



15. NOR'EASTER

15.1 HAZARD PROFILE

15.1.1 Hazard Description

A nor'easter is a cyclonic storm that moves along the east coast of North America, with damaging winds over coastal areas that blow from the northeast. Nor'easters can occur any time of the year but are most frequent and strongest between September and April. These storms usually develop between Georgia and New Jersey within 100 miles of the coastline and typically move from southwest to northeast along the Atlantic Coast (NWS n.d.). To be classified a nor'easter, a storm must do the following (State of New Jersey 2019):

- Persist for at least a 12-hour period
- Have a closed circulation
- Show general movement from the south-southwest to the north-northeast
- Contain wind speeds greater than 23 miles per hour (mph)

A nor'easter event can cause storm surges, waves, heavy rain, heavy snow, wind, and coastal flooding. Nor'easters have diameters that can span thousands of miles, impacting large areas of coastline. The forward speed of a nor'easter is usually much slower than that of a hurricane, so a nor'easter can linger for days and cause tremendous damage to impacted areas. A nor'easter that stalls off the mid-Atlantic coast can result in prolonged episodes of precipitation, coastal flooding, and high winds. Approximately 20 to 40 nor'easters occur in the northeastern United States every year (NPS 2023). New Jersey can be impacted by 10 to 20 nor'easters each year, with five to 10 of them having significant impact (State of New Jersey 2019).

15.1.2 Location

The entire State of New Jersey, including Sussex County, is susceptible to the effects of nor'easters; low-lying areas are particularly vulnerable.

15.1.3 Extent

The magnitude of a nor'easter depends on climatological patterns related to wind speeds, temperatures, visibility, storm duration, topography, time of occurrence during the day, and time of season. Nor'easters are classified into two major categories—Miller Types A and B—which were developed by researcher J. E. Miller in 1946. The Miller Type A nor'easter is the most common type of nor'easter. These classic nor'easters form in the Gulf of Mexico and develop into full-fledged storms that move along the East Coast. Miller Type B nor'easters originate as low-pressure systems in the United States' Midwest. These less-common systems diminish after crossing the Appalachian Mountains and reform into nor'easters on the East Coast (National Geographic 2022). In 2004, Wayne Albright and Hugh Cobb found that there are five predominant patterns that produce 4 inches or more of snowfall across the Mid-Atlantic. This finding added classification types C through E onto the Miller classification system (Siebers n.d.). The formation of each category is shown in Figure 15-1 through Figure 15-5. Of the five categories, only the Type C and Type E storms have a threat area for significant snow that includes northern New Jersey.

Strong Polar Jet

Weak Subtropical Jet

Threat Area for Significant Snow

Weak Surface Low Pressure on tail of surface front

Strong Low-level East-Northeast Winds Develop

Surface Low Pressure Significantly Intensifies as Upper Level System Reaches Coast

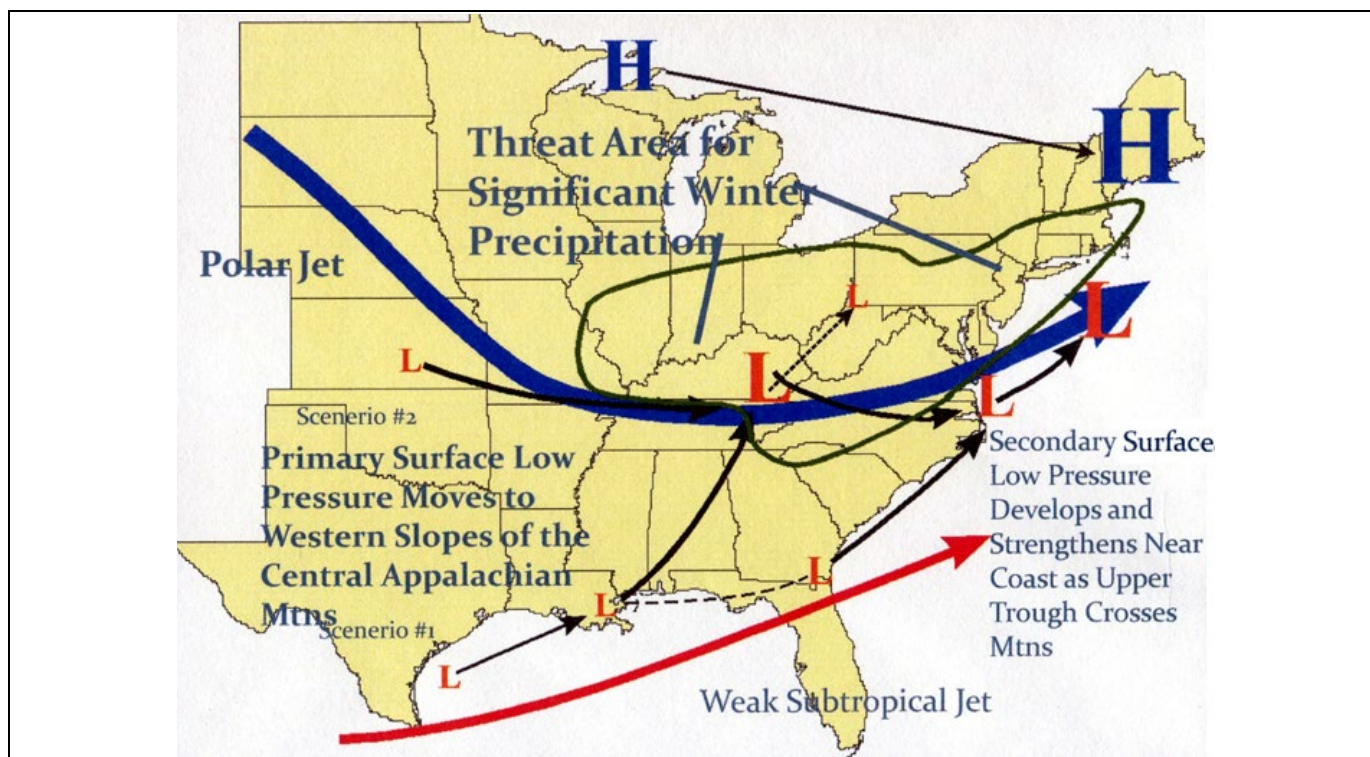
The map illustrates two scenarios for winter precipitation in the Southeastern United States, based on the position of a primary surface low pressure system and the strength of the subtropical jet.

- Scenario #1 (Weak Primary Surface Low Pressure):** The primary surface low pressure (L) is located to the west of the Southern Appalachian Mountains. A weak subtropical jet (red arrow) is shown. A secondary surface low pressure (L) develops and strengthens near the coast as the upper trough crosses the mountains. This scenario results in a threat area for significant winter precipitation in the Southeast.
- Scenario #2 (Strong Primary Surface Low Pressure):** The primary surface low pressure (L) is located further east, closer to the coast. A strong subtropical jet (red arrow) is shown. A secondary surface low pressure (L) develops and strengthens near the coast as the upper trough crosses the mountains. This scenario also results in a threat area for significant winter precipitation in the Southeast.

Other features on the map include the Polar Jet (blue arrow), Low Level Cold Air Flow (green arrow), and High (H) and Low (L) pressure systems in the North and West.

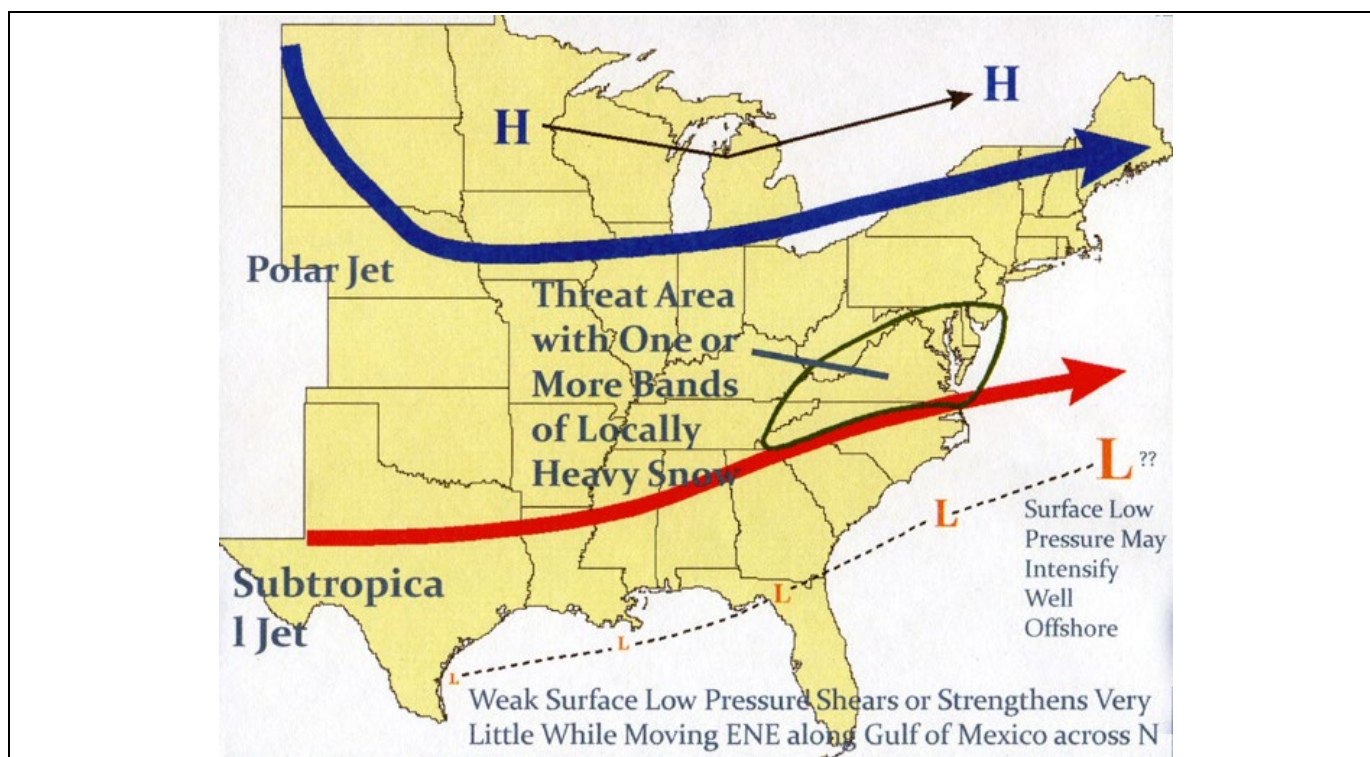
Source: Siebers n.d.

Figure 15-3. Nor'easter Miller Classification: Type C



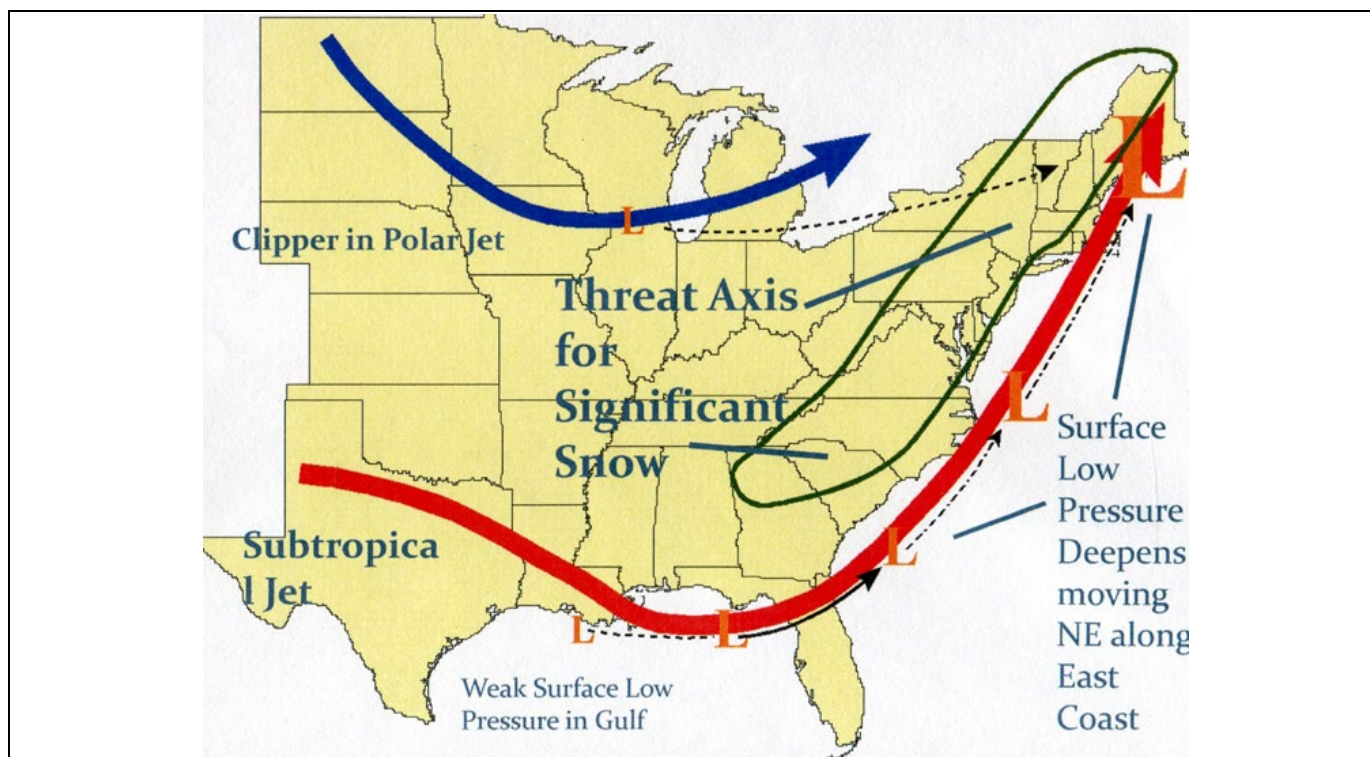
Source: Siebers n.d.

Figure 15-4. Nor'easter Miller Classification: Type D



Source: Siebers n.d.

Figure 15-5. Nor'easter Miller Classification: Type E



Source: Siebers n.d.

15.1.4 Previous Occurrences

FEMA Major Disaster and Emergency Declarations

Sussex County has been included in three major disaster (DR) or emergency (EM) declarations for nor'easter-related events (FEMA 2024), as listed in Table 15-1.

Table 15-1. FEMA Declarations for Nor'easter Events in Sussex County

Event Date	Declaration Date	Declaration Number	Description
April 14 – 20, 2007	April 26, 2007	DR-1694	Severe Storms and Inland and Coastal Flooding
October 29 – 30, 2011	November 30, 2011	DR-4048	Severe Storm
January 31 – February 2, 2021	Apr 28, 2021	DR-4597	New Jersey Severe Winter Storm and Snowstorm

Sources: FEMA 2024

USDA Declarations

The U.S. Secretary of Agriculture is authorized to designate counties as disaster areas to make emergency loans from the U.S. Department of Agriculture (USDA) to producers suffering losses in those counties and in contiguous counties. Since the previous Sussex County HMP, the County has not been included in any USDA nor'easter-related agricultural disaster declarations (USDA 2024).



Previous Events

Known nor-easter events that impacted Sussex County between January 2020 and June 2024 are discussed in Table 15-2. For events prior to 2020, refer to the 2021 Sussex County HMP.

Table 15-2. Nor'easter Events in Sussex County (2020 to 2024)

Event Date	FEMA Declaration or State Proclamation Number	Sussex County included in declaration?	Location Impacted	Description
December 16-17, 2020	N/A	N/A	Sussex County	Heavy snow and sleet fell over the area, with some areas also changing to rain as warmer ocean air surged inland and warmer air moved in aloft. Heavy snow fell in the county, with widespread amounts of 8 to 12 inches observed.
January 31, 2021	DR-4597	Yes	Sussex County	A significant and unusually long duration winter storm produced widespread snow accumulation. Areas of extreme snowfall rates of 2 to 4 inches per hour occurred in northern New Jersey. Areas where precipitation remained all snow and that experienced the heavy banding saw extreme snowfall totals, with isolated amounts of near 3 feet of snow and a widespread swath of more than 2 feet.
February 7, 2021	N/A	N/A	Sussex County	A fast-moving low-pressure system produced a general 4 to 8 inches of snow, with some higher localized totals.
February 18-19, 2021	N/A	N/A	Sussex County	A low-pressure system led to wintry precipitation. Many areas saw snow, some locally heavy, with a change to sleet and rain towards coastal areas. As precipitation became lighter, a mix of light snow and light freezing rain or drizzle provided some additional accumulations and impacts. The highest report was 5.6 inches in Andover. Other reports of 3 to 4 inches were received from the county.
January 16-17, 2022	N/A	N/A	Sussex County	A strong storm began as snow in most areas away from the coast, but a rapid transition from snow to mixed precipitation to rain occurred in most areas within hours. Frozen precipitation held on for longer across the interior. A maximum snowfall report of 7.0 inches was received from Wantage Twp. The Sussex Airport reported 0.09 inches of ice accretion.
March 12, 2022	N/A	N/A	Sussex County	A coastal low-pressure system brought colder air, changing from rain to snow. In some areas, precipitation remained steady to heavy for a few hours, allowing several inches of snow to accumulate. Dropping temperatures also led to instances of flash freezing. Winds increased, exacerbating impacts caused by the wet snow and leading to scattered power outages. Around 3 to 6 inches of snow fell. Wind gusts over 60 mph were recorded near High Point along with scattered power outages.

Source: FEMA 2024; NOAA NCEI 2024



15.1.5 Probability of Future Occurrences

Probability Based on Previous Occurrences

Information on previous nor'easter occurrences in the County was used to calculate the probability of future occurrence of such events, as summarized in Table 15-3. Based on historical records and input from the Steering Committee, the probability of occurrence for nor'easters in the County is considered "occasional."

Table 15-3. Probability of Future Nor'easter Events in Sussex County

Hazard Type	Number of Occurrences Between 1996 ^a and 2024	Percent Chance of Occurring in Any Given Year
Nor'easter	21	72.4%

Sources: FEMA 2024; NOAA NCEI 2024

a. Events prior to 1996 are not included because sources of earlier data are not considered to be complete.

Effect of Climate Change on Future Probability

Current research is unclear on the potential impact of climate change on the frequency of nor'easters (National Oceanic and Atmospheric Administration 2018). Climate projections indicate that an increase in temperatures in New Jersey will be felt more during the winter (December, January, and February), resulting in less intense cold waves, fewer sub-freezing days, and less snow accumulation (see Section 3.3.4). However, the state's weather also is projected to experience more precipitation in winter. The increase in moisture will allow for more intense periods of precipitation, exacerbating the potential impacts from nor'easters, including floods.

15.1.6 Cascading Impacts on Other Hazards

Secondary hazards of nor'easters may include flooding, extreme wind, erosion, infrastructure deterioration or failure, utility failures, power outages, water quality and supply concerns, and transportation issues.

Nor'easters may exacerbate flooding issues in the County. Maintaining snow and ice removal could minimize the potential risk of flooding during a warming period. Nor'easters often coincide with cold temperatures and generate strong winds that result in very low wind chills. Nor'easters could also result in falling trees and tree branches due to ice, snow, and strong winds. Fallen trees and branches increases available fuel for wildfires. Ice and snow accumulation can be destructive to the functionality of utilities by breaching power lines and disconnecting the utility systems.

15.2 VULNERABILITY AND IMPACT ASSESSMENT

For the nor'easter hazard, all of Sussex County has been identified as at risk. Due to a lack of quantifiable loss information, a qualitative assessment was conducted to evaluate the assets exposed to this hazard and its potential impacts.



15.2.1 Life, Health, and Safety

Overall Population

The entire population of Sussex County (144,221) could be exposed to impacts associated with a nor'easter. Some residents may be displaced or require temporary to long-term sheltering. Outdoor workers are vulnerable to nor'easter events. Employers should prepare for the hazards associated with adverse weather conditions that may require special facilities and safety equipment being provided to employees, or in some instances, work stoppage to ensure the safety and health of workers. Rain, ice, snow, and high wind conditions can pose a greater threat to employees working in the construction, and shipbuilding industries (Hazwoper 2020).

Socially Vulnerable Population

Economically disadvantaged populations may be more vulnerable to the impacts of nor'easters because they lack adequate shelter or resources to evacuate. The population over age 65 is also more vulnerable because they are more likely to need medical attention that may not be available due to isolation during a nor'easter event that could result in power outages from wind, snow, or flooding. They also may have more difficulty evacuating.

Without a quantitative assessment of potential impacts of a nor'easter on socially vulnerable populations, the Planning Partners can best assess mitigation options through an understanding of the general numbers and locations of such populations across Sussex County. Section 3.5.3 provides detailed data on socially vulnerable populations within the planning area. Table 15-4 summarizes highlights of this information. For planning purposes, it is reasonable to assume that percentages and distribution of socially vulnerable populations affected by a nor'easter will be similar to the countywide numbers.

Table 15-4. Distribution of Socially Vulnerable Populations by Municipality

Category	Sussex County Total		Municipality Highest in Category		Municipality Lowest in Category	
	Number	Percent	Number	Percent	Number	Percent
Population Over 65	25,451	17.65%	Vernon (T) 3,687	Walpack (T) 100.00%	Walpack (T) 7	Sparta (T) 13.38%
Population Under 5	6,500	4.51%	Sparta (T) 1,160	Lafayette (T) 7.21%	Walpack (T) 0	Walpack (T) 0.00%
Non-English-Speaking Population	1,922	1.33%	Hopatcong (B) 339	Hamburg (B) 10.17%	Andover, Frankford, Sandyston, Stanhope, Stillwater, Walpack 0	Andover, Frankford, Sandyston, Stanhope, Stillwater, Walpack 0.00%
Population With Disability	15,697	10.88%	Vernon (T) 2,318	Franklin (B) 17.32%	Walpack (T) 0	Walpack (T) 0.00%
Population Below Poverty Level	7,320	5.08%	Vernon (T) 877	Sussex (B) 18.03%	Walpack (T) 0	Walpack (T) 0.00%
Households Below ALICE Threshold	14,428	21%	Vernon (T) 1,833	Sussex (B0) 48%	Branchville (B) 90	Green (T) 14%



15.2.2 General Building Stock

The entire County's building stock is exposed to the wind, rain, or snow from a nor'easter event. Sussex County is estimated to have 71,937 buildings, with a total replacement cost value (structure and content) of approximately \$68.5 billion (see Section 3.7.1).

15.2.3 Community Lifelines and Other Critical Facilities

All of Sussex County's critical facilities are exposed to the wind, rain, or snow from a nor'easter event.. Sussex County is estimated to have 625 critical facilities, all but six of which are considered to be community lifelines (see Section 3.8.9).

15.2.4 Economy

Nor'easter events can greatly impact the economy, including loss of business function, damage to inventory (utility outages), relocation costs, wage loss, and rental loss due to the repair/replacement of buildings. Damage to buildings can impact a community's economy and tax base. Damage to buildings and critical infrastructure can delay emergency response services during these events.

15.2.5 Natural, Historic and Cultural Resources

Natural

The impacts of nor'easter winds on the environment typically take place over a large area. Widespread severe damage to tree and plant species is likely. This includes uprooting or destruction of trees and an increased threat of wildfire in areas where dead trees are not removed.

Historic

Winds associated with nor'easters can cause damage or destruction to the County's historical resources, especially historical buildings not constructed to withstand high wind loads. The weight of the snow associated with winter nor'easters also could strain the structural integrity of historical infrastructure.

Cultural

Winds associated with nor'easters can cause damage or destruction to the County's cultural resources, especially older buildings not constructed to withstand high wind loads. The weight of the snow associated with winter nor'easters also could strain the structural integrity of cultural infrastructure. A nor'easter could impact the participants at cultural events or result in the event becoming postponed or cancelled.

15.3 CHANGE OF VULNERABILITY SINCE 2021 HMP

Overall, Sussex County's vulnerability to nor'easters has not changed. Any perceived or actual changes in vulnerability may be attributed to changes in population numbers and density.



15.4 FUTURE CHANGES THAT MAY AFFECT RISK

Understanding future changes that affect vulnerability can assist in planning for future development and ensure establishment of appropriate mitigation, planning, and preparedness measures. The following sections examine potential conditions that may affect hazard vulnerability.

15.4.1 Potential or Planned Development

As discussed in Section 3 (County Profile), areas targeted for future growth and development have been identified across the County. Any areas of growth could be impacted by a nor'easter event if structures do not implement measures to withstand flooding, rain, wind, and snow. Therefore, it is the intention of the County and all participating municipalities to encourage higher regulatory standards for construction.

15.4.2 Projected Changes in Population

Changes in the density of population can impact the number of persons exposed to the nor'easter hazard. Persons that move into older buildings may increase their overall vulnerability. Those moving into newer construction may decrease their vulnerability.

The New Jersey Department of Labor and Workforce Development produced population projections by County from 2014 to 2019, 2024, 2029, and 2034. According to these projections, Sussex County is projected to have a decrease in population in the upcoming years. These projection totals include a population of 140,400 by 2024, 137,300 by 2029, and 136,600 by 2034 (State of New Jersey 2017).

15.4.3 Climate Change

The effect of climate change on the risk associated with nor'easters remains in need of further study. Previous studies have found average annual snowfall in the eastern United States may decline, but also that extreme winter precipitation events may increase (National Oceanic and Atmospheric Administration 2018). While predicting changes to the intensity of nor'easter events and their effects under a changing climate is difficult, understanding vulnerabilities to potential changes is a critical part of estimating future climate change impacts on human health, society, and the environment.