5.4.3 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 the 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 4 inches or more in depth in 12 hours or less; or snowfall accumulating to 6 inches or more in depth in 24 hours or less. A snow squall is an intense, but limited duration, period of moderate to heavy snowfall (e.g. 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: Extratropical 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 extratropical cyclones (mid-latitude storms, or Great Lake storms. A Nor'Easter is a macro-scale extratropical 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) (NYSEMO, 2008).

Nor'Easters can cause heavy snow, rain, gale force winds, and oversized waves (storm surge) that can cause beach erosion, coastal flooding, structural damage, power outages and unsafe human conditions. 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. When people must use space heaters and fireplaces to stay warm, the risk of household fires and carbon monoxide poisoning increases.

> 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].

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. Wind Chill is not the actual temperature but rather how wind and cold feel on exposed skin. As the wind increases, heat is carried away from the body at an accelerated rate, driving down body temperature. Animals are also affected by wind chill; however, cars, plants and other objects are not. 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).

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 climatologically 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 5.4.3-1). 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 5.4.3-1. 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 mi2—roughly 1–3 times the size of the state of New York—with significant areas of 20-in. (50-cm) accumulations.
4	Crippling	6.0 – 9.99	These storms consist of some of the most widespread, heavy snows of the sample and can be best described as crippling to the northeast U.S, with the impact to transportation and the economy felt throughout the United States. These storms encompass huge areas of 10-in. (25-cm) snowfalls, and each case is marked by large areas of 20-in. (50-cm) and greater snowfall accumulations.
5	Extreme	10 +	The storms represent those with the most extreme snowfall distributions, blanketing large areas and populations with snowfalls greater than 10, 20, and 30 in. (25, 50, and 75 cm). These are the only storms in which the 10-in. (25-cm) accumulations exceed 200 × 103 mi2 and affect more than 60 million people.

Source: Kocin and Uccellini, 2004

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 5.4.3-4 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 5.4.3-2, 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 5.4.3-2. 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

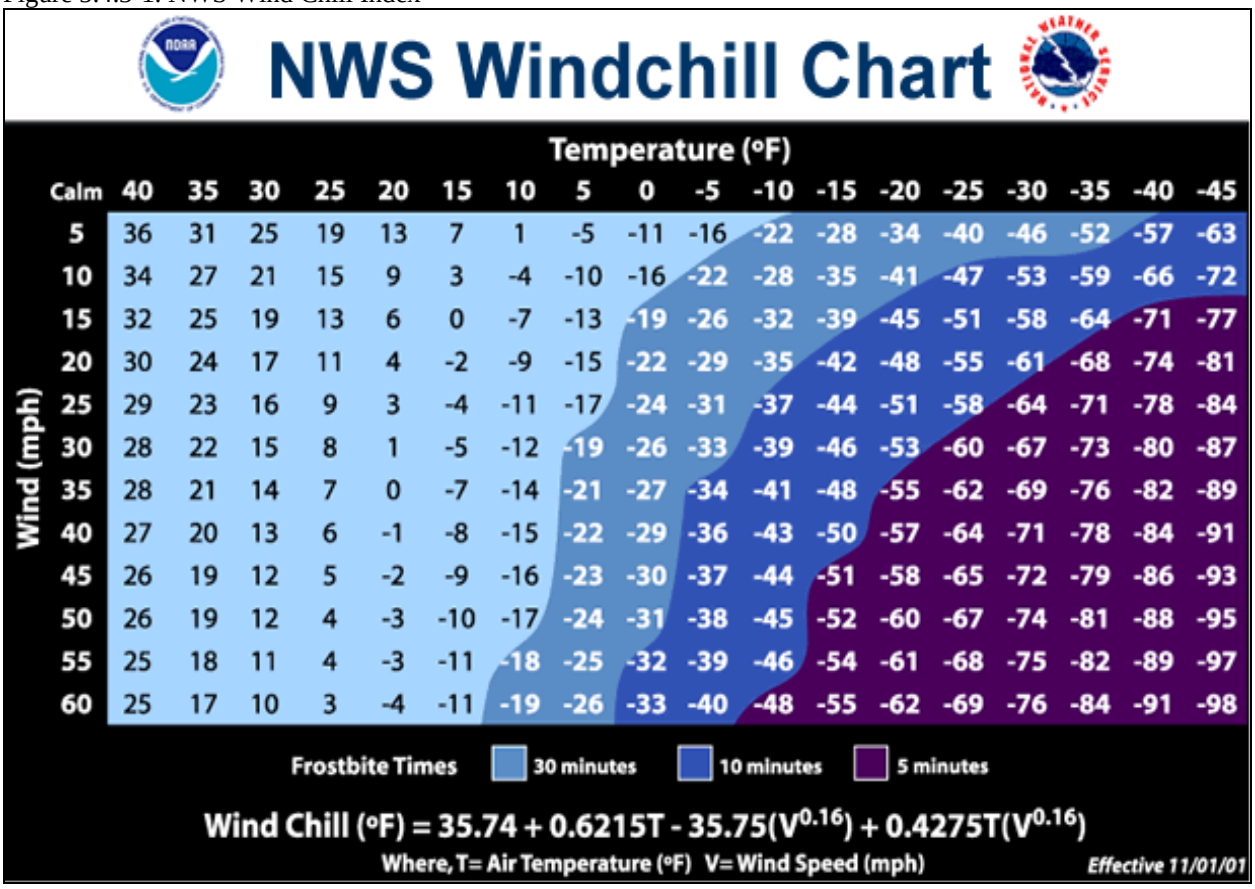
Source: MESO, 2002

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 (Zeilinski, 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 (known by the National Weather Service (NWS) as the Wind Chill Temperature Index). 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 5.4.3-1), 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 5.4.3-1. NWS Wind Chill Index



Source: NWS, 2008

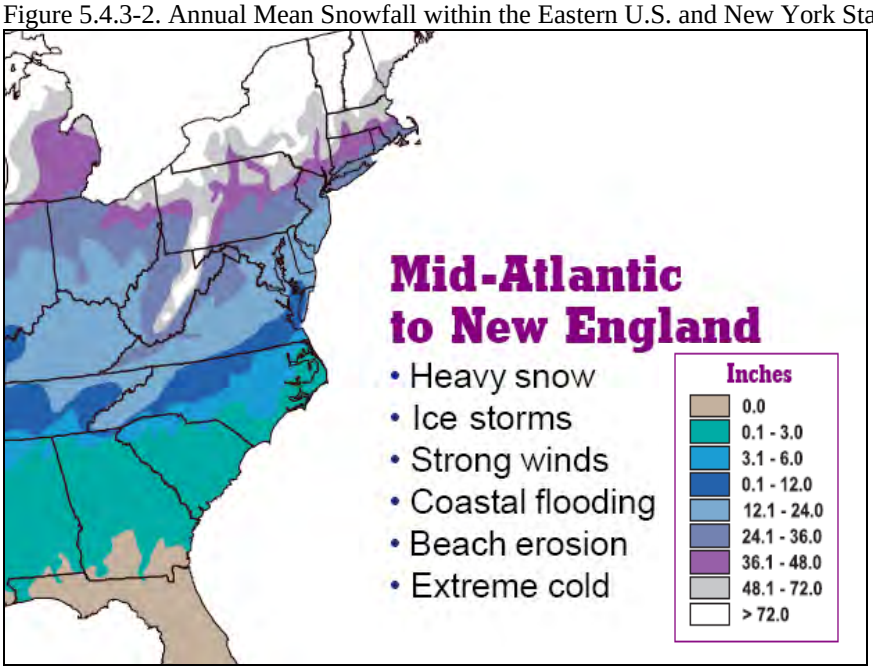
Location

Winter weather, particularly snowstorm events, has historically affected many U.S. states, mainly in the Northeast and Midwest, including all of New York State. 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 NYS HMP, communities in New York receive more snow than most other communities in the Nation. Although the entire State is subject to winter storms, the Easternmost

and West-Central portions of the State are more likely to suffer under winter storm occurrences than are other locations (New York State Disaster Preparedness Commission (NYSDPC), 2008).

Although not as frequent or as severe as the northeastern or west-central counties of the State, all of Greene County is susceptible to winter storms. Figure 5.4.3-2 indicates the mean annual snowfall in 2001 for the U.S. The mean annual snowfall at that time for Greene County appears to be between 36.1 and 72.0 inches (NWS, 2001).

Figure 5.4.3-2. Annual Mean Snowfall within the Eastern U.S. and New York State



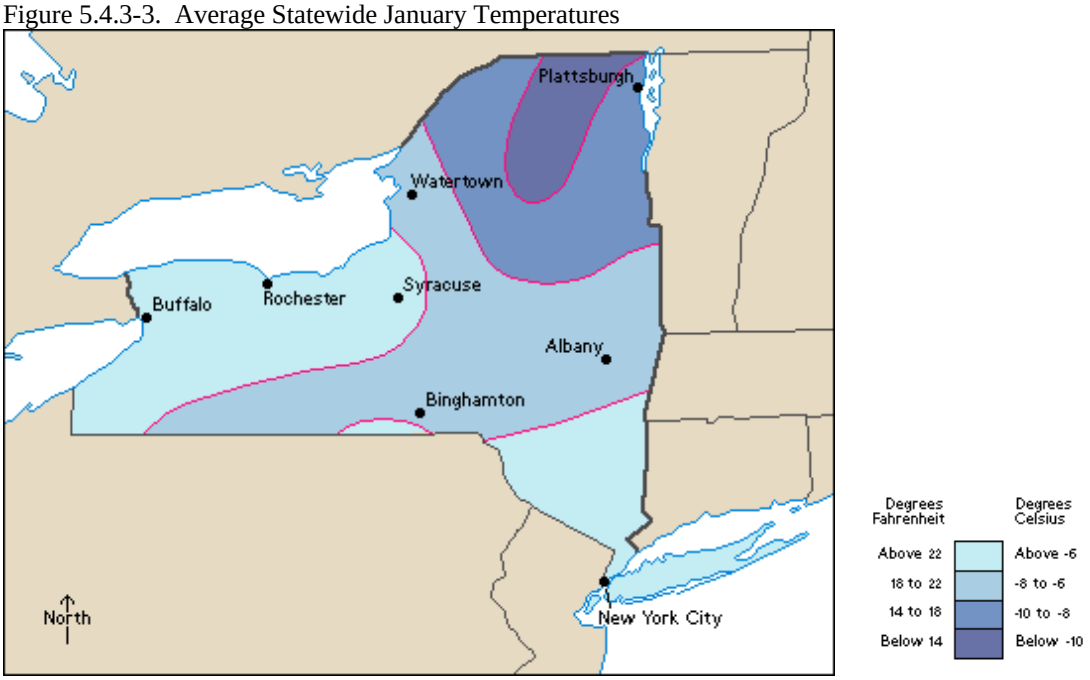
Source: NWS, 2001

Overall, the NYSDPC and NYSEMO listed Greene County as the 36th County in the state most threatened by and vulnerable to snow and snow loss, with an annual average snowfalls ranging between 30 and 75 inches. Greene County is also listed as the 53rd County in New York State most threatened by and vulnerable to ice storms and ice storm loss (NYSDPC, 2008). Although Greene 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 New York State Climate (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 5.4.3-3, 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.

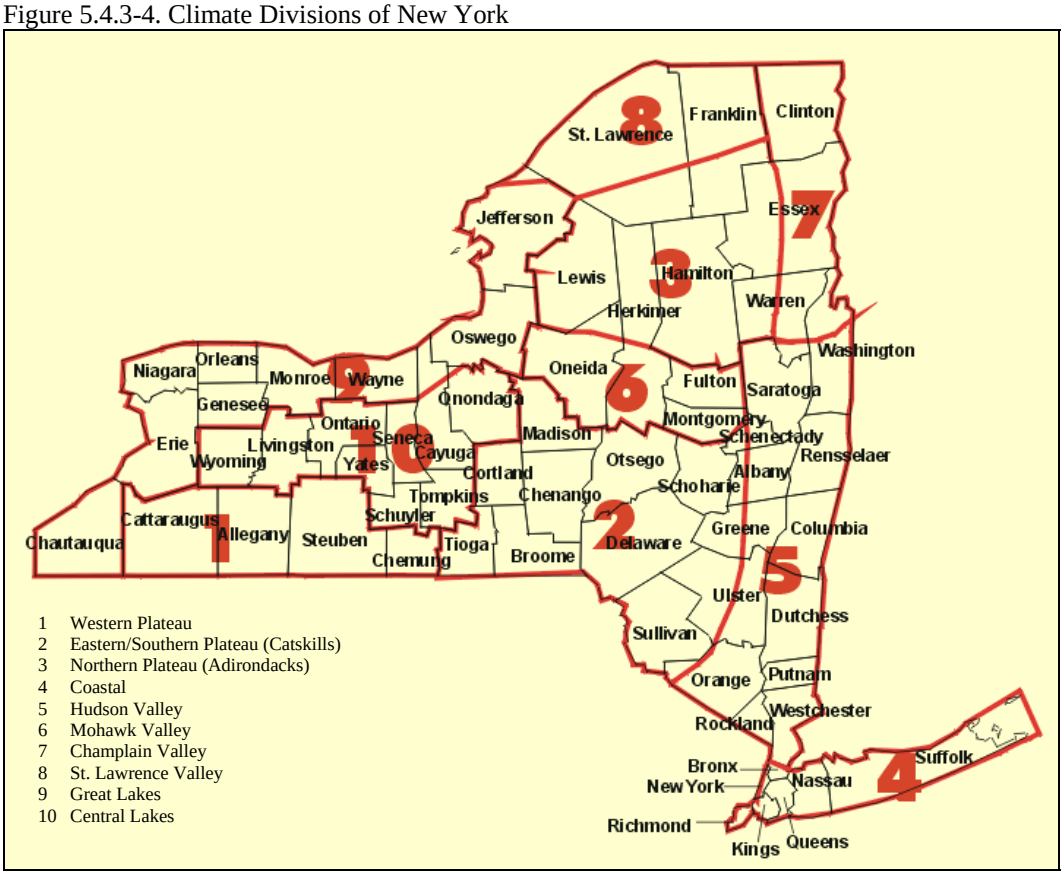
Figure 5.4.3-3. Average Statewide January Temperatures



Source: World Book Inc., 2007

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 5.4.3-4 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) [Climate Prediction Center (CPC), 2005]. These regions have been divided because they are climatically homogenous or similar in comparison (Energy Information Administration, 2005).

Figure 5.4.3-4. Climate Divisions of New York



Source: CPC, 2005; NYSC, Date Unknown

Greene County falls within the Eastern Plateau Climate Division (Division 2) and the upper Hudson Valley Climate Division (Division 5) (CPC, 2005; ERSL, Date Unknown). With the County located in two climatic regions of the State with different altitudes, there is a wide range of cold extremes throughout the County. The higher altitudes present throughout the Eastern Plateau Division (Catskill Mountains) create conditions where winters can be longer and colder (which includes the western portion of Greene County). In the majority of winter seasons, a temperature of -15°F or colder can be expected in the Catskills. In the Catskill region and in the upper Hudson Valley division, below zero minimums are observed on about 15 days in most winters and on more than 25 days in notably cold seasons (NYSC, Date Unknown).

As provided by The Weather Channel, a range of average high and low temperatures during the winter months in Greene County are identified in Table 5.4.3-3.

Table 5.4.3-3. Average High and Low Temperature Range for Winter Months in Greene County

Month	Average High	Average Low	Record Low Event(s)
January	31 to 34 °F	9 to 16°F	-28°F (1971)
February	33 to 37°F	9 to 18°F	-22°F (1980); -22 (1971)
March	41 to 48°F	18 to 28°F	-19°F (1993)
November	46 to 50°F	26 to 33°F	-2°F (1989)
December	35 to 38°F	15 to 22°F	-20°F (1989)

Source: The Weather Channel, 1995-2007

Previous Occurrences and Losses

Many sources provided historical information regarding previous occurrences and losses associated with severe winter storms and extreme cold temperatures throughout New York State and Greene County. With so many sources reviewed for the purpose of this HMP, loss and impact information for many events could differ. 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 5.4.3-4) (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 Greene County. This list does not represent all storms that may have impacted the northeastern U.S.

Table 5.4.3-4. 74 Snowstorm Cases That Affected the Northeastern U.S (1888 – 2007) (Arranged by Rank/Category)

Rank	Date	NESIS	Category	Description	Snowfall Range in Greene County (in inches)
1	March 12-14, 1993	12.52	5	Extreme	20-40
2	January 6-8, 1996	11.54	5	Extreme	4-20
3	February 15-18, 2003	8.91	4	Crippling	10-30
4	March 11-14, 1888	8.34	4	Crippling	20-50
5	February 11-14, 1899	8.11	4	Crippling	10-20
6	March 2-5, 1960	7.63	4	Crippling	10-20
7	January 21-24, 2005*	6.80	4	Crippling	NA
8	February 10-12, 1983	6.28	4	Crippling	4-10
9	February 5-7, 1978	6.25	4	Crippling	10-30
10	February 2-5, 1961	6.24	4	Crippling	10-30
11	February 14-17, 1958	5.98	3	Major	10-40
12	January 19-21, 1978	5.90	3	Major	4-10
13	January 11-14, 1964	5.74	3	Major	10-30
14	February 12-15, 2007*	5.63	3	Major	10-30
15	December 25-28, 1969	5.19	3	Major	10-30
16	January 29-31, 1966	5.05	3	Major	10-20
17	January 21-23, 1987	4.93	3	Major	10-30
18	January 7-8, 1988	4.85	3	Major	NA
19	February 8-12, 1994	4.81	3	Major	10-20
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

Rank	Date	NESIS	Category	Description	Snowfall Range in Greene County (in inches)
23	December 24-25, 2002	4.42	3	Major	20-30
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	4-10
28	February 22-28, 1969	4.01	3	Major	0-4
29	March 18-21, 1958	3.92	2	Significant	4-20
30	February 5-7, 1967	3.82	2	Significant	4-10
31	December 23-25, 1966	3.79	2	Significant	20-30
32	April 6-7, 1982	3.75	2	Significant	4-20
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	10-20
37	February 2-4, 1995	3.51	2	Significant	10-20
38	December 26-27, 1947	3.50	2	Significant	10-20
39	January 18-21, 1961	3.47	2	Significant	4-10
40	March 2-4, 1994	3.46	2	Significant	NA
41	February 8-10, 1969	3.34	2	Significant	10-20
42	December 19-20, 1995	3.32	2	Significant	NA
43	December 22-23, 1963	3.17	2	Significant	NA
44	January 24-26, 2000	3.14	2	Significant	10-20
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	4-10
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	10-20
51	March 15-18, 2007*	2.55	2	Significant	10-30
52	December 30-31, 2000	2.48	1	Notable	20-30
53	February 19-20, 1964	2.39	1	Notable	NA
54	March 31-April 1, 1997	2.37	1	Notable	20-40
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	1-4

Rank	Date	NESIS	Category	Description	Snowfall Range in Greene County (in inches)
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	4-10
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	4-10
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 Jesse 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, the NYS HMP and other sources indicate that Greene County has been declared as a disaster area as a result of 6 winter storm events (FEMA, 2008; NYSDPC, 2008). No extreme cold temperature events resulted in federal disaster declarations. Table 5.4.3-5 summarizes the FEMA Presidential Disaster (DR) or Emergency (EM) Declarations for winter storm events for the County.

Table 5.4.3-5. Presidential Disaster / Emergency Declarations for Severe Winter Storm Events in Greene 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. East Jewett received 20 inches of snow during this event, which was the largest amount of snowfall in the State (McFadden). Thousands of knocked down trees and power lines were everywhere in the Hudson Valley, blocking roads and leaving thousands of people in their homes without power.

Type of Event*	Date**	Declaration Number	Cost of Losses (approximate)***
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. New York State experienced approximately $8.4 M in eligible damages (NYSDPC). Greene County received between 20 to 40 inches of snow from this event. Prattsville received 36 inches of snow. The type of damage, monetary losses and location were not reported for Greene County.
Blizzard	January 1996	DR-1083	New York State experienced approximately $21.3 M in eligible damages. Greene County received between 4 to 30 inches of snow and experienced approximately $160 K in property damages. Prattsville received its record snowfall of 38 inches. Extreme cold temperatures occurred during this event throughout the County ranging from -2 to -20^{o}F, mostly in the Towns of Lexington and Prattsville.
Snowstorm	December, 2002 through January, 2003	EM-3173	Multiple counties throughout New York State experienced an impact from this disaster. State/County loss information for the December event is unknown. In December 2002, Greene County received between 20 to 30 inches of snow (Ashland and Catskill received 16 inches) and New York State Thruway was closed between the cities of Catskill and Syracuse. December snow totals in Greene County included Prattsville, 29 in.; Ashland, 16.0 in.; Catskill, 16.0 in.; Platte Cove, 23.2 in.; Windham, 20.0 in.; and Cairo, 18.3 in. The January 2003 snowstorm resulted in experienced approximately $430 K in property damages throughout the State. Greene County received between 10 to 20 inches of snow and experienced approximately $29 K in damages. January snow totals in Greene County included Platte Cove, 19.4 in.; East Jewett, 23.0 in.; and Cairo, 20.0 in. More than $11.3 M in disaster aid was approved for the State for both events. FEMA indicated that the County received approximately $462 K in disaster aid for both events.
Snowstorm	February 2003	EM-3184	Multiple counties throughout New York State experienced an impact from this regional event. Approximate losses within the State are unknown (NYSDPC). Greene County received between 10 to 30 inches of snow from this event. Snow totals in Greene County included Platte Cove, 18.4 in.; East Jewett, 21.0 in.; Windham, 22.0 in.; and Cairo, 19.0 in.

Type of Event*	Date**	Declaration Number	Cost of Losses (approximate)***
Severe Storms / Inland and Coastal Flooding (also identified as a Nor'Easter)	April 2007	DR-1692	New York State experienced between $12.8 and $60 M in eligible damages (NYSDPC; Alarcon-The Daily Mail). The Greene County Department of Emergency Services indicated that preliminary storm damage totals eligible for federal public assistance for the County totaled approximately $472 K, with the Town of Cairo and Village of Catskill experiencing the most losses. Preliminary storm damage totals for individual assistance in the County totaled $111 M, with the Town/Village of Catskill experienced the most losses, totaling $110 M (These figures may be inaccurate). Individual assistance losses to the County were denied by FEMA. Other sources indicate that final losses eligible for public assistance were estimated at $1.3 M as a result of damage, response and debris removal costs throughout the County. Final losses to homeowners were tallied at $547 K (Alarcon – The Daily Mail). At the current time, it is unclear which loss estimated is correct. More than $61 M in Federal disaster aid has been approved for the State. As of July 11, 2007, public assistance to Greene County totaled $58 K. The latest public assistance details were not made available through the materials reviewed for this plan. The Schoharie Creek at Prattsville crested to 12.98 feet (.98 feet above 12-foot flood stage). The Catskill Creek in the Town of Catskill experienced continued stream bank erosion and migration from this event, which would cost an estimated $1 M to $1.5 M to restore if funding was available. Additionally, a landslide occurred along Warren Stein Road in Cairo (also mentioned in Section 5.4.1 Flood).
Severe Winter Storm	December 2008	DR-1827	A disaster declaration was declared on March 4, 2009 for the ice storm that struck many parts of New York State. Several counties were declared disaster areas, including Greene County. The County had approximately $1.2 million in reimbursable damages.

Source: FEMA, 2008; NCDC, 2008; NYSEMO, 2006; Kocin and Uccellini, 2004

Notes: Dollars rounded to nearest thousand. Recorded losses indicate the dollar value of covered losses paid, as available through the public records reviewed. B = Billion, K = Thousand, M = Million

* The 'Type of Event' is the disaster classification that was assigned to the event by FEMA.

** Represents the date of the event.

*** Flood impact or damage associated with this event is further discussed in Section 5.4.1

Based on all sources researched, many severe winter storm and extreme cold events have impacted Greene County, as summarized in Table 5.4.3-6. With winter weather documentation for the State being so extensive, not all sources may have been identified or researched. Hence, Table 5.4.3-6 may not include all events that have occurred throughout the region.

Table 5.4.3-6. Severe Winter Events between 1888 and 2007

Event Date / Name	Location	Losses / Impacts	Source(s)
Snowstorm April 21, 1857	Windham, Durham, Ashland, Acra	Windham received over 3 feet of snow. Many homes, barns, and businesses "caved in" and suffered extensive damage from the snow. Experienced over $2 K in damages (1857 USD), which would cost over $48 K in damages in 2007 USD.	Windham Journal, Freedman
Snowstorm April 25, 1857	Windham, Durham, West Durham, Prattsville	Durham and West Durham received between 2 ½ to 4 feet of snow. In Durham, roads were wholly impassible, many buildings were damaged and fruit trees/orchards were destroyed. Many barns were destroyed and farm animals were killed. A cider mill was crushed. Prattsville received 3 feet of snow causing over eleven buildings to be crushed.	Windham Journal
Blizzard March 11-14, 1888 (Blizzard of '88 or "Great White Hurricane")	Multi-State	$25 M nationwide in fire losses, 20 to 50 inches of snow fell in Greene County.	Brunner, Kocin and Uccellini, NWS
Snowstorm / Extreme Cold February 11-14, 1899	Multi-County	10 to 20 inches of snow fell in Greene County. From Georgia to Maine, temperatures dropped to record temperatures. Greene County experienced temperatures ranging from 10 to -10^{O}F.	Kocin and Uccellini, NCDC, NY Times Archives
Snowstorm November 26-28, 1901	Multi-County	Windham received 12 inches of snow.	NCDC Station Snow Climatology Database
Snowstorm February 17, 1902	Windham	Windham received 16 inches of snow.	NCDC Station Snow Climatology Database
Extreme Cold January 5, 1904	Windham	Record cold event for this station between 1900 and 1913 recorded at -34^{O}F.	MRCC
Snowstorm March 1-2, 1914	Statewide	The State experienced between 10 to 35 inches of snow. Snowfall totals in Greene County are unknown.	AMS Monthly Weather Review
Extreme Cold January 19, 1938	Cairo	Record cold event for this station between 1925 and 1963 recorded at -26^{O}F.	MRCC
Snowstorm December 26-27, 1947	Multi-County	10 to 20 inches of snow fell in Greene County.	Kocin and Uccellini
Snowstorm January 15-18, 1958	Multi-County	Prattsville received 22 inches of snow.	NCDC Station Snow Climatology Database

Event Date / Name	Location	Losses / Impacts	Source(s)
Snowstorm February 14-17, 1958	Multi-County	10 to 40 inches of snow fell in Greene County.	Kocin and Uccellini, NWS
Snowstorm March 18-22, 1958	Multi-County	4 to 20 inches of snow fell in Greene County. Prattsville received 21.3 inches of snow.	Kocin and Uccellini, NCDC Station Snow Climatology Database
Snowstorm March 2-5, 1960	Multi-County	Greene County experienced over $8 K in property damages. 10 to 20 inches of snow fell in Greene County.	Kocin and Uccellini
Snowstorm December 11-13, 1960	Multi-County	4 to 10 inches of snow fell in Greene County.	Kocin and Uccellini
Snowstorm / Extreme Cold January 18-22, 1961	Multi-County	Greene County experienced over $8 K in property damages. 4 to 10 inches of snow fell in Greene County. Low temperatures in Athens, Catskill, Coxsackie, and Leeds: -24^{O}F.	Kocin and Uccellini, The Weather Channel
Snowstorm / Extreme Cold February 2-5, 1961	Statewide	Greene County experienced approximately $80 K in property damages. 10 to 30 inches of snow fell in Greene County.	Hazards and Vulnerability Research Institute (SHELDUS), Kocin and Uccellini, Evans, The Weather Channel
Extreme Cold January 25, 1963	Multi-County	Low temperatures in Athens, Catskill, Coxsackie and Leeds: -20^{O}F.	The Weather Channel
Extreme Cold February 4, 1963	Multi-County	Low temperatures in Athens, Catskill, Coxsackie and Leeds: -18^{O}F.	The Weather Channel
Snowstorm / Extreme Cold January 11-15, 1964	Multi-County	10 to 30 inches of snow fell in Greene County. Low temperatures in Athens, Catskill, Coxsackie, and Leeds: -20^{O}F.	Kocin and Uccellini, The Weather Channel
Snowstorm January 29-31, 1966	Multi-County	10 to 20 inches of snow fell in Greene County.	Kocin and Uccellini
Snowstorm December 23-29, 1966	Multi-County	20 to 30 inches of snow fell in Greene County. Prattsville received 21 inches of snow.	Kocin and Uccellini, NCDC Station Snow Climatology Database
Snowstorm February 5-7, 1967	Multi-County	4 to 10 inches of snow fell in Greene County.	Kocin and Uccellini
Extreme Cold January 8-13, 1968	Multi-County	Low temperatures in Athens, Catskill, Coxsackie, and Leeds: -9 to -17^{O}F.	MRCC, The Weather Channel
Snowstorm February 8-10, 1969	Multi-County	10 to 20 inches of snow fell in Greene County.	Kocin and Uccellini
Snowstorm December 25-28, 1969	Multi-County	Greene County experienced approximately $8 K in property damages. 10 to 30 inches of snow fell in Greene County. Prattsville received 23 inches of snow.	Kocin and Uccellini, NCDC Station Snow Climatology Database, NWS
Extreme Cold January 17-20, 1971	Multi-County	Low temperatures throughout County: -20 to -28^{O}F. This was a record low event for the month of January in New Baltimore.	The Weather Channel
Extreme Cold February 1-4, 1971	Multi-County	Low temperatures in Athens, Catskill, Coxsackie, Leeds and New Baltimore: -15 to -22^{O}F.	The Weather Channel

Event Date / Name	Location	Losses / Impacts	Source(s)
Snowstorm November 24-26, 1971	Multi-County	Prattsville received 20 inches of snow; Windham received 25 inches.	NCDC Station Snow Climatology Database, NWS
Snowstorm / Extreme Cold February 18-23, 1972	Multi-County	Greene County experienced less than a $1 K in property damages. 10 to 20 inches of snow fell in Greene County. Windham received 29 inches of snow. Low temperatures in New Baltimore: -14 to -19^{O}F.	Kocin and Uccellini, NCDC Station Snow Climatology Database, The Weather Channel
Extreme Cold January 9-10, 1976	Multi-County	Low temperatures in New Baltimore: -14 to -15^{O}F	The Weather Channel
Extreme Cold January 30-31, 1977	Multi-County	Low temperatures in New Baltimore: -14 to -18^{O}F	The Weather Channel
Snowstorm March 23-25, 1977	Multi-County	Windham received 24.5 inches of snow.	NCDC Station Snow Climatology Database
Snowstorm January 19-23, 1978	Multi-County	4 to 30 inches of snow fell in Greene County. Prattsville received 20.5 inches of snow and Windham received 33 inches.	Kocin and Uccellini, NCDC Station Snow Climatology Database
Blizzard February 5-8, 1978	Multi-County	10 to 30 inches of snow fell in Greene County. Prattsville received between 25 and 28 inches of snow.	Kocin and Uccellini, NCDC Station Snow Climatology Database, NWS
Snowstorm December 25-28, 1978	Multi-County	Windham received 23 inches of snow.	NCDC Station Snow Climatology Database
Extreme Cold February 11-14, 1979	Multi-County	Low temperatures in New Baltimore: -12 to -18^{O}F	The Weather Channel
Extreme Cold February 18-19, 1979	Multi-County	Low temperatures in New Baltimore: -14 to -17^{O}F	The Weather Channel
Extreme Cold February 1-2, 1980	Multi-County	Low temperatures throughout County: -17 to -22^{O}F. This was a record low event for the month of February in Cairo, Durham, Greenville and Palenville.	The Weather Channel
Extreme Cold December 18-27, 1980	Multi-County	Low temperatures throughout County: -6 to -16^{O}F. This was a record low event for the month of December in Cairo, Durham, Greenville and Palenville.	The Weather Channel
Extreme Cold January 2-4, 1981	Multi-County	Low temperatures in Cairo, Durham, Greenville, New Baltimore and Palenville: -4 to -15^{O}F.	The Weather Channel
Extreme Cold January 12-14, 1981	Multi-County	Low temperatures in Athens, Cairo, Catskill, Coxsackie, Durham, Greenville, Leeds, New Baltimore and Palenville: -8 to -22^{O}F.	The Weather Channel
Snowstorm December 19-20, 1981	Multi-County	Prattsville received 16 inches of snow and Windham received 22 inches.	NCDC Station Snow Climatology Database
Extreme Cold January 18-19, 1982	Multi-County	Low temperatures in Athens, Cairo, Catskill, Coxsackie, Durham, Greenville, Leeds and Palenville: -17 to -22^{O}F.	The Weather Channel

Event Date / Name	Location	Losses / Impacts	Source(s)
Snowstorm April 6-7, 1982	Multi-County	4 to 20 inches of snow fell in Greene County.	Kocin and Uccellini
Snowstorm January 15-16, 1983	Multi-County	Greene County experienced approximately $238 K in property damages.	Hazards and Vulnerability Research Institute (SHELDUS), NWS
Snowstorm January 23, 1983	Multi-County	Greene County experienced approximately $238 K in property damages.	Hazards and Vulnerability Research Institute (SHELDUS)
Snowstorm February 6-11, 1983	Multi-County	Greene County experienced approximately $27.8 M in property damages (This monetary figure appears inaccurate). 4 to 10 inches of snow fell in Greene County.	Hazards and Vulnerability Research Institute (SHELDUS)
Snowstorm March 11, 1983	Multi-County	Greene County experienced approximately $24 K in property damages.	Hazards and Vulnerability Research Institute (SHELDUS)
Snowstorm April 19-21, 1983	Multi-County	Greene County experienced approximately $238 K in property damages. Prattsville received 16 inches of snow and Windham received 26 inches.	Hazards and Vulnerability Research Institute (SHELDUS), NCDC Station Snow Climatology Database
Snowstorm December 6, 1983	Multi-County	Greene County experienced approximately $178 K in property damages.	Hazards and Vulnerability Research Institute (SHELDUS)
Snowstorm December 29, 1983	Multi-County	Greene County experienced approximately $178 K in property damages.	Hazards and Vulnerability Research Institute (SHELDUS)
Extreme Cold January 16-17, 1984	Multi-County	Low temperatures in Cairo, Durham, Greenville and Palenville: -14 to -16^{O}F.	The Weather Channel
Extreme Cold January 21-23, 1984	Multi-County	Low temperatures in Cairo, Durham, Greenville, New Baltimore and Palenville: -16 to -25^{O}F.	The Weather Channel
Snowstorm February 5, 1984	Multi-County	Greene County experienced approximately $24 K in property damages.	Hazards and Vulnerability Research Institute (SHELDUS,
Freezing Rain February 28, 1984	Multi-County	Greene County experienced approximately $238 K in property damages.	Hazards and Vulnerability Research Institute (SHELDUS)
Snowstorm January26-28, 1986	Multi-County	Windham received 20.5 inches of snow.	NCDC Station Snow Climatology Database
Snowstorm March 7, 1986	Multi-County	Greene County experienced approximately $24 K in property damages.	Hazards and Vulnerability Research Institute (SHELDUS)
Snowstorm / Freezing Rain December 2, 1986	Multi-County	Greene County experienced approximately $19 K in property damages.	Hazards and Vulnerability Research Institute (SHELDUS)
Snowstorm December 18, 1986	Multi-County	Greene County experienced approximately $19 K in property damages.	Hazards and Vulnerability Research Institute (SHELDUS)

Event Date / Name	Location	Losses / Impacts	Source(s)
Snowstorm January 21-24, 1987	Multi-County	10 to 30 inches of snow fell in Greene County. Windham received 20 inches of snow and Prattsville received 16 inches.	Kocin and Uccellini, NCDC Station Snow Climatology Database
Extreme Cold January 25-28, 1987	Multi-County	Low temperatures in Ashland, Hunter, Jewett, New Baltimore, Tannersville and Windham: -10 to -22^{O}F	The Weather Channel
Extreme Cold February 14-16, 1987	Multi-County	Low temperatures in Ashland, Hunter, Jewett, Lexington, Prattsville, Tannersville and Windham: -10 to -16^{O}F	The Weather Channel
Snowstorm October 4, 1987 (FEMA DR-801)	Multi-County	See FEMA Disaster Declarations (Table 5.4.3-5)	Hazards and Vulnerability Research Institute (SHELDUS), McFadden (NY Times), FEMA, NYSDPC, NWS, Weather Underground
Extreme Cold December 28, 1987	Multi-County	Greene County experienced approximately $50 K in property damages.	Hazards and Vulnerability Research Institute (SHELDUS)
Extreme Cold January 11-15, 1988	Multi-County	Low temperatures in Ashland, Hunter, Jewett, Lexington, Prattsville, Tannersville, Windham: -13 to -17^{O}F.	The Weather Channel
Extreme Cold December 11-13, 1988	Multi-County	Low temperatures throughout County: 4 to -16^{O}F. This was a record low event for the month of December in Ashland, Hunter, Jewett, Lexington, Prattsville, Tannersville and Windham.	The Weather Channel
Snowstorm January 26, 1989	Multi-County	Greene County experienced approximately $24 K in property damages.	Hazards and Vulnerability Research Institute (SHELDUS)
Extreme Cold December 19-24, 1989	Multi-County	Low temperatures throughout County: -4 to -20^{O}F. This was a record low event for the month of December in New Baltimore.	The Weather Channel
Snowstorm February 15, 1990	Multi-County	Greene County experienced approximately $20 K in property damages.	Hazards and Vulnerability Research Institute (SHELDUS)
Snowstorm February 24, 1990	Multi-County	Greene County experienced approximately $45 K in property damages.	Hazards and Vulnerability Research Institute (SHELDUS)
Snowstorm December 26-27, 1990	Multi-County	4 to 10 inches of snow fell in Greene County.	Kocin and Uccellini
Freezing Rain January 16, 1991	Multi-County	Greene County experienced approximately $36 K in property damages.	Hazards and Vulnerability Research Institute (SHELDUS)
Ice Storm December 2, 1991	Multi-County	Greene County experienced approximately $385 K in property damages	Hazards and Vulnerability Research Institute (SHELDUS)
Coastal Storm / Nor'Easter December 10-13, 1992	Multi-County	Resulted in a Disaster Declaration for 5 New York State counties (DR-974), however, it did not include Greene County. Greene County experienced approximately $25 K in property damages. Prattsville received 25 inches of snow.	Hazards and Vulnerability Research Institute (SHELDUS), NCDC Station Snow Climatology Database, NWS

Event Date / Name	Location	Losses / Impacts	Source(s)
Snowstorm December 21, 1992	Multi-County	Greene County experienced approximately $25 K in property damages	Hazards and Vulnerability Research Institute (SHELDUS)
Extreme Cold February 1-2, 1993	Multi-County	Over $50K in damages from this event throughout the State. Temperatures of 10 to 30^{O}F below zero were common across much of the New York area. Temperatures in Greene County are unknown.	NOAA-NCDC
Extreme Cold February 19-28, 1993	Multi-County	Low temperatures in Ashland, Cairo, Durham, Greenville, Hunter, Jewett, Lexington, Palenville, Prattsville, Tannersville and Windham: -4 to -20^{O}F	The Weather Channel
Severe Blizzard "The Storm of the Century" March 12-15, 1993 FEMA EM-3107	Statewide	See FEMA Disaster Declarations (Table 5.4.3-5)	FEMA, Kocin and Uccelliini, NYSDPC, NCDC Station Snow Climatology Database, NWS
Extreme Cold March 14-20, 1993	Multi-County	Low temperatures throughout County: -7 to -19^{O}F. This was a record low event for the month of January for Ashland, Cairo, Durham, Greenville, Hunter, Jewett, Palenville, Tannersville and Windham	The Weather Channel
Extreme Cold December 28-30, 1993	Multi-County	Low temperatures in Ashland, Hunter, Jewett, Lexington, Prattsville, Tannersville and Windham: -8 to -13^{O}F	The Weather Channel
Extreme Cold January 16-22, 1994	Multi-County	Low temperatures throughout County: -16 to -26^{O}F. This was a record low event for Athens, Catskill, Coxsackie and Leeds	The Weather Channel
Snowstorm / Extreme Cold January 27-28, 1994	Multi-County	Greene County experienced approximately $26 K in property damages. Low temperatures throughout County: -16 to -27^{O}F. This was a record low event for the month of January for Ashland, Cairo, Durham, Greenville, Hunter, Jewett, Palenville, Tannersville and Windham	The Weather Channel, Hazards and Vulnerability Research Institute (SHELDUS), MRCC
Extreme Cold February 1-4, 1994	Multi-County	Low temperatures throughout Ashland, Hunter, Jewett, Tannersville and Windham: -13 to -15^{O}F	The Weather Channel
Snowstorm February 8-12, 1994	Multi-County	New York State experienced approximately $500 K in property damages. Greene County experienced approximately $5 K in property damages. 10 to 20 inches of snow fell in Greene County. East Jewett received 8 inches of snow.	Kocin and Uccellini, NOAA-NCDC
Snowstorm / Freezing Rain December 9-10, 1994	Multi-County	Greene County experienced approximately $36 K in property damages	Hazards and Vulnerability Research Institute (SHELDUS)
Snowstorm / Freezing Rain December 31, 1994	Multi-County	Greene County experienced approximately $36 K in property damages	Hazards and Vulnerability Research Institute (SHELDUS)
Snowstorm February 2-4, 1995	Multi-State	Greene County experienced approximately $18 K in property damages. 10 to 20 inches of snow fell in Greene County.	Kocin and Uccellini

Event Date / Name	Location	Losses / Impacts	Source(s)
Extreme Cold February 6-9, 1995	Multi-County	Low temperatures throughout County: -5 to -19^{O}F. This was a record low event for the month of February in Ashland, Hunter, Jewett, Lexington, Prattsville, Tannersville and Windham	The Weather Channel
Snowstorm February 15, 1995	Multi-County	Greene County experienced approximately $500 K in property damages.	Hazards and Vulnerability Research Institute (SHELDUS), NRCC, NOAA-NCDC
Snowstorm / Freezing Rain February 26, 1995	Multi-County	Greene County experienced approximately $24 K in property damages.	Hazards and Vulnerability Research Institute (SHELDUS)
Snowstorm December 14, 1995	Multi-County	East Jewett received 10 inches of snow.	NOAA-NCDC
Blizzard / Extreme Cold January 6-9, 1996 (FEMA DR-1083)	Multi-State	See FEMA Disaster Declarations (Table 5.4.3-5)	FEMA, Hazards and Vulnerability Research Institute (SHELDUS), Kocin and Uccellini, Enloe, NOAA-NCDC, The Weather Channel, NYSEMO, Weather Underground
Snowstorm March 7, 1996	Multi-County	Windham received 14 inches of snow	NOAA-NCDC
Snowstorm December 6-7, 1996	Multi-County	New York State experienced approximately $250 K in property damages. Greene County experienced approximately $33 K in property damages. Power outages were widespread in Hunter, Jewett, Tannersville, Prattsville and Lexington. Platte Cove received 12 inches of snow and East Jewett received 11 inches.	Hazards and Vulnerability Research Institute (SHELDUS), NOAA-NCDC
Snowstorm “April Fool’s Nor’Easter” March 31-April 1, 1997	Multi-County	New York State experienced approximately $7.8 M in property damages. Greene County experienced approximately $709 K in property damages. 20 to 40 inches of snow fell in Greene County. East Jewett received 37 inches of snow (highest recorded in the state). Windham received 30 inches and Prattsville received 29 inches, 30,000 customers within Greene County lost power. A State of Emergency was declared in Greene, Schoharie and Dutchess Counties.	NOAA-NCDC, Hazards and Vulnerability Research Institute (SHELDUS), Kocin and Uccellini, NCDC, NCDC Station Snow Climatology Database, Weather Underground
Snowstorm April 18, 1997	Multi-County	New York State experienced approximately $40 K in property damages. The heavy wet snow downed several trees which resulted in isolated power outages. Windham received 10 inches of snow and East Jewett received 17 inches.	NOAA-NCDC
Snowstorm December 29-30, 1997	Multi-County	New York State experienced approximately $155 K in property damages. Heavy wet snow caused scattered power outages. Greene County experienced approximately $14 K in property damages. Windham received 15 inches of snow.	NOAA-NCDC, Hazards and Vulnerability Research Institute (SHELDUS)
Snowstorm	Multi-County	New York State experienced approximately $51 K in property	NOAA-NCDC

Event Date / Name	Location	Losses / Impacts	Source(s)
January 2, 1999		damages. Two highways in Greene County (Route 23 and route 23A) were temporarily closed due to very slick conditions. Ice buildup downed power lines which caused 2,500 residents to be without power in the Mid Hudson Valley.	
Snowstorm January 13, 2000	Multi-County	New York State experienced approximately $98 K in property damages. Greene County experienced approximately $20 K in property damages. East Jewett received 8 inches of snow.	Hazards and Vulnerability Research Institute (SHELDUS), NOAA-NCDC
Extreme Cold January 18-19, 2000	Multi-County	Low temperatures in Ashland, Hunter, Jewett, Lexington, Prattsville, Tannersville and Windham: -12 to -20°F	The Weather Channel
Snowstorm January 24-26, 2000	Multi-County	New York State experienced approximately $577 K in property damages. Greene County experienced approximately $43 K in property damages. 10 to 20 inches of snow fell in Greene County. East Jewett received 17 inches of snow. Many schools and businesses were closed.	NOAA-NCDC, Hazards and Vulnerability Research Institute (SHELDUS), Kocin and Uccellini
Snowstorm February 18, 2000	Multi-County	New York State experienced approximately $111 K in property damages. Cairo received 8 inches of snow. Many schools and businesses were closed.	NOAA-NCDC
Snowstorm April 9, 2000	Multi-County	New York State experienced approximately $375 K in property damages. Greene County experienced approximately $25 K in property damages.	NOAA-NCDC, Hazards and Vulnerability Research Institute (SHELDUS)
Extreme Cold May 2000	Multi-County	Governor George E. Pataki d emergency disaster aid to farm families in 30 New York counties who've suffered devastating fruit crop losses from hail storms, freezing temperatures and other crop losses from continual heavy rains. Fruit trees throughout Greene County were damaged from freezing temperatures.	Chittenden (New York Department of Agriculture and Markets)
Snowstorm December 30-31, 2000	Multi-County	20 to 30 inches of snow fell in Greene County. Platte Cove in Greene county received the heaviest amount of snow with 28.9 inches. East Jewett received 26 inches.	Kocin and Uccellini, NOAA-NCDC
Snowstorm February 5, 2001	Multi-County	Platte Cove in Greene County received 13.1 inches of snow.	NOAA-NCDC
Snowstorm March 4-7, 2001	Multi-State	10 to 30 inches of snow fell in Greene County. Prattsville received 25 inches, Windham received 26 inches and East Jewett received 21 inches of snow.	NRCC, Kocin and Uccellini, NOAA-NCDC, NWS
Snowstorm March 31, 2001	Multi-County	Affected Counties experienced approximately $80 K in property damages. East Jewett received 8 inches of snow and Prattsville received 10 in.	NOAA-NCDC
Snowstorm January 6-7, 2002	Multi-County	Slide Mountain in Greene County received 17 inches of snow. Snow totals in Greene County included East Jewett, 14.0 in.;	NOAA-NCDC, NWS

Event Date / Name	Location	Losses / Impacts	Source(s)
		Platte Cove, 13.2 in.; Windham, 16.0 in.; and Slide Mountain, 17 in.	
Snowstorm March 20, 2002	Multi-County	Platte Cove in Greene County received 11.8 inches of snow.	NOAA-NCDC
Snowstorm May 18, 2002	Multi-County	Significant snowfall amounts took place across the elevated sections of Greene and Schoharie Counties. Prattsville received 8 in. of snow.	NOAA-NCDC
Snowstorm / Freezing Rain November 16-18, 2002	Multi-County	Freezing rain was more extensive south of Albany, where up to 58,000 customers lost power in the Mid Hudson Valley. Platte Cove received 8.2 inches of snow.	NOAA-NCDC, NWS
Snowstorm December 11-12, 2002	Multi-County	Storm total accumulations exceeded a foot across Western Greene County, where East Jewitt and Windham both reported 15 inches. Other snow totals include Catskill, 6.0 in.; Platte Cove, 11.5 in.; Cairo, 8.3 in.	NOAA-NCDC, NWS
Snowstorm December 25-26, 2002 and January 3-4, 2003 (FEMA EM-3173)	Multi-County	See FEMA Disaster Declarations (Table 5.4.3-5)	FEMA, NWS, NOAA-NCDC, NYSDPC, Hazards and Vulnerability Research Institute (SHELDUS), Kocin and Uccellini, Weather Underground, NWS
Snowstorm "President's Day Storm" February 17-18, 2003 (FEMA EM-3184)	Multi-County	See FEMA Disaster Declarations (Table 5.4.3-5)	FEMA, NWS, NOAA-NCDC, NYSDPC, Hazards and Vulnerability Research Institute (SHELDUS), Kocin and Uccellini, Weather Underground, NWS
Extreme Cold March 7, 2003	Multi-County	Low temperatures throughout County: -8 to -10^{O}F. This was a record low event for the month of March for Cairo, Durham, Greenville, Lexington, New Baltimore, Palenville and Prattsville.	The Weather Channel
Snowstorm December 6-7, 2003	Multi-State	Snow totals in Greene County included Cairo, 13.8 in.; Freehold, 16.0 in.; East Jewett, 23.0 in.; Windham, 16.0 in.; Platte Cove, 22.2 in.; and Catskill, 13.0 in.	NWS
Extreme Cold / Wind Chill January 14-16, 2004	Multi-County	Wind chill readings ranged from 25 to 30 below zero in the Mid-Hudson Valley. The brutal cold spell resulted in many closed schools and businesses and many frozen and broken water pipes. Lexington and Prattsville experienced low temperatures ranging from -18 to -22 ^{O}F.	NOAA-NCDC, The Weather Channel
Snowstorm / Extreme Cold January 27-28, 2004	Multi-County	Platte Cove in Greene County received 10.6 in. of snow. Record low temperatures for the month of February in Lexington and Prattsville: -22 to -26^{O}F	NOAA-NCDC, The Weather Channel
Extreme Cold February 17, 2004	Multi-County	Low temperatures in Ashland, Hunter, Jewett, Tannersville and Windham: -16^{O}F	The Weather Channel

Event Date / Name	Location	Losses / Impacts	Source(s)
Snowstorm January 5-6, 2005	Multi-County	The average snowfall total across Greene County ranged between 5 and 7 in.	NOAA-NCDC, NWS
Snowstorm January 22-23, 2005	Multi-County	Snow totals in Greene County included East Jewett, 19.0 in.; Cairo, 18.0 in.; Windham, 18.0 in.; Freehold, 15.5 in.; Ashland, 15.0 in.; Jewett, 13.0 in.; Athens, 12.0 in.; Coxackie, 10.0 in.; and Catskill, 13.0 in.	NOAA-NCDC, NWS
Extreme Cold January 29-31, 2005	Multi-County	Low temperatures in Ashland, Hunter, Jewett, Lexington, Prattsville, Tannersville and Windham: -6 to -21^{O}F	The Weather Channel
Snowstorm March 1-2, 2005	Multi-County	Snow totals in Greene County included Windham, 12.0 in.; Ashland, 10.0 in.; Jewett, 10.0 in.; Cairo, 9.8 in.; and Catskill, 8.0 in.	NOAA-NCDC, NWS
Snowstorm March 23-24, 2005	Multi-County	Snow totals in Greene County ranged between 8.1 and 10.4 inches.	NOAA-NCDC, NWS
Snowstorm October 26, 2005	Multi-County	Law enforcement reports that heavy snow occurred at Prattsville, and that hundreds of tree limbs were down due to the heavy wet snow. There were 10 to 12 in. of snow at Prattsville. It was reported that there were similar snowfall amounts and damage at other high-elevation towns including Haines Falls, Ashland, Windham, Tannersville, East Jewett, and Jewett.	NOAA-NCDC
Snowstorm January 3, 2006	Multi-County	7 to 10 in. of snow fell in western Greene County	NOAA-NCDC
Snowstorm February 12-13, 2006	Multi-County	4 to 10 in. of snow fell in western Greene County. Ten inches of snow fell at East Jewett and Maple Crest.	Kocin and Uccellini, NOAA-NCDC, Enloe, NWS
Snowstorm March 2, 2006	Multi-County	Snow totals in Greene County ranged between 8.0 inches in East Jewett to 2.0 in. in Haines Falls.	NWS
Snowstorm “Valentines Day Storm” February 12-15, 2007	Multi-County	10 to 30 in. of snow fell in Greene County. Snow totals in Greene County included Prattsville, 28.0 in.; Elka Park, 27.0 in.; East Jewett, 26.0 in.; Windham, 26.0 in.; Ashland, 25.0 in.; Maplecrest, 20.0 in.; Halcott, 18.0 in.; Coxsackie, 17.0 in.; and Catskill, 13.8 in. In Ulster and Greene counties, there were nearly 1,500 power outages, mostly in New Paltz, Coxsackie and the Town of Lloyd.	Evans, Kocin and Uccellini, NWS, NCDC, Knauth
Snowstorm “St. Patrick’s Day Storm” March 15-18, 2007	Multi-County	10 to 30 in. of snow fell in Greene County. Snow totals in Greene County included Windham, 24.0 in.; Platte Cove, 20.0 in.; Cairo, 18.9 in.; Maplecrest, 18.0 in.; Haines Falls, 17.5 in.; Catskill, 16.2 in.; Ashland, 12.0 in.; and Prattsville, 12.0 in.	Kocin and Uccellini, Enloe, NWS

Event Date / Name	Location	Losses / Impacts	Source(s)
Severe Storms and Inland and Coastal Flooding (also identified as a Nor'Easter) April 16, 2007 (FEMA DR-1692)	Multi-County	See FEMA Disaster Declarations (Table 5.4.3-5)	NOAA, FEMA
Snowstorm December 13-14, 2007	Multi-County	Snow totals in Greene County ranged between 10.0 in. in Elka Park to 6.5 in. in Halcott Center.	NWS
Snowstorm December 16-17, 2007	Multi-County	Snow totals in Greene County ranged between 10.0 in. in Maplecrest to 3.4 inches in Windham.	NWS
Snowstorm January 1-2, 2008	Multi-State	Snow totals in Greene County ranged between 9.0 in. in East Jewett to 3.8 inches in Cairo.	NWS
Snowstorm February 22, 2008	Multi-State	Snow totals in Greene County ranged between 8.0 in. in Halcott Center to 4.0 inches in Climax.	NWS
Ice Storm December 13-31, 2008 (FEMA DR-1827)	Multi-County	See FEMA Disaster Declarations (Table 5.4.3-5)	FEMA

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 Greene County has experienced 101 snow and ice storm events and 7 extreme cold temperature events between January 1, 1950 and January 31, 2008. However, most events are regional events not specific to Greene 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): As provided by SHELDUS, over 132 winter storm events were listed for Greene County with property losses for each event ranging in the hundreds to the millions. Only events with monetary losses greater then $18,000 were included in this table. This source indicates that property damages for the County for all winter storm events between 1960 and 2003 averaged $32 M; crop damages averaged $12 K.

Note (3): 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.

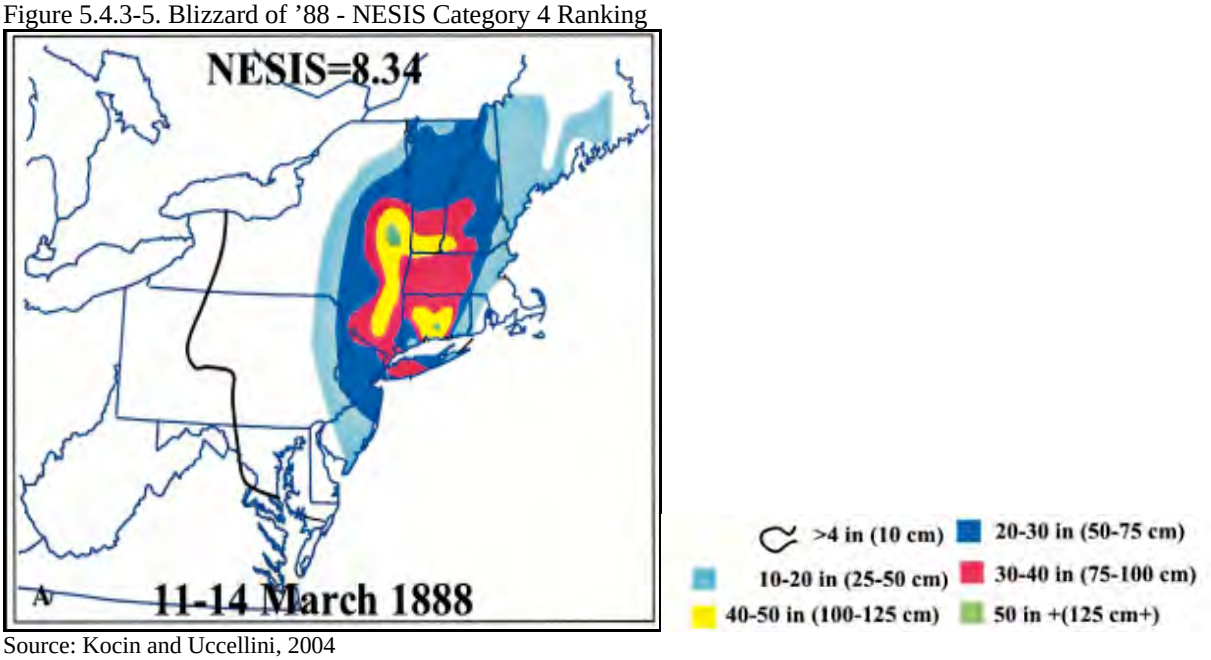
AMS	American Meteorological Society
B	Billion ($)
DEC	Department of Environmental Conservation
DR	Federal Disaster Declaration
EM	Federal Emergency Declaration
FSA	Farm Service Agency
FEMA	Federal Emergency Management Agency
HMP	Hazard Mitigation Plan
K	Thousand ($)
M	Million ($)
MRCC	Midwest Regional 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
NYS	New York State
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 and extreme cold events that have impacted Greene County are provided below for selected events where details regarding their impact (where 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 United States and Atlantic Canada from the Chesapeake Bay to Maine, and including the Maritime Provinces of Eastern Canada (Figure 5.4.3-5). Telegraph infrastructure was disabled, isolating NY 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. Overall, more than 400 deaths were reported. Sources vary, but National Weather service estimated that fifty inches of snow fell in Connecticut and Massachusetts and forty inches covered New York and New Jersey. Winds blew up to 48 miles an hour, creating snowdrifts forty to fifty feet high (Brunner, 2007). It was identified that over 20 to 50 inches of snow had accumulated within various locations of Greene County. Cost estimates of property damage in Greene County were unavailable in the materials reviewed to develop this plan.

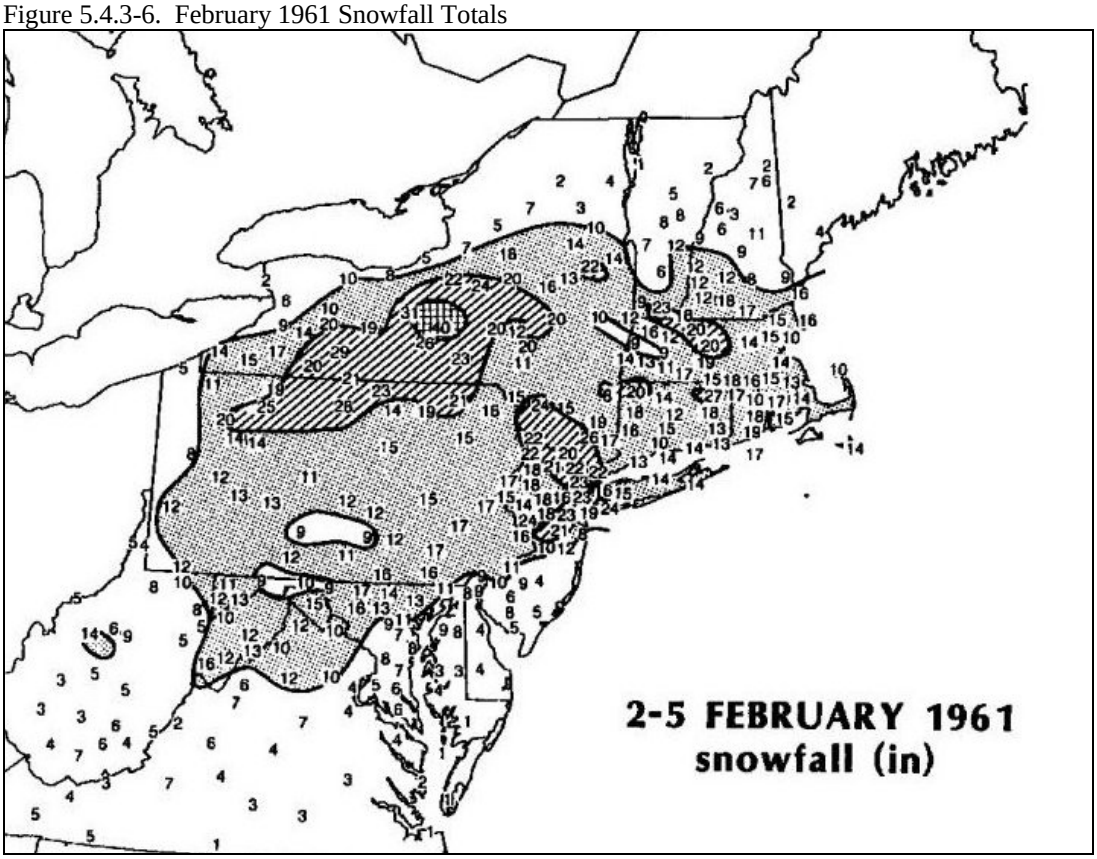
Figure 5.4.3-5. Blizzard of '88 - NESIS Category 4 Ranking



Source: Kocin and Uccellini, 2004

February 2-5, 1961: This 1961 storm produced a maximum of 40 inches of snow in central New York. A large area of 1 to 2 feet of snow accumulated across central New York and northeast Pennsylvania (Evans, 2007) (Figure 5.4.3-6). In Greene County, 10 to 20 inches of snow fell during this event, resulting in over $80,000 in property damages (Kocin and Uccellini, 2004; Hazards and Vulnerability Research Institute, 2008).

Figure 5.4.3-6. February 1961 Snowfall Totals



Source: Evans, 2007

October 4, 1987 (FEMA DR-801): This northeastern coastal storm broke records by dumping heavy, wet snow over eastern New York, Vermont and western portions of Connecticut and Massachusetts. From the Catskills and Berkshires of upstate New York to the Green and White Mountains of Vermont and New Hampshire, the snow transformed the landscape, isolating entire communities. This event was the earliest snow for the season on record in eastern New York since 1870. Throughout the four state area, the snow brought down power lines, resulting in a loss of electricity to about 333,000 customers, closed roads and airports, and brought down an untold number of trees and tree limbs that were still in full leaf. Many vehicles were damages by the falling trees and limbs and many weather related traffic accidents resulted in death and injury (NWS, 1987; Weather Underground, 2007).

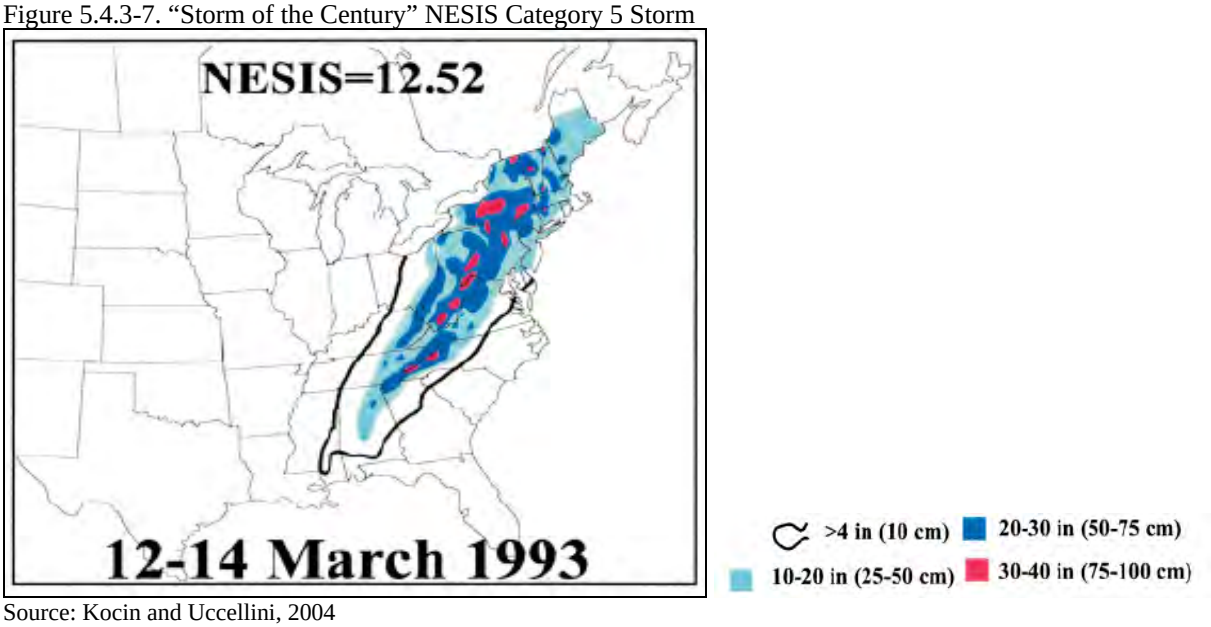
In New York State, leaf-laden trees caught falling snow and the weight snapped branches and toppled trees across power lines and roads. Many highways and a 26-mile stretch of the Thomas E. Dewey Thruway were closed, and power failures hit 230,000 homes in New York State. Many traffic accidents were reported throughout the region and motorists were warned to stay off roads. Emergencies were declared in some communities in the Hudson Valley, and thousands of people were stranded at homes and weekend retreats. Crops of apples, peppers, eggplant and sweet corn were reported damaged. The heaviest snow, 20 inches, was reported at East Jewett, in Greene County. Elsewhere in New York State, the National Weather Service reported accumulations of up to 15 inches in Ulster County, 13 inches in Rensselaer County, 12 inches in the Catskills and 10 inches in Columbia County (McFadden, 1987). Overall, New York State experienced approximately $13.5 M in eligible damages (NYSDPC, 2008). Cost estimates of property damage in Greene County were unavailable in the materials reviewed to develop this plan.

This storm resulted in a FEMA Emergency Declaration (FEMA DR-801) on November 10, 1987. Through this declaration, the following Counties were declared eligible for federal and State disaster funds: Albany, Columbia Dutchess, Greene, Putnam, Rensselaer, Saratoga, Schenectady, Washington (NYSEMO, 2006; NYSDPC, 2008). Disaster aid for Greene County has not been disclosed in the materials reviewed to develop this plan.

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 5.4.3-7). Total snowfall accumulations for Greene County were between 20 and 40 inches, with Prattsville recieving over 36 inches of snow (Kocin and Uccellini, 2004). Cost estimates of property damage or losses in Greene County were unavailable in the materials reviewed to develop this plan.

Figure 5.4.3-7. "Storm of the Century" NESIS Category 5 Storm



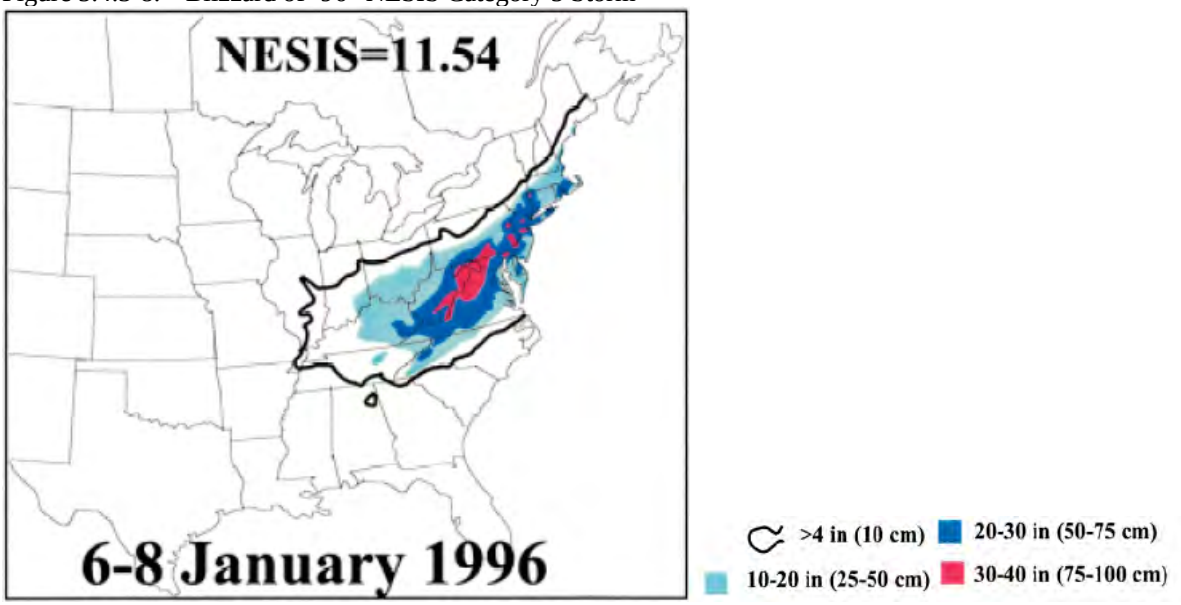
Source: Kocin and Uccellini, 2004

This storm resulted in a FEMA Emergency Declaration (FEMA EM-3107) on March 17, 1993. Through this declaration, multiple Counties were declared eligible for federal and State disaster public assistance funds (NYSEMO, 2006; FEMA, 2008). Disaster aid for Greene County has not been disclosed in the materials reviewed to develop this plan.

January 6-9, 1996 (FEMA DR-1083) ("Blizzard of '96"): Much of the eastern U.S. seaboard, from Tennessee to Maine, was affected by this blizzard. Many areas received between 1 and 3 feet of snow during this storm. This blizzard achieved a NESIS rating of 11.54, placing the storm in the Extreme category (Figure 5.4.3-8). A total of 4 to 40 inches of snow fell along the storms path, with the highest

accumulations in the States of Pennsylvania, New Jersey, New York, Maryland, Virginia and West Virginia (Kocin and Uccellini, 2004).

Figure 5.4.3-8. "Blizzard of '96" NESIS Category 5 Storm



Source: Kocin and Uccellini, 2004

The major effects from this storm in New York State were felt across the southeastern sections of the State, resulting in property damages ranging from $21.3 to $70 million (NYSDPC, 2008; NWS, 1996). The Albany NWS forecast office reported that snowfalls ranged from half an inch at Albany to isolated amounts over 30 inches in Dutchess and Berkshire Counties. Snowfalls ranged from 10 to 20 inches with 6- to 10-foot drifts in Berkshire County, Massachusetts; Litchfield County, Connecticut; and Greene, Columbia, Delaware, Ulster, Sullivan, and Dutchess Counties in New York. States of Emergency were declared in Litchfield, Pittsfield, Berkshire, Dutchess, Columbia, and Ulster Counties (NWS, 1996). Some sources indicate that Greene County experienced as much as 30 inches of snow during the blizzard (Kocin and Uccellini, 2004). The County also, experienced extreme cold temperatures during the blizzard, ranging from -2 to -20°F, mostly in the Towns of Lexington and Prattsville (The Weather Channel, 2008). Greene County experienced approximately $160,000 in property damages during this event (Hazards and Vulnerability Research Institute, 2008).

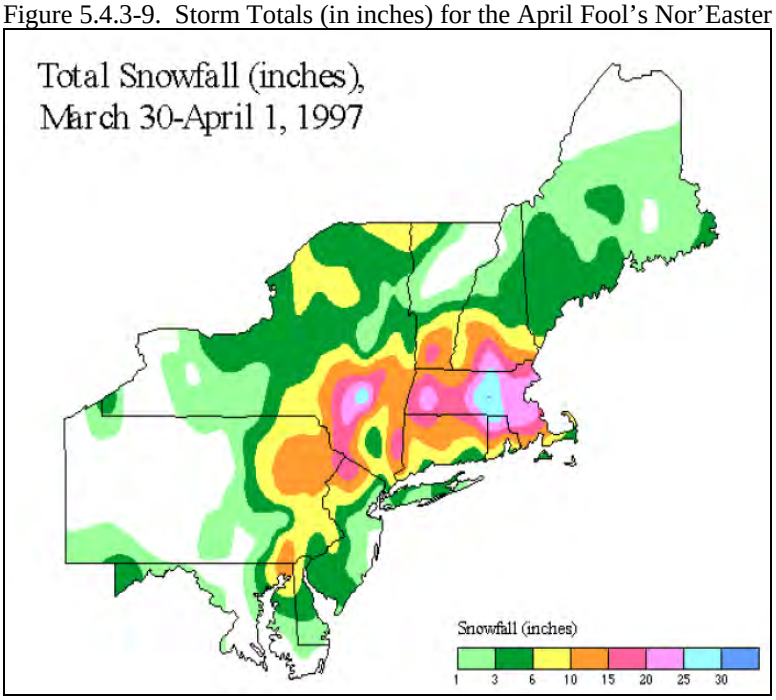
This storm resulted in a FEMA Disaster Declaration (FEMA DR-1083) on January 12, 1996. Through this declaration, the following Counties were declared eligible for federal and State disaster funds: Albany, Bronx, Columbia, Delaware, Dutchess, Greene, Kings, Nassau, New York, Orange, Putnam, Queens, Rensselaer, Richmond, Rockland, Suffolk, Sullivan, Ulster, Westchester (NYSEMO, 2006; FEMA, 2008). Disaster aid for Greene County has not been disclosed in the materials reviewed to develop this plan.

March 31 – April 1, 1997 ("April Fool's Nor'Easter"): An intensifying storm off the Mid-Atlantic coast brought record-setting snow to portions of the Northeast. Snowfall amounts of 12 inches and higher covered northeast Pennsylvania, northwestern New Jersey, eastern New York, and central New England. Snowfall amounts of 24 inches and higher covered the northern Catskill Mountain region of New York and central and eastern Massachusetts. The storm also brought high winds, with peak winds between 30 and 50 mph (NRCC, 1997). The storm achieved a NESIS rating of 2.37, placing the storm in the 'Notable' category (Figures 5.4.3-9 through 5.4.3-10) (Kocin and Uccellini, 2004). The wet snow and

strong winds brought down many trees and caused widespread power outages throughout the New York State counties affected. Overall, the affected counties of the State experienced over $7.8 million in property damages from this storm (NCDC, 2008).

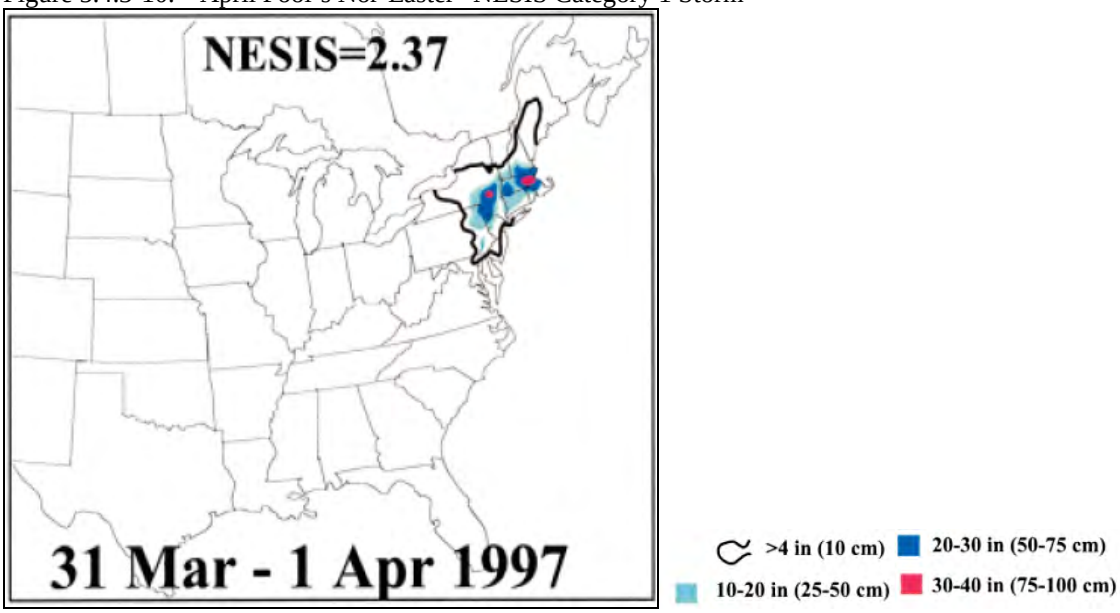
Snow accumulations totaled 20 to 40 inches in Greene County, with East Jewett receiving 37 inches of snow; the highest accumulations recorded in the State. Additionally, Windham received 30 inches and Prattsville received 29 inches of snow (Kocin and Uccellini, 2004; NCDC, 1997). Over 30,000 customers within Greene County lost power during this event. A State of Emergency was declared in Greene, Schoharie and Dutchess Counties (NCDC, 2008). Greene County experienced approximately $709,090 in property damages during this event (Hazards and Vulnerability Research Institute, 2008).

Figure 5.4.3-9. Storm Totals (in inches) for the April Fool's Nor'Easter



Source: NCDC, 2004

Figure 5.4.3-10. "April Fool's Nor'Easter" NESIS Category 1 Storm

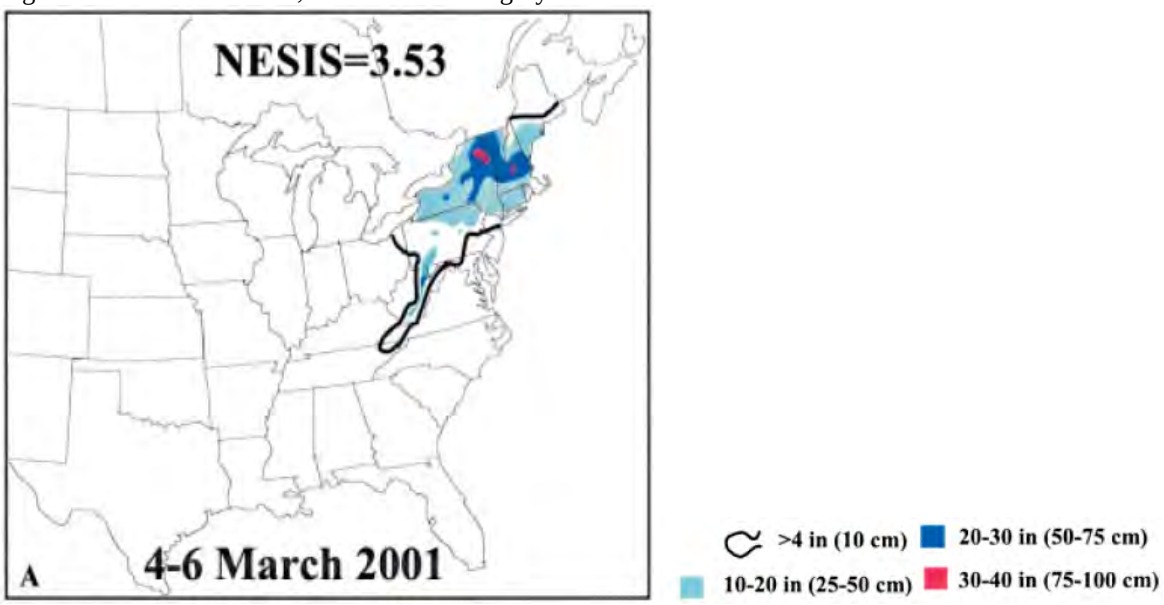


Source: Kocin and Uccellini, 2004

March 4-7, 2001: A major snowstorm caused snow to fall at a rate of one inch per hour, respectively, throughout the northeastern U.S. over a 2-day period of time. High winds caused snowdrifts and whiteout conditions in many parts of southern and central New York State (NCDC, 2008). Achieving a NESIS rating of 3.53, this event places itself in the 'Significant' category (Figures 5.4.3-11 and 5.4.3-12) (Kocin and Uccellini, 2004).

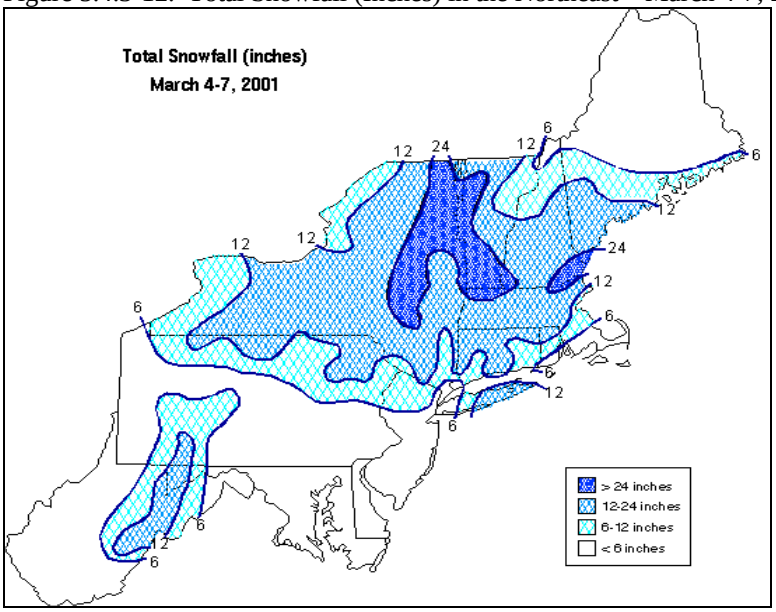
The heaviest snowfall from this event fell across Pennsylvania, New York State, and New England. Snowfall totals for Greene County ranged from 10 to 30 inches (Kocin and Uccellini, 2004; NRCC, 2001). Prattsville received 25 inches, Windham received 26 inches and East Jewett received 21 inches of snow (NWS, 2001). Cost estimates of property damage or losses throughout the State, including Greene County, were unavailable in the materials reviewed to develop this plan.

Figure 5.4.3-11. March 4-7, 2001 NESIS Category 2 Storm



Source: Kocin and Uccellini, 2004

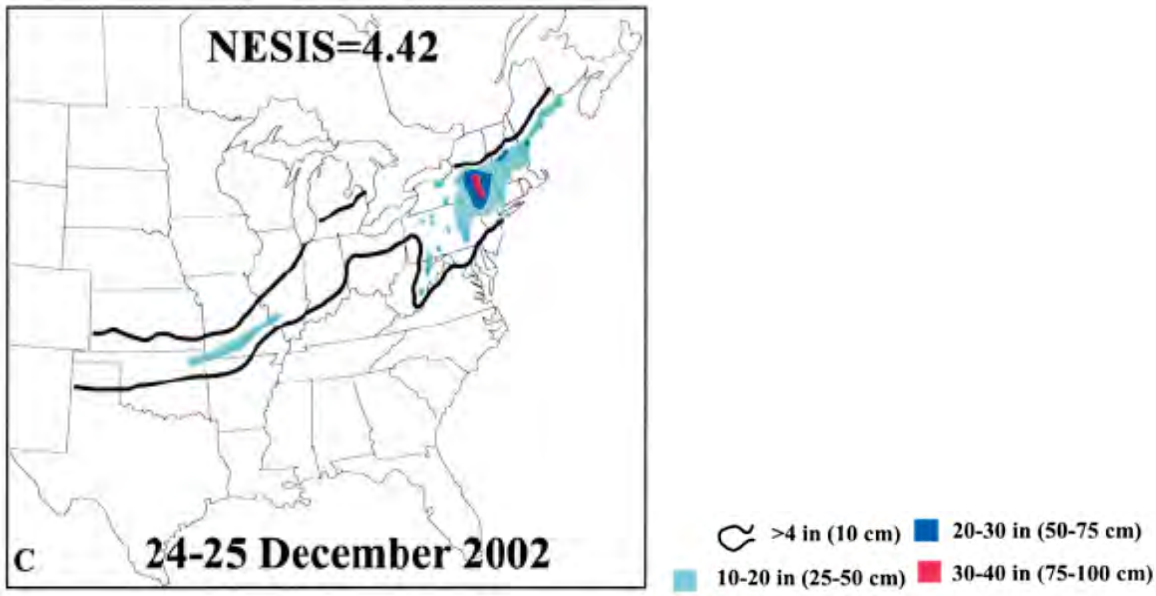
Figure 5.4.3-12. Total Snowfall (Inches) in the Northeast – March 4-7, 2001



Source: NRCC, 2001

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. The first storm, December 25-26, 2002, began as light snow and later on, heavy snow began to fall across central NY. Snowfall rates were several inches an hour, resulting in snow amounts ranging from 8 inches to 3 feet. Many New York counties declared state of emergencies, including Greene County (NCDC, 2008). Snowfall totals in Greene County ranged between 10 to 40 inches during the December event. Snowfall totals for certain locations in Greene County included: Prattsville (29 inches), Ashland (16 inches), Catskill (16 inches), Platte Cove (23.2 inches), Windham (20 inches), and Cairo (18.3 inches) (NOAA, 2002). Achieving a NESIS rating of 4.42, this event placed itself in the 'Major' category (Figure 5.4.3-13) (Kocin and Uccellini, 2004).

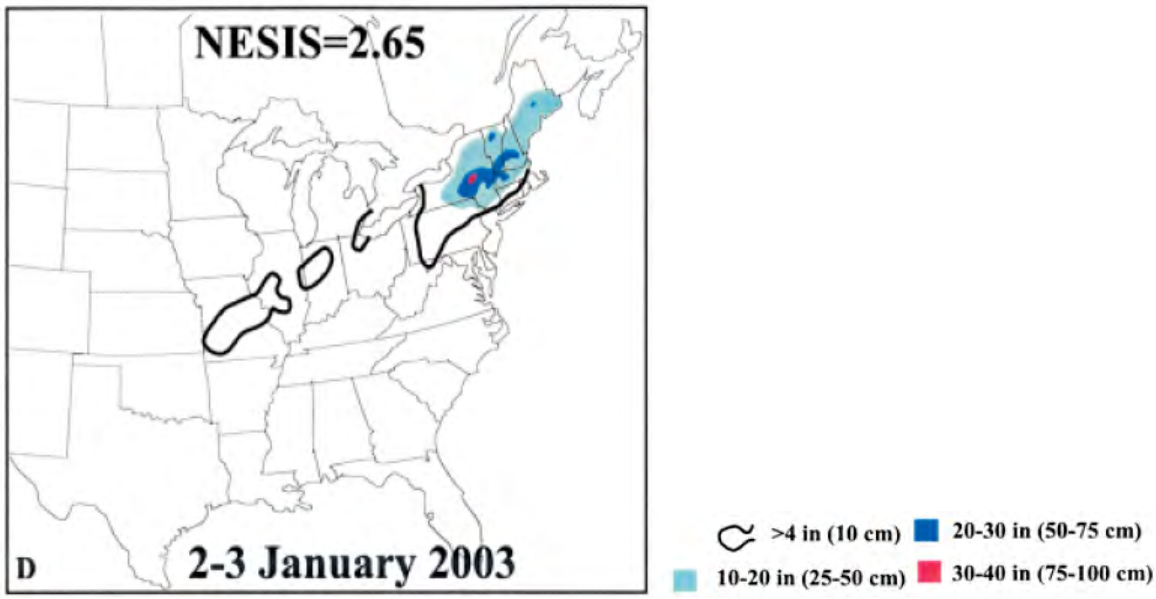
Figure 5.4.3-13. December 24-25, 2002 NESIS Category 3 Storm



Source: Kocin and Uccellini, 2004

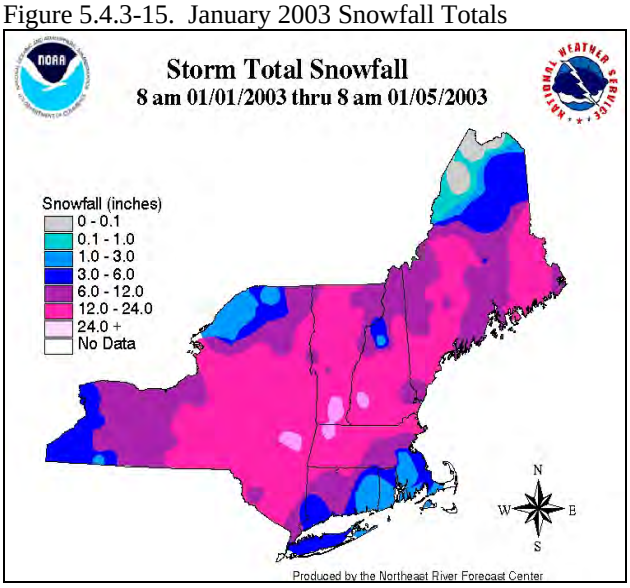
The second storm on January 3-4, 2003 also brought heavy snow to New York State, resulting in approximately $434,000 in property damages in the counties affected. Snowfall totals in Greene County ranged between 20 to 30 inches during this January event. Snowfall totals for certain locations in Greene County included: Ashland (16 in.), Catskill (16 in.), Prattsville (18 in.) and Platte Cove (22.1 in.) (NCDC, 2002). Achieving a NESIS rating of 2.65, this event placed itself in the 'Significant' category (Figure 5.4.3-14) (Kocin and Uccellini, 2004). Cost estimates of property damage or losses from both events throughout the State, including Greene County, were unavailable in the materials reviewed to develop this plan.

Figure 5.4.3-14. January 2-3, 2003 NESIS Category 2 Storm



Source: Kocin and Uccellini, 2004

Figure 5.4.3-15. January 2003 Snowfall Totals

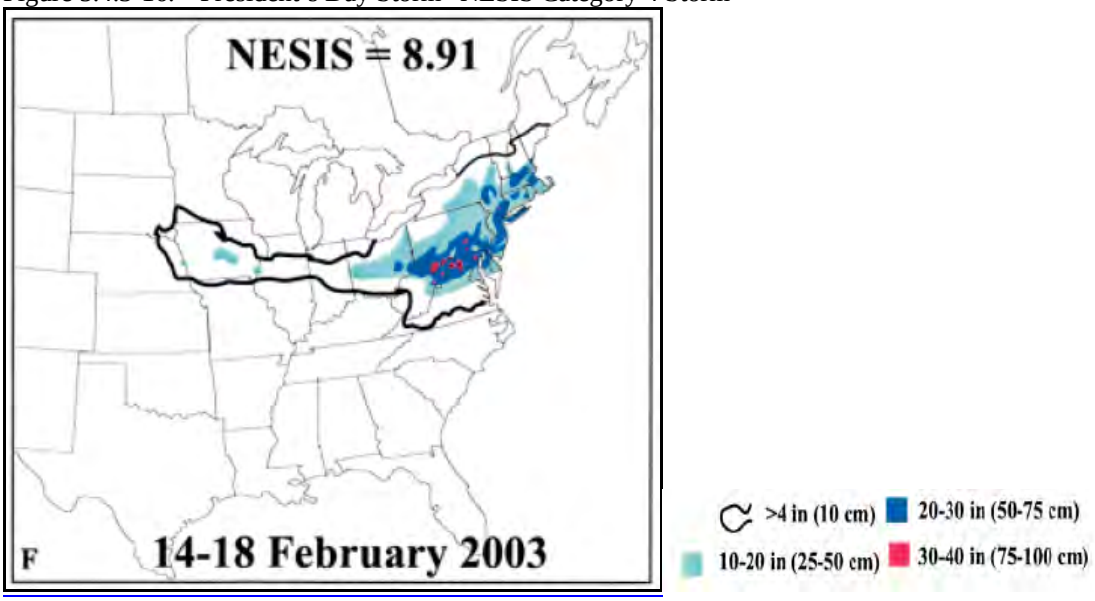


Source: NCDC, 2003
Note: From NOAA's National Weather Service Northeast River Forecast Center shows snowfall totals in the Northeast for the first week of January 2003.

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 nearly $11.3 million in disaster aid was made available to all declared counties as result of this event. FEMA approved $461,919 in public assistance reimbursements for Greene County.

February 17-18, 2003 ("President's Day Storm") (FEMA EM-3184): This snowstorm, also known as the "President's Day Storm" was a coastal storm, resulting in heavy snowfall. The storm delivered record and near-record snowfall to the Mid-Atlantic States. This storm achieved a NESIS rating of 8.91, placing the storm in the 'Crippling' category. The storm's total area, at peak, reached from Ohio to Maine, bringing a final total 4 to 40 inches of snowfall (Figure 5.4.3-16) (Kocin and Uccellini, 2004).

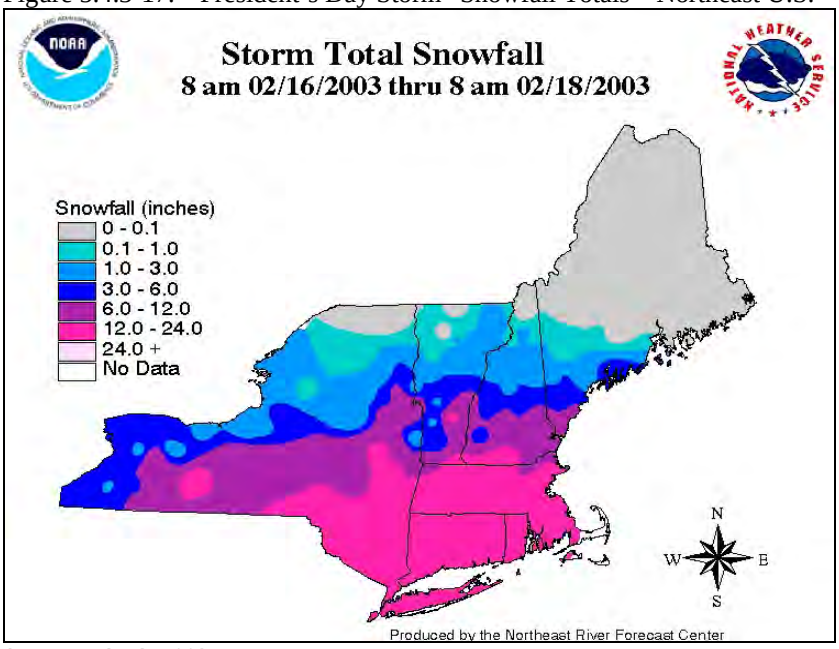
Figure 5.4.3-16. "President's Day Storm" NESIS Category 4 Storm



Source: Kocin and Uccellini, 2004

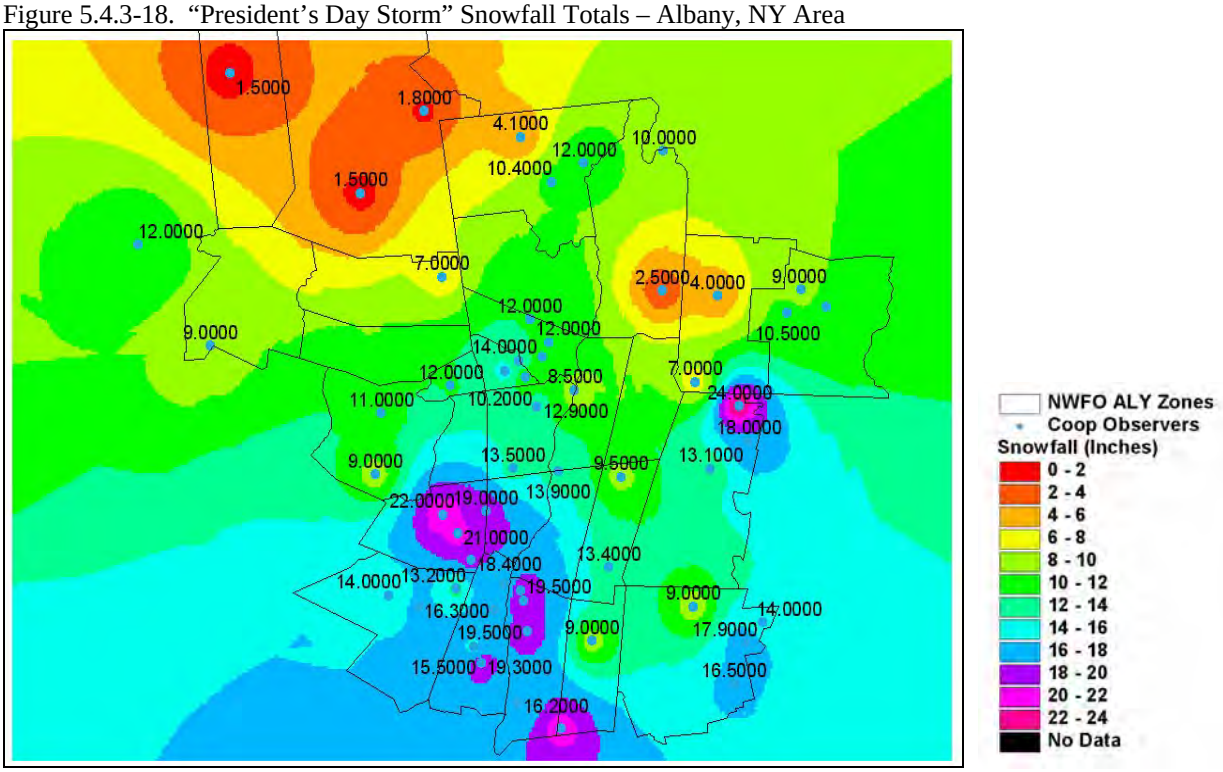
In New York State, Governor George E. Pataki declared a Snow Emergency on February 17, 2003 for New York City and the following counties: Suffolk, Nassau, Westchester, Rockland, Putnam, Orange, Sullivan, Dutchess, Columbia, Greene, Ulster, Delaware, Schenectady and Albany [New York State Department of Transportation (NYSDOT), 2003].. These southeastern Counties of the State received between 12 and 24 inches of snowfall throughout the storm (Figure 5.4.3-17). Snowfall totals for certain locations in Greene County included: Platte Cove, 18.4 in.; East Jewett, 21.0 in.; Windham, 22.0 in.; and Cairo, 19.0 in. (See Figure 5.4.3-18) (Kocin and Uccellini, 2004; NWS, 2003). Cost estimates of property damage or losses throughout the State, including Greene County, were unavailable in the materials reviewed to develop this plan.

Figure 5.4.3-17. "President's Day Storm" Snowfall Totals – Northeast U.S.



Source: NCDC, 2003

Figure 5.4.3-18. "President's Day Storm" Snowfall Totals – Albany, NY Area

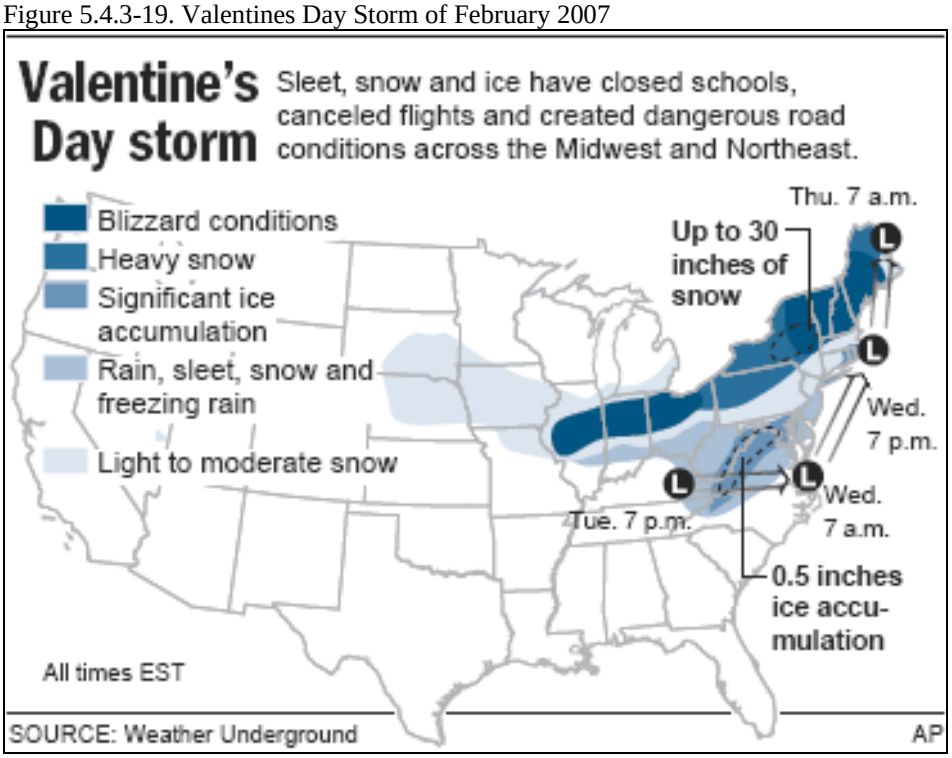


Source: NWS, 2003

This storm resulted in a FEMA Emergency Declaration (FEMA EM-3184) on March 27, 2003. Through this declaration, the following Counties were declared eligible for federal and State disaster funds: Albany, Bronx, Broome, Chenango, Columbia, Delaware, Dutchess, Greene, Kings, Nassau, New York, Orange, Putnam, Queens, Richmond, Rockland, Schenectady, Schoharie, Suffolk, Sullivan, Ulster, Westchester (FEMA, 2008). Disaster aid for Greene County has not been disclosed in the materials reviewed to develop this plan.

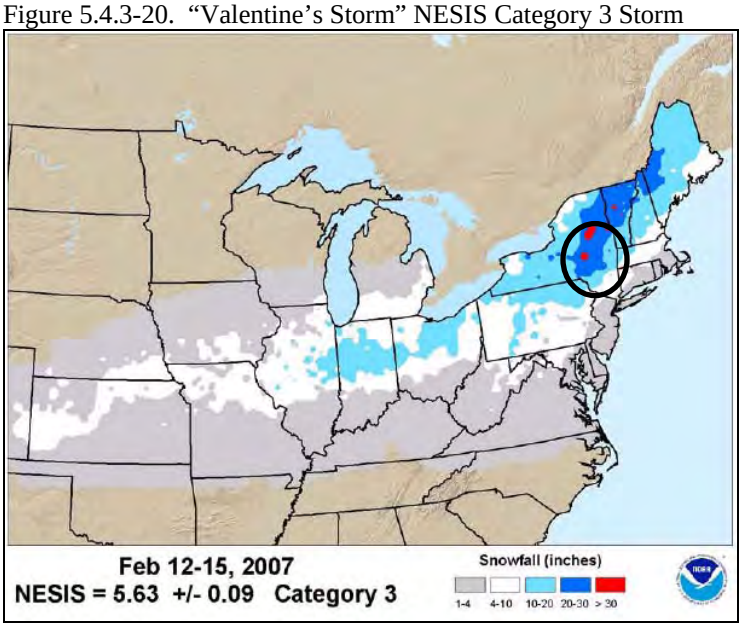
February 12-15, 2007 ("Valentine's Day Storm"): The "Valentine's Day Storm" was the largest storm to affect central New York State and north-northeast Pennsylvania during the 2006-2007 winter season. In much of the area, the storm was the biggest blizzard in several years with snow accumulations of up to 30 inches in some locations (Evans, 2007; MSNBC, 2007) (Figure 5.4.3-19). This storm achieved a NESIS rating of 5.63, placing the storm in the 'Major' category (Figure 5.4.3-20) (Kocin and Uccellini, 2004).

Figure 5.4.3-19. Valentines Day Storm of February 2007



Source: MSNBC, 2007 (provided via Weather Underground)

Figure 5.4.3-20. "Valentine's Storm" NESIS Category 3 Storm



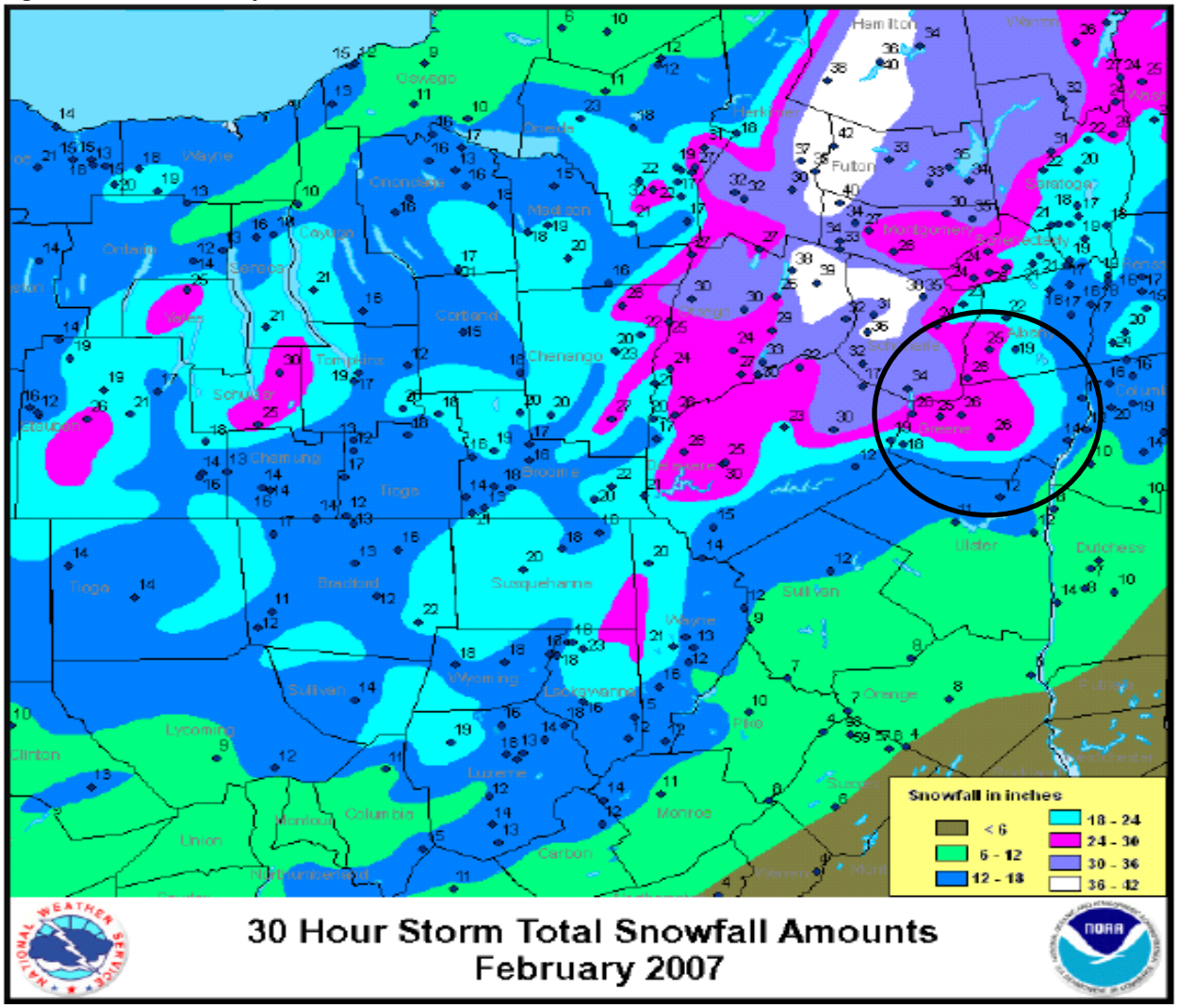
Source: NOAA, 2007

In New York State, Schenectady, Schoharie, Montgomery, Washington, Essex, Warren and Clinton counties, which were affected by extensive snowfall from the storm, had declared a state of emergency. Several other counties (including Greene County) declared snow emergencies (CBS Broadcasting, 2007). The NWS indicated that accumulations within Greene County from this storm ranged from 13 to 28 inches, with the greatest accumulation in Prattsville (Evans, 2007; NWS, 2007) (Figure 5.4.3-21). The following snowfall totals were documented for Greene County communities:

- Prattsville – 28.0 inches
- Elka Park – 27.0 inches
- East Jewett – 26.0 inches
- Windham – 26.0 inches
- Ashland – 25.0 inches
- Maplecrest – 20.0 inches
- Halcott – 18.0 inches
- Coxsackie – 17.0 inches
- Catskill – 13.8 inches (NWS, 2007).

Cost estimates of property damage or losses throughout the State, including Greene County, were unavailable in the materials reviewed to develop this plan.

Figure 5.4.3-21. February 13-14, 2007 Snowfall Accumulations



Source: Evans, 2007
Note: Snowfall totals for Greene County range from 12 inches to 26 inches.

April 14-18, 2007 (FEMA DR-1692): This Nor'Easter generally impacted the northeastern U.S. states of New York, New Jersey and Connecticut. The combined effects of high winds and heavy rainfall during this event led to flooding, storm damages, power outages, and evacuations, and disrupted traffic and

commerce. Various counties in the eastern Catskills and Mid-Hudson Region of New York State were impacted by several inches of rain during this event (NWS, 2007).

Precipitation totals for Greene County ranged from 3 to 6 inches, with the greatest accumulations centrally located within the County in the Towns of Lexington, Jewett and Hunter (Figure 5.4.3-21) (NOAA, 2007). This event resulted in widespread flooding throughout the County; therefore, its flood impact is further mentioned in Section 5.4.1 (Flood).

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 – Fall season, what is not easily determined is how many such storms will occur during that time frame (NYSDPC, 2008). As with winter storms, the frequency of occurrence of ice storms cannot be predicted as well.

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 ("frequent" [likely to within 25 years, as presented in Table 5.3-1]). 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, Greene County is currently listed as the 36th County in the state most threatened by and vulnerable to snow and snow loss, with an annual average snowfalls ranging between 30 and 75 inches. Greene County is also listed as the 53rd County in New York State most threatened by and vulnerable to ice storms and ice storm loss (NYSDPC, 2008). Although Greene 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. It is estimated that Greene County and all of its jurisdictions, will continue to experience direct and indirect impacts of severe winter storms annually that may induce secondary hazards such as snow melt, flooding, and water quality and supply concerns and experience utility failures, power outages, transportation delays/accidents/inconveniences and public health concerns.

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 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%. Over the next century, New York'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 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 Greene County have not been found. However, if scientific predictions are accurate and based on the regional studies that have been done for New York and its surrounding states, it is anticipated that Greene 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 Greene 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 Greene 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

For the purposes of this HMP, the entire population in Greene County (48,195 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 Greene 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 5.4.3-7 summarizes the population over the age of 65 and individuals living below the Census poverty threshold.

Table 5.4.3-7. Vulnerable Population Exposed to Severe Winter Storm/Extreme Cold Events in Greene County

Population Category	Number of Persons Exposed	Percent of Total County Population
Elderly (Over 65 years of age) (1)	7,544	15.7
Persons living below Census poverty threshold* (1)	5,432	12.2
Elderly (Over 65 years of age) living below Census poverty threshold (2)	751	1.6

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 Greene 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 Greene County has experienced losses up to $709,000 due to a severe winter storm event (March 31 to April 1, 1997 "April Fools Nor'Easter"); however, specific losses to structures are unknown. 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 5.4.3-8 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. 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 5.4.3-8. General Building Stock Exposure and Estimated Losses from Severe Winter Storm/Extreme Cold Events in Greene County

Building Occupancy Class	Total Value	1% Damage Loss Estimate	5% Damage Loss Estimate	10% Damage Loss Estimate
Residential	$3,246,873,000	$32,468,730	$162,343,650	$324,687,300
Commercial	$488,682,000	$4,886,820	$24,434,100	$48,868,200
Industrial	$99,237,000	$992,370	$4,961,850	$9,923,700
Agricultural	$16,393,000	$163,930	$819,650	$1,639,300
Religious	$52,299,000	$522,990	$2,614,950	$5,229,900
Government	$57,912,000	$579,120	$2,895,600	$5,791,200
Educational	$62,135,000	$621,350	$3,106,750	$6,213,500
Total	$4,023,531,000	$40,235,310	$201,176,550	$402,353,100

Source: HAZUS-MH MR3, 2007
Notes: The building values shown are building structure only because damage for the severe winter storm/extreme cold hazard will 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 Greene 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.

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. According to the Planning Committee, no police stations or fire stations have a backup power supply. 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.

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. Specific economic losses were not available to include in this HMP.

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.

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 Town roads, structures, facilities, utilities, and population. The overall hazard ranking determined for the severe winter storm/extreme cold hazard is 'High', with a 'frequent' probability of occurrence (hazard event occurring within 25 years) (see Tables 5.3-3 through 5.3-6).

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.