5.4.14 SEVERE WINTER STORM

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

Hazard Profile

This section presents the severe winter storm hazard description, extent, location, previous occurrences and losses, and probability of future occurrences.

Description

As per the Suffolk County Steering Committee and Planning Partnership, most severe winter storm hazards in the County include heavy snow (snowstorms), blizzards, sleet, freezing rain, and ice storms. Generally, winter storms are annually-occurring events that take place from late October until mid-April. These types of winter events or conditions are further defined below.

A winter storm is considered a storm with significant snowfall, ice, and/or freezing rain. The quantity of precipitation varies by elevation. Heavy snowfall in non-mountainous areas is four inches or more in a 12-hour period, or six inches or more in a 24-hour period. In mountainous areas, heavy snowfall is considered 12 inches or more in a 12-hour period or 18 inches or more in a 24-hour period. Blizzards are storms with considerable falling and/or blowing snow combined with sustained winds or frequent wind gusts of 35 mph or greater that frequently reduce visibility to less than 0.25 mile for at least three hours.

Some winter storms are large enough to immobilize an entire region while others may only affect a single community. Winter storms are typically accompanied by low temperatures, high winds, freezing rain or sleet, and heavy snowfall. The aftermath of a winter storm can have an impact on a community or region for days, weeks, or even months; potentially causing cold temperatures, flooding, storm surge, closed and/or blocked roadways, downed utility lines, and power outages.

Refer to Section 5.4.7 (Extreme Temperature) and Section 5.4.12 (Nor'Easter) for additional discussions regarding extreme cold temperatures that accompany severe winter storms, and Nor'Easters which are a specific type of storm event that share characteristics of winter storms.

Heavy Snow

According to the National Snow and Ice Data Center (NSIDC), 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 snow crystals or snow pellets, which then fall to the earth. Snow falls in different forms, such as 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 that are below freezing but remain a liquid. The cloud droplets then freeze to the crystals. A heavy snowstorm is defined as a snowstorm with accumulations of 4 inches or more of snow in a 6-hour period, or 6 inches of snow in a 12-hour period (NWS 2009).

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°F. 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 2012).

Sleet

Sleet is made up of drops of rain that freeze into ice as they fall. They are usually smaller than 0.30 inch in diameter (NSIDC 2013). A sleet storm involves significant accumulations of solid pellets, which form from the freezing of raindrops or partially melted snowflakes causing slippery surfaces, posing a hazard to pedestrians and motorists (NWS 2009).

Freezing Rain

Freezing rain occurs when rain falls into areas that are below freezing. In order for this to occur, ground-level temperatures must be colder than temperatures aloft. Freezing rain can also occur when the air temperature is slightly above freezing but the surface that the rain lands upon is still below freezing from prior cold air temperatures (NWS 2009).

An ice storm is an event caused by damaging accumulations of ice during freezing rain events. An ice storm involves significant accumulation of rain or drizzle freezing on objects (trees, power lines, roadways, etc.) as it strikes them, causing slippery surfaces and damage from sheer weight of ice accumulations (NWS 2009). Significant ice accumulations are typically 0.25 inch or greater (NWS 2013).

Extent

The magnitude or severity of a severe winter storm depends on several factors, including a region's climatological susceptibility to snowstorms, snowfall amounts, snowfall rates, wind speeds, temperatures, visibility, storm duration, topography, time of occurrence during the day (for example, weekday versus weekend), and time of season. While sleet accumulation is measured and tracked in a method similar to snow events, the extent or severity of freezing rain or an ice storm requires a different and sometimes more challenging process. According to NWS, ice accumulation does not coat the surface of an object evenly, as gravity typically forces rainwater to the underside of an object before it freezes. Wind can also force rainwater downward prior to freezing, resulting in a thicker coating of ice on one side of the object than the other side. Ice mass is then determined by taking the average from the thickest and thinnest portions of ice on the sample used for measurement.

The NOAA National Centers for Environmental Information (NCEI) produces the Regional Snowfall Index (RSI) for significant snowstorms that impact the eastern two-thirds of the United States. The RSI ranks snowstorm impacts on a scale from Category 1 to 5, which is similar to the Enhanced Fujita scale for tornadoes or the Saffir-Simpson scale for hurricanes. 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-NCEI no date). Table 5.4.14-1 explains the five categories:

Table 5.4.14-1. RSI Ranking Categories

Category	Description
1	Notable
2	Significant
3	Major
4	Crippling
5	Extreme

Source: NOAA-NCDC no date

The NWS operates a widespread network of observation systems, such as geostationary satellites, Doppler radars, and automated surface observing systems that feed into the current state-of-the-art numerical computer models to provide a look into future weather, ranging from hours to days. The models are then analyzed by NWS meteorologists who then write and disseminate forecasts (NWS 2013). While winter weather is normal during the winter season for Suffolk County, the NWS uses winter weather watches, warnings, and advisories to help people anticipate what to expect in the days and hours prior to an approaching storm.

- A ***winter storm watch*** is issued when severe winter conditions (heavy snow, ice, etc.) may affect a certain area, but its occurrence, location, and timing are uncertain. A watch is issued to provide 24 to 72 hours of notice of the possibility of severe winter weather.

- A ***winter storm warning*** is issued when hazardous winter weather, in the form of heavy snow, heavy freezing rain, or heavy sleet, is imminent or occurring. A warning is usually issued 12 to 24 hours before the event is expected to begin.

- A ***winter weather advisory*** is issued when a hazardous winter weather event is occurring, is imminent, or has a greater than 80 percent chance of occurrence. Advisories are used to inform people that winter weather conditions are expected to cause significant inconveniences and that conditions may be hazardous. These conditions may refer to sleet, freezing rain, or ice storms, in addition to snow events.

- NWS may also issue a ***blizzard warning*** when snow and strong winds combine to produce the potential for blinding snow, deep drifts, and wind chill (NWS 2010).

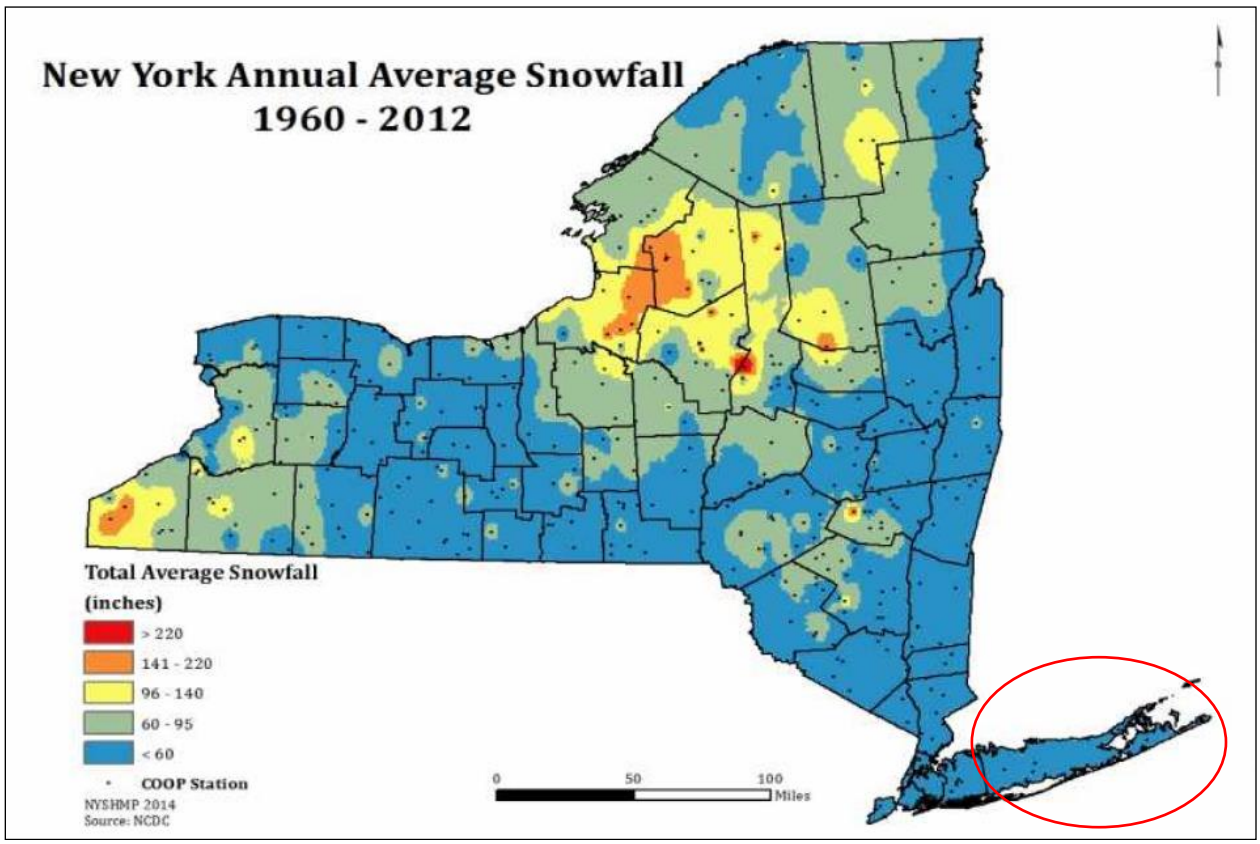
Location

Although all of New York 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).

Snow and Blizzards

The trajectory of the storm center—whether it passes close to the New York coast or at a distance—largely determines both the intensity and the duration of the snowfall event. Winter storms tend to have the heaviest snowfall within a 150-mile wide swath to the northwest of what are generally southwest to northeast moving storms. Figure 5.4.14-2, an annual average snowfall map, illustrates the annual average snowfall totals over a 50 year period for New York State. The average annual snowfall in Suffolk County is less than 60 inches annually (NYS DHSES 2014).

Figure 5.4.14-1. Annual Average Snowfall for New York State



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

Ice Storms

Based on data from 1948–2000, Suffolk County can anticipate 2-3 days with freezing rain per year (Changnon & Karl 2003). Based on data from 1932–2001, the County can anticipate 6-9 total hours of freezing rain per year (Changnon 2004).

Previous Occurrences and Losses

Between 1954 and 2020, the State of New York was included in 22 severe winter storm-related disaster (DR) or emergency (EM) declarations. Suffolk County was included in six of the 22 declarations (FEMA 2020).

Table 5.4.14-2. Severe Winter Storm-Related FEMA Declarations for Suffolk County, 1954 to 2020

Date(s) of Event	FEMA Declaration Number	Event Type
March 13-17, 1993	EM-3107	New York Severe Blizzard
January 6-12, 1996	DR-1083	New York Blizzard
February 17-18, 2003	EM-3184	New York Snowstorm
December 26-27, 2011	DR-1957	Severe Winter Storm and Snowstorm
February 8-9, 2013	DR-4111	Severe Winter Storm and Snowstorm
March 14-15, 2017	DR-4322	New York Severe Winter Storm and Snowstorm

Source: FEMA 2020

Severe winter storm events that have impacted Suffolk County between 2013 and 2020 are identified in Table 5.4.14-3. Events identified in the 2014 Plan are included in Appendix E.

Table 5.4.14-3. Winter Storm Events Between 2013 and 2020.

Dates of Event	Event Type	FEMA Declaration Number	County Designated?	Location	Description
February 8 – 9, 2013	Severe Winter Storm and Snowstorm, Blizzard	DR-4111	Yes	Suffolk County	Low pressure that formed along the northern Gulf coast by the morning of Thursday, February 7, 2013 moved northeast to near Cape Hatteras by the morning of Friday, February 8, 2013. The low then rapidly intensified while moving northeast to a position east of Cape Cod by the morning of Saturday, February 9, 2013, producing very heavy snowfall and blizzard conditions across central and eastern Long Island on February 8th and 9th, and winter storm conditions across the rest of southeast New York.
January 2-3, 2014	Heavy Snow	N/A	N/A	Suffolk County	A low pressure system moving into the Ohio Valley on January 2 redeveloped and intensified along the Mid Atlantic coast, bringing heavy snow to southeast New York before moving out to sea on the third of January. Trained spotters, the public, NWS employees and CoCoRaHS observers reported snowfall of 7 to 14 inches.
January 10, 2014	Winter Weather	N/A	N/A	Suffolk County	Warm air overriding a stationary front to the south with cold Arctic high pressure in place combined to produce freezing rain across parts of southeast New York, especially Long Island. Newsday reports that ice-coated roadways caused dozens of motor-vehicle accidents and filled hospital emergency rooms with weather-related injuries. In a two-hour span, Suffolk reported 600 ambulance calls. There were at least 250 vehicle crashes and also 300 calls for help, which exclude car accidents but counts slip and falls and medical emergencies, such as heart attacks.
January 21-22, 2014	Heavy Snow	N/A	N/A	Suffolk County	Low pressure moving from the central Appalachians the morning of the 21st intensified off the Mid Atlantic coast and brought heavy snow to most of southeast New York on the 21st and 22nd. NWS employees in Patchogue and Sayville reported snowfall totals of 11.8 and 10.2 inches, respectively. Elsewhere, the public and trained spotters reported widespread snowfall totals of 11 to 15 inches.
February 3, 2014	Heavy Snow	N/A	N/A	Suffolk County	Weak low pressure passing to the south brought a swath of heavy snow to much of Southeast New York on the third. MacArthur Airport reported 7 inches snowfall. The public, a trained spotter, and an NWS employee also reported widespread 5 to 10 inch snowfall.
January 26-27, 2015	Winter Storm, Blizzard	N/A	N/A	Suffolk County	A potent Alberta Clipper low moved from southwestern Canada on January 24th to the Plains states and Ohio Valley on the 25th. The low then redeveloped off the Mid Atlantic coast on the 26th and rapidly intensified into

Dates of Event	Event Type	FEMA Declaration Number	County Designated?	Location	Description
					a strong nor'easter, bringing heavy snow and strong winds to much of southeastern New York, and blizzard conditions to Suffolk County. Trained spotters and the public reported snowfall of 16 to 26 inches. North winds gusted to 52 mph at Eaton's Neck, with blowing and drifting of snow. MacArthur Airport reported 24.8 inches of snowfall. MacArthur Airport experienced one-quarter mile visibility in heavy snow. Trained spotters and the public also reported snowfall of 16 to 26 inches. North winds gusted to 50 mph at MacArthur Airport, with blowing and drifting of snow. The NWS office in Upton reported snowfall of 17.1 inches. A trained spotter in Orient reported snowfall of 30 inches. North winds gusted to 56 mph at Great Gull Island, with blowing and drifting of snow. The public reported snowfall of 29 inches in Southampton. A trained spotter in Flanders reported snowfall of 22 inches. North winds gusted to 60 mph at Gabreski Airport, with blowing and drifting of snow.
February 1-2, 2015	Heavy Snow	N/A	N/A	Northwest Suffolk	An area of low pressure tracked east from the Ohio Valley the night of February 1 to just south of Long Island the afternoon of February 2. The close proximity of the low with arctic air to the north resulted in snow at the onset, which transitioned to a wintry mix during the morning hours before going back to snow by early afternoon. Some interior locations remained all snow. Much of southeast New York received 5 to 10 inches of snowfall along with up to a quarter inch of ice near the coast. Snowfall ranged from 5 to 10 inches across the county, along with one to two tenths of an inch of ice. The highest amount of 10 inches was reported in East Northport, NY.
March 1, 2015	Heavy Snow	N/A	N/A	Suffolk County	Weak low pressure approaching from the Ohio Valley brought heavy snow to parts of Southeast New York. NWS employees, the public and trained spotters reported snowfall of 5 to 8 inches in Northwest Suffolk. NWS employees, the public and trained spotters reported snowfall of 5 to 6 inches. Islip MacArthur Airport reported 5.6 inches of snow. The NWS forecast office in Upton reported 5.9 inches of snow. The public and trained spotters reported 5 to 7 inches of snow elsewhere.
March 5, 2015	Heavy Snow	N/A	N/A	Suffolk County	Rain associated with a wave of low pressure moving along a cold front to the south changed to snow before sunrise on March 5, and became heavy across Southeast New York.

Dates of Event	Event Type	FEMA Declaration Number	County Designated?	Location	Description
					NWS employees, trained spotters, and the public measured snowfall of 6 to 9 inches. NWS Upton NY measured 7.3 inches of snow. NWS employees, trained spotters, and the public also measured snowfall of 7 to 9 inches. Islip MacArthur Airport reported 6.2 inches of snow. NWS employees, trained spotters, and the public also measured snowfall of 6 to 9 inches. A trained spotter in Southampton measured 7.3 inches of snow.
January 23, 2016	Winter Storm, Blizzard	N/A	N/A	Suffolk County	Low pressure moving across the deep South on Thursday January 21st and Friday January 22nd intensified and moved off the Mid Atlantic coast on Saturday January 23rd, bringing heavy snow and strong winds to southeast New York, and blizzard conditions to Long Island, New York City, and nearby southern Westchester County. NY Gov. Cuomo declared a state of emergency early Saturday January 23rd. Metro North and Long Island Railroad service halted at 4 PM Saturday. An NWS employee, the public, and trained spotters reported snowfall of 19 to 26 inches. MacArthur Airport reported snowfall of 23.7 inches. Numerous ASOS and mesonet stations also reported sustained winds of 35 to 45 mph, with gusts as high as 58 mph at Islip Airport and nearby Blue Point. The public, trained spotters, and NWS cooperative weather observers reported snowfall ranging from 15 to 27 inches. At Eaton's Neck, northeast winds were sustained at 49 mph at noon on Saturday the 23rd, and gusted to 59 mph at 9:55 AM on Saturday the 23rd. At Mount Sinai Harbor, north winds gusted to 42 mph at 7:46 PM on Saturday the 23rd. NWS cooperative observers in Westhampton and Riverhead, trained spotters, an NWS employee, and the public reported snowfall of 15 to 22 inches. ASOS and numerous mesonet stations also reported strong northeast winds, highest at Shinnecock Light, with sustained winds of 43 mph and gusts to 58 mph at 12:20 PM Saturday January 23rd. The NWS office in Upton reported snowfall of 18.2 inches. Elsewhere, the public and a trained spotter reported snowfall of 9 to 16 inches. Also, northeast winds at Great Gull Island were sustained at 43 mph at 10:03 AM, with a gust to 54 mph at 11:38 AM.
February 5, 2016	Heavy Snow	N/A	N/A	Suffolk County	Low pressure developing along a cold front moving through the region on Thursday February 4th moved off the southern Mid Atlantic coast on Friday February 5th, bringing heavy snow to Long Island on the fifth.

Dates of Event	Event Type	FEMA Declaration Number	County Designated?	Location	Description
					Trained spotters, NWS employees, and official NWS observations indicated a 7 to 11 inch snowfall. MacArthur Airport in Islip reported 9.8 inches of snow. Trained spotter, NWS employee, and public reports indicated an 8 to 12 inch snowfall. The NWS forecast office in Upton reported 7.7 inches of snowfall. Elsewhere, public reports indicated a 5 to 7 inch snowfall. Public and NWS employee reports indicated a 5 to 8 inch snowfall.
February 8, 2016	Heavy Snow	N/A	N/A	Suffolk County	An intensifying offshore storm passed close enough on Monday February 8th to bring heavy snow to parts of central and much of eastern Long Island, NY. Trained spotters and the public reported 5 to 6 inches of snow. The NWS forecast office in Upton measured 5.4 inches of snow.
January 7-8, 2017	Heavy Snow	N/A	N/A	Suffolk County	Low pressure developed across the southeast coast early on January 7, 2017 and deepened as it tracked off the coast. The low tracked south and east of the 40 degrees N/70 degrees W benchmark. Despite the low tracking this far east, the Tri-State area was located in the right entrance region of a strong upper level jet streak. This allowed for snow to expand well to the northwest of the low bringing heavy snow to Long Island and New York City and portions of the Lower Hudson Valley. Islip Airport contract observer, NWS Employees, and trained spotters reported snowfall ranging from 7 to 10 inches. Trained spotters, a COOP observer, and the public reported snowfall ranging from 8 to 12 inches.
February 9, 2017	Winter Storm, Blizzard	N/A	N/A	Suffolk County	Low pressure developed along a cold front over the Middle Atlantic early Thursday, February 9th. The low rapidly intensified as it moved off the Delmarva coast in the morning and then to the south and east of Long Island late morning into the afternoon. The low brought blizzard conditions to Long Island and portions of the Lower Hudson Valley. Heavy snow and strong winds also occurred over the New York City Metro. The blizzard brought delays and cancellations to the regions transportation systems as well as numerous accidents on roadways. The Long Island Railroad had system wide delays and at least 20 trains were cancelled. Several hundred rescues were performed by police and fire departments on Long Island. Trained spotters, NWS Employees, and the Public reported 12 to 16 inches of snowfall. Winds also gusted to 57 mph at Eatons Neck at 12:20 pm. Islip

Dates of Event	Event Type	FEMA Declaration Number	County Designated?	Location	Description
					Airport reported 14.3 inches of snow. Trained spotters, NWS Employees, and the Public reported 12 to 16 inches of snowfall. Winds also gusted to 48 mph at the Islip Airport at 1:47 pm. Trained spotters and the Public reported 10 to 13 inches of snowfall. Winds also gusted to 50 mph at Sag Harbor at 1:00 pm, and to 45 mph at Orient at 12:05 pm. Trained spotters, an NWS Employee, and the Public reported 10 to 13 inches of snowfall. Winds also gusted to 66 mph at Mecox at 12:25 pm, 61 mph in the Hampton Bays at 12:35 pm, and 49 mph at Westhampton Beach Airport at 12:26 pm.
March 14-15, 2017	Severe Winter Storm	DR-4322	Yes	Suffolk County	On Tuesday, March 14th, rapidly deepening low pressure tracked up the eastern seaboard resulting in winter storm conditions in upstate New York and damaging winds in Suffolk County.
January 4, 2018	Winter Storm, Blizzard	N/A	N/A	Suffolk County	The development of the blizzard/winter storm began along the southeast coast on Wednesday January 3, 2018. An amplifying upper level trough spawned the development of low pressure off the coast of Florida. The low pressure rapidly intensified on Wednesday night through Thursday January 4, 2018 as it moved north-northeast along the coast. The low passed just east of the 40 degrees N 70 degrees W benchmark Thursday afternoon. The central pressure when the storm developed was around 1004 millibars at 1 pm Wednesday. 24 hours later, the central pressure fell to around 950 mb, approximately a 54 millibar drop. The rapid intensification of the storm led to heavy snow, strong winds, and blizzard conditions over Long Island. Thundersnow was also observed across eastern Long Island. Thousands of flights were cancelled on January 4, 2018 and nearly 900 were cancelled the day after the blizzard. System-wide delays and cancellations occurred on the Long Island Railroad and Metro North Railroad. There were also numerous accidents on across southeast New York. Thousands of homes and businesses also lost power. CoCoRaHS observers, trained spotters, and the public reported 10 to 16 inches of snowfall. The nearby Republic Airport ASOS in East Farmingdale measured a 59 MPH wind gust at 12:06 PM. Winds frequently gusted 40 to 50 MPH during the peak of the winter storm. The FAA Contract Observer at Long Island MacArthur Airport (Islip, NY) reported 15.8 inches of snow. Trained spotters, CoCoRaHS observers, and the public reported 10 to 16 inches of snow. Winds frequently gusted 40 to 50 MPH during the peak of the winter storm at the Long Island MacArthur Airport.

Dates of Event	Event Type	FEMA Declaration Number	County Designated?	Location	Description
					The NWS Office in Upton, NY reported 12.3 inches of snow. Trained spotters, CoCoRaHS observers, and the public reported 10 to 14 inches of snow. The nearby Brookhaven Airport ASOS (Shirley, NY) measured a 54 MPH wind gust at 3:24 PM. The nearby Gabreski Airport ASOS (Westhampton Beach, NY) measured a 49 MPH wind gust at 5:59 PM. Winds also frequently gusted 40 to 50 MPH during the peak of the winter storm. Trained spotters and CoCoRaHS observers, and the public reported 10 to 14 inches of snowfall. The nearby Brookhaven Airport ASOS (Shirley, NY) measured a 54 MPH wind gust at 3:24 PM. Winds also frequently gusted 40 to 50 MPH during the peak of the winter storm.
January 29-30, 2018	Heavy Snow	N/A	N/A	Suffolk County	Low pressure developed along the North Carolina coast during the afternoon of January 29, 2018. The low moved off the coast to a location east of the 40 degrees N/70 degrees W benchmark during the morning of January 30, 2018. Heavy snow bands were able to develop well north and west of the low pressure system across Eastern Long Island due to a strong upper level jet. An NWS Employee, FAA contract Observer, trained spotters, CoCoRaHS observers and the public reported 6 to 9 inches of snowfall.
March 12-13, 2018	Heavy Snow	N/A	N/A	Suffolk County	A strong area of low pressure tracked well offshore of the eastern seaboard, but tracked close enough to eastern Long Island to bring heavy snow bands during the morning and early afternoon on Tuesday, March 13, 2018. Snowfall rates were 1 to 2 inches per hour at times in the morning across eastern Long Island. Trained spotters, COOP observers, CoCoRaHS observers, and the public reported 6 to 12.5 inches of snow. The highest amount was reported by a trained spotter in Orient with 12.5 inches of snow. An NWS Employee in Stony Brook reported 8.3 inches of snow. Trained spotters, CoCoRaHS observers, and the public reported 6 to 11 inches of snow. A trained spotter reported 18.3 inches of snow in Southampton. The public reported 10.3 inches of snow in East Hampton. The FAA Contract Observer at the Islip Airport reported 6.4 inches of snow. Trained spotters and the public reported 5 to 8 inches of snow.
March 21-22, 2018	Winter Storm	N/A	N/A	Suffolk County	A large and slow moving low pressure developed along the Middle Atlantic coast on Wednesday, March 21st and moved slowly north and east along the coast through Thursday, March 22nd. Moderate to heavy snow bands moved across Long Island and New York City with lighter snow across the Lower Hudson Valley. The heaviest snow occurred in New York City and Long Island Wednesday night into early Thursday morning. The highest snowfall

Dates of Event	Event Type	FEMA Declaration Number	County Designated?	Location	Description
					rates occurred on Long Island with generally 2 to 4 inches per hour at times. The NWS official observation at the Islip Airport indicated a snowfall rate of 5 inches per hour between 9pm and 10pm on March 21st with around 9 inches of snow falling from 8pm to 10pm. Within these heavier bands, near-blizzard conditions occurred with visibilities one quarter mile or less and winds gusting 30 to 35 mph. The Official NWS Observation at Islip Airport was 18.4 inches of snow. The FAA Contract Observer at the Airport reported snowfall rates 2 to 4 inches per hour during the night of March 21st with a one hour rate of 5 inches. NWS Employees reported similar snowfall rates in Ronkonkoma, Patchogue, and Sayville. Snowfall amounts ranged from 9 to 20 inches across Southwest Suffolk as reported by NWS Employees, trained spotters, social media, and the public. Near-blizzard conditions occurred with visibility falling below one quarter mile at times and winds gusting 30 to 35 mph during the highest snowfall rates. Trained spotters, social media, broadcast media, and the public reported 10 to 20 inches of snowfall. Near-blizzard conditions occurred at times during the evening of March 21st with visibility falling below one quarter of a mile at times and winds gusting 25 to 30 mph.

Sources: NOAA-NCEI 2020; FEMA 2020; NWS 2020; SHELDUS 2020

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 Occurrence

Winter storm events in New York State occur annually due to its latitude and exposure to large quantities of moisture from the Great Lakes and Atlantic Ocean. Based on historical snow-related disaster declaration occurrences, New York State can expect a snowstorm 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 DHSES 2011).

According to the Storm Events Database, Suffolk County has been impacted by 74 severe winter storm events between 1950 and 2020 (Table 5.4.14-4).

Table 5.4.14-4. Probability of Occurrence of Severe Winter Storm Events in Suffolk County

Hazard Type	Number of Occurrences Between 1950 and 2020	Rate of Occurrence or Annual Number of Events (average)	Recurrence Interval (in years) (# Years/Number of Events)	Probability of Event in any given year	% chance of occurrence in any given year
Blizzard	10	0.14	7.10	0.14	14.08%
Heavy Snow	48	0.69	1.48	0.68	67.61%
Ice Storm	2	0.03	35.50	0.03	2.82%
Sleet	0	0.00	0.00	0.00	0.00%
Winter Storm	14	0.20	5.07	0.20	19.72%
Total	**74**	**1.06**	**0.96**	**1.04**	**100%**

Source: NOAA NCEI 2020

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 to determine the ranking of each hazard. Based on historical records and input from the Planning Committee, the probability of occurrence for severe winter storms in the County is considered 'frequent'.

Climate Change Impacts

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: the area contains the highest population density in the State; sea level rise and storm surge increase coastal flooding, erosion, and wetland loss; challenges for water supply and wastewater treatment; increase in heat-related deaths; illnesses related to air quality increase; and higher summer energy demand stresses the energy system (NYSERDA 2011).

In Region 4, it is estimated that temperatures will increase by 4.1ºF to 5.7ºF by the 2050s and 5.3ºF to 8.8ºF by the 2080s (baseline of 54.6 ºF, mid-range projection). Precipitation totals will increase between 4 and 11% by

the 2050s and 5 to 13% by the 2080s (baseline of 49.7 inches, mid-range projection) (NYSERDA 2014). Average annual precipitation is projected to increase in the region by four to 11-percent by the 2050s and five to 13-percent by the 2080s (New York City Panel on Climate Change [NPCC] 2015).

Table 5.4.14-5 displays the projected seasonal precipitation change for the New York City and Long Island ClimAID Region (NYSERDA 2011).

Table 5.4.14-5. 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 n.d.). Overall winter temperatures in New York State are almost five degrees warmer than in 1970 (NYSDEC n.d.). 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).

Due to the increase in temperature, snow cover and sea ice extent are predicted to likely decrease over the next century and the snow season length is very likely to decrease over North America. However, warming of the lower atmosphere could potentially lead to more ice storms by allowing snow to more frequently melt as it falls and then refreeze near or at surface (NPCC 2009).

Some climatologists believe that climate change may play a role in the frequency and intensity of Nor'Easters. Two ingredients are needed to produce strong Nor'Easters and intense snowfall: (1) temperatures which are just below freezing, and (2) massive moisture coming from the Gulf of Mexico. When temperatures are far below freezing, snow is less likely. As temperatures increase in the winter months they will be closer to freezing rather than frigidly cold. Climate change is expected to produce more moisture, thus increasing the likelihood that these two ingredients (temperatures just below freezing and intense moisture) will cause more intense snow events.

Vulnerability Assessment

To understand risk, a community must evaluate what assets are exposed or vulnerable to the identified hazard. All assets in the County (population, structures, critical facilities and lifelines), as described in the County Profile (Section 4), are exposed vulnerable to the severe winter storm hazard.

Impact on Life, Health and Safety

The entire population of Suffolk County (1,488,179 people) is exposed to severe winter storm events (ACS 2018). The homeless and elderly are considered most susceptible to this hazard. The elderly are considered 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. According to the 2018 ACS 5-Year estimate, there are 239,284 persons over 65 years old that reside in the County. In addition, severe winter storm events and their associated impacts to roads and utilities can reduce the ability of these populations to access emergency services.

The homeless and residents below the poverty level may not have access to housing or their housing could be less able to withstand cold temperatures (e.g., homes with poor insulation and heating supply). Residents with low incomes might not have access to housing or their housing can be less able to withstand cold temperatures (e.g., homes with poor insulation and heating supply). In Suffolk County, the Village of Ocean Beach has the highest concentration of population living below the poverty level (i.e., 21-percent). Refer to Section 4 (County Profile) that displays the densities of low-income populations in Suffolk County.

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 2018).

Impact on General Building Stock

The entire general building stock inventory is exposed to the severe winter storm hazard. In general, structural impacts include damage to roofs and building frames, rather than building content; with older structures having the greatest vulnerability. 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. This allows planners and emergency managers to select a range of potential economic impact based on an estimate of the percent of damage to the general building stock. Table 5.4.14-6 below summarizes the estimated loss based on 1-, 5-, and 10-percent losses. Given professional knowledge and the currently available information, the potential loss for this hazard is many times considered to be overestimated because of varying factors (building structure type, age, load distribution, building codes in place, etc.). Therefore, the following information should be used as estimates only for planning purposes with the knowledge that the associated losses for severe winter storm events vary greatly.

Table 5.4.14-6. General Building Stock Exposure and Estimated Losses from Severe Winter Storm Events

Jurisdiction	Total Replacement Cost Value (RCV)	1% Exposure/Loss	5% Exposure/Loss	10% Exposure/Loss
Amityville (V)	$5,519,611,238	$55,196,112	$275,980,562	$551,961,124
Asharoken (V)	$379,192,198	$3,791,922	$18,959,610	$37,919,220

Jurisdiction	Total Replacement Cost Value (RCV)	1% Exposure/Loss	5% Exposure/Loss	10% Exposure/Loss
Babylon (T)	$82,740,965,827	$827,409,658	$4,137,048,291	$8,274,096,583
Babylon (V)	$6,110,029,951	$61,100,300	$305,501,498	$611,002,995
Belle Terre (V)	$680,761,603	$6,807,616	$34,038,080	$68,076,160
Bellport (V)	$2,358,752,934	$23,587,529	$117,937,647	$235,875,293
Brightwaters (V)	$1,932,120,865	$19,321,209	$96,606,043	$193,212,086
Brookhaven (T)	$221,811,756,528	$2,218,117,565	$11,090,587,826	$22,181,175,653
Dering Harbor (V)	$88,595,797	$885,958	$4,429,790	$8,859,580
East Hampton (T)	$26,516,571,402	$265,165,714	$1,325,828,570	$2,651,657,140
East Hampton (V)	$5,002,346,911	$50,023,469	$250,117,346	$500,234,691
Greenport (V)	$1,316,147,268	$13,161,473	$65,807,363	$131,614,727
Head of the Harbor (V)	$1,052,509,872	$10,525,099	$52,625,494	$105,250,987
Huntington (T)	$82,709,382,979	$827,093,830	$4,135,469,149	$8,270,938,298
Huntington Bay (V)	$642,162,208	$6,421,622	$32,108,110	$64,216,221
Islandia (V)	$4,798,220,611	$47,982,206	$239,911,031	$479,822,061
Islip (T)	$157,009,867,271	$1,570,098,673	$7,850,493,364	$15,700,986,727
Lake Grove (V)	$4,999,176,933	$49,991,769	$249,958,847	$499,917,693
Lindenhurst (V)	$9,110,586,538	$91,105,865	$455,529,327	$911,058,654
Lloyd Harbor (V)	$2,057,808,899	$20,578,089	$102,890,445	$205,780,890
Nissequogue (V)	$1,430,093,283	$14,300,933	$71,504,664	$143,009,328
North Haven (V)	$2,221,433,929	$22,214,339	$111,071,696	$222,143,393
Northport (V)	$2,610,724,998	$26,107,250	$130,536,250	$261,072,500
Ocean Beach (V)	$483,689,958	$4,836,900	$24,184,498	$48,368,996
Old Field (V)	$967,667,970	$9,676,680	$48,383,398	$96,766,797
Patchogue (V)	$11,533,289,631	$115,332,896	$576,664,482	$1,153,328,963
Poquott (V)	$540,263,069	$5,402,631	$27,013,153	$54,026,307
Port Jefferson (V)	$10,546,648,033	$105,466,480	$527,332,402	$1,054,664,803
Quogue (V)	$5,371,998,365	$53,719,984	$268,599,918	$537,199,837
Riverhead (T)	$27,561,801,284	$275,618,013	$1,378,090,064	$2,756,180,128
Sag Harbor (V)	$3,157,033,580	$31,570,336	$157,851,679	$315,703,358
Sagaponack (V)	$3,548,811,980	$35,488,120	$177,440,599	$354,881,198
Saltaire (V)	$406,571,331	$4,065,713	$20,328,567	$40,657,133
Shelter Island (T)	$3,894,434,021	$38,944,340	$194,721,701	$389,443,402
Shoreham (V)	$155,005,274	$1,550,053	$7,750,264	$15,500,527
Smithtown (T)	$381,052,410	$3,810,524	$19,052,621	$38,105,241

Jurisdiction	Total Replacement Cost Value (RCV)	1% Exposure/Loss	5% Exposure/Loss	10% Exposure/Loss
Southampton (T)	$62,086,530,012	$620,865,300	$3,104,326,501	$6,208,653,001
Southampton (V)	$69,558,169,929	$695,581,699	$3,477,908,496	$6,955,816,993
Southold (T)	$13,027,590,722	$130,275,907	$651,379,536	$1,302,759,072
The Branch (V)	$17,842,698,534	$178,426,985	$892,134,927	$1,784,269,853
West Hampton Dunes (V)	$55,549,783	$555,498	$2,777,489	$5,554,978
Westhampton Beach (V)	$1,414,333,647	$14,143,336	$70,716,682	$141,433,365
Shinnecock Tribal Nation	$5,590,458,778	$55,904,588	$279,522,939	$559,045,878
Unkechaug Tribal Nation	$766,363,715	$7,663,637	$38,318,186	$76,636,371
Suffolk County	**$861,988,782,069**	**$8,619,887,821**	**$43,099,439,103**	**$86,198,878,207**

Source: Suffolk County GIS 2020; RS Means 2019

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 infrastructures are presented in the flood hazard profile (Section 5.4.8 Flood). Generally, losses resulting from flooding associated with severe winter storms should be less than that associated with the 1-percent annual chance flood.

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.

Heavy snow can immobilize a region and paralyze a city, stranding commuters, stopping the flow of supplies, and disrupting emergency and medical services. 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).

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).

Impact on the Environment

Severe winter weather can have a major impact on the environment. Not only does winter weather create changes in natural processes, the residual impacts of a community's methods to maintain its infrastructure through winter weather maintenance may also have an impact on the environment. For example, an excess amount of snowfall and earlier warming periods may affect natural processes such as flow within water resources (USGS n.d.). Rain-on-snow events can also exacerbate runoff rates with warming winter weather. Consequentially, these flow rates and excess volumes of water can erode banks, tear apart habitat along the banks and coastline, and disrupt terrestrial plants and animals.

Furthermore, chemically based winter maintenance practices have its own effect on the natural environment. Melting snow and ice that carry deicing chemicals onto vegetation and into soils can contaminate the local waterways. Elevated salt levels may hinder vegetation from absorbing nutrients, slowing plant growth (The Environmental Literacy Council 2015).

Cascading Impacts on Other Hazards

Severe winter weather events may exacerbate flooding. As discussed, the freezing and thawing of snow and ice associated with winter weather events can create major flooding issues in the County. Maintaining winter weather hazards through snow and ice removal could minimize the potential risk of flooding during a warming period.

Future Changes That May Impact Vulnerability

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)

Projected Development

As discussed in Section 4, areas targeted for future growth and development have been identified across the County. Any areas of growth located could be potentially impacted by severe winter weather events; however, these structures will be built in accordance with the latest building codes.

Projected Changes in Population

According to the Suffolk County Economic Development and Planning Department's February 2017 Annual Report update, the population of the County is growing. The report indicates that slow population growth is expected to continue in the future. Any growth can create changes in density throughout the County. Higher density can, not only create issues for local residents during evacuation of a natural hazard event, but can also impact tourists that travel to or through Suffolk County for vacation. Historically, winter weather events with associated snowfall and ice accumulation have severely impacted transportation corridors as well as infrastructure. Refer to Section 4 (County Profile), which includes a discussion on population trends for the County.

Climate Change

As discussed above, most studies project that the State of New York will see an increase in average annual temperatures and precipitation. Annual precipitation amounts in the region are projected to increase, primarily in the form of heavy rainfalls, which have the potential to freeze into heavy snowfall and icing. This increase in snow and ice could result in an increased risk to life and health, an increase in structural losses, a diversion of additional resources to response and recovery efforts, and an increase in business closures affected by severe winter events due to loss of service or access.

Change of Vulnerability Since 2014 HMP

Since the 2014 analysis, population statistics have been updated using the 5-Year 2014-2018 ACS population estimates. The general building stock was also updated using RS Means 2019 building valuations that estimated replacement cost value for each building in the inventory. Updated building stock provided by the County was utilized to update the user-defined facility inventory and critical facility inventory dataset. Overall, this vulnerability assessment uses a more accurate and updated building inventory which provides more accurate estimated exposure and potential losses for Suffolk County.