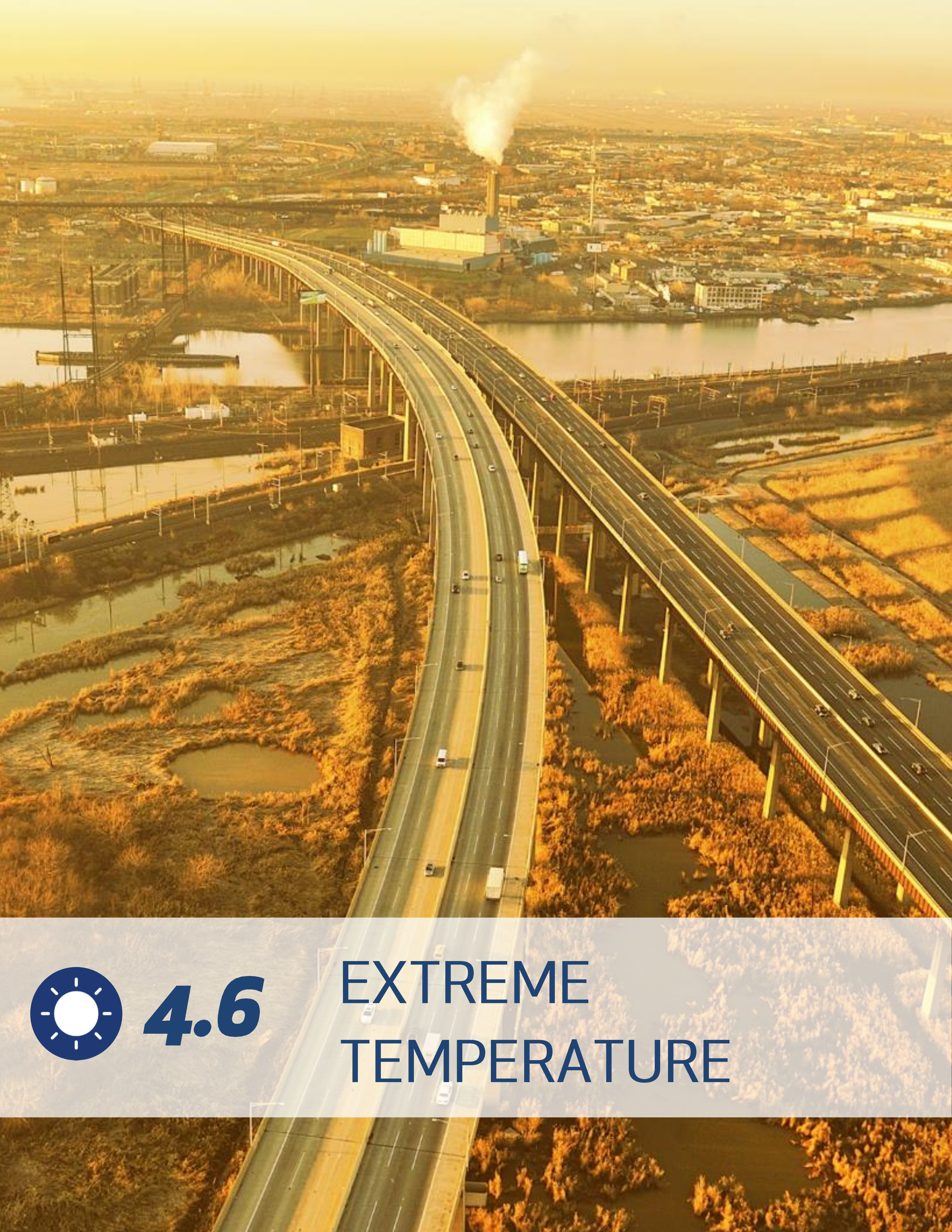

4.6 EXTREME TEMPERATURE

SECTION 4.6 EXTREME TEMPERATURE

4.6-1 HAZARD OVERVIEW

Extreme temperature is a weather-driven hazard that can cause illness or death, infrastructure failure, and ecosystem degradation or crop failure. It includes both high and low temperatures and can occur anywhere in New Jersey. All 21 counties in New Jersey identify extreme temperature as a hazard of concern in their most recent hazard mitigation plans. While New Jersey has experienced extreme temperature events, the state has not been included in any extreme-temperature related disaster or emergency declarations from FEMA. See Section 5.0 for ongoing capabilities and Section 6.0 for planned activities in the mitigation strategy to address extreme heat.

Extreme Heat

The Centers for Disease Control and Prevention (CDC) defines extreme heat as summertime temperatures that are much hotter and/or humid than average. FEMA considers an extreme heat event to be a period where temperatures are above 90 degrees for at least two days. A period of sustained high temperatures is referred to as a heat wave. The specific threshold for a heat wave varies by location and is defined below for New Jersey. Heat stresses the body by making it work harder to maintain a normal body temperature. Humidity can make it seem hotter than it really is, which adds to the stress a person may experience. Both high temperatures and humidity can cause illness or death.

In addition to the public health concerns, extreme heat events can create or provoke secondary hazards including, but not limited to dust storms, droughts, wildfires, water shortages, and power outages (FEMA, 2006; CDC, 2006). This could result in a broad and far-reaching set of impacts throughout a local area or entire region. Impacts could include loss of life and illness; economic costs in transportation, agriculture, production, energy, and infrastructure; and losses of ecosystems, wildlife habitats, and water resources (Meehl and Tebaldi, 2004; CDC, 2006). High temperatures, with or without humidity, can increase air pollution and decrease air quality, which may lead to more illness.

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 generally characterized in temperate zones by the ambient air temperature dropping to approximately 0°F or below (CDC, 2005).

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. Hypothermia occurs when the core body temperature is <95°F. If persons exposed to excessive cold are unable to generate enough heat (e.g., through shivering) to maintain a normal core body temperature of 98.6°F, their organs (e.g., brain, heart, or kidneys) can malfunction. When brain function deteriorates, persons with hypothermia are less likely to perceive the need to seek shelter. Signs and symptoms of hypothermia (e.g., lethargy, weakness, loss of coordination, confusion, or uncontrollable shivering) can increase in severity as the body's core temperature drops (CDC, 2005).

Extremely cold temperatures may accompany a winter storm, which can cause power failures and icy roads. Although staying indoors as much as possible can help reduce the risk of motor vehicle accidents and falls on ice, individuals may also face indoor hazards. The use of space heaters and fireplaces to keep warm increases the risk of household fires and carbon monoxide poisoning (CDC, 2007).

4.6-2 LOCATION, EXTENT, AND MAGNITUDE

Location

Extreme heat can occur anywhere in the State. According to the Office the of NJ State Climatologist, every weather station in the state has recorded a maximum temperature of 100 degrees or greater at some point over the past century.

The following are some of the highest temperatures recorded for the period from 1893 to 2022:

- New Brunswick: 106°F (July 1901 and August 1918)
- Atlantic City International Airport: 106°F (June 1969)
- Old Bridge (Runyon): 110°F (July 1936)
- Newark Liberty Airport: 108°F (August 2001)

Calm and clear weather conditions result in more severe urban heat islands by maximizing the amount of solar energy reaching urban surfaces and minimizing the amount of heat that can be carried away. Conversely, strong winds and cloud cover suppress heat island formation (EPA, 2023). Geographic features can also impact the heat island effect. For example, nearby mountains can block wind from reaching a city, or create wind patterns that pass through a city.

Interior lowlands of the State have the largest number of hot days, experiencing, on average, 20 to 30 days of greater than or equal to 90°F annually. Fewer than 10 days of temperatures greater than or equal to 90°F occur each summer along the coast and at higher elevations. Days when temperatures are equal to or greater than 100°F are rare throughout New Jersey and average one day or less each year (ONJSC Rutgers University, 2013d).

The northwestern corner of the State experience cooler summertime maximum temperatures with averages between 80° to 85°F while the rest of the State is temperatures between 85° and 90°F.

Urban Heat Islands

The term 'heat island' describes areas that are hotter than nearby areas. Most often found in cities or densely developed areas, "heat islands" form as a result of reduced vegetated landscapes, the use of low albedo, dark heat absorbing surfaces and heat-storing materials in the built environment, as well as the dimensions and spacing of buildings that can block wind and trap heat close to the earth's surface. Trees, vegetation, and water bodies tend to cool the air by providing shade, transpiring water from plant leaves, and evaporating surface water, respectively. Cities with many narrow streets and tall buildings can block natural wind flow that would bring cooling effects.

The dimensions and spacing of buildings within a city influence wind flow and urban materials' ability to absorb and release solar energy. In heavily developed areas, surfaces and structures obstructed by neighboring buildings become large thermal masses that cannot release their heat readily. Vehicles, air-conditioning units, buildings, and industrial facilities all emit heat into the urban environment. These sources of human-generated, or anthropogenic, waste heat can contribute to heat island effects. According to the Massachusetts Institute of Technology, on average, cities tend to be 1-7°F warmer than the surrounding countryside during the daytime and as much as 5°F warmer at night (Gregory et. al, 2021).

To identify urban heat island areas throughout New Jersey, NJDEP used Landsat 8 and 9 satellite imagery provided by the United States Geological Survey (USGS) and developed a web application to visualize land surface temperature (LST) values for New Jersey from the summer of 2022. This web application allows users to view the surface temperature values within specific areas of interest at a resolution of approximately 1000 ft, and land surface temperature within and surrounding New Jersey's designated overburdened communities (NJDEP, 2023). This web application shows that the highest land surface temperatures (113°F to 162°F) in summer 2022 were concentrated in Bergen, Essex, Hudson, Middlesex, and Union counties as well as eastern Passaic County and central Somerset County. Higher land surface temperatures were also recorded in metropolitan regions including Trenton, Camden, Vineland, Freehold and Lakewood. Communities along the Delaware River from Mercer County to Gloucester County and the entire Atlantic Coast of New Jersey also experienced higher land surface temperatures.

Extent and Magnitude

Extreme Heat

There are two commonly used measures of the magnitude of heat stress; WetBulb Globe Temperature (WBGT) and Heat Index. WBGT is a forecast tool that estimates expected heat stress on the human body when in direct sunlight. WBGT uses a combination of temperatures from three thermometers to estimate the effect of temperature, relative humidity, wind speed, and solar radiation on humans. The National Weather Service recommends using this measurement tool for active, acclimatized people performing strenuous outdoor activities (NOAA - NWS, n.d.). The Heat Index factors in relative humidity to actual air temperature to measure how hot it feels. Figure 4.6 -1 shows the NWS Heat Index. Since records began in 1943, the mean nighttime minimum temperature between June and August has risen almost two degrees at Atlantic City international airport, according to NOAA. Warmer nights don't allow people time to recover before the next hot day.

Figure 4.6-1 NWS Heat Index

NWS Heat Index — 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										

Likelihood of Heat Disorders with Prolonged Exposure or Strenuous Activity

Caution — Extreme Caution — Danger — Extreme Danger

Source: NOAA-NWS, n.d.

Extreme Cold

The NWS states that the extent (severity or magnitude) of extreme cold temperatures is generally measured through the Wind Chill Temperature (WCT) Index. Wind Chill Temperature is the temperature that people and animals feel when outside and 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. The NWS WCT Index includes a frostbite indicator. The shaded colors on the figure below illustrate the conditions where temperature, wind speed, and exposure time will produce frostbite to humans.

Figure 4.6-2 NWS Wind Chill Chart

Wind Chill Chart

Temperature (°F)

Wind (mph)	40	35	30	25	20	15	10	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45
Calm																		
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

$$\text{Wind Chill (°F)} = 35.74 + 0.6215T - 35.75(V^{0.16}) + 0.4275T(V^{0.16})$$

Where, T= Air Temperature (°F) V= Wind Speed (mph)

Effective 11/01/01

Source: NOAA-NWS, n.d.

The following are some of the lowest temperatures recorded for the period from 1893 to 2022:

- River Vale: -34°F (Jan 1904)
- Layton: -23°F (February 1934)
- Atlantic City International Airport: -11 °F (February 1979)
- Newark: -8°F (January 1985)

In New Jersey, temperatures fall below freezing on as many as 150 days each year in the coldest portions of the northwest portion of the State, while less than 75 days below freezing occur along the southern coast. The average lies between 90 and 100 days over two-thirds of the State. Minimal temperatures during the three core winter months of December, January, and February average below freezing (≤32°F) over the entire State, with the exception of some southern coastal locations in December. Generally, the minimal temperature averages 20°F during these months, with the exception of northwest, where January and February averages can drop into the teens. March temperatures run in the upper 20°F to low 30°F in the northern half of the State and the low to mid 30°F in the southern portion. The Pinelands are somewhat colder than the adjacent coast and southwest farmland, and an urban heat island bias occurs within and near Newark and some other small cities (ONJSC Rutgers University, 2013d).

Lows equal to or below 20°F occur on more than 60 days annually in the northwest, while only one-third of that number are found in southern coastal locations. A majority of the State experiences these temperatures on 20 to 30 days of the year. Below 0°F lows, on average, occur only a day or two a year over most of the State. Exceptions are the northwest where as many as six days or slightly more, on average, exhibit these temperatures (ONJSC Rutgers University, 2013).

4.6-3 PREVIOUS OCCURRENCES AND LOSSES

FEMA Disaster Declarations

New Jersey has not been part of an emergency declaration for extreme heat or extreme cold. At the time of this plan update, there has never been a federal disaster declaration for extreme heat. For extreme cold, there have been emergency declarations for freezing events, in addition to those for winter storms, in other states. These events were declared when freezing conditions caused significant infrastructure and/or economic failure. The most recent designation for freezing, without winter storm conditions, was in 2013 in the Navajo Nation within Arizona.

Historical Events Summary

The New Jersey Scientific Report notes that the state's annual temperatures have risen by about 4°F since 1900 (NJDEP, 2020). The majority of warming has occurred since 1980. Conversely, the months which set records for extreme cold temperatures tended to have occurred prior to 1930. Table 4.6-1 summarizes the significant historic extreme heat events since 2010 and Table 4.6-2 summarizes significant historic cold/wind chill and extreme cold events since 2010. This table summarizes all events included in NOAA's Storm Events Database and may not include all incidents of extreme temperature that have occurred during this period.

Table 4.6-1 Significant Extreme Heat Events Since 2010

Date(s) of Event	Counties Affected	Description
June 23 to 24, 2010	Statewide	Temperatures ranged from 97°F to 99°F
June 27 to 28, 2010	Statewide	Temperatures ranged from 95°F to 99°F
July 4 to 7, 2010	Statewide	Temperatures ranged from 90°F to 105°F. One fatality was reported from this event.
July 21 to 24, 2011	Statewide	It caused 2 deaths and hundreds of heat-related injuries. Temperatures ranged from 100°F in Cumberland and Cape May Counties, to 106°F in Mercer County.
June 20 to 22, 2012	Statewide	A three-day heat wave occurred with temperatures between 94°F and 99°F.
June 29, 2012	Statewide	Maximum hourly heat indices reached between 100°F and 105°F. High temperatures ranged from 93°F in Hunterdon, Warren, Cape May and Atlantic Counties, to 99°F in Burlington County.
July 2 to 7, 2012	Central and Southern New Jersey	Temperatures ranged from 90°F to 101°F between July 2 and 7, peaking on July 7 with afternoon hourly heat indices peaking around 105°F.
July 17 to 18, 2012	Statewide	Temperatures ranged from 97°F in Sussex County, to 102°F in Morris, Ocean and Camden Counties.
July 6 to 7, 2013	Central and Southern New Jersey	Hot weather that combined high temperatures in the 90s and more oppressive humidity levels.
July 15 to 20, 2013	Statewide	The most oppressive hot spell of the summer season affected New Jersey from July 15th through the 20th. Widespread high temperatures reached into the mid to upper 90s.
September 9, 2013	Statewide	An unseasonably hot and humid air mass caused most high temperatures to reach 90F to 95F.
June 17, 2014	Statewide	High temperatures in the lower to mid-90s were reported. Afternoon heat index values were in the mid-90s.
July 2, 2014	Statewide	High temperatures in the lower to mid-90s and heat index values reaching 100 to 105 degrees.
June 12, 2015	Southwest New Jersey	An unseasonably hot and humid air mass caused temperatures to reach the lower to mid-90s.
June 23, 2015	Camden, Atlantic, Cumberland, Salem, Burlington, Gloucester	High temperatures reached into the lower to mid-90s and afternoon heat indices of around 100F. In Atlantic County, about 30 people had to be treated for heat exhaustion at the Egg Harbor Township graduation.
July 19 to 20, 2015	Statewide	High temperatures in most areas reached into the lower to mid-90s both days. The combination of heat and humidity brought afternoon heat index values as high as 100F to 105F on the 19th.
July 28, 2016	Statewide	The State Emergency Operations Center reported 17 heat related illnesses, due to heat exposure during the PGA tournament in Springfield, NJ. The combination of temperatures and humidity made it feel like the mid-90s.
July 20, 2017	Statewide	A Bermuda high pressure system ushered in hot and humid weather across the east coast.
July 1 to 3, 2018	Northern and Western New Jersey	Temperatures in the middle to upper 90s and dew points in the upper 60s to lower 70s led to excessive heat across northern and western New Jersey.
July 19 to 20, 2019	Northeastern New Jersey	A Bermuda high pumped in a hot and humid air mass into the area.

Date(s) of Event	Counties Affected	Description
June 29 to 30, 2021	Northern and Western New Jersey	High temperatures in the mid to locally upper 90s combined with dew points in the upper 60s to near 70 caused heat index values to reach 105 to 110 over much of the region.
August 11 to 12, 2021	Statewide	Temperatures in the mid to upper 90s combined with dew point values near 70 caused widespread heat index values near to above 105°F on both August 11 and 12, and locally into the 13th before a cold front brought relief.
August 9, 2022	Central New Jersey	Heat index values rose to the mid to upper 100s across the region.

Source: NOAA-NCEI, 2022; ONJSC Rutgers University, 2013

Table 4.6-2 Significant Cold/Wind Chill and Extreme Cold Events Since 2010

Date(s) of Event	Counties Affected	Description
1/24/2011	Statewide	Cold/Wind Chill. Northwest winds produced wind chill factors below zero in most of the State. Sussex County experienced a wind chill of -15°F. Temperatures throughout the State ranged from -14°F in Warren County to 9°F in Cape May County.
1/23/2013	Central and Northwest	Cold/Wind Chill. The northwest flow behind a departing low-pressure system coupled with one of the coldest air masses of the winter dropped temperatures into single numbers.
1/4/2014	Statewide	Cold/Wind Chill. A high-pressure system that moved over New Jersey coupled with fresh snow cover from the winter storm on the 2nd and 3rd gave the area one of its coldest winter mornings in years. This was the first of three arctic blasts in the state during the month.
1/7/2014	Statewide	Cold/Wind Chill. Some record calendar day low temperatures occurred and combined with strong northwest winds produced wind chill factors as low as 15 to 25 degrees below zero in most areas.
1/22/2014	Statewide	Cold/Wind Chill. Strong northwest winds behind the departing strong low-pressure system coupled with another arctic air mass dropped low temperatures.
1/7/2015	Statewide	Cold/Wind Chill. The arrival of an arctic air mass brought one of the coldest mornings of the month of January to most of New Jersey. Morning low temperatures were mainly in the single numbers above zero.
2/13/2015	Statewide	Cold/Wind Chill. Northwest winds that persisted into the morning of the 13th combined with an arctic air mass to produce wind chill factors of around 10 degrees below zero and low temperatures in the positive single numbers.
2/15-2/16, 2015	Statewide	Cold/Wind Chill. The near arrival of the center of the arctic air mass brought some of the lowest wind chills and temperatures of the winter season. This produced wind chill factors as low as around 20 degrees below zero in most of the state.
2/19 – 2/20, 2015	Statewide	Extreme Cold. The arrival of another arctic air mass brought some of the lowest wind chills as well as the lowest temperatures of the winter season. Actual lowest temperatures on either the 20th or 21st included 17 degrees below zero in Sussex County.
2/24/2015	Statewide	Cold/Wind Chill. The high-pressure system responsible for third and last arctic blast of the month. Air and wind chill temperatures were nearly the same. The calm conditions and snow cover combined to give many locations in northwest New Jersey the coldest morning of the winter season.
1/4/2016	Sussex	Cold/Wind Chill. Arctic High Pressure settling across the eastern portion of the country produced the coldest temperatures of the winter season so far from late Monday afternoon January 4th into Wednesday morning, January 6th. These cold temperatures, combined with north to northwest winds gusting up to 30 mph in the higher elevations of northwest New Jersey, produced wind chill values as low as 25 degrees below zero, and prompted a Wind Chill Advisory for Sussex County for Monday evening into Tuesday morning.
2/14/2016	Statewide	Cold/Wind Chill. Bitter cold temperatures and strong northwest winds associated with an Arctic outbreak combined to create dangerous wind chill temperatures.
1/4/2018	Cumberland	Cold/Wind Chill. An area of low pressure interacting with a cold front led to a winter storm across the state. A man in Cumberland County was found dead from exposure to cold. Severe cold continued for the next week.
12/23/2022	Statewide	Cold/Wind Chill. An Arctic cold front swept through the region on December 23rd ushering in a very cold and dry airmass. Temperatures fell into the single digits and teens with wind chills ranging from -5 to -20 degrees in New Jersey.
2/3/2023	Sussex	Cold/Wind Chill. An Arctic cold front passed through the region on the 3rd ushering a cold and dry airmass along with windy conditions. Low temperatures on the 4th were well into the single digits to below zero in the higher elevations. This combined with the breezy to windy conditions resulted in dangerously low wind chills ranging from -10 to -20 degrees across portions of northern New Jersey.

Source: NOAA-NCEI, 2023; ONJSC Rutgers University, 2013

4.6-4 PROBABILITY OF FUTURE OCCURRENCES

Potential Effects of Climate Change

As the climate changes, the number of extreme cold events are expected to decrease and extreme heat events are anticipated to increase in the State. Global and regional temperatures are expected to continue increasing, with New Jersey warming faster than the rest of the Northeast region and the global average (NJDEP 2020).

Extreme Heat

Summers in the State are becoming hotter and heat waves becoming longer and more frequent. Since 1895, New Jersey's annual temperature has increased by 3.5° F, a trend projected to continue with average annual temperatures in New Jersey expected to increase by 4.1 to 5.7°F by 2050 compared to the 1895 average (NJDEP, 2020). In the Northeast, heatwaves are expected to impact larger areas, with more frequency and longer duration by 2050 (NCA, 2018).

Heat waves are among the most dangerous natural hazards for human health. These projected increases in temperature are expected to lead to substantially more premature deaths, hospital admissions, and emergency department visits due to heat across the Northeast, disproportionately affecting socially vulnerable populations and environmental justice communities. Social vulnerability is the susceptibility of social groups to the adverse impacts of natural hazards, including disproportionate death, injury, loss, or disruption of livelihood (FEMA, n.d.). Environmental justice is the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies (NJDEP, 2023).

In New Jersey alone, heat-related hospital admissions during the warm season (May to September) increased approximately 156% from 2004 to 2013 (Moran et al., 2017, NJDEP, 2022). Climate change could result in a 55% increase in summer heat-related mortalities during these events (NJDEP, 2022).

Extreme Cold

Given the changing climate it is uncertain if New Jersey will have the same risk from extreme cold in the future. Since 1895, New Jersey's annual temperature has increased by 3.5° F, a trend projected to continue. The general warming trend in the state is expected to be felt more during the winter months, and result in less intense cold waves, fewer sub-freezing days, and less snow accumulation (NJDEP, 2022).

Although the trend in the state is generally towards warmer temperatures, as the climate changes, traditional weather patterns are being disrupted. Climate change is predicted to further alter weather phenomena such as the Polar Vortex which typically keeps polar air in place over the North Pole, leading to events where extremely cold weather patterns can move out of the arctic to lower latitudes such as New Jersey where they may settle. Such an event could expose the State to severe and abnormal cold (Lindsey, 2021).

4.6-5 VULNERABILITY ASSESSMENT

Extreme temperature presents a threat to the built environment, human health, the economy, and New Jersey's natural systems. This section includes analysis from multiple third-party studies from published papers to give an understanding of the risk extreme temperatures creates in New Jersey, including FEMA's National Risk Index (NRI).

Vulnerable Jurisdictions

A review of the historic record indicates that all counties have experienced extreme temperature events. Further, all counties identified extreme temperature as a hazard of concern in their hazard mitigation plans, either as a standalone hazard or under the extreme weather hazard, as summarized in the table below. In addition to the rankings created by the counties, Table 4.6-3 includes the Hazard Risk Rating data from the National Risk Index. The ratings are relative to other jurisdictions and based on an equation that accounts for expected annual loss, social vulnerability, and community resilience. Organizationally, the NRI differentiates between heat waves and cold waves whereas all county HMPs address both extreme heat and extreme cold as a single hazard under extreme temperatures.

Table 4.6-3 Extreme Temperature Risk Ratings

County	NRI		County
	Extreme Heat/Heat Wave Hazard Risk Rating	Extreme Cold/Cold Wave Hazard Risk Rating	Ranking of Extreme Temperature Hazard by County HMP
Atlantic	Relatively High	No Rating	Medium
Bergen	Relatively High	Very Low	Profiled, Not Ranked
Burlington	Relatively High	No Rating	High
Camden	Relatively High	No Rating	Low
Cape May	Relatively Moderate	No Rating	Low
Cumberland	Relatively Moderate	No Rating	Medium
Essex	Relatively High	No Rating	Low
Gloucester	Relatively Moderate	No Rating	Medium
Hudson	Relatively High	No Rating	Low
Hunterdon	Relatively Moderate	No Rating	Low
Mercer	Relatively High	No Rating	Low
Middlesex	Relatively High	No Rating	Medium
Monmouth	Relatively High	No Rating	Medium
Morris	Relatively Moderate	Very Low	Low
Ocean	Relatively High	No Rating	Medium
Passaic	Relatively High	Relatively Low	Low
Salem	Relatively Low	No Rating	Medium
Somerset	Relatively Moderate	No Rating	Medium
Sussex	Relatively Moderate	Relatively Low	Not Profiled
Union	Relatively High	No Rating	High
Warren	Relatively Moderate	No Rating	High

Source: FEMA's NRI (accessed July 3, 2023), County Hazard Mitigation Plans (accessed June 2023)

Built Environment

Table 4.6-4 shows estimated potential annual losses (EAL) for extreme temperatures by county in the state of New Jersey. Total building EAL was derived from FEMA's NRI while EAL for state owned assets was calculated using Replacement Cost Value for state owned facilities per county derived from Land and Building Asset Management (LBAM) data and Expected Annual Loss Rate for Buildings by county provided by the NRI. This table only represents the estimated annual losses for buildings and not population or agriculture where losses for extreme temperature may be higher. The built environment in New Jersey is generally able to withstand temperature, thus these numbers sometimes amount to mere cents on the dollar.

Table 4.6-4 Estimated Potential Annual Losses Due to Building Damage for Extreme Temperatures

County	Extreme Heat/Heat Wave		Extreme Cold/Cold Wave	
	Total Buildings	State-Owned Assets	Total Buildings	State-Owned Assets
Atlantic	$0.05	$0.00	-	-
Bergen	$6.81	$0.01	$0.01	$0.00
Burlington	$0.14	$0.00	-	-
Camden	$0.11	$0.00	-	-
Cape May	$0.01	$0.00	-	-
Cumberland	$0.03	$0.00	-	-
Essex	$34.53	$0.22	-	-

County	Extreme Heat/Heat Wave		Extreme Cold/Cold Wave	
	Total Buildings	State-Owned Assets	Total Buildings	State-Owned Assets
Gloucester	$0.38	$0.00	-	-
Hudson	$21.99	$0.07	-	-
Hunterdon	$0.13	$0.00	-	-
Mercer	$0.10	$0.00	-	-
Middlesex	$0.13	$0.00	-	-
Monmouth	$0.04	$0.00	-	-
Morris	$0.09	$0.00	$0.72	$0.00
Ocean	$0.02	$0.00	-	-
Passaic	$2.45	$0.01	$219.24	$0.65
Salem	$0.01	$0.00	-	-
Somerset	$0.28	$0.00	-	-
Sussex	$0.57	$0.00	$771.56	$2.10
Union	$24.71	$0.04	-	-
Warren	$0.68	$0.00	-	-

Source: FEMA NRI, NJOMB, 2023

Lifeline Impacts

FEMA created the eight Community Lifelines to contextualize information from incidents, communicate impacts in plain language, and promote a more unified effort across a community that focuses on stabilization of these lifelines during response. More information on these lifelines can be found in Section 4.1: Risk Assessment Overview. Table 4.6-5 showcases the most likely lifelines to be impacted by extreme temperatures, including a short description of anticipated impacts.

Table 4.6-5 Community Lifelines Most Likely Impacted by Extreme Temperatures

Lifeline Category	Potential Impacts
Safety and Security	Schools fall under the safety and security lifeline and have had documented operational challenges related to extreme temperatures. Older facilities are not equipped with central air conditioners and may need to close during heat events.
Health and Medical	Extreme temperature events will require medical care be administered in response and recovery and facilities themselves will require adequate heating and cooling infrastructure. In addition, potential issues with the power grid could lead to issues with hospital operations.
Food, Hydration, Shelter	Extreme temperatures can have adverse impacts on Food, Water, and Shelter lifelines. Agricultural operations may lose crops or livestock to extreme heat or cold impacting food availability and supply chains. Extreme cold can cause water to freeze and damage infrastructure such as pipes, extreme heat can lead to algal growth and other issues affecting drinking water quality and make hydration difficult for those exposed to the heat.
Energy	Extreme temperatures can lead to a larger strain on the power grid due to increase demand for electricity because of usage of heating and cooling utilities in response. In addition to increased demand, power facilities may face supply problems caused by extreme temperatures possibly resulting in blackouts as extreme temperatures can impact electrical equipment and renewable energy production from solar panels and windmills, also impacting supply
Transportation	Extreme temperatures can damage Transportation lifelines such as roads, rail tracks, and bridges as well as the vehicles operating on that infrastructure. Rail and road buckling occurs with sustained high heat events; this has a secondary impact of disruption supply chains. Heatwaves can also impact flights as heat may reduce air density to the point where planes aren't provided with enough lift to take off. These impacts can have cascading effects on other categories of community lifeline.
Communications	Communications lifelines could be impacted due to power outages due to increased energy demand during heat waves, leading to reduced telecommunications service.
Hazardous Materials	Nearly all chemicals are affected by heat. Extreme temperatures can impact hazardous materials storage as the materials, especially if they are volatile, may react to extreme heat and undergo changes. Containers containing chemicals exposed to extreme heat could increase the internal pressure exerted on the container which could cause it to rupture and release the contents. This is especially a risk when transporting these materials during extreme heat.

Lifeline Category	Potential Impacts
Water Services	Extreme cold temperatures can cause water infrastructure such as pipes to burst. Water expands when it freezes, bursting pipes that aren't adequately protected. Then when the temperature rises, those broken pipes start leaking. This affects water pressure impacting delivery of water to homes, businesses, and other community lifelines. Extreme heat could affect the Water Service Lifeline by increasing demand for water increasing the potential for shortages if supply can't meet the demand, especially if the extreme heat is occurring in combination with drought.

Population and Economy

Economic Impacts

Extreme temperatures can lead to power interruption or failure. Business owners may be faced with increased financial burdens due to unexpected repairs such as pipes bursting, higher than normal utility bills or business interruption due to power failure (e.g., loss of electricity, telecommunications). Increased demand for water and electricity may result in shortages and a higher cost for these resources. Industries that rely on water for business operations and services may be impacted the hardest during extreme heat events (e.g., landscaping businesses). Even though most businesses will still be operational, they may be impacted superficially. These superficial aesthetic impacts are significant to the recreation and tourism industry.

Both extreme heat and cold temperature events can negatively impact the agricultural industry. New Jersey has nearly 10,000 farms that produce products valued over $1 billion annually (USDA, 2017). Extreme heat can cause crops to fail. Prolonged periods of extreme heat may be associated with drought conditions and impact ground and surface water supplies.

Population Impacts and Changes in Development

Extreme heat events account for more loss of life than any other weather event. According to the Energy Information Administration's final data release in March 2023, approximately 4% of New Jersey's 3.39 million residences, or 157,200 residences, don't have air conditioning. Those at greatest risk are located in urban areas due to the urban heat island effect. While they often have more resources to address high heat events, cities are more susceptible to the stresses of heat waves due to their large populations, which amplify the effects of heat. The population living in urban areas are also at high risk to poor air quality which may accompany extreme heat events. Extended periods of extreme heat without reprieve of lower nighttime temperatures, further exacerbated by urban heat islands, can cause negative health impacts. NJ Department of Health collects emergency room visit data across the state. Between 2016 and 2021, when the dataset is available, New Jerseyans averaged 970 visits to the emergency room due to the effects of heat, including heatstroke and heat exhaustion (NJDOH, 2023). Development that expands the densely developed urban centers across the state has the potential to increase the vulnerability to extreme heat due to heat island effect.

Socially Vulnerable Populations

Whether for extreme heat or extreme cold, vulnerable populations include the homeless population, elderly, low income or linguistically isolated populations, people with pre-existing health conditions exacerbated by heat, and residents living in areas that are isolated from major roads.

Extreme heat may impact schedules for outdoor workers. With increased high heat days, waste management workers may need to shift to work at night or take more break. Lower wage workers also tend to experience greater instances of injury due to the nature of the jobs they perform (NJDEP, 2022).

Areas that are prepared for high heat events with the infrastructure of cooling centers may be better positioned than areas that typically cool at night where residents might not have air conditioning and the communities do not have the infrastructure to support these populations. New Jersey has pending legislation modeled on the current Code Blue laws that would require operation of cooling centers and support for vulnerable populations to find respite during heat events.

Ecosystems and Natural Systems

Extreme Heat

Air Quality: Air quality is negatively impacted during periods of extreme heat by accelerating the production of ozone which can exacerbate existing respiratory and cardiovascular illnesses in sensitive populations. High temperatures with little rain can also create conditions favorable to forest fires which can further degrade air quality by the production of fine particulate matter from smoke.

Water Resources: Extreme heat from climate change is anticipated to influence the volume of groundwater by lengthening the growing season thus growing the demand for irrigation. However, groundwater recharge is difficult to predict due to uncertainty in future rainfall events (NJDEP, 2020). Extreme heat events may be associated with drought conditions that can impact surface and ground water supplies. The major sources of water supply in the southern part of the State have the potential to be vulnerable to prolonged periods of drought, since there are a limited number of reservoirs to back up the groundwater supply.

Freshwater and Coastal Wetlands: Extreme heat events associated with increased drought frequency and intensity will decrease the availability of freshwater vernal pools which provide important habitat to many sensitive wildlife species. Additionally, as temperatures continue to rise, estuarine habitats may experience environmental conditions favorable for an increase of invasive species like the clinging jellyfish (NJDEP, 2020). Extreme heat elevates the temperature of runoff as it makes contact with hot surfaces; this leads to an influx of hot water into waterways.

Forests and Vegetated Lands: Extreme heat during dry periods creates conditions favorable to forest fires. The duration and frequency of wildfires could continue to increase as a result from increased temperatures (NJDEP, 2020). For more information about wildfire, see Section 4.12 Wildfire. Additionally, increased temperatures allow insect pests to mature faster and inhabit new vegetated areas that may not have experienced the pressure of these pests (Olatinwo et al., 2014).

Extreme Cold

Freshwater and Coastal Wetlands: Extreme cold temperatures could result in long term frozen wetland soils which may cause a reduction in water seepage. Snowmelt water may then run off out of the wetland making it unusable in spring and summer.

Forests and Vegetated Lands: Weather associated with extreme cold temperatures can result in damage to trees and crops by causing heavy snow and ice accumulations that can bring down vegetation and tree limbs. Prolonged periods of extreme cold temperatures can damage vegetation and crops which could negatively impact the agricultural industry.