Section 3.15: SEVERE WINTER STORM

2014 SHMP Updates
• Annual average snowfall map has been added. • Historical and Recent Events and Losses table added. • Presidential Declared Disaster table and map has been added. • Vulnerability and loss data from local plans have been addressed.

3.15.1 Winter Storm Profile

New York State is located at relatively high latitude and exposed to large quantities of moisture from the Great Lakes and the Atlantic Ocean; therefore, it is highly susceptible to severe winter storms. Occasionally these storms are large enough to encompass almost the entire state.

Hazard	Terms and Definitions
Winter Storm	• *Weather Advisory* – this alert may be issued for a variety of severe conditions. Weather advisories may be announced for snow, blowing or drifting snow, freezing drizzle, freezing rain, or a combination of weather events. • *Winter Storm Watch* – severe winter weather conditions may affect your area (freezing rain, sleet or heavy snow may occur separately or in combination). • *Winter Storm Warning* – severe winter weather conditions are imminent. • *Freezing Rain or Freezing Drizzle* – rain or drizzle is likely to freeze upon impact, resulting in a coating of ice glaze on roads and all other exposed objects. • *Sleet* – small particles of ice usually mixed with rain. If enough sleet accumulates on the ground, it makes travel hazardous. • *Blizzard Warning* – sustained wind speeds of at least 35 mph are accompanied by considerable falling or blowing snow. This alert is the most perilous winter storm with visibility dangerously restricted. • *Frost/Freeze Warning* – below freezing temperatures are expected and may cause significant damage to plants, crops and fruit trees. • *Wind Chill* – a strong wind combined with a temperature slightly below freezing can have the same chilling effect as a temperature nearly 50 degrees lower in a calm atmosphere. The combined cooling power of the wind and temperature on exposed flesh is called the wind-chill factor.

Characteristics

Severe Winter Storm is defined as an event that occurs during the winter season that includes one or more of the following conditions: snow, ice, high winds, blizzard conditions, and other wintry conditions; causing physical damage or loss to improved property (NWS, 2013). It can range from a moderate snow over a few hours to a blizzard with blinding wind driven snow that can last for multiple days. During late October through mid-April, temperatures can range between 0 degree Fahrenheit and 32 degree Fahrenheit with February having the greatest average snowfall. Cold moisture combined with high wind and large accumulations of snow cause "Lake Effect" storms. Lake Effect storms leave huge quantities of snow with a few days in its wake. They primarily affect the western and central region of New York, but have been known to affect the eastern portion of the State, if the storm becomes large enough.

Extreme cold and heavy snowfall can immobilize the entire state causing road closures, power outages, disruption in communication services, and no heat for several days, under the most severe circumstances. Severe storms can require persons to abandon their homes and seek shelter.

*February 8, 2013, **Winter Storm Nemo** caused New York, Massachusetts, Connecticut, New Hampshire and Rhode Island to declare states of emergency after dumping a massive three feet of snow across the North East Coast.*

The severity or magnitude of a severe winter storm depends on several factors including a region's climatological susceptibility to snowstorms, snowfall amounts and rates, wind speeds, temperatures, visibility, storm duration, topography, time, day of the week, and 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 Scale, which measures the impact of tornados and Saffir-Simpson Scale, which classify hurricanes, there is no widely used scale to categorize snowstorms. NESIS was developed by Paul Kocin of The Weather Channel and Louis Uccellini of the National Weather Service (NWS) to characterize and rank high impacts of northeastern 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 3.15a** identifies and describes each ranking. 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, 2011).

Table 3.15a: NESIS Ranking Categories

Category	Description	NESIS Range	Definition
1	Notable	1.0 – 2.49	These storms are notable for their large areas of 4-inch accumulations and small areas of 10-inch snowfall.
2	Significant	2.5 – 3.99	Includes storms that produce significant areas of greater than 10-inch snows while some include small areas of 20-inch snowfalls. A few cases may even include relatively small areas of very heavy snowfall accumulations (greater than 30 inches).
3	Major	4.0 – 5.99	This category encompasses the typical major Northeast snowstorm, with large areas of 10-inch snows (generally between 50 and 150 × 103 mi^{-2}— roughly one to three times the size of New York State with significant areas of 20-inch 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-inch snowfalls, and each case is marked by large areas of 20-inch 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 inches. These are the only storms in which the 10-inch 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, 2011).

While it is almost certain that a number of significant winter storms will occur during the fall and winter seasons, it is difficult to predict how many storms will occur during that time frame. For example, during the calendar year 1997, three (3) significant winter storms occurred. In contrast, during the calendar year 2000, the State encountered sixteen (16) storms.

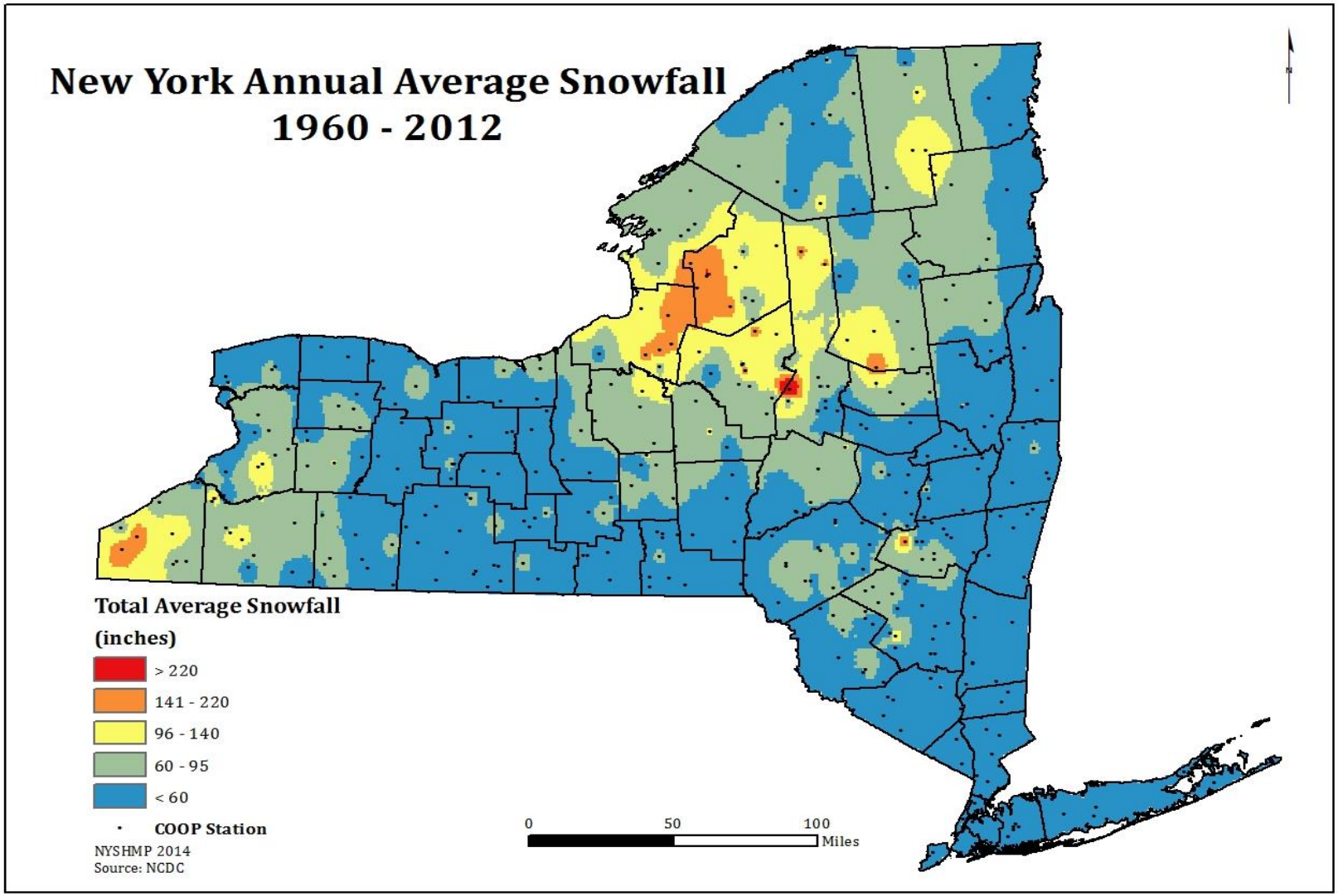
Location

On average, New York receives more snow fall than other states within the United States. Average annual snowfall is about 65 inches, but it varies greatly in different regions of the State. Although the entire State is subject to severe winter storms, the easternmost and west-central portions of the State are more likely to suffer under severe winter storm occurrences than the southern portion.

Albany, Syracuse, Buffalo and Rochester are typically in the top ten cities in the nation in annual snowfall. Hamilton and Essex are rural low populous counties and home to the six (6) million-acre Adirondack Park, which also receive extensive annual snowfall. Parts of Chautauqua, Herkimer, Jefferson, Oswego, and Lewis Counties receive the heaviest snowfall averaging 96-220 inches annually. The coastal region of the State has the lightest annual snowfall, but is extremely vulnerable to Nor'easters if a hurricane or coastal storm occurs.

Figure 3.15a is a map of historical average snowfall totals for the State. The National Weather Service's Cooperative Observer Program (COOP) collects daily meteorological data, including snowfall. Monthly totals for the years of 1960-2012 were used to create the annual average surface from the COOP stations. This figure shows a clear visual of areas that are subject to future occurrences and vulnerable to high levels of snowfall.

Figure 3.15a: New York Annual Average Snowfall 1960-2012



FEMA 9523.1 Snow Assistance Policy

Entities that meet the applicant eligibility, 44 CFR §206.222, and are performing work that meets the requirements of general work eligibility, 44 CFR §206.223, are eligible for snow assistance.

Eligible work, under Category B, emergency protective measures, as described in the Public Assistance Guide, FEMA 322 (PDF), includes snow removal, snow dumps, de-icing, salting, and sanding of roads and other facilities essential to eliminate or lessen immediate threats to life, public health, and safety. In addition, activities related to the snowstorm such as search and rescue, sheltering, and other emergency protective measures are eligible work. Other categories of work may be eligible under a snowstorm declaration where appropriate.

In a major disaster declaration for a Severe Winter Storm, snow removal costs are not eligible for FEMA assistance if the county does not meet the requirements for snow assistance under paragraph (B) of this policy. A limited level of snow removal incidental to disaster response may be eligible for assistance. Generally, snow removal that is necessary to perform otherwise eligible emergency work is eligible. For example, snow removal necessary to access debris or to repair downed power lines is eligible, while normal clearance of snow from roads is not eligible. (FEMA, 2013)

Previous Winter Storm Occurrences

New York State Department of Homeland Security and Emergency Services (DHSES) Mitigation staff researched several data sources for historical winter storm records including NYS Office of Emergency Management archives, FEMA statistics, Disaster Declaration data, Spatial Hazard Events and Losses Databases for the United States (SHELDUS), and NOAA's National Climatic Data Center (NCDC) storm event database. According to FEMA, 11 major severe winter storm events occurred from 1976 to 2013 causing Presidential Disaster Declarations. **Table 3.15a** documents severe winter storm Presidential declaration events that occurred from 1976-2013 (excluding emergency declarations).

Table 3.15b: Severe Winter Storm Presidential Declarations 1976-2013

Disaster Number	Date Declared	Affected Locations
DR-4111	4/23/2013	Suffolk County
DR-1957	2/18/2011	Nassau and Suffolk Counties
DR-1827	3/4/2009	Albany, Columbia, Delaware, Greene, Rensselaer, Saratoga, Schenectady, Schoharie and Washington Counties
DR-1467	5/12/2003	Cayuga, Chenango, Livingston, Madison, Monroe, Oneida, Onondaga, Ontario, Orleans, Oswego, Otsego, Schenectady, Seneca, Wayne, and Yates Counties
DR-1404	3/1/2002	Erie County
DR-1196	1/6/1998	Clinton, Essex, Franklin, Jefferson, Lewis, and Saint Lawrence Counties
DR-1083	1/12/1996	Albany, Bronx, Columbia, Delaware, Dutchess, Greene, Kings, Nassau, New York, Orange, Putnam, Queens, Rensselaer, Richmond, Rockland County, Suffolk, Sullivan, Ulster, and Westchester Counties
DR-898	3/21/1991	Allegany, Genesee, Jefferson, Lewis, Livingston, Monroe, Ontario, Orleans, Saint Lawrence, Steuben, Wayne, Wyoming, and Yates Counties
DR-801	11/10/1987	Albany, Columbia, Dutchess, Greene, Putnam, Rensselaer, Saratoga, Schenectady, and Washington Counties
DR-527	2/5/1977	Cattaraugus, Chautauqua, Erie, Genesee, Jefferson, Lewis, Niagara, Orleans, and Wyoming Counties
DR-494	3/19/1976	Cattaraugus, Chautauqua, Erie, Genesee, Livingston, Monroe, and Wyoming Counties

Figure 3.15b displays the Presidential declared disaster totals by county for winter events for the period of 1954 through July 2013. Monroe and Genesee Counties have the highest number of winter declarations.

Figure 3.15c references NYS winter events by county from 1960-2012. The highest number of Severe Winter Storm occurrences from 1960-2012 were in Western, Central and Northern New York State. On average 290-370 events were reported in the following counties: Chautauqua, Erie, Oswego, Oneida, Lewis, St. Lawrence, Franklin, Clinton and Essex. The lowest number of occurrences was along the coastal region of the State in Suffolk, Nassau, Bronx, Queens, Kings, Richmond, Rockland and Westchester Counties with 60-89 events

Figure 3.15b: Presidential Disaster Declarations for Winter Events for 1954- 2013

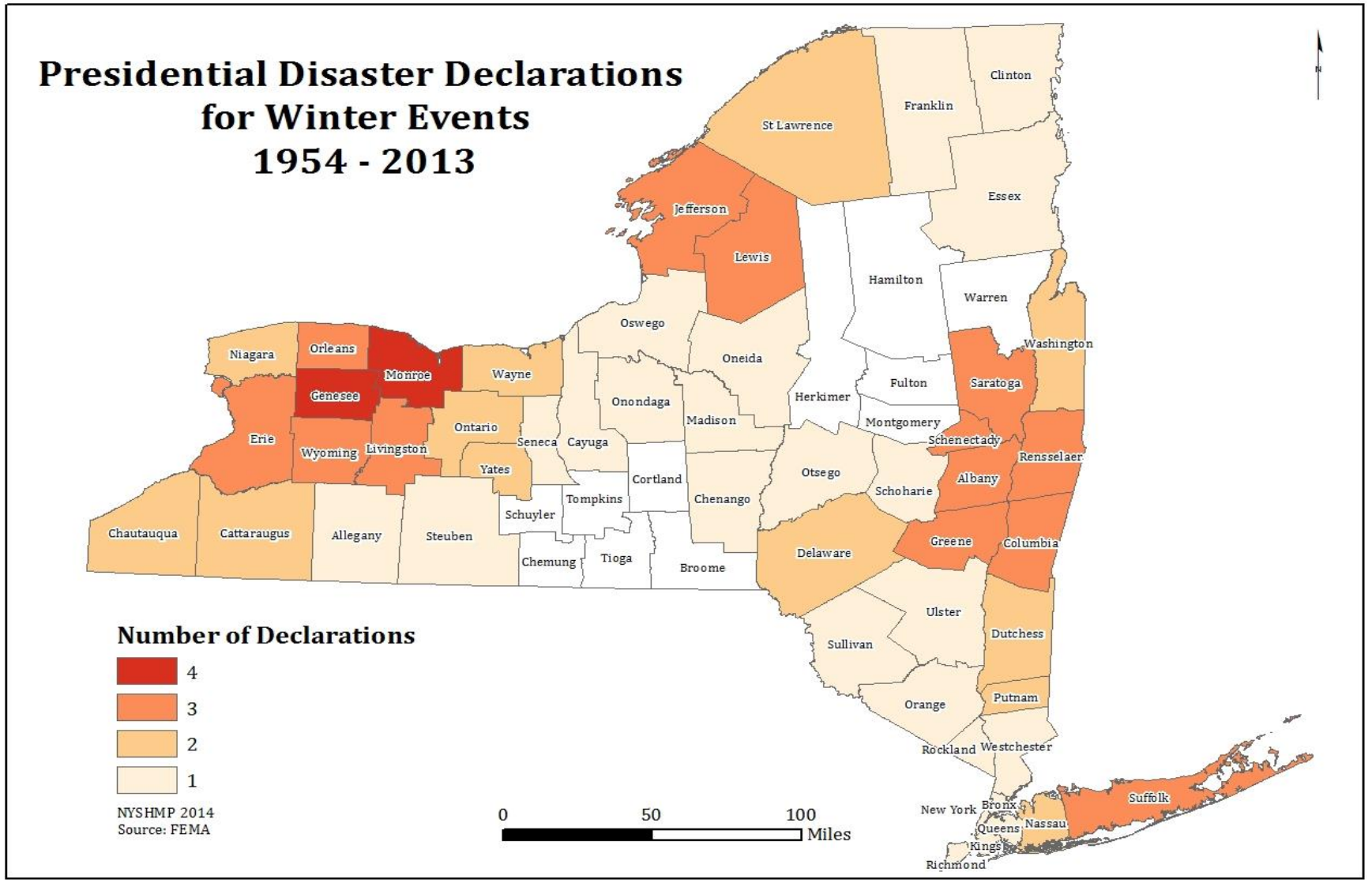
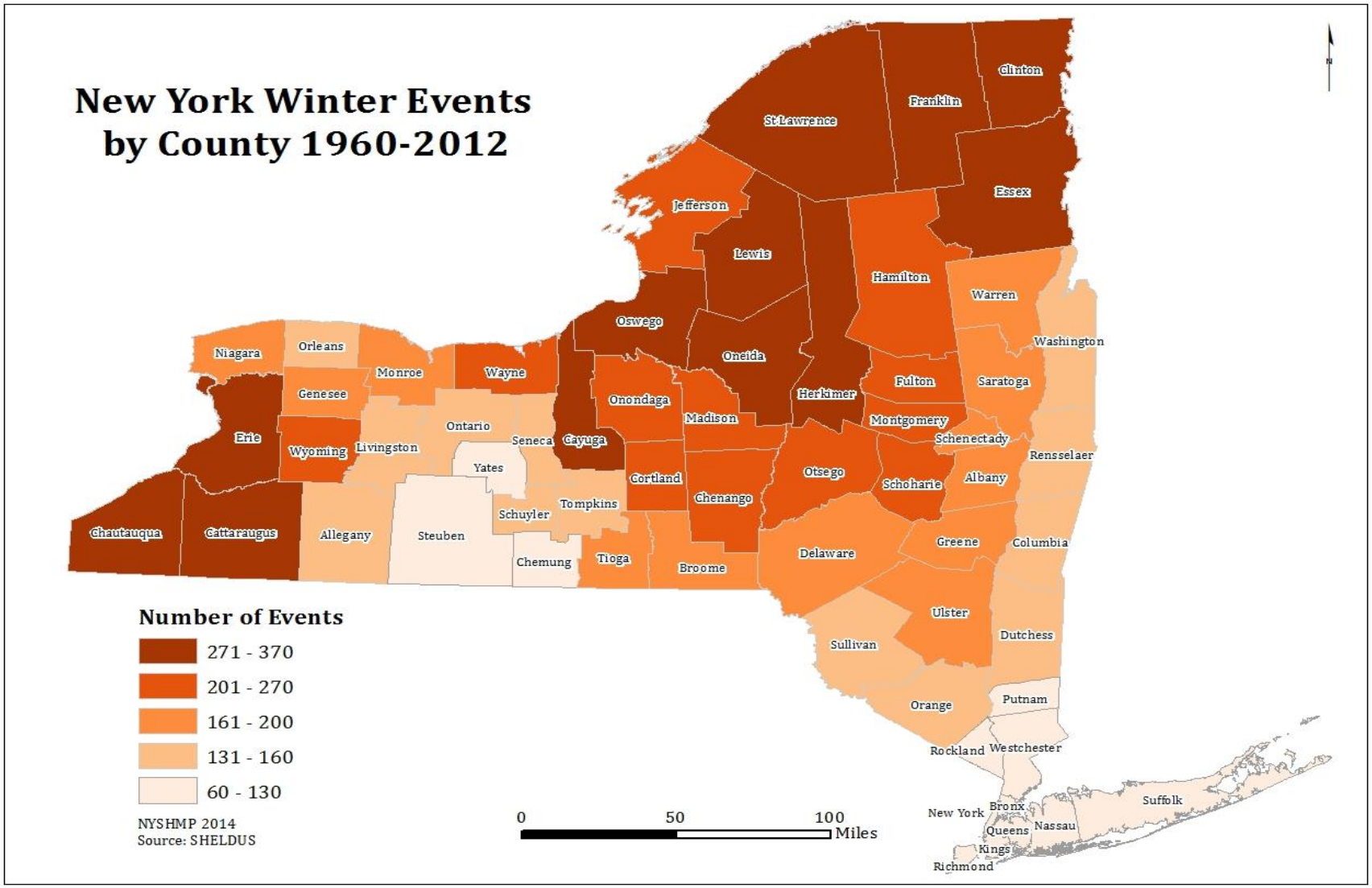


Figure 3.15c: New York Winter Events by County 1960-2012



SHELDUS data reports 11,876 severe winter storm event occurrences throughout New York State from 1960 to 2012; with property damage exceeding $1.7 billion. Additionally, 327 storm events occurred in 26 out of 62 counties from 2010-2012; property damage was approximately $4.2 million. From 1960 to 2012, 503 fatalities occurred, 2,560 injuries were reported, and crop damage exceeded $27 million. **Table 3.15c** represents historical and recent severe winter storm events and losses.

Table 3.15c: Historical and Recent Severe Winter Storm Events and Losses

	Historical Record (1960-2012)							Recent Record (2010-2012)				
County	Future Probability%	Recurrence Interval	No. of Events	Fatalities	Injuries	Property Damage	Crop Damage	No. of Events	Fatalities	Injuries	Property Damage	Crop Damage
Albany	375	0.27	195	11	60	$48,308,713	$222,108	10	0	0	$165,000	$40,000
Allegany	290	0.34	151	4	7	$14,585,332	$49,259	0	0	0	$0	$0
Bronx	125	0.80	65	4	25	$3,187,310	$23	1	0	0	$0	$0
Broome	335	0.30	174	8	49	$22,342,815	$892,969	0	0	0	$0	$0
Cattaraugus	538	0.19	280	11	8	$18,871,011	$99,259	16	0	0	$363,000	$60,000
Cayuga	533	0.19	277	6	21	$17,199,331	$964,898	11	0	0	$153,000	$0
Chautauqua	581	0.17	302	7	11	$20,008,714	$139,259	14	0	0	$228,000	$100,000
Chemung	250	0.40	130	4	8	$3,608,059	$9,259	0	0	0	$0	$0
Chenango	423	0.24	220	6	51	$24,948,711	$226,610	0	0	0	$0	$0
Clinton	610	0.16	317	5	30	$24,244,805	$1,147,345	31	0	0	$320,000	$125,000
Columbia	294	0.34	153	10	62	$50,487,953	$228,458	0	0	0	$0	$0
Cortland	452	0.22	235	8	60	$24,354,205	$216,610	0	0	0	$0	$0
Delaware	350	0.29	182	8	81	$50,062,019	$892,969	0	0	0	$0	$0
Dutchess	302	0.33	157	16	67	$49,255,537	$892,742	0	0	0	$0	$0
Erie	573	0.17	298	11	12	$57,206,821	$74,259	18	0	0	$385,000	$40,000
Essex	627	0.16	326	3	35	$24,292,489	$1,077,901	33	0	0	$282,000	$50,000
Franklin	623	0.16	324	4	35	$24,451,784	$1,097,345	31	0	0	$231,000	$75,000

	Historical Record (1960-2012)							Recent Record (2010-2012)				
County	Future Probability%	Recurrence Interval	No. of Events	Fatalities	Injuries	Property Damage	Crop Damage	No. of Events	Fatalities	Injuries	Property Damage	Crop Damage
Fulton	427	0.23	222	11	76	$23,434,361	$221,897	0	0	0	$0	$0
Genesee	352	0.28	183	8	6	$55,135,364	$964,815	4	0	0	$60,000	$0
Greene	342	0.29	178	6	65	$48,721,694	$178,708	1	1	1	$0	$0
Hamilton	460	0.22	239	8	76	$24,492,612	$1,047,751	0	0	0	$0	$0
Herkimer	529	0.19	275	14	93	$53,224,195	$1,059,923	0	0	0	$0	$0
Jefferson	527	0.19	274	5	25	$23,762,578	$215,926	14	0	0	$180,000	$40,000
Kings	123	0.81	64	4	31	$3,178,727	$23	1	0	0	$0	$0
Lewis	637	0.16	331	5	16	$20,118,702	$251,770	23	0	0	$326,000	$38,000
Livingston	296	0.34	154	4	7	$26,404,955	$1,114,815	7	0	0	$115,000	$50,000
Madison	502	0.20	261	13	95	$27,409,298	$226,673	0	0	0	$0	$0
Monroe	363	0.28	189	12	8	$58,982,826	$1,064,815	7	0	0	$125,000	$0
Montgomery	427	0.23	222	11	84	$51,797,855	$221,897	0	0	0	$0	$0
Nassau	125	0.80	65	6	25	$3,178,727	$23	0	0	0	$0	$0
New York	117	0.85	61	31	25	$3,178,227	$23	2	0	0	$0	$0
Niagara	346	0.29	180	9	9	$52,395,560	$989,815	6	0	0	$95,000	$0
Oneida	610	0.16	317	31	109	$27,749,142	$226,589	0	0	0	$0	$0
Onondaga	410	0.24	213	7	23	$9,246,255	$47,186	0	0	0	$0	$0
Ontario	296	0.34	154	5	6	$18,037,569	$1,114,815	6	0	0	$65,000	$50,000
Orange	260	0.39	135	13	66	$51,378,251	$892,994	1	1	1	$0	$0
Orleans	319	0.31	166	8	6	$48,866,215	$964,815	5	0	0	$85,000	$0
Oswego	715	0.14	372	6	13	$20,448,562	$1,146,481	21	0	0	$483,000	$15,000
Otsego	487	0.21	253	14	87	$27,456,976	$231,673	0	0	0	$0	$0
Putnam	238	0.42	124	5	63	$48,963,490	$892,744	0	0	0	$0	$0

	Historical Record (1960-2012)							Recent Record (2010-2012)				
County	Future Probability%	Recurrence Interval	No. of Events	Fatalities	Injuries	Property Damage	Crop Damage	No. of Events	Fatalities	Injuries	Property Damage	Crop Damage
Queens	125	0.80	65	5	40	$3,178,727	$23	1	0	0	$0	$0
Rensselaer	281	0.36	146	6	52	$47,911,109	$184,014	0	0	0	$0	$0
Richmond	115	0.87	60	4	26	$3,173,231	$23	0	0	0	$0	$0
Rockland	160	0.63	83	4	32	$31,256,617	$9,284	0	0	0	$0	$0
Saratoga	390	0.26	203	8	142	$49,126,368	$221,858	0	0	0	$0	$0
Schenectady	375	0.27	195	7	60	$48,351,389	$221,858	0	0	0	$0	$0
Schoharie	437	0.23	227	8	78	$24,508,827	$216,592	0	0	0	$0	$0
Schuyler	256	0.39	133	4	10	$8,412,743	$9,259	0	0	0	$0	$0
Seneca	287	0.35	149	4	12	$8,322,264	$9,259	0	0	0	$0	$0
St Lawrence	719	0.14	374	10	44	$26,565,519	$1,272,343	43	0	0	$297,000	$250,000
Steuben	225	0.44	117	5	7	$11,182,784	$9,259	0	0	0	$0	$0
Suffolk	135	0.74	70	12	51	$3,235,509	$23	0	0	0	$0	$0
Sullivan	273	0.37	142	3	42	$47,891,131	$892,969	0	0	0	$0	$0
Tioga	354	0.28	184	5	42	$24,516,058	$892,969	0	0	0	$0	$0
Tompkins	275	0.36	143	7	13	$5,708,247	$9,259	0	0	0	$0	$0
Ulster	337	0.30	175	12	67	$49,207,868	$178,708	0	0	0	$0	$0
Warren	365	0.27	190	5	63	$47,673,307	$219,684	0	0	0	$0	$0
Washington	294	0.34	153	8	55	$47,331,119	$181,840	0	0	0	$0	$0
Wayne	438	0.23	228	7	11	$25,269,775	$1,064,815	8	0	0	$155,000	$0
Westchester	171	0.58	89	5	65	$31,362,912	$25	0	0	0	$0	$0
Wyoming	421	0.24	219	6	7	$19,629,080	$59,259	12	0	0	$167,000	$50,000
Yates	217	0.46	113	4	7	$16,085,802	$109,259	0	0	0	$0	$0

Source: SHELDUS, 2013

A significant winter storm generally occurs over more than a single day, with two days being common and three days being rare. They can cause significant damage, for instance, in March 1991, in western New York, a severe winter storm caused heavy ice accumulation on tree branches, bending or breaking limbs and tree boles, or toppling trees. The resulting tree debris disrupted power lines, blocked roads, and damaged residential and commercial property. Subsequent disturbance can also occur when broken limbs or whole trees can suddenly break and fall. These "widow makers" are high priority for removal after the event to prevent personal injury.

Damage from the January 1998 ice storm event was extensive across northern New York, northern New England and Canada. Over 17 million acres were impacted, with 5 million acres experiencing severe damage. The combination of cold surface temperatures, warm air aloft, and several days of rain contributed to the accumulation of more than four inches of ice in some areas. Hardwoods suffered the greatest damage, as was evident in the areas with many sugar maple trees. The magnitude of power disruption, debris removal, emergency tree pruning and removal, and the resulting loss of the resources were unprecedented. Further, the weakening of tree limbs during the storm left open the possibility of similar damage from future weather related events.

Historical Winter Storm Events

Winter Storm Nemo – February 8-9, 2013

By February 9, 2013 Winter Storm Nemo dropped more than 12 inches of snow on Suffolk County. Upstate New York encountered 10-12 inches of snow in the Hudson Valley and Adirondacks, 12 inches fell in Rochester, and 8 inches in Buffalo. Approximately 10,000 homes and businesses lost power on Long Island. Several vehicles were stranded on the Long Island Expressway overnight and police had to use snowmobiles to reach fire trucks, ambulances, police vehicles, and some snowplow trucks to rescue passengers. Roofs, weighed down by the snow, collapsed at a bowling alley and a home in Suffolk County; however, no one was injured. Winter Storm Nemo claimed two lives.

Photo of Central Park New York, Blizzard of Feb. 2010; www.panoramio.com

Blizzard of 2010 – December 26, 2010

On December 26, 2010, a Nor'easter dropped more than 20 inches of snow on New York City. Strong winds pushed the falling snow into drifts that measured up to four feet. Transportation suffered major delays as airports and rail shut down across the city and Long Island. Travelers driving home from the holidays got stuck in the snow and abandoned their vehicles. These abandoned vehicles made it difficult for the city's plows to clear the accumulating snow. The 2010-2011 winter went on to be one of the snowiest on record, with 56.1 inches falling in January 2011 alone.

After the storm, OEM introduced a Snow Emergency Declaration to caution residents against unnecessary driving during a snowstorm and keep roads clear for plows and emergency vehicles.

Ice and Snowstorm – December 11-12, 2008

The precipitation came down heavy December 11th. By December 12th, ice accumulations ranged from around half of an inch up to an inch across portions of the Capital District and the Berkshires. Snowfall reports ranged from 2 to 4 inches just north and west of the Capital District, where sleet mixed in along with lesser ice accumulations, up to 8 to 12 inches across portions of the southern Adirondacks. Widespread tree and power line damage across the local area causing power outages across East Central New York. More than 60,000 customers were out of power December 15th and power was not restored to 10,000+ customers until December 18th.

Snow Storm – February 13, 2007

A low pressure system developed over the southern plains on February 12th, and intensified rapidly as it neared the East Coast on the night of the 13th. The storm then continued to strengthen as it moved up the Atlantic Seaboard during the day on February 14th. The storm spread snow into central New York beginning the evening of Tuesday, the 13th. The snow continued heavy at times through the 14th and gradually tapered off to snow showers on the 15th as the storm pulled northeast past the Gulf of Maine. Some sleet mixed with the snow for brief periods of time. The snow became heavy with near blizzard conditions at times over the Finger Lakes and central southern tier of New York during the early morning hours of the 14th. The heavy snow and near blizzard conditions shifted east to the upper Susquehanna Region of New York and western Mohawk Valley by the afternoon and evening of the 14th. Gusty winds to 40 mph developed behind the storm late on the 14th and through the 15th which led to considerable blowing and drifting snow. This hampered snow plowing and snow cleanup operations. As a result, many roads and highways were closed during the height of the snowstorm. Many counties and municipalities declared snow emergencies. Storm total snowfall amounts across much of central New York ranged between 15 and 30 inches. Less snow fell in Sullivan County, New York where more sleet was reported. This kept snowfall amounts down between 8 and 12 inches in this area. The heaviest snowfall from this storm occurred in Delaware and Otsego

counties where between 2 and 3 feet was common. The highest snowfall was reported in Roseboom where 39 inches of snow occurred and Springfield where 38 inches fell. The weight of the snow caused several roofs to collapse.

Snow and Ice Storm – April 4, 2003

A stationary front was west to east across Pennsylvania during the 3rd and 4th of April. Areas of low pressure moved along the front bringing precipitation to upstate New York. A large area of high pressure, centered over Hudson Bay Canada helped to keep cold air at the surface. The morning of the 5th low pressure moved northeast to Erie, Pennsylvania then to northeast New York that evening. A trailing cold front brought with it an end to the precipitation from west to east. Patchy freezing rain was across these counties first the night of the 3rd into the 4th. At this time the freezing rain was most widespread in Northern Oneida County. Steady widespread freezing rain started during the day of the 4th across Oneida, Onondaga, and Madison Counties. During the evening of the 4th colder air spread further south into the Finger Lakes and northern Susquehanna Region. This changed moderate rain to freezing rain in these areas especially at the higher elevations. Across northern Oneida County the freezing rain changed to snow. The snow accumulated up to five inches. Ice accumulations were mostly a quarter to half an inch with a few locations up to an inch. The Schuyler County Emergency Manager reported an inch of ice across most of the county. Tens of thousands of electricity customers were without power, some for up to a week. States of emergencies were declared for most of these counties.

Winter Storm – March 6, 1996

A winter storm formed over the Carolinas and tracked up the coast, bringing heavy snow to central New York. Snowfall accumulations ranged from 6 to 12 inches by the time the snow tapered off on the evening of the 7th. During the height of the storm, many accidents were reported due to poor visibility, including one in which an elderly couple was killed and one person injured in a collision in Lansing (Tompkins County). In Onondaga County, one man was killed and one injured in a two-car accident in Marcellus. Two people were injured near Rome in Oneida County when their car drove off the road, and six people were injured in Homer, Cortland County, when a tour bus drove off Interstate 81 in near zero visibility.

The Blizzard of 1993; http://photos.syracuse.com/post-standard/2009/03/the_blizzard_of_1993_10.html

Blizzard of 1993 – March 14-15, 1993

This blizzard virtually shut down eastern New York on March 13th and 14th. Also, record snows fell

from the Southern Tier of New York to the Catskills. In addition to the heavy snow, high winds damaged structures and caused almost 200,000 power outages across the state. An avalanche in the Catskills buried a county snow plow.

The Downslope Nor'easter – December 10-12, 1992

This storm produced incredible snowfall totals across many mountainous locations, while barely having any effect on valley locations. Strong east winds caused the air to "downslope" off the Berkshires and Taconics, and "dry it out." Snowfall totals in the Berkshires ranged from 30 to 48 inches with drifts up to 12 feet. Schools were closed for a week and the National Guard had to bring in heavy equipment to remove the snow. The Catskills and Helderbergs also got their share of snow with 18 to 39 inches reported. On Friday, December 11, at the height of the storm, the city of Albany received a half inch of snow with temperatures in the middle 30's. Albany did eventually get 6", but most of that fell toward the end of the storm, on Saturday the 12th, after the winds turned more northerly.

Surprise October Snowstorm – October 4, 1987

The highest snowfall that ever fell in Albany in the month of October; heavy, extreme wet snow fell on fully leaved trees. Fallen trees and down power lines blocked roads and damaged homes. The extreme devastation left residents without power for up to two weeks.

January Snowstorm of 1983 – January 15-16, 1983

Eastern New York was severely impacted by this storm. High accumulation of snow halted travel across the area. Several auto accidents with injure were documented. Albany reported 24.5 inches of snow and Saratoga County reported less than 30 inches.

Blizzard of 1978 - February 6-7, 1978

This storm affected Long Island and eastern New York. The storm produced strong wind causing snow drifts; snow was reported up to 25 inches.

Thanksgiving Snowstorm of 1971 – November 24, 1971

Thanksgiving Eve snow fell and continued into the next day. Numerous travelers were stranded on the busiest travel day of the year. The City of Albany picked up 22.5 inches; other areas of New York reported up to 30 inches of snow.

Post-Christmas Snowstorm of 1969 – December 25-28-1969

Christmas night Albany encountered a storm system moving northward along the east coast. The storm moved inland for a short period then headed back to sea December 28th

causing heavy, wet snowfall mixed with freezing rain. Snow removal was a challenge; streets were not cleared for up to four weeks. A total of 26.7 inches fell making this the third greatest storm on record.

Blizzard of 1966 – January 29-31, 1966

This storm is known for its blizzard conditions from intense lake squalls that developed as arctic air streamed across Lake Ontario. Oswego County reported 75 inches, with some unofficial reports of around 100 inches in that vicinity. Rome, which is approximately 75 miles from Lake Ontario, received 41 inches and Albany County received a foot of snow over a two day period.

Worst Snow Storm on Record – December 4-5, 1964

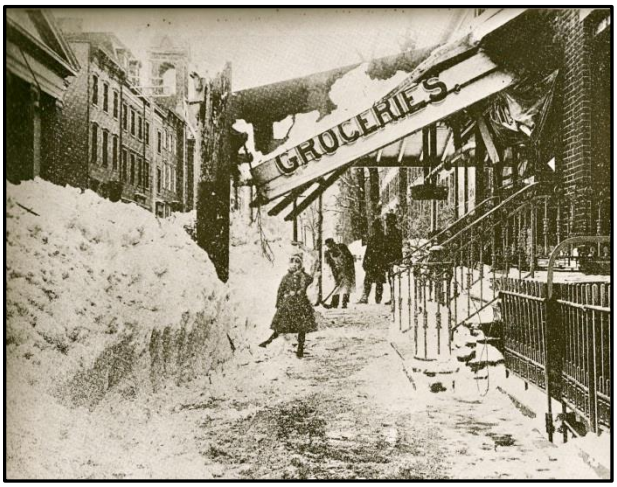
Freezing rain caused ice accumulations of up to 1.5 inches paralyzing east central New York. Residents had no power for up to two weeks and schools were shut down for a week. The State incurred damages close to $5 million.

Blizzard of 1958 – February 5-16, 1958

A Nor'easter blew 30 inches of snow across the Catskills dropping 17.9 inches in Albany. Snow blocked the majority of roadways making travel impossible. Cattle were stranded; helicopters dropped food to them, in Operation "Haylift".

Great Appalachian Storm – November 24-25, 1950

Rain and snow were associated with this storm; however, wind gusts were recorded in Albany up to 83 mph, with sustained winds of 50-60 mph. Two very high pressure centers produced an extremely tight pressure gradient, one east of Labrador and the other over the Mississippi Valley. Wind damage was critical in New York State causing downed power lines and trees throughout the region. The state incurred damage totaling more than 20 million dollars.



Blizzard of 1888, New York City's 11th Street; http://myinwood.net/a-buried-city-the-blizzard-of-1888/

Blizzard of 1888 – March 11-14, 1888

All blizzards are measured by this event. It was considered the "worst storm in living memory in the northeast". The City of Albany was shut down. There was no heat, road closures, and doctors were unable to make house calls. Light snow began mid-afternoon March 11th accumulating to 3 inches by midnight. Snow intensified

overnight, accumulating 18 inches of snow by day break. Total snowfall by March 14th was 46.7 inches, the drifts were significantly higher.

Probability of Future Winter Storm Events

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

NYS uses Hazards New York (HAZNY) as its methodology to rank natural and man-made disasters, which focuses on preparedness and response; for the purpose of mitigation NYS uses a modified version of HAZNY to rank hazards in relation to their potential for mitigation. Based on **Table 3.2a in Section 3.2,** the HAZNY-Mitigation hazard ranking table; local jurisdictions rank severe winter storms as a low risk hazard. Mitigation activities such as, plowing snow, salting roadways and maintaining trees for severe winter storms are handled at the local level.

According to the data provided in **Table 3.15b**, Historical and Recent Severe Winter Storm Events and Losses, the counties with the highest probability for future occurrences are noted in **Table 3.15d.**

Table 3.15d: Future Probability of Severe Winter Storm Events

County	Future Probability (%)
St. Lawrence	719
Oswego	715
Lewis	637
Essex	627
Franklin	623
Clinton	610
Oneida	610

Justification for Minimal Vulnerability/Loss Assessment
Severe Winter Storm occurrences in New York State are typically regional in scale; and, while past occurrences have resulted in loss of life, the scale of impacts and consequences are isolated compared to flood and hurricane events, and are typically within the capabilities of the impacted jurisdictions to prepare, respond, and recover. Severe Winter Storm was ranked as "low" with a HAZNY-Mitigation score of 18, based on severity of impact and mitigation potential. (Section 3.0 describes the hazard ranking methodology used to determine this finding.) Therefore, it is determined that there is not sufficient evidence that Severe Winter Storm has a high level of overall risk to population and property that has potential for mitigation to justify further analysis for the 2014 Plan update. The information provided in the Risk Assessment sections below serves as guidance for impact and consequence analysis and local hazard mitigation planning.

3.15.2 Assessing Winter Storm Vulnerability and Estimating Potential Losses by Jurisdiction

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

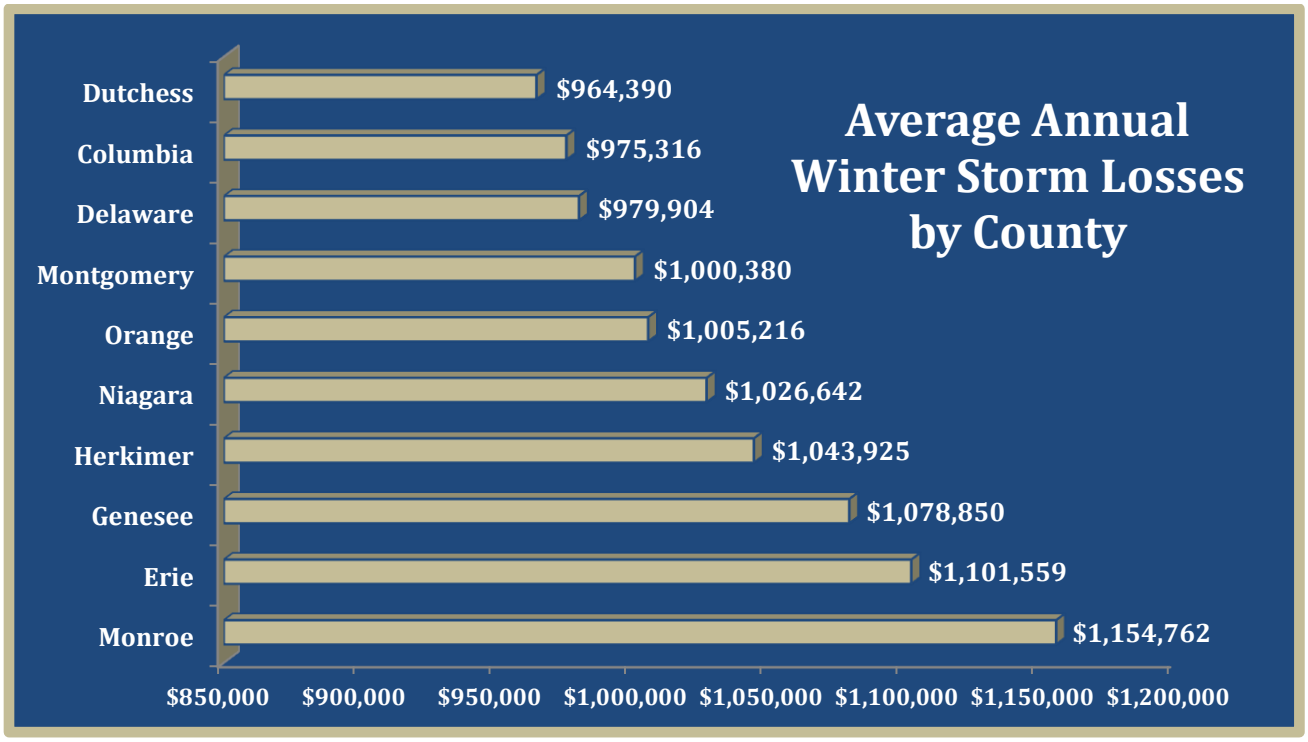
Table 3.15e provides the annualized losses for severe winter storm events. The data used was based on SHELDUS records from 1960-2012, with the exception of hurricane, earthquake, and flood hazards which were derived from HAZUS-MH 2.1. For those specific hazards, a probabilistic run was generated to determine the total annual losses for each county found within the State. The information provided by SHELDUS was determined by taking the total economic losses divided by the number of years of record (52) to obtain the losses per year. **Figure 3.15d,** illustrates the top ten counties annualized losses with a total of $34,845,157 in severe winter storm losses for the entire State of New York.

Table 3.15e: Average Annual Severe Winter Storm Losses by County 1960-2012

County	Winter Storm	County	Winter Storm	County	Winter Storm
Monroe	$ 1,154,762	Westchester	$ 603,133	Chautauqua	$ 387,461
Erie	$ 1,101,559	Rockland	$ 601,267	Wyoming	$ 378,622
Genesee	$ 1,078,850	Oneida	$ 537,995	Ontario	$ 368,315
Herkimer	$ 1,043,925	St Lawrence	$ 535,344	Cattaraugus	$ 364,813
Niagara	$ 1,026,642	Otsego	$ 532,474	Cayuga	$ 349,312
Orange	$ 1,005,216	Madison	$ 531,461	Yates	$ 311,443
Montgomery	$ 1,000,380	Livingston	$ 529,226	Allegany	$ 281,434
Delaware	$ 979,904	Wayne	$ 506,434	Steuben	$ 215,232
Columbia	$ 975,316	Franklin	$ 491,329	Onondaga	$ 178,720
Dutchess	$ 964,390	Hamilton	$ 491,161	Schuyler	$ 161,962
Putnam	$ 958,774	Tioga	$ 488,635	Seneca	$ 160,222
Orleans	$ 958,289	Clinton	$ 488,311	Tompkins	$ 109,952
Ulster	$ 949,742	Essex	$ 487,892	Chemung	$ 69,564
Saratoga	$ 949,004	Chenango	$ 484,141	Suffolk	$ 62,222
Greene	$ 940,392	Schoharie	$ 475,489	Bronx	$ 61,295
Sullivan	$ 938,156	Cortland	$ 472,516	Kings	$ 61,130
Schenectady	$ 934,101	Jefferson	$ 461,125	Nassau	$ 61,130
Albany	$ 933,285	Fulton	$ 454,928	Queens	$ 61,130
Rensselaer	$ 924,906	Broome	$ 446,842	New York	$ 61,120
Warren	$ 921,019	Oswego	$ 415,289	Richmond	$ 61,024
Washington	$ 913,711	Lewis	$ 391,740	**Total**	**$34,845,157**

Source: SHELDUS, 2013

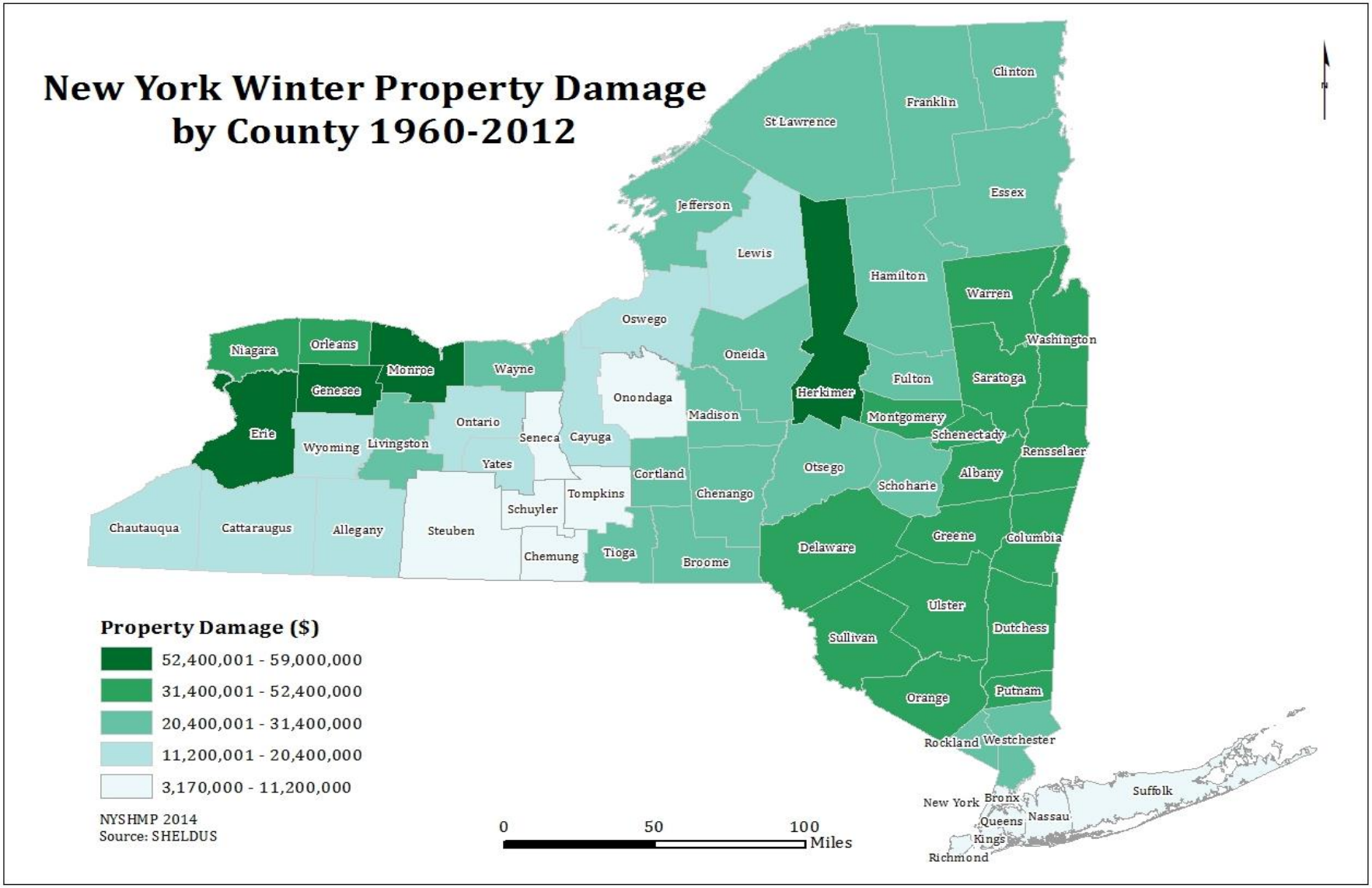
Figure 3.15d: Average Annual Severe Winter Storm Losses by County 1960-2012



Source: SHELDUS, 2013

Over the past 52 years 11,876 severe winter storm events occurred throughout NYS. Counties reporting the highest amount of property damage were Monroe, Erie, Genesee, Herkimer, and Niagara collectively exceeding more than $276 million in property damage. **Figure 3.15e** shows the total cost of property damage caused by severe winter storm events from 1960-2012.

Figure 3.15e: New York Winter Property Damage by County 1960-2012



Based on the historical and recent severe winter storm events and loss data assessed by the NYS mitigation team all 62 New York State counties have been affected by severe winter storm events over the past 52 years.

Tables 3.15f: Summary of Winter Storm Hazard Impacts and Rankings by County

Local County Winter Storm Hazard Impacts		
Highest Occurrences	**Highest Fatalities**	**Highest Property Damage**
St. Lawrence	Oneida	Monroe
Oswego	New York	Erie
Lewis	Dutchess	Genesee
Essex	Otsego	Herkimer
Franklin	Herkimer	Niagara

Source: SHELDUS

Local County Winter Storm Hazard Rankings	
High	**Moderately High**
Broome, Cayuga, Franklin, Fulton, Greene, Montgomery, Orleans, Saratoga, Suffolk, and Tioga	Albany, Allegany, Cattaraugus, Delaware, Essex, Jefferson, Lewis, Madison, Monroe, Onondaga, Ontario, Oswego, Otsego, Rensselaer, Schenectady, Seneca, Sullivan, Ulster, Warren, Wayne, and Wyoming

Source: LHMP

Development in hazard prone areas

NYS will always be vulnerable to severe winter events; because of its geographic location. Leading up to the winter months, the State does focus on preparedness and response, but mitigation strategies and measures are developed and executed by each local jurisdiction.

On the local level, economic impact may be felt by increased consumption of heating fuel, which can lead to energy shortages and higher prices. House fires and resulting deaths tend to occur more frequently from increased and improper use of alternate heating sources. Fires during these events also present a greater danger because water supplies may freeze and impede firefighting efforts.

Additional, 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. 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).

Because severe winter storms are not limited to geographic boundaries or population groups, it is difficult to identify development and population trends that impact this hazard. Current NYS land use and building codes incorporate standards that address and mitigate snow accumulation. Several local jurisdictions have implemented the following activities to eliminate loss of life and damage to property and infrastructure during the severe winter events:

- Remove snow from roadways.
- Remove dead trees and trim trees/brush from road ways to lessen falling limbs and trees.
- Ensure proper road signage is visible and installed properly.
- Bury electrical and telephone utility lines to minimize downed lines.
- Remove debris/obstructions in waterways and develop routine inspections/maintenance plans to reduce potential flooding.
- Replace substandard roofs of critical facilities (such as hospitals) to reduce exposure to airborne germs resulting from leakage.
- Purchase and install backup generators in evacuation facilities and critical facilities to essential services to residents.
- Install cell towers in areas where limited telecommunication is available to increase emergency response efforts and cell phone coverage.

Statewide Winter Storm Preparedness Maintenance Program

NYS does maintain State highways for accessibility during winter events. The New York State Thruway Authority (Authority) implements its aggressive winter maintenance program. During periods of inclement winter weather the program's goal is to provide customers a roadway that is safely drivable at reasonable speeds, with the ultimate goal of returning to bare pavement as quickly as possible. Each fall the New York State Thruway Authority (Authority) implements its aggressive winter maintenance program. During periods of inclement winter weather the program's goal is to provide customers a roadway that is safely drivable at reasonable speeds, with the ultimate goal of returning to bare pavement as quickly as possible.

Source: New York State Thruway Authority

Winter preparations begin in the spring

with the start of the Authority's annual preventive maintenance program on all plow trucks and winter maintenance equipment. Further preparations include renewing or establishing salt contracts, procuring needed equipment and supplies, and ensuring a trained and adequately staffed workforce.

The Authority's four Divisions: New York, Albany, Syracuse and Buffalo are tasked with the operational response to winter weather events. Each of the Authority's 21 maintenance locations is responsible for snow and ice operations over approximately 30 miles of roadway, as well as the accompanying interchanges, service areas and related facilities. Operations are set to achieve approximately one hour cycle times for plowing and spreading the roadway, although this can vary substantially due to traffic, weather and other factors.

The Authority has approximately 200 large plow trucks to plow snow and to disperse salt. In addition, each location also has a complement of smaller plow trucks and other ancillary equipment such as front-end loaders and skid steer mounted snowblowers. Every piece of equipment undergoes a thorough preventive maintenance service between each winter season. These efforts are generally completed by late October. By the start of the winter schedule, all material spreaders are mounted on trucks and calibration for proper salt application rates is complete. Additionally, the Authority owns five large truck mounted snowblowers. These units are stationed strategically across the system and relocated as forecasts and conditions dictate. In addition, there are 15 smaller skid steer mounted snowblowers that are used for more routine snow removal needs.

The Authority's primary weapon to fight roadway icing is rock salt. The average annual usage for the past ten years is approximately 180,000 tons. The Authority's 38 storage locations provide for the secure covered storage of approximately 128,100 tons of salt. Sheds are filled prior to the start of winter and salt is reordered as usage occurs throughout the season. With dedicated Authority salt contracts and timely ordering to replenish stockpiles, adequate salt supplies are guaranteed absent the most severe of winters.

In addition to rock salt, the Authority utilizes straight salt brine and a beet brine mixture in both an anti-icing application and as a pre-treatment for the rock salt. Other liquids such as calcium chloride and magnesium chloride are utilized to improve effectiveness at lower temperatures. This program demonstrates the State's role and capabilities in preparedness and response to winter storm events.

3.15.3 Assessing Winter Storm Vulnerability of State Facilities

Found in **Section 3.1.6** is a full description of the current status and data limitations to state-owned facilities and critical infrastructures for New York State.

A comprehensive analysis of state facilities has not been undertaken for this hazard in the 2014 update; the 2011 plan provides a methodology and data for a gross estimate of

potential snow losses to identified vulnerable State facilities in terms of dollar value of exposed property. While the data in **Table 3.38: State Facilities – Assessing Vulnerability and Estimating Loss for Snow Hazard** (see 2014 Plan Update, **Appendix 3, Attachment A: Data Supplement**) is not current, the process followed to create a GIS layer for State facilities using the coordinate information and overlay onto a snow hazard layer developed using NOAA NCDC annual average snowfall data is still valid. The intention of this analysis was to assess vulnerability and provide an aggregate exposure of State facilities as a proxy for a potential loss estimate. The analysis methodology had limitations for complete accuracy, and applicability of the results was not considered to be highly reliable beyond a general indication. Instead, the analysis results and process may best be used as a guide to help target those facilities that might benefit from further analysis and is, consequently, included in the 2014 update.

Unlike flood or earthquake hazard, there are no standard loss estimation models or methodologies for the snow hazard. A preliminary dollar loss estimate could have been calculated based on known information such as total structures for general occupancy class, indicated higher snow hazard areas (average annual and extreme snowfall potential map and data) as determined earlier in this plan, and use of residential structure dollar value estimates. However, many assumptions and generalizations would need to be made for several unknowns.

Unknowns or data that are available but not prepared or analyzed include: inventory estimates of the more vulnerable structures such as those pre-building code structures, flat roof structures, and historical or critical structures, and the type of damage and dollar damage figures. The many generalizations and guess work would result in figures with little accuracy, and potentially misleading indications of a jurisdiction's vulnerability and potential loss to the snow hazard. Therefore, this version of the NYS risk assessment instead includes an identification of needed data and establishes actions necessary to gather data needed to estimate potential losses. As local mitigation plans with snow hazard risk assessment data become available, this information will be incorporated into a state risk assessment repository for integration into future vulnerability analyses. Additionally, application of GIS technology will continue, including exploring the possibility of obtaining and incorporating certain data that may better define the high hazard area characteristics such as more comprehensive snowfall extremes data, and real property data layers in support of future snow hazard vulnerability analysis.

3.15.4 Data Limitations, Sources and Key Documents

The profile outlined in this section has been developed from the following sources:

- Northeast Regional Climate Center (NRCC) based at Cornell University, *http://nysc.eas.cornell.edu/climate_of_ny.html*
- NOAA Satellite and Information Services and National Climate Data Center, http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwevent~storms
- NYS Emergency Management Office (NYSEMO), www.dhses.ny.gov
- National Weather Service's Cooperative Observer Program (COOP), www.nws.noaa.gov/om/coop
- New York State Thruway Authority, www.thruway.ny.gov/
- Federal Emergency Management Agency (FEMA), www.fema.gov
- Kocin, P. J. and L. W. Uccellini, 2004: A Snowfall Impact Scale Derived From Northeast Storm Snowfall Distributions. *Bull. Amer. Meteor. Soc.*, 85, 177-194
- Squires, M. F. and J. H. Lawrimore, 2006: Development of an Operational Snowfall Impact Scale. 22nd IIPS, Atlanta, GA.
- Spatial Hazard Events and Losses Databases for the United States (SHELDUS)

Please Note: *Data obtained from the Spatial Hazard Events and Losses Database for the United States (SHELDUS™). SHELDUS is a county-level hazard data set for the U.S. for 18 different natural hazard event types such thunderstorms, hurricanes, floods, and tornados. For each event the database includes the beginning date, location (county and state), property losses, crop losses, injuries, and fatalities that affected each county. The data derives from the national data source, National Climatic Data Center's monthly Storm Data publications. Using the latest release of SHELDUS™ 12.0, the database includes every loss causing and/or deadly event between 1960 through 1992 and from 1995 onward. Between 1993 and 1995, SHELDUS™ reflects only events that caused at least one fatality or more than $50,000 in property or crop damages.*