5.4.13 Severe Winter Storm

This section provides a profile and vulnerability assessment for the severe winter storm hazard.

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 Suffolk County, most severe winter storm hazards include heavy snow (snowstorms), blizzards, sleet, freezing rain, and ice storms. According to the New York State Hazard Mitigation Plan (NYS HMP), winter storms are frequent events for the State of New York and occur from late October until mid-April. These types of winter events or conditions are further defined below. Northeasters or "Nor'Easters" are also a common type of storm that may occur during winter months within the eastern portion of New York State. However, given the frequency of Nor'Easters in the study area and their severe potential impact, Nor'Easter storms are considered by the Suffolk County planning committee as a separate hazard and are further discussed in Section 5.4.9 (Nor'Easters) within this HMP.

Heavy Snow

According to the National Snow and Ice Data Center, snow is precipitation in the form of ice crystals. It originates in clouds when temperatures are below the freezing point (32°F), when water vapor in the atmosphere condenses directly into ice without going through the liquid stage. Once an ice crystal has formed, it absorbs and freezes additional water vapor from the surrounding air, growing into a snow crystals or snow pallet, which then falls to the earth. Snow falls in different forms: snowflakes, snow pellets, or sleet. Snowflakes are clusters of ice crystals that form from a cloud. Snow pellets are opaque ice particles in the atmosphere. They form as ice crystals fall through super-cooled cloud droplets, which are below freezing but remain a liquid. The cloud droplets then freeze to the crystals. Sleet is made up of drops of rain that freeze into ice as they fall. They are usually smaller than 0.30 inches in diameter (NSIDC, 2013).

Heavy snow accumulations can immobilize a region and paralyze a city, stranding commuters, stopping the flow of supplies, and disrupting emergency and medical services. Ice storms can be accompanied by high winds, and they have similar impacts, especially to trees, power lines, and residential utility services. New Jersey, because of its unique location at a climactic crossroads and distinctive geography, experiences the full effect of all four seasons, and winter is no exception. Snowstorms are the most obvious manifestation of intense winter weather.

Blizzards

A blizzard is a winter snowstorm with sustained or frequent wind gusts of 35 mph or more, accompanied by falling or blowing snow reducing visibility to or below 0.25 mile. These conditions must be the predominant over a 3-hour period. Extremely cold temperatures are often associated with blizzard conditions, but are not a formal part of the definition. The hazard created by the combination of snow, wind, and low visibility significantly increases; however, with temperatures below 20°. A severe blizzard is categorized as having temperatures near or below 10° F, winds exceeding 45 mph, and visibility reduced by snow to near zero. Storm systems powerful enough to cause blizzards usually form when the jet stream dips far to the south, allowing cold air from the north to clash with warm air from the south.

Blizzard conditions often develop on the northwest side of an intense storm system. The difference between the lower pressure in the storm and the higher pressure to the west creates a tight pressure gradient, resulting in strong winds and extreme conditions caused by the blowing snow (The Weather Channel 2012b).

Ice Storms

An ice storm describes those events when damaging accumulations of ice are expected during freezing rain situations. Significant ice accumulations are typically accumulations of ¼" or greater (NWS, 2013). Heavy accumulations of ice can bring down trees, power lines and utility poles, and communication towers. Ice can disrupt communications and power for days. Even small accumulations of ice can be extremely dangerous to motorists and pedestrians (NWS, 2008).

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. NOAA's National Climatic Data Center (NCDC) is currently producing the Regional Snowfall Index (RSI) for significant snowstorms that impact the eastern two-thirds of the U.S. The RSI ranks snowstorm impacts on a scale from one to five, which is similar to the Fujita scale for tornadoes or the Saffir-Simpson scale for hurricanes. The RSI differs from the NESIS because it includes population. RSI is based on the spatial extent of the storm, the amount of snowfall, and the combination of the extent and snowfall totals with population (based on the 2000 Census). The NCDC has analyzed and assigned RSI values to over 500 storms since 1900 (NOAA-NCDC, Date Unknown). Table 5.4.13-1 explains the five categories:

Table 5.4.13-1. RSI Ranking Categories

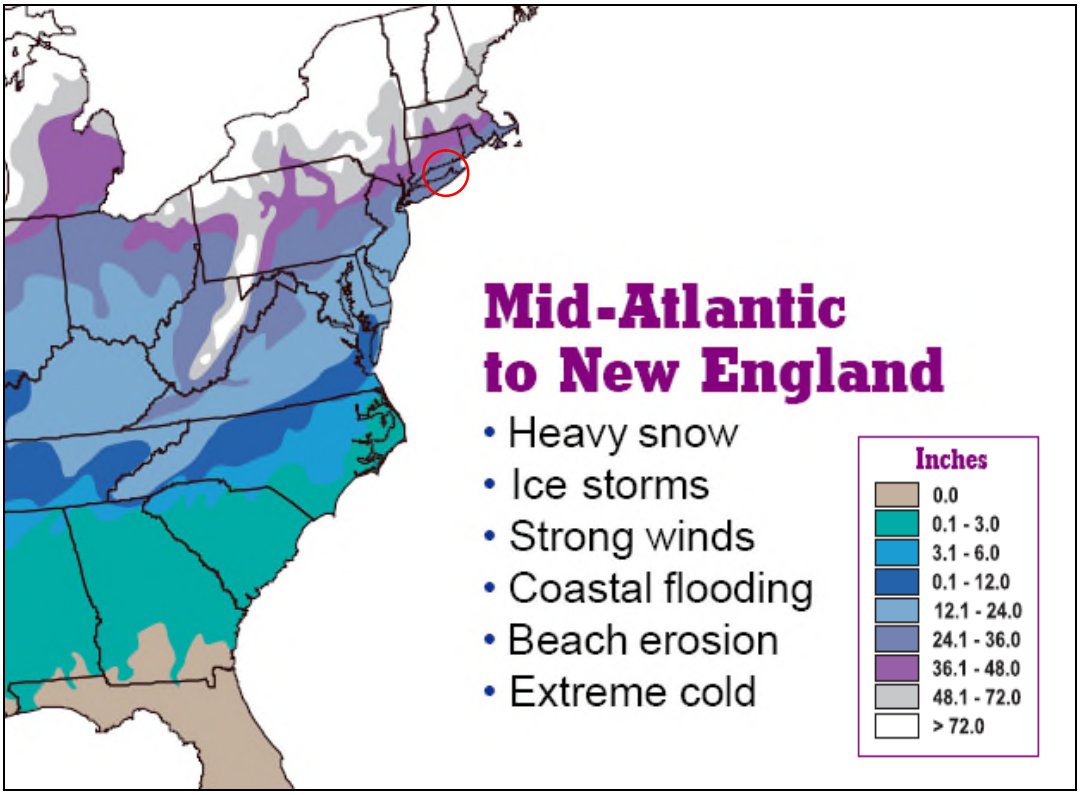
Category	Description	RSI Value
1	Notable	1-3
2	Significant	3-6
3	Major	6-10
4	Crippling	10-18
5	Extreme	18.0+

Source: NOAA-NCDC, Date Unknown

Location

The climate of New York State is marked by abundant snowfall. Winter weather can reach New York State as early as October and is usually in full force by late November with average winter temperatures between 20 and 40° F. As indicated in the NYS HMP, communities in New York State 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 any other location (NYS HMP, 2014). With the exception of coastal New York State, the State receives an average seasonal amount of 40 inches of snow or more. The average annual snowfall is greater than 70 inches over 60-percent of New York State's area; with Suffolk County's average between 12.1 and 24 inches (Figure 5.4.13-1). However, according to the New York State Climatologist (NYSC), normal seasonal snowfall in Suffolk County is 29.8 inches (NYSC, 2013).

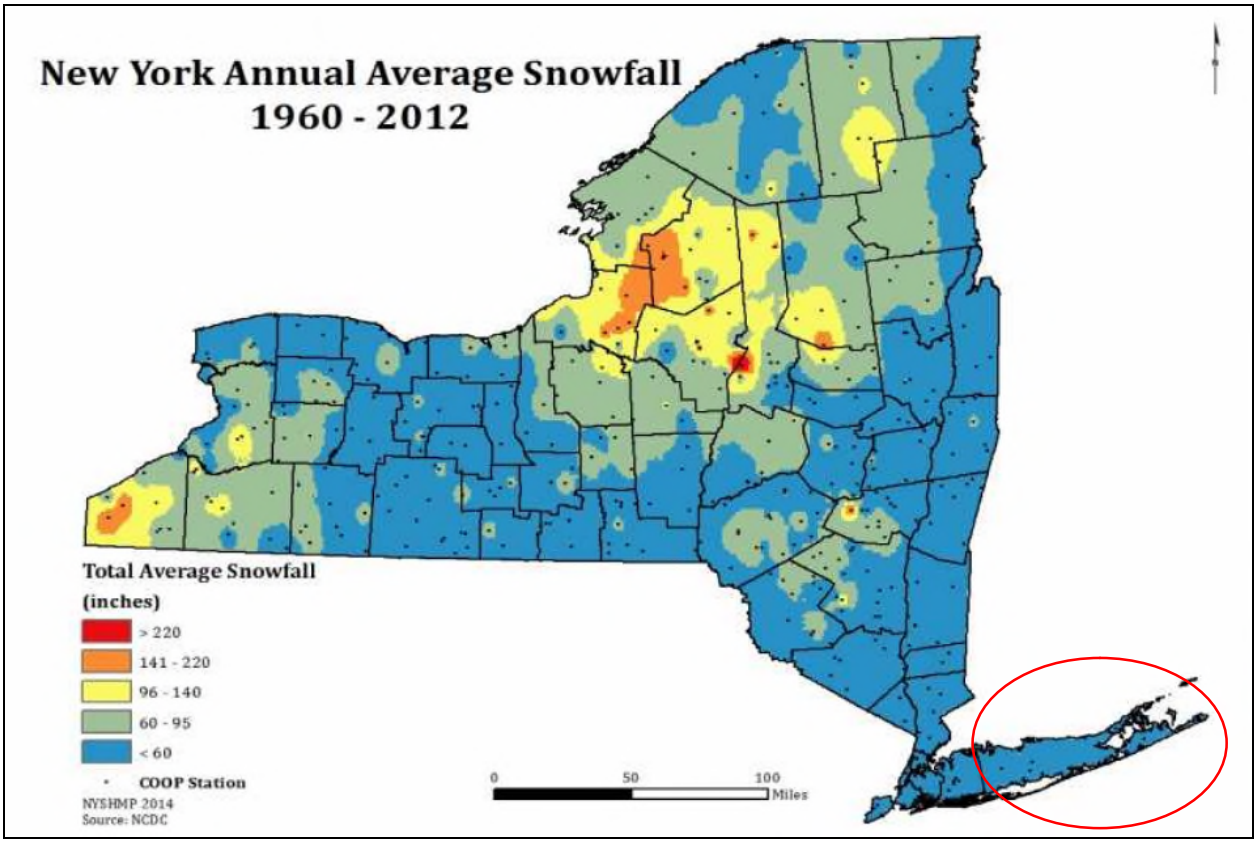
Figure 5.4.13-1. Annual Mean Snowfall within the Eastern U.S.



Source: NWS, 2001

Figure 5.4.13-2, an annual average snowfall map, illustrates the annual average snowfall totals over a 50 year period for New York State. The general indication of the average annual snowfall map shows areas that are subject to a consistent risk for large quantities of snow (NYS HMP, 2014).

Figure 5.4.13-2. Annual Average Snowfall for New York State



Source: NYS HMP, 2014
Note: Suffolk County is indicated by a red circle with an annual average snow accumulation of greater than 60 inches.

Previous Occurrences and Losses

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

According to NOAA-NCDC storm events database, Suffolk County experienced at least 15 winter weather events (blizzard, ice storm, heavy snow, and winter weather) between 2008 and 2013. Total property damages were estimated at over $32 million and eight deaths.

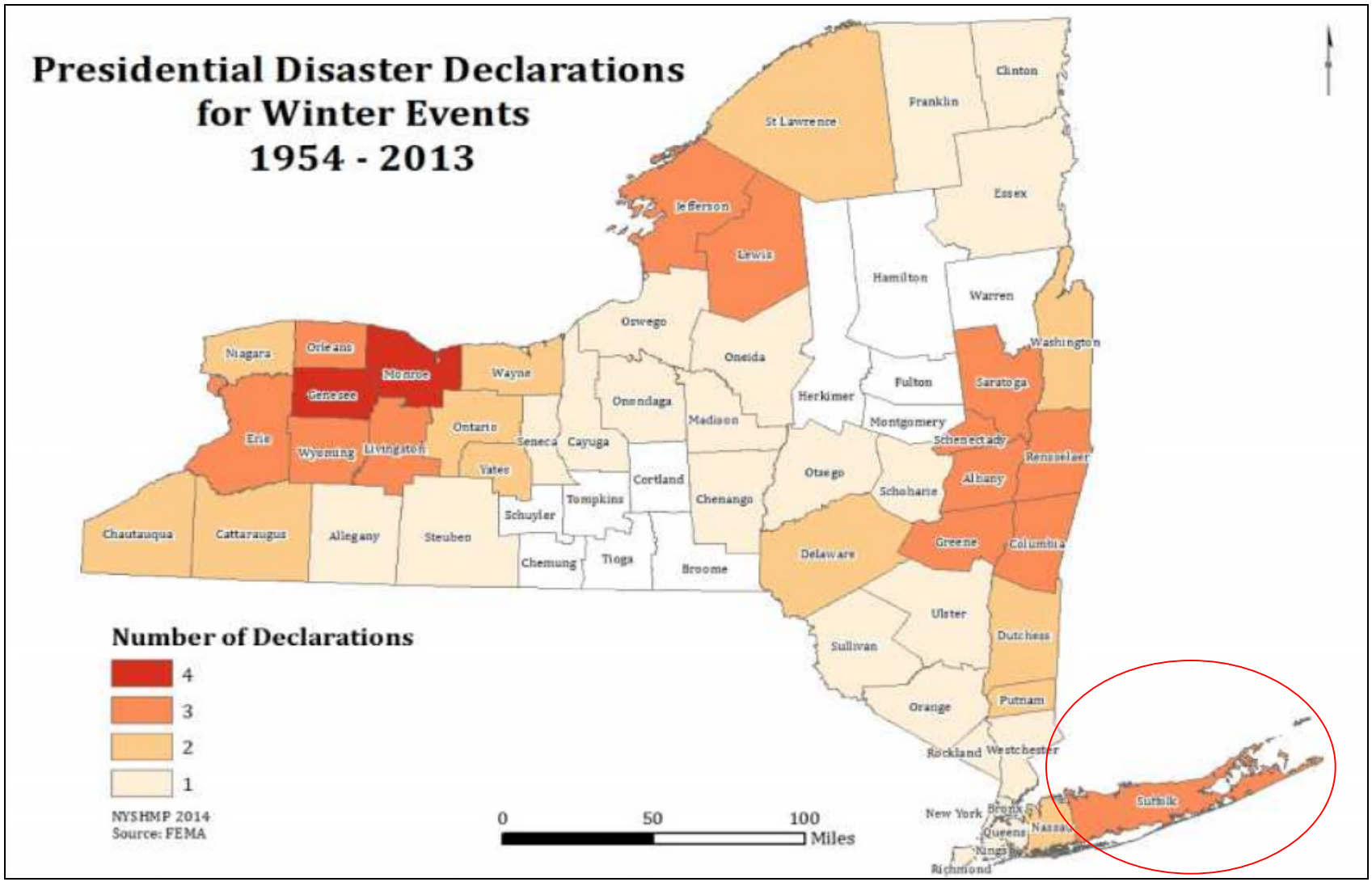
The Hazard Research Lab at the University of South Carolina's Spatial Hazard Events and Losses Database for the U.S. (SHELDUS) is a county-level hazard data set for the U.S. for 18 different natural hazard event types (avalanche, coastal, drought, earthquake, flooding, fog, hail, heat, hurricane/tropical storm, landslide, lightning, severe storm/thunderstorm, tornado, tsunami/seiche, volcano, wildfire, wind, and winter weather). Currently, the database includes every loss causing and/or deadly event between 1960 and 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. Therefore, the numbers provided by SHELDUS do not represent all winter weather events that occurred in Suffolk County.

According to SHELDUS, between 2008 and 2013, one winter storm event occurred within the County. This event resulted in one fatality and $7,000 in property damage.

Between 1954 and 2013, FEMA declared that New York State experienced 21 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, snow, snowstorm, and flooding. Generally, these disasters cover a wide region of the State; therefore, they may have impacted many counties. However, not all counties were included in the disaster declarations. Of those events, the NYS HMP and other sources indicate that Suffolk County has been declared as a disaster area as a result of five winter storm-related events (FEMA, 2013).

Figure 5.4.13-4 shows the FEMA disaster declarations (DR) for "winter storms" and "blizzards" in New York State, from 1953 to 2013. This figure indicates that Suffolk County has been included in two disaster declarations. Since the date of this figure, Suffolk County has been included in two other FEMA disaster declarations.

Figure 5.4.13-3. Presidential Disaster Declarations in New York State from Winter Snow Storms and Blizzards (1954 to 2013)



Source: NYS HMP, 2014
Note: The red circle indicates the approximate location of Suffolk County. Suffolk County has been included in two winter storm/blizzard disaster declaration in New York State between 1954 and 2013.

For this 2014 Plan Update, known winter storm events that have impacted Suffolk County between 2008 and 2013 are identified in Table 5.4.13-2. Events identified in the 2007 Plan are included in Appendix H. With winter storm documentation for New York State and Suffolk County being so extensive, not all sources have been identified or researched. Therefore, Table 5.4.13-2 may not include all events that have occurred in the County.

Table 5.4.13-2. Winter Storm Events Between 2008 and 2013.

Dates of Event	Event Type	FEMA Declaration Number	County Designated?	Losses / Impacts
March 1-2, 2009	Winter Storm	N/A	N/A	Heavy snow fell across the tri-state area with snowfall rates of two to three inches an hour during the pre-dawn hours on the 1st. Snowfall totals in Suffolk County ranged from nine inches in West Islip to 15.7 inches in Mastic.
December 19-20, 2009	Blizzard	DR-1827	No	Blizzard to near blizzard conditions struck Long Island for several hours, with northeast winds of 15 to 25 mph and gusts of 35 to 45 mph. Visibilities were below a mile. Near whiteout conditions were experienced across Suffolk County during the height of the storm. Snowfall rates of two to four inches per hour occurred in western and central Long Island. Snowfall totals in Suffolk County ranged from 12 inches in Montclair Colony to 27.5 inches in East Patchogue. FEMA issued a disaster declaration for several counties in NYS; however, Suffolk County was not included in the declaration.
December 26-27, 2010	Severe Winter Storm and Snowstorm	DR-1957	Yes (PA)	This storm caused over $7 million in property damages and required over $30 million dollars in public assistance emergency protective measures.
January 11-12, 2011	Heavy Snow	N/A	N/A	Southeast New York State received heavy snow. The storm tracked southeast of Long Island. This event started as light snow and became heavy with embedded TSTMs. Some sleet and rain mixed in across eastern Long Island. Eastern Long Island received between 10 and 18 inches of snow. Snowfall totals in Suffolk County ranged from 8.8 inches to 18.6 inches. In the Town of Southampton, snowfall totals included 11.2 inches in the hamlet of Westhampton, 11.8 inches in the Village of Southampton, and 16 inches in the hamlet of Bridgehampton.
January 26-27, 2011	Heavy Snow	N/A	N/A	A period of moderate to heavy snow fell over the region, producing between two and five inches of snow. The snow tapered off to a light wintery mix during the late afternoon of the 26th; however, a heavier round of precipitation fell during the evening. A very heavy snow band developed over New York City, southern and eastern portions of the Lower Hudson Valley and northern and western Long Island. This heavy band caused snow to fall at rates of three to four inches per hour, over a four to six hour period. Snowfall totals of 15 to 20 inches were reported across much of the region. In eastern Long Island, snowfall totals ranged between eight and 12 inches.
January 21, 2012	Heavy Snow	N/A	N/A	A band of moderate to heavy snow brought between five and seven inches across the Lower Hudson Valley and northeast Suffolk County.
February 8-9, 2013	Severe Winter Storm and Snowstorm	DR-4111	Yes (PA)	Blizzard conditions were met for several hours. Snowfall ranged from 10.3 inches in the hamlet of Shirley to 33.5 inches in the hamlet of Medford. 7 deaths and $32 million in property damages were reported throughout the County. Several motorists were stranded. Several trees and limbs were downed. FEMA provided over $9 million in Public Assistance Grants to Suffolk County.

Dates of Event	Event Type	FEMA Declaration Number	County Designated?	Losses / Impacts
March 7, 2013	Winter Weather	N/A	N/A	7.1 inches of snow were reported at the hamlet of Orient. No damages were reported.

Sources: NOAA-NCDC, 2013; FEMA, 2013; NWS, 2013; SHELDUS, 2013
Note: 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.

DR	Disaster Declaration
EM	Emergency Declaration
FEMA	Federal Emergency Management Agency
HMP	Hazard Mitigation Plan
N/A	Not Applicable
NCDC	National Climatic Data Center
NOAA	National Oceanic and Atmospheric Administration
NWS	National Weather Service
PA	Public Assistance
SHELDUS	Spatial Hazard Events and Losses Database for the United States
TSTM	Thunderstorm

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 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). In addition, the State is exposed to large quantities of moisture from both the Great Lakes and the Atlantic Ocean. While it is almost certain that a number of significant winter storms will occur during the winter and fall season, what is not easily determined is how many such storms will occur during that time frame (NYS HMP, 2014).

The New York State HMP includes a similar ranking process for hazards that affect the State. Based on historical records and input from the Planning Committee, the probability of at least one winter snow storm of emergency declaration proportions, occurring during any given calendar year is virtually certain in the State. Based on historical snow related disaster declaration occurrences, New York State can expect a snow storm of disaster declaration proportions, on average, once every three to five 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 seven to 10 years within the State (NYS HMP, 2014). It is estimated that Suffolk County will continue to experience direct and indirect impacts of severe winter storms annually.

In Section 5.3, the identified hazards of concern for Suffolk County were ranked. The probability of occurrence, or likelihood of the event, is one parameter used for hazard rankings. Based on historical records and input from the Planning Committee, the probability of occurrence for severe winter storms in the County is considered 'frequent' (event that occurs more frequently than once in 10 years, as presented in Table 5.3-3).

Climate Change Impacts

New York State averages more than 40 inches of snow each year. Snowfall varies regionally, based on topography and the proximity to large lakes and the Atlantic Ocean. Maximum snowfall is more than 165 inches in parts of the Adirondacks and Tug Hill Plateau, as well as in the westernmost parts of the State. The warming influence of the Atlantic Ocean keeps snow in the New York City and Long Island areas below 36 inches each year.

Climate change is beginning to affect both people and resources in New York State, and these impacts are projected to continue growing. Impacts related to increasing temperatures and sea level rise are already being felt in the State. ClimAID: the Integrated Assessment for Effective Climate Change in New York State (ClimAID) was undertaken to provide decision-makers with information on the State's vulnerability to climate change and to facilitate the development of adaptation strategies informed by both local experience and scientific knowledge (New York State Energy Research and Development Authority [NYSERDA], 2011).

Each region in New York State, as defined by ClimAID, has attributes that will be affected by climate change. Suffolk County is part of Region 4, New York City and Long Island. Some of the issues in this region, affected by climate change, include: this region has the highest population density in the state; sea level rise and storm surge will increase coastal flooding, erosion and wetland loss; heat-related deaths will increase; illness related to air quality will increase; and higher summer energy demand will stress the energy system (NYSERDA, 2011).

Temperatures are expected to increase throughout the state, by 1.5 to 3ºF by the 2020s, 3.5 to 5.5ºF by the 2050s and 4.5 to 8.5ºF by the 2080s. The lower ends of these ranges are for lower greenhouse gas

emissions scenarios and the higher ends for higher emissions scenarios. Annual average precipitation is projected to increase by up to five-percent by the 2020s, up to 10-percent by the 2050s and up to 15-percent by the 2080s. During the winter months is when this additional precipitation will most likely occur, in the form of rain, and with the possibility of slightly reduced precipitation projected for the late summer and early fall. Table 5.4.13-3 displays the projected seasonal precipitation change for the New York City and Long Island ClimAID Region (NYSERDA, 2011).

Table 5.4.13-3. Projected Seasonal Precipitation Change in Region 4, 2050s (% change)

Winter	Spring	Summer	Fall
0 to +15	0 to +10	-5 to +10	-5 to +10

Source: NYSERDA, 2011

It is uncertain how climate change will impact winter storms. Based on historical data, it is expected that the following will occur at least once per 100 years:

- Up to eight inches of rain fall in the rain band near the coast over a 36-hour period
- Up to four inches of freezing rain in the ice band near central New York State, of which between one and two inches of accumulated ice, over a 24-hour period
- Up to two feet of accumulated snow in the snow band in northern and western New York State over a 48-hour period (NYSERDA, 2011)

New York State is already experiencing the effects of climate change during the winter season. Winter snow cover is decreasing and spring comes, on average, about a week earlier than it did a few years ago. Nighttime temperatures are measurably warmer, even during the colder months (NYSDEC, Date Unknown). Overall winter temperatures in New York State are almost five degrees warmer than in 1970 (NYSDEC, Date Unknown). The State has seen a decrease in the number of cold winter days (below 32°F) and can expect to see a decrease in snow cover, by as much as 25 to 50% by end of the next century. The lack of snow cover may jeopardize opportunities for skiing, snowmobiling and other types of winter recreation; and natural ecosystems will be affected by the changing snow cover (Cornell University College of Agriculture and Life Sciences, 2011).

Vulnerability Assessment

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

- Overview of vulnerability
- Data and methodology used for the evaluation
- Impact on: (1) life, health and safety of residents, (2) general building stock, (3) critical facilities, (4) economy, and (5) future growth and development
- Effect of climate change on vulnerability
- Change of vulnerability as compared to that presented in the 2008 Suffolk County Hazard Mitigation Plan
- Further data collections that will assist understanding this hazard over time

Overview of Vulnerability

Severe winter storms are of significant concern to Suffolk County because of the frequency and magnitude of these events in the region, 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

Default HAZUS-MH population and the custom general building stock data were used to support an evaluation of assets exposed to this hazard and the potential impacts associated with this hazard.

Impact on Life, Health and Safety

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

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

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

For the purposes of this HMP, the entire population of Suffolk County (1,493,350) is exposed to severe winter storm events (U.S. Census, 2010). 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 the County Profile for population statistics for each participating municipality.

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. 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).

Impact on General Building Stock

The entire general building stock inventory in Suffolk County is exposed and vulnerable to the severe winter storm hazard. In general, structural impacts include damage to roofs and building frames, rather than building content. Table 5.4.13-5 presents the total exposure value for general building stock for each participating municipality (structure only).

Current modeling tools are not available to estimate specific losses for this hazard. As an alternate approach, this plan considers percentage damages that could result from severe winter storm conditions. Table 5.4.13-4 below summarizes percent damages that could result from severe winter storm conditions for the County's total general building stock (structure only). Given professional knowledge and information available, the potential losses for this hazard are considered to be overestimated.

Table 5.4.13-4. General Building Stock Exposure (Structure Only) and Estimated Losses from Severe Winter Storm Events in Suffolk County

Municipality	Total RV (Structure only)	1% Damage Loss Estimate	5% Damage Loss Estimate	10% Damage Loss Estimate
Amityville (V)	$2,426,554,828	$24,265,548	$121,327,741	$242,655,483
Asharoken (V)	$246,948,478	$2,469,485	$12,347,424	$24,694,848
Babylon (T)	$37,743,707,206	$377,437,072	$1,887,185,360	$3,774,370,721
Babylon (V)	$2,819,603,339	$28,196,033	$140,980,167	$281,960,334
Belle Terre (V)	$444,533,486	$4,445,335	$22,226,674	$44,453,349
Bellport (V)	$1,208,906,603	$12,089,066	$60,445,330	$120,890,660
Brightwaters (V)	$969,618,449	$9,696,184	$48,480,922	$96,961,845
Brookhaven (T)	$118,529,755,564	$1,185,297,556	$5,926,487,778	$11,852,975,556
Dering Harbor (V)	$33,627,158	$336,272	$1,681,358	$3,362,716
East Hampton (T)	$9,459,653,667	$94,596,537	$472,982,683	$945,965,367
East Hampton (V)	$1,613,596,961	$16,135,970	$80,679,848	$161,359,696
Greenport (V)	$567,762,804	$5,677,628	$28,388,140	$56,776,280
Head of the Harbor (V)	$963,232,409	$9,632,324	$48,161,620	$96,323,241
Huntington (T)	$52,857,304,922	$528,573,049	$2,642,865,246	$5,285,730,492
Huntington Bay (V)	$538,143,360	$5,381,434	$26,907,168	$53,814,336
Islandia (V)	$1,756,324,667	$17,563,247	$87,816,233	$175,632,467
Islip (T)	$71,059,790,931	$710,597,909	$3,552,989,547	$7,105,979,093
Lake Grove (V)	$3,106,890,070	$31,068,901	$155,344,504	$310,689,007
Lindenhurst (V)	$4,486,424,019	$44,864,240	$224,321,201	$448,642,402

Municipality	Total RV (Structure only)	1% Damage Loss Estimate	5% Damage Loss Estimate	10% Damage Loss Estimate
Lloyd Harbor (V)	$1,564,844,289	$15,648,443	$78,242,214	$156,484,429
Mastic Beach (V)	$2,122,748,723	$21,227,487	$106,137,436	$212,274,872
Nissequogue (V)	$2,362,754,133	$23,627,541	$118,137,707	$236,275,413
North Haven (V)	$691,458,438	$6,914,584	$34,572,922	$69,145,844
Northport (V)	$1,903,102,156	$19,031,022	$95,155,108	$190,310,216
Ocean Beach (V)	$319,226,662	$3,192,267	$15,961,333	$31,922,666
Old Field (V)	$651,884,013	$6,518,840	$32,594,201	$65,188,401
Patchogue (V)	$3,245,189,258	$32,451,893	$162,259,463	$324,518,926
Poquott (V)	$408,615,571	$4,086,156	$20,430,779	$40,861,557
Port Jefferson (V)	$3,055,844,863	$30,558,449	$152,792,243	$305,584,486
Quogue (V)	$1,648,654,386	$16,486,544	$82,432,719	$164,865,439
Riverhead (T)	$11,945,244,221	$119,452,442	$597,262,211	$1,194,524,422
Sag Harbor (V)	$1,606,601,418	$16,066,014	$80,330,071	$160,660,142
Sagaponack (V)	$1,019,076,011	$10,190,760	$50,953,801	$101,907,601
Saltaire (V)	$380,313,158	$3,803,132	$19,015,658	$38,031,316
Shelter Island (T)	$1,688,724,628	$16,887,246	$84,436,231	$168,872,463
Shoreham (V)	$290,506,436	$2,905,064	$14,525,322	$29,050,644
Smithtown (T)	$44,600,395,207	$446,003,952	$2,230,019,760	$4,460,039,521
Southampton (T)	$24,537,212,114	$245,372,121	$1,226,860,606	$2,453,721,211
Southampton (V)	$3,686,301,026	$36,863,010	$184,315,051	$368,630,103
Southold (T)	$9,340,393,599	$93,403,936	$467,019,680	$934,039,360
Village of the Branch (V)	$775,010,219	$7,750,102	$38,750,511	$77,501,022
West Hampton Dunes (V)	$206,608,200	$2,066,082	$10,330,410	$20,660,820
Westhampton Beach (V)	$1,749,222,754	$17,492,228	$87,461,138	$174,922,275
Shinnecock Tribal Nation	$253,644,366	$2,536,444	$12,682,218	$25,364,437
Unkechaug Tribal Nation	$47,406,282	$474,063	$2,370,314	$4,740,628
Suffolk County	**$430,933,361,053**	**$4,309,333,611**	**$21,546,668,053**	**$43,093,336,105**

Source: Suffolk County Planning Department; Suffolk County Real Property Tax Service
Notes: RV = Replacement Cost Value

A specific area that is vulnerable to the severe winter storm hazard is the floodplain. Severe winter storms can cause flooding through blockage of streams or through snow melt. At risk residential infrastructure are presented in the presentation for the flood hazard. Generally, losses resulting from flooding associated with severe winter storms should be less than that associated with a 100-year flood. Please refer to the flood profile (Section 5.4.5). In addition, coastal areas are at high risk during winter storm events that involve high winds. Please refer to the Nor'Easter and/or severe storm profiles for losses resulting from wind (Sections 5.4.9 and 5.4.9, respectively).

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 event. 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. 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 the clearing roadways and alerting citizens to dangerous conditions; following the winter season, resources for road maintenance and repair are required.

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.

The Suffolk County Department of Public Works clears County roads of snow and ice, while the State Highway Department is responsible for State highways and Town Highway Departments are responsible for local roads (Suffolk County Public Works, 2007).

Future Growth and Development

As discussed in Sections 4 and 9, 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 hazard because the entire planning area is exposed and vulnerable. Areas targeted for potential future growth and development in the next five (5) years have been identified across the County at the municipal level. Refer to the jurisdictional annexes in Volume II of this HMP.

Current New York State land use and building codes incorporate standards that address and mitigate snow accumulation. Some local municipalities in the State have implemented the following activities to eliminate loss of life and property and infrastructure damages during winter storm events:

- Removal of snow from roadways
- Removal of dead trees and trim trees/brush from roadways to lessen falling limbs and trees
- Ensure proper road signs are visible and installed properly
- Bury electrical and telephone utility lines to minimize downed lines
- Removal of debris/obstructions in waterways and develop routine inspections/maintenance plans to reduce potential flooding
- Replace substandard roofs of critical facilities 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 and cell phone coverage (NYS HMP, 2014)

Effect of Climate Change on Vulnerability

Climate is defined not simply as average temperature and precipitation but also by the type, frequency and intensity of weather events. Both globally and at the local scale, climate change has the potential to alter the prevalence and severity of extremes such winter storms. While predicting changes of winter storm events under a changing climate is difficult, understanding vulnerabilities to potential changes is a critical part of estimating future climate change impacts on human health, society and the environment (U.S. Environmental Protection Agency [EPA], 2006).

The 2011 'Responding to Climate Change in New York State' report was prepared for New York State Energy Research and Development Authority to study the potential impacts of global climate change on New York State. According to the synthesis report, it is uncertain how climate change will influence extreme winter storm events. Winter temperatures are projected to continue to increase. In general, warmer winters may lead to a decrease in snow cover and an earlier arrival in spring; all of which have numerous cascading effects on the environment and economy. Annual average precipitation is also projected to increase. The increase in precipitation is likely to occur during the winter months as rain, with the possibility of slightly reduced precipitation projected for the late summer and early fall. Increased rain on snowpack may lead to increased flooding and related impacts on water quality, infrastructure, and agriculture in the State. Overall, it is anticipated that winter storms will continue to

pass through New York State (NYSERDA, 2011). Future enhancements in climate modeling will provide an improved understanding of how the climate will change and impact the Northeast.

Change of Vulnerability

When comparing the 2008 original HMP vulnerability assessment to this update, there is an increase in estimated potential losses from severe winter storms. The difference stems from the building inventory used to estimate these losses. The 2008 original HMP used the default general building stock inventory in HAZUS-MH ($158 billion – structure only) while this update used the custom building inventory (greater than $430 billion – structure only). Overall, the County's vulnerability has not changed and the entire County will continue to be exposed and vulnerable to severe winter storm events.

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. Mitigation strategies addressing early warning, dissemination of hazard information, provisions for snow removal and back-up power are included in Volume II, Section 9 of this plan.