
Severe Storm / Inland and Coastal Flooding April 14-17, 2007*	Countywide	Resulted in a Disaster Declaration for multiple New York State counties (DR-1692), however, it did not include Saratoga County. Snow totals in Saratoga County ranged from 2.5	FEMA, Freedom Communications, NWS

Event Date / Name	Location	Losses / Impacts	Source(s)
(also identified as a Nor'Easter)		inches in the Town of Clifton Park to 14 inches in Middle Grove.	
Winter Storm February 12, 2008	Multi-County	Dozens of accidents were reported storm due to ice covered roadways, with several cars reportedly veering off the Adirondack Northway in Wilton, Lake George and Chester.	NOAA-NCDC
Snowstorm March 1, 2008	Multi-County	Snow totals in Saratoga County ranged from 4 inches in the Town of Clifton Park to 10.5 inches in Gansevoort.	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 Saratoga County has experienced 116 snow and ice storm events and 8 extreme cold temperature/wind chill events between January 1, 1950 and July 31, 2008. However, most events are regional events not specific to Saratoga 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.

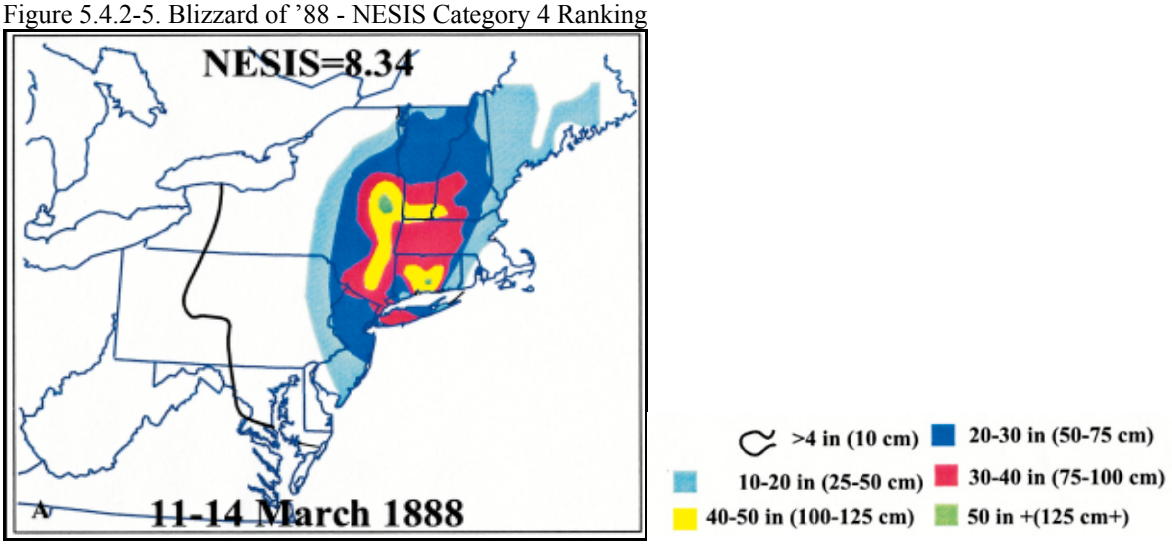
AMS American Meteorological Society
B Billion ($)
DR Federal Disaster Declaration
EM Federal Emergency Declaration
FSA Farm Service Agency
FEMA Federal Emergency Management Agency
HMP Hazard Mitigation Plan
K Thousand ($)
M Million ($)
MRCC Midwest Regional Climate Center
NA Not Available
NCDC National Climate Data Center
NOAA National Oceanic Atmospheric Administration
NRCC Northeast Regional Climate Center
NSIDC National Snow and Ice Data Center
NWS National Weather Service
NYSDEC New York State Department of Environmental Conservation
NYSDOT New York State Department of Transportation
SHELDUS Spatial Hazard Events and Losses Database for the United States
USDA U.S. Department of Agriculture
USACE U.S. Army Corps of Engineers

Further descriptions of particular severe winter storm/extreme cold events that have impacted Saratoga 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.

March 11-14, 1888 ("Blizzard of '88" or "Great White Hurricane"): The "Blizzard of '88," remains perhaps the most infamous and unpredictable of all Northeast snowstorms. This event paralyzed the east coast of the U.S. and Atlantic Canada from the Chesapeake Bay to Maine, and including the Maritime Provinces of Eastern Canada (Figure 5.4.2-5). Telegraph infrastructure was disabled, isolating New York City, Boston, Philadelphia, Baltimore, and Washington, D.C. for days. Two hundred ships were grounded and at least one hundred seamen died. Fire stations were immobilized; property losses from fire alone were estimated at $25 million. Saratoga County received between 30 and 50 inches of snow during this storm (Kocin and Uccellini, 2004). Saratoga Springs received the highest amount of snow in New York State, averaging 58 inches (Lott, 1993). Estimated losses for Saratoga County were not available in the materials reviewed to develop this plan.

Figure 5.4.2-5. Blizzard of '88 - NESIS Category 4 Ranking



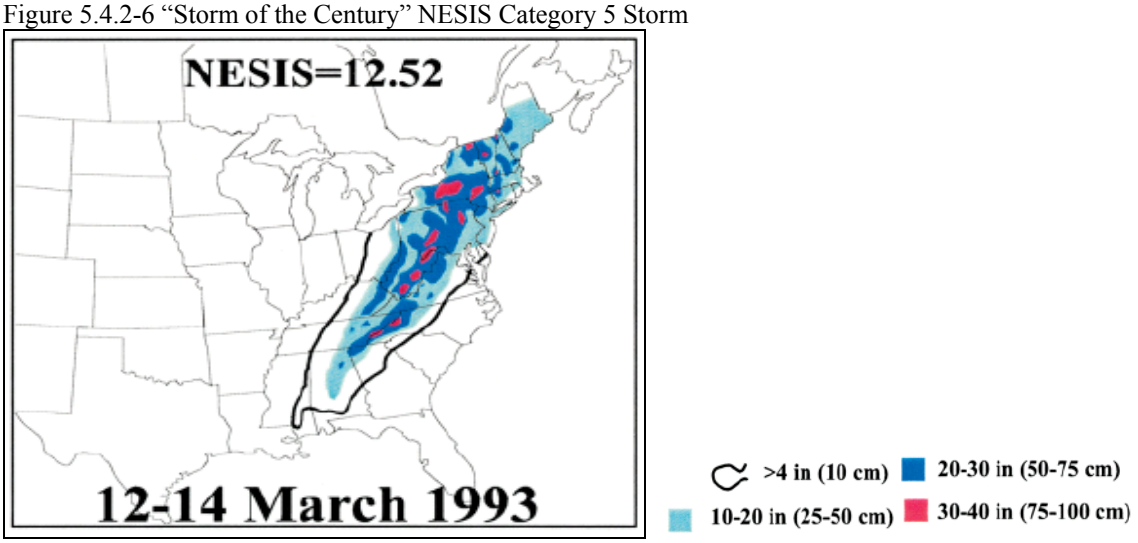
Source: Kocin and Uccellini, 2004

March 12-15, 1993 ("Superstorm of 1993," "Storm of the Century" or "Great Storm of 1993") (FEMA EM-3107): This storm was identified as both a Nor'easter and a blizzard by many sources. It was a massive storm complex, affecting at least 26 states and much of eastern Canada. The March 1993 storm is listed among the NOAA Top Billion Dollar Weather Disasters (Miller, 1995-2007), reportedly causing a total of $6.6 billion in damages along the eastern coast of the U.S. and resulting in over 270 fatalities (23 fatalities in New York State) (Lott, 1993). According to NYS HMP and NYSEMO, this blizzard resulted in total eligible damages of approximately $8.5 million through New York State (NYSDPC, 2008; NYSEMO, 2006).

Achieving a NESIS rating of 12.52, the "Storm of the Century" ranks as an 'Extreme' snow event. With a total area impacting, at peak, from Maine to Florida, a final total 5 to 50 inches of snowfall, and hurricane

force winds, this storm ground most of the Eastern seaboard to a halt for days (Figure 5.4.2-6). Total snowfall accumulations for Saratoga County were between 20 and 30 inches (Kocin and Uccellini, 2004). Saratoga Springs reportedly received 27 inches of snow during this event (Freedom Communications, 2008). Estimated losses for the County were not available in the materials reviewed to develop this plan.

Figure 5.4.2-6 "Storm of the Century" NESIS Category 5 Storm

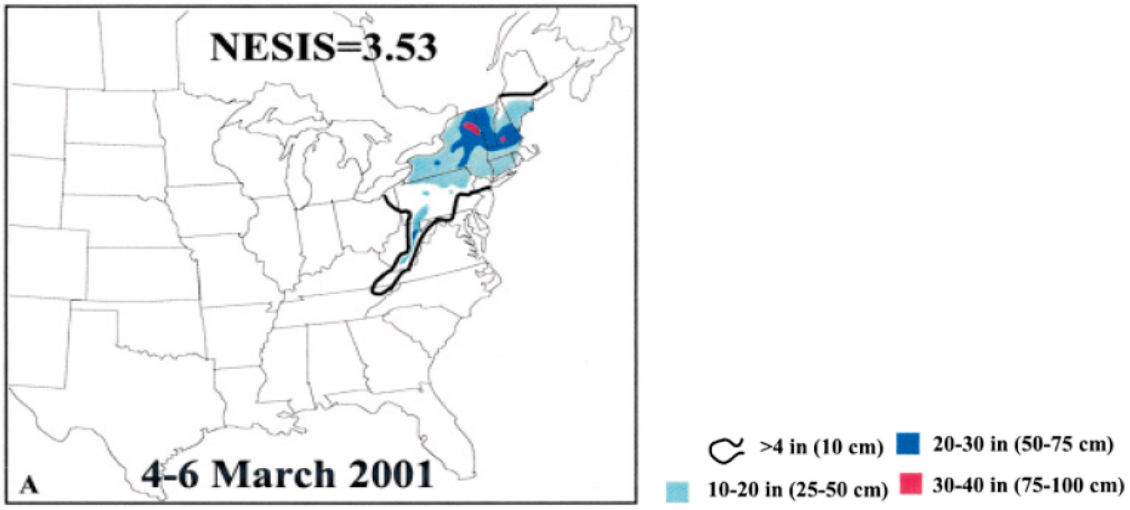


Source: Kocin and Uccellini, 2004

This storm resulted in a statewide FEMA Emergency Declaration (FEMA EM-3107) on March 17, 1993. Through this declaration, all counties were declared eligible for federal and State disaster public assistance funds (NYSEMO, 2006; FEMA, 2008). Disaster aid for Saratoga County was not available in the materials reviewed to develop this plan.

March 4-7, 2001: A major snowstorm caused snow to fall at a rate of one inch per hour throughout the northeastern U.S. over a two-day period. Snowfall amounts ranged from 10 to 30 inches. High winds caused snowdrifts and whiteout conditions in many parts of southern and central New York State (NCDC, 2007). Achieving a NESIS rating of 3.53, this event places itself in the 'Significant' category (Figure 5.4.2-7) (Kocin and Uccellini, 2004).

Figure 5.4.2-7. March 4-7, 2001 NESIS Category 2 Storm



Source: Kocin and Uccellini, 2004

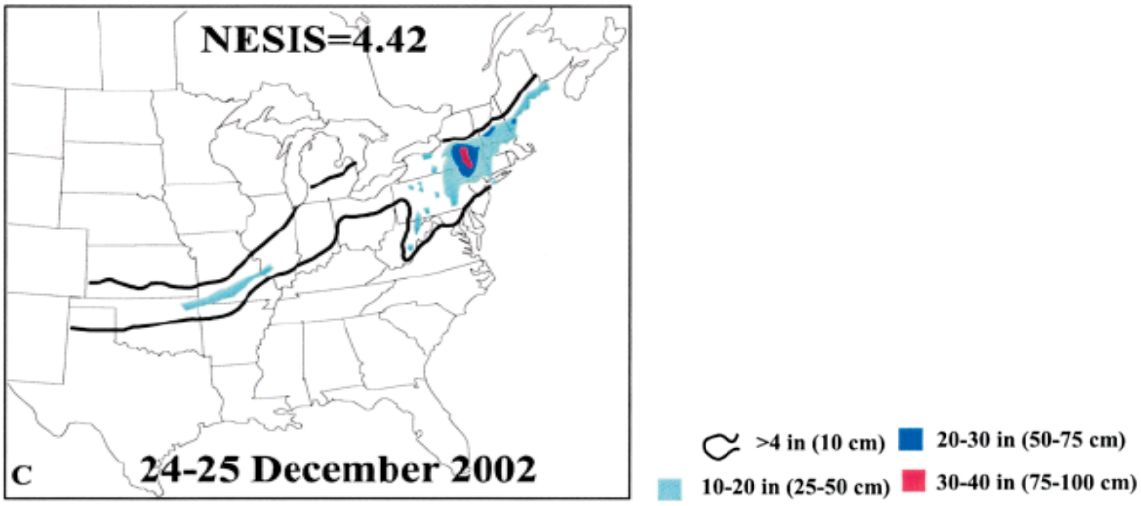
The heaviest snowfall from this event fell across Pennsylvania, New York State, and New England. Snowfall totals for Saratoga County ranged from 10 inches to 30 inches (Figure 5.4.2-7) (Kocin and Uccellini, 2004; NRCC, 2001). Specific snowfall totals within the County include:

- Jonesville (32 inches)
- Saratoga Springs (31.5 inches)
- Ballston Lake (30.5 inches)
- Porter Corners (30 inches)
- Mechanicville (30 inches)
- Malta (29 inches)
- Ballston Spa (27 inches)
- Charlton (26 inches)
- Milton (25.5 inches)
- Greenfield Center (25 inches)
- Burnt Hills (24.5 inches)
- Clifton Park (24 inches)
- Corinth (24 inches)
- Northumberland (24 inches)
- South Glens Falls (23.5 inches)
- Middle Grove (21 – 23 inches)
- Edinburg (21 inches)
- Rexford (20.5 inches) (Freedom Communications, 2008).

Cost estimates of property damage or losses in Saratoga County were unavailable in the materials reviewed to develop this plan.

December 24-26, 2002 and January 2-4, 2003 (FEMA EM-3173): Two major storm systems extending through the northeastern U.S. on December 25-26, 2002 and January 3-4, 2003. Achieving a NESIS rating of 4.42, the December event placed itself in the 'Major' category (Figure 5.4.2-8) (Kocin and Uccellini, 2004).

Figure 5.4.2-8. December 24-25, 2002 NESIS Category 3 Storm



Source: Kocin and Uccellini, 2004

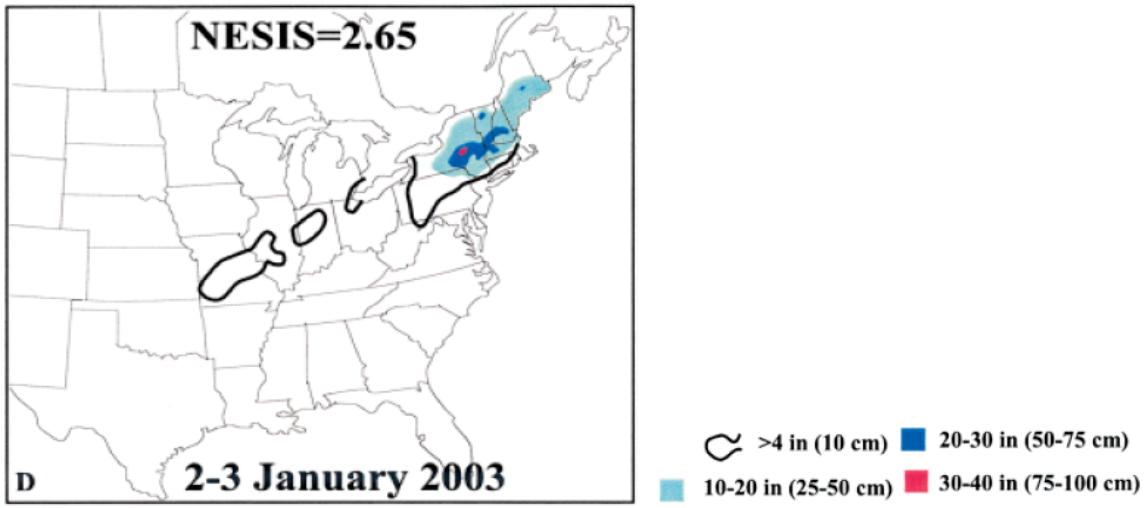
Snowfall totals in Saratoga County ranged between 10 to 30 inches during the December event. A transformer malfunction left 2,600 customers in the dark in the Ballston Spa area with spotty power outages noted elsewhere. Specific snowfall totals within the County include:

- Town of Galway (22.6 inches)

- Harmony Corners (21.5 inches)
- Village of Ballston Spa (22.0 inches)
- Town of Clifton Park (18.2 inches) (NWS, 2003)

The second storm on January 3-4, 2003 brought heavy snow to New York State, resulting in approximately $434,000 in property damages in the counties affected. Achieving a NESIS rating of 2.65, this event placed itself in the 'Significant' category (Figure 5.4.2-9) (Kocin and Uccellini, 2004).

Figure 5.4.2-9 January 2-3, 2003 NESIS Category 2 Storm



Source: Kocin and Uccellini, 2004

Snowfall totals in Saratoga County ranged between 14 and 22 inches during this January event and resulted in nearly $29,000 in property damages. Specific snowfall totals within the County include:

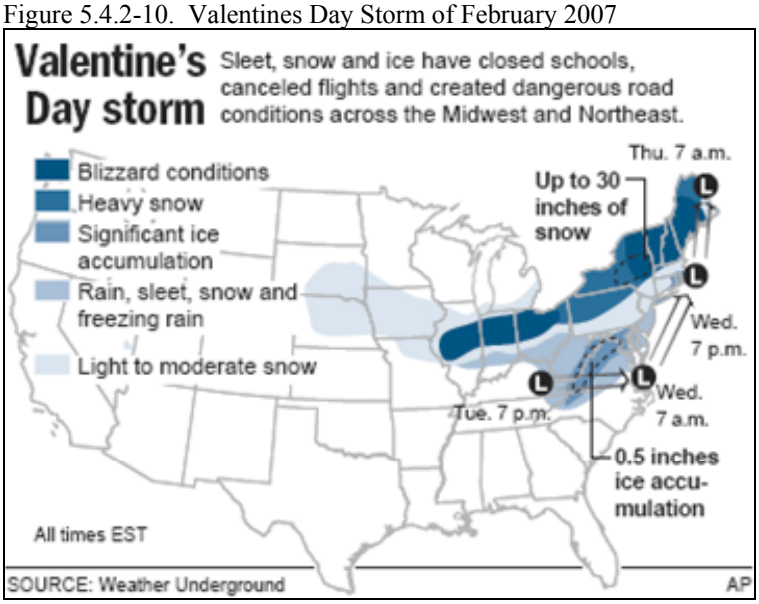
- Malta (22.0 inches)
- Clifton Park (19.0 inches)
- Providence (18.0 inches)
- Charlton (18.0 inches)
- Saratoga Springs (14.0 to 19.0 inches)
- Jonesville (17.5 inches)
- Gansevoort (16.0 inches)
- Greenfield Center (16.0 inches)
- Galway (16.0 inches)
- Milton (15.1 inches)
- Hadley (15.0 inches)
- Edinburg (14.0 inches)
- Corinth (14.0 inches)(Freedom Communications, 2008)

These storms resulted in a FEMA Emergency Declaration (FEMA EM-3173) on February 25, 2003. Through this declaration, the following Counties were declared eligible for federal and State disaster funds: Albany, Broome, Chenango, Columbia, Delaware, Fulton, Greene, Herkimer, Madison, Montgomery, Oneida, Orange, Otsego, Rensselaer, Saratoga, Schenectady, Schoharie, Sullivan, Tioga and Ulster (NYSEMO, 2006; FEMA, 2008). As of April 29, 2003, FEMA indicated that $11.3 million in disaster aid was approved for the Counties affected by these storms. Saratoga County received $559,025 in disaster aid from this event (FEMA, 2003).

February 12-15, 2007 ("Valentine's Day Storm"): The "Valentine's Day Storm" was the largest storm to affect central New York State and north-northeast Pennsylvania during the 2006-2007 winter season. In much of the area, the storm was the biggest blizzard in several years with snow accumulations of over

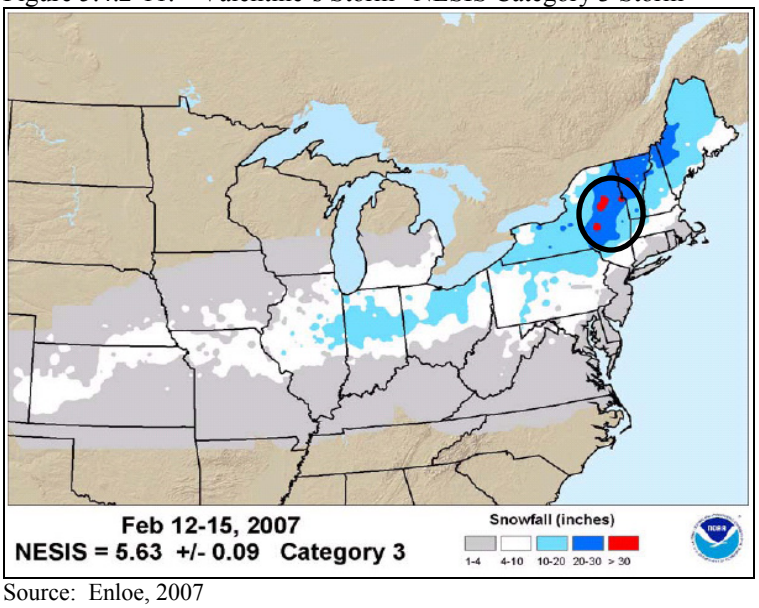
two to three feet in some locations (Evans, 2007) (Figure 5.4.2-10). This storm achieved a NESIS rating of 5.63, placing the storm in the 'Major' category (Figure 5.4.2-11) (Kocin and Uccellini, 2004).

Figure 5.4.2-10. Valentines Day Storm of February 2007



Source: MSNBC, 2007 (provided via Weather Underground)

Figure 5.4.2-11. "Valentine's Storm" NESIS Category 3 Storm



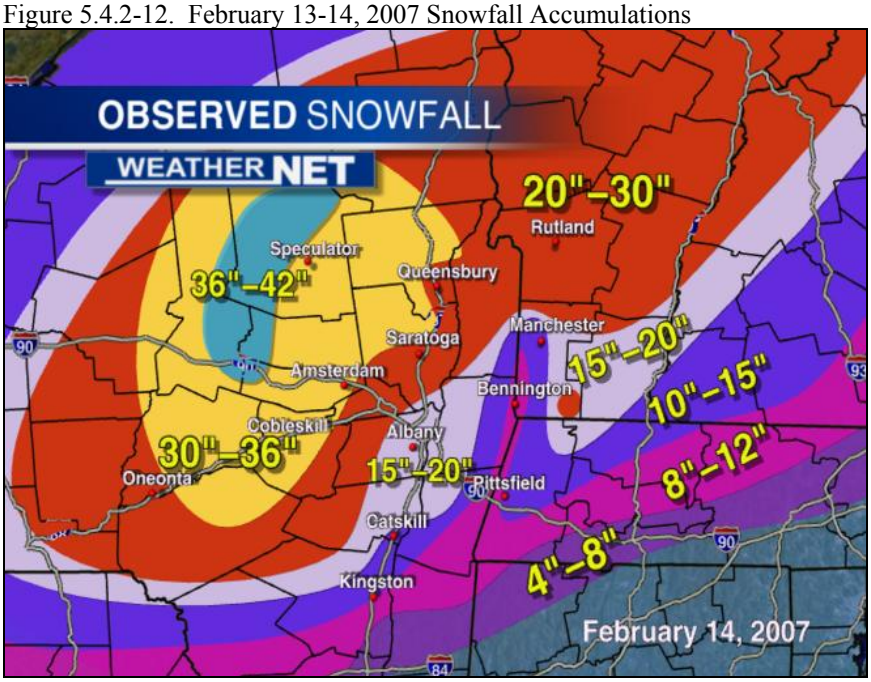
Source: Enloe, 2007

The following snowfall totals were provided by NWS for Saratoga County communities:

- Porter Corners (30.5 inches)
- Greenfield Center (30.0 inches)
- Gansevoort (27.0 inches)
- South Glens Falls (24.0 inches)
- Waterford (23.5 inches)
- Saratoga Springs (22.0 inches)
- Jonesville (22.0 inches)
- Wilton (22.0 inches)
- Middle Grove (21.8 inches)
- Ballston Lake (21.0 inches)

- Burnt Hills (20.5 inches)
- Clifton Park (20.1 inches)
- Round Lake (20.0 inches)
- Vischer Ferry (19.0 inches)
- Malta (18.0 inches)
- Mechanicville (18.0 inches) (NWS, 2007)

Figure 5.4.2-12. February 13-14, 2007 Snowfall Accumulations



Source: Freedom Communications, 2008

Cost estimates of property damage or losses in Saratoga County were unavailable in the materials reviewed to develop this plan.

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, Saratoga County is currently listed as the 20th County in the state most threatened by and vulnerable to snow and snow loss, with an annual average snowfalls of 68.7 inches. Saratoga County is also listed as the 40th 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 Saratoga County is considered 'frequent' (hazard event is likely to occur within 25 years) (Section 5.3).

Also, although extreme cold temperatures are not separately discussed in detail in the NYS HMP, it is anticipated that the State will continue to experience cold temperature events during the winter weather months. However, 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 weather months, which could influence the quantity of winter storm events through the U.S. 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 regions which would include 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 northern North America, 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 Saratoga 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 Saratoga 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 Saratoga 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 Saratoga 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 MR3 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 Saratoga County (200,635 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 Saratoga 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 5.4.2-7 summarizes the population over the age of 65 and individuals living below the Census poverty threshold.

Table 5.4.2-7 Vulnerable Population Exposed to Severe Winter Storm/Extreme Cold Events in Saratoga County

Population Category	Number of Persons Exposed	Percent of Total U.S. 2000 County Population
Elderly (Over 65 years of age)	22,741	11.3
Persons living below Census poverty threshold*	11,238	5.6
Elderly (Over 65 years of age) living below Census poverty threshold	1,283	< 1

Source: Census, 2000.

* The Census poverty threshold for a three person family unit is approximately $15,000.

Impact on General Building Stock

The entire general building stock inventory in Saratoga County is exposed and vulnerable to the severe winter storm/extreme cold hazard. In general, structural impacts include damage to roofs and building frames. Historic information indicates Saratoga County has experienced losses up to $833,000 in damages due to a single severe winter storm event. In this case, the losses were experienced due to a freezing rain event in December 1991; however, specific losses to structures are unknown. Additionally, Saratoga County has received greater than $500,000 in disaster aid for one severe winter storm event.

Historic data and 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 5.4.2-8 summarizes the exposed building values in the County and losses that would result from 1, 5, and 10-percent damage to this inventory as a result of a severe winter storm/extreme cold event. Table 5.4.2-9 summarizes percent damages that could result from severe winter storm/extreme cold conditions for each jurisdiction'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 5.4.2-8 General Building Stock Exposure (Structure Only) and Estimated Losses from Severe Winter Storm/Extreme Cold Events in Saratoga County

Building Occupancy Class	Total Value	1% Damage Loss Estimate	5% Damage Loss Estimate	10% Damage Loss Estimate
Residential	$11,751,168,000	$117,511,680	$587,558,400	$1,175,116,800
Commercial	$2,267,243,000	$22,672,430	$113,362,150	$226,724,300
Industrial	$426,378,000	$4,263,780	$21,318,900	$42,637,800
Agricultural	$57,143,000	$571,430	$2,857,150	$5,714,300
Religious	$173,400,000	$1,734,000	$8,670,000	$17,340,000
Government	$147,829,000	$1,478,290	$7,391,450	$14,782,900
Educational	$336,525,000	$3,365,250	$16,826,250	$33,652,500
Total	**$15,159,686,000**	**$151,596,860**	**$757,984,300**	**$1,515,968,600**

Source: HAZUS-MH MR3, 2007

Notes: 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). The valuation of general building stock and the loss estimates determined in Saratoga County were based on the default general building stock database provided in HAZUS-MH MR3. The general building stock valuations provided in HAZUS-MH MR3 are Replacement Cost Value from RSMeans as of 2006.

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

Jurisdiction	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
Town of Ballston	$6,011,970	$30,059,850	$60,119,700	$4,702,680	$23,513,400	$47,026,800
Village of Ballston Spa	$4,041,320	$20,206,600	$40,413,200	$2,910,280	$14,551,400	$29,102,800
Town of Charlton	$2,886,870	$14,434,350	$28,868,700	$2,626,330	$13,131,650	$26,263,300
Town of Clifton Park	$28,549,410	$142,747,050	$285,494,100	$22,446,260	$112,231,300	$224,462,600
Town of Corinth	$1,948,180	$9,740,900	$19,481,800	$1,786,320	$8,931,600	$17,863,200
Village of Corinth	$1,631,880	$8,159,400	$16,318,800	$1,059,390	$5,296,950	$10,593,900
Town of Day	$1,976,710	$9,883,550	$19,767,100	$1,754,450	$8,772,250	$17,544,500
Town of Edinburg	$2,279,180	$11,395,900	$22,791,800	$2,151,460	$10,757,300	$21,514,600
Town of Galway	$3,055,620	$15,278,100	$30,556,200	$2,802,100	$14,010,500	$28,021,000
Village of Galway	$151,430	$757,150	$1,514,300	$124,880	$624,400	$1,248,800
Town of Greenfield	$4,296,910	$21,484,550	$42,969,100	$3,664,260	$18,321,300	$36,642,600
Town of Hadley	$1,312,280	$6,561,400	$13,122,800	$1,206,580	$6,032,900	$12,065,800
Town of Halfmoon	$11,970,560	$59,852,800	$119,705,600	$9,368,650	$46,843,250	$93,686,500
Town of Malta	$9,192,510	$45,962,550	$91,925,100	$7,548,080	$37,740,400	$75,480,800
City of Mechanicville	$3,034,310	$15,171,550	$30,343,100	$2,453,570	$12,267,850	$24,535,700
Town of Milton	$7,239,530	$36,197,650	$72,395,300	$5,765,100	$28,825,500	$57,651,000
Town of Moreau	$6,126,510	$30,632,550	$61,265,100	$4,794,370	$23,971,850	$47,943,700
Town of Northumberland	$2,615,710	$13,078,550	$26,157,100	$2,346,730	$11,733,650	$23,467,300
Town of Providence	$1,178,470	$5,892,350	$11,784,700	$1,012,450	$5,062,250	$10,124,500
Village of Round Lake	$417,200	$2,086,000	$4,172,000	$296,470	$1,482,350	$2,964,700
Town of Saratoga	$2,485,640	$12,428,200	$24,856,400	$2,087,160	$10,435,800	$20,871,600
City of Saratoga Springs	$27,672,590	$138,362,950	$276,725,900	$17,728,110	$88,640,550	$177,281,100
Village of Schuylerville	$845,350	$4,226,750	$8,453,500	$586,640	$2,933,200	$5,866,400
Village of South Glens Falls	$2,026,670	$10,133,350	$20,266,700	$1,538,520	$7,692,600	$15,385,200
Town of Stillwater	$3,424,590	$17,122,950	$34,245,900	$2,825,210	$14,126,050	$28,252,100
Village of Stillwater	$928,530	$4,642,650	$9,285,300	$777,360	$3,886,800	$7,773,600
Village of Victory	$302,410	$1,512,050	$3,024,100	$251,700	$1,258,500	$2,517,000
Town of Waterford	$4,705,810	$23,529,050	$47,058,100	$3,738,950	$18,694,750	$37,389,500
Village of Waterford	$1,350,050	$6,750,250	$13,500,500	$1,064,210	$5,321,050	$10,642,100
Town of Wilton	$7,938,660	$39,693,300	$79,386,600	$6,093,410	$30,467,050	$60,934,100

Jurisdiction	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
Saratoga County	**$151,596,860**	**$757,984,300**	**$1,515,968,600**	**$117,511,680**	**$587,558,400**	**$1,175,116,800**

Source: HAZUS-MH MR3, 2007

Notes: 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). The valuation of general building stock and the loss estimates determined in Saratoga County were based on the default general building stock database provided in HAZUS-MH MR3. The general building stock valuations provided in HAZUS-MH MR3 are Replacement Cost Value from RSMeans as of 2006.

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 Saratoga County are discussed in Section 5.4.1.

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 MR3 estimates the replacement value for each police station is $1,652,000 and 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 Saratoga 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 5.4.1. 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.