5.4.7 Extreme Temperature

This section provides a hazard profile and vulnerability assessment of the extreme temperature hazard for the Suffolk County HMP.

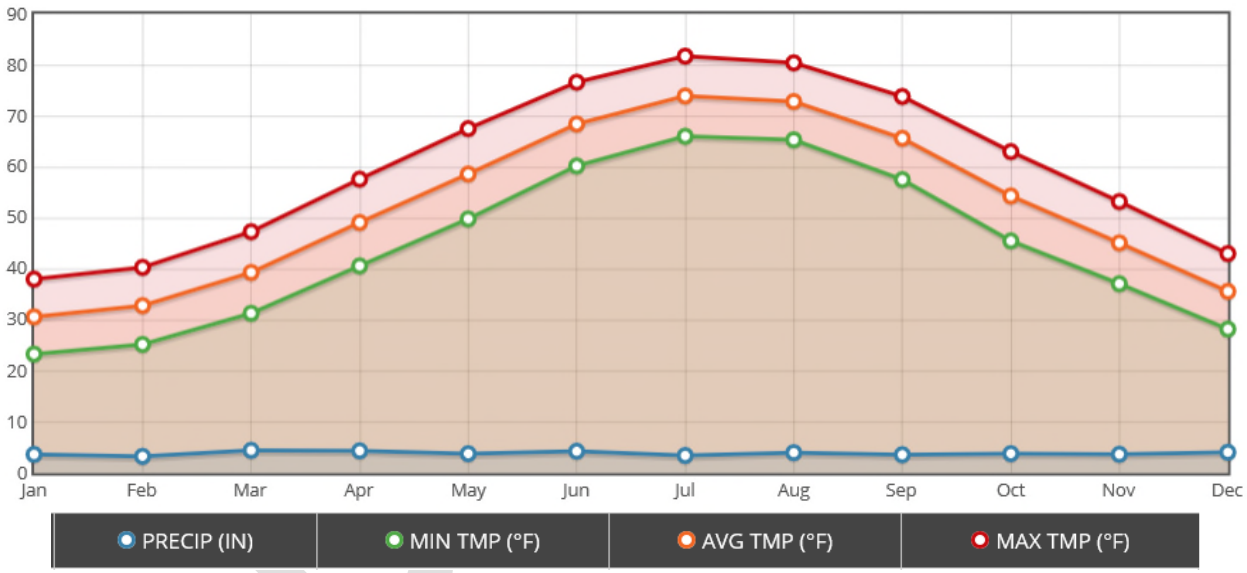
Hazard Profile

This section presents information regarding the description, extent, location, previous occurrences and losses, and probability of future occurrences for the extreme temperature hazard (heat and cold).

Description

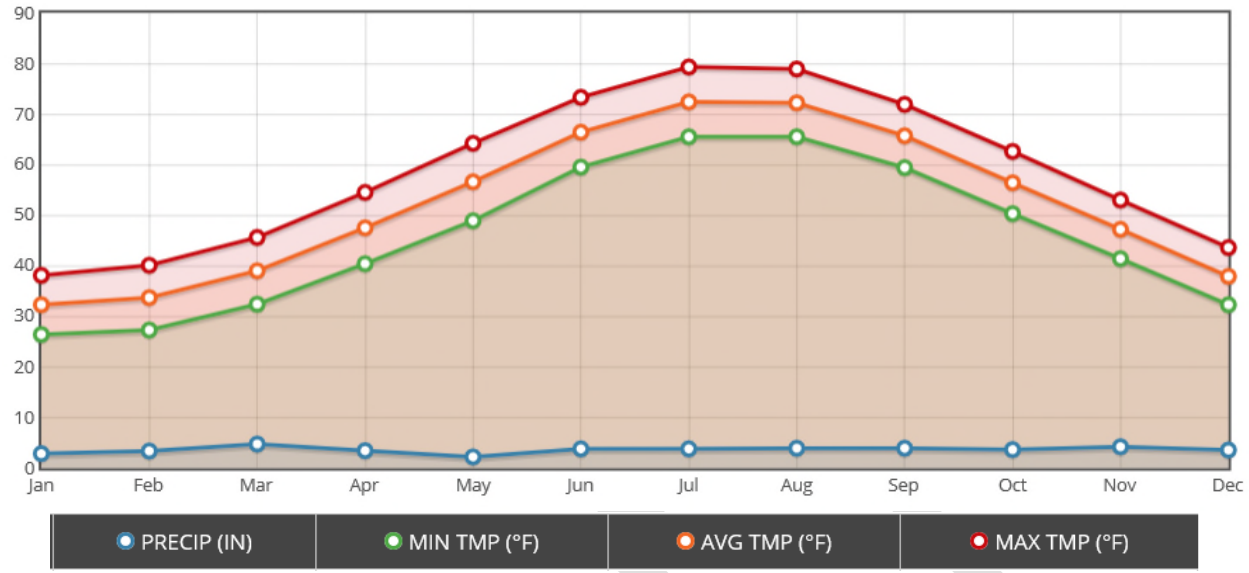
Extreme temperature includes both heat and cold events, which can have a significant impact to human health, commercial/agricultural businesses and primary and secondary effects on infrastructure (e.g., burst pipes and power failure). What constitutes "extreme cold" or "extreme heat" can vary across different areas of the country, based on what the population is accustomed to. Figure 5.4.7-1 and Figure 5.4.7-2 show the average low and high temperatures each month at the Islip LI MacArthur Airport station and Montauk Airport station in Suffolk County.

Figure 5.4.7-1. Average Temperatures at Islip LI MacArthur Airport



Source: NOAA NCEI 2020

Figure 5.4.7-2. Average Temperatures at Montauk Airport



Source: NOAA NCEI 2020

Extreme Cold

Extreme cold events are when temperatures drop well below normal in an area. In regions relatively unaccustomed to winter weather, near freezing temperatures are considered "extreme cold." Extreme cold temperatures are characterized by the ambient air temperature dropping to approximately 0 degrees Fahrenheit (ºF) or below (National Weather Service [NWS] 2015). Extensive exposure to extreme cold temperatures can cause frostbite or hypothermia and can become life-threatening. Infants and the elderly are most susceptible to the effects of extreme changes in temperatures. Extreme cold also can cause emergencies in susceptible populations, such as those without shelter, those who are stranded, or those who live in a home that is poorly insulated or without heat (such as mobile homes). Infants and the elderly are particularly at risk, but anyone can be affected (Centers of Disease Control and Prevention [CDC] 2007). In New York State, extreme cold days are defined to reflect the State's regional climate variations. Extreme cold days in the State are individual days with minimum temperatures at or below 32° F or 0° C (NYSERDA 2014).

There are several health hazards related to extreme cold temperatures and include wind chill, frostbite, and hypothermia.

- *Wind chill* is not the actual temperature but rather how wind and cold feel on exposed skin. As the wind increases, heat is carried away from the body at an accelerated rate, driving down the body temperature.
- *Frostbite* is damage to body tissue caused by extreme cold. A wind chill of -20°F will cause frostbite in just 30 minutes. Frostbite can cause a loss of feeling and a white or pale appearance in extremities.
- *Hypothermia* is a condition brought on when the body temperature drops to less than 95°F and it can be deadly. Warning signs of hypothermia include uncontrollable shivering, memory loss, disorientation, incoherence, slurred speech, drowsiness and apparent exhaustion.

Extreme Heat

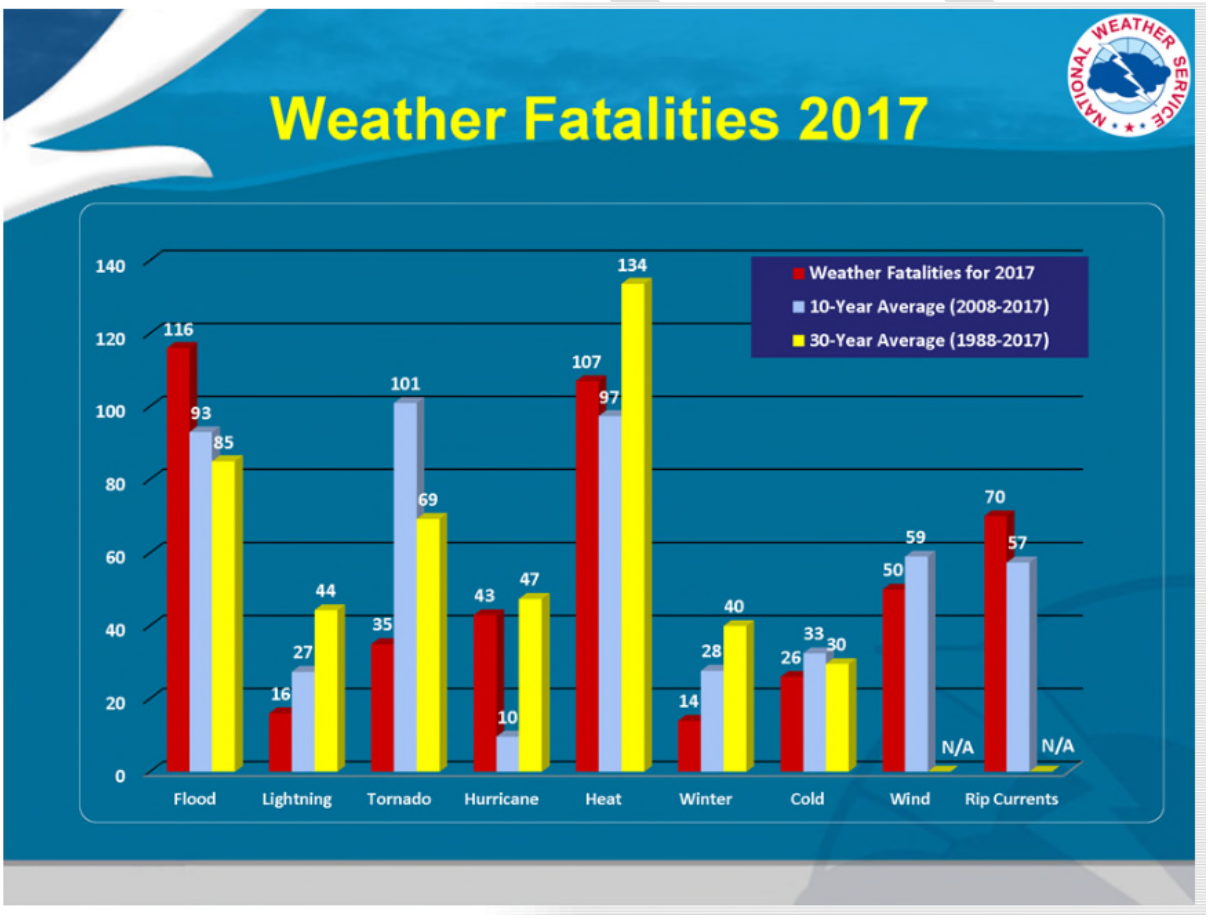
Extreme heat is defined as temperatures which hover 10 degrees or more above the average high temperature for a region and that last for several weeks (CDC 2016). Humid or muggy conditions occur when a 'dome' of high atmospheric pressure traps hazy, damp air near the ground. An extended period of extreme heat of three or

more consecutive days is typically called a heat wave and is often accompanied by high humidity (NWS 2013). In New York State, high temperatures and heat waves are defined in several ways to reflect the diversity of conditions experienced across the State. Extreme hot days in New York State are defined as individual days with maximum temperatures at or above 90° F or at or above 95° F. Heat waves are defined as three consecutive days with maximum temperatures above 90° F (NYSERDA 2014).

Depending on severity, duration and location; extreme heat events can create or provoke secondary hazards including, but not limited to, dust storms, droughts, wildfires, water shortages and power outages (CDC 2016). This could result in a broad and far-reaching set of impacts throughout a local area or entire region. Impacts could include significant loss of life and illness; economic costs in transportation, agriculture, production, energy and infrastructure; and losses of ecosystems, wildlife habitats and water resources (Adams Date Unknown; Meehl and Tebaldi 2004; CDC 2016; NYS DHSES 2014).

Extreme heat one of the leading weather-related cause of death in the United States. On average, 113 people die each year from excessive heat. Figure 5.4.7-1 shows the number of weather fatalities based on a 10-year average and 30 year average. Heat has the highest average of weather-related fatalities between 2006 and 2015.

Figure 5.4.7-3. Average Number of Weather Related Fatalities in the United States



Source: NWS 2018a

Urbanized areas and urbanization create an exacerbated type of risk during an extreme heat event, compared to rural and suburban areas. As defined by the U.S. Census, urban areas are classified as all territory, population, and housing units located within urbanized areas and urban clusters. The term urbanized area denotes an urban

area of 50,000 or more people. Urban areas under 50,000 people are called urban clusters. The U.S. Census delineates urbanized area and urban cluster boundaries to encompass densely settled territory, which generally consists of:

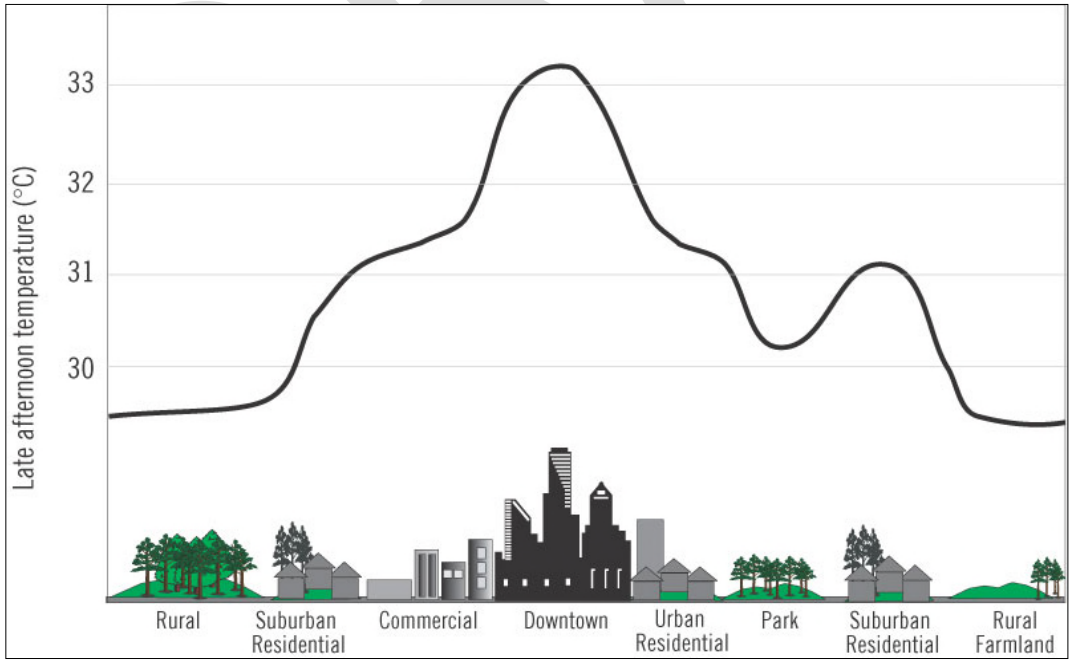
- A cluster of one or more block groups or census blocks each of which has a population density of at least 1,000 people per square mile at the time.
- Surrounding block groups and census blocks each of which has a population density of at least 500 people per square mile at the time.
- Less densely settled blocks that form enclaves or indentations or are used to connect discontiguous areas with qualifying densities (U.S. Census 2019).

As these urban areas develop and change, so does the landscape. Buildings, roads, and other infrastructure replace open land and vegetation. Surfaces that were once permeable and moist are now impermeable and dry. These changes cause urban areas to become warmer than the surrounding areas. This forms an 'island' of higher temperatures (U.S. Environmental Protection Agency [EPA] 2019).

The term 'heat island' describes built up areas that are hotter than nearby rural areas. The annual mean air temperature of a city with more than one million people can be between 1.8 ºF and 5.4ºF warmer than its surrounding areas. In the evening, the difference in air temperatures can be as high as 22ºF. Heat islands occur on the surface and in the atmosphere. On a hot, sunny day, the sun can heat dry, exposed urban surfaces to temperatures 50ºF to 90ºF hotter than the air. Heat islands can affect communities by increasing peak energy demand during the summer, air conditioning costs, air pollution and greenhouse gas emissions, heat-related illness and death, and water quality degradation (U.S. EPA 2019).

Figure 5.4.7-4 below illustrates an urban heat island profile. The graphic demonstrates that heat islands are typically most intense over dense urban areas. Further, vegetation and parks within a downtown area may help reduce heat islands (U.S. EPA 2019).

Figure 5.4.7-4. Urban Heat Island Profile



Source: EPA 2019
ºC degrees Celsius

Extent

Extreme Cold

The extent (severity or magnitude) of extreme cold temperatures are generally measured through the Wind Chill Temperature (WCT) Index. The Index uses advances in science, technology, and computer modeling to provide an accurate, understandable, and useful formula for calculating the dangers from wind chill. For details regarding the WCT, refer to: http://www.nws.noaa.gov/om/winter/windchill.shtml. The WCT is presented in Figure 5.4.7-5

Figure 5.4.7-5. NWS Wind Chill Index

Wind (mph) \ Temperature (°F)	40	35	30	25	20	15	10	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45
Calm	40	35	30	25	20	15	10	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45
5	36	31	25	19	13	7	1	-5	-11	-16	-22	-28	-34	-40	-46	-52	-57	-63
10	34	27	21	15	9	3	-4	-10	-16	-22	-28	-35	-41	-47	-53	-59	-66	-72
15	32	25	19	13	6	0	-7	-13	-19	-26	-32	-39	-45	-51	-58	-64	-71	-77
20	30	24	17	11	4	-2	-9	-15	-22	-29	-35	-42	-48	-55	-61	-68	-74	-81
25	29	23	16	9	3	-4	-11	-17	-24	-31	-37	-44	-51	-58	-64	-71	-78	-84
30	28	22	15	8	1	-5	-12	-19	-26	-33	-39	-46	-53	-60	-67	-73	-80	-87
35	28	21	14	7	0	-7	-14	-21	-27	-34	-41	-48	-55	-62	-69	-76	-82	-89
40	27	20	13	6	-1	-8	-15	-22	-29	-36	-43	-50	-57	-64	-71	-78	-84	-91
45	26	19	12	5	-2	-9	-16	-23	-30	-37	-44	-51	-58	-65	-72	-79	-86	-93
50	26	19	12	4	-3	-10	-17	-24	-31	-38	-45	-52	-60	-67	-74	-81	-88	-95
55	25	18	11	4	-3	-11	-18	-25	-32	-39	-46	-54	-61	-68	-75	-82	-89	-97
60	25	17	10	3	-4	-11	-19	-26	-33	-40	-48	-55	-62	-69	-76	-84	-91	-98

Frostbite Times: 30 minutes | 10 minutes | 5 minutes

Source: NWS 2016b

The National Weather Service (NWS) issues the nation's Wind Chill Warning, Watch and Advisory:

- Wind Chill Warning: NWS issues a wind chill warning when dangerously cold wind chill values are expected or occurring.
- Wind Chill Watch: NWS issues a wind chill watch when dangerously cold wind chill values are possible.
- Wind Chill Advisory: NWS issues a wind chill advisory when seasonably cold wind chill values but not extremely cold values are expected or occurring (NYS DHSES 2019)

Cold weather can also impact the County's crops. In late spring or early fall, cold air outbreaks can damage or kill produce for farmers, as well as residential plants and flowers. A freeze occurs when the temperature drops below 32°F. Freezes and their effects are significant during the growing season. Frost develops on clear, calm nights and can occur when the air temperature is in the mid-30s. Each plant species has a different tolerance to cold temperatures (NYS DHSES 2019).

The NWS issues the nation's Freeze Watch, Warning and Frost Advisory:

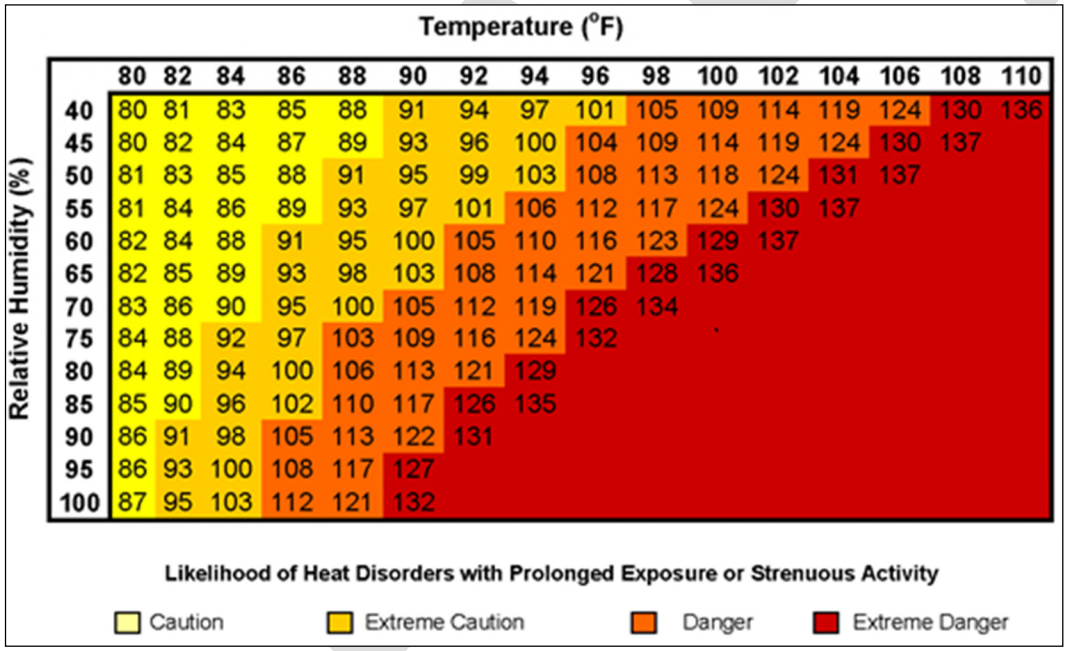
- Hard Freeze Warning: NWS issues a hard freeze warning when temperatures are expected to drop below 28°F for an extended period of time, killing most types of commercial crops and residential plants.

- Freeze Warning: When temperatures are forecasted to go below 32°F for a long period of time, NWS issues a freeze warning. This temperature threshold kills some types of commercial crops and residential plants.
- Freeze Watch: NWS issues a freeze watch when there is a potential for significant, widespread freezing temperatures within the next 24-36 hours. A freeze watch is issued in the autumn until the end of the growing season and in the spring at the start of the growing season.
- Frost Advisory: A frost advisory means areas of frost are expected or occurring, posing a threat to sensitive vegetation (NYS DHSES 2019).

Extreme Heat

The extent of extreme heat temperatures is generally measured through the Heat Index, identified in Table 5.4.7-1. Created by the NWS, the Heat Index is a chart which accurately measures apparent temperature of the air as it increases with the relative humidity. To determine the Heat Index, the temperature and relative humidity are needed. Once both values have been identified, the Heat Index is the corresponding number of both the values (as seen in Table 5.4.7-1). This provides a measure of how temperatures actually feel; however, the values are devised for shady, light wind conditions. Exposure to full sun can increase the Index by up to 15 degrees (NYS DHSES 2014).

Table 5.4.7-1. Heat Index Chart



Source: NWS 2016c

Table 5.4.7-2 describes the adverse effects that prolonged exposure to heat and humidity can have on an individual.

Table 5.4.7-2. Adverse Effects of Prolonged Exposures to Heat on Individuals

Category	Heat Index	Health Hazards
Extreme Danger	130 °F – Higher	Heat Stroke / Sunstroke is likely with continued exposure.
Danger	105 °F – 129 °F	Sunstroke, muscle cramps, and/or heat exhaustion possible with prolonged exposure and/or physical activity.

Category	Heat Index	Health Hazards
Extreme Caution	90 °F – 105 °F	Sunstroke, muscle cramps, and/or heat exhaustions possible with prolonged exposure and/or physical activity.
Caution	80 °F – 90 °F	Fatigue possible with prolonged exposure and/or physical activity.

Source: NYS DHSES 2014

The National Weather Service (NWS) provides alerts when Heat Indices approach hazardous levels. Table 5.4.7-3 explains these alerts. In the event of an extreme heat advisory, the NWS does the following:

- Includes Heat Index values and city forecasts
- Issues special weather statements including who is most at risk, safety rules for reducing risk, and the extent of the hazard and Heat Index values
- Provides assistance to state/local health officials in preparing Civil Emergency Messages in severe heat waves (NYS DHSES 2019).

Table 5.4.7-3. National Weather Service Alerts

Alert	Criteria
Heat Advisory	Issues 12-24 hours before the onset of the following conditions: heat index of at least 100°F but less than 105°F for at least two hours per day
Excessive Heat Watch	Issued by the NWS when heat indices of 105°F or greater are forecast in the next 24 to 72 hours
Excessive Heat Warning	Issued within 12 hours of the onset of the following criteria: heat index of at least 105°F for more than three hours per day for two consecutive days, or heat index more than 115°F for any period of time

Source: NYS DHSES 2014

Location

According to the New York 2019 State HMP, the entire State is susceptible to extreme temperatures. Varying land elevations, character of the landscape, and close proximity to large bodies of water play a significant role in the State's temperatures. The location of Suffolk County within the State makes it susceptible to both extreme cold and extreme heat temperature events.

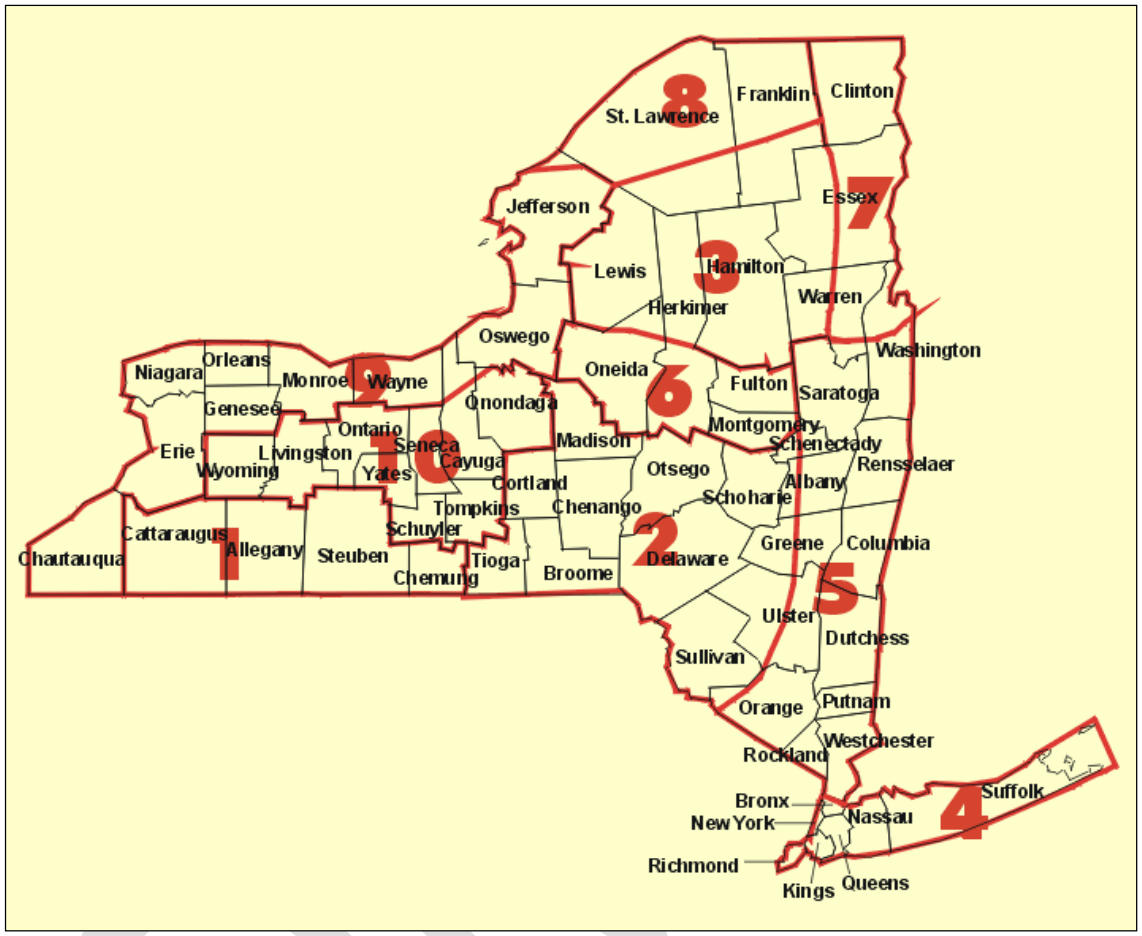
Extensive periods of either extreme cold temperatures are a result from movement of great high pressure systems into and through the eastern United States. Under higher than normal atmospheric pressures when Arctic air masses are present, extreme winter temperatures hover over New York. New York State's location in the Northeast makes it highly susceptible to extreme cold that can cause impact to human life and property (NYS DHSES 2019). Extreme cold temperatures occur throughout most of the winter season and generally accompany most winter storm events throughout the State. The NYSC Office of Cornell University indicates that cold temperatures prevail over the State whenever arctic air masses, under high barometric pressure, flow southward from central Canada or from Hudson Bay (Cornell University Date Unknown).

Excessive heat can occur anywhere in New York State and occurrences of excessive heat are generally widespread and will cover an entire county. However, there can be spot locations that are somewhat cooler (e.g. a shady park near a stream) or hotter (e.g. urban areas because of their built environment holds the heat) (NYS DHSES 2019). Extreme heat temperatures of varying degrees are existent throughout the State for most of the summer season, except for areas with high altitudes (Cornell University Date Unknown).

New York State is divided into 10 climate divisions: Western Plateau, Eastern Plateau, Northern Plateau, Coastal, Hudson Valley, Mohawk Valley, Champlain Valley, St. Lawrence Valley, Great Lakes, and central Lakes. According to NCDC, "Climatic divisions are regions within each state that have been determined to be

reasonably climatically homogeneous" (CPC 2005). Suffolk County is located within the Coastal Climate Division (Division 4); refer to Figure 5.4.7-6 which depicts the climate divisions in New York State.

Figure 5.4.7-6. New York State Climate Divisions



Source: CPC, 2005
Note: (1) Western Plateau; (2) Eastern Plateau (Catskill Mountains); (3) Northern Plateau (Adirondack Mountains); (4) Coastal; (5) Hudson Valley; (6) Champlain Valley; (7) St. Lawrence Valley; (8) Great Lakes; and (10) Central Lakes.

Many atmospheric and physiographic controls on the climate result in a considerable variation of temperature conditions over New York State. The average annual mean temperature ranges from about 40°F in the Adirondacks to near 55°F in the New York City area. In January, the average mean temperature is approximately 16°F in the Adirondacks and St. Lawrence Valley, but increases to about 26°F along Lake Erie and in the lower Hudson Valley and to 31°F on Long Island. The record coldest temperature in New York State is -52°F at Stillwater Reservoir (northern Herkimer County) on February 9, 1934. Approximately 30 communities have recorded temperatures of -40°F or colder, most of them occurring in the northern half of New York State and the remainder in the Western Plateau Climate Division and in localities just south of the Mohawk Valley (NCDC n.d.). The winters are long and cold in the Plateau Divisions of New York State (including the Eastern Plateau). In the majority of winter seasons, a temperature of -25°F or lower can be expected in the northern highlands and -15°F or colder in the southwestern and east-central highlands (NCDC n.d.). Extreme heat temperatures of varying degrees are existent throughout the State for most of the summer season, except for areas with high altitudes.

Previous Occurrences and Losses

FEMA Major Disasters and Emergency Declarations

Between 1954 and 2020, New York State and Suffolk County have not experienced any extreme temperature FEMA disaster (DR) or emergency (EM) classifications.

USDA Disaster Declarations

The Secretary of Agriculture from the U.S. Department of Agriculture (USDA) is authorized to designate counties as disaster areas to make emergency loans available to producers suffering losses in those counties and in counties that are contiguous to a designated county. Between 2014 and 2020, Suffolk County has been included in the following USDA disaster declaration in relation to extreme temperature:

- S4045: 2016, Drought; Wind, high winds; Fire, wildfire; Heat, excessive heat, high temp; Insects

USDA causes of loss are another method that can be used to track the impact of drought on agriculture in Suffolk County. In 2016, losses to all other crops from heat totaled $5,369. In 2018, losses to all other crops from heat totaled $4,848.75. In 2019, losses to all other crops from heat totaled $2,541 (USDA 2020).

Extreme Temperature Events

The National Oceanic and Atmospheric Administration (NOAA) National Centers for Environmental Information (NCEI) Storm Events database records and defines extreme temperature events as follows:

- Cold/Wind Chill is reported in the NOAA-NCEI database when a period of low temperatures or wind chill temperatures reach or exceed locally or regionally defined advisory conditions (typical value is -18 °F or colder).
- Excessive Heat is reported in the NOAA-NCEI database whenever heat index values meet or exceed locally or regionally established excessive heat warning thresholds.
- Extreme Cold/Wind Chill is reported in the NOAA-NCEI database when a period of extremely low temperatures or wind chill temperatures reaches or exceeds locally or regionally defined warning criteria (typical value around -35 °F or colder).
- Heat is reported in the NOAA-NCEI database whenever heat index values meet or exceed locally or regionally established advisory thresholds.

Table 5.4.7-4 summarizes the known extreme temperature events that have impacted Suffolk County between 1999 and 2020.

Table 5.4.7-4. Extreme Temperature Events in Suffolk County, 1999 to 2020

Dates of Event	Event Type	FEMA Declaration Number (if applicable)	Suffolk County Designated?	Location	Description
July 4-6, 1999	Heat	N/A	N/A	Southeast Suffolk, Northwest Suffolk, Northeast Suffolk, Southwest Suffolk	An extremely hot and humid airmass covered the region from July 4th through July 6th. On Sunday July 4th, temperatures soared into the mid and upper 90s. The combination of high temperatures and moderate humidity caused most heat indices to range from 100 to 105 degrees. On Monday July 5th, many new maximum temperature records were set. At Islip McArthur Airport, the temperature reached 102 degrees, which set an all-time record high. High temperatures ranged from 96 degrees at Montauk Point to 102 degrees at Islip, Farmingdale, and JFK Airport. Heat indices peaked from 110 to 115 degrees. "Rolling" electrical blackouts occurred across the Metropolitan Region. On July 6th, new record high temperatures were set again. Heat indices peaked around 110 degrees. Widespread blackouts occurred across the Metro area, including Westchester County's sound shore from Pelham Manor to Port Chester.
January 17, 2000	Extreme Cold/Wind Chill	N/A	N/A	Southeast Suffolk, Northwest Suffolk, Northeast Suffolk, Southwest Suffolk	An arctic cold front swept across the region during Sunday afternoon, January 16th. Strong and gusty northwest winds combined with well below normal temperatures and produced extremely low wind chill values mainly from midnight to 10 am on January 17th and from 1 am to noon on January 18th. On January 17th, wind speeds from 15 to 20 mph combined with temperatures from 5 to 10 degrees above 0, produced wind chill values from 15 to around 20 degrees below 0 in New York City and from 20 to 30 degrees below 0 across the Lower Hudson Valley. On January 18th, wind speeds averaging 15 mph combined with temperatures from 0 to 5 above zero, produced wind chill values from 20 degrees below 0 at Central Park to 30 degrees below 0 at LaGuardia Airport. Wind chills across the Lower Hudson Valley were 30 to 35 degrees below 0.
January 21, 2000	Extreme Cold/Wind Chill	N/A	N/A	Southeast Suffolk, Northwest Suffolk, Northeast Suffolk,	The combination of a quickly intensifying low pressure system off the New England Coast and a strong high pressure system west of the Great Lakes caused strong and gusty northwest winds. Northwest winds averaged 25 to 35 mph with gusts from 38 mph at Montgomery Airport in Orange County to 52 mph at LaGuardia Airport from around 2 pm to 8 pm. As temperatures fell to around 10 degrees, wind chill values plummeted from 20 to 30 degrees below zero along the coast and to 25 to 35 degrees below zero inland.

Dates of Event	Event Type	FEMA Declaration Number (if applicable)	Suffolk County Designated?	Location	Description
				Southwest Suffolk	
January 27, 2000	Extreme Cold/Wind Chill	N/A	N/A	Southeast Suffolk, Northwest Suffolk, Northeast Suffolk, Southwest Suffolk	Strong and gusty northwest winds combined with well below normal temperatures and produced extremely low wind chill values. Across Suffolk County, wind chills ranged from 23 degrees below zero at Farmingdale to 29 degrees below zero at Islip. At Montauk Pt., a wind chill of 24 degrees below zero occurred.
August 5-10, 2001	Heat	N/A	N/A	Northwest Suffolk, Southwest Suffolk	A Bermuda high pressure system "pumped" hot temperatures and high humidities across the region. The 6 day heat wave began on Sunday, August 5th, when temperatures first reached 90 degrees at Central Park. Record high temperatures at Central Park were broken on two consecutive days, August 8th and 9th. High temperatures at Central Park reached 103 degrees on the 9th and 99 degrees on the 7th and 8th. Heat indices peaked across the entire region on Thursday, August 9th to between 105 and 110 degrees. Heat indices were also quite high on Friday, August 10th, reaching 105 to 110 degrees, as humidity levels increased, despite slightly lower temperatures. On Monday, August 6th, high temperatures ranged from 90 degrees at White Plains to 94 at Central Park. Heat indices in urban areas ranged from 95 to 100 degrees. On Tuesday, August 7th, high temperatures ranged from 91 degrees at Montauk Point to 99 at Central Park. Most temperatures were from the mid to upper 90s. Heat indices in urban and inland areas ranged from 98 to 103 degrees. On Wednesday, August 8th, high temperatures ranged from 92 degrees at Westhampton Beach to a record breaking 99 degrees at Central Park. Heat indices ranged from 100 to 105 degrees across the entire area. On Thursday, August 9th, high temperatures in urban and inland areas ranged from 100 to 105 degrees with heat indices near 105 degrees. On Friday, August 10th, high temperatures ranged from 91 degrees at Farmingdale, to 97 degrees at Central Park. Despite slightly lower temperatures, increased humidity levels led to heat indices ranging from 105 to 110 degrees in highly urban and inland areas. As temperatures rose higher each day, demand for electricity increased. Scattered power outages first occurred in urban areas on August 7th, then spread across the suburbs on the 8th and became more widespread on August 9th and 10th. Excessive heat caused a portion of Sunrise Highway at Exit 40 (near Route 231) to "buckle,"

Dates of Event	Event Type	FEMA Declaration Number (if applicable)	Suffolk County Designated?	Location	Description
					which caused road closure. During August 7th and 8th, the Long Island Power Authority reported about 21,000 outages which were scattered across Nassau and Suffolk Counties. In Suffolk County, a male in Wyandanch was found in his apartment in critical condition with a high fever. There was no air conditioning in his apartment. Farmers, particularly in eastern Suffolk County on Long Island, reported moderate crop damage due to the excessive heat. Leafy vegetable and potato crops suffered the greatest damage from the extreme heat.
July 2-4, 2002	Heat	N/A	N/A	Southeast Suffolk, Northwest Suffolk, Northeast Suffolk, Southwest Suffolk	Temperatures rose into the mid and upper 90s across the region. Overnight low temperatures remained in the lower 80s on the third and fourth in highly urbanized areas throughout the New York City Metropolitan Area. Overall, temperatures averaged 10 to 15 degrees above normal. On July 4th, the temperature reached 98 degrees at LaGuardia Airport, which set a new record high temperature. High temperatures and humidities combined to produce heat indices from 100 to 105 degrees throughout the region. Many cooling centers were opened across the city. On July 4th, the New York Times reported, "Hospital emergency rooms reported some heat exhaustion cases and other heat-related ailments. Small power failures throughout the day left as many as 20,000 homes without electricity." Brownouts occurred throughout the New York City Metropolitan Area, which included New Rochelle, where over 3,300 city residents lost power. Other areas affected included Eastchester, Tuckahoe, and Bronxville, where power outages developed around 1:30 pm on July 2nd. The Long Island Power Authority (LIPA) also reported scattered power outages that affected about 2700 customers throughout Long Island on July fourth.
July 29-31, 2002	Heat	N/A	N/A	Southeast Suffolk, Northwest Suffolk, Northeast Suffolk, Southwest Suffolk	An eight day "heat wave" began on July 29th and extended through August 5th across the region. High temperatures rose into the mid and upper 90s from July 29th through the 31st. These temperatures combined with humidity produced heat indices from 100 to 105 degrees on the 29th and from around 95 to 100 on the 30th and 31st.
January 15, 2004	Cold/Wind Chill	N/A	N/A	Southeast Suffolk, Northwest Suffolk, Northeast Suffolk,	An arctic cold front swept southeast across the region during Tuesday afternoon, January 13th. Extremely cold air followed this front through Wednesday, January 14th. As an Alberta Clipper passed south of Long Island Wednesday night, it rapidly intensified as it moved northeast of Long Island Thursday. The large difference in pressure between a strong low pressure system northeast of New England and a strong

Dates of Event	Event Type	FEMA Declaration Number (if applicable)	Suffolk County Designated?	Location	Description
				Southwest Suffolk	arctic high pressure system in Southeast Canada resulted in the combination of extremely low temperatures, high winds, and extremely low wind chill index values from sunset Thursday evening through sunrise Friday morning, January 16th. On January 15th a record low temperature of 1 degree above 0 was set at Islip Airport. On January 16th a record low temperature of 2 degrees above 0 was set at Islip Airport.
January 27, 2005	Cold/Wind Chill	N/A	N/A	Southeast Suffolk, Southwest Suffolk	Temperatures fell to 8 to 13 degrees above zero from Farmingdale east to Shirley, NY between 6 am and 8 am. Combined with north winds averaging 15 mph, wind chill temperatures fell to approximately 10 degrees below zero. Three deaths were reported by Newsday. All bodies were found in the snow close to their homes.
August 1-3, 2006	Heat	N/A	N/A	Southeast Suffolk, Northwest Suffolk, Northeast Suffolk, Southwest Suffolk	An oppressive air mass moved slowly east across the region from August 1 to August 3. This was preceded by a hot dry air mass, when temperatures reached at least 90 degrees for 5 consecutive days at LaGuardia Airport, from July 27 to July 31. Excessive heat occurred mainly from noon to midnight each day for 3 consecutive days. High temperatures ranged mainly from the upper 90s to around 100 degrees. With surface dew point temperatures in the mid-70s, heat indices ranged from 105 to 115 degrees. Islip McArthur Airport reported record temperatures of 95 degrees F on August 1 and 98 degrees F on August 2 and August 3.
July 22, 2011	Excessive Heater	N/A	N/A	Southeast Suffolk, Northwest Suffolk, Northeast Suffolk, Southwest Suffolk	An oppressive hot and humid air mass produced excessive heat that resulted in daytime temperatures 95 to 105 degrees with nighttime lows in the 70s and 80s. Heat indices peaked around 115 degrees during Friday afternoon, July 22. Excessive heat between 95 and 105 degrees, along with heat indices in excess of 105 degrees occurred for a couple of days. The heat index was as high as 113 degrees at 2 PM at Islip MacArthur Airport (KISP) on July 22nd.
July 19, 2013	Excessive Heat	N/A	N/A	Southwest Suffolk	A large area of high pressure remained nearly stationary to the south for almost a week. This resulted in a prolonged period of high to excessive heat across the area. The combination of high heat and humidity resulted in a heat index of 107 degrees at Farmingdale Airport during the afternoon hours. At Islip airport, the heat index reached 105 degrees.
August 13-14, 2016	Excessive Heat	N/A	N/A	Southwest Suffolk	High pressure over the western Atlantic Ocean ushered in hot and humid air northward across the area.

Dates of Event	Event Type	FEMA Declaration Number (if applicable)	Suffolk County Designated?	Location	Description
					The combination of hot temperatures in the 90s, and high humidity resulted in a heat index up to 106 degrees at Islip MacArthur Airport on August 13 and 108 degrees on August 14.
August 28, 2018	Heat	N/A	N/A	Northwest Suffolk	A Bermuda high pumped hot and humid air northward across the area. The broadcast media reported an 11 year old girl died in Coram at 345 pm. The girl was found alone in a hot car. Heat indices reached 100 degrees at Islip MacArthur Airport during the afternoon.
July 20-21, 2019	Excessive Heat	N/A	N/A	Southeast Suffolk, Northwest Suffolk, Northeast Suffolk, Southwest Suffolk	A Bermuda High pumped in a hot and humid and humid air mass northward into the area. On July 20, the KFOK ASOS recorded a heat index of 105 to 110 from 1200 to 1400 hours and then again at 1600 hours. On July 21, the KHWV ASOS recorded a heat index between 105 and 110 at 1400 and 1600 hours.

Source: NOAA NCEI 2020; FEMA 2020

Note: With temperature documentation for New York State and Suffolk County being so extensive, not all sources have been identified or researched. Therefore, Table 5.4.4-4 may not include all events that have occurred in the County.

Probability of Future Occurrences

It is estimated that Suffolk County will continue to experience extreme temperatures annually that may induce secondary hazards such potential snow, hail, ice or wind storms, thunderstorms, drought, human health impacts, utility failure and transportation accidents as well as many other anticipated impacts.

According to the NOAA-NCEI database, Suffolk County experienced 18 extreme temperature events between 1950 and 2020. Table 5.4.7-5 shows these statistics, as well as the annual average number of events and the percent chance of these individual extreme temperature events occurring in Suffolk County in future years (NOAA NCEI 2020).

Table 5.4.7-5. Probability of Occurrences of Extreme Temperature Events

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
Cold/Wind Chill	2	0.03	35.50	0.03	2.82
Excessive Heat	6	0.09	11.83	0.08	8.45
Extreme Cold/Wind Chill	3	0.04	23.67	0.04	4.23
Heat	7	0.10	10.14	0.10	9.86
Total	**18**	**0.26**	**3.94**	**0.25**	**25.35**

Source: NOAA NCEI 2020
Note: Probability was calculated using the available data provided in the NOAA-NCEI storm events database.

Based on historical records and input from the Planning Committee, the probability of occurrence for extreme temperatures in Suffolk County is considered "frequent".

Climate Change Impacts

Summer temperatures have been increasing across New York State and are expected to continue rising. New York is currently the 8th-fastest warming state in the country, in terms of annual average temperature. By 2050, New York is projected to see a five-fold increase in heat wave days. In the past decade average summer temperatures have risen by 1-2 degrees in most areas in the state. The number of days with maximum temperatures above 95ºF in New York State has been increasing, putting New Yorkers at higher risk of heat-related illness. As a result of climate change, the frequency of extreme temperature events is expected to increase, and such events are associated with increased morbidity and mortality (NYS DHSES 2019).

Temperatures in New York State are warming, with an average rate of warming over the past century of 0.25° F per decade. Average annual temperatures are projected to increase across New York State by 2° F to 3.4° F by the 2020s, 4.1° F to 6.8° F by the 2050s, and 5.3° F to 10.1° F by the 2080s. By the end of the century, the greatest warming is projected to be in the northern section of the State (NYSERDA 2014). The total number of hot days in New York State is expected to increase as this century progresses. The frequency and duration of heat waves, defined as three or more consecutive days with maximum temperatures at or above 90 ˚F, are also expected to increase (Table 5). In contrast, extreme cold events, defined both as the number of days per year with minimum temperature at or below 32 ˚F and those at or below 0 ˚F, are expected to decrease as average temperatures rise (NYSERDA 2011).

However, each region in New York State, as defined by ClimAID, has attributes that will be uniquely affected by climate change. Suffolk County is part of Region 4. 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 (middle range estimate, baseline of 54.6ºF).

The frequency of heat waves is projected to increase while cold events is projected to fall in Region 4. With the increase in temperatures, heat waves will become more frequent and intense, increasing heat-related illness and death and posing new challenges to the energy system, air quality and agriculture (NYSERDA 2011). Table 5.4.7-6 displays the projected changes in extreme events and includes the minimum, central range and maximum days per year.

Table 5.4.7-6. Changes in Extreme Events in Region 4 – Heat Waves and Intense Precipitation

Event Type	# Days Per Year	Baseline	2020s	2050s	2080s
Heat Waves	**Number of Days per year with maximum temperature exceeding: minimum, (central range), and maximum**				
	90°F	18	26 to 31	39 to 52	44 to 76
	Number of heat waves per year	2	3 to 4	5 to 7	6 to 9
	Average duration	4	5	5 to 6	5 to 7
Extreme Cold	**Number of days per year: minimum, (central range), and maximum**				
	Below 32°F	71	52 to 58	42 to 48	30 to 42

Source: NYSERDA 2014
Note: Based upon the middle range (25th to 75th percentile estimate)

5.4.7.2 Vulnerability Assessment

To understand risk, a community must evaluate what assets are exposed and vulnerable to the identified hazard. The following discusses Suffolk County's vulnerability, in a qualitative nature, to the disease outbreak hazard.

Impact on Life, Health and Safety

The entire population of Suffolk County is exposed to extreme temperature events (population of 1,488,179 people, according to the 2014-2018 American Community Survey population estimates). Extreme temperature events have potential health impacts including injury and death. According to the Centers for Disease Control and Prevention (CDC), populations most at risk to extreme cold and heat events include the following: 1) the elderly, who are less able to withstand temperatures extremes due to their age, health conditions, and limited mobility to access shelters; 2) infants and children up to four years of age; 3) individuals with chronic medical conditions (e.g., heart disease, high blood pressure), 4) low-income persons that cannot afford proper heating and cooling; and 5) the general public who may overexert during work or exercise during extreme heat events or experience hypothermia during extreme cold events (CDC 2016).

According to the 2018 ACS 5-Year Population Estimate, persons that are most vulnerable to extreme temperature events make up more than 20-percent of the total population in Suffolk County. For example, 239,284 persons within Suffolk County are over 65 years in age. Higher concentrations of persons over 65 years in age are found in the Village of Saltaire (i.e., 50-percent of total jurisdictional population). Refer to Section 4 (County Profile) that displays the densities of populations over 65 in Suffolk County.

Furthermore, the homeless and residents below the poverty level might not have access to housing or their housing could be less able to withstand extreme temperatures (e.g., homes with poor insulation and heating supply). There is a total of 104,660 persons living in poverty in the County (ACS 2018). In Suffolk County, areas with the highest concentration of population below the poverty level, thus most vulnerable communities due

to potentially fewer resources to protect against extreme temperatures, are located in the Village of Ocean Beach. Refer to Section 4 (County Profile) that displays the densities of low-income populations in Suffolk County.

The 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. Suffolk County's overall score is 0.2318, indicating that its communities have low vulnerability (CDC 2016). This map shows that areas more likely vulnerable to drought fairly distributed throughout the County but are generally concentrated in the interior and southern coastal municipalities.

Risk of structural fire in the winter months is elevated with approximately 30 percent of all deaths caused by fire occurring in the winter months. Cooking and heat sources too close to combustible materials are leading factors in winter home fires (U.S. Fire Administration 2018). Often times, power outages occur during extreme cold events. Individuals powering their homes with generators are subjected to carbon monoxide poisoning if proper ventilation procedures are not followed (NYC 2019). Improperly connected portable generators are capable of 'back feeding' power lines which may cause injury or death to utility workers attempting to restore power and may damage house wiring and/or generators.

Meteorologists can accurately forecast extreme heat and cold event development and the severity of the associated conditions with several days of lead time. These forecasts provide an opportunity for public health and other officials to notify vulnerable populations, implement short-term emergency response actions, and focus on surveillance and relief efforts on those at greatest risk. Adhering to extreme temperature warnings can significantly reduce the risk of temperature-related deaths.

Impact on General Building Stock

All buildings are exposed to the extreme temperature hazard. Refer to Section 4 (County Profile), which summarizes the building inventory in Suffolk County. Extreme heat generally does not impact buildings; however, elevated summer temperatures increase the energy demand for cooling. Losses can be associated with the overheating of heating, ventilation, and air conditioning (HVAC) systems. Extreme cold temperature events can damage through freezing/bursting pipes and freeze/thaw cycles, as well as increasing vulnerability to home fires. Additionally, manufactured homes (mobile homes) and antiquated or poorly constructed facilities can have inadequate capabilities to withstand extreme temperatures.

The 2019 New York City Hazard Mitigation Plan states that older buildings following less stringent building codes are more vulnerable to drafts during extreme cold events due to cracks and leaks in the walls (NYC 2019). Roof damage can also occur due to excessive snow fall and extreme temperature change. Extreme heat may also be damaging to older structures. Further, structures with glass exposed to sunlight and structures exposed to heat on all four sides are more susceptible to damages, including interior damages from overheating (NYC 2019).

Impact on Critical Facilities

All critical facilities in the County are exposed to the extreme temperature hazard. Impacts to critical facilities that are buildings will experience similar issues as described for general building stock. Additionally, it is essential that critical facilities remain operational during natural hazard events. Extreme heat events can sometimes cause short periods of utility failures, commonly referred to as *brown-outs*, due to increased usage from air conditioners and other energy-intensive appliances. Similarly, heavy snowfall and ice storms, associated with extreme cold temperature events, can cause power interruption. Backup power is recommended for critical facilities and infrastructure.

The 2019 New York City Hazard Mitigation Plan indicates that transportation infrastructure may experience damages from extreme temperature events. This is particularly the case with ground transportation systems at risk of cracking, buckling, or sagging due to high temperatures (NYC 2019). This can cause disruptions to essential services that travel along these routes to provide services to the community.

Impact on Economy

Extreme temperature events also impact the economy, including loss of business function and damage to and loss of inventory. Business-owners can be faced with increased financial burdens due to unexpected repairs caused to the building (e.g., pipes bursting), higher than normal utility bills, or business interruption due to power failure (i.e., loss of electricity, telecommunications). Disruptions in public transportation service will also impact the economy for both commuters and customers alike.

Impact on the Environment

Extreme temperature events can have a major impact on the environment. For example, freezing and warming weather patterns create changes in natural processes. An excess amount of snowfall and earlier warming periods may affect natural processes such as flow within water resources (USGS nd). Likewise, rain-on-snow events also exacerbate runoff rates with warming winter weather.

Extreme heat events can have particularly negative impacts on coastal marine aquatic systems, contributing to fish kills, aquatic plant die offs, and increased likelihood of harmful algal blooms.

Cascading Impacts to Other Hazards

Extreme heat events can exacerbate the drought hazard and increase the potential risk of wildfires for the County. Refer to Sections 5.4.4 and 5.4.16 for more information about the impacts of drought and wildfires, respectively.

Future Changes that May Impact Vulnerability

Understanding future changes that may 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 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

As discussed in Section 4, areas targeted for future growth and development have been identified across Suffolk County. The ability of new development to withstand extreme temperature impacts lies in sound land use practices, building design considerations (e.g. Leadership in Energy and Environmental Design [LEED]), and consistent enforcement of codes and regulations for new construction. New development will change the landscape where buildings, roads, and other infrastructure potentially replace open land and vegetation. Surfaces that were once permeable and moist are now impermeable and dry. These changes cause urban areas to become warmer than the surrounding areas forming (heat islands as described above). Specific areas of recent and new development are indicated in tabular form and/or on the hazard maps included in the jurisdictional annexes in Volume II, Section 9 (Jurisdictional Annexes) of this plan.

Projected Changes in Population

According to the Suffolk County Department of Economic Development and Planning'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, but it is important to note that the population is aging (Suffolk County 2017). Since vulnerable populations (i.e., persons over 65) are increasing throughout the County, it can be assumed that the number of persons at greater risk of impacts from extreme temperature events is increasing. More information about the distribution of changes in population for the County can be reviewed in Section 4 (County Profile).

Climate Change

As discussed above, most studies project that the State of New York will see an increase in average annual temperatures (NYC 2019). As the climate warms, extreme cold events might decrease in frequency, while extreme heat events might increase in frequency; the shift in temperatures could also result in hotter extreme heat events. With increased temperatures, vulnerable populations could face increased vulnerability to extreme heat and its associated illnesses, such as heatstroke and cardiovascular and kidney disease. Additionally, as temperatures rise, more buildings, facilities, and infrastructure systems may exceed their ability to cope with the heat.

Change of Vulnerability Since the 2014 HMP

Extreme temperature events (heat and cold) are a new hazard of concern for Suffolk County. As existing development and infrastructure continue to age, they can be at increased risk to failed utility and transportation systems if they are not properly maintained and do not adapt to the changing environment.