5.4.4 Severe Winter Storm

The following section provides the hazard profile (hazard description, location, extent, previous occurrences and losses, probability of future occurrences, and impact of climate change) and vulnerability assessment for the severe winter storm hazard for the Cattaraugus County Hazard Mitigation Plan (HMP).

5.4.4.1 Hazard Profile

Hazard Description

A winter storm is a weather event in which the main types of precipitation are snow, sleet, or freezing rain. They can be a combination of heavy snow, blowing snow, and dangerous wind chills. According to the National Oceanic and Atmospheric Administration (NOAA) National Severe Storms Laboratory (NSSL), the three basic components needed to make a winter storm include the following:

- Below freezing temperatures (cold air) in the clouds and near the ground to make snow and ice.
- Lift, something to raise the moist air to form clouds and cause precipitation, such as warm air colliding with cold air and being forced to rise over the cold dome or air flowing up a mountainside (oleographic lifting).
- Moisture to form clouds and precipitation, such as air blowing across a large lake or the ocean (NOAA-NSSL n.d.).

In Cattaraugus County, winter storms include blizzards, snowstorms, sleet, freezing rain, and ice storms. Extreme cold temperatures and wind chills are associated with winter storms. Important issues associated with a severe winter storm in the planning area include the following:

- Older building stock in Cattaraugus County might be more vulnerable to the aftermath of a winter storm event. Heavy snow loads on the roofs of buildings might not be able to withstand the extra weight.
- Ice and freezing temperatures can lead to frost heaving, damaging roads, bridges, buildings, home foundations, and railroad tracks.
- The impacts of drought and invasive species can lead to dead or dying trees. These trees are more susceptible to falling during winter storm events from the weight of snow and ice, causing power outages, closed roadways, and damage to buildings and property.
- Downed power lines from the weight of snow and ice lead to power outages, leaving many homes without a source of heat.
- Loss of economic activity when travel is restricted

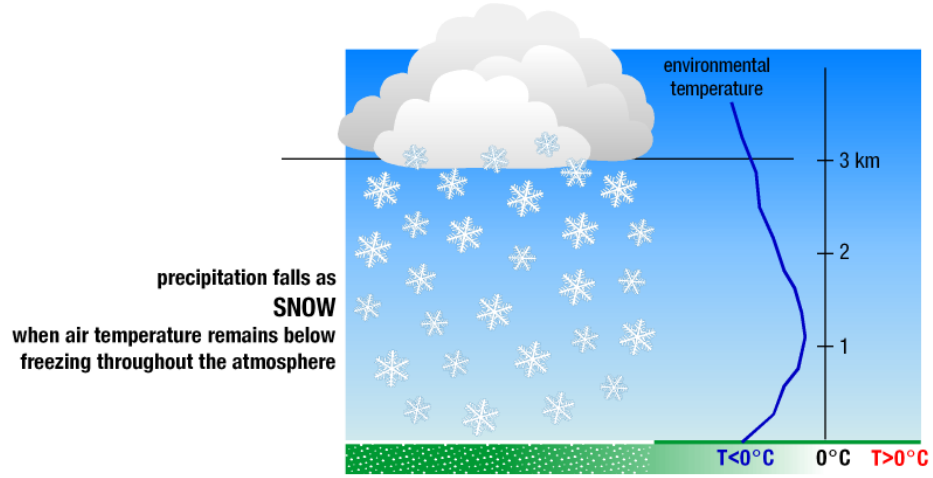
Blizzards

A blizzard is a winter snowstorm with sustained or frequent wind gusts of 35 miles per hour (mph) or more, accompanied by falling or blowing snow reducing visibility to or below 0.25 mile. These conditions must be predominant over a 3-hour period to be considered a blizzard. 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 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 0 mile. 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 (The Weather Channel 2012).

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) and 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 a snow pellet, 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. Figure 5.4.4-1 depicts snow creation.

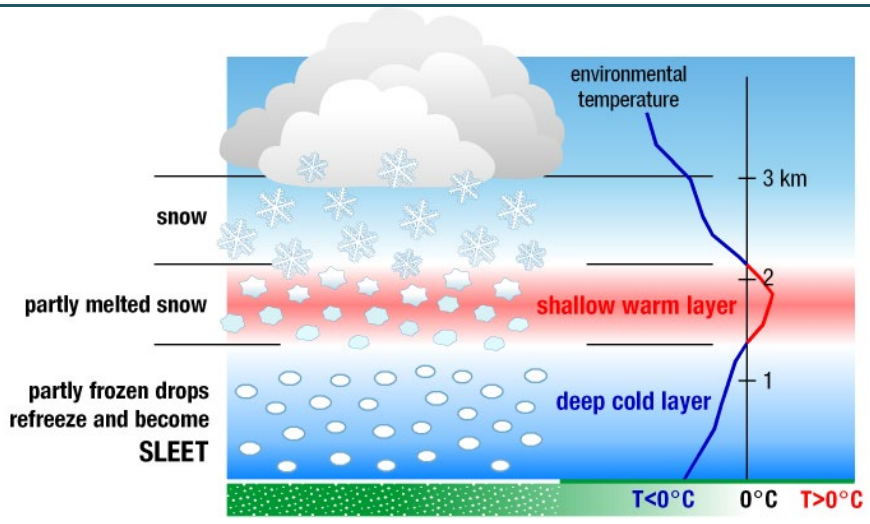
Figure 5.4.4-1. Snow Creation



Source: NOAA-NSSL 2015

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 through colder air layers. They are usually smaller than 0.30 inch in diameter (NSIDC 2013). Figure 5.4.4-2 depicts sleet creation.

Figure 5.4.4-2. Sleet Creation

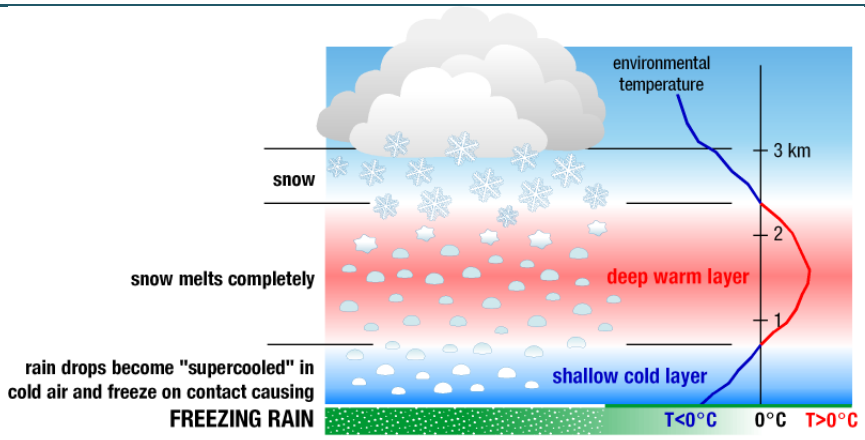


Source: NOAA-NSSL 2015

Ice Storms

An ice storm describes those events when damaging accumulations of ice are expected during freezing rain situations. Significant ice accumulations typically are accumulations of 0.25 inch or greater (National Weather Service [NWS] 2013). Heavy accumulations of ice can bring down trees, power lines, 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).

Figure 5.4.4-3. Freezing Rain Creation



Source: NOAA-NSSL 2015

Location

Portions of northern Cattaraugus County are located within the traditional snowbelt. Most of the severe winter storms in Cattaraugus County result from lake-effect snow from Lake Erie. Lake-effect snow is caused when very cold air flows over the relatively warmer water of a large lake. Evaporation from the lake surface under these conditions forms convective clouds that cannot contain all this water, and some of it falls back to the surface as snow. Lake-effect snow showers often form into bands or lines, with abrupt edges to the falling snow. One location can receive a foot of snow, while another location just a few miles away receives only flurries. Cattaraugus County is prone to winter storms that have affected every jurisdiction within Cattaraugus County.

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 and week (e.g., weekday versus weekend), and time of season.

Table 5.4.4-1. 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-NCEI 2018
Note: RSI = Regional Snowfall Index

The extent of a severe winter storm can be classified by meteorological measurements and by evaluating its societal impacts. 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 United States. The RSI ranks snowstorm impacts on a scale from 1 to 5 (Table 5.4.4-1) and is based on the spatial extent of the storm, the amount of snowfall, and the interaction of the extent and snowfall totals with population (U.S. Census Bureau 2000). The NCDC has analyzed and assigned RSI values to over 500 storms since 1900 (NOAA 2015).

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). According to NWS, the magnitude of a severe winter storm can be qualified into five main categories by event type, as listed below (NWS 2018).

Heavy Snowstorm	Accumulations of 4 inches or more of snow in a 6-hour period, or 6 inches of snow in a 12-hour period.
Sleet Storm	Significant accumulations of solid pellets that form from the freezing of raindrops or partially melted snowflakes causing slippery surfaces, posing a hazard to pedestrians and motorists.
Ice Storm	Significant accumulation of rain or drizzle freezing on objects (trees, power lines, roadways) as it strikes them, causing slippery surfaces and damage from sheer weight of ice accumulations.
Blizzard	Wind velocity of 35 mph or more, temperatures below freezing, considerable blowing snow with visibility frequently below one-quarter mile prevailing over an extended period.
Severe Blizzard	Wind velocity of 45 mph, temperatures of 10 °F or lower, a high density of blowing snow with visibility frequently measured in feet prevailing over an extended period.

Additionally, 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.

Previous Occurrences and Losses

Many sources have provided historical information regarding previous occurrences and losses associated with severe winter storm events in Cattaraugus County. According to the NOAA National Centers for Environmental Information (NCEI) Storm Events Database, Cattaraugus County experienced 118 winter weather events between 1950 and 2020, including 83 heavy snow events and 29 winter storms events (NOAA NCEI 2020). Table 5.4.4-2 shows these statistics.

Table 5.4.4-2. Severe Winter Events 1950-2020

Hazard Type	Number of Occurrences Between 1950 and 2020	Total Fatalities	Total Injuries	Total Property Damage ($)	Total Crop Damage ($)
Blizzard	1	0	0	$33K	$0
Extreme Cold/Wind Chill	3	0	0	$0	$0
Heavy Snow	83	0	0	$12.740M	$0
Ice Storm	2	0	0	$47K	$0
Sleet	0	0	0	$0	$0
Winter Storm	29	0	0	$608K	$0
Winter Weather	0	0	0	$0	$0
TOTAL	**118**	**0**	**0**	**$13.428M**	**$0**

Source: NOAA-NCEI 2020

Between 1954 and October 2018, Federal Emergency Management Agency (FEMA) included New York State (NYS) in 25 winter storm-related major disaster (DR) or emergency (EM) declarations classified as one or a combination of the following disaster types: severe winter storm, snowstorm, snow, ice storm, winter storm, blizzard, and flooding. Generally, these disasters cover a wide region of the State; therefore, they may have impacted many counties. Cattaraugus County was included in eight of these declarations (Table 5.4.4-3).

Table 5.4.4-3. FEMA Major Disasters and Emergency Declarations in Cattaraugus County

FEMA Declaration Number	Date(s) Of Event	Declaration Date	Event Type	Details
DR-494	March 19, 1976	March 19, 1976	Severe Ice Storm	Ice Storm, Severe Storms, and Flooding
EM-3027	January 29, 1977	January 29, 1977	Snow	Snowstorm
DR-527	February 5, 1977	February 5, 1977	Snow	Snowstorm
EM-3107	March 13-17, 1993	March 17, 1993	Snow	Severe Blizzard
EM-3136	January 1-15, 1999	January 1,1993	Snow	Snow
EM-3157	November 19-21, 2000	December 4, 2000	Snow	Snow
EM-3170	December 24-29, 2001	December 31, 2001	Snow	Snow
DR-4204	November 17-26, 2014	December 22, 2014	Snow	Severe Winter Snowstorm

Source: FEMA 2020

The Secretary of Agriculture from the U.S. Department of Agriculture (USDA) is authorized to designate counties as disaster areas to make emergency loans to producers suffering losses in those counties and in counties that are contiguous to a designated county. Between 2012 and 2020, Cattaraugus County was included in six USDA declarations related to severe winter weather, mainly involving freezes.

- S3411 – 2012 - Freezing temperatures
- S3257 – 2012 - Frosts, freezes, unseasonably warm temperatures, and excessive heat
- S3250 – 2012 - Frosts and freezes
- S3672 – 2014 - Freeze
- S3666 – 2014 - Freeze
- S3886 – 2015 - Frost, freeze, and excessive snow

The USDA crop loss data provide another indicator of the severity of previous events. Additionally, crop losses can have a significant impact on the economy by reducing produce sales and purchases. Such impacts may have long-term consequences, particularly if crop yields are low the following years as well. USDA records indicate that Cattaraugus County has experienced crop losses from severe winter storm events. Table 5.4.4-4 provides details regarding crop losses in Cattaraugus County according to USDA records.

Table 5.4.4-4. USDA Crop Losses from Severe Winter Storms in Cattaraugus County

Year	Crop Type	Cause of Loss	Losses
2013	Corn	Other (Snow, Lightning, etc.)	$10,472.50
2013	Soybeans	Other (Snow, Lightning, etc.)	$22,795
2014	Corn	Other (Snow, Lightning, etc.)	$453,703
2015	Corn	Other (Snow, Lightning, etc.)	$157,784
2015	Grapes	Freeze	$71,250
2015	Grapes	Cold Winter	$57,176
2018	Grapes	Freeze	$1,005

Source: USDA 2020

Table 5.4.4-5 identifies known severe winter storm events that impacted Cattaraugus County between 2013 and 2020. Detailed information on damages and impacts to each municipality are provided in Section 9, Jurisdictional Annexes.

Table 5.4.4-5. Severe Winter Weather Events in Cattaraugus County, 2013 to 2020

Dates of Event	Event Type	FEMA Declaration Number	County Designated?	Event Details*
January 21-23, 2013	Lake-Effect Snow	N/A	N/A	Specific snowfall reports included: 25 inches at Perrysburg, 16 inches at West Valley, and 13 inches at Warsaw. Overall, $12K in property damages were reported throughout the county.
February 1, 2013	Lake-Effect Snow	N/A	N/A	$10K in property damages were reported throughout the county.
February 20, 2013	Lake-Effect Snow	N/A	N/A	$10K in property damages were reported throughout the county.
March 21, 2013	Lake-Effect Snow	N/A	N/A	Specific snowfall reports off Lake Erie: 20 inches at Franklinville; 19 inches at Perrysburg. $15K in property damages were reported throughout the county.
November 26-27, 2013	Winter Storm	N/A	N/A	Several counties issued travel advisories due to the hazardous road conditions. The fact that the storm occurred just a day or two prior to Thanksgiving only added to the impact of the storm. Specific snowfall reports included: 9 inches at Perrysburg; 8 inches at Randolph and Little Valley; and 7 inches at Franklinville. $15K in property damages were reported throughout the county.
December 10-11, 2013	Lake-Effect Snow	N/A	N/A	Snowfall amounts of 3 to 4 feet fell in a 24- to 36-hour period. $15K in property damages were reported throughout the county.
December 15, 2013	Lake-Effect Snow	N/A	N/A	$12K in property damages were reported throughout the county.
December 18, 2013	Lake-Effect Snow	N/A	N/A	Within the higher snowfall rates, thunder snow occurred. Gusty winds and the timing of early morning did bring accidents on area roads slowing the morning commute. $13K in property damages were reported throughout the county.
December 31, 2013	Lake-Effect Snow	N/A	N/A	The heaviest snow fell during New Year's Eve evening with snow winding down during the morning of the first. Overall snow totals for this event were moderate. Off Lake Erie specific snowfall totals included: 23 inches at Perrysburg and 18 inches at Gowanda. $10K in property damages were reported throughout the county.
January 2-3, 2014	Heavy Snow	N/A	N/A	11 inches Perrysburg; 9 inches at Randolph; 8 inches at Franklinville. Overall, approximately $22K in property damages were reported.
February 4-5, 2014	Heavy Snow	N/A	N/A	. $20K in property damages were reported throughout the county.
March 12, 2014	Blizzard	N/A	N/A	$33K in property damages were reported throughout the county.
March 29-30, 2019	Winter Storm	N/A	N/A	$20K in property damages were reported throughout the county.
November 20-21, 2014	Lake-Effect Snow	DR-4204	Yes	This event combined with the lake-effect snow event following the next couple of days qualified the area for a Federal Disaster Declaration. $550K in property damages were reported throughout the county.
December 10-11, 2014	Winter Storm	N/A	N/A	Specific snowfall amounts received included: 18 inches as Perrysburg and 11 inches at Franklinville. $35K in property damages were reported throughout the county.
January 8-10, 2015	Lake-Effect Snow	N/A	N/A	$15K in property damages were reported throughout the county.
February 1-2, 2015	Winter Storm	N/A	N/A	Specific snowfall reports included 12 inches at Perrysburg; 11 inches at Franklinville. $20K in property damages were reported throughout the county.
February 14-15, 2015	Winter Storm	N/A	N/A	$20K in property damages were reported throughout the county.
December 18-19, 2015	Lake-Effect Snow	N/A	N/A	$16K in property damages were reported throughout the county.

Table 5.4.4-5. Severe Winter Weather Events in Cattaraugus County, 2013 to 2020

Dates of Event	Event Type	FEMA Declaration Number	County Designated?	Event Details*
January 1-2, 2016	Lake Effect Snow	N/A	N/A	$15K in property damages were reported throughout the county.
January 10-11, 2016	Lake-Effect Snow	N/A	N/A	$10K in property damages were reported throughout the county.
January 12-13, 2016	Lake-Effect Snow	N/A	N/A	$30K in property damages were reported throughout the county.
January 17-19, 2016	Lake-Effect Snow	N/A	N/A	$30K in property damages were reported throughout the county.
February 10-11, 2016	Lake-Effect Snow	N/A	N/A	$20K in property damages were reported throughout the county.
February 15-16, 2016	Winter Storm	N/A	N/A	$15K in property damages were reported throughout the county.
November 19-21	Lake Effect Snow	N/A	N/A	$25K in property damages were reported throughout the county.
December 8-11, 2016	Lake-Effect Snow	N/A	N/A	$25K in property damages were reported throughout the county.
December 14-16, 2016	Lake-Effect Snow	N/A	N/A	$20K in property damages were reported throughout the county.
December 29-30, 2016	Lake-Effect Snow	N/A	N/A	$20K in property damages were reported throughout the county.
January 4-6, 2017	Lake Effect Snow	N/A	N/A	$20K in property damages were reported throughout the county.
January 7, 2017	Lake-Effect Snow	N/A	N/A	$20K in property damages were reported throughout the county.
January 26-29, 2017	Lake-Effect Snow	N/A	N/A	$16K in property damages were reported throughout the county.
February 15-16, 2017	Lake-Effect Snow	N/A	N/A	$20K in property damages were reported throughout the county.
March 13-15, 2017	Winter Storm	DR-4322	No	$75K in property damages were reported throughout the county.
December 6-8, 2017	Lake-Effect Snow	N/A	N/A	$30K in property damages were reported throughout the county.
December 11-13, 2017	Lake-Effect Snow	N/A	N/A	$35K in property damages were reported throughout the county.
December 15-16, 2017	Lake-Effect Snow	N/A	N/A	$35K in property damages were reported throughout the county.
December 24-27, 2017	Lake-Effect Snow	N/A	N/A	$75K in property damages were reported throughout the county.
December 29-30, 2017	Lake-Effect Snow	N/A	N/A	35K in property damages were reported throughout the county.
January 12-13, 2018	Winter Storm	N/A	N/A	$25K in property damages were reported throughout the county.
March 1-2, 2018	Winter Storm	N/A	N/A	$45K in property damages were reported throughout the county.

Sources: *FEMA 2020; NOAA-NCEI 2020; SPC 2020*
Note: *Many sources were consulted to provide an update of previous occurrences and losses; event details and loss/impact information may vary and has been summarized in the above table. Due to the large number of winter storm events in the NOAA-NCEI archive, only winter storm events over $10K in property damages were included.*
DR *Major Disaster Declaration (FEMA)*
FEMA *Federal Emergency Management Agency*
Mph *Miles per Hour*
NCEI *National Centers for Environmental Information*
NOAA *National Oceanic and Atmospheric Administration*
N/A *Not Applicable*

Climate Change Projections

Each region in New York State, as defined by ClimAID: The Integrated Assessment for Effective Climate Change in New York State (ClimAID), has attributes that will be affected by climate change. Cattaraugus County is part of Region 3, which includes the Southern Tier of New York. Some of the issues in this region that are affected by climate change include the dairy dominating agricultural economy, milk production losses projected, increased Susquehanna River flooding, and first portion of the state to be impacted by invasive species moving north (New York State Energy Research and Development Authority [NYSERDA] 2014).

Temperatures are expected to increase throughout the state, by 2 to 3.4 ºF by the 2020s, 4.1 to 6.8 °F by the 2050s, and 5.3 to 10.1 °F by the 2080s. Annual average precipitation is projected to increase by 1 percent to up to 8 percent by the 2020s, from 3 percent to up to 12 percent by the 2050s, and from 4 percent to up to 15 percent by the 2080s. By the end of the century, the greatest increases in precipitation are projected to be in the northern parts of the state. Although seasonal projections are less certain than annual results, this additional precipitation will most likely occur during the winter months. However, with temperatures rising, some of the increased winter precipitation may fall as rain as opposed to snow. In Region 3, the number of days with temperature below 32°F is projected to drop from 122–130 days in the 2020s to 79–103 days in the 2080s, reducing the likelihood of precipitation falling as snow.

New York State is already experiencing the effects of climate change during the winter season. Annual ice cover has decreased 71 percent on the Great Lakes since 1973. This decrease may lead to increased lake-effect snow in Cattaraugus County in the next two decades through greater moisture availability. By mid-century, however, lake-effect snow will generally decrease as temperatures below freezing become less frequent (NYSERDA 2014). Winter snow cover is decreasing, and spring weather is seen, on average, about one week earlier than a few years ago. Night-time temperatures are measurably warmer, even during the colder months (NYSDEC n.d.). Overall winter temperatures in New York State are almost 5 °F warmer than in 1970 (NYSDEC n.d.). NYS 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 percent by end of the next century. The lack of snow cover may jeopardize winter sport businesses offering skiing, snowmobiling, and other types of winter recreation. Natural ecosystems will be affected by the changing snow cover (Cornell University College of Agriculture and Life Sciences 2011).

Probability of Future Occurrences

Table 5.4.4-6 summarizes data regarding the probability of occurrences of severe winter storm events in Cattaraugus County based on the historic record. Heavy snow events are the most common in Cattaraugus County, followed by winter storms. The information used to calculate the probability of occurrences is based solely on NOAA-NCEI storm events database results.

Table 5.4.4-6. Probability of Future Occurrence of Severe Winter Weather Events

Hazard Type	Number of Occurrences Between 1996 and 2020	Rate of Occurrence or Annual Number of Events (average)	% chance of occurrence in any given year
Blizzard	1	0.04	4.17%
Extreme Cold/Wind Chill	3	0.13	12.50%
Heavy Snow	83	3.61	100%
Ice Storm	2	0.09	8.33%
Sleet	0	0	0%
Winter Storm	29	1.26	100%
Winter Weather	0	0	0%
Total	**118**	**5.13**	100%

Source: NOAA-NCEI 2020

Based on historical data from NYSERDA, it is expected that the following will occur at least once per 100 years:

- Up to four inches of freezing rain in the ice band near central New York State of which between 1–2 inches of accumulated ice will occur 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).

In Section 5.3 of this HMP, the identified hazards of concern for Cattaraugus 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 has a 100-percent annual probability and may occur multiple times per year).

5.4.4.2 Vulnerability Assessment

All of Cattaraugus County is exposed to the severe winter storm hazard; therefore, all assets in the county (population, structures, critical facilities, and lifelines), as described in Section 4, County Profile, are potentially vulnerable to a severe winter storm event. The following summarizes the estimated potential impacts of severe winter storm events on the county.

Impact on Life, Health, and Safety

Heavy snow can immobilize a region and paralyze a city. Additional impacts include 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 Cattaraugus County, the towns are generally rural compared to the villages and cities. The economic impact of winter weather each year is huge, with costs for snow removal, damage and loss of business in the millions (NOAA-NSSL 2020).

Research has shown that some populations, while they may not have more hazard exposure, may experience exacerbated impacts and prolonged recovery if/when impacted. This is due to many factors including their physical and financial ability to react or respond during a hazard. Of the population exposed, the most vulnerable include the economically disadvantaged and the population over age 65. Economically disadvantaged populations may be more vulnerable because they are likely to evaluate their risk and make decisions to evacuate based on net economic impacts on their families. The population over age 65 is also more vulnerable because they are more likely to seek or need medical attention that may not be available due to isolation during a flood event, and they may have more difficulty evacuating. Within Cattaraugus County, there are approximately 14,046 people over the age of 65 and 12,222 people below the poverty level (American Community Survey 2018).

The Centers for Disease Control and Prevention (CDC) 2016 Social Vulnerability Index (SVI) ranks U.S. Census tracts on socioeconomic status, household composition and disability, minority status and language, and housing and transportation. Cattaraugus County's overall score is 0.7106, indicating that its communities have moderate to high social vulnerability (CDC 2016). This indicates that residents in Cattaraugus County may not have the proper resources to react and address the impacts of severe winter storm events.

The homeless and 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). Additionally, homeless populations may not have access to housing or sheltering during a severe winter storm. Section 4, County Profile, displays the densities of low-income populations in Cattaraugus County.

Impact on General Building Stock

The entire general building stock inventory in Cattaraugus County is exposed and potentially vulnerable to the severe winter storm hazard; however, properties in poor condition or in particularly vulnerable locations may be at risk for the most damage. In general, structural impacts include damage to roofs and building frames rather than building content. Current modeling tools are not available to estimate specific losses for this hazard. As an alternate approach, the percent damage to structures that could result from severe winter storm conditions is considered. 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 5.4.4-7 summarizes the estimated loss to structures as a result of 1-percent, 5-percent, and 10-percent loss. 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 5.4.4-7. General Building Stock Exposure and Estimated Losses from Severe Winter Storm Events

Jurisdiction	Total Replacement Cost Value (RCV)	1-Percent Exposure/Loss	5-Percent Exposure/Loss	10-Percent Exposure/Loss
Allegany (T)	$1,995,224,472	$19,952,245	$99,761,224	$199,522,447
Allegany (V)	$754,717,827	$7,547,178	$37,735,891	$75,471,783
Ashford (T)	$922,022,498	$9,220,225	$46,101,125	$92,202,250
Carrollton (T)	$348,432,403	$3,484,324	$17,421,620	$34,843,240
Cattaraugus (V)	$625,337,729	$6,253,377	$31,266,886	$62,533,773
Coldspring (T)	$313,395,045	$3,133,950	$15,669,752	$31,339,505
Conewango (T)	$1,141,077,674	$11,410,777	$57,053,884	$114,107,767
Dayton (T)	$591,736,768	$5,917,368	$29,586,838	$59,173,677
Delevan (V)	$348,026,561	$3,480,266	$17,401,328	$34,802,656
East Otto (T)	$438,642,865	$4,386,429	$21,932,143	$43,864,286
Ellicottville (T)	$1,598,675,883	$15,986,759	$79,933,794	$159,867,588
Ellicottville (V)	$660,648,036	$6,606,480	$33,032,402	$66,064,804
Farmersville (T)	$419,542,828	$4,195,428	$20,977,141	$41,954,283
Franklinville (T)	$553,691,738	$5,536,917	$27,684,587	$55,369,174
Franklinville (V)	$634,263,362	$6,342,634	$31,713,168	$63,426,336
Freedom (T)	$986,939,932	$9,869,399	$49,346,997	$98,693,993
Gowanda (V)	$699,071,287	$6,990,713	$34,953,564	$69,907,129
Great Valley (T)	$906,431,658	$9,064,317	$45,321,583	$90,643,166
Hinsdale (T)	$667,353,019	$6,673,530	$33,367,651	$66,735,302
Humphrey (T)	$296,687,949	$2,966,879	$14,834,397	$29,668,795
Ischua (T)	$288,127,010	$2,881,270	$14,406,350	$28,812,701
Leon (T)	$915,671,381	$9,156,714	$45,783,569	$91,567,138
Little Valley (T)	$358,002,270	$3,580,023	$17,900,113	$35,800,227
Little Valley (V)	$561,442,185	$5,614,422	$28,072,109	$56,144,218

Jurisdiction	Total Replacement Cost Value (RCV)	1-Percent Exposure/Loss	5-Percent Exposure/Loss	10-Percent Exposure/Loss
Lyndon (T)	$424,831,663	$4,248,317	$21,241,583	$42,483,166
Machias (T)	$880,491,464	$8,804,915	$44,024,573	$88,049,146
Mansfield (T)	$689,267,836	$6,892,678	$34,463,392	$68,926,784
Napoli (T)	$514,455,736	$5,144,557	$25,722,787	$51,445,574
New Albion (T)	$471,572,394	$4,715,724	$23,578,620	$47,157,239
Olean (C)	$7,169,192,523	$71,691,925	$358,459,626	$716,919,252
Olean (T)	$750,434,377	$7,504,344	$37,521,719	$75,043,438
Otto (T)	$376,418,830	$3,764,188	$18,820,941	$37,641,883
Perrysburg (T)	$642,404,678	$6,424,047	$32,120,234	$64,240,468
Persia (T)	$231,207,770	$2,312,078	$11,560,389	$23,120,777
Portville (T)	$1,044,666,295	$10,446,663	$52,233,315	$104,466,630
Portville (V)	$346,884,521	$3,468,845	$17,344,226	$34,688,452
Randolph (T)	$1,284,336,162	$12,843,362	$64,216,808	$128,433,616
Red House (T)	$127,341,670	$1,273,417	$6,367,083	$12,734,167
Salamanca (C)	$4,706,213,138	$47,062,131	$235,310,657	$470,621,314
Salamanca (T)	$177,314,009	$1,773,140	$8,865,700	$17,731,401
South Dayton (V)	$244,313,568	$2,443,136	$12,215,678	$24,431,357
South Valley (T)	$138,238,926	$1,382,389	$6,911,946	$13,823,893
Yorkshire (T)	$1,259,882,782	$12,598,828	$62,994,139	$125,988,278
Cattaraugus County (Total)	**$38,504,630,718**	**$385,046,307**	**$1,925,231,536**	**$3,850,463,072**

Source: Cattaraugus County Office of Real Property and GIS Services 2020; Cattaraugus County GIS 2020; Microsoft 2018; RSMeans 2019
Notes: % = Percent; C = City; T = Town; V = Village

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 5.4.1). Generally, losses resulting from flooding associated with severe winter storms should be less than that associated with a 100-year 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.

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 can prevent the commuter population traveling to work within and outside of the county. Depending on the severity of a storm, the state, county, or municipalities can implement travel advisories

or restrictions. With these advisories and restrictions in place, businesses and government offices can be closed, resulting in a loss of productivity and economic activity.

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 (U.S. Geological Survey [USGS] 2020). 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

Understanding future changes that impact vulnerability in the county can assist in planning for future development and ensuring that appropriate mitigation, planning, and preparedness measures are in place. The County considered the following factors to examine potential conditions that may affect hazard vulnerability:

- Potential or projected development
- Projected changes in population
- Other identified conditions as relevant and appropriate, including the impacts of climate change.

Projected Development

Areas targeted for future growth and development have been identified across Cattaraugus County (presented in Section 4, County Profile). Any areas of growth could be potentially impacted by the severe winter storm hazard. Current New York State land use and building codes incorporate standards that address and mitigate snow accumulation. Some local municipalities in the county have implemented the following activities to eliminate loss of life and property and infrastructure damages during winter storm events:

- Remove snow from roadways and sidewalks.
- Remove 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.
- Remove 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 or mold 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 Division of Homeland Security and Emergency Services [DHSES] DHSES 2014).

Projected Changes in Population

According to population projections from the Cornell Program on Applied Demographics, Cattaraugus County will experience a population decrease through 2040. Population change is not expected to have a measurable effect on the overall vulnerability of the county's population over time. Those moving to from areas of lower vulnerability to higher will increase their vulnerability, though not in a dramatic fashion. However, a closer examination of the age of the population, changes in their geography and how climate change may alter the winter weather received (rain versus snow) will be just as important to continue to assess future changes in vulnerability. Section 4.6.2, Population Trends, in the County Profile for a discussion on trends for the county.

Climate Change

As discussed earlier, it is uncertain how climate change will influence extreme winter storm events; initially the region may experience an increase in lake-effect snow due to increased moisture availability from decreasing ice cover on the Great Lakes, while by mid-century, the region may see a decrease in snow due to less frequent temperatures below freezing (NYSERDA 2014). With a potential for more frequent lake-effect snow events over the next two decades, the county's assets will be at risk for the impacts of more frequent severe winter storm events. An increase in the frequency and severity of severe winter storms may result in an increase of snow loads on the county's building stock and infrastructure, putting each building at risk for structural damage. More frequent and severe events will also result in increased resources being spent to prepare for and clean-up after an event. However, as winter temperatures continue to rise, the increase in precipitation is likely to occur during the winter months as rain. Increased rain on snowpack or frozen or saturated soils may lead to increased flooding and related impacts on the county's assets.

Change of Vulnerability

Overall, the entire county remains vulnerable to severe winter storms. The general building stock was updated using RSMeans 2019 building valuations that estimated replacement cost value for each building in the inventory. Updated 2018 building stock data downloaded from Microsoft was utilized to update the user-defined facility inventory and critical facility inventory dataset. Parcel information from the Cattaraugus tax assessor was used to update building attributes, such as year built, number of stories, basement type, property class, and square footage.

Overall, this vulnerability assessment uses a more accurate and updated building inventory than that used in the 2014 HMP. This information provides more accurate exposure and potential loss estimates for Cattaraugus County.