SOMERSET COUNTY

HAZARD MITIGATION PLAN

SOMERSET COUNTY MULTI-JURISDICTIONAL HAZARD MITIGATION PLAN

FINAL PLAN UPDATE
JULY 2019

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Section 5.4.5: RISK ASSESSMENT- EXTREME TEMPERATURE

Prepared by the Somerset County Mitigation Planning Committee

5.4.5 EXTREME TEMPERATURE

This section provides a profile and vulnerability assessment for the extreme temperature hazard.

HAZARD PROFILE

This section provides profile information including description, extent, location, previous occurrences and losses and the probability of future occurrences.

Description

Extreme temperature both heat and cold events, can have a significant impact to human health, commercial/agricultural businesses and infrastructure. What constitutes "extreme cold" or "extreme heat" can vary across different areas of the country, based on climate and topography.

Extreme Cold: Extreme cold events are when temperatures drop well below normal in an area. A cold wave, as defined by the U.S. National Weather Service, is a rapid fall in temperature within 24 hours to temperatures requiring substantially increased protection to agriculture, industry, commerce and social activities (Glossary of Meteorology, Date Unknown).

Prolonged exposure to cold temperatures, whether indoors or outside, can lead to serious or life-threatening health problems such as hypothermia, cold stress, frostbite or freezing of the exposed extremities such as fingers, toes, nose and ear lobes. 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], 2005).

Extreme Heat: Extreme heat is when temperatures hover 10 degrees or more above the average high temperature for the region and last for several weeks (FEMA, 2006; CDC, 2006). A heat wave is a period of abnormally and uncomfortably hot and unusually humid weather that lasts two or more days (NWS Glossary, 2009). A heat wave is applied both to routine weather variations and to extraordinary spells of heat, which may only occur once of century.

Individuals exposed to extreme heat for a prolonged time may experience serious health problems including heat cramps, heat stroke, heat exhaustion, and death. Seniors, young children and those who have respiratory problems, or are overweight are more likely to succumb to extreme heat (Centers of Disease Control and Prevention [CDC], 2005).

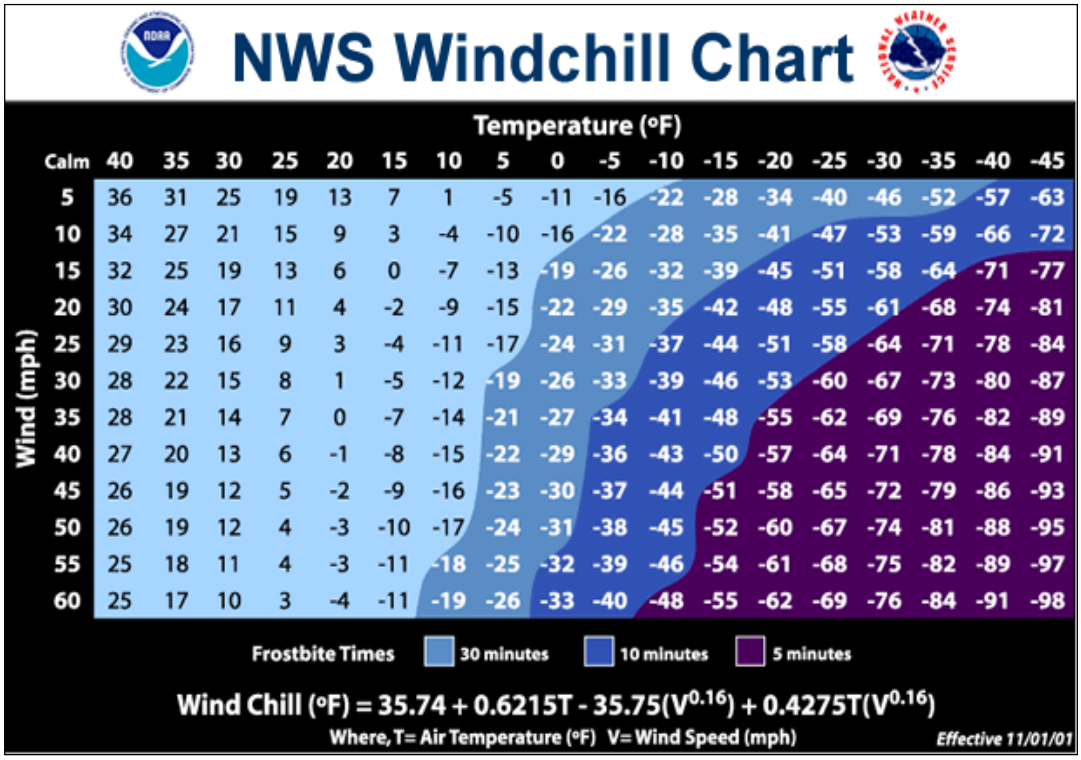
Extent

Extreme Cold Temperatures

The extent (severity or magnitude) of extreme cold temperatures are generally measured through the Wind Chill Temperature (WCT) Index. Wind Chill Temperature is the temperature people feel when outside. It is based on the rate of heat loss from exposed skin by the effects of wind and cold. As the wind increases, the body is cooled at a faster rate causing the skin's temperature to drop (NWS, 2009).

Figure 5.4.5-1 shows the WCT Index. The Index depicts the difference between actual air temperature and perceived temperature, and the amount of time until frostbite occurs (NWS, 2009).

Figure 5.4.5-1 NWS Wind Chill Index



Source: NWS, 2008

Extreme Heat Temperatures

The extent of extreme heat temperatures are generally measured through the Heat Index, identified in Table 5.4.5-1. Created by the NWS, the Heat Index is a chart which accurately measures apparent temperature of the air as it increases with relative humidity. It is important to know that the Heat Index values are devised for shady, light wind conditions. Exposure to full sunshine can increase the Heat Index by up to 15 degrees (NYSDEC, 2008).

Table 5.4.5-1 Heat Index Chart

	Temperature (°F)																
Relative Humidity (%)	80	82	84	86	88	90	92	94	96	98	100	102	104	106	108	110
40	80	81	83	85	88	91	94	97	101	105	109	114	119	124	130	136
45	80	82	84	87	89	93	96	100	104	109	114	119	124	130	137	
50	81	83	85	88	91	95	99	103	108	113	118	124	131	137		
55	81	84	86	89	93	97	101	106	112	117	124	130	137			
60	82	84	88	91	95	100	105	110	116	123	129	137				
65	82	85	89	93	98	103	108	114	121	128	136					
70	83	86	90	95	100	105	112	119	126	134						
75	84	88	92	97	103	109	116	124	132							
80	84	89	94	100	106	113	121	129								
85	85	90	96	102	110	117	126	135								
90	86	91	98	105	113	122	131									
95	86	93	100	108	117	127										
100	87	95	103	112	121	132										

Key: Likelihood of Heat Disorders with Prolonged Exposure or Strenuous Activity: Yellow = Caution; Peach = Extreme Caution; Orange = Danger; Red = Extreme Danger

Source: NCDC, 2000; NYSDPC, 2008

Table 5.4.5-2 describes the adverse effects that prolonged exposure to heat and humidity can have on an individual.

Table 5.4.5-2 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.
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: NWS 2009

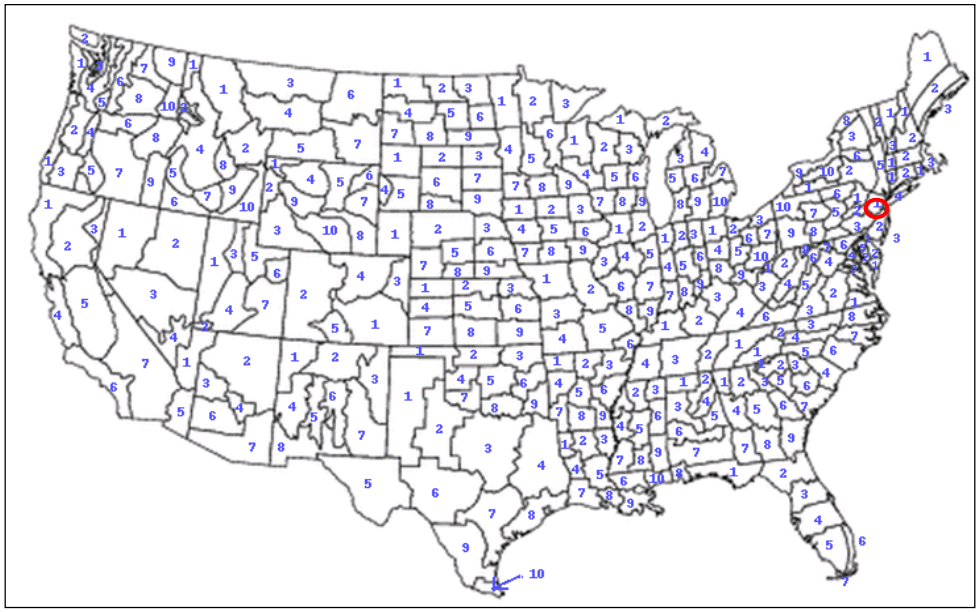
Location

The location of extreme temperature events throughout the State of New Jersey and Somerset County are further identified below.

Climate divisions are regions within a state that are climatically homogenous. The National Oceanic and Atmospheric Administration (NOAA) has divided the U.S. into 359 climate divisions. Of these, 344 are in the conterminous U.S., with additional divisions in Alaska, Hawaii, Puerto Rico, the U.S. Virgin Islands, and Pacific trust territories. The boundaries of these divisions typically coincide with the county boundaries, except in the western U.S., where they are based largely on drainage basins (Energy Information Administration, 2005).

According to NOAA, the State of New Jersey is made up of three climate divisions: Northern Climate Division, the Southern Climate Division and the Coastal Climate Division. Somerset County is located within the Northern Climate Division (NOAA, Date Unknown). Figure 5.4.5-2 shows the climate divisions throughout the U.S. and Figure 5.4.5-3 shows the climate divisions of the State of New Jersey.

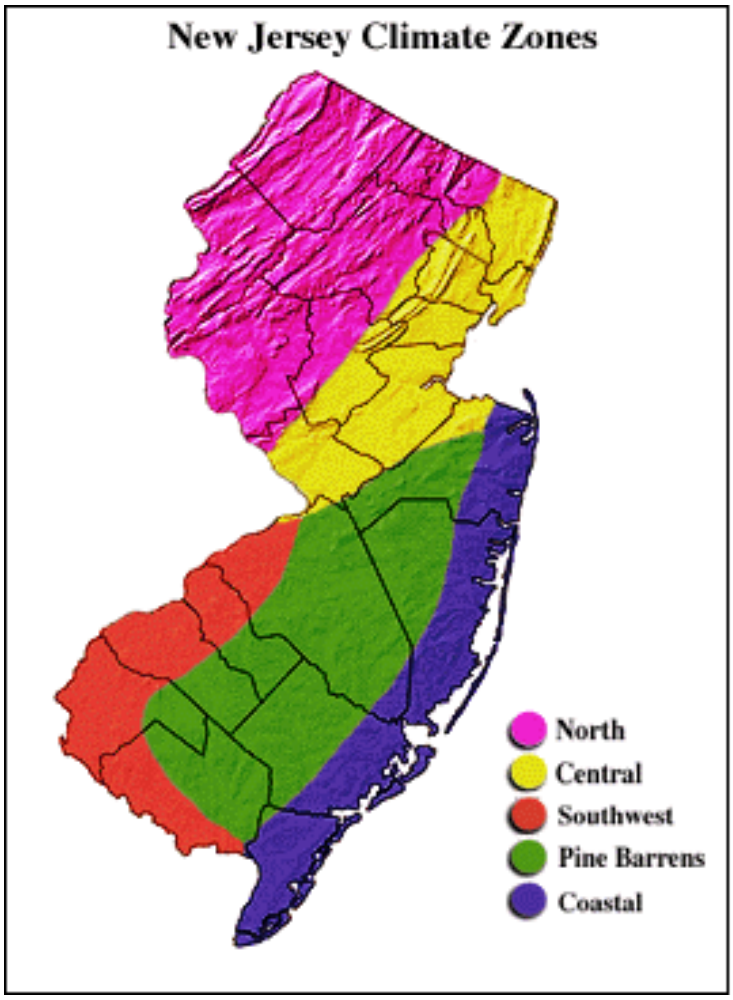
Figure 5.4.5-2 Climate Divisions of the U.S.



Source: NOAA, Date Unknown
Note (1): The red circle indicates the approximate location of Somerset County, Climate Division 1.
Note (2): 1 = Northern Climate Division; 2 = Southern Climate Division; 3 = Coastal Climate Division

New Jersey has five distinct climate zones (these regions should not be confused with the State Climate Divisions, discussed in Section 5.4.6 Drought). The geology, distance from the Atlantic Ocean, and prevailing atmospheric flow patterns produce distinct variations in the daily weather between each of the regions. As identified by the Office of New Jersey State Climatologist (ONJSC) at Rutgers University, the five regions include Northern, Central, Pine Barrens, Southwest, and Coastal (Figure 5.4.5-3) (ONJSC, 2007). As illustrated below, Somerset County is located in both the Northern and Central regions.

Figure 5.4.5-3 Climate Divisions of New Jersey



Source: ONJSC, 2007

Somerset County Climate

Somerset County lies within two distinct climate zones, as shown in Figure 5.4.5-3. They are the Northern Climate Zone and the Central Climate Zone. Additional information about these zones follows.

Northern Climate Zone: This zone covers approximately one-quarter of New Jersey and consists mainly of elevated highlands and valleys which are part of the Appalachian Uplands. Being in the northernmost portion of the State, and with small mountains up to 1,800 feet in elevation, the Northern Zone normally exhibits a colder temperature regime than other climate regions of the State. This difference is most dramatic in winter when average temperatures in the Northern Zone can be more than 10° F cooler than in

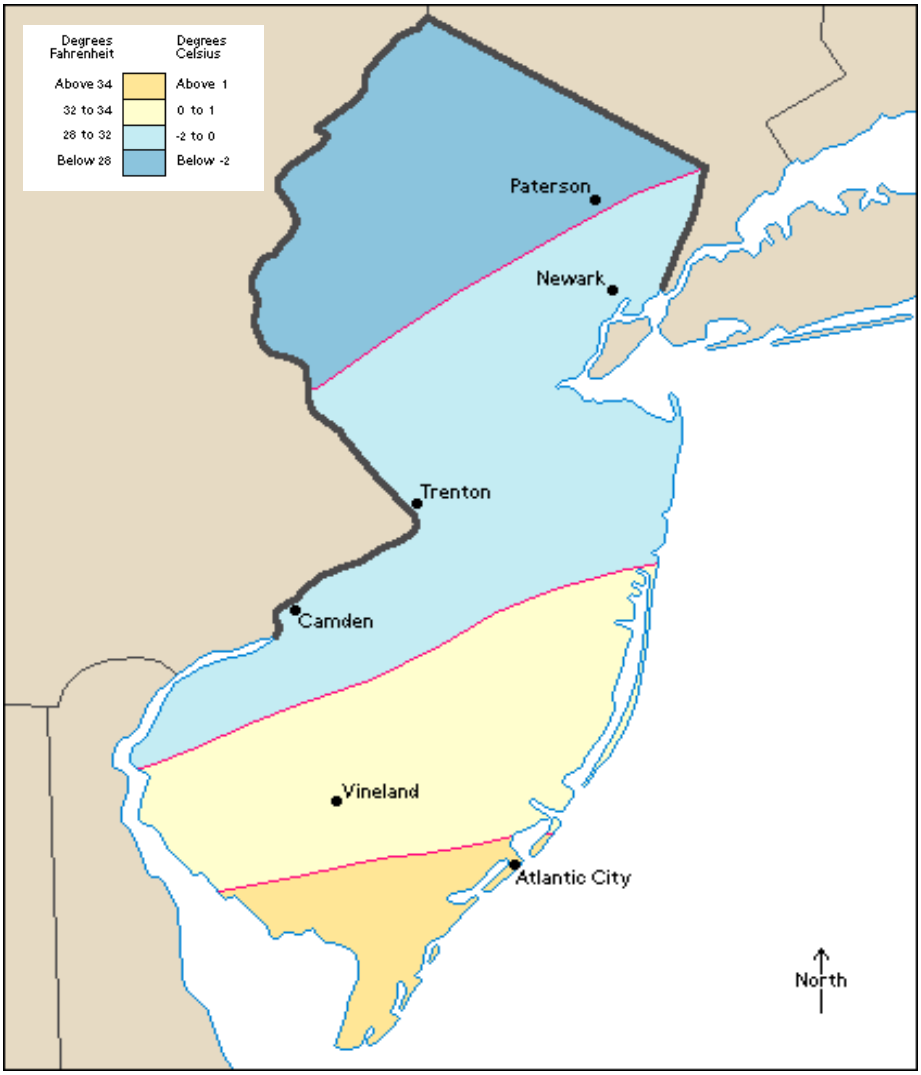
the Coastal Zone. Annual snowfall averages between 40 and 50 inches in the northern zone as compared with an average of 10 to 15 inches in the extreme south. The highlands and mountains in this area play a role in making the climate of the Northern Zone different from the rest of the State (ONJSC, 1994 - 2007).

Central Climate Zone: This zone has many urban locations, with large amounts of pollutants produced by the high volume of automobile traffic and industrial processes. The concentration of buildings and paved surfaces serve to retain more heat, thereby affecting the local temperatures. Because of the asphalt, brick, and concrete, the observed nighttime temperatures in heavily developed parts of the zone are regularly warmer than surrounding suburban and rural areas (often referred to as a "heat island" and further discussed below). The northern edge of the Central Zone is often the boundary between freezing and non-freezing precipitation during wintertime. In summer, the northern reaches often mark the boundary between comfortable and uncomfortable sleeping conditions. Areas to the south of the Central Zone tend to have nearly twice as many days with temperatures above 90° F than the 15-20 days commonly observed in the central portion of the State (ONJSC, 1994 - 2007).

Extreme Cold Temperatures

According to the 1983 *New Jersey Weather Book* by David Ludlum, a Rutgers University study has shown that the extreme northwest corner of the State can expect a temperature as low as 0^{o}F almost every year, and the entire northwest quarter about once every two years. In the northern section the combined effects of latitude, topography, and elevation create favorable radiational cooling conditions at night, with low temperatures resulting. A secondary zone of low minimum temperatures is found in the Pine Barrens, where the flat terrain and strong radiational quality of sandy soil result in low readings (Ludlum, 1983). Average January temperatures are coldest in the north and mildest in the southern tip of the State. The average January temperature in Somerset County is between 28° F and 32° F. (Figure 5.4.5-4). The average temperature in the State of New Jersey during the month of January, for all years between 1895 and 2017, was 29.77.

Figure 5.4.5-4 Average Statewide January Temperatures



Source: World Book Inc., 2007

As provided by The Weather Channel, average high and low temperatures during the winter months around Somerset County are identified in Table 5.4.5-3.

Table 5.4.5-3 Average High and Low Temperature Range for Winter Months in Somerset County

Month	Average High	Average Low	Record Low Event(s)
January	38ºF	18ºF	-16ºF in 1984
February	41ºF	20ºF	-12ºF in 1933
March	50ºF	27ºF	-1ºF in 1967
November	54ºF	31ºF	5ºF in 1938
December	42ºF	23ºF	-10ºF in 1950

Source: The Weather Channel, 2017 (no changes since 2012)

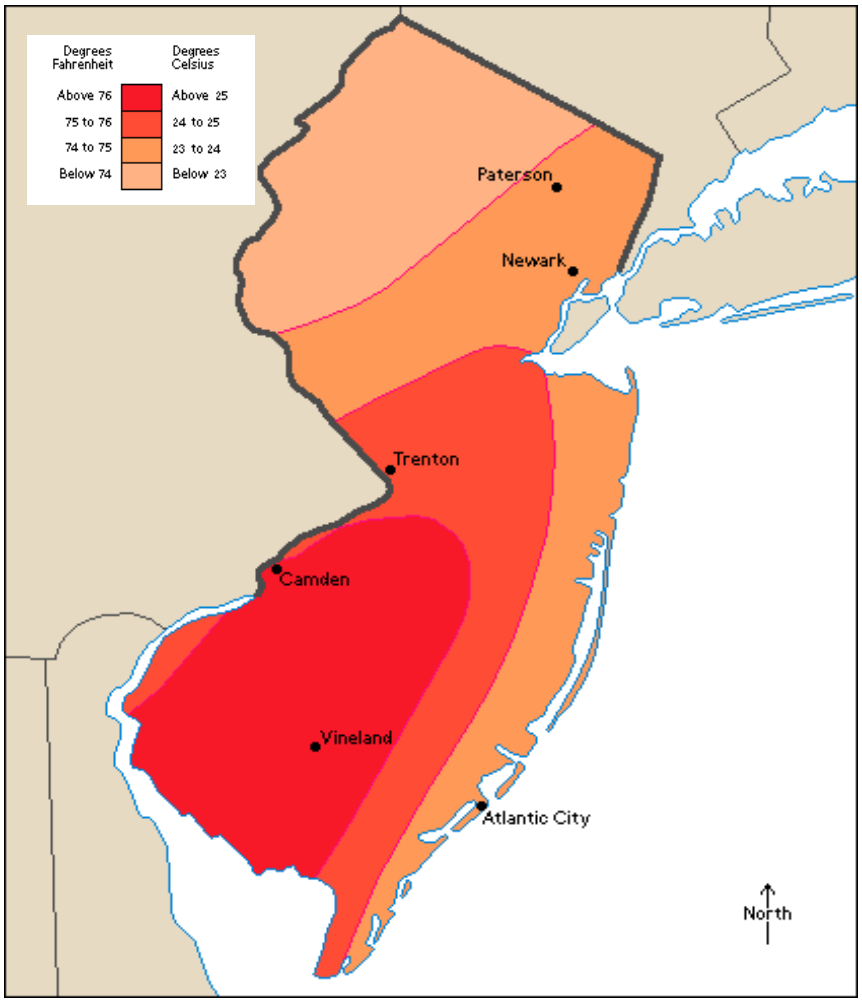
Extreme Heat Temperatures

Heat waves and extreme high temperatures are common in New Jersey during summer months. High temperatures vary across the state depending on topography, landscape, proximity to the ocean, etc. For example, the coastal strip from Cape May to Sandy Hook generally experiences cooler average temperatures than most of the state as a result of a recurrent cooling sea breeze. Higher elevation in the Northwest section of the state often decreases summer temperatures to comfortable levels. The southwest interior experiences higher average temperatures due to its distance from the ocean and flat topography.

In addition, urban environments can exacerbate extreme heat into a phenomenon known as the urban heat island effect. As urban areas develop, changes occur in their landscape. Buildings, roadways, and other infrastructure replace open land and vegetation. Surfaces that were once permeable and moist become impervious and dry. Furthermore, impervious surfaces such as asphalt may release heat even after the sun sets. These changes cause urban regions to become warmer that their rural surrounding, forming and island of higher temperatures (U.S. Environmental Protection Agency [U.S. EPA], 2012).

Average July temperatures are illustrated in Figure 5.4.5-5, Somerset County's average July temperatures range from below 74 degrees to 76 degrees depending on the location within the County.

Figure 5.4.5-5 Average Statewide July Temperatures



Source: World Book Inc., 2007

As provided by The Weather Channel, average high and low temperatures during the summer months around Somerset County are identified in Table 5.4.5-4.

Table 5.4.5-4 Average High and Low Temperature Range for Summer Months in Somerset County

Month	Average High	Average Low	Record High Event(s)
May	72ºF	46ºF	99ºF in 1962
June	80ºF	56ºF	101ºF in 1952
July	85ºF	61ºF	104ºF in 1949
August	83ºF	60ºF	105ºF in 1955
September	76ºF	52ºF	105ºF in 1953

Source: The Weather Channel, 2017 (no changes since 2012)

Previous Occurrences and Losses

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

The Midwest Regional Climate Center (MRCC) operates an online annual temperature, precipitation, and snowfall extremes database of the Continental U.S., reported in their "Daily Station Selector" tool. The data set contains the annual maximum and minimum temperature, precipitation, and snowfall records for stations across the United States. Not every city, town, and/or village in New Jersey contains a station. There are 585 stations located in the State of New Jersey. Of these, 44 are located in Somerset County. Four of Somerset County's station records include temperature data (one station in Bound Brook, one in Manville, and two in Somerville). For this most recent plan update, MRCC data was queried in December 2017 (MRCC, 2017).

There may be some potential problems with the data collected at the stations. The records were created by MRCC at the request of a user. The values of the all-time records for stations with brief histories are limited in accuracy and could vary from nearby stations with longer records. Although the data sets have been through quality control, there is still a need for more resources to quality control extremes. The record sets are for single stations in the cooperative observer network and are limited to the time of operation of each station under one coop number. The records for a place may need to be constructed from several individual station histories. Some of the data may vary from NWS records due to NWS using multiple stations and additional sources like record books (MRCC, Date Unknown).

Based on the data provided by MRCC, Table 5.4.5-5 presents the extreme cold (minimum) and hot (maximum) temperature records for Somerset County from 1893 to 2017.

Table 5.4.5-5 MRCC Temperature Extremes – Somerset County

Station Name	Begin Year	End Year	Max. (°F)	Max. Date	Min. (°F)	Min. Date	Avg. Max	Avg. Min
Bound Brook 2W	2010	2017	104	7/23/2011	5	1/25/2011	63.4	47
Manville	1945	1967	98	7/11/1948	-2	1/19/1948	59.4	43.2
Somerville 4NW	1893	2006	109	9/21/1895	-20	1/17/1893	62.8	40.6
Somerville Somerset AP	1999	Current	104	7/22/2011	-9	1/23/2011	64.1	41.8

Source: MRCC, 2017 (Note: Begin Year is when the data collection began; End Year is when the data collection stopped. If End Year is listed as "current", station was actively reporting at the time the dataset was queried.)

Between 1953 and 2017, the State of New Jersey was not included in any major disaster declarations or emergency declarations due to extreme temperatures. Information regarding specific details of temperature extremes in Somerset County is scarce, particularly prior to the start of NOAA NCDC records in 1996; therefore, previous occurrences and losses associated with extreme temperature events are limited. Table 5.4.5-6 summarizes notable extreme temperature events in the County. As part of the most recent plan update, occurrences since the last version of the plan was prepared have been added as the last rows of the table, from July 2013 through February 2016 (as queried in December 2017).

Table 5.4.5-6 Extreme Temperature Events between 1893 and 2017

Dates of Event	Event Type	FEMA Declaration Number	County Designated?	Losses / Impacts	Source(s)
January 17, 1893	Extreme Cold	N/A	N/A	Somerville experienced the lowest recorded cold event (-20°F).	Somerset County HMP
September 21, 1895	Extreme Heat	N/A	N/A	Somerville experienced the highest recorded heat event (109°F).	Somerset County HMP
February 10-11, 1899	Extreme Cold	N/A	N/A	Somerset County experienced temperature ranging from -10°F to -13°F	Somerset County HMP
June - July 1901	Extreme Heat	N/A	N/A	Somerville experienced 107°F temperatures.	Somerset County HMP
January 5-6, 1904	Extreme Cold	N/A	N/A	Somerset County experienced temperatures around -15°F.	Somerset County HMP
July 10-11, 1911	Extreme Heat	N/A	N/A	Temperatures in New Jersey ranged between 98 and 107°F. Somerville experienced 6 days with temperatures over 100 °F.	Somerset County HMP
January 14, 1912	Extreme Cold	N/A	N/A	Temperatures in New Jersey ranged from -18 to -32°F.	Somerset County HMP MP
1917-1918 (Winter)	Extreme Cold	N/A	N/A	New Jersey experienced an eight day cold wave, Somerset County experienced -18°F temperatures.	Somerset County HMP
August 7, 1918	Extreme Heat	N/A	N/A	Temperatures in New Jersey ranged from 103 to 108°F. Somerville reported temperatures near 108°F, a state record at that time.	Somerset County HMP
February 9, 1934	Extreme Cold	N/A	N/A	Temperatures in New Jersey ranged from -11 to -26°F. Lowest recorded temps (-17°F) in North Plainfield, Warren and Watchung.	Somerset County HMP
January 28, 1935	Extreme Cold	N/A	N/A	Temperatures in New Jersey ranged from -11 to -26°F. Lowest recorded temps (-16°F) in Rocky Hill	Somerset County HMP
July 9-11, 1936	Extreme Heat	N/A	N/A	Temperatures in New Jersey ranged from 104 to 110°F. Highest recorded temps (106°F) in North Plainfield, Warren and Watchung and 105°F in Rocky Hill	Somerset County HMP
January 11, 1942	Extreme Cold	N/A	N/A	Temperatures in New Jersey ranged from -13 to -23°F.	Somerset County HMP
August 26, 1948	Extreme Heat	N/A	N/A	Temperatures in New Jersey ranged from 103 to 106°F	Somerset County HMP
September 3, 1953	Extreme Heat	N/A	N/A	Temperatures in New Jersey ranged from 102 to 106°F. Highest recorded temps (102°F) in Bernardsville.	Somerset County HMP

Dates of Event	Event Type	FEMA Declaration Number	County Designated?	Losses / Impacts	Source(s)
1955	Extreme Heat	N/A	N/A	Highest recorded temps (105°F) for Bedminster, Bound Brook, Bridgewater, Far Hills, Hillsborough, Manville, Peapack/Gladstone, Raritan, Somerville, South Bound Brook.	Somerset County HMP
July 22, 1957	Extreme Heat	N/A	N/A	Temperatures in New Jersey ranged from 101 to 105°F	Somerset County HMP
January 22, 1961	Extreme Cold	N/A	N/A	Temperatures in New Jersey ranged from -10 to -26°F.	Somerset County HMP
January 15-18, 1965	Extreme Cold	N/A	N/A	Temperatures in New Jersey ranged from -2 to -15°F	Somerset County HMP
July 3-7, 1966	Extreme Heat	N/A	N/A	Temperatures in New Jersey ranged from 98 to 106°F	Somerset County HMP
January 17-18, 1982	Extreme Cold	N/A	N/A	Temperatures in New Jersey ranged from -2 to -19°F. Lowest recorded temps (-16°F) in Bernardsville.	Somerset County HMP
January 22, 1984	Extreme Cold	N/A	N/A	Temperatures in New Jersey ranged from -8 to -17°F. Lowest recorded temps (-16°F) in Bedminster, Bound Brook, Bridgewater, Far Hills, Hillsborough, Manville, Peapack/Gladstone, Raritan, Somerville, South Bound Brook.	Somerset County HMP
January 20-21, 1985	Extreme Cold	N/A	N/A	Temperatures in New Jersey ranged from -3 to -14°F	Somerset County HMP
December 1989	Extreme Cold	N/A	N/A	33 states, including New Jersey, received Emergency Contingency Funds for this event totaling $50 M.	Somerset County HMP
July 4, 1993	Heat Wave	N/A	N/A	N/A	SHELDUS
January 19-27, 1994	Extreme Cold	N/A	N/A	Temperatures in New Jersey ranged from -3 to -29°F. 23 states, including New Jersey, received Emergency Contingency Funds for this event totaling $298M.	Somerset County HMP
July 13, 1995	Heat Wave	N/A	N/A	One fatality experienced.	NOAA-NCDC, SHELDUS
July 25, 1995	Heat Wave	N/A	N/A	A heat wave lasted over seven days for central New Jersey.	NOAA-NCDC, SHELDUS
August 15, 1995	Heat Wave	N/A	N/A	Central Jersey experienced its last heat wave of the brutal 1995 summer season. Temperatures ranged from 90 to 95°F	NOAA-NCDC, SHELDUS
February 4, 1996	Extreme Cold	N/A	N/A	The coldest air mass of the winter season moved into New Jersey after a snowstorm. Most locations had low temperatures below 0°F.	NOAA-NCDC

Dates of Event	Event Type	FEMA Declaration Number	County Designated?	Losses / Impacts	Source(s)
May 19, 1996	Excessive Heat	N/A	N/A	N/A	NOAA-NCDC
January 17, 1997	Extreme Cold	N/A	N/A	The coldest air mass of the winter season moved into New Jersey with strong gusty northwesterly winds.	NOAA-NCDC
June 27, 1997	Excessive Heat	N/A	N/A	The first hot spell of 1997 brought the hottest weather in two years to New Jersey. Belle Mead experienced 95^{O}F temperatures.	Somerset County HMP
July 12-19, 1997	Heat Wave	N/A	N/A	Longest heat wave for central New Jersey since 1993 and the longest and hottest heat wave of the 1997 summer season. One of the highest temperatures during this heat wave included 101^{O}F in Belle Mead. Water restrictions were placed on many counties, including Somerset.	Somerset County HMP
August 16, 1997	Excessive Heat	N/A	N/A	The hottest and most humid air of the summer season reached central New Jersey the weekend of August 16th and 17th. High temperatures reached well into the 90s in most places, and dew point temperatures were in the 70s, making for a very uncomfortable weekend.	NOAA-NCDC
June 25-26, 1998	Excessive Heat	N/A	N/A	Highest Temperatures of the summer in New Jersey. Belle Mead experienced 95^{O}F temperatures.	Somerset County HMP
July 20, 1998	Excessive Heat	N/A	N/A	A heat wave affected Central and Southern New Jersey from July 20th through the 23rd. This heat wave brought the highest temperatures of the year to central New Jersey.	NOAA-NCDC
August 22, 1998	Heat Wave	N/A	N/A	N/A	NOAA-NCDC
July 4-7, 1999	Extreme Heat	N/A	N/A	Temperatures in New Jersey ranged from 101 to 103 ^{O}F. 26 states, including New Jersey, received Emergency Contingency Funds for this event totaling $100 M. Power outages/blackouts, buckled roads, 17 fatalities (1 in Somerset County) and 160 injuries. Somerville experienced 102^{O}F temperatures.	Somerset County HMP
July 16-19, 1999	Extreme Heat	N/A	N/A	Somerville experienced 100^{O}F temperatures. Overall, heat extremes were present throughout the month of July.	Somerset County HMP
June 26, 2001	Excessive Heat	N/A	N/A	A large ridge of high pressure both at the surface and aloft along the western Atlantic Ocean produced six consecutive days of heat and increasing humidity across most of New Jersey from June 26th through July 1st.	NOAA-NCDC

Dates of Event	Event Type	FEMA Declaration Number	County Designated?	Losses / Impacts	Source(s)
July 24, 2001	Excessive Heat	N/A	N/A	A hot and humid air mass pushed daytime high temperatures into the lower and middle 90s across much of central and southern New Jersey.	NOAA-NCDC
August 7-10, 2001	Extreme Heat	N/A	N/A	Temperatures in New Jersey ranged from 99 to 105^{O}F. Extremely high temperatures throughout the state, causing power outages and water restrictions. Belle Mead experienced 102^{O}F temperatures and Somerville experienced 99^{O}F temperatures.	Somerset County HMP
June 24, 2002	Excessive Heat	N/A	N/A	The first prolonged period of heat and humidity of the summer season affected most of central and southern New Jersey.	NOAA-NCDC
July 1-2, 2002	Extreme Heat	N/A	N/A	33 states, including New Jersey, received Emergency Contingency Funds for this event totaling $100 M. Somerville experienced 96^{O}F temperatures.	Somerset County HMP
July 15-19, 2002	Extreme Heat	N/A	N/A	Somerville experienced 97^{O}F temperatures.	Somerset County HMP
July 28-August 5, 2002	Extreme Heat	N/A	N/A	The excessive heat that began on July 28th continued through August 5th. The combination of high temperatures in the 90s and high dew points produced heat indices of over 100 ^{O}F each day through the 5th.	Somerset County HMP
August 11-20, 2002	Heat Wave	N/A	N/A	Longest heat wave for New Jersey since July 1999. Power outages, water restrictions, 1 death. Somerville experienced 99^{O} F temperatures.	Somerset County HMP
August 8, 2002	Extreme Heat	N/A	N/A	New Jersey allocated $4.8 M in emergency Low Income Home Energy Assistance Program (LIHEAP) funds.	Somerset County HMP
January 14, 2003	Extreme Cold/Wind Chill	N/A	N/A	A cold frontal passage on the 13th initiated about a two week run of unseasonably cold weather, even by January standards across New Jersey. There was one cold related death and a few others that were indirectly caused by the cold weather.	NOAA-NCDC
June 24, 2003	Excessive Heat	N/A	N/A	The first run of excessive heat and humidity of the summer season occurred during the work week of June 23rd. The highest temperatures and heat indices occurred on the 26th. This was a marked contrast from the unseasonably cool and wet June prior to this.	NOAA-NCDC
January 15-16, 2004	Extreme Cold/Wind Chill	N/A	N/A	Extreme utility usage, dangers to homeless, pipes froze, delayed openings to schools. Far Hills and Belle Mead experienced 1^{O}F temperatures. Ended up being the coldest January since 1985.	Somerset County HMP

Dates of Event	Event Type	FEMA Declaration Number	County Designated?	Losses / Impacts	Source(s)
December 20, 2004	Extreme Cold/Wind Chill	N/A	N/A	A high pressure system of arctic origin built into New Jersey on the 20th. This was one of the coldest air masses of the entire winter season. The strong northwest winds circulating around the high pressure system produced wind chill factors in the single digits.	NOAA-NCDC
January 18, 2005	Extreme Cold/Wind Chill	N/A	N/A	An unseasonably cold air mass and strong northwest winds poured across the Middle Atlantic States on the 18th.	NOAA-NCDC
January 23, 2005	Extreme Cold/Wind Chill	N/A	N/A	Canadian high pressure brought gusty winds and unseasonably cold temperatures to central New Jersey.	NOAA-NCDC
January 28, 2005	Extreme Cold/Wind Chill	N/A	N/A	The combination of light winds and snow cover one of the coldest mornings of the winter season in New Jersey. Low temperatures were mainly around zero and some in the negative digits.	NOAA-NCDC
June 13, 2005	Excessive Heat	N/A	N/A	The first run of unseasonably hot and humid weather of the summer season on June 13th and 14th caused early dismissals for many schools that did not have air conditioners and near record energy demands.	NOAA-NCDC
August 11, 2005	Excessive Heat	N/A	N/A	High temperatures reached into the 90s with some high temperatures soaring towards 100 °F.	NOAA-NCDC
July - August 2006	Heat Wave	N/A	N/A	Second warmest year in New Jersey history. 41 injuries occurred throughout New Jersey.	Somerset County HMP
January 26, 2007	Cold/Wind Chill	N/A	N/A	A strong northwest flow around an arctic high pressure system produced the coldest morning in two years across most of New Jersey. Most low temperatures were in the single numbers. Wind chill factors were below zero. Actual low temperatures included 8°F in Somerville.	NOAA-NCDC
February 5-6, 2007	Extreme Cold/Wind Chill	N/A	N/A	An arctic air mass that originated near the North Pole invaded New Jersey. The combination of the unseasonably cold air and gusty northwest winds produced wind chill factors as low as 0°F to around -10°F.	NOAA-NCDC
February 19, 2007	Cold/Wind Chill	N/A	N/A	Strong northwest flow brought unseasonably cold air into central New Jersey. Morning wind chills were between 0°F and -10°F. Actual low temperatures were in the positive single numbers. Since this occurred on President's Day, it did not have the same effect as a typical weekday day. Low temperatures included 8°F in Pequest and 9°F in Basking Ridge.	NOAA-NCDC

Dates of Event	Event Type	FEMA Declaration Number	County Designated?	Losses / Impacts	Source(s)
March 6, 2007	Cold/Wind Chill	N/A	N/A	The combination of the strong northwest winds and an unseasonably cold air mass produced wind chill factors around zero in the southern half of the state and around ten degrees below zero in the northern half of the state. Actual low temperatures were between 10 and 20°F in most areas, 12°F was recorded in Hillsborough.	NOAA-NCDC
June 26, 2007	Excessive Heat	N/A	N/A	The first heat wave of the season occurred across most of central and southern from the 26th through the 28th. The hottest day with respect to both temperature and humidity occurred on the 27th as many high temperatures reached into the mid-90s and heat indices were as high as 100°F. Highest temperatures included 95°F in Hillsborough.	NOAA-NCDC
July 9, 2007	Excessive Heat	N/A	N/A	A heat wave brought unseasonably hot weather to most of New Jersey on July 8th through the 10th. The highest temperatures were mostly in the mid to upper 90s.	NOAA-NCDC
August 8, 2007	Excessive Heat	N/A	N/A	One of the hottest and most humid air masses of the summer affected central and southern New Jersey. Highest temperatures were close to 100°F in most areas.	NOAA-NCDC
August 25, 2007	Excessive Heat	N/A	N/A	An unseasonably hot and humid air mass affected most of New Jersey with high temperatures in the lower to mid-90s and dew point temperatures in the mid-70s. This produced afternoon heat indices of around 105°F. Highest temperatures included 92°F in Hillsborough.	NOAA-NCDC
June 7, 2008	Excessive Heat	N/A	N/A	The most oppressive heat wave of the summer affected New Jersey from June 7th through the 10th. High temperatures were well into the 90s to around 100 and dew point temperatures were in the 70s.	NOAA-NCDC
July 16, 2008	Excessive Heat	N/A	N/A	The longest heat wave of the summer affected New Jersey from July 16th through the 22nd.	NOAA-NCDC
January 16, 2009	Cold/Wind Chill	N/A	N/A	A large arctic high pressure system kept maximum temperatures only in the teens, with even some single digits across New Jersey. The majority of the state experienced wind chill values between 0 and -10°F during early morning hours. Some low temperatures on the 16th included; -2°F in Basking Ridge. Some low temperatures on the 17th included; -2°F in Somerville.	NOAA-NCDC
August 10, 2009	Excessive Heat	N/A	N/A	A hot and very humid air mass over New Jersey resulted in heat indices at or above the century marking in many places. High temperatures included 95°F in Hillsborough.	NOAA-NCDC

Dates of Event	Event Type	FEMA Declaration Number	County Designated?	Losses / Impacts	Source(s)
June 27, 2010	Excessive Heat	N/A	N/A	Most high temperatures reached in the mid to upper 90s and combined with high humidity to produce afternoon heat indices of around 100°F. Highest temperatures included 97°F in Hillsborough. The unseasonably hot weather throughout June made June 2010 the hottest June on record in the state of New Jersey. The average monthly temperature of 74.4°F (5.0 degrees above average) surpassed June of 1943 by three tenths of one degree.	NOAA-NCDC
July 5, 2010	Excessive Heat	N/A	N/A	One of the hottest and longest heat waves of the season affected New Jersey. For many areas, this was the first time since August of 2001 that high temperatures exceeded 100°Fand lasted for two consecutive days. The strain on electrical networks caused about 3,700 homes and businesses to lose power on the 6th. Highest temperatures included 104°F in Hillsborough and 103°F in Somerville.	NOAA-NCDC
July 23, 2010	Excessive Heat	N/A	N/A	The last heat wave in July culminated with some of the highest heat indices of the summer. The combination of the heat and humidity produced heat index values of around 105°F. Highest temperatures included 98°F in Hillsborough and 94°F in Somerville. The month of July was the second hottest July on record in New Jersey dating back to 1895.	NOAA-NCDC
August 10, 2010	Heat Wave	N/A	N/A	A four day heat wave across central and southern New Jersey culminated with high temperatures in the mid-90s and afternoon heat indices of around 100°F on the 10th. Actual highest temperatures for the 10th and 11th included 95°F in Somerville. For the state of New Jersey as a whole, it was the 14th warmest August on record dating back to 1895. The summer of 2010 was the warmest meteorological summer on record for the State of New Jersey dating back to 1895 with an average temperature of 75.8°F.	NOAA-NCDC
June 9, 2011	Heat Wave	N/A	N/A	Unseasonably hot weather occurred on June 8th and 9th across New Jersey. High temperatures reached the mid to upper 90s both days, with some low 100s across southeastern New Jersey. There were a couple of occurrences of heat related illnesses reported in the central part of the state. One person was injured in Somerset County. Many schools and school districts closed early both days. Many districts also canceled after school classes and activities. Many communities opened cooling centers in libraries, senior centers and town halls. Highest temperatures included 98°F in Hillsborough.	NOAA-NCDC, SHELDUS

Dates of Event	Event Type	FEMA Declaration Number	County Designated?	Losses / Impacts	Source(s)
July 21, 2011	Excessive Heat	N/A	N/A	One of the most oppressive heat waves since July 1995. The heat was responsible for two deaths and hundreds of heat related injuries. The most oppressive day was July 22nd when the combination of temperature and dew points pushed many afternoon heat index values to 110°F to around 120°F. Three people were injured. Nearly every county in the state opened cooling centers. New Jersey activated its 211 information line. The hours of air-conditioned senior citizen centers were extended. Construction workers adjusted their work days and started early. Paving work was postponed. Water and electrical service shutoffs were postponed. The PJM Interconnect set an all-time record usage of 158,000 megawatts at 5 p.m. EDT on July 21st. Atlantic City Electric set a new usage record of 3,074 megawatts at 3 p.m. EDT on the 22nd. Public Service Electric and Gas had its second highest electrical usage on record also on the 22nd only behind August 1, 2006. Highest temperatures included 104°F in Somerville. This heat wave helped make July 2011 the third hottest July on record for the state of New Jersey with a statewide average temperature of 78.4°F.	NOAA-NCDC, SHELDUS
June 20, 2012	Heat Wave	N/A	N/A	New Jersey experienced high temperatures in the mid to upper 90s and afternoon heat indices of around 100 degrees. New Jersey utilities reported scattered outages due to the heat. Cooling centers were opened in Franklin Township in Somerset County. Highest temperatures included 97°F in Hillsborough and 96°F in Somerville.	NOAA-NCDC
June 29, 2012	Heat Wave	N/A	N/A	An unseasonably hot and humid day produced high temperatures in the mid to upper 90s in most of New Jersey. South of the Interstate 80 corridor, the combination of heat and humidity levels, produced maximum hourly heat indices that reached between 100°F and 105°F. High temperatures included 95°F in Somerville.	NOAA-NCDC
July 1, 2012	Heat Wave	N/A	N/A	An ongoing heat wave persisted across most of central and southern New Jersey. Afternoon heat index values reached around 100°F. High temperatures were mostly in the mid to upper 90s and included 97°F in Hillsborough.	NOAA-NCDC

Dates of Event	Event Type	FEMA Declaration Number	County Designated?	Losses / Impacts	Source(s)
July 4, 2012	Heat Wave	N/A	N/A	Both excessive heat and more humidity returned to central and southern New Jersey starting on Independence Day and lasted until the 7th. Highest temperatures all occurred on the 7th and included 98°F in Somerville.	NOAA-NCDC
July 18, 2012	Excessive Heat	N/A	N/A	High temperatures on the 17th reached into the mid to upper 90s with afternoon heat indices near 100°F. On July 18th, the combination of scorching high temperatures (around 100°F) and higher dew points produced hourly afternoon heat indices that reached between 105°F and 110°F. Highest temperatures included 101°F in Somerville.	NOAA-NCDC
July 6, 2013	Heat	N/A	N/A	Hot weather that combined high temperatures in the 90s and more oppressive humidity levels affected central and southern NJ on July 6th and most of the state on July 7th. High temperatures reached into the lower to mid-90s both days combined with dew points of around 70°F produced afternoon heat index values around 10°F. Highest temperatures included 94°F in Somerville.	NOAA-NCDC
July 15, 2013	Heat	N/A	N/A	The most oppressive hot spell of the summer season affected NJ from July 15th through the 20th. Widespread high temperatures reached into the mid to upper 90s and the most oppressive days occurred on the 18th and 19th. Afternoon heat indices reached 105 to 110°F. Highest temperatures included 97°F in Somerville.	NOAA-NCDC
July 18, 2013	Excessive Heat	N/A	N/A	The most oppressive hot spell of the summer season affected NJ from July 15th through the 20th. Widespread high temperatures reached into the mid to upper 90s and the most oppressive days occurred on the 18th and 19th. Afternoon heat indices reached 105 to 110°F. Highest temperatures included 97°F in Somerville.	NOAA-NCDC
July 20, 2013	Heat	N/A	N/A	The most oppressive hot spell of the summer season affected NJ from July 15th through the 20th. Widespread high temperatures reached into the mid to upper 90s and the most oppressive days occurred on the 18th and 19th. Afternoon heat indices reached 105 to 110°F. Highest temperatures included 97°F in Somerville.	NOAA-NCDC
September 11, 2013	Heat	N/A	N/A	An unseasonably hot and humid air mass caused most high temperatures to reach 90°-95°F on the 11th. Combined with high dew point levels, afternoon heat index values reached between 100° and 105°F away from the immediate coast. Maximum temperatures included 94°F in Hillsborough.	NOAA-NCDC

Dates of Event	Event Type	FEMA Declaration Number	County Designated?	Losses / Impacts	Source(s)
January 4, 2014	Cold/Wind Chill	N/A	N/A	A high pressure system that moved over NJ coupled with fresh show cover from the winter storm on the 2nd and 3rd gave the area one of its coldest winter morning in years. While this was the coldest morning of the winter, it was not the harshest. Because the high pressure system was over the region, wind chill factors and actual air temperatures were nearly the same. Low temperatures included -5°F in Hillsborough.	NOAA-NCDC
January 7, 2014	Cold/Wind Chill	N/A	N/A	One of the harshest arctic outbreaks in years occurred in NJ on the 7th. Record low temperatures occurred, combined with strong northwest winds produced wind chill factors as low as 15° to 25°F below zero in most areas. Low temperatures were near zero. High temperatures struggled to reach double digits. While temperatures were higher than occurred on January 4th, the wind made it feel much colder. Low temperatures included 2°F in Somerville.	NOAA-NCDC
January 22, 2014	Cold/Wind Chill	N/A	N/A	Strong northwest winds behind the departing strong low pressure system coupled with another arctic air mass dropped low temperatures in the morning into the single digest, with some below zero in the northwest part of the state. Low temperatures included 3°F in Somerville.	NOAA-NCDC
July 2, 2014	Heat	N/A	N/A	A hot start to July peaked on the 2nd in interior NJ with high temperatures in the lower to mid-90s and afternoon heat index values reaching 100° to 105°F. Highest temperatures included 96°F in Hillsborough and 95°F in Somerville.	NOAA-NCDC
January 7, 2015	Cold/Wind Chill	N/A	N/A	Morning low temperatures were mainly in the single numbers above zero. In addition, gusty northwest winds continued into the morning and lowest hourly wind chill factors reached around 9° below zero throughout the state. Low temperatures included 6°F in Somerville. Lowest hourly wind chill factors included -9°F in Somerville.	NOAA-NCDC
February 13, 2015	Cold/Wind Chill	N/A	N/A	Northwest winds that persisted into the morning, combined with an arctic air mass to produce wind chill factors of around -10°F and low temperatures in the positive single digits, and claimed the life of one homeless man in Burlington County. The lowest hourly wind chill factors included -11°F in Somerville. Actual morning low temperatures included 6°F in Somerville. Many counties and municipalities declared code blues.	NOAA-NCDC

Dates of Event	Event Type	FEMA Declaration Number	County Designated?	Losses / Impacts	Source(s)
February 15, 2015	Cold/Wind Chill	N/A	N/A	Strong high winds and an approaching arctic air mass produced wind chill factors 10-15°F below zero. Actual morning low temperatures were around 10°F. Many municipalities declared code blues. Actual low temperatures included 10°F in Somerville.	NOAA-NCDC
February 16, 2015	Cold/Wind Chill	N/A	N/A	Winds were not as strong on the 16th, however air temperatures were lower. Wind chill factors were as low as 20°F below 0 in most of the state. Actual low temperatures were around zero. Code Blues remained in effect. Lowest hourly wind chill factors included -18°F in Somerville. Actual low temperatures included 1°F in Somerville.	NOAA-NCDC
February 20, 2015	Cold/Wind Chill	N/A	N/A	The arrival of another arctic air mass brought some of the lowest wind chills as well as the lowest temperatures of the winter season on the 20th and 21st. Wind chill factors on the 20th were as low as -20°F during the morning. Actual low temperatures were around zero. Lowest hourly wind chill factors included -15°F in Somerville with lowest actual temperatures including -4°F in Somerville.	NOAA-NCDC
February 24, 2015	Cold/Wind Chill	N/A	N/A	Air and wind chill temperatures were nearly the same as the arctic outbreak was not accompanied by strong winds. Morning low temperatures averaged 25-35° colder than normal. Actual low temperatures included -6°F in Hillsborough.	NOAA-NCDC
July 19, 2015	Heat	N/A	N/A	High temperatures in most areas reached into the lower to mid-90s on the 19th and 20th. The combination of heat and humidity brought afternoon heat index values as high as 100-105°F, some of the highest indexes of the summer. Highest temperatures included 95°F in Somerville and Hillsborough.	NOAA-NCDC
February 14, 2016	Cold/Wind Chill	N/A	N/A	Bitter cold temperatures and strong northwest winds combined to create dangerous wind chill temperatures on the 13th and 14th. Wind chill values ranged from -46°F at High Point to 10°F near the waters of the back bays near the coast. Many local governments set up Code Blue shelters.	NOAA-NCDC

Note (1): 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 increased U.S. Inflation Rates.

°F	Degrees Fahrenheit	NOAA-NCDC	National Oceanic Atmospheric Administration – National Climate Data Center
HMP	Hazard Mitigation Plan	NWS	National Weather Service
M	Million ($)	SHELDUS	Spatial Hazard Events and Losses Database for the United States
N/A	Not applicable		

Probability of Future Events

Several extreme temperature events occur each year throughout Somerset County. It is estimated that the 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.

Based on historical records and input from the Planning Committee, the probability of occurrence for extreme temperatures in Somerset County is considered frequent (hazard event that is likely to occur within 25 years).

Climate Change Impacts

Global climate change poses risks to human health and to terrestrial and aquatic ecosystems. Important economic resources such as agriculture, forestry, fisheries, and water resources may also be affected. Warmer temperatures, more severe droughts and floods, and sea level rise could have a wide range of impacts. All these stresses can add to existing stresses on resources caused by other influences such as population growth, land-use changes, and pollution.

Climate change may result from:

- Natural factors, such as changes in the sun's intensity, slow changes in the Earth's orbit around the sun, and/or changes in solar radiation;
- Natural processes within the climate system (e.g. changes in ocean circulation or changes in composition of the atmosphere); and
- Human activities that change the atmosphere's composition (e.g. through burning fossil fuels) and the land surface (e.g. deforestation, reforestation, urbanization, desertification, etc.) (U.S. EPA, 2008; IPCC, 2007).

The U.S. EPA's current level of understanding, as summarized in the IPCC Fourth Assessment Report (IPCC, 2007), is as follows:

> *"Since 1950, the number of heat waves has increased and widespread increases have occurred in the numbers of warm nights. The extent of regions affected by droughts has also increased as precipitation over land has marginally decreased while evaporation has increased due to warmer conditions. Generally, numbers of heavy daily precipitation events that lead to flooding have increased, but not everywhere. Tropical storm and hurricane frequencies vary considerably from year to year, but evidence suggests substantial increases in intensity and duration since the 1970s. In the extratropics, variations in tracks and intensity of storms reflect variations in major features of the atmospheric circulation, such as the North Atlantic Oscillation."*

The IPCC projects the following likely, very likely, or virtually certain changes in extreme events and associated effects between now and 2100 in Table 5.4.5-7 (IPCC, 2007):

Table 5.4.5-7 Projected Changes and Effects from Climate Change (2007 to 2100)

Projected Change	Projected Impacts by Sector			
	Agriculture, forestry	Water resources	Human health/ mortality	Industry/settlement/society
Warmer/fewer cold days/nights; warmer/more hot days/nights over most land areas.	Increased yields in colder environments; decreased yields in warmer environments	Effects on water resources relying on snow melt	Reduced human mortality from decreased cold exposure	Reduced energy demand for heating; increased demand for cooling; declining air quality in cities; reduced effects of snow, ice etc.
Warm spells/heat waves: frequency increases over most land areas	Reduced yields in warmer regions due to heat stress at key developmental stages; fire danger increase	Increased water demand; water quality problems, e.g., algal blooms	Increased risk of heat-related mortality	Reduction in quality of life for people in warm areas without air conditioning; impacts on elderly and very young; reduced thermoelectric power production efficiency
Heavy precipitation events: frequency increases over most areas	Damage to crops; soil erosion, inability to cultivate land, water logging of soils	Adverse effects on quality of surface and groundwater; contamination of water supply	Deaths, injuries, infectious diseases, allergies and dermatitis from floods and landslides	Disruption of settlements, commerce, transport and societies due to flooding; pressures on urban and rural infrastructures
Area affected by drought: increases	Land degradation, lower yields/crop damage and failure; livestock deaths; land degradation	More widespread water stress	Increased risk of food and water shortage and wild fires; increased risk of water- and food-borne diseases	Water shortages for settlements, industry and societies; reduced hydropower generation potentials; potentials for population migration
Number of intense tropical cyclones: increases	Damage to crops; windthrow of trees	Power outages cause disruption of public water supply	Increased risk of deaths, injuries, water- and food-borne diseases	Disruption by flood and high winds; withdrawal of risk coverage in vulnerable areas by private insurers

Projected Change	Projected Impacts by Sector			
	Agriculture, forestry	Water resources	Human health/ mortality	Industry/settlement/society
Incidence of extreme high sea level: increases	Salinization of irrigation and well water	Decreased freshwater availability due to saltwater intrusion	Increase in deaths by drowning in floods; increase in stress-related disease	Costs of coastal protection *versus costs of land-use* relocation; also see tropical cyclones above

Source: U.S. EPA, 2008

The IPCC Fourth Assessment Report indicates that all of North America is very likely to warm during this century, and the annual mean warming is likely to exceed the global mean warming in most areas. In northern regions, warming is likely to be largest in winter, and in the southwest U.S., largest in summer. The lowest winter temperatures are likely to increase more than the average winter temperature in northern North America, and the highest summer temperatures are likely to increase more than the average summer temperature in the southwest U.S. (IPCC, 2007).

In the State of New Jersey, as indicated directly by the U.S. EPA, over the last century, the average temperature in New Brunswick, New Jersey, has increased from 50.4°F (1889-1918 average) to 52.2°F (1966-1995 average), and precipitation in some locations in the State has increased by 5-10%. Over the next century, New Jersey's climate may change even more. Based on projections given by the IPCC and results from the United Kingdom Hadley Centre's climate model (HadCM2), a model that accounts for both greenhouse gases and aerosols, by 2100 temperatures in New Jersey could increase about 4°F (with a range of 2-8°F) in winter and spring, and slightly more in summer and fall, if greenhouse-gas emissions are not controlled. The frequency of extreme hot days in summer is expected to increase along with the general warming trend. It is not clear how severe storms such as hurricanes would change (U.S. EPA, 1997).

As presented by NextGenerationEarth of the Columbia University Earth Institute and as provided by the U.S. EPA report on climate change, which uses data from the 2001 Third Assessment Report of the IPCC, potential impacts of climate change to temperatures in New Jersey include, but are not limited to, the following:

- By 2100 temperatures in New Jersey could increase about 4°F (with a range of 2-8°F) in winter and spring, and slightly more in summer and fall. The frequency of extreme hot days in summer is expected to increase along with the general warming trend.
- Higher temperatures and increased frequency of heat waves may increase the number of heat-related deaths and the incidence of heat-related illnesses. New Jersey, with its irregular, intense heat waves, seems very susceptible.
- There is concern that climate change could increase ozone levels. A 4°F warming in New York City, with no other change in weather or emissions, could increase concentrations of ozone, a major component of smog, by 4%. Similar increases also could occur in New Jersey. Virtually all of New Jersey is classified as an "extreme and severe" nonattainment area for ozone. Ground-level ozone has been shown to aggravate existing respiratory illnesses such as asthma, reduce lung function, and induce respiratory inflammation. In addition, ambient ozone reduces agricultural crop yields and impairs ecosystem health (NextGenerationEarth, Date Unknown).

The New Jersey Climate Adaption Alliance facilitated by Rutgers University provided a description of climate change in New Jersey, the report included past changes that have been documented from historical observations as well as expected changes based on projections of temperature, precipitation and sea level through the end of the century. Among other findings the report states that projections are that over the upcoming century, temperatures across the Northeast are projected to continue to rise, with larger increases under higher emissions scenarios relative to lower emissions scenarios, and greater increases in summer as compared to winter temperatures (Frumhoff et al, 2007; Horton 2011; Hayhoe et al 2008). Specifically, the Northeast's annual average temperature increases are expected to range between 1.5 and 3 degrees by the 2020s, 3 and 6 degrees by the 2050s and from 3.5 to 10 degrees by the 2080s.

In addition, both the number of days above 90°F or 100°F and the duration of heat events are expected to increase. Current projections show that the number of days above 90°F will increase from an average of 14 days per year to 23-29 days per year in 2020, 29-45 days per year in 2050, and 37-64 days per year in 2080. Those over 100°F could increase by late-century to 3-9 days under the lower-emissions scenario to 14-28 days under the higher-emissions scenario (NJ Climate Adaptation Alliance, 2012). Table 5.4.5-8 depicts a summary of climate change data and projections relevant to the northeast and New Jersey.

Table 5.4.5-8 Summary of Climate Change Data and Projections Relevant to the Northeast and New Jersey.

Source/ Organization	Geographic Region	Trend Data	Projects	Model/ Methods	Scenarios
Frumhoff, et al 2007 (NECIA)	Northeast (ME to PA)	**Temp:** Avg. increase of .5°F (1.3°F winter) per decade since 1970 Avg. number of days exceeding 90°F per year: 10-15 days (increased by roughly two since 1970).	**Temp:** (Compared with 1961-1990 avg.) High scenario: +2.6°F , 2020 +5.8°F, 2050 +6.5-12.5°F, 2100 30-60 days over 90°F, 2050 60+ days over 90°F, 2100 Lower scenario: +2.4°F, 2020 +3.7°F, 2050 +3.5 to 6.5°F, 2100 30 days over 90°F, 2100	3 GCMs, with statistical downscaling	A1FI (higher) and B1 (lower)
Horton et al 2011 (NYSERDA)	NY State (looking at just NYC and Catskill/ Hudson regions 2, 4)	**Temp:** 48°F to 53°F, have risen about 2.4°F since 1970 (winter 4.4°F)	**Temp:** (range reflects low to high emissions scenarios) +1.5 to 3°F, 2020s +3 to 5°F, 2050s +4 to 7.5°F, 2080s	16 GCMs used. SLR projection based on average of ClimAID GCM for range of scenarios. (ClimAID is a group of researchers from Cornell, Columbia Univ. and CUNY.)	A2 – High A1B – Medium B1 – Low SLR projection doesn't include rapid ice melt scenario.
NPCC 2009	NYC (projections apply to 100 mile radius)	**Temp:** Baseline 55°F (1971-2000) – nothing about increases 14 days with temp over 90°F	**Temp:** +1.5 to 3°F, 2020 +3 to 5°F, 2050 +4 to 7.5°F, 2080 • Heat index increase "very likely" throughout 20th century Days with temp over 90 °F: 23 to 29, 2020s	Based on 16 GCMs and three emissions scenarios. (7 GCMs for SLR) Projections are middle 67%	SLR doesn't include rapid ice-melt scenario.

Source/ Organization	Geographic Region	Trend Data	Projects	Model/ Methods	Scenarios
			29 to 45, 2050s 37 to 64, 2080s		
Partnership for the Delaware Estuary 2010	Delaware Estuary (Southwestern NJ)	Couldn't find baseline used.	**Temp:** +3.5 to 7°F, 2100 (more in summer)	Median of 14 models	Two emissions scenarios used (high and low) Range of change is difference between high and low.
Hayhoe et al 2008	Northeast (ME to PA)		**Temp:** Rise throughout century, higher with A1 scenario and more in summer 20 to 40 more days above 1990 90th percentile (twice the number of days)	Downscaling of three GCMs	IPCC scenarios higher (A1FI) and lower (B1)
Hayhoe et al 2007	Northeast (ME to PA)	**Temp:** (1970-2000) + .43 to .47°F/decade, greatest changes in winter, (+ 1.2 to 1.4°F/decade)	**Temp:** +9.5°F, 2080s, (relative to 1961– 1990 under A1FI) +8.1°F, 2080s under A2 +5.2°F, 2080s under B1	9 models	A1FI (higher), A2 (mid-high) , B1 (lower)
Najjar et al 2009	Mid-Atlantic estuaries	**Temp:** +.2°F (1911-1940 to 1971- 2000) for Chesapeake. Bay +.9°F Hudson River +1.1°F Del River	**Temp:** • Both scenarios and all models increase 3.6 to 15.7°F (2070- 2099), with respect to 1971-2000 avg. A2 scenario (Hudson and Delaware): +1.4 to 2.9°F, 2020s +3.8 to 7°F, 2050s +5.6 to 12°F, 2080s	Avg. of 7 models from TAR (older than AR4)	A2 and B2
NJ TPA 2012	NJ – Coastal and Central	**Temp:** 3.3 days over 95°F. (baseline avg. Atlantic City and New Brunswick)	**Temp:** Low scenario: 7 to 8 days over 95°F, 2100 Medium scenario: 10 days over 95°F, 2050 23 days over 95°F, 2100 High scenario: 10 to11 days over 95°F, 2050 45 to 50 days over 95°F, 2100	15 GCM's. Least sensitive paired with B1, most sensitive paired with A2 and average used for A1B.	A2 (high) A1B (medium) B1 (low) Three SLR scenarios selected for 2100: 50cm, 100cm, 150 cm and projected for 2050 using MAGICC and SlimCLIM tools

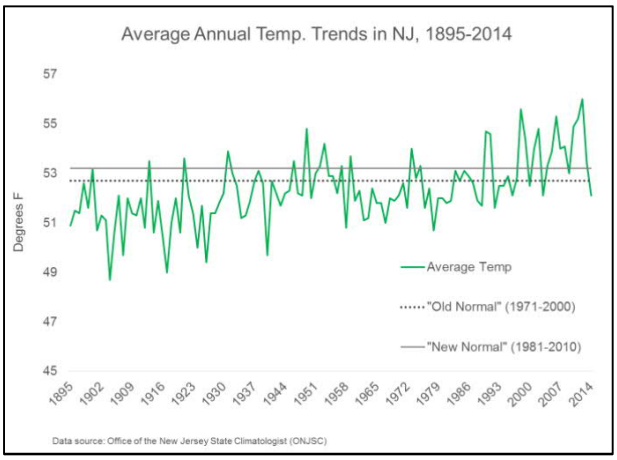
Source: NJ Climate Adaptation Alliance, 2012

Local studies regarding climate change and its affects specifically to Somerset County have not been found; however, based on the regional studies that have been done for New Jersey and its surrounding states, it is anticipated that Somerset County is no exception and will also experience a change in temperatures in the future.

In March 2017, the New Jersey Climate Adaptation Alliance released a report entitled "Story Map of New Jersey Temperature Trends and Projections." In it, the Alliance reproduced statewide temperature

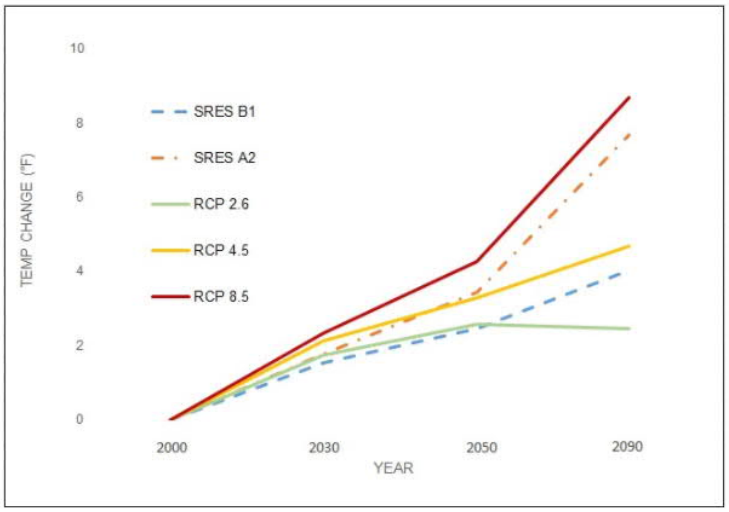
and precipitation records maintained by the Office of the New Jersey State Climatologist going back to 1895. As shown in Figure 5.4.5-6, these data show that there has been an observed upward trend in average statewide temperature over the last 120 years.

Figure 5.4.5-6 Average Annual Temperature Trends in NJ, 1895 - 2014



The report indications that this warming trend is expected to continue over the next several decades. Projections for average annual temperatures across the State indicate that temperatures are expected to rise throughout the next century. The extent to which they are expected to rise varies among climate models and emissions scenarios, with projected average annual temperature increases of between roughly 2 and 8 degrees Fahrenheit over the next century, depending on the scenario used (as shown in Figure 5.4.5-7).

Figure 5.4.5-7 Projected Change in Average Annual Statewide Temperature Compared to the 1981-2010 Baseline



This same Story Map report projects that the estimated number of extreme heat days will also increase over the next century under all scenarios. This would have important health implications across the entire population, but particularly in the very young and the very old, who are particularly susceptible to heat related illness.

VULNERABILITY ASSESSMENT

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

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

Overview of Vulnerability

Extreme temperatures generally occur for a short period of time but can cause a range of impacts, particularly to vulnerable populations that may not have access to adequate cooling or heating. This natural hazard can also cause impacts to agriculture (crops and animals), infrastructure (e.g., through pipe bursts associated with freezing, power failure) and the economy.

Data and Methodology

Data used to assess the extreme temperature natural hazard include U.S. Census 2010, USDA, and Somerset County and Planning Committee sources. At the time of this HMP, historic impacts to population, general building stock and the economy were not available and potential future losses could not be quantified. Available information and a preliminary assessment are provided below.

Impact on Life, Health and Safety

For the purposes of this HMP, the entire population in the County is exposed and vulnerable to extreme temperature events. Extreme temperature events have potential health impacts including injury and death.

The U.S. Climate Resilience Toolkit is a website (**toolkit.climate.gov**) developed by the National Oceanic and Atmospheric Administration (NOAA) and other Federal agencies to enable decision-makers to take action to boost their climate resilience using data-driven tools, information, and subject-matter expertise to make smarter decisions. The Toolkit was released in November 2014, and offers information from across the federal government regarding climate-related risks and opportunities as well as steps to improve resilience. According to the US Climate Resilience Toolkit, 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 who are physically ill (e.g., heart disease or 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, 2009). Drought conditions, often associated with extreme high temperature events, impact the infirm, young, and elderly as well. Drought is also considered a significant concern to Somerset County and is included as a separate hazard in Section 5.4.6.

The high cost of fuel to heat residential homes can create a financial strain on populations with low or fixed incomes (a portion of which includes the elderly population). In addition, low income residents 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). Refer to Section 4, County Profile, for figures that show the distribution of persons over the age of 65 and low income populations in Somerset County. Table 4.2 summarizes the population over the age of 65 and individuals living below the Census poverty threshold.

Meteorologists can accurately forecast extreme heat 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 (EPA, 2006).

Impact on General Building Stock

All of the building stock in Somerset County is exposed to the extreme temperature hazard. Table 4-3 summarizes the general building stock in the County. Based on available data, it appears that there are almost just as many extreme heat events as extreme cold and extreme cold/wind chill events. Extreme cold temperature events can damage buildings through freezing/bursting pipes and freeze/thaw cycles. Additionally, antiquated or poorly constructed homes and facilities may have inadequate capabilities to withstand extreme temperatures. Due to a lack of data regarding past losses specific to Somerset County or its municipalities, it is not possible at this time to estimate potential future losses to extreme temperature events.

Impact on Critical Facilities

All critical facilities in Somerset County are exposed to the extreme temperature hazard. Impacts to critical facilities are the same as described for general building stock (above). Additionally, it is essential that critical facilities remain operational during natural hazard events. Extreme heat events can sometimes cause short periods of electric utility failure, commonly referred to as “brown-outs”, due to increased usage from air conditioners, appliances, etc. Similarly, heavy snowfall and ice storms, associated with extreme cold temperature events, can cause power interruption as well. As mentioned in the Severe Winter Storm section, backup power is recommended for critical facilities and infrastructure.

Impact on Economy

Extreme temperature events also have impacts on the economy, including loss of business function and damage/loss of inventory. Business-owners may 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).

The Low Income Home Energy Assistance Program (LIHEAP) is a federally funded program that assists the elderly and people living in poverty pay for winter heating and/or summer cooling bills. This program is available to NJ residents and is administered by the NJ Department of Human Services (New Jersey Department of Human Services, Date Unknown). During the August 2002 extreme heat event, NJ allocated $4.8 M in emergency funds; however, it is unknown how much funding was allocated to Somerset County (US Newswire, 2002).

The agricultural industry is most at risk in terms of economic impact and damage due to extreme temperature events. In total, 34,735 acres of farm land are vulnerable to extreme temperature events (USDA, 2012). Livestock raised in Somerset County are also vulnerable.

Extreme heat events can result in drought and dry conditions and directly impact livestock and crop production. Due to the significant agricultural activities in the area, drought is considered a significant concern and is included as a separate hazard (Section 5.4.6). Extreme low temperatures and unseasonable frost events during the growing season and harvest months can cause significant losses in crops, depending on the duration of the frost event.

Due to a lack of data regarding past losses specific to Somerset County or its municipalities, in addition to the lack of current modeling tools for this hazard (NJHMP, 2014), it is not possible at this time to estimate potential future losses to extreme temperature events.

Change of Vulnerability

When examining the change in the County's vulnerability to extreme temperature events from the 2008 original HMP to this second plan update, it is important to look at each entity that is exposed and vulnerable. The total population across the County has increased as shown by the 2000 to 2010 U.S. Census. The County's population continues to be exposed to this hazard. Interim estimates of the County's 2016 population are also higher, with a 3.2 percent increase since the 2010 Census.

In terms of the agricultural industry for Somerset County, from 2007 to 2012, there was a 10 percent decrease in the number of farms (445 farms to 400 farms, respectively); however there was an increase in the number of acres of land in farms (six percent change from 32,721 acres to 34,735 acres) and the average size of a farm (from 74 acres to 87 acres). The total market value of products sold in Somerset County, both crop and livestock sales increased from nearly $19 million in 2007 to more than $23 million in 2012 (USDA, 2012). Therefore, their potential crop and livestock loss due to extreme temperature events has increased overall.

Future Growth and Development

As discussed in Section 4, areas targeted for future growth and development have been identified across the County. Future development of recreational and agricultural areas including golf courses, farms, or nurseries may be impacted (reduced) by this hazard due to unfavorable conditions.

Additional Data and Next Steps

Extreme temperature loss data appears to be somewhat limited for Somerset County and the surrounding area. Over time, Somerset County can track data on extreme temperature events, obtain additional County- and jurisdiction-specific information on past and future events, particularly in terms of any injuries, deaths, shelter needs/cooling-heater centers, pipe freeze, agricultural losses and other impacts. This will help to identify any concerns or trends for which mitigation measures should be developed or refined. Mitigation actions for the County are identified in Section 6 of this plan and in the Appendix for the participating jurisdictions. Periodic review and update of the plan will address tracking the progress on these initiatives and inclusion of additional actions. Section 7, Plan Maintenance contains the procedures for the update of the plan.